

Galway City Council

Comhairle Cathrach na Gaillimhe



GALWAY MAIN DRAINAGE

Stage 3

Mutton Island Wastewater Treatment Plant Upgrade

Environmental Impact Statement

MARCH 2006



Sub Consultants:



Document Amendment Record

Client:	Galway City Council
Project:	Galway Main Drainage – Stage 3
Title:	Mutton Island Wastewater Treatment Plant Upgrade – Environmental Impact Statement

PROJECT NUMBER: 2148			DOCUMENT REF: 2148 Mutton Island EIS D.doc		
D	Final	P Salmon	H Watson / P Fogarty	P Fogarty	1/03/2006
C	Third Draft to Client	P Salmon	H Watson / P Fogarty	P Fogarty	01/02/2006
B	Second Draft to Client	P Salmon	H Watson/ P Fogarty	P Fogarty	03/10/2005
A	First Draft to Client	P Salmon	H Watson / MF Garrick/ P Fogarty	P Fogarty	16/09/2005
Revision	Purpose / Description	Originated	Checked	Authorised	Date
TOBIN / NICHOLAS O'DWYER and ENTEC					

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Non-Technical Summary

Introduction

Galway City Council is proposing to modify the Mutton Island Wastewater Treatment Plant (WWTP) so that it can treat greater volumes of raw sewage, but without extending the plant beyond its current boundary.

An Environmental Impact Assessment (EIA) has been undertaken to identify, describe and evaluate the environmental effects of this proposed upgrade in treatment capacity to the WWTP which is located approximately 900m offshore of the South Park/Salthill area of Galway City, on the western portion of Mutton Island.

An Environmental Impact Statement (EIS), presenting the findings of the EIA, has been prepared for submission to An Board Pleanála for their consideration as part of the planning process.

This document is the Non-Technical Summary of the EIS.

Need for the Development

Galway City is the third largest city in the Republic of Ireland and has sustained strong economic and population growth over recent years. This rapid growth has required sustainable solutions to various issues including that of wastewater (sewage) treatment and disposal. The provision of a modern treatment facility, located on Mutton Island, in the latter half of 2003 meant that it was possible to close various outfall pipes that had been discharging untreated sewage into Galway Bay.

This original WWTP was supported by an EIS which certifies the WWTP for a population equivalent¹ (p.e.) of 91,600 persons.

The rapid growth of the city means that Mutton Island WWTP is now nearing its design capacity, and with growth projected to continue there is a requirement to increase treatment capacity to cater for both residential and industrial expansion within the area. It is possible to meet this requirement in the short term by upgrading the capacity of the Mutton Island WWTP. This is because there is spare capacity in some of the existing units which, combined with certain modifications to the plant, will enable the plant's capacity to be increased in a short time frame and, moreover, without requiring any additional land to be used.

We have determined from process modelling that the reconfigured and upgraded Mutton Island WWTP will be capable of treating a peak loading of 170,000 p.e. and we

¹ For a conceptual design, WWTPs are designed to treat a particular population equivalent (p.e.). Population equivalent is a term used as a measure of the water pollution load, and is an accepted measurement of the residential, commercial and industrial loading to a WWTP.



have assessed the impacts from such a loading in preparing the EIS. However, we have recommended that this be interpreted as permitting a planned load averaging 145,000 p.e., with the remainder being treated as an allowance for summer peaking, and as an operational reserve for maintenance and other purposes at the Plant. The EIA can therefore be considered to assess a worst case situation.

Galway Main Drainage - Strategic Overview

It is estimated, based on projected rates of population, commercial and industrial growth, that the upgraded capacity of Mutton Island could again be exceeded at the end of the decade. Within the limits of uncertainty in planning, particularly related to industrial development, this will require a new WWTP to be constructed and commissioned to handle the load surplus to the upgraded Mutton Island WWTP's capacity.

Such a new WWTP will, in due course, have to pass through the EIA process on its own merits, but the final site selection for that WWTP has yet to be determined. The new facility will be located in the Galway County Council administrative area on the eastern side of Galway City and this Galway East WWTP will discharge its treated effluent offshore to Galway Bay. Any cumulative effects of the two WWTP discharges will be fully assessed and presented as part of the EIA for the proposed new Galway East discharge.

The Existing WWTP and the Proposed Development

The WWTP occupies most of the western part of Mutton Island and is connected to the mainland by a causeway. Within the causeway lies a main sewer, which delivers raw sewage to the WWTP for treatment. The treated effluent is discharged into the sea approximately 400m to the south of the island via an outfall pipe equipped with diffusers. (Diffusers increase the rate at which the treated effluent is diluted). There is a second, smaller, outfall pipe to the west of Mutton Island which discharges effluent (after screening) under storm conditions, thus preventing the WWTP from becoming overloaded.

The upgraded plant will be contained entirely within the existing WWTP site, which is surrounded by a protective wave wall and rock armouring, and it will not require any work to the causeway, mains sewer or outfalls.

A large proportion of the WWTP is already occupied by treatment tanks, so there is limited room for additional tanks. However, in order to minimise visual effects and construction disturbance, the aim is to avoid further development outside the existing WWTP site boundary and to minimise any increase in the overall height of the plant structures. Thus, the design philosophy for the increase in capacity is to maximise the effectiveness of the existing process units and minimise the requirement for new structures.

The options for achieving capacity upgrade are therefore limited to using the existing process tanks in a different configuration either/or with a different treatment process that enables the treatment of a greater volume of wastewater. It is proposed that the

WWTP is operated as a conventional, non-nitrifying activated sludge plant because in this mode the capacity of the aeration process units are increased.

The increased volumes of wastewater treated at the plant will generate additional sewage sludge (the solids left over from the treatment process) for processing and ultimate disposal. Two future options for the treatment and disposal of sludge are considered appropriate for consideration:

Option A: Modifications to the sludge treatment process carried out at the WWTP including separation of primary and secondary sludges such that only secondary sludges are digested. Furthermore, an additional centrifuge (used for thickening sludge) will be installed to enable the WWTP to cope with the extra volume of raw sewage. This thickened sludge would then be taken off site for further treatment.

Option B: Installation of a sludge dryer at the plant which will convert the liquid sludge to a dried sludge. This option will require modifications to some of the buildings and tanks currently used for sludge treatment plus the installation of additional equipment outside the existing buildings and the installation of ducts and pipework between the various units, some of which will be overground. The detail of the equipment to be installed will depend on the specific manufacturer of the plant and cannot be determined until the appointed contractors present their detailed proposals.

At this stage, therefore, it is not yet certain which option will be taken forward. Consequently, each of the environmental topic assessments presented in this EIS considers the worst case option.

As part of these proposals public access to the causeway linking Mutton Island to the mainland will be increased so that access will be possible along the majority of the length of the causeway.

Construction

It is likely that the contract will be let as a Public Private Partnership (PPP) arrangement and it is envisaged that construction will take approximately 12 months and that it will start in 2007, subject to approvals.

Construction activities will normally be restricted to 07.00 - 19.00 hours on weekdays and 07.00 - 13.00 on Saturday mornings. Working outside of these hours will not be permitted without prior permission from Galway City Council.

All construction will be confined within the WWTP site and no construction compound or temporary works will be allowed at South Park. The contractor will be required to plan the delivery and removal of equipment and material from the site on this basis.

This decision has been made in order to reduce the disturbance from the construction works on local residents and people using the area for recreational purposes. It will be a requirement of the Contract for the contractor to conform to this decision.

Construction access to the WWTP was assessed during the construction of the existing WWTP, and subsequent consultation with local residents led to agreed routes and

signage locations for construction traffic. It is anticipated that this previous agreement will be adhered to for this phase of development, subject to agreement between Galway City Council and An Garda Síochána along with further consultation with local residents. Further measures to reduce effects from construction traffic, such as the timing of deliveries to avoid the start and end of the school day, will be included in a Traffic Management Plan that the Contractor will be obliged to comply with.

Due to the nature of the work envisaged, there will be very little surplus soil/spoil (or other wastes) generated as part of the proposed construction, but any that is generated will be disposed of to a suitable licensed facility.

Consideration of Alternatives

As the Mutton Island WWTP is already operational and as the modification can be accommodated within the boundary of the existing site, no alternative sites have been considered. This approach is a minimum disturbance option which results in a greater contribution to sustainable development than would provision of an alternative site.

Preliminary investigations have identified several possible design options for the upgrade, with the work to be procured under a Public Private Partnership (PPP) where the bidders will submit their tenders for individual designs for the Design Build and Operate (DBO) contract. The final site design and processes to be used will ultimately be determined in accordance with the requirements of the contract documents. Design envelopes set out in the EIS clearly define the range of impacts, effluents and emissions that will be permitted, and each submitted proposal will be robustly examined to ensure strict adherence with these envelopes. No transgressions from these envelopes will be permitted in the finally accepted proposal and no treatment process will be acceptable to Galway City Council that is not based on proven technology. Additionally, any requirements from An Bord Pleanála identified in their approval for the upgrade will be passed on to the contractor for implementation.

This approach should allow a range of potential solutions to come forward, thus maximising opportunity for use of the best available technology whilst protecting the environment via the use of strict criteria.

Scoping and Consultation

To assist Galway City Council in reaching an opinion, and to facilitate broader consultation with bodies that may be unfamiliar with the proposals, a Scoping Report (a report outlining the proposed development and seeking feedback on the range of potential environmental effects requiring investigation) was produced and issued to key consultee organisations, including the local residents association. The responses from each of these assisted in determining the final scope (range of issues examined) of the assessment.

Following the scoping process and the evolution in scheme design, it was determined that there was no potential for significant effects to occur in relation to cultural heritage, traffic and soil/ground contamination, and hence that no detailed assessment of these

aspects was required. However, mitigation in relation to traffic identified later in the EIA process has been incorporated in response to concerns from local residents.

A public consultation event was held on Thursday 19th January 2006 in the Galway Bay Hotel, Salthill, from 2pm to 8pm with the event publicised in the local papers and a local radio station.

The event was attended by 20 members of the general public. Written comments were sought during this event and have been taken into account in finalising the EIS. The main comments regarding the upgrade proposals related to minimising odours and to the protection of the South Park area from construction activity disturbance, both of which have been considered within the EIS and mitigated against.

Odour

An odour control unit is already operational at the plant, and either it or an alternative upgraded unit supplied by the successful tenderer will be used for the modified WWTP. We have established the change in odour due to the capacity upgrade and the provision of a new sludge dryer (this option is considered to be worst case) via the use of an odour model. The results of this modelling show that there would be a very slight increase in the overall odour footprint of the plant but as a result of the use of an appropriate odour control unit, the odour received at Grattan Road would still be about ten times lower than the adopted nuisance criterion. Thus the impact of odours will not be significant and there are unlikely to be complaints about the odour emission from the plant.

Dust and Air Quality

Due to the very limited amount of earthworks likely to be needed for the upgrade, the presence of the site boundary wall and the distance offshore of the treatment plant, very little dust will reach the mainland.

A suite of new EU Directives setting out the approach to the monitoring, assessment and management of air quality has been adopted in recent years. The objectives of the new Directives include avoiding, preventing and reducing the impact of harmful air emissions on human health and the environment. Any new sewage sludge dryer located within the site will be required to operate within statutory limits.

Air quality modelling has been undertaken for the operational stage of the upgrade, including emissions from the proposed on-site sludge dryer. The results of the modelling show that levels of the relevant parameters at Grattan Road will be approximately ten times less than the required National Air Quality Standards for these gases. No significant effects from emissions are therefore predicted.

Noise and Vibration

Residents of Grattan Road have complained of a low frequency hum and a spot survey has confirmed the presence of a low frequency tone. However, an analysis of noise sources at Mutton Island does not indicate a corresponding clear tone from any of the equipment on the island.

During the modification of the WWTP there may be periods when construction activities result in elevated noise levels, but such occasions are likely to be infrequent and short-lived.

Construction noise effects would be reduced through restriction of working hours, and it should be noted that all construction activities will be contained within the existing WWTP which is surrounded by a high protective, concrete wall. This will reduce the effect from construction noise on the mainland where predicted construction noise levels are well below accepted criteria for daytime construction noise levels (70 dB(A)), and are below the daytime and night time baseline noise levels recorded at Grattan Road (the closest residential area).

The existing background noise levels for Grattan Road have been used to define the acceptable level of noise that the upgraded WWTP should be designed to avoid exceeding. Mitigation will be incorporated in the design including, if required, complete enclosure of noise-generating equipment to meet the noise criterion.

It is unlikely that there will be any significant vibration effects associated with either the modification or operation of the modified plant. The nearest sensitive receptor is over 900m from the WWTP and is therefore highly unlikely to be affected by any vibration effects.

Socio-Economics

Due to the small scale of the envisaged work, the construction phase will not have any significant effects on the local economy.

The on-going population growth in Galway is driven, at least in part, by expansion of employment and business. An upgrade of the WWTP will allow for this growth, with attendant economic benefits ensuing for the City, County and the wider region.

Without this wastewater treatment provision, development will be constrained and the local and regional economy will not be able to develop as is envisaged in a number of national, regional and local planning documents.

The economy of the area is closely linked to the quality of water within the bay (e.g. aquaculture and tourism). The results of the water quality and marine ecology assessments indicate that there will be no significant adverse effects, and therefore it is considered that no significant, adverse effect on water based economic activities will occur.

Thus the development will have highly significant beneficial effects on the socio-economic well being of the area, contributing to sustainable growth of the city and wider region.

Landscape and Visual Effects

The character of Mutton Island is that of a small island with the treatment plant occupying the majority of the land area above high tide level. The lighthouse and cottage, once the focus of the island, now share the scene with the WWTP although the

distinctive white lighthouse with its red railings is still the tallest structure on the island and therefore draws the eye. In the wider context the character of the area is coastal, with the expanse of Galway Bay stretching towards the Burren to the south in Co. Clare.

Galway City Council has undertaken to ensure that the sludge treatment facility will be the only new structure allowed to be taller than the highest existing structure on the site to minimise the visual impact of the upgrade. If possible, the new sludge treatment facility will be constructed with part of it below ground level to reduce potential impacts on views and the landscape. The external protruding part of the sludge dryer shall be a maximum of 4m wide and shall not extend any higher than 2m above the existing treatment works structures.

Views from the coastline of Galway Bay in the vicinity of the city towards Mutton Island will change little, due to the incorporation of the upgrade works within the existing site, with only the potential for the sludge dryer to be seen above the existing wall. The proposed sludge dryer facility would be located within the existing site boundary using material and an architectural style that will reflect that of the existing treatment plant. This, in combination with Mutton Island's distance off-shore (almost 1 km from the closest visible points on the mainland), would greatly reduce its potential visual intrusiveness. Overall, the effect of the operational site on the landscape and seascape of Galway Bay will be negligible, localised and insignificant.

Water Quality

A range of site practices will be established and implemented during the modification works to reduce the potential for pollutants to enter Galway Bay to the lowest practicable level. These will include the isolation of any drains near construction work areas to ensure that any contaminated run-off is contained and removed for appropriate treatment.

The WWTP will have to treat an increasing wastewater loading as the local population increases. Irrespective of the volume of wastewater being treated, the final treated effluent will have to meet effluent discharge standards (as laid out by the EU and incorporated into national legislation) prior to being discharged to Galway Bay.

Within Galway Bay there are several bathing beaches (including Salthill, Silver Strand, Grattan and Ballyloughane) and shellfish/aquaculture production areas. Water quality modelling has been undertaken to assess compliance with microbiological standards in these areas under a variety of tidal and wind conditions under realistic worst case discharge conditions. The modelling shows that no designated beach will fail the rigorous Blue Flag standard for faecal coliforms (a sewage indicator bacteria) due to the influence of the Mutton Island discharge. It is also predicted that areas of shellfish/aquaculture production will not be affected by the increased discharge to any noticeable degree.

Modelling of potential effects from increased organic loading and ammonia show that no significant effects should occur.

Marine Ecology

The protective measures applied during the construction stage to protect water quality within Galway Bay will have attendant benefits for the local marine ecology.

Mutton Island is located within the Galway Bay Complex candidate Special Area of Conservation (cSAC). This is a European conservation designation and highlights the importance of Galway Bay for a number of habitats including rocky reefs and mudflats/sandflats. The bay supports an important common seal colony, migratory fish and important bird colonies (see below).

Surveys have been undertaken to find out if there are any plants and animals which could be affected by the increased discharge from the WWTP. It should be noted that parts of the bay will be improving in quality as much of the crude sewage that formerly entered the bay via a number of discharge pipes is now being treated (since late 2003) by the Mutton Island WWTP.

None of the species or habitats recorded during the sub-tidal survey are of specific nature conservation importance or interest, with the exception of maerl (calcified red seaweed) which was identified in the vicinity of the Tawin Shoals approximately 1.5km south of Mutton Island. However, at this distance the extent of treated effluent dilution and dispersion is such that no effects on the maerl are predicted.

Given the secondary treatment quality standards required by law, it is considered unlikely that the proposed increase in volume of treated effluent discharge will have a significant effect on the marine ecology of the area including seals, dolphins, porpoises and all important sub-tidal and inter-tidal communities.

It is considered that aquaculture interests will not be adversely affected because the nearest, off Rinville Point and Ardry Point, where mussels and oysters are grown respectively, are some 4 km distant.

Birds

Mutton Island WWTP is located within an important area for bird populations (parts of the bay being designated as a Special Protection Area (SPA) by the European Union and also as a 'Ramsar' site, international designations intended to protect birds and wetlands respectively).

Mutton Island and the surrounding area support large numbers of birds, especially during the winter period. The results of the surveys carried out during construction of the causeway and the WWTP suggest that the construction activities did not disturb the majority of birds present.

The main effect of the plant modification works 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. It is unlikely to be significant as the modification

works are on a much smaller scale than the original WWTP construction and will only involve activity within the existing WWTP site.

Construction workers will be restricted to the WWTP and its access route with access to the wider island prohibited.

Increasing the treatment capacity of the Mutton Island WWTP will not lead to any significantly greater level of operational activity, and hence disturbance, than is currently the case and no significant effects on bird populations are likely to occur.

The increased treated discharge has been shown not to adversely affect the marine ecology of the area and therefore it is considered that the effects on bird food resources will be negligible and probably undetectable.

Conclusion

There is a clear need to upgrade the treatment capacity for wastewater in Galway City and the surrounding area to cater for the current and predicted growth in domestic population, and in the commercial and industrial sectors. An additional WWTP will be required in the near future, east of Galway City in the Galway County Area, and this will be subject to statutory assessment at a later date. Galway City Council has identified that modifications to the Mutton Island WWTP to increase the sewage treatment capacity will provide a solution in the short term, and that it will be possible to do this without extending the plant beyond its current boundary.

It is predicted that with the mitigation measures proposed in the EIS in place, there will be no significant adverse effects arising from the modification works or the operation of the upgraded WWTP. The project will be implemented under a Public Private Partnership (PPP), where the bidders will submit their tenders for designing, building and operating the proposed upgrade. Any treatment process offered by the selected Contractor will be considered appropriate provided that it is based on proven technology and that any adverse impacts it has are of lesser significance than those outlined in the EIS.

Submissions

Written submissions and observations in relation to the implications of the proposed development for proper planning and sustainable development in the area and the likely effects on the environment of the proposed development, if carried out, may be made to An Bord Pleanála, 64 Marlborough Street, Dublin 1, up to close of business on Thursday 20th April.

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Glossary, Abbreviations & Definitions

Term	Description
Activated Sludge Plant	A form of sewage treatment in which air is forced in to sewage liquor to develop a microbiological community which reduces the organic content of the sewage.
ADMS	Atmospheric dispersion modelling software used for air quality modelling
AERMOD	Atmospheric dispersion modelling software used for air quality modelling
AERMIC	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee
Aerobic	A biochemical process or condition occurring in the presence of oxygen
Algal blooms	A proliferation of microscopic algae in water bodies, stimulated by the input of nutrients, which can cause toxicity through oxygen depletion
Anaerobic Digestion	The breaking down of organic matter in oxygen free conditions
Angiosperms	Flowering plants which produce seeds enclosed in an ovary
Anoxic	A condition in which oxygen is absent
Anthropogenic	Effects or processes derived from human activities, as opposed to natural effects or processes that occur in the environment without human influences
Aquaculture	The controlled cultivation and harvest of aquatic plants or animals
Ascidian	Ascidians are sack-like marine filter feeders known as Sea-Squirts
Bathymetry	The measurement of ocean depths and the charting of the topography of the ocean floor
Benthos	An ecological community, comprising organisms on the bed of a water body. The community is termed a 'benthic' community. See also, Epifauna
Blue Flag	The Blue Flag for beaches is awarded annually by the Foundation for Environmental Education (FEE) and is based on compliance with 29 criteria covering aspects such environmental education and information, water quality, environmental management and safety and services.
Biotope	An area that is uniform in environmental conditions and in its distribution of animal and plant life
BCD	Below Chart Datum
BOD ₅	Biochemical Oxygen Demand
Bryozoan	Marine invertebrate animals with planktonic larvae that settle and form attached branched or mossy colonies by budding, otherwise known as Sea-Mats.
BSL	Below Sea Level
Chlorophylla	The green photosynthetic pigment contained in all living algae that can

Term	Description
	be directly measured and used as the primary indicator of algal biomass
COD	Chemical Oxygen Demand
Compensation	Measures taken to offset/compensate for residual adverse effects that cannot be entirely mitigated. These usually take the form of replacing what will be lost.
CSO	Combined Sewer Overflow
D ₅₀	This figure is obtained when the 50% detection threshold (D ₅₀) is reached when one European Reference Odour Mass is evaporated into 1 m ³ of neutral gas at standard conditions causing the elicitation of a physiological response by an odour panel.
DAHGI	Department of Arts, Heritage, Gaeltacht and the Islands
DBO	Design Build and Operate contract
DCMNR	Department of Communications, Marine and Natural Resources
DEHLG	Department of the Environment, Heritage and Local Government
Demersal	Species that live near the bottom of a water body
Design envelopes	Environmental limits incorporated into the Contract Documents which will define the range of impacts and emissions that will be permitted.
Dewatering	To remove the free water from a solid substance (e.g. to reduce water content in thereby reduce the overall volume).
DIN	Dissolved Inorganic Nitrogen
DS	Dry Solids
DWF	Dry Weather Flow
3DWF	3 times the DWF is the maximum flow to full treatment at Mutton Island WWTP
6DWF	6 times the DWF is the maximum flow to Preliminary treatment at Mutton Island WWTP
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ENC	Environmental Noise Criteria
EPA	Environmental Protection Agency
Epifauna	Animals living on the surface of the bottom of a water body (See also Benthic)
EROM	European Reference Odour Mass
Eulittoral	The marine intertidal zone subject to wave action
Eutrophication	The process whereby a body of water becomes rich in dissolved nutrients through natural or man-made processes. This often results in a deficiency of dissolved oxygen, producing an environment that favours

Term	Description
	restricted biological communities.
dB	Decibel, a unit for the measurement of sound
dB (A)	A correction factor known as 'A Weighting' used by microphones when recording sound.
FC	Faecal coliform (A sewage indicator bacteria)
FEE	Foundation for Environmental Education
Flora and Fauna	The plant and animal life
Foliose	A lichen supporting a leaf-like growth
Fucoid	An alga of the family Fucaceae
GTPS	Galway Transportation and Planning Study
GLVIA	Guidelines for Landscape & Visual Assessment
HCV	Heavy Commercial Vehicle (<i>also ref to as Heavy Construction Vehicle</i>)
Hedonic tone	The degree to which an odour is perceived as pleasant or unpleasant
HGV	Heavy Goods Vehicle
Hydraulic load	The total wastewater which arrives at the treatment plant
Hz	Hertz
IBA	Important Bird Area
IDA	Industrial Development Agency
IEMA	Institute of Environmental Management & Assessment
Infauna	Animals living within submerged sediments
INDG	Irish Whale and Dolphin Group
Intertidal	Region between the high tide mark and the low tide mark
ISCOPE	International Symposium on Computing in Object-Oriented Parallel Environments
Isopleth	The line connecting points of an equal value (e.g. an <i>Isobar</i> connects places of equal pressure).
I-WeBS	Irish Wetland Bird Survey
JNCC	Joint Nature Conservation Committee
L _{Aeq T}	The sound level of a steady sound having the same energy as a fluctuating sound over the same period.
L _{A90}	An index representing the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period
L _{A50} and L _{A10}	The level exceeded for 50% and 10% of the measurement period respectively

Term	Description
L_{Amax}	The maximum recorded noise level during the measurement period
LI	Landscape Institute
LMX	Littoral Mixed Sediments
Lowest Astronomical Tide	The lowest tidal level expected to occur under average meteorological conditions and any combination of astronomical conditions
Macroalgae	Multicellular plants with a leafy appearance that grow in water and are visible to the human eye
Maerl	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.
MarLIN	Marine Life Information Network of Britain and Ireland
Mesotidal	Coastal ocean or waterway with a moderate mean tidal range
MHWS	Mean High Water Spring
MRP	Molybdate Reactive Phosphate
NAQS	National Air Quality Standards
NHA	National Heritage Area
NH_3	Un-Ionised Ammonia
NH_4^+	Ammonium Ion
Nitrification	The biological oxidation of ammonium salts to nitrites and the further oxidation of nitrites to nitrates
NSS	National Spatial Strategy
NO_2	Nitrogen Dioxide
NO_3^-	Nitrate
OU_E	European odour unit
Organic load	The total amount of organic matter to enter the treatment plant
Olfactometry	Measurement of the response of assessors to olfactory stimuli
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
Pathogen	An organism that causes disease in another organism
Pasteurisation	A form of heat treatment that kills any pathogenic organisms
p.e.	"population equivalent" is a measurement of organic biodegradable load. A population equivalent of 1 (1 p.e.) means the organic biodegradable load having a five-day biochemical oxygen demand

Term	Description
	(BOD5) of 60g of oxygen per day.
Photic zone	The upper portion of the water column admitting sufficient light for photosynthesis
Phytoplankton	The plant plankton and primary producers in aquatic ecosystems
PPP	Public Private Partnership
PrOWs	Public Right of Way
PS	Primary Sludge
psu	Practical Salinity Unit
Q-values	A biological quality ratings for rivers and streams used by the EPA
Ramsar	Abbreviation for the "Ramsar Convention on Wetlands". The Convention on Wetlands is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. It was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975.
RAS	Return Activated Sludge
RBD	River Basin District. "River basin district" means the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters, which is identified as the main unit for management of water resources under the Water Framework Directive.
Receptor	Any element in the environment which is subject to impacts
RPG	Regional Planning Guidelines
ROV	Remotely operated vehicle, utilised to survey sub-tidal marine habitats
SAM	Scheduled Ancient Monument
cSAC	candidate Special Area of Conservation designated under the EU Habitats Directive (92/43/EEC) enacted in Irish legislation by the European Communities (Natural Habitats) Regulations, 1997 (S.I. 94 of 1997).
Sewerage	The system of pipes and apparatus for the collection and transportation of sewage / wastewater
SO ₂	Sulphur Dioxide
SPA	A Special Protection Area designated under the EU Birds Directive(79/409/EEC) enacted in Irish legislation by the S.I. No. 397/1985: European Communities (Wildlife Act, 1976) (Amendment) Regulations, 1985.
SPL	Sound Pressure Level
SWL	Sound Power Level

Term	Description
Sub tidal	Region seaward of the low tide mark
SUDS	Sustainable Drainage Systems
Supra-littoral	The coastal zone just above high water of spring tides
Surface Boil	The area where discharged treated effluent reaches the water surface after rising through the receiving water body.
TDS/d	Total dry solids/day
TMP	Traffic Management Plan
Tonal noise	A noise in which it is possible to identify a particular pitch due to noise being at a prominent frequency
Trophic	The position of organisms in the food chain of an ecosystem based on type of food supply required. The trophic status of a waterway refers the rate at which organic matter is supplied, with high levels of nutrients leading to algal growth and deterioration in water quality.
TSS	Total Suspended Solids
µg	Microgramme
UKAS	United Kingdom Accreditation Service
UKBAP	United Kingdom Biodiversity Action Plan
USEPA	United States Environmental Protection Agency
UWWTR	Urban Wastewater Treatment Regulations, 2001 (S.I. No. 254 of 2001)
Visual Effects	Recognised by the landscape institute as a subset of landscape effects and are concerned wholly with the effect of the development on views, and the general visual amenity.
WAS	Waste Activated Sludge
WFD	Water Framework Directive. Directive 2000/60/EC establishing a framework for Community action in the field of water policy and commonly referred to as the Water Framework Directive. The WFD is implemented in Ireland by S.I. No. 722 of 2003, the European Communities (Water Policy) Regulations 2003.
WWTP	Wastewater Treatment Plant
ZVI	Zone of Visual Influence

1. Background to the project

1.1 This Document

This document is the Environmental Impact Statement (EIS) for the Mutton Island Wastewater Treatment Plant (WWTP) upgrade.

The document presents the findings of an Environmental Impact Assessment (EIA) which has been undertaken to identify, evaluate and describe the environmental effects of the construction and operation of a proposed upgrade to the Mutton Island WWTP and an increase in the loading of wastewater being treated at the existing site and subsequently discharged to Galway Bay.

Environmental Impact Assessment (EIA) is required for certain developments under *the Local Government (Planning and Development) Regulations 2001*² (the Planning Regulations). Following determination that an EIA was required, a study to define the scope of the work needed to assess the likely significant environmental effects associated with the proposed development and to evaluate their significance was undertaken. The findings were set out in a Scoping Report, which was submitted to Galway City Council and disseminated to various bodies for their comment as identified in **Section 4.2**.

This EIS includes an assessment of the likely and significant predicted effects of the proposed development. The content of the EIS, as well as the overall approach to the EIA, has also been designed to reflect other requirements of the EIA Regulations as well as widely recognised good practice in EIA.

1.2 Mutton Island WWTP Upgrade

Galway City is the third largest city in the Republic of Ireland and has sustained strong economic and population growth over recent years.

The National Spatial Strategy (NSS) has identified the city as having reached a strategic threshold in terms of population, education and job opportunities for continued favourable growth (Galway City Council, 2004). The city is recognised as having the

² S.I. No. 600 of 2001

³ Effects which are 'probable' i.e. they are planned to take place or can reasonably be foreseen as inevitable consequences of the normal construction and operation of the development (EPA, 2002)

potential for achieving national objectives for balanced regional development and has been assigned 'gateway' status⁴.

The recent period of rapid growth has required sustainable solutions to various issues including that of wastewater (sewage) treatment and disposal. Direct discharge of sewage into Galway Bay at various locations has recently⁵ been replaced by the provision of a modern treatment facility located on Mutton Island in Galway Bay (see **Figure 1.1**). This development was supported by an EIS, which is reported in P.H. McCarthy Son & Partners (1992). The EIS certifies the WWTP for a population equivalent⁶ (p.e.) of 91,600 persons.

The rapid growth of the city means that Mutton Island WWTP is now nearing its design capacity, and with growth projected to continue there is a requirement to increase treatment capacity to cater for both residential and industrial expansion within the area. However, it is possible to upgrade the capacity of the Mutton Island WWTP to accommodate this growth in the short term. This option has been selected because there is spare capacity in some of the existing units, which, combined with certain modifications to the plant enables the plant capacity to be increased in a short time frame and within the existing footprint (minimising construction disturbance).

We have determined from process modelling that the reconfigured and upgraded Mutton Island WWTP will be capable of treating a peak loading of 170,000 p.e. and we have assessed the impacts from such a loading in preparing the EIS. However, we have recommended that this be interpreted as permitting a planned load averaging 145,000 p.e., with the remainder being treated as an allowance for summer peaking, and as such as an operational reserve for maintenance and other purposes at the Plant. The EIA can therefore be considered to assess a worst case situation.

The increased volumes of wastewater treated at the plant will generate additional sewage sludge (the solids left over from the treatment process) for processing and ultimate disposal. At present all the sludge at Mutton Island is stabilised in anaerobic digestors and dewatered prior to being spread on suitable agricultural land. Two future options for the treatment and disposal of sludge are considered appropriate for consideration, as set out below.

⁴ Gateway sites will act at a national level, through their large scale and critical mass, to both drive development over the urban and rural areas they influence, and support more balanced patterns of development nationally.

⁵ The WWTP began actively treating sewage in the latter half of 2003 with flows being increased over a period, up to its current level by April/May 2004.

⁶ For a conceptual design, WWTPs are designed to treat a particular population equivalent (p.e.). Population equivalent is a term used as a measure of water pollution load based on figures of an average 'pollution production' of one person in one day and is an accepted measurement of the residential, commercial and industrial loading to a WWTP.

Option A: Modification of the existing sludge treatment process such that primary sludges⁷ only are digested and an additional centrifuge is installed to dewater sludge to approximately 25% solids content with export of this sludge to a Sludge Hub Centre for treatment.

Option B: Installation of a sludge dryer at the plant which will produce a dried sludge of approximately 80% solids content. This option will require modifications to some of the buildings and tanks currently used for sludge treatment and the installation of additional equipment outside the existing buildings and the installation of ducts and pipework between the various units, part of which will be overground. The detail of the equipment to be installed will depend on the specific manufacturer of the plant and can not be determined until the procurement of the plant upgrade has been undertaken.

At this stage it is not clear which option will be taken forward as part of the WWTP upgrade. This EIS considers the worst case option for all technical assessments (e.g. including a new on-site sludge dryer with respect to landscape/visual effects, odour and air quality, but considering off-site treatment when discussing traffic numbers/generation).

The proposed development covered by this EIS only relates to the upgrade of the Mutton Island WWTP as part of the overall Galway Main Drainage Stage 3 Scheme. Other elements of the Galway Main Drainage Stage 3 Scheme include rehabilitation and extensions to the sewer network and the development of a Galway East WWTP.

1.3 Galway Main Drainage - Strategic Overview

On current projected rates of population, commercial and industrial growth, the anticipated upgraded capacity of Mutton Island will again be exceeded around the end of the decade (see **Section 2.1.2**). Within the limits of uncertainty in planning, particularly related to industrial loads, this will require a Galway East WWTP to be constructed and commissioned by 2009 to handle the surplus load over the upgraded Mutton Island capacity.

Preliminary designs are currently being prepared for this new WWTP, and its associated main drainage facilities. The Galway East WWTP will in due course have to pass through the EIA process, on its own merits and on an independent basis, and a final site selection for that WWTP has not yet been determined. It is likely, however, that its treated effluent outfall will be taken to the eastern shores of Galway Bay. This therefore defines the proper planning context for the Mutton Island upgrade; within a decade it is likely to be one of two treated effluent outfalls to Galway Bay.

Hydrodynamic modelling of the proposed Galway East WWTP treated effluent plume, currently being undertaken as part of the Preliminary Report research, will examine the combined impacts of both treated effluent discharges, so that the design of the Galway

⁷ Primary sludges are those originating from the settlement of suspended solids in the incoming raw wastewater.

East WWTP will be such as to guarantee the sustainability of the combined discharges, to the satisfaction of the stakeholders in Galway Bay. This cumulative effects assessment will be presented as part of the EIA for the new Galway East discharge.

1.4 Applicant and project team

A project team has been put together to undertake project feasibility, design and environmental impact assessment, comprising those organisations identified in **Table 1.1**.

Table 1.1 Development, engineering and environmental team

Organisation	Role
Galway City Council	Developer
Patrick J. TOBIN & Co.	Lead Consulting Engineers
Nicholas O'Dwyer	Consulting Engineers
Brady Shipman Martin	Population Projections
Entec	Environmental Impact Assessment and Treatment Process Feasibility
RPS Kirk McClure and Morton	Water Quality Modelling

1.5 Regulatory Context

1.5.1 Environmental Impact Assessment

This EIA has been carried out in accordance with the requirements of the Local Government (Planning and Development) Regulations 2001⁸ (the Planning Regulations) and the European Communities (Environmental Impact Assessment) Regulations 1989 to 2001⁹, herein referred to as 'the EIA Regulations'. This EIS report, has been prepared with due regard to the criteria set out in these Regulations. The Planning Regulations determine the necessity for EIA and those clauses relating to wastewater treatment plants are set out below.

⁸ S.I. No. 600 of 2001

⁹ S.I. No. 349 of 1989; S.I. No. 84 of 1994; S.I. No. 101 of 1996; S.I. No. 351 of 1998; S.I. No. 93 of 1999; S.I. No. 450 of 2000 and S.I. No. 538 of 2001

11. Other projects

(c) Wastewater treatment plants with a capacity greater than 10,000 population equivalent as defined in Article 2, point (6), of Directive 91/271/EEC not included in Part 1 of this Schedule.

.....

13. Changes, extensions, development and testing

(a) Any change or extension of development which would:-

(i) result in the development being of a class listed in Part 1 or paragraphs 1 to 12 of Part 2 of this Schedule, and

(ii) result in an increase in size greater than –

- 25 per cent, or

- an amount equal to 50 per cent of the appropriate threshold,

whichever is the greater.

Clause 13 of Schedule 5 of the Planning & Development Regulations requires that an extension or upgrade of the Mutton Island WWTP resulting in an increase in size greater than 22,900 p.e. (i.e. 25% of 91,600) or 5,000 p.e. (50% of threshold for mandatory EIA for a new WWTP [Clause 11 of Schedule 5]), whichever is the greater, requires a mandatory EIS.

This project falls within the threshold criteria for the provision of an EIS, as set out within the above Planning Regulations, as the proposed upgrade of the works to increase the capacity of the Mutton Island WWTP will exceed the population equivalent thresholds that are set within the Regulations.

In addition, when determining the need for EIA account must be taken, *inter alia*, of the sensitivity of the environment¹⁰. It should be noted here that the discharge will be made directly into areas designated for nature conservation at a European level (Galway Bay Complex candidate Special Area of Conservation (cSAC) and Inner Galway Bay Special Protection Area (SPA)).

1.5.2 EIS for the original Mutton Island WWTP

The EIS for the original Mutton Island scheme was published in May 1992 and was confirmed by the then Minister for the Environment in May 1993. The existing Mutton Island WWTP is certified for a loading of 91,600 p.e.

1.6 The EIA Process

Environmental Impact Assessment (EIA) is a process by which information about the environmental effects of a project is collected, evaluated and presented in a form that

¹⁰ See Schedule 7 of S.I. No. 600 of 2001

provides a basis for consultation. Decision-makers can then take account of these effects when determining whether or not a project should proceed.

The EIA process also defines environmental monitoring and other work to be carried out following any decision to allow a development to proceed (e.g. monitoring carried out during the construction or operation phases). The results of the study are reported in an Environmental Impact Statement (EIS), which is submitted to An Bord Pleanála for approval. The EIS is made available to consultees in a statutory consultation process in accordance with the Planning and Development Regulations, 2001 (S.I 600 of 2001).

The EIA process has a number of key characteristics:

- it is systematic, comprising a sequence of tasks defined both by regulation and by practice;
- it is analytical, requiring the application of specialist skills from the environmental sciences;
- it is impartial, its aim being to inform the decision-maker;
- it is consultative, with provision being made for obtaining feedback from interested parties including local authorities and statutory agencies; and
- it is interactive, allowing opportunities for environmental concerns to be addressed during the planning, design and implementation of a project.

A significant part of the EIA process involves identifying ways in which effects can be reduced and minimised (mitigated) and where it is not possible fully to achieve this, ways of compensating for the effect. In certain circumstances a particular development may result in an improvement in the local environment, i.e. an enhancement. The terms mitigation, compensation and enhancement are adopted within the EIS to describe the effects of the proposed development and these are defined in **Box 1**.

Box 1 Definitions of mitigation/compensation/enhancement
<p>Mitigation:</p> <ul style="list-style-type: none"> • Avoidance: Measures taken to avoid adverse effects. • Reduction: Measures taken to reduce adverse effects. <p>Compensation:</p> <ul style="list-style-type: none"> • Measures taken to offset/compensate for residual adverse effects that cannot be entirely mitigated. These usually take the form of replacing what will be lost. <p>Enhancement:</p> <ul style="list-style-type: none"> • The genuine enhancement of environmental interest.

1.6.1 The limitations of the EIA process

In accordance with the Regulations, and with accepted good practice, the EIA must identify any limitations due to lack of know-how or lack of engineering detail available.

At this stage, the general design parameters have been determined but the detailed design has yet to be finalised. It is likely that the work will be procured via a Public Private Partnership (PPP), where the bidders will submit their tenders on a Design, Build and Operate (DBO) basis and final designs will be undertaken by the appointed Contractor.

In those cases where assumptions have had to be made, the EIS has considered the ‘worst case scenario’, and/or has specified design limits on emissions (including noise) necessary to meet environmental standards. The specific environmental limits will be incorporated into the Contract Documents for the upgrade of the WWTP in terms of ‘design envelopes’. These design envelopes will clearly define the range of impacts and emissions that will be permitted, and each submitted proposal will be robustly examined to ensure strict adherence with these design envelopes. No transgressions from these envelopes whatsoever will be permitted in the finally accepted proposal.

In summary therefore, any treatment process offered by the DBO Contractor will be considered appropriate provided:

- its impacts are equal to the impacts to be outlined in this EIS; and/or
- its positive impacts are of greater significance than those to be outlined in this EIS; and/or
- its negative impacts are of lesser significance than those to be outlined in this EIS.

Under Paragraph 3(g) of the second schedule of the EIA Regulations there is a legal requirement to outline any difficulties such as technical deficiencies or lack of knowledge encountered in compiling any specified information. Therefore each of the technical chapters identifies difficulties encountered.

1.7 The Assessment Method

The content of the EIS is in accordance with the European Communities (Environmental Impact Assessment) Regulations, 1989 to 2001, and is structured as per **Table 1.2**. This EIS has been structured as per the ‘grouped format’ structure identified under the Environmental Protection Agency’s (EPA) guidelines (EPA, 2002).

Different methodologies are required to assess the effects relating to each of the environmental topics that are investigated as part of the EIA. Individual methodologies are outlined at the start of each topic subsection and are based upon recognised good practice.

The assessment is based on a thorough understanding of the proposed development with each of the environmental topics being appraised against existing ‘baseline’ data.

The EIA has taken account of both beneficial and adverse effects, as well as covering direct, indirect and cumulative effects.

Table 1.2 Structure of this EIS

Section	Contents	
	A non-technical summary of the EIS	
1	Background to the project and the EIA process.	
2	Project context (including the regulatory and national and local planning policy context).	
3	Description of the proposed development (including infrastructure, processes, and a discussion of the alternatives considered).	
4	Explanation of, and results of, the scoping exercise.	
Technical Assessments		
5	An assessment in relation to odour.	Impacts principally affecting the human population.
6	An assessment in relation to air quality.	
7	An assessment in relation to noise and vibration	
8	An assessment in relation to socio-economics	
9	An assessment in relation to landscape and visual	
10	An assessment in relation to water quality	Impacts on the natural and built environment.
11	An assessment in relation to marine ecology	
12	An assessment in relation to avian ecology	
13	A summary of the predicted residual effects.	
Each of the technical assessment chapters follows the following format:		
a) description of the existing environmental conditions;		
b) identification of the potential effects of the proposed Mutton Island upgrade and identification of the incorporated mitigation to reduce effects; and		
c) an assessment of the effects of the scheme (following incorporation of the identified mitigation measures).		

Effects have been evaluated using a matrix approach, taking account of the type of effect (positive or negative), its magnitude, the probability of its occurrence and the policy importance or sensitivity of the receptor, using standard criteria, as far as possible.

The EIA Regulations state that significant effects should be assessed and these are identified in this report. The report also identifies effects of minor and no significance, in order that consultees and decision-makers are provided with a complete picture.

1.7.1 Temporal Scope

The temporal scope of the EIA covers the period from commencement of the construction through to, and including, the operational phase.

The construction period would be likely to commence in 2007 and last for approximately 12 months so full capacity would be available in 2008.

1.7.2 Spatial Scope

In its broadest sense, the spatial scope of the EIA is the area over which changes to the environment may occur as a consequence of the development. As required by the Regulations, the EIA focuses on those areas where these effects have the potential to be significant.

The spatial scope varies between both effects and specialist topic areas. For example, the effect of a proposed development upon the waters of Galway Bay is likely to require a greater spatial scope than, for example, the study of effects on noise. The spatial extent of each part of the assessment is made clear under each individual technical heading.

1.8 Overall appreciation

This EIS sets out the proposed project and covers both the construction and operation phases of the project, considering its impact on a range of local receptors, including local residents, as well as Galway Bay (which will receive treated effluent from the proposed works) and its associated ecology.

1.8.1 Construction phase

The EIS considers impacts during the construction phase of the proposed facility. The construction impacts are assessed on the basis of the upgrade of the WWTP to its maximum capacity.

1.8.2 Operation phase

In relation to the operational phase, the EIS addresses both static impacts, such as visual impact, and dynamic impacts arising from operational activities, particularly emissions to air and water. Routine replacement and upgrading of electrical and mechanical equipment is considered to be part of normal operation.

1.8.3 Extensions and decommissioning

The requirement for treatment will continue for the foreseeable future, thus no decommissioning requirement is envisaged.

1.9 Terminology used in this EIS

In some EIAs, the terms ‘impact’ and ‘effect’ are used interchangeably, whilst in others the terms are given different meanings. Some use ‘impact’ to mean the cause of an ‘effect’ whilst others use the converse meaning. This variety of definitions has led to a great deal of confusion over the terms ‘impact’ and ‘effect’, both among the environmental specialists that undertake EIAs and those who read the resulting EIS.

The convention used in this document is to use ‘impact’ only within the context of the term Environmental *Impact* Assessment, which describes the process from scoping through EIS preparation to subsequent monitoring and other work. Otherwise, this document uses the phrase environmental ‘effect’ when describing the implications of the development, covering both changes and consequences.

1.10 Significance assessment

The EIS must define the significance of the consequences that it has assessed. The approach adopted is to define significance based on the interaction between two factors, namely the:

- magnitude of environmental consequence; and
- value of the resource or sensitivity of the receptor affected.

The magnitude of the consequence refers to the degree or extent of change, defined where possible in quantifiable terms. The different dimensions of magnitude might include variables such as the area of a particular resource or number of receptors that are affected, or the duration, frequency or extent of a consequence. Examples might include the area of land-take, the increase in noise levels, or the extent of visibility of new infrastructure.

Resource value is determined by reference to criteria such as rarity or sensitivity, or to a geographical hierarchy of designations (e.g. Special Areas of Conservation, designated in relation to the EC Habitats Directive, and of international wildlife conservation value whilst Natural Heritage Areas are of national importance).

Receptor sensitivity is related to the type of human use. For example, residential dwellings are generally considered more sensitive than commercial premises; schools and hospitals are considered to be especially sensitive.

These considerations, together with any relevant environmental standards or guidelines, form the basis upon which each specialist bases his or her definition of significance. The scale presented in **Box 2** is used in the assessment of significance.

Box 2	Assessment of significance
	<ul style="list-style-type: none"> • Major significance: An effect that is of such importance that it should be considered as a major factor that should influence whether or not the development should be allowed to proceed. • Minor significance: An effect that is not sufficiently important to influence whether or not the development should be allowed to proceed but which requires careful attention to ensure that, if adverse, it is adequately mitigated, and if beneficial, that measures are put in place to ensure that the benefits are realised. • Not significant: An effect that is of such small importance that it requires no specific attention.

1.11 References

Brady Shipman Martin in association with TOBIN/Nicholas O’Dwyer. (May 2005). *Galway Main Drainage – Stage 3 – Planning and Development Report*.

Environmental Protection Agency. (2002). *Guidelines on the information to be contained in Environmental Impact Statements*.

Galway City Council. (2005). *Galway City Council Development Plan 2005 – 2011*.

P.H. McCarthy Son & Partners. (1992). *Galway Main Drainage – Proposed Causeway and Sewage Treatment Plant on Mutton Island: Environmental Impact Statement*.

TOBIN and O’Dwyer. (2006). *Galway Main Drainage – Stage 3, Preliminary Report, Volume A1*.

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2. Project Context

2.1 The Need for Additional Wastewater Treatment

Galway City is recognised in the National Spatial Strategy (NSS) as an important national gateway location. To fulfil this national role a high standard of infrastructure to support planned future economic activity in the city is required. Several planning policy documents support the development of the city as a dynamic social, economic and cultural entity (see **Section 2.2**).

The rapid and continued growth of Galway City and environs will require additional wastewater treatment capacity over the coming years as the present WWTP, located on Mutton Island, will not be able to cope with the additional flows that will result from predicted expansion. Without this provision, continued development of the city will become restricted as insufficient wastewater treatment capacity will exist.

2.1.1 Domestic Population Increases

The present Mutton Island WWTP is certified for a population equivalent (p.e.) of 91,600. An overview of the various population projections and population distribution forecasts which have been made in planning and transportation studies of Galway City and County in the recent past is presented in a recent report compiled for the Galway Main Drainage project (Brady Shipman Martin, in association with TOBIN/Nicholas O'Dwyer, 2005).

Table 2.1 outlines projected domestic population growth up to 2023 in the catchment area under high and medium growth scenarios. It is clear that even the domestic population growth will soon cause the current Mutton Island WWTP to become overloaded. Potential effects would include increases in spills of preliminary treated (screened) sewage causing knock on effects to Galway Bay and its ecology. **Figure 2.1** shows the Galway main drainage catchment area.

Table 2.1 Projected Domestic Population in Study Area on High Growth and Medium Growth Scenarios

	Census		Medium Term		Excluding Business Park Employment		Including Business Park Employment	
	1996	2002	2007	2009	2016	2023	2016	2023
Galway City	57,241	65,832	69,380	70,800	72,067	80,534	75,789	86,248
Barna		250	1,600	2,100	3,689	4,862	3,836	5,088
Ardaun			3,000	8,000	18,129	19,602	18,855	20,717
Oranmore	1,400	1,620	5,147	5,912	8,175	8,943	8,588	9,577
Athenry	1,600	2,100	5,024	6,044	8,549	9,601	9,614	11,237
Clarinbridge Kilcolgan	4,021	4,984	5,532	5,762	6,259	6,863	6,567	7,335
Galway Rural	3,333	3,972	4,207	4,301	4,630	4,999	4,630	4,999
Oranmore Rural	1,933	2,399	2,374	2,365	2,330	2,535	2,330	2,535
Athenry Rural	1,965	2,329	2,337	2,340	2,351	2,585	2,351	2,585
Barna Rural	2,105	2,226	2,358	2,411	2,595	2,801	2,595	2,801
High Growth Scenario	73,598	85,712	100,959	110,034	128,774	143,325	135,155	153,122
Medium Growth Scenario			98,855	106,955	122,159	135,495	128,540	145,292

2.1.2 Overall Loading Increases

In addition to the rise in the total loading delivered to the works (as measured by p.e.) due to the increase in population of Galway City (and its associated sewerage catchment) over the coming years, there will be increases associated with commercial and industrial effluents.

Galway has been designated a Gateway in the National Spatial Strategy, 2002, taking account of quality of life attractions, transport connections and capacity to innovate with the support of its third level institutions. A gateway is a nationally significant centre, whose location and scale support the achievement of the type of critical mass necessary to sustain strong levels of job growth in the region. It is estimated, based on projected rates of population, commercial and industrial growth, that the upgraded capacity of Mutton Island could again be exceeded at the end of the decade and consequently an additional treatment plant will be required to cater for the needs of the Study Area. Proposals for a new Galway East WWTP in the Galway County Council area, in the context of a strategic overview of Galway Main Drainage, are set out in **Section 1.3** of this EIS.

2.2 Planning Context

2.2.1 Introduction

This section sets out in full the relevant planning policies governing the proposed development. The policy framework consists of:

- The National Spatial Strategy 2002-2020;
- Regional Planning Guidelines for the West Region (adopted May 2004);
- The Galway City Council Development Plan 2005 – 2011; and
- The Galway City Development Board Strategy 2002.

Section 2.2.2 sets out the National Planning Framework for Ireland, whilst **Section 2.2.3** sets out the Regional Planning Guidance for the West Region. The Development Plan policy context is outlined in **Section 2.2.4**, including a description of the policies to be considered in assessing the proposed development. The Galway City Council Development Plan is of particular importance to the process of considering the suitability of a specific development proposal. Any proposal will be considered on its merits having regard to the Development Plan and all other material considerations. **Section 2.2.5** outlines the Galway City Development Board Strategy, which is centred around economic, social and cultural subject matters, with **Section 2.2.6** summarising the Planning and Regulatory Context for the proposed development.

2.2.2 National Planning Framework

The planning system is based on the Local Government (Planning and Development) Act 1963. Legislation and regulations regarding planning matters are formulated by the Department of the Environment, Heritage and Local Government.

The Planning and Development Act 2000 consolidates all previous Planning Acts and much of the EIA legislation. The key legislative instruments governing planning in Ireland are as follows:

- Planning and Development Act, 2000; and
- Planning and Development Regulations, 2001 (SI No. 600 of 2001).

Where a local authority (that is a planning authority) provides an EIS, as required under the Planning Regulations, they must have due regard to Part X (Section 175) of the Act. Provision is made in this part of the Act for the submission of the EIS to An Bord Pleanála (Planning Appeals Board) for approval.

Regard should be had to the provisions of the Development Plan, the provisions of any special amenity area order relating to that area, any European or other site, Government Policy and/or any provision or requirement of the 2000 Act.

The Environmental Protection Agency (EPA) advises independently, or at the request of Government Ministers, on environmental protection in relation to any of the functions and responsibilities of the Minister or local authorities. It can advise local authorities on the environmental content of the Development Plan.

In 2002, the government published the National Spatial Strategy (NSS) for Ireland 2002 to 2020. NSS is a coherent national planning framework that includes the following five core messages:

- A wider range of work opportunities,
- A better quality of life,
- Better places to live,
- Effective urban and rural planning, and
- Getting things done.

The Spatial Strategy covers all seven regions, including the provision of a framework for spatial policy for the West Region, within which Galway City lies. There is a strong emphasis placed upon gateways, including Galway City, and the need for a high standard of infrastructure and services to fulfil their national level role. The NSS states the importance of building upon the dynamic role of Galway City as a gateway, and expanding its influence in promoting economic activity.

Galway has been identified in the NSS as a centre which has now achieved a critical mass in terms of driving its own development, and as the engine driving regional development in the West.

The policies within the Spatial Strategy are currently being translated into regional and local policy.

2.2.3 Regional Planning Guidelines for the West Region

The West Regional Authority adopted Regional Planning Guidelines for the West Region on 6th May 2004. The document is the first of its kind for the West Region and provides a strategic development and planning vision, and the framework for the delivery of that vision. Under the Planning and Development Act 2000, planning authorities must have regard to any regional guidelines in force for the area when making and adopting their Development Plan.

Section 1 – Introduction

The West Region comprises a number of counties and also Galway City. The City of Galway is the major regional centre (a regional gateway).

The Galway City Development Board Strategy (Section 2.2.5) specifically states that its underlying aim is to enhance its regional gateway status and to develop the city as a dynamic social, economic and cultural entity in the early years of the new millennium.

It also identifies other topics of concern in the regional sphere including waste management.

Section 2 – Profile of the Region

Population

Ireland's population is predicted to grow up to the year 2020 with the West Region expected to achieve significant population growth, from its present level of 380,057 (2004) to 460,000 in 2020.

Physical and Infrastructure Assessment

The Regional Planning Guidelines state that possibly the most important physical requirement of any region is the need for high quality access corridors and infrastructure which is to a standard that can attract and promote inward investment. There is a need to improve existing services and the capacity of such infrastructure in the West Region.

Access

The West Region relies heavily on its public road network for transportation and access to the region. The region is also highly dependent on private forms of transport, which is not a sustainable trend.

Waste and Sewerage

It is an objective of the local authorities in the West Region to provide water and sewerage infrastructure throughout the region for domestic, industrial, agricultural and other uses. It is also their objective to implement the water and sewerage schemes as formulated.

“The local authorities will seek to bring all wastewater treatment plants to a suitable standard and will give priority to the construction of the necessary plants to achieve this.” (2.5.6)

Spatial Structure

For the period 1991 to 2001, Galway City has increased its primacy over the County, with a strong clustering of jobs and population and new residential development in and around the city. Population in the city is rising rapidly, and this has significant implications for future land requirements for housing, industry, commerce, recreation and amenity.

Section 3 – Key Issues and Strategic Goals

The Regional Planning Guidelines lists eight strategic goals for the region. Goals relevant to the proposed Mutton Island WWTP upgrade include:

- Goal 1: Spatial Structure - *“To identify, formulate and implement policies that will promote the gateway, Galway and hubs, Tuam and Castlebar / Ballina into achieving their targets and fulfil their roll as set out in the NSS...” (3.2)*

- Goal 3: Service Infrastructure – “To ensure that a framework is devised to meet the service infrastructural requirements of the Region for both now and in the future” (3.2)
- Goal 5: The Environment, Sustainability and Quality of Life Issues – To improve quality of life for citizens of the West Region by promoting the concept of sustainable development and protecting the environment amongst others.

Section 4 - Aims

The overall aim of the Regional Planning Guidelines is to provide a broad context that allows the co-ordination of the physical planning of the region, and provides a planning framework. It is also intended to facilitate the provision of the physical and infrastructure facilities and resources needed to secure goals that are set out in Section 3 of the Guidelines. Some of the important core objectives and associated policies which relate to the proposed Mutton Island WWTP upgrade are:

Spatial Strategy

“To formulate and to implement a settlement strategy for the region that builds up the ‘critical mass’ in the nominated gateway, Galway ...” (4.3).

Service Infrastructure

To provide necessary funding to enable the provision of water and wastewater facilities to support a sustainable settlement pattern in the region.

The Environment, Sustainability and Quality of Life

- To protect and respect the built and natural environment and the contribution they make to the quality of life in the region; and
- To promote high standards of design in new developments, and ensure development is properly assimilated into their surroundings.

Section 6 - A Strategic Framework for the Region

Population

The Galway gateway had a population of 63,695 in 1996 and 73,614 in 2002. By 2020 it is anticipated that the population of the gateway will reach at least 100,000. Populations within gateways, hubs and linked-hubs must continue to increase to achieve better-balanced regional development.

Infrastructure Priorities

Water and Wastewater Treatment Infrastructure

A number of schemes have either begun, or have recently been completed, in the Gateway. This has included on-going work on the development of the Mutton Island

Wastewater Treatment Plant. Continued co-ordination is required to ensure populations are adequately catered for.

Galway City Gateway

The population of Galway City and its environs is growing significantly. Therefore:

“In order to facilitate such growth the completion of the infrastructural requirements set out in the Regional Planning Guidance will be critical, in particular the construction of the Outer city by-pass and the commissioning of the Wastewater facility at Mutton Island”. (6.6)

2.2.4 Development Plan Provisions

The responsibility for planning at both the strategic and detailed levels lies with Galway City Council.

The provisions that cover the subject land at Mutton Island are defined in the Galway City Council Development Plan (2005 - 2011).

Galway City Council Development Plan (2005 - 2011)

The Galway City Council Development Plan (2005-2011) has been prepared in accordance with the provisions of the Planning and Development Act 2000. This Plan was adopted on 31st January 2005 and supersedes the 1999 Development Plan. The relevant provisions of the Plan are set out below.

Chapter 1 – Overall Strategy

Overall Goals

The strategic goals of the Plan are to:

- Promote balanced and sustainable economic development to enable Galway City to fulfil its national gateway and regional centre role;
- Provide for a high quality built and natural environment;
- Promote social inclusion; and
- Facilitate the achievement of goals in the City Development Board Strategy.

Strategic Aims

The overall goals of the Plan are in turn integrated into strategic aims of what the Council seeks to achieve over the lifetime of the Plan. These aims also provide the framework for the formulation of policies and specific objectives of the various chapters of the Plan. These strategic aims include provision of essential infrastructure and to minimise adverse impacts of development upon the environment.

Overall Strategic Context

The overall strategy of the plan is largely determined by the ‘Galway Transportation and Planning Study’ (GTPS) recommendations, which apply to a sub-regional area and cover the period up to 2016. The GTPS includes a settlement strategy.

The focus for development in the city will be the consolidation of the growth it has achieved to date and ensuring that future development is more co-ordinated and sustainable. Considering the gateway status of the city and the synergies it creates for wider prosperity, it is mutually beneficial for the City and the County that the City is enhanced and maintained.

Land use and Transportation

Policy 3.3 states the need to promote closer co-ordination between land use and transportation through zoning objectives.

Chapter 8 – Environment and Infrastructure

The strategy set out in this chapter is to protect and enhance the environment of the City whilst also facilitating its sustainable development and growth. It is also to have a waste management system in the city in line with EU and national policies.

Waste Management

Policy 8.3 in the Plan relates to waste management. The policy aims include to:

- Secure the provision of waste management facilities and infrastructure; and
- Ensure waste facilities are located within sustainable locations in relation to existing and potential surrounding land-uses, transportation and environmental considerations.

Drainage

Galway City is currently going through a period of rapid growth. This must be sustained by adequate and efficient drainage infrastructural provision. In the past, the majority of sewage discharges went, without treatment, directly into Galway Bay. This has been addressed by the construction of the Mutton Island WWTP to achieve compliance the EU Urban Wastewater Treatment Directive¹¹ (91/271/EEC).

“Secondary treatment in the city is now required and discharges are being treated at the wastewater treatment plant on Mutton Island” (8.4).

This wastewater treatment works will contribute to facilitating the efficient treatment of wastewater, as well as the improvement of water quality in the bay.

¹¹ The Urban Wastewater Treatment Regulations (UWWTR) implement this Directive in Irish law.

“Continuing the development of infrastructure within the city is imperative to its development as a gateway.”

As part of the water investment programme 2003 to 2005, the Council will undertake in conjunction with the County Council a Preliminary Report on Galway Main Drainage Stage 3 of the City and its environs, including areas in County Galway. The study will provide an integrated approach to the sustainable and efficient enhancement and future development of the city’s drainage system.

Policy 8.4 relates to drainage and states the need

“To provide for the effective management, enhancement and extension of the drainage system for the long-term sustainable development of the city, through the Mutton Island wastewater treatment plant and all associated works and required extensions ...”; and to

“Implement the requirements of the EU Water Framework Directive with regard to a sustainable approach to water services management by fully internalising the costs of water usage and wastewater generation in respect of the non-domestic sector”.

Chapter 11 Part A – Land Use Zoning Objectives

Land Use Zoning General

The Development Plan provides the land use zoning objectives for the different areas within the City, indicating the examples of uses, which may or may not be acceptable within each zone.

“Zoning seeks to promote the development of uses that achieve the objectives for the area concerned and to prevent the development of incompatible uses” (11.2).

Mutton WWTP is located within Zone RA, which has an objective to provide for and protect recreational uses, open space, amenity uses and natural heritage.

Natural Heritage, Recreation and Amenity RA Land Use Zoning Objectives

In zone RA, development relating to public utilities such as wastewater treatment works, may contribute to the zoning objectives depending on the location of the RA and the scale of the proposed development.

Chapter 11 Part B – Development Standards and Guidelines

Waste Management Facilities (11.9.4)

Waste management facilities should comply in general with policy considerations as outlined under Policy 8.3 (outlined above).

2.2.5 Galway City Development Board Strategy

The Galway City Development Board published “*Gaillimh – Beo Agus Briomhar!*” - a strategy for economic, social and cultural development within Galway (March 2002). The Strategy sets out goals and objectives for the City between 2002 and 2012, and provides the following vision:

“A city that people are proud to be part of, to work in, to live in and which is attractive to visitors and investors alike”.

The Strategy will aim to “*copper-fasten*” the sustainable growth of the city, employing mechanisms founded on consultation, equality and social inclusion. Goals and key objectives of relevance in the Strategy include the following:

- *Goal – A city with infrastructure facilitating continued economic growth*

Objective 1 – To develop co-ordinated transport infrastructure into and within the City

Objective 2 – To promote integrated provision of utilities, renewable energies and services in the city, which includes providing adequate water supply and wastewater treatment facilities to provide compliance with water quality standards and continuity of supply.

- *Goal – Enhancing the city as a gateway for regional development; and*
- *Goal – Preserving as well as enhancing the natural environment.*

2.2.6 Planning Summary

The salient planning policies emerging from this review include the following:

- The Regional Planning Guidance for the West Region which aims to provide “*a broad planning framework for the region*” includes an objective for local authorities to provide water and sewerage infrastructure throughout the region for domestic, industrial, agricultural and other uses, and to implement the water and sewerage schemes as formulated.
- There is a need to address the existing wastewater services within Galway City in order to meet planned growth. The Development Plan includes policy 8.4 which aims:

“To provide for the effective management, enhancement and extension of the drainage system for the long-term sustainable development of the city, through the Mutton Island wastewater treatment plant and all associated works and required extensions ...”; and to

“Implement the requirements of the EU Water Framework Directive with regard to a sustainable approach to water services management by fully internalising the costs of water usage and wastewater generation in respect of the non-domestic sector”.

The subject site is located within a zone identified for recreational and amenity (RA) uses. In this zone the Development Plan states that development relating to wastewater treatment works may be acceptable depending on location and scale.

2.3 References

Brady Shipman Martin in association with TOBIN/Nicholas O’Dwyer, May 2005, *Galway Main Drainage – Stage 3 – Planning & Development Report*.

TOBIN and O’Dwyer. (2006). *Galway Main Drainage – Stage 3, Preliminary Report, Volume A1*.

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3. Description of the Proposed Development

3.1 Site Description

The existing WWTP is located on Mutton Island, which is located approximately 900m south of the South Park/Salthill area of Galway City, within Galway Bay (see **Figure 1.1**). Mutton Island is a low lying outcrop with large intertidal areas and a predominantly stony foreshore.

The proposed extension to the works will be contained entirely within the curtilage of the existing WWTP which is surrounded by a protective wave wall and approximately 50,000 tonnes of rock armouring (see **Figure 3.1**).

The site occupies the majority of the western side of the island and is connected to the mainland by a 890m long causeway. Within the causeway lies an 1800mm diameter steel mains sewer which delivers raw sewage from the sewered catchment area to the WWTP for treatment. The treated effluent is discharged approximately 400m to the south of the island via a sea outfall equipped with diffusers.

There is a second, smaller outfall to the west of Mutton Island which discharges preliminary treated effluent which reaches the WWTP when flows are greater than 6DWF. This is a storm outfall which is used to stop the WWTP becoming overloaded.

Neither the causeway, mains sewer nor outfalls will require any work associated with this proposal.

3.2 Existing infrastructure on the site

Construction of the causeway to Mutton Island commenced in April 1998 and commencement of the construction of the civil works for the treatment plant on the Island followed in March 2001. The civil works and installation of mechanical and electrical plant were completed in 2003, and the treatment of foul sewage flows commenced in the latter half of 2003. The WWTP was designed to cater for an equivalent population of 91,600 in line with the EIS for the works.

The processes involved in treating wastewater at Mutton Island are set out in **Table 3.1**.

Table 3.1 Existing Treatment Processes at Mutton Island WWTP

For flows up to 3 x Dry Weather Flow : Full Secondary Treatment	For flows up to 6 x Dry Weather Flow: Preliminary Treatment
<ul style="list-style-type: none"> • Primary Sedimentation Tanks <ul style="list-style-type: none"> • Aeration Tanks • Secondary Sedimentation Tanks 	<ul style="list-style-type: none"> • Boulder Traps • Coarse screening through 2 rotating bar interceptors • Fine screening • Grit Removal

The existing WWTP comprises the following (main) elements:

- inlet works (incorporating screw pumps, fine screens and grit removal);
- primary sedimentation tanks;
- an activated sludge plant, incorporating aeration tanks and final settlement tanks;
- sludge holding tanks;
- a sludge digestion plant;
- sludge dewatering; and
- a Control and Administration Building.

Figure 3.1 shows an aerial photograph of the current WWTP with a schematic of the current WWTP layout presented in **Figure 3.2**.

3.3 Proposed Development

The existing site at Mutton Island WWTP is very compact and enclosed by a wave wall leaving very limited room for any form of modification or upgrade. Due to the large area of the site occupied by the existing treatment tanks, there is limited room for additional tanks. Future upgrade of the plant within the site is therefore limited to using the existing process tanks in a different configuration or with a different process.

The design philosophy for the increase in capacity is to maximise the efficacy of existing process units and provide minimal additional infrastructure on-site so as to increase capacity of the works without compromising the site boundary and with the absolute minimum in increased profile of the site through additional vertical elements rising above the tallest infrastructure already present at the WWTP.

By changing the use of some of the existing treatment components (e.g. primary and secondary treatment tanks) and adding appropriate supporting infrastructure (e.g. connecting pipelines) the works' treatment capacity can be increased to treat an estimated final p.e. of up to 170,000. The increased wastewater treatment will generate additional sewage sludge for processing and ultimate disposal. An upgraded sludge

treatment facility will therefore be required on-site to deal with this waste stream (see **Section 3.3.2**). Additionally, the existing inlet works will require modification.

A major design decision has been taken to confine the proposed upgrade to the area within the existing site boundary. No increase of the WWTP to take up any more land or any development that would require the enlargement of Mutton Island will occur. The existing site perimeter wave wall and rock armouring will not be breached by any proposed development covered within this EIS. Additionally, no physical works to the causeway linking Mutton Island to the mainland are proposed.

The WWTP will continue to discharge to Galway Bay via the existing outfalls¹² and the transfer of sewage from the mainland will also continue via the existing pipeline. Both pieces of infrastructure are deemed to be of sufficient size and integrity not to require any works to be undertaken to accommodate the additional flows.

As part of these proposals public access to the causeway linking Mutton Island to the mainland will be increased so that access will be possible along the majority of the length of the causeway.

3.3.1 Wastewater Flows and Treatment

Background

In a general sense, wastewater treatment plants are designed with two objectives in mind. The first objective is to treat whatever volume of wastewater will arrive at the treatment plant. This volume is termed the hydraulic load to the treatment plant. The second objective is to treat whatever is transported by or within the wastewater itself. Wastewater typically contains a large component of biodegradable material, and this is termed the organic load to the treatment plant. The ultimate goal of the treatment plant to discharge a treated effluent, which will have as low an environmental impact as is reasonably possible and complies with all legislative requirements.

In terms of design, a treatment plant must have the capacity to deal with both the hydraulic and organic loads anticipated over its lifetime. The hydraulic load will determine the physical size of the units and pipework within the plant while the organic load is treated by appropriate physical and biological processes. In addition to the organic load, wastewater generally also contains non-biodegradable material, such as grit and plastics, which are removed by physical processes.

The wastewater arriving at the Mutton Island WWTP consists of a mixture of waste flows from various sources, including domestic, commercial and industrial. Added to this are flows due to surface water drainage and flows due to infiltration into the drainage network from groundwater. While, ideally, surface water and infiltration should not be allowed enter the wastewater drainage network, some degree of infiltration is inevitable and must be allowed for in the design of a WWTP.

¹² I.E. The main outfall to the south and storm outfall (for flows >6DWF) to the west.



Large scale infiltration can be minimised by proper regular maintenance of the drainage network. Surface water drainage has historically been connected into wastewater drainage systems, but any new connections to the drainage network in Galway should be ‘wastewater only’ connections. Surface water should be diverted elsewhere in line with Sustainable Drainage Systems (SUDS) principles. This issue is examined in more detail in the context of the drainage policy for new developments (TOBIN and O’Dwyer, 2006).

Current Situation

Mutton Island WWTP was designed to treat a population equivalent of 91,600 p.e. An assessment of the current hydraulic loading to Mutton Island WWTP indicates that currently there is a marked seasonal variation, with summer loading being of the order of 18-19% higher than winter loading (TOBIN and O’Dwyer, 2006).

Proposed Treatment

It is proposed that the WWTP is operated as a conventional activated sludge plant (i.e. without nitrification) because in this mode the capacity of the aeration process units are increased, as oxygen is no longer required for the conversion of Ammonia to Nitrate, and all the Oxygen in the aeration tank is available for biochemical removal. This additional biochemical removal increases the wastewater load which can be treated at Mutton Island WWTP.

Assessment of the treated effluent discharged under this conventional scenario has been undertaken in relation to the current, baseline scenario and also against appropriate standards and regulations in **Section 10** (Water Quality). Effects on the local marine flora and fauna are presented in **Section 11**. The assessments show that it will be acceptable to run the WWTP as a non-nitrifying plant with respect to accepted limits for water quality and ecological condition.

If the plant is converted to a non-nitrifying process, the primary constraint on increasing load relative to the capacity of the units is its hydraulics. The hydraulics of the plant have been examined in detail in the Preliminary Report for the development (TOBIN and O’Dwyer, 2006) and on the basis of this analysis two options for providing the additional capacity have been identified. **Section 3.5.2** outlines these alternative processes.

3.3.2 Sewage Sludge

Background

The treatment of municipal wastewater results in the production of organic sludge. This sludge is a waste by product and needs to be dealt with appropriately. Typically, sludges from wastewater treatment are either sent to landfill, used as organic fertiliser or incinerated.

There are two types of sludge generated at Mutton Island WWTP: Primary Sludge (PS) and Waste Activated Sludge (WAS). PS is generated from the settlement of suspended

solids in the incoming raw wastewater. WAS is generated by the removal of dissolved and particulate organic matter in wastewater. The emphasis in the past has been on the lowest cost route of sludge disposal as treatment and disposal of the resultant sludge can be a significant proportion of overall running costs of a WWTP. However, more stringent environmental legislation and the recognition of the potential value of sludge as an organic fertiliser, a soil conditioner or a fuel, has changed the emphasis to improving the quality of the sludge for re-use.

Current Situation

Mutton Island WWTP is currently the largest single source of wastewater sludge in Galway County/City. In 2004, the average daily production of sludge at Mutton Island was about 4.13 tonnes Dry Solids/day (TDS/d) (1,507 tDS/annum). Currently, all the sludge at Mutton Island is stabilised in anaerobic digestors and dewatered to circa 23% Dry Solids (DS) prior to removal from site. The sludge is then disposed to land as an agricultural fertilizer. The principal processes of the sludge treatment line at Mutton Island WWTP are Thickening, Pasteurisation, Two Stage Anaerobic Digestion and Dewatering.

Currently, approximately nine sludge trucks serve the site each week.

Proposed Treatment

As identified in **Section 1.2**, two options are under consideration for the future treatment of sludge generated by the Mutton Island WWTP.

Option A – On-site sludge dewatering with transport to a Sludge Hub Centre for further treatment

This option includes modification of the existing sludge treatment process such that primary sludges only are digested and an additional centrifuge is installed to dewater sludge to approximately 25% solids content with export of this sludge to a Sludge Hub Centre for treatment.

Under this scenario separate treatment process lines will be provided for the primary and secondary sludges:

- Primary sludge process line to include a picket fence thickener, digester feed buffer tank, sludge digesters and centrifuge for dewatering; and
- Secondary sludge process line to include mechanical sludge thickening and a centrifuge for dewatering.

Under the above regime, the sludge produced at the upgraded works would be dewatered to in excess of 20% DS before transportation to the proposed Sludge Hub Centre. Due to the increased quantities of WAS which would require to be handled and the difficulty in providing additional sludge storage capacity on-site due to space limitations it is proposed that an additional centrifuge be provided. This unit would be located adjacent to the existing centrifuge units and would act on a standby basis.

Calculations (TOBIN and O’Dwyer, 2006) show that 9.7 tDS/day (or 3,549 tonnes Dry Solids per annum) would be generated on-site, an increase of 135% over the current average daily sludge production.

This yearly output would equate to an annual average of 21 sludge trucks serving the site each week (an increase of 12 from the existing situation).

This option is in accordance with the Draft Sludge Management Plan for Galway City and County which proposes a centralised Sludge Hub Centre.

Option B – Provision of an on-site sludge drying facility with the residual product being used as an agricultural fertiliser

Investigations have shown that it is possible to locate a sludge dryer within the confines of the existing Mutton Island WWTP. This option will require modifications to some of the buildings and tanks currently used for sludge treatment and the installation of additional equipment outside the existing buildings and the installation of ducts and pipework between the various units, part of which will be overground. The detail of the equipment to be installed will depend on the specific manufacturer of the plant and can not be determined until the procurement of the plant upgrade has been undertaken. However, it is considered that due to the restricted space available for a dryer, a small footprint, compact centrifuge type dryer (e.g. a CentriDry unit) would be suitable. Investigations have shown that this dryer type could be accommodated within the site, producing a dried sludge of approximately 80% solids content. For the purposes of assessing this sludge treatment option, a suitably sized CentriDry has been used as the basis for the assessment (especially with respect to the air quality, odour and landscape/visual technical assessments). An outline layout of this unit within the Mutton Island WWTP is shown on **Figure 3.3**.

The CentriDry process combines mechanical dewatering by centrifuge and flash drying of raw sludge in a single process unit. The process produces an enhanced dried product, which can be pelletised. **Figure 3.3** shows in outline how the CentriDry plant could be accommodated at the Mutton Island WWTP. The main equipment would be incorporated in the building currently used to house the Pasteurisation Plant. The Cyclone and Pelletiser would be accommodated in the area currently used as the Skip Storage Area. The purpose of the cyclone is to separate the dried sludge from fines and dust. The gas stream from the cyclone, containing dust, inert gases and water vapour, is mainly recycled to the hot gas generator and reused as the drying air. A small amount is bled from the hot gas stream and passes through a gas cleaning system and then discharges to the odour scrubber system.

Notwithstanding the proposals in the Draft Sludge Management Plan for Galway City and County for a centralised Sludge Hub Centre, it is considered that provision of sludge drying at the Mutton Island WWTP would offer the advantage of reducing sludge quantities to be removed from the WWTP thus minimising traffic movements. This would reduce traffic movements (and their associated environmental effects) as well as transportation costs. There are additional benefits relating to risk management and economics which also strengthen the case for this option.

Calculations (TOBIN and O’Dwyer, 2006) show that 10m³/day (or 3,654m³ per annum) would be generated on-site, a decrease in volume of 77% over a solution with dewatering and no drying.

This yearly output equates to an annual average of five sludge trucks serving the site each week (a decrease of four from the existing situation).

3.4 Construction

It is likely that the contract will be let as a PPP arrangement and it is envisaged that the construction phase will take approximately 12 months. The construction programme for the development has yet to be finalised, but it is envisaged that construction will commence in 2007, subject to approvals. An outline of the anticipated construction activities is presented in **Table 3.2**. A period of commissioning of the upgraded works will follow construction.

Table 3.2 Anticipated Construction Activities and Timings

Activity	Duration (weeks)	Site plant and usage
General site clearance and preparation works	4	Diggers and small plant used for construction of the laydown and preparation of working areas.
Civil construction	16 – 18 (No major civil works structures).	Mainly diggers for trenching, plus cranes for lifting and laying pipes (full time). This stage will include creation of foundations, buildings and services.
Mechanical and Electrical works	10 (5 weeks overlapping with civils works).	This stage will include steel erection and installation of mechanical plant, construction of structural steel framework and placement of equipment on foundations using a range of mobile cranes and on-site assembly of plant. Fabrication and installation of pipes and ducts will be undertaken and electrical controls/plant installed.

Note: All stages will require construction workers to access the site, numbers of whom will reach up to a predicted maximum of 30 site workers on any single day.

Note: This prediction is made on the best available information regarding the potential construction period considering the DBO nature of the upgrade.

Construction activities will normally be restricted to 07.00 - 19.00 hours on weekdays and 07.00 - 13.00 on Saturdays. Working outside of these hours will not be permitted without prior permission from Galway City Council.

All construction will be confined within the WWTP site and no construction compound or temporary works will be allowed at South Park. The contractor will be required to plan delivery and removal of equipment and material from the site on this basis. This

decision has been made in order to reduce the disturbance from the construction works on local residents and people using the area for recreational purposes. It will be mandatory for the contractor to conform to this decision.

3.4.1 Construction traffic

It is likely that there will be a maximum of 30 Heavy Construction Vehicles (HCV) movements per day associated with the construction at Mutton Island. It should be noted that this estimate is the maximum numbers of HCV movements expected and it is likely that this level of traffic would only occur for short periods of time.

Additionally, there will be a number of worker movements per day, mostly comprising light vehicle movements.

3.4.2 Construction access

Construction access to the WWTP was assessed during the construction of the existing WWTP (P.H. McCarthy Son & Partners, 1992) and subsequent consultation with local residents led to agreed routes for construction traffic. It is anticipated that this previous agreement will be adhered to for this phase of development, subject to agreement between Galway City Council, An Garda Síochána and further consultation with residents. **Figure 3.4** identifies this previously agreed route.

In addition to obtaining agreement on construction traffic routes the contractor will be required to compile a Traffic Management Plan (TMP) in order to minimise disturbance due to traffic. The following measures will be included in the TMP (as a minimum):

- limiting delivery times to standard construction hours (07.00 – 19.00 Monday to Friday and 07.00 – 13.00 Saturday);
- construction traffic will be programmed to avoid the start and end of the school day where any of the agreed routes pass a school;
- street cleansing will be undertaken in the vicinity of Grattan Road at reasonable periods during the construction period if mud and debris finds its way on to the public road network; and
- appropriate information and diversionary signage associated with the construction will be implemented.

3.4.3 Waste management and disposal

Due to the nature of the work envisaged, there will be very little surplus soil/spoil (or other wastes) generated as part of the proposed construction. As set out in **Section 3.3**, the design philosophy for the increase in capacity is to maximise the efficacy of existing process units and provide minimal additional infrastructure on-site. No major earthworks are therefore predicted as part of the construction phase. This approach substantially limits the waste generated on-site that may require disposal.

Any waste that is generated will be disposed of to a suitable licensed facility.

3.5 Alternatives Considered

3.5.1 Alternative Sites

An EIS was completed as part of the statutory procedures for the existing and now well-established Mutton Island WWTP. This document (P.H. McCarthy Son & Partners, 1992) outlined a number of alternative sites considered for the development.

As the Mutton Island WWTP is already operational and as the modification can be accommodated within the boundary of the existing site, no alternative sites have been considered. This approach is a minimum disturbance option which results in a greater contribution to sustainable development than would provision of an alternative site. The issue of alternative sites for the WWTP upgrade has not, therefore, been considered further.

3.5.2 Alternative Sewage Treatment Designs and Processes

The upgrade of Mutton Island under a DBO contract would allow for flexibility and innovation in relation to upgrading the plant within the confined space. The exact details of this are best left to a DBO Contractor, but two possible upgrade options have been provisionally identified in the Preliminary Report (TOBIN and O'Dwyer, 2006).

Due to the tight constraints of the site, it will be difficult to add additional process tankage/units without demolishing existing parts of the plant. This option has not been examined further as investigations show that other solutions to upgrading the plant are possible and are likely to be more attractive to any tenderer.

The final site design and processes to be used will be finally determined via the Contract Documents. Design envelopes defined in this EIS will clearly define the range of impacts, effluents and emissions that will be permitted, and each submitted proposal robustly examined to ensure strict adherence with these envelopes. No transgressions from these envelopes whatsoever will be permitted in the finally accepted proposal and, no treatment process will be acceptable to Galway City Council that is not based on proven technology.

Option 1 (see Figure 3.5)

The following essential modifications are required to maximise the capacity of the plant:

- Modification (Raising) of the Storm Bypass Weir;
- Additional pipe (900mm diameter) from intermediate pumping station to aeration tank;
- Additional pumping plant at the intermediate pumping station, which delivers primary settled sewage and RAS to Aeration Tanks (1000 l/s);
- Modification of the peripheral outlet system from the Final Sedimentation tanks;

- Modifications to the Return Activated Sludge System to increase capacity; and
- Modifications to ducts and other ancillary pipework to accommodate the above works.

Option 2 (see Figure 3.6)

The Preliminary Report (TOBIN and O’Dwyer, 2006) also examined increasing the capacity of the works by modifying two of the primary sedimentation tanks to operate as secondary sedimentation tanks. This would require additional modifications to pumping and pipework to that described above for Option 1 as follows:

- Pumping Station and 800mm diameter pipework to pump wastewater from the Aeration Tanks to the 2 Primary Settlement Tanks converted to Final Settlement Tanks;
- Upsizing from 250mm to 500mm of the sludge withdrawal pipework from the converted Primary Settlement Tanks;
- Upsizing from 600mm to 800mm of the inlet pipework to the 2 Primary Settlement Tanks;
- Additional 600mm diameter pipework to deliver settled sewage from the 2 converted Primary Settlement Tanks to the Intermediate Pumping Station; and
- Additional pipework to deliver final effluent from the 2 converted Primary Settlement Tanks to the Outfall Pumping Station.

It is likely that these works will be procured under a DBO process and accordingly a DBO Contractor is best placed to determine the best method to implement these upgrade works.

Other variations on the above proposals could include:

- Running pipework over ground in certain situations e.g. attaching the 800mm diameter pipe from the Aeration Tanks to the converted Primary Settlement Tanks to the inside face of the Site Boundary Wall; and
- Modifying pumping arrangements rather than upsizing of pipework.

3.5.3 Alternative Sludge Treatment Designs and Processes

Section 3.3.2 outlines the options for the sludge treatment processes considered suitable for the WWTP upgrade. The DBO Contractor will be best placed to determine the most suitable sludge treatment upgrade option based on the two main treatment options and once this has been determined, the most suitable equipment as part of their overall upgrade design.

3.6 References

P.H. McCarthy Son & Partners. (1992). *Galway Main Drainage – Proposed Causeway and Sewage Treatment Plant on Mutton Island: Environmental Impact Statement*.

TOBIN and O’Dwyer. (2006). *Galway Main Drainage – Stage 3, Preliminary Report, Volumes A1 & B1*.

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4. Scoping and Consultations

4.1 Introduction

Scoping describes the process of identifying the potentially significant issues that should be addressed in detail in an EIS. The scope of this EIS has been defined on the basis of:

- reference to the Environmental Protection Agency’s ‘*Advice Notes on Current Practice in the Preparation of Environmental Impact Statements*’ and ‘*Draft Guidelines on the Information to be contained in Environmental Impact Statements*’;
- the project team’s experience of environmental impact statements;
- information obtained from consultees;
- site visits; and
- consultation with Galway City Council to confirm that an EIS with the scope as defined will enable them to identify the full range of environmental effects of the proposed development.

4.2 Scoping Report

To assist Galway City Council in reaching an opinion, and to facilitate broader consultation with bodies that may be unfamiliar with the proposals, a Scoping Report was produced (TOBIN, O’Dwyer and Entec, 2005) which included the following information:

- an outline description of the proposed development;
- the site location and description;
- the purpose of the proposal; and
- the proposed basis of the EIA.

The EIA Regulations state that significant effects should be assessed and, in our view, these were all identified in the Scoping Report. We also identified effects which we considered to be minor and not significant, in order that as complete a picture as possible of potential effects was presented.

Appendix A identifies the predicted environmental effects to be addressed in this EIS. It should be noted that some aspects have been ‘scoped out’ of the EIS because of the low predicted magnitude and minor significance of potential effects.

4.2.1 Scheme changes since scoping report production

Table 4.1 summarises the major elements identified for exclusion from detailed assessment and presents the rationale for this.

Table 4.1 Elements Identified for Exclusion from the Full Assessment

Ref No.	Topic Area	Issue	Rationale
1	Water Quality	No assessment of the construction phase will be progressed.	Although construction can lead to accidental releases of fuels/oils and soils/sediments to <i>Galway Bay</i> , the limited construction being undertaken, entirely within a previously developed site, reduces the risk to a level where no likely significant effects will result.
2	Marine Ecology	No assessment of the construction phase on marine ecology is proposed.	Effects of construction on <i>sensitive species and habitats</i> , particularly the permanent loss of habitat and the displacement of species are unlikely given the restricted construction footprint and works.
3	Air Quality	No assessment of air quality changes as a result of emissions from vehicles and heavy plant during the construction process will be progressed.	Effects of emissions from vehicles and heavy plant on <i>local properties</i> during the construction process is unlikely due to the small amount of traffic generated by the proposals during construction.
4	Air Quality	Dust emissions will not be considered within the full assessment.	Effects of dust from construction activities on <i>local properties/buildings</i> will be non-significant given the remoteness of the site from receptors and the limited ground disturbance that will occur.
5	Noise and Vibration	No assessment relating to traffic noise will be undertaken.	Noise and vibration from construction traffic on <i>local properties/buildings</i> is unlikely due to the low additional volume of traffic predicted.
6	Traffic and Transport	No assessment on traffic effects will be undertaken and presented in the EIS.	Construction and operational traffic effects on the <i>local road infrastructure</i> and <i>residents</i> are not likely to be significant as the additional number of vehicles visiting the site will be low compared to the surrounding road network. These additions will be below recognised thresholds for significant effects to occur.
7	Cultural Heritage	No significant effects are likely and this aspect will be scoped out of the EIS.	Potential loss or disturbance of <i>artefacts</i> within the proposed extension area is extremely unlikely due to the development being undertaken entirely within previously developed land.
8	Visual	No significant effects are likely and this aspect will be scoped out of the EIS.	Visual effects on <i>local properties/buildings</i> arising from construction activities, including use of cranes and other heavy plant will be limited due to the distance from receptors and the high surrounding wall of the WWTP excluding views of all but the tallest plant. Visual effects on <i>local properties/buildings</i> arising from the operation of new facilities/infrastructure within the site are unlikely to be significant.

Ref No.	Topic Area	Issue	Rationale
9	Landscape	No significant effects are likely and this aspect will be scoped out of the EIS.	<p>The proposed infrastructure would blend in with the existing WWTP, adding little visible mass to the site as viewed from the mainland and not increasing the extent of the visual envelope of the WWTP.</p> <p>Significant effects on the <i>landscape character</i> arising from construction activities are unlikely given the small amount of plant which could interact with the overall landscape setting.</p> <p>Effects on the <i>landscape character</i> arising from the operation of new facilities/infrastructure within the site are unlikely to be significant due to the small scale of the proposals in comparison with existing infrastructure and screening of all but the tallest structures by the perimeter wall. A height restriction will be imposed on all new infrastructure.</p>
10	Land Contamination	No significant effects are likely and this aspect will be scoped out of the EIS.	The lack of known soil contamination and the minimal need for groundworks precludes the likelihood for significant effect to occur to <i>site workers</i> or <i>local ecological receptors</i> .

Formal scoping consultation has been carried out with the scoping report issued to the following bodies:

- Development Applications Unit, Dublin;
- Coastal Zone Management Division, Dept of Marine and Natural Resources, Dublin;
- Western Regional Fisheries Board, Galway;
- Western River Basin District Management Group;
- An Taisce – Galway Branch, Galway; and
- Claddagh Residents Association, Galway.

The responses from each organisation are summarised in **Appendix B** along with a response to each of the points raised.

As with many civil engineering projects, the Mutton Island WWTP upgrade scheme has evolved over time. Since the Scoping Report was produced and circulated for comment the option for an on-site sludge dryer has been added to the proposals. Consideration of the implications of this option have determined that, although originally scoped out, assessment of operational air quality and landscape/visual elements was required. These two technical areas have therefore been included within this EIS.

4.3 Public Consultation

In addition to the Scoping Report being circulated to the local residents association a public information day was undertaken in order to explain the project to visiting members of the public and facilitate them in making comments on the project.

The information day was held on Thursday 19th January 2006 in the Galway Bay Hotel, Salthill from 2pm to 8pm. The event was publicised in The Galway Advertiser on Thursday 12th January, The Galway Independent on Wednesday 18th January and on Galway FM on Tuesday 17th January.

Members of Galway City Council and the wider project team were available to discuss the proposals and a 16 poster exhibition was set up to inform the public of the proposals and the findings of the EIA.

The event was attended by 20 members of the general public.

Written comments were received during this event will be fed back into the decision making process to assist in determining a balanced way forward regarding the proposals. The main comments regarding the upgrade proposals related to minimising odours and the protection of the South Park area from construction activity disturbance.

4.4 References

TOBIN, O'Dwyer and Entec. (2005). *Mutton Island Wastewater Treatment Works Upgrade – Scoping Report*.

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5. Odour

5.1 Existing Environment

5.1.1 Introduction

The issue of malodours from wastewater treatment works and sludge treatment facilities has gained increased public recognition over the last 20 years, along with growing expectations of quality of life and a reduced tolerance towards adverse environmental effects of business and utilities upon public amenity.

Odours are not generally additive in the same way as other nuisance parameters such as decibels for noise (Environment Agency, 2002). This reflects the way in which the brain responds to odour. The human brain has a tendency to “screen out” those odours which are always present or those that are in context to their surroundings. For example, an individual is more likely to be tolerant of an odour from a factory in an industrial area than in the countryside. The human brain will also develop a form of acceptance to a constant background of local odours.

As such, any new odours introduced cannot be added to an existing background odour level to give a figure for total odour. An intermittent or fluctuating or new odour is more likely to stand out against this background. Normal background odours such as from traffic, grass cutting, plants etc, indeed the “normal” medley of “environmental” odours amounts to anything from 5 to 40 ou/m³ (Wijnin, 1986). A new odour at much lower concentration can still be noticeable against this background. This “screening out” is different to olfactory fatigue where receptors in the nose become fatigued and less effective at detecting a particular smell.

The use of olfactometry in the assessment of odour assumes that all odour concentrations are above this background. There may be occasions, however, when it needs to be considered, for example if there are known to be additive or synergistic effects with other odours or substances that are present in a particular environment.

Limited research is available into what constitutes an appropriate and workable odour standard for wastewater treatment. The Concise Guide (Valentin and North, 1980) considers that odours at 5 times their detection threshold (effectively 5 ou_E/m³) can be considered as having the potential to cause annoyance. Although this is not directly aimed at the water industry, it provides for a common guideline as to the historical approaches that have been adopted.

The main criterion adopted in Ireland and the UK to avoid odour annoyance has been derived from the Newbiggin-by-the-Sea public inquiry (McGovern and Clarkson, 1994 & Department of the Environment, 1993). The absence of complaints at Newbiggin-by-the-Sea (Alan Thompson, Northumbrian Water, *Pers Comm.*) appears to give weight to the 5 ou_E/m³ 98th percentile compliance at the receptor being a level of odour that can be

tolerated by the population. It should, however, be noted that no post-commissioning sampling has been conducted, as such, it is not possible to categorically enumerate the actual odour concentrations at the receptor, which may be lower or even greater than the $5 \text{ ou}_E \text{ m}^{-3}$ 98th percentile criterion. The Newbiggin-by-the-Sea odour criteria has its origins in a study (Miederna *et al*, 2000) from the Netherlands.

Although this criterion has had many successes in the planning arena for water service providers, certain circumstances have arisen where the population may be especially sensitive to odour from wastewater and sludges, namely through prolonged exposure and encroachment

Research in the Netherlands (Information Centre for the Environment, 2001) has highlighted the complexity of the assessment of odours from WWTPs. It states that situations exist where $5 \text{ ou}_E/\text{m}^3$ has been achieved and no complaints are received, yet cases also exist where $1 \text{ ou}_E/\text{m}^3$ has been achieved and complaints are still received. Here, the Netherlands Emission Guidelines for Air considers that the exposure concentration where complaints escalate is at concentrations above $2.5 \text{ ou}_E/\text{m}^3$ as the 98th percentile of hourly averages.

The conclusion is that an appropriate nuisance criteria could lie anywhere between $1 \text{ ou}_E/\text{m}^3$ and $10 \text{ ou}_E/\text{m}^3$ as the 98th percentile of hourly averages at a critical receptor (Hall and McIntyre, 2004).

For many wastewater treatment works and sludge treatment centres in Ireland, dispersion modelling output has been assessed against an odour annoyance criterion whereby no critical receptor shall be exposed to a concentration of more than $5 \text{ ou}_E/\text{m}^3$ 98th percentile of hourly averages as a result of emissions from a wastewater treatment works (McGovern and Clarkson, 1994 & Department of the Environment, 1993). Entec's extensive experience of applying and designing to this criterion over the last ten years for wastewater and sludge treatment schemes indicates that, where compliance occurs, complaints with respect to odour are unlikely.

5.1.2 Scope

This assessment is concerned with the establishment of the potential for the existing and proposed scenarios to cause an odour nuisance. This has been established through the measurement and modelling of emissions.

5.1.3 Methodology

Odour Emission Sampling

Area sources at Mutton Island WWTP were monitored using a sampling hood during September 2004. The hood was placed over the area of interest and ventilated with odour free air at a known rate to give an air velocity over the surface of around 0.3 to 0.4 m s^{-1} . Samples were then collected at the outlet.

For sampling from point sources, such as the existing odour control facility, air was extracted direct from the stack into a sample bag.

All samples prepared for olfactometry were also analysed on site for the concentrations of hydrogen sulphide using a Jerome gold leaf analyser. The Jerome draws a small amount of the malodorous air over a gold leaf. Reduced sulphide compounds adsorb onto the gold leaf and in so doing producing an electrical current that is directly proportional to the concentration of reduced sulphide collected.

All odour samples were taken in duplicate to increase the confidence intervals. The lower limit confidence interval with a duplicate sample would be $\leq 77.9\%$ with an upper limit confidence interval of $\leq 95.5\%$. All samples were collected and analysed in accordance with the protocols laid down in the British Standard for olfactometry (British Standards Institute, 2003).

Odour Units and Olfactometry

An odour unit is defined as the number of times a sample needs to be diluted with odour free air to reach a point at which half of the panel can detect the odour.

The European odour unit (ou_E) is the amount of odorant that when evaporated into 1 m^3 at standard conditions, elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM) evaporated in 1 m^3 of neutral gas at standard conditions.

One EROM, evaporated into 1 m^3 of neutral gas at standard conditions, is the mass of substance that will elicit the 50% detection threshold (D_{50}) physiological response assessed by an odour panel in conformity with this standard and has by definition a concentration of $1\text{ ou}_E/\text{m}^3$.

For n-butanol (CAS-Nr. 71-36-3) one EROM is $123\text{ }\mu\text{g}$. Evaporated in 1 m^3 of neutral gas, at standard conditions, this produces a concentration of $0.040\text{ }\mu\text{mol/mol}$ (equal to 40 ppb by volume).

The relationship between ou_E for the reference odorant and that for any mixture of odorants at the D_{50} concentration;

$$1\text{ EROM} \equiv 123\text{ }\mu\text{g n-butanol} \equiv 1\text{ ou}_E \text{ (for a mixture of odorants)}$$

By definition odour units are expressed as n-butanol mass equivalents.

Odour concentration of a gaseous sample of odorants is determined by presenting a panel of selected and screened human subjects with that sample, varying the concentration by diluting with neutral gas in order to determine the dilution factor at D_{50} .

At that dilution factor the odour concentration is $1\text{ ou}_E\text{ m}^{-3}$ by definition. The odour concentration of the sample is then expressed as a multiple (equal to the dilution factor at $1\text{ ou}_E\text{ m}^{-3}$) of one European odour unit per cubic metre at standard conditions for olfactometry. The odour laboratories used for this study are UKAS accredited.

Odour Dispersion Modelling

Over the last 10 years, new generation dispersion modelling codes have been developed (ADMS and AERMOD), which more precisely simulate the effect of atmospheric physical parameters on material dispersion and current best practice dictates that one of these two models should now be used for dispersion modelling assessments. It is the experience of Entec that in using these dispersion models for predicting odour dispersion from wastewater and sludge treatment facilities, that there is little to choose technically in most applications between the two. AERMOD however, has been used extensively in Ireland for numerous odour assessments at wastewater and sludge treatment works, and as such has been used for this assessment.

The AERMOD Dispersion Model

The odour modelling was conducted using a computer dispersion modelling package AERMOD. AERMOD is the result of work conducted by AERMIC (American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee), to introduce state-of-the-art modelling concepts into the United States Environmental Protection Agencies (USEPA) local-scale air quality models. The AERMIC's focus was on a new platform for regulatory steady-state plume modelling.

Special features of AERMOD include its ability to treat the vertical inhomogeneity of the planetary boundary layer, special treatment of surface releases, circular and irregularly-shaped area sources, a three plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base (USEPA, 2002).

The output of AERMOD is a prediction of ambient concentrations at receptor points for averaging periods including 1 hour, 8 hour, 24 hour, and annual. The AERMOD output allows for post processing predicting percentiles, which is essential for odour assessment.

The meteorological data for Shannon Airport has been obtained for the years 2001 to 2003. Entec considers that this meteorological station with upper air data would be the most representative for the area of Galway. Although Shannon Airport is located 50 km to the south of Galway, but would be influenced by similar coastal air movements as seen in Galway. More local meteorological stations do not collect the specific data required for the modelling.

The modelling of the baseline scenario makes use of the sampled emission data, with the proposed scenarios modelled using the sampled emission data in addition to source inputs from Entec's extensive library of emission rates. This database has been compiled through sampling exercises undertaken by Entec in the UK and Ireland over the past 6 years.

Dispersion Model Outputs

For each of the receptors forming part of the model input, the dispersion model predicts an ambient concentration averaged over an hour. The data is post processed to predict

concentrations as a percentile of hourly averages. The output to the dispersion model is then transferred to a contour plotting package which produces isopleths laid over a base map.

In addition to the receptor grid, critical receptors, identified as discrete Cartesian receptors, have been included in the dispersion model, against which the odour annoyance criterion of $5 \text{ ou}_E \text{ m}^{-3}$ has been assessed.

5.1.4 Existing Situation

The existing wastewater treatment facility uses conventional, activated sludge treatment (see **Section 3.2**). The sludge storage and treatment facility has an extraction system to remove odour and treat these using a biofilter. **Table 5.1** presents the results of the emission monitoring of the main sources on the site.

The results of the dispersion modelling are presented as **Figures 5.1a to 5.1c** (using meteorological data from the years 2001 - 2003 respectively).

The closest residential receptors that could be affected are residential properties on Grattan Road whilst users of South Park could also be affected by odours. The dispersion modelling shows these locations are subject to a predicted odour concentration of less than $0.5 \text{ ou}_E \text{ m}^{-3}$ as the 98th percentile of hourly averages.

Table 5.1 Emission Monitoring

Source	Odour Concentration ($\text{ou}_E \text{ m}^{-3}$)		Odour Emission Rate
	Sample 1	Sample 2	
Primary Settlement Tank	392	192	$0.63 \text{ ou}_E \text{ m}^2 \text{ s}^{-1}$
ASP Aerobic	268	359	$1.05 \text{ ou}_E \text{ m}^2 \text{ s}^{-1}$
ASP Anoxic	380	541	$0.71 \text{ ou}_E \text{ m}^2 \text{ s}^{-1}$
Final Settlement Tanks	226	212	$0.51 \text{ ou}_E \text{ m}^2 \text{ s}^{-1}$
Filter 1 Outlet	524	479	$601.8 \text{ ou}_E \text{ s}^{-1}$
Filter 2 Outlet	642	811	$722.3 \text{ ou}_E \text{ s}^{-1}$
Filter 1 Inlet	28, 317	-	
Filter 2 Inlet	23, 605	-	

5.1.5 Predicted Trends

Given the way that the odour is treated by the human brain, a concern must be made of any odour that has a similar hedonic tone. No future developments have been proposed for this area which may contribute similar hedonic tones.

5.1.6 Information Gaps

No information gaps have been identified.

5.2 Potential Effects and Incorporated Mitigation

5.2.1 Potential Effects During Construction and Incorporated Mitigation

During the construction process, the wastewater treatment process is unlikely to change sufficiently as to increase the odour concentration at Grattan Road or at South Park compared with the baseline scenario.

5.2.2 Predicted Effects During Operation and Incorporated Mitigation

Increasing the wastewater loading throughput of the WWTP will be undertaken under a DBO contract, and two process options for wastewater treatment are identified in **Section 3.5.2**. Increased sewage sludge production will occur due to the greater volume of sewage being treated at the site, as identified in Section 3.3.2. With respect to odour the worst case scenario for the treatment of this increased sludge production is the provision of on-site treatment via a sludge drying facility (identified as Option B in **Section 3.3.2**). The upgrade will have the potential to increase odours released from the WWTP and this effect has been assessed in **Section 5.3.3**.

To reduce potential effects of the emission of odour from any on-site sludge dryer, its emissions shall be routed via an odour control system. For the purpose of this assessment it has been assumed that this would be a biofilter with a calcified media. This system has been identified as being capable of dealing with variable odour loads from any potential sludge drying facility. It is not thought necessary to provide wet chemical scrubbing for this location.

As the contract is a DBO the final selection of odour control technique may differ. However, the selected technique will be assessed and will have to be at least as effective at reducing odours as the biofilter with calcified media used in this assessment.

Table 5.2 summarises the incorporated mitigation measures.

Table 5.2 Avoidance/reduction measures – likely significant effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		
Shoreline receptors (inc. Grattan Road)	None Identified	

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Operation		
Shoreline receptors	Increase in odour concentration resulting in an odour nuisance	<p>High certainty of effectiveness:</p> <p>To reduce potential effects extraction of air from any sludge treatment facilities to the existing odour control unit will occur (or a new unit with an equivalent, or lower, odour release).</p> <p>Following release the concentration of odour will decrease through dispersion. Given the long distance to the shoreline receptors it is predicted that the concentration at this point will not be sufficient to cause a nuisance.</p>

Compensation

No compensation has been identified or is relevant.

5.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 5.3**.

Table 5.3 Implementation of incorporated mitigation and enhancement measures

Description of measures including any monitoring requirement	Responsibility for implementation	Implementation mechanism
Construction		
None identified		
Operation		
Extraction of odour from the sludge treatment facility to the existing odour control unit (or better) will be undertaken	Site Operator	Contract Documents

5.3 Assessment of Effects

5.3.1 Scope and Methodology

The assessment of the effect of the emission of odours from the upgraded WWTP (including sludge treatment facility) is defined through the measurements and modelling of the odours. Odours have been sampled from the existing WWTP to define the

baseline emission of odours and the concentration of these are predicted at the shoreline receptors (see **Figure 5.1**). The upgraded WWTP has then been remodelled using appropriate emission rates from the Entec emissions database and other sources. The resultant predicted concentrations are considered against the defined odour criterion.

The odour model input parameters for the additional odour control unit and its associated release point are shown in **Table 5.4**.

Table 5.4 Emission Parameters

Dryer Odour Control Emission Point Parameters	Value
Height above ground level (m)	4
Diameter (m)	0.45
Efflux velocity (m s^{-1})	10.06
Efflux temperature ($^{\circ}\text{C}$)	Ambient
Odour emission rate ($\text{ou}_E \text{ s}^{-1}$)	1600

5.3.2 Significance evaluation methodology

The significance of the proposed development with respect to odour is defined through the prediction of odour at Grattan Road and at South Park.

It is generally accepted that where a receptor is being exposed to concentrations less than $5 \text{ ou}_E \text{ m}^{-3}$ as the 98th percentile of hourly averages it is unlikely to give rise to a nuisance. Concentrations above $5 \text{ ou}_E \text{ m}^{-3}$ as the 98th percentile of hourly averages would give an increased possibility of a nuisance occurring.

5.3.3 Predicted effects and their significance

Construction

Given the predicted concentration of odour as a result of operating the site as per the proposed site configuration, it is considered that the probability of complaints as a consequence of the odour emission from the site would be unlikely, with the impact of odours not being of significance.

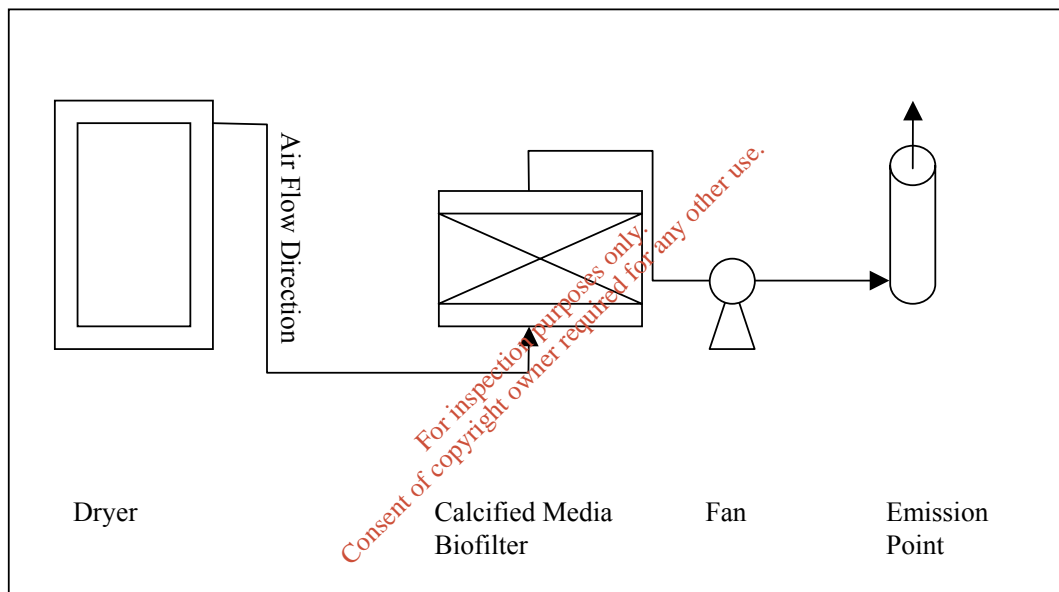
Operation

The effect of the proposed upgrade at Mutton Island WWTP will be a very small increase in the odour emission from the site. Any new on-site sludge dryer would be extracted to a dedicated odour control unit as outlined in **Figure 5.2**. The emissions from the odour control unit have been calculated from emission testing from a comparable dryer to that proposed at Mutton Island (i.e. a CentriDry unit, see **Section 3.3.2** (Option B) for more details of this type of dryer).

The predicted concentration of odour at Grattan Road is an order of magnitude less than the adopted nuisance criterion of $5 \text{ ou}_E \text{ m}^{-3}$ as the 98th percentile of hourly averages and, as such, is not considered to give rise to an odour nuisance. The increase in odour above the present situation is very small and no change will be noticeable for local residents. The related contour plots have been included as **Figure 5.1d** to **5.1f** (using meteorological data from the years 2001 to 2003 respectively).

Given the predicted concentration of odour as a result of operating the site as per the proposed site configuration, it is considered that the probability of complaints as a consequence of the odour emission from the site would be unlikely, with the impact of odours not being of significance.

Figure 5.2. Flow Diagram for the proposed Odour Control Unit



5.3.4 Compensation

No compensation has been identified.

5.3.5 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

5.3.6 Summary of significance evaluation

Table 5.5 Effects on odour and evaluation of significance

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Construction						
Odour nuisance at mainland receptors	-ve	Unlikely	Local	Minor	Not Significant	No change is predicted to the odour emissions from the WWTP as part of the construction process.
Operation						
Odour nuisance at mainland receptors	-ve	Unlikely	Local	Minor	Not Significant	Odours will be reduced via an appropriate control system and subsequent concentrations of odour will decrease through dispersion. Given the long distance to the receptor it is predicted that the concentration at this point will not be sufficient to cause a nuisance.
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			

5.4 References

British Standard Institute, (2003), *Air Quality - Determination of Odour Concentration by Dynamic Olfactometry, prEN 13725:2003*

Environment Agency, (2002), *DRAFT Horizontal Guidance for Odour Part 1- Regulation and Permitting*

Department of the Environment, (1993), *Report by the Inspector on a Public Enquiry into the Appeal by Northumbrian Water Limited for Additional Sewage treatment Facilities on Land Adjacent to Spital Burn, Newbiggin by the Sea, Northumberland. DoE APP/F2930/A/92/206240.*

Hall, D. L., McIntyre, A. E., (2004), The Derivation of Odour Standards and their Role and the Foundation of Odour Management Plans for Planning Regulation. *In Proceedings of the Second National Conference Volume Two September 2004. Ed N. J. Horan*

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6. Air Quality

6.1 Existing Environment

6.1.1 Introduction

This chapter presents information relating to the existing and predicted future air quality in the vicinity of Mutton Island WWTP. Data are presented relating to the background air quality in Galway, and for predicted effects of the construction on this baseline situation. The atmospheric dispersion model AERMOD has been used to predict ground level concentrations of nitrogen dioxide and sulphur dioxide (NO₂ and SO₂) as detailed by the Irish National Air Quality Standards (Environmental Protection Agency, 2005).

6.1.2 Scope

This assessment is concerned with the establishment of the potential for the upgraded WWTP to affect local air quality. This has been established through the measurement and modelling of emissions from thermal dryers, and from information gathered from the Environmental Protection Agency.

6.1.3 Methodology

Nitrogen Dioxide and Sulphur Dioxide Background Concentrations

The pollutant concentrations for the area surrounding Mutton Island were assessed against the Irish National Air Quality Standards (NAQS). The limit values for SO₂ and NO₂ are shown in **Table 6.1**.

Table 6.1 National Air Quality Standards

Pollutant	Statutory or Non-statutory	Averaging Period	Value (µg m ⁻³)	Date to be achieved
Nitrogen dioxide	S	Annual mean	40	2010
	S	1-hour mean, not more than 18 exceedences a year	200	2010
Sulphur dioxide	S	1-hour mean, not to be exceeded more than 24 times a year	350*	2005
	S	24-hour mean, not to be exceeded more than 3 times a year	125	2005

*Dependant on associated smoke median concentration of <150 µg m⁻³

6.1.4 Existing Situation

Air quality data from 2003 (EPA, 2005) has been used to determine the existing air quality in the Galway area. The City of Galway falls into Zone C (cities and towns, excluding Dublin and Cork) with regard to air quality assessment and management. **Table 6.2** presents the background concentrations of SO₂ and NO₂, from monitoring stations in Galway and Athlone. Reported smoke levels determine the limit value that is applied, so these have also been reported.

The closest receptors that could be affected by changes to air quality from Mutton Island WWTP are residential properties along Grattan Road.

Table 6.2 Background Pollutant Concentrations 2003

Parameter	Galway, $\mu\text{g m}^{-3}$	Athlone, $\mu\text{g m}^{-3}$
Smoke daily median	3	-
SO ₂ daily mean	13	-
SO ₂ daily mean, 98 percentile	32	-
SO ₂ hourly mean	-	7
SO ₂ hourly mean, 98 percentile	-	23
NO ₂ mean	9	-
NO ₂ hourly mean, 98 percentile	39	-
NO ₂ hourly mean, 99.8 percentile	77	-

Source: Environmental Protection Agency (2005)

The background SO₂ concentration in the area of Galway is considered to be very low, comprising 10% of the NAQS limit value. The continuous analyser in Athlone has an hourly mean of 7 $\mu\text{g m}^{-3}$ which is only 2% of the NAQS limit value. The daily mean recorded in Galway was only 13 $\mu\text{g m}^{-3}$ which is 10.4% of the limit value.

The background NO₂ concentration in the area is also very low. The continuous analyser in Galway has an hourly mean of 9 $\mu\text{g m}^{-3}$ which is only 4.5% of the NAQS limit value. The mean NO₂ is also <25% of the NAQS limit for the annual mean (40 $\mu\text{g m}^{-3}$).

6.1.5 Predicted Trends

Large industrial processes can add to the pollutant concentrations. No future developments have been proposed for this area which may contribute a large concentration of these pollutants.

Across Ireland the demand for the burning of coal on domestic fires is decreasing, as such the emissions from this source are considered to be diminishing accordingly.

6.1.6 Information Gaps

No information gaps have been identified.

6.2 Potential Effects and Incorporated Mitigation

6.2.1 Potential Effects During Construction and Incorporated Mitigation

Traffic

During the construction phase, air quality effects could arise from increases in traffic on local roads (and therefore an increase in vehicle exhaust emissions) and from dust arising from construction activity. The levels of traffic associated with the construction phase of the project are low and will not significantly increase levels of air pollutants or cause a breach of the air quality standards in place (NAQS). No further consideration of changes in air quality due to construction traffic has been made.

Dust

The potential for nuisance from wind blown dust depends upon the respective locations of the sensitive receptors and work being undertaken as well as the extent/duration of any dust generating activities e.g. ground excavations. In addition to the nature of the activity being carried out, wind direction, wind speed and precipitation, will all influence whether the potential for nuisance exists. Most of these factors are dependent on site operating and weather conditions at any given time.

As a general rule, prior to any mitigation, dust nuisance would not be expected at a distance beyond 250m from the work activity, and even then only when these receptors are downwind of the construction work. The amount of groundworks predicted for the construction phase are low and this, added to the fact that there are no receptors within 250m of the WWTP site makes it extremely unlikely that any dust nuisance will occur. No further consideration of nuisance caused by dust is required.

6.2.2 Predicted Effects During Operation and Incorporated Mitigation

The potential addition of a sludge dryer, and its associated odour control unit, at the WWTP can be considered to be the worst case scenario with respect to air quality from the operational, upgraded WWTP (as identified as Option B in **Section 3.3.2**) and this option has been assessed.

As a side-effect of the extraction of air from the sludge treatment facility to a new odour control unit, small concentrations of NO₂ and SO₂ will be released.

Table 6.3 summarises the incorporated mitigation measures.

Table 6.3 Avoidance/reduction measures – likely significant effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		
Shoreline receptors (inc. Grattan Road)	None Identified	
Operation		
Shoreline receptors (inc. Grattan Road)	Increase in air pollutant concentration resulting in an increase to background levels of NO ₂ and SO ₂	High certainty of effectiveness: Releases of NO ₂ and SO ₂ are predicted to be low. Following release the concentration of air pollutants will decrease through dispersion. Given the long distance to the shoreline receptors it is predicted that the concentration at this point will not be sufficient to cause a significant increase to background NO ₂ and SO ₂ concentrations. No further mitigation has therefore been identified.

Compensation

No compensation has been identified or is relevant.

6.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 6.4**.

Table 6.4 Implementation of incorporated mitigation and enhancement measures

Description of measures including any monitoring requirement	Responsibility for implementation	Implementation mechanism
Construction		
None identified		
Operation		
None identified		

6.3 Assessment of Effects

6.3.1 Scope and Methodology

This assessment is concerned with the establishment of the potential for the proposed upgrade to affect baseline air quality. This potential has been established through the

measurement and modelling of emissions, and from information gathered from the EPA.

Nitrogen Dioxide and Sulphur Dioxide Emission Sampling

The pollutant emission rates for both nitrogen dioxide and sulphur dioxide were supplied by a supplier of thermal dryer of appropriate design for this site (Euroby, 2006). The pollutant concentrations were assessed against the Irish National Air Quality Standards (NAQS).

Atmospheric Dispersion Modelling

Over the last 10 years, new generation dispersion modelling codes have been developed (ADMS and AERMOD), which more precisely simulate the effect of atmospheric physical parameters on material dispersion and current best practice dictates that one of these two models should now be used for dispersion modelling assessments. It is the experience of Entec that in using these dispersion models for predicting air quality is that there is little to choose technically in most applications between the two. AERMOD however, has been used extensively in Ireland for numerous assessments at treatment works, and as such has been used for this assessment. This model has also been used for the odour assessment in **Section 5**.

The AERMOD Dispersion Model

The air quality modelling was conducted using a computer dispersion modelling package AERMOD and this software is described in **Section 5.1.3**.

The meteorological data for Shannon Airport has been obtained for the years 2001 to 2003. Entec considers that this meteorological station with upper air data, would be the most representative for the area of Galway. Shannon Airport is located 50 km to the south of Galway, but would be influenced by similar coastal air movements as seen in Galway.

Dispersion Model Outputs

For each of the receptors forming part of the model input, the dispersion model predicts an ambient concentration averaged over an hour. The data is post processed to predict concentrations as a percentile of hourly averages. The output of the dispersion model is then transferred to a contour plotting package which produces isopleths laid over a base map.

In addition to the receptor grid, critical receptors, have been included in the dispersion model, against which the air quality pollutant concentrations have been assessed. The closest critical receptor defined is the shore front developments some 900m to the north of the Mutton Island WWTP.

6.3.2 Significance evaluation methodology

The significance of the proposed development with respect to the air quality pollutants (SO₂ and NO₂) is defined through the modelled dispersion of the pollutants reported as a

ground level concentration by means of contours over-laid on a basemap. A significant, negative effect is determined to occur if the predicted air quality breaches either the SO₂ or NO₂ NAQS limit.

As defined by the contours, the impact on air quality will be minimal. No additional SO₂ and NO₂ are likely to be detected at Grattan Road. The contour plots for both SO₂ and NO₂ show rapid dispersion, with very little pollutant concentration added to the background concentration estimated once the shoreline is reached.

6.3.3 Predicted effects and their significance

Construction

No emissions (including dust) from the site are predicted to affect receptors on the shoreline during the construction period, with the predicted emissions not being of significance.

Operation

The emissions from the odour control unit have been based on measurements supplied by manufacturers of the equipment, undertaken at a different site already utilising a CentriDryer (see **Section 3.3.2**).

With the contribution of the emissions of NO₂ and SO₂ from the proposed upgrade at Mutton Island WWTP to Grattan Road (the nearest receptor) is predicted to be a small increase in the pollutant concentrations, with the NO₂ increasing by 3% and SO₂ by 4%.

The associated contour plots have been included as **Figure 6.1a** to **6.1f** (using meteorological data from the years 2001 to 2003 respectively). The 1 hour, 98 percentile contours should be compared with the limit values of 200 µg m⁻³ for NO₂ and against 350 µg m⁻³ for SO₂. It can be seen that the predicted concentrations of NO₂ and SO₂ at Grattan Road are approximately an order of magnitude less than the NAQs of 200 and 350 µg m⁻³ as the 98th percentile of hourly averages respectively and, as such, is not considered to give rise to exceedence of the NAQS values.

Given the predicted concentration of NO₂ and SO₂ as a result of operating the site as per the proposed site configuration under a worst case scenario (i.e. with an on-site sludge dryer), it is considered that the probability of breaches of the NAQS as a consequence of the additional emission from the site would be extremely unlikely, with the impact of air pollutants not being of significance.

6.3.4 Compensation

No compensation has been identified.

6.3.5 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

6.3.6 Summary of significance evaluation

Table 6.5 Effects on Air Pollutant concentration and evaluation of significance

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Construction						
Dust nuisance at mainland receptors	-ve	Unlikely	Local	None	Not Significant	The lack of dust generating activities and the distance to receptors reduces the potential for nuisance to extremely low levels.
NAQS exceedance due to traffic emissions at mainland receptor	-ve	Unlikely	Local	Minor	Not Significant	Given the relatively low numbers of traffic movements during construction it is predicted that pollutant concentrations at receptors will not be sufficient to impact on the NAQS.
Operation						
NAQS exceedance due to traffic emissions at mainland receptor	-ve	Unlikely	Local	Minor	Not Significant	Concentration of emitted NO ₂ and SO ₂ will decrease through dispersion. Given the long distance to the receptor it is predicted that the concentrations at receptors will not be sufficient to impact on the NAQS.
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			

6.4 Reference

Environmental Protection Agency, (2005) *Air Quality and Emissions to Air Report - 2003*.

7. Noise and Vibration

7.1 Existing Environment

7.1.1 Introduction

The proposed upgrade to the existing WWTP will be contained entirely within the curtilage of the existing WWTP on Mutton Island, which is located approximately 900m south of the South Park/Salthill area of Galway City.

This section deals with potential noise and vibration effects of the upgrade during its construction and operation on identified receptors.

Noise terminology

The ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. Because of the wide range a scale based on a logarithmic basis is used in noise level measurement. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ear has the ability to recognise a particular sound depending on the pitch or frequencies found at the source. Microphones cannot differentiate noise in the same way as the ear, and to counter this weakness the noise-measuring instrument applies a correction to correspond more closely to the frequency response of the ear. The correction factor is called "A Weighting" and the resulting measurements are written as dB(A). "A Weighting" refers to the noise level that represents the human ear's response to sound. The dB(A) is internationally accepted and has been found to correspond well with people's subjective reaction to noise.

Typical dB(A) noise levels for familiar noises are given in **Table 7.1**.

Table 7.1 Typical noise levels

Approximate Noise Level dB(A)	Example
0	Limit of hearing
30	Rural area at night, no wind or adverse weather conditions
40	Library
50	Quiet office without noisy machinery, such as typewriters
60	Normal conversation
70	In car noise without radio
80	Household vacuum cleaner
100	Pneumatic drill
140	Threshold of pain

Source : Entec

Noise levels vary over time depending on noise generating activities. The following indices are used to take account of these variations:

- SPL is the instantaneous sound pressure level; it is a measure of the noise level at a particular point in space. The SPL of a noise source will vary with distance from the noise source.
- SWL is the instantaneous sound power level, it is a measure of the sound energy produced by a noise source.
- $L_{Aeq T}$ is the equivalent continuous sound level and is the sound level of a steady sound having the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. $L_{Aeq T}$ is considered the best general purpose index for environmental noise.
- L_{A90} index represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is usually referred to as the background noise level.
- L_{A50} and L_{A10} refer to the level exceeded for 50% and 10% of the measurement period respectively. L_{A10} is widely used as a descriptor of traffic noise.
- L_{Amax} is the maximum recorded noise level during the measurement period.

7.1.2 Scope

The 1992 EIS for the Mutton Island WWTP (P.H. McCarthy Son & Partners, 1992) predicted that background noise levels in the vicinity of Grattan Road, even at night-time would typically be about 35 dB(A). However no noise monitoring data was included within the 1992 report.

Residents of 'Frenchville' a property on Grattan Road, have complained of a low frequency hum and a spot survey has identified the presence of a low frequency tone in the 80 Hertz third octave band¹³. An initial analysis of noise sources at Mutton Island does not indicate a corresponding clear tone from any of the equipment on the island. Alternative hypotheses, that the tone corresponds to ships in Galway Harbour or, to flow in large diameter pipes as part of the sewerage system, have not been substantiated.

The above information has been used to provide a basis for baseline data gathering, in relation to receptors affected during both the construction and operation phases of the project. The nearest sensitive receptors have been identified as properties on Grattan Road and these will be used as the basis for the assessment. The Scoping Report for the WWTP upgrade (TOBIN, O'Dwyer and Entec, 2005) set out the likely nearest sensitive receptors and identified that the surveying would be undertaken over a 24 hour period during a mid-week day. The Scoping Report identified that there will be no significant

¹³ Biospheric Engineering, letter to Mr. Matt Cremlin, 9th March 2004.

effects associated with noise from construction or operational traffic as these traffic levels are likely to be low. Therefore this issue has been scoped out of the assessment (see **Table 4.1**).

It is unlikely that there will be any significant vibration effects associated with the construction and operational phases of the development. The nearest sensitive receptor is over 900m from the site and is therefore highly unlikely to be affected by any vibration effects from the construction or operational phases. Therefore, vibration effects have not been considered any further as part of this assessment as no likely significant effects are predicted.

7.1.3 Methodology

Background noise monitoring has been carried out along Grattan Road (see **Figure 9.1**), with the survey location being representative of the nearest properties in the vicinity of the site (as far as practicable). The noise monitoring location was selected to provide an indication of the noise levels experienced by properties along Grattan Road and in particular, took into account the complaints received about low frequency noise at ‘Frenchville’.

Frequency analysis was also undertaken as part of the noise survey to establish if low frequency noise levels were present as part of the existing noise environment. Frequency analysis was undertaken at the noise monitoring location on Grattan Road and also on Mutton Island itself to establish whether low frequency noise levels were associated with existing WWTP equipment.

As the WWTP will operate 24 hours a day, noise levels were measured during the evening on Wednesday 20th October 2004 and during the day on Thursday 21st October 2004. The monitoring was undertaken to gain an understanding of the variability of noise levels at times when construction and operational activities at the site could be taking place.

On 20th October weather conditions were cold and overcast with an occasional slight breeze (<5 m/s). There was no rainfall but road conditions were damp.

On the morning of 21st October weather conditions were cold and breezy, (about 5 m/s). There was no rain and conditions were clear although road conditions were damp. Later on during 21st October the weather changed and conditions were wet with steady rainfall which was occasionally heavy and resulted in wet road conditions. The wind speed was around 8 m/s but occasionally increased to between 12 and 15 m/s.

Noise regulatory context

S.I. No. 157/1990: European Communities (Protection Of Workers) (Exposure To Noise) Regulations, 1990 give effect to the Council Directive 86/188/EEC of 12 May, 1986 on the protection of workers from the risks related to exposure to noise at work.

The Environmental Protection Agency published, in 1995, a Guidance Note for Noise in relation to Scheduled Activities listed in the EPA Act, 1992. WWTPs are not included

in the First Schedule to the EPA Act (1992) and therefore this guidance is not directly applicable. However, this document does present the general guideline that, ideally, total noise at sensitive receptors should not exceed a daytime $L_{A_{rT}}$ of 55dB. (this is the equivalent continuous sound pressure level which has been corrected for tonal or impulsive components), or a night-time $L_{A_{eqT}}$ value of 45dB.

Sections 107 and 108 of the EPA Act include provisions relating to environmental noise. Section 107 deals with the power of a local authority or Agency to require measures to be taken to prevent or limit noise. S.I. No. 179/1994: Environmental Protection Agency Act, 1992 (Noise) Regulations, 1994 prescribe the form of notice to be served under section 108 of the Environmental Protection Agency Act, 1992, by a local authority or a person who intends to make a complaint to the District Court, concerning a person who is alleged to have made, caused or been responsible for noise giving reasonable cause for annoyance.

To date there are no national standards for noise emissions in Ireland, and therefore reference has been made to appropriate UK Standards.

The Planning Act provides that conditions may be attached to planning permissions for developments to reduce emissions from and/or intrusions into structures by noise. Most new and expanded projects are required by law to be assessed in regard to their expected impact on the local noise pattern.

7.1.4 Existing Situation

Baseline Noise

The noise monitoring results are summarised in **Table 7.2** using relevant noise criteria, and are presented in full in **Appendix C**.



Table 7.2 Summary of Monitored Noise Levels dB(A), October 2004

Identified Receptor(s)	Night time LAeq	Night time LA90	Daytime LAeq	Daytime LA90
Location 1: Properties on Grattan Road	62	39	63	52

LAeq is the equivalent continuous sound level and is the sound level of a steady sound having the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. LAeq is considered the best general purpose index for environmental noise.

LA90 index represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is usually referred to as the background noise level.

The data show that background (L_{A90}) night time noise levels are much quieter than daytime noise levels as would be expected, as there is less traffic during night time hours. There is little difference between night time and day time LAeq noise levels. This is likely to be due to the variation in sampling location required due to prevailing weather conditions during the sampling periods.

During the noise assessment site visit, it was noted that the dominant noise source in the area was road traffic noise from Grattan Road with other sources comprising of noise from passing ships and boats. The plant at the existing WWTP was not audible. In summary, the noise levels recorded are those typical for a suburban area.

Frequency Analysis

Frequency Monitoring was undertaken on Grattan Road (see **Figure 9.1**). The results from this monitoring are outlined in the **Table 7.3** and shown in **Figure 7.1a**.

Table 7.3 Summary of Frequency Monitoring Results (dB) at Grattan Road – October 2004

Frequency (Hz)	Average daytime (dB)	Average night time (dB)
20	75.6	49.5
25	68.8	46.6
31	65.9	43.2
40	61.5	42.3
50	62.0	45.2
63	62.0	45.7
80	56.1	48.6
100	53.5	48.8

Frequency (Hz)	Average daytime (dB)	Average night time (dB)
125	48.3	40.7
160	45.9	37.2
200	47.7	38.3
250	46.2	37.1
315	44.1	36.3
400	43.7	36.0
500	44.3	36.0
630	44.6	43.6
800	44.4	43.4
1K0	48.8	43.6
1K2	52.8	42.3
1K6	57.8	63.2
2K0	55.9	43.8
2K5	56.4	38.5
3K1	50.0	42.3
4K0	48.0	37.5
5K0	47.0	35.7
6K0	46.9	35.7
8K0	46.3	35.1
10k	44.1	35.1
12k	43.6	35.1
16k	43.6	35.1
20k	43.6	35.1
All	88.1	63.1

The frequency analysis results show that there are higher noise levels at a lower frequency which decrease and level out as the frequency increases. There is a peak in noise levels at 1600 Hz to 2500 Hz for both daytime and night time noise levels.

Frequency monitoring was undertaken at various locations around the existing WWTP site. The results from this monitoring are outlined in **Table 7.4** and **Figure 7.1b**.

Table 7.4 Summary of Noise Frequency Monitoring Results dB(A) – Mutton Island WWTP, October 2004

Frequency	North End of Air Blower House [A]	South End of Air Blower House [B]	Odour Control Unit and Gas Holder [C]	Treatment works building [D]	Primary Settlement Tanks [E]	Outfall Pumping Station [F]	Intermediate Screw Pumps [G]
20	78.8	71.9	64.6	65.9	70.3	75.1	89.9
25	65.7	68.3	64.7	56.4	69.3	76.8	76.4
31	56.6	67.1	64.9	54.9	58.9	69.5	72
40	58.0	64.3	61.8	74.6	60.5	69.3	64.9
50	65.6	62.9	66.3	72.4	61.1	64.6	71.3
63	63.9	64.7	67.9	62.6	56.1	57.3	75.2
80	58.2	63.9	65.1	68.2	61.1	55.1	69.1
100	56.7	59.5	65.4	63.1	57.4	57.1	78.9
125	64.8	57.3	68.6	60.2	49.9	55.5	71.2
160	62.7	58.2	71.4	62.9	45.5	53.1	65.8
200	56.8	53.9	69.4	62.4	45.5	48.4	62.1
250	53.4	52.3	70.6	62.5	45.1	46.1	62.5
315	56.3	50.5	67.1	62	45.8	49.2	69.5
400	54.9	49.3	66.7	61.9	45.8	45.1	70.2
500	58.7	49.2	63.9	61.3	46.3	43.1	67.9
630	59.8	48.4	62.5	57.9	45.4	42.1	72.4
800	54.9	48.3	62.6	54.1	47.9	40.9	66.3
1K0	54.9	48.9	61.9	51.7	46.8	40.2	65.3
1K2	52.8	50.1	60.3	50.6	44.4	39.4	62.9
1K6	52.5	49.9	60.1	50.3	43.8	40.4	68.9
2K0	53.4	48.2	59.9	52.6	43.4	40.8	64.1
2K5	53.7	46.6	56.8	50.1	42.8	40.2	58.3
3K1	51.4	45.7	54.4	46.9	41.6	39.8	57.1
4K0	48.8	44.8	52.3	45.9	40.8	40.3	56.6
5K0	45.6	42.6	50.8	44.6	39.8	39.2	56.4
6K0	43.4	40.4	49.4	43.4	37	36.5	56.3
8K0	40.7	40.1	46.3	43.3	33.9	31.8	55.4
10k	40.2	40.1	43.6	43.9	31.3	30.1	53.3
12k	40.2	40.1	39.9	37.6	30.1	30.1	50.9
16k	40.2	40.1	37.6	34.3	30.1	30.1	47
20k	40.2	40.1	33.3	30.6	30.1	30.1	42.8
All	82.2	80.9	79.3	79.7	78.6	88.4	97.8

The above figure and table show that the existing equipment at Mutton Island exhibits a range of noise levels at different frequencies and that there is no one particular frequency where all equipment produces a higher noise level. Generally the equipment produces higher noise levels at lower frequencies and these levels fall as the frequency increases.

A low frequency noise was not heard or detected in the frequency analysis results.

7.1.5 Predicted Trends

Galway City is predicted to grow over the forthcoming years as residential, industrial and economic development takes place. An increase in employment and population levels may result in an increase in road traffic levels and therefore noise. Beyond this general trend, there are no specific, predicted trends within the vicinity of the receptors on Grattan Road which may have an effect on noise levels in the local area.

7.1.6 Information Gaps

There is no other information, which could have reasonably been obtained as part of this assessment.

7.2 Potential Effects and Incorporated Mitigation

7.2.1 Potential Effects During Construction and Incorporated Mitigation

The Scoping Report identified that there will be no significant effects associated with noise from construction or operational traffic as these traffic levels are likely to be low.

Construction works are often characterised by temporary increases in ambient noise levels which may result in short-term disturbance to nearby sensitive receptors. The main effects that could result from noise during the construction period can be identified as nuisance/disturbance to residents on Grattan Road. An increase in ambient noise levels can result in sleep disturbance, annoyance and stress. However, this is dependent upon the overall noise level, the times over which it occurs, the frequency of the noise and its character.

The distance from the WWTP to the nearest residential receptors (c.900m) will minimise disturbance from construction noise but assessment has been undertaken to identify if any further mitigation is required to avoid disturbance.

7.2.2 Predicted Effects During Operation and Incorporated Mitigation

Additional infrastructure and new or different processes at the WWTP could cause an increase in noise emitted from the site which could potentially be picked up at receptors.

The distance from the WWTP to the nearest residential receptors (c.900m) will minimise disturbance from operational noise but assessment has been undertaken to identify the Environmental Noise Criteria required for operation. This limit will

provide suitable mitigation to ensure that the likelihood of causing unacceptable noise at residences in Grattan Road is minimal.

In addition to the overall ENC limit, the final design of the plant will also consider the potential for tonal noise. The human ear is very sensitive to "tonal" noise, that is, a noise in which it is possible to identify a particular pitch due to noise at a prominent frequency. The detailed design will include measures to minimise the potential for tonal noise.

Avoidance/reduction measures

Table 7.5 summarises the incorporated mitigation measures.

Table 7.5 Avoidance/reduction measures – likely effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		
Residential receptors along Grattan Road	Potential increase in baseline noise levels from construction machinery.	<p>High certainty of effectiveness:</p> <p>Use of equipment fitted with effective silencers/insulation. Use of SMART reversing alarms to reduce the effect of reversing beepers on all vehicles that are used on-site.</p> <p>Appointment of site contact to whom complaints/queries about construction activity can be directed. Any complaints to be investigated and action taken where appropriate.</p> <p>Restrictions on the proposed hours of operation to avoid sensitive periods and in particular no night time working without prior agreement.</p>
Operation		
Residential receptors along Grattan Road	Potential increase in baseline noise levels from operation of WWTP	<p>High certainty of effectiveness:</p> <p>Mitigation will be incorporated in the design including, if required, complete enclosure of noise-generating equipment to meet the operational noise criteria.</p> <p>The design of any upgrade will have regard for tonal noise.</p>

Compensation

No compensation has been identified or is relevant.

7.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 7.6**

Table 7.6 Implementation of incorporated mitigation and enhancement measures

Description of measures including any monitoring requirement	Responsibility for implementation	Implementation mechanism
Construction		
Working hours limited to standard daytime hours	Construction Contractor	Contract Documents
Site contact for noise complaints	Construction Contractor – to be reviewed by Galway City Council	Contract Documents
Modern silencing equipment to be used on site plant	Construction Contractor	Contract Documents
Operation		
Upgrade to be designed in accordance with Environmental Noise Criterion	Site Designer	Contract Documents

7.3 Assessment of Effects

7.3.1 Scope and Methodology

Construction

The assessment will consider noise effects in relation to construction activity. Potential noise effects from construction traffic have been scoped out of the assessment.

It is anticipated that the overall duration of the construction programme for the upgrade will be approximately 12 months. During this time there would be a number of different construction phases, some of which would overlap for different periods of time. The activities with the greatest potential for noise generation are outlined below; it should be noted that this information is indicative and the final construction details are not known at this stage. The greatest potential for noise generation may result from:

- site preparation – mainly involving creation of construction laydown and working areas, clearance of overlying soils and preparation of base for foundations.;
- civils stage – creation of foundations, buildings, services, i.e. drains, roads, etc;
- steel erection and installation of mechanical plant - construction of structural steel framework and placement of equipment on foundations using a range of mobile cranes and on-site assembly of plant;
- duct and pipework - fabrication and installation of pipes and ducts; and
- pipeline laying.

Construction activities will normally be restricted to between 07.00 - 19.00 hours on weekdays and 07.00 and 13.00 on Saturdays. Working outside of these hours will not be permitted without prior permission from Galway City Council.

Day to day activities will vary and not all construction equipment will be operational at all times. In order to assess potential construction noise effects, a number of possible scenarios have been considered for the proposed development areas. These will be based on periods when activities overlap within the construction programme. These are:

- Scenario 1: During the earthworks/site preparation, foundation construction and civils works occur elsewhere on site; and
- Scenario 2: Steel fabrication close to the site boundary, with installation of mechanical plant and duct/pipe fabrication taking place at different locations within the site.

The final phases including painting of external surfaces and installation of electrical and instrumentation equipment would not generate significant noise and have not been considered further.

Construction noise effects have been assessed using the methodology and information outlined in *BS5228 Noise and Vibration Control on Construction and Open Sites, 1997*¹⁴. As the actual types of equipment are not known at this stage, typical source noise data for the construction plant have been obtained from this guidance. These data provide an indication of noise levels from construction plant taken from measurements at various sites. An anticipated equipment list for the works has been identified and plant likely to be used on site is identified in **Appendix D**.

It should be noted that the plant noise levels set out in *BS5228 Noise and Vibration Control on Construction and Open Sites, 1997* and that have been used in the assessment, are worst case. The 'on-time' of individual types of plant has been estimated based on experience of other similar construction projects. There is therefore scope for mitigation and reduction by use of modern, quieter plant.

Operation

The assessment will consider the noise effects from operational activity but there will be no assessment of effects associated with operational traffic as stated in the scoping report.

A low frequency noise problem has been identified by the residents of Grattan Road. The baseline noise monitoring has included frequency analysis of noise levels both at Grattan Road and Mutton Island. The results have not shown any significant low frequency noise levels at either location. The equipment and machinery will be selected and designed so as not to include any equipment which will produce tonal noise at

¹⁴ It should be noted that no Irish equivalent of this British standards exists.

particular frequencies. Therefore no significant effects in relation to low frequency noise will occur as a result of the upgrade to the WWTP.

The information outlined in the *BS4142 Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas 1997* will be used to assess noise effects from the operational phase of the development.

As the final plant items have not been determined, it has not been possible to prepare any detailed calculations for operational noise in the EIA. However, the assessment determines acceptable operational noise levels, the Environmental Noise Criterion (ENC) for the upgrade to the WWTP, which is based on the existing background noise levels at the nearest properties on Grattan Road. Compliance with the ENC will be one of the specifications required to be fulfilled by the Contractor appointed to design, build and operate the WWTP.

7.3.2 Significance evaluation methodology

Construction activity

The relevant criteria for the assessment of effect on construction noise for the surrounding areas have therefore been taken from *Advisory Leaflet 72 Noise Control on Building Sites, 1976* and are set out in **Table 7.7**.

Table 7.7 Construction noise assessment criteria

Period	Criterion
Daytime (07:00 - 19:00) $L_{Aeq, 12 \text{ hour}}$	70 dB(A) – for rural, suburban and urban areas
Evening (19:00 - 22:00) $L_{Aeq, 12 \text{ hour}}$	60 dB(A) – no construction anticipated
Night-time (22:00 - 07:00)	No construction.

These levels are not proposed as construction noise limits for the WWTP upgrade, but they are useful for comparative purposes. The area around the site comprises the foreshore, with suburban land use along the coastline close to the entrance to the causeway.

Operational activity

In order to determine the ENC, the most appropriate standard is *BS4142 Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas 1997*. This UK Standard has been used as it has no Irish equivalent. It provides a method for determining whether a new noise source is likely to cause noise complaints by comparing the operational noise level (as L_{Aeq}) with the measured background level (as L_{A90}). An increase of 10 dB or more means complaints are likely, whereas 5dB is of marginal significance. For differences of less than 5dB the likelihood of complaints reduces further.

The detailed design of the extension to the WWTP will be undertaken by the Contractor appointed to design and build the plant to specifications set down by Galway City Council. An ENC of $L_{A90} + 5$ dB(A) at each sensitive location is proposed and will be included within the design specifications for the proposed extension. This level has been chosen since BS4142 indicates that any complaints would be of marginal significance.

7.3.3 Information gaps

At this stage of the development, only minimal information is available on the construction programme and phasing and on the methods, equipment and machinery which will be used to construct the upgrade of the WWTP. Therefore assumptions about programming and construction machinery have been made on a worst case basis to assess noise effects.

7.3.4 Assessment of predicted effects

Construction

Predictions have been made for the nearest residential receptors on Grattan Road. The results are summarised in **Table 7.8** and full calculations are included as **Appendix D**.

It should be noted that the construction will be contained within the existing WWTP which is surrounded by a high protective, concrete wall. This will provide some barrier attenuation for the construction noise generated. Due to this a reduction of 5 dB(A) has been applied to the modelled results, as identified in *BS5228*¹⁵ for scenarios where construction plant may just be visible from the reception point.

Table 7.8 Construction Noise Predictions, $L_{Aeq, 1hour}$ dB

Location	Scenario 1: Earthworks and Foundations	Scenario 2: Civils, steel fabrication and pipe work
Receptors – Grattan Road	35	38

It should be noted that noise generating activities are not anticipated to occur during the evening or night-time periods.

Predicted construction noise levels are well below the criteria set out in **Table 7.7** for daytime construction noise levels (70 dB(A)) and are below the daytime and night time baseline L_{Aeq} noise levels recorded at Grattan Road. The predicted levels from the construction works are similar to those in a library (see **Table 7.1**).

¹⁵ As set out in Annex D, Part 1, Para D.3.2.2.1

Therefore, no significant noise effects are expected from the construction phase of the proposed upgrade to the WWTP at the nearest residential receptors on Grattan Road.

Operation

Predictions of noise levels from the WWTP at Grattan Road have not been undertaken, since the designs have not been finalised and no sound power level data for the noise sources is available. Therefore, this part of the assessment develops an ENC which can be used to ensure that operational noise levels are acceptable to local residents. Compliance with the ENC will be one of the specifications required to be fulfilled by the Contractor appointed to design and build the WWTP.

As the upgraded WWTP will be operational 24 hours per day, 7 days per week, the ENC will be based on the quietest background levels. As shown in **Table 7.9** the quietest periods occurred during weekday night time at Grattan Road. The existing background noise level during weekday night time and corresponding ENC are presented in **Table 7.9**.

Table 7.9 Environmental Noise Criteria Operational Noise

Location	Background Noise Level L_{A90} dB(A)	Operational ENC Levels as $L_{Aeq,1\text{ hour}}$
Receptors – Grattan Road	39	44

The information from the baseline noise surveying gave results for L_{Aeq} noise levels of 63 dB(A) for daytime hours and 62 dB(A) for night time hours. Noise levels (in decibels) are based on a logarithmic scale, and the combination of two identical sounds leads to an increase of 3dB not a doubling of the decibel rating. If the difference between two noise levels is 15 dB or more the increase in overall sound level is less than 0.5 dB. The minimal increase in noise audible to the human ear is 3dB. Therefore as the difference between the daytime and night time measured noise levels at Grattan Road and the predicted operational ENC is more than 15dB, operational noise from the upgraded WWTP would not be audible from Grattan Road.

7.3.5 Cumulative Effects

No cumulative effects on residential receptors along Grattan Road are anticipated. There are no known developments within the vicinity of Grattan Road that may have the potential to cause an increase in noise levels experienced by the residents. In addition, the noise assessment has shown that construction and operational noise from the proposed WWTP upgrade at Mutton Island will not have an effect on the residents of Grattan Road, the nearest sensitive receptors to the proposed development.

7.3.6 Compensation

No compensation has been identified.

7.3.7 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

7.3.8 Summary of significance evaluation

Table 7.10 Summary of significance of effects

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Construction						
Disturbance to residential receptors on Grattan Road from noise from construction activity	-ve	Unlikely	Local	Minor	Not significant	The assessment of potential noise associated with construction machinery (based on a worst-case assessment) has shown that due to the distance between Mutton Island and residential receptors along Grattan Road there will be no significant effects.
Operation						
Disturbance to residential receptors on Grattan Road from noise from operation of the upgraded WWTP activity	-ve	Unlikely	Local	Minor	Not significant	The assessment has shown that providing that the final scheme is designed in accordance with the ENC specified there will be no significant noise effects from operational activity.
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			

7.4 References

BSI, 1997, *BS5228 Noise and Vibration Control on Construction and Open Sites*.

BSI, 1997, *BS4142 Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Area*.

Department of Environment, 1976, *Advisory Leaflet 72 Noise Control on Building Sites*.

P.H. McCarthy Son & Partners. (1992). *Galway Main Drainage – Proposed Causeway and Sewage Treatment Plant on Mutton Island: Environmental Impact Statement*.

TOBIN, O’Dwyer and Entec. (2005). *Mutton Island Wastewater Treatment Works Upgrade – Scoping Report*.

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8. Socio-Economics

8.1 Existing Environment

8.1.1 Introduction

The social and economic health of the region, city and surrounding areas, within which the proposed development is to be located, can be illustrated through analysis of a range of available data detailing regional and local perspectives.

8.1.2 Scope

The Scoping Report (TOBIN, O’Dwyer and Entec, 2005) identified potential effects on the growth of the city and on particular economic sectors.

The report indicated that increased provision of wastewater treatment would allow continued growth of the city in line with the National Spatial Strategy (National Spatial Strategy for Ireland 2002-2020) and Draft Development Plan (which has since been adopted). This would provide for enterprise development, particularly in bio-medical and information technology sectors, and for the associated growth in population. The growth of these sectors in particular was anticipated as a result of the current location of these types of organisation, and the tendency for technology-intensive companies to co-locate.

The Scoping Report also indicated that there may be potential effects on those sectors dependent on water quality, if the additional capacity of the WWTP resulted in unacceptable, adverse changes to water quality and dependant ecology. These sectors include tourism and shell-fisheries.

8.1.3 Methodology

The assessment of the current socio-economic characteristics was undertaken through desk-based review of literature. Sources included the following:

- Brady Shipman Martin in association with TOBIN/Nicholas O’Dwyer, May 2005, *Galway Main Drainage – Stage 3 – Planning & Development Report*.
- Camp Dresser & McKee (Ireland) Ltd (CDM), 2004, *Economic Analysis of Water Use in Ireland*, 2004;
- Fáilte Ireland, *Tourism Facts, Regions- West 2003*;
- Galway City Council, *Galway City Council Development Plan 2005-2011*;
- Galway City and County Tourism Committee, *Developing Sustainable Tourism in Galway: A Framework for Action 2003-2012*;

- Marine Institute, November 2004, *A National Survey of Water-based Leisure Activities 2003*; and
- Marine Institute, Bord Iascaigh Mhara and Taighde Mara Teo, November 2004, *Status of Irish Aquaculture 2003*.

8.1.4 Existing Situation

Population and employment

Information on the current population in the region is included in **Table 8.1** below (Brady Shipman Martin, 2005). It is broadly assumed that the upgraded Mutton Island WWTP would cover Galway City, Oranmore and Barna, which have a combined 2002 population of 67,702.

Table 8.1 (Near) current and estimated population

	Census	
	1996	2002
Galway City	57,200	65,832
Barna	-	250
Ardaun	-	-
Oranmore	1,400	1,620
Athenry	1,600	2,100
Clarinbridge/ Kilcolgan	4,021	4,984
Galway Rural	3,333	3,972
Oranmore Rural	1,933	2,399
Athenry Rural	1,965	2,329
Barna Rural	2,105	2,226
Total	73,557	85,712

The population of Galway City is increasingly employed in professional and other services, and the National Spatial Strategy (National Spatial Strategy for Ireland 2002-2020) predicts that future growth in employment will be concentrated in services rather than manufacturing and these are expected to be particularly within the bio-medical and electronics sectors. **Table 8.2** and **Figure 8.1** show the growth within different sectors between 1991 and 2002. The figures for 1991 include those working within Galway City, whereas the figures for 1996 and 2002 are limited to those living in the city, since the census did not ask for location of work.

Table 8.2 Employment of residents of Galway City, 1991 to 2002

Sector	1991	1996	2002
Agriculture, forestry and fishing	250	267	200
Mining, quarrying and turf production	23	46	40
Manufacturing industries	3,147	3,874	4,527
Electricity, gas and water supply	83	87	112
Building and construction	933	970	1,686
Commerce, insurance, finance and business services	3,813	4,767	7,615
Transport, communication and storage	909	1,018	1,199
Public administration and defence	1,228	1,329	1,452
Professional and other services not stated	6,809	9,255	11,357
Total	17,195	21,613	28,188

Sectors affected by water quality

Tourism, both in Galway City and Galway County, is an important industry. Galway also acts as a gateway to the west region (which also includes Roscommon and Mayo), with visitors to the west region generating revenue of €690.8 million in 2003. Domestic tourists still dominate visitors to Galway (34%), followed by overseas visitors from Britain (17%) and the USA (15%). This is reflected in the shorter than average stay (5.3 nights compared to the national average of 7.9 nights), and the greater proportion of people visiting the region by car. To improve the current situation, the tourism strategy is seeking to address challenges of marketing, access, visitor attractions and tourist satisfaction, in order to increase the number of visitors and length of stay.

At a national level, water-based leisure accounts for a significant part of the domestic tourism market, involving 1,475,000 of the 6,657,000 participants. Water-based leisure also generated €433.6 million of the €970.9 million associated with domestic tourism, and accounted for 5,100 of the 22,300 jobs.

In addition to tourism, the aquaculture sector is also an important sector reliant on water quality. In Galway Bay, there is farming of oysters, mussels, scallops and clams (see **Section 11**). Galway Bay trades on its shellfisheries with events such as the Clarinbridge Oyster Festival in September and with notable eateries such as Moran's of the Weir Oyster Pub at the mouth of the Dunkillin River.

Elsewhere around the coast of Galway abalone, salmonids, sea urchins, seahorses, seaweed and turbot are also farmed. Figures for the production in Galway Bay were not available, although there are 126 aquaculture licences issued for Galway, of 646 for Ireland as a whole. These licences accounted for 50% of finfish licences, 26% of mussels, 15% of oysters, and 6% of other shellfish. For Ireland, the value of aquaculture production exceeded €100 million in 2003, of which €42 million was from



shellfish production of 45,000 tonnes and €60 million was from finfish production of 18,000 tonnes (Marine Institute *et al.*, 2004).

Water based recreation activities in Galway Bay include swimming (there are several swimming clubs based at/near Salthill), windsurfing, sailing (especially at Renville, Oranmore) and diving (mainly based out of Galway City). A ferry service runs to the Aran Islands from Galway harbour and other commercial activities take place in the active harbour area.

8.1.5 Predicted Trends

The National Spatial Strategy (National Spatial Strategy for Ireland 2002-2020) and other development plans for the region aim for significant growth in businesses in Galway, with resultant impacts on population. The implications of these plans for the population of the area are included in **Table 2.1**.

Based on the approximation that Mutton Island WWTP would be expected to serve population in Galway City and Oranmore, this indicates that by 2016 the population could have increased from current levels (67,452) to 76,972 if the IDA developments do not go ahead, or 79,019 if they are taken forward. By 2023, numbers may be up to 86,953 depending on IDA development.

While the information on population is presented as a trend, these changes are subject to a number of assumptions, and also will depend on the decision on the upgrade of Mutton Island WWTP. The projections are made based on current plans and policies, and it is assumed that the other infrastructure, including wastewater treatment, will be able to meet the pressures of this additional population. As such, the projections are presented as trends, although the degree of uncertainty and relationships with other plans should be noted.

There are no specific trends identified for employment or changes in other economic sectors.

8.1.6 Information Gaps

No information gaps which could reasonably be expected to be collected to aid the assessment have been identified.

8.2 Potential Effects and Incorporated Mitigation

8.2.1 Potential Effects During Construction and Incorporated Mitigation

Whilst the construction programme for the development has yet to be finalised, it is envisaged that the development will take approximately 12 months to construct and this will commence in 2007, subject to approvals. It is unlikely that significant new employment opportunities will arise during the construction of the WWTP due to the relatively small scale of the construction.

Any effects will be positive and mitigation is therefore not relevant to this assessment.

8.2.2 Predicted Effects During Operation and Incorporated Mitigation

Potential effects of the WWTP upgrade include the following:

- Impacts on employment, population and sustainable development by providing facilities to deal with the wastewater resulting from population and business increases; and
- Impacts on water dependent industries, in particular tourism and aquaculture, through changes in water quality in Galway Bay. An assessment in changes to water quality is provided in **Section 10**.

Avoidance/reduction measures

Table 8.3 summarises the incorporated mitigation measures.

Table 8.3 Avoidance/reduction measures – likely effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		
None identified		
Operation		
Population and businesses within the sewerage catchment area of the WWTP	Increased provision for expansion of population and employment in accordance with NSS and other plans	No mitigation proposed, as this is key to the rationale for development and is expected to be positive.
Water-dependent sectors, e.g. tourism and aquaculture	Increase in treated effluent discharge leading to deterioration of water quality and failure of mandatory (or guideline) water quality standards. Reduction in the economic value of shellfisheries and water-based tourism activities may occur as a result.	High certainty of effectiveness: Design of the sewage treatment processes to achieve protective quality standards will prevent any adverse effects on the water quality of the receiving water. Standards are designed to be environmentally protective and to comply with the relevant legislation. Further information relating to water quality is presented in Section 10 whilst Section 11 deals with marine ecology.

Compensation

No compensation has been identified or is relevant.

8.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 8.4**.

Table 8.4 Implementation of incorporated mitigation and enhancement measures

Description of measures including any monitoring requirement	Responsibility for implementation	Implementation mechanism
Construction		
No mitigation or enhancement measures are proposed		
Operation		
Design and operation of the sewage treatment processes to achieve suitably protective water quality standards will prevent any adverse effects on the water quality of the receiving water.	Site Designer and Operator	Contract Documents

8.3 Assessment of Effects

8.3.1 Scope and Methodology

Construction

A qualitative judgement has been applied to the potential effects during construction using knowledge of the scale and methodology of the construction to be undertaken.

Operation

In order to assess the impacts of the upgraded WWTP during operation, the potential impacts on socio-economic factors have been considered against an alternative scenario where the WWTP is not upgraded (i.e. a ‘do-nothing’ scenario). The assessment considers impacts on the population and employment in the area, and on economic sectors affected by water quality, specifically tourism and aquaculture. This assessment is based on the review of the baseline situation and anticipated changes through qualitative judgement.

8.3.2 Significance evaluation methodology

The significance of the potential effects has been assessed based on qualitative judgement, and with reference to the baseline situation and anticipated trends.

8.3.3 Information gaps

Assessment has been made on the basis of information available. In some cases, for example the value of aquaculture production in Galway Bay, this has been limited. However, such limitations have been incorporated as appropriate within the assessment.

8.3.4 Predicted effects and their significance

Construction

The construction phase of the upgrade will not be significant enough to create substantial new employment opportunities.

During the construction, the existing WWTP will continue to treat wastewater from Galway City to the required standards (see **Section 10.2.2**) and thus no potential effect on water dependant economies are identified.

Overall, no significant effects have been identified in relation to the socio-economics of Galway City, its wider environs and Galway Bay.

Operation

General Socio-Economy

The upgrade of the Mutton Island WWTP will provide wastewater treatment for an increased population, and an increase in industrial and business activity. **Section 2.1.1** sets out the predicted domestic population increases. The population growth would be driven, at least in part, by expansion of employment and business, particularly within the bio-medical and information technology sectors. Therefore, an upgrade of the WWTP would allow for this growth, with attendant economic benefits ensuing. Bio-medical and information technology tend to be high value sectors, and therefore, their expansion could have significant benefits for the economy of the City, County and the wider region.

As stated in **Section 2.2.2**, Galway has been identified in the National Spatial Strategy as a centre which has now achieved a critical mass in terms of driving its own development, and which is the engine driving regional development in the West. The provision of an increased wastewater treatment facility will therefore enable growth in the residential population and provide for suitable, future industrial opportunities in a sustainable manner.

Without this wastewater treatment provision, development will be constrained and the local and regional economy will not be able to develop as is hoped for, as set out in a number of national, regional and local planning documents (as set out in **Section 2.2**).

Water Based Economies

The upgrade of the Mutton Island WWTP may also have an impact on water quality due to increased loadings discharged to Galway Bay. The economy of the area is closely linked to the quality of water within the bay (e.g. aquaculture and tourism). Assessment of changes to water quality within Galway Bay are described in detail in **Section 10** whilst **Section 11** deals with the dependant marine ecology (including shellfisheries and fish-farming).

The results of the water quality and marine ecology assessments indicate that there will be no significant, adverse effects and therefore it is considered that no significant, adverse effect on water based economies will occur.

Recreational Activities

The Blue Flag Campaign is a voluntary eco-label for beaches and marinas, run by the Foundation for Environmental Education (FEE). An Taisce is the national operator for the Blue Flag Campaign in Ireland. The Blue Flag is awarded to beaches and marinas that meet a specific set of criteria concerning environmental information and education, water quality, safety and services and environmental management. Local Authorities nominate beaches from the list of designated beaches each year. The applications are assessed by a National Blue Flag Jury and if approved are then forwarded to the International Blue Flag Jury Panel. The beach at Silver Strand currently has Blue Flag status.

If the WWTP upgrade is *perceived* as causing unacceptable, water quality/pollution effects, water based recreation may fall. However, if the local beaches continue to be awarded Blue Flag status and local aquaculture does not suffer any problems (neither of which are predicted) then, in time, this perception will fade and no long term effects will occur.

As part of these proposals public access to the causeway linking Mutton Island to the mainland will be increased so that access will be possible along the majority of the length of the causeway.

8.3.5 Cumulative Effects

The provision of increased wastewater treatment capacity will contribute towards development of the local and regional economy. Other infrastructure developments and adherence to policies contained in relevant planning documents (see **Section 2.2**) will be cumulative in their beneficial effect.

8.3.6 Compensation

No compensation has been identified.

8.3.7 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

8.3.8 Summary of significance evaluation

Table 8.5 Effects on socio-economics and evaluation of significance

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Construction						
Increased employment opportunities in the construction industry	+ve	Likely	Local	Minor	Not Significant	The number of new construction jobs is expected to be small.
Operation						
Increased capacity will allow for growth of the economy in Galway City, County Galway and the West Region in line with plans and policies	+ve	Likely	Regional	High	Major	The WWTP will contribute towards sustainable development of Galway as a Gateway City with regional implications.
Deterioration of water quality leading to poorer conditions for water based economies	-ve	Unlikely	Local	Minor	Not Significant	Water quality modelling (see Section 10) indicates that no significant effects will occur and that aquaculture activities will not be affected.
Deterioration of water quality leading to poorer conditions for water based recreation	-ve	Unlikely	Local	Minor	Not Significant	Water quality modelling (see Section 10) indicates that no significant effects will occur at designated bathing waters.
Increase in access out in to the bay towards Mutton Island increasing informal recreational space	+ve	Certain	Local	Minor	Not Significant	Increasing access along the causeway will allow public access to a location they are currently excluded from.
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			

8.4 References

Marine Institute, Bord Iascaigh Mhara and Taighhde Mara Teo. (2004). *Status of Irish Aquaculture 2003*.

National Spatial Strategy for Ireland 2002-2020.

TOBIN, O'Dwyer and Entec. (2005). *Mutton Island Wastewater Treatment Works Upgrade – Scoping Report*.

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9. Landscape and Visual

9.1 Existing Environment

9.1.1 Introduction

This section describes the present situation at the existing Mutton Island WWTP with the assessment distinguishing between landscape and visual effects which are described in separate **Section 9.3.1**.

9.1.2 Scope

The coverage of the study area was chosen with the following objectives in mind:

- to reflect the land within an estimated visual envelope (see **Figure 9.1**); and
- to include an area that is sufficient to gain a full understanding of the factors that influence the form and appearance of the landscape around the proposed development.

9.1.3 Methodology

A description of the existing (baseline) *landscape* resource and visual amenity¹⁶ forms a cornerstone of the assessment process and establishes the landscape context and sensitivity of the defined study area. The existing environment includes reference to the existing landscape character and quality or condition of the landscape and landscape elements on the site and within the surrounding area, as well as general trends in landscape change across the defined study area.

Visual effects are recognised by the Landscape Institute as a subset of landscape effects and are concerned wholly with the affect of the development on views, and the general visual amenity. The existing situation identifies the zone of visual influence (ZVI) of the WWTP as locations within this area may be affected by any visible change to the built environment. This ZVI forms the basis of the subsequent visual assessment.

9.1.4 Existing Situation

Local Topography

The topography within the site boundary on Mutton Island is made up of generally even ground very close to sea level. At a wider level, the site lies in Galway Bay between

¹⁶ Visual amenity as defined by the Landscape Institute ‘*The value of a particular area or view in terms of what is seen*’ and not the more general term.

Claddagh, and Tawin Island. Mutton Island itself has a rocky shoreline with mud banks along the eastern side of the concrete causeway from South Park. The shoreline of the island is an intertidal zone of silt and rock outcrop. Beyond the Island to the north lies the South Park area and further still is Galway Harbour, at the mouth of the River Corrib.

The Built Environment

The existing WWTP takes up a large proportion of Mutton Island. It is made up of a number of treatment tanks, pipes, control buildings and other infrastructure as identified in **Section 3.2**. A high, protective wall surrounds the existing treatment works with rock armouring also protecting the site immediately outside of the boundary wall. The wall is sufficiently high to obscure most of the site infrastructure from outside views with only a few structures visible above it.

The other buildings on the Island include the lighthouse and keeper's cottage. The lighthouse was established in 1817 and expunged in 1977. Both the lighthouse and the cottage are in a poor state of repair and may be restored in the near future. The lighthouse is listed in the Galway City Council Record of Protected Structures (Ref No. 6501).

The Island is connected to the mainland via an 896m long concrete causeway (incorporating the WWTP access road).

The mainland and Galway City are situated to the north beyond Mutton Island and the causeway. The built environment of this area which includes Claddagh and Salthill is urban with a distinct seaside resort ambience. There are many types of buildings along the seafront. These include hotels and guesthouses, recreational facilities such as Leisureland, Atlantiquaria, casinos, pubs and restaurants. During the summer months an outdoor funfair is set up at Leisureland.

The seashore itself is a mixture of stony bays, sandy beach and parkland which ends to the north of the causeway at Alexander Nimmo's Pier at the entrance to Galway Harbour. Road infrastructure for the area begins at the harbour near Wolfe Tone Bridge. The Claddagh Quay Road follows the coastline south and becomes Grattan Road. Several minor roads join Grattan Road to the west of the causeway access namely Fairhill Road and Grattan Terrace. Grattan Road continues west past Grattan Park and Beech Court before joining Dr. Colohan Road and the Seapoint Promenade. This continues in a south westerly direction for several kilometres before joining the roundabout on Salthill Road Upper. Several large carparks which service the recreational facilities of the area line the coast roads.

Vegetation

There is very little vegetation on Mutton Island. There are a few small shrubs around the lighthouse cottage and some grassland but no trees. On the mainland there are areas of amenity grassland but again few trees.

Planning Policy

The Local Government (Planning and Development) Act 2000 recognises the importance of landscape and visual amenity and requires that the Development Plan includes objectives to preserve the landscape, views and the amenities of places and features of natural beauty.

The Galway City Council Development Plan (2005 – 2011) recognises the importance of a number of views within the City, “*which require special protection due to their significant contribution to scenic amenity*” (Section 4.9). A significant proportion of these views relate to those of the coastal area and the Development Plan recognises that “*these views are not static and can be changed by nature and man*” and that some changes can be “*absorbed without jeopardising the integrity of the view*”.

Protected views include:

- V.4 Seascape views of Galway Bay from Grattan Road, Seapoint Promenade in Salthill and the coast road to the western boundary of the golf course;
- V.12 Seascape views of Galway Bay from Kingston Road; and
- V.14 Seascape views of Galway Bay at Ballyloughane from south of the railway bridge.

Overall, “*It is the objective of the Council to assess proposed developments, which are located in the line of a protected view and prevent developments, which by virtue of their impact scale, design or location would have a detrimental impact on these views.*”

This is formalised in Policy 4.9 (Protected Views of Special Amenity Value and Interest) which states that the Council will:

- *protect views and prospects of special amenity value and interest, which contribute significantly to the visual amenity and character of the city through the control of inappropriate development; and*
- *require landscaping schemes as part of planning applications to have regard to such views and limit any planting which could have a detrimental impact on the value of protected views.*

Landscape Character

The character of the site area of Mutton Island is that of a small island with a sewage treatment works occupying the majority of the land area. The lighthouse and cottage, once the focus of the island now share the scene although the distinctive white lighthouse with its red railings is still the tallest structure on the island and therefore draws the eye. In the wider context the character of the area is coastal with the expanse of Galway Bay stretching towards the Burren Mountains to the south in Co. Clare.

Estimated Visual Envelope

The estimated visual envelope is presented in **Figure 9.1**.

9.1.5 Predicted Trends

Given that the majority of Mutton Island is now given over to the WWTP it is considered unlikely that the situation will change in any significant manner in the medium term. However, as previously noted the lighthouse and keeper's cottage that previously formed the only built development in the Island are now in a deteriorating condition, although the former continues to be visually relatively prominent. Unless the possible restoration work is undertaken these buildings will continue to deteriorate.

9.1.6 Information Gaps

No data which could reasonably have been expected to be obtained that would significantly improve this assessment has been identified.

9.2 Potential Effects and Incorporated Mitigation

9.2.1 Potential Effects During Construction and Incorporated Mitigation

A major design decision has been taken to confine the proposed upgrade to the area within the existing site boundary. No increase of the WWTP to take up any more land or any development that would require the enlargement of Mutton Island will occur. The existing site perimeter wave wall and rock armouring will not be breached by any proposed development covered within this EIS. Additionally, no physical works to the causeway linking Mutton Island to the mainland are proposed and no construction compound on South Park (or any other local area) will be required.

The above restriction in the spatial extent of the upgrade provides significant mitigation in relation to any potential landscape and visual effects during construction. The construction phase will be relatively short lived and existing screening elements such as the existing perimeter wall will screen the vast majority of the construction activities. However, some tall plant such as cranes will be temporarily visible to short and middle distance receptors.

It is considered that no additional mitigation is required due to the relatively low level construction to be undertaken, the available screening, the distances to visual receptors involved and the overall setting of the WWTP within the expanse of Galway Bay.

9.2.2 Potential Effects During Operation and Incorporated Mitigation

The primary mitigation to reduce the visual and landscape effects of the WWTP upgrade, as engrained in the design philosophy for the upgrade (as outlined in **Section 3.3**), is to increase the WWTP's capacity by maximising the efficiency of existing process units and provide minimal additional infrastructure on-site so as to increase capacity of the works without compromising the site boundary and with the absolute minimum in increased profile of the site through additional vertical elements rising above the tallest infrastructure already present at the WWTP.

Investigations have shown that there are two elements of the operational work which may need to rise above the tallest structure already on the site:

- a small amount of ducting/pipework to link process units; and
- the top of any sludge dryer (e.g. CentriDry unit).

Of the two it is considered that the top of the sludge dryer (which is an option for the site [see **Section 3.3.2**]) will be the more prominent. The type of unit considered suitable for the site (e.g. CentriDry unit – see Section 3.3.2) does not incorporate a visually intrusive stack as part of its design).

If possible, the new sludge treatment facility will be constructed with part of it below ground level to reduce potential impacts on views and the landscape. The external protruding part of the sludge dryer shall be a maximum of 4m wide and shall not extend any higher than 2m above the existing treatment works structures. When viewed from a distance of 900m, it will have no impact on the visual amenity of the area.

Avoidance/reduction measures

Table 9.1 summarises the incorporated mitigation measures.

Table 9.1 Avoidance/reduction measures – likely effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		
Visual receptors on the mainland ; and the local <i>landscape character</i> .	Visual intrusion of construction plant and changes to the landscape character	High certainty of effectiveness: Restriction of construction activities to within the current, well screened WWTP with no requirement for any external construction compound in the vicinity of Mutton Island e.g. on South Park.
Operation		
Visual receptors on the mainland	Visual intrusion of newly built, operational elements and changes to the landscape character	High certainty of effectiveness: Restriction in the design to introduce new built elements into the landscape to only those absolutely necessary e.g. some pipework and the top of any sludge dryer. These elements will not rise more than 2m above the tallest structure already on the site. Careful consideration of colour and texture on visible elements to minimise any effects (e.g. glint) to mainland receptors.

Compensation

No compensation has been identified or is relevant.

9.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 9.2**.

Table 9.2 Implementation of incorporated mitigation and enhancement measures

Description of measures including any monitoring requirement	Responsibility for implementation	Implementation mechanism
Construction		
Restriction of construction activities to within the WWTP with no requirement for any external construction compound in the vicinity of Mutton Island e.g. on South Park.	Contractor	Contract Documents
Operation		
Restriction in the design to introduce new built elements into the landscape to only those absolutely necessary. These elements will not rise more than 2m above the tallest structure already on the site.	Contractor	Contract Documents
Careful consideration of colour and texture on visible elements to minimise any effects (e.g. glint) to mainland receptors.		

9.3 Assessment of Effects

9.3.1 Scope and Methodology

This landscape and visual assessment has been based upon the second edition of *Guidelines for Landscape and Visual Assessment (GLVIA)* (Landscape Institute and the Institute of Environmental Management and Assessment, 2002). Regard is also given to the guidelines for *'Landscape and Landscape Assessment'* (Department of the Environment and Local Government, 2002).

The landscape and visual assessment was prepared according to a methodology developed by Entec based upon the above referenced guidelines. Detailed landscape assessment was restricted to the application site and the immediate and neighbouring landscape and seascape character areas. Effects beyond these areas have been assessed under the visual assessment through the selection of potential visual receptors.

Visual assessment was restricted to the potential visual envelope from where there may be a view of the proposals, as shown in **Figure 9.1**, and this is used as an appropriate starting point for undertaking the visual assessment.

Landscape

Landscape Receptors

The introduction of the proposed sludge dryer will have *indirect* and *direct* effects on the landscape, with *indirect* effects being those which affect the landscape character and *direct* effects those which physically modify landscape elements. Five aspects of the landscape resource are considered:

- On-site landscape elements which may experience *direct* physical effects;
- The contextual patterns and dynamic of development and broad scale characteristics found throughout the study area which may be *indirectly* affected through the WWTP upgrade, and these are encompassed in the grain of the landscape;
- The landscape character types which have been identified in the baseline that apply to parts of the study area and which may be indirectly altered through the WWTP upgrade;
- Designated features, such as designed landscapes and important buildings which may be *indirectly* altered through the WWTP upgrade; and
- Designated landscapes, such as Special Landscape Areas, or non-designated landscapes identified under specific criteria.

The landscape effects will be assessed by consideration of three criteria: type of effect; the sensitivity of the landscape resource; and the predicted magnitude of change. Consideration of the sensitivity of the landscape resource against the magnitude of change posed by the development is fundamental to landscape assessment and these two criteria are defined in more detail later in this section.

Types of Landscape Effect

The effect of the sludge dryer on each identified landscape receptor is classified according to its ability to accommodate the consequent effects of the construction and operation of the proposed sludge dryer. This ability is expressed using the following definitions:

- **Positive** where it is felt to complement or contribute to the landscape, strengthening it or adding positive characteristics and qualities which were not previously available;
- **Neutral** where it neither contributes to nor detracts from the landscape, and can be accommodated comfortably by the landscape context;
- **Negative** where it introduces elements which are not currently found in the landscape and cannot be accommodated without some detrimental effect.

The ability of landscape receptors to accommodate the sludge dryer is assessed through professional judgement based on the factors considered in the evaluation of the

sensitivity of receptors and the magnitude of the effects and on the knowledge of the study area as a whole which the assessors have gained. The significance of the effect of the sludge dryer on each of these landscape receptors is assessed through a combination of their sensitivity and the magnitude of the change that they will experience.

Magnitude

The magnitude of change is an expression of the degree of addition, change or loss which would be experienced by the baseline landscape conditions and is classified as high, medium, low or negligible.

The following factors are considered in the evaluation of magnitude of change:

- The **nature** of the perceived contrast, or integration, of any new features or changes with the existing landscape including the nature of the sludge dryer facility layout;
- The **scale** of change in the landscape with respect to the proportion of the landscape affected by the sludge dryer and the degree to which it is affected; and
- The **duration** and **reversibility** of the effect on the landscape.

The manner in which these considerations are reflected in the magnitude categories used in the assessment are indicated in **Table 9.3**, although it is recognised that for some developments in certain locations there may be combinations of factors that do not comply with the range of effects set out in the table. In these situations professional judgement has to be made concerning the definition of the level of landscape effects.

Table 9.3 Magnitude of Landscape Effects

Predicted Landscape Effects	Level
Large-scale changes in landscape character over an extensive area/intensive, irreversible change over a more limited area/complete loss of notable features or elements	High ↓
Moderate scale changes over a localised area/partial loss/alteration of notable features or elements	Medium ↓
Little change in any landscape feature	Low

Sensitivity

The sensitivity of each landscape receptor is dependent on its value and its ability to accommodate the proposed sludge dryer, and is classified as high, medium or low. This classification is derived from consideration of a number of variables:

- **Landscape quality:** an appraisal of the state of repair or condition of landscape elements, the integrity and intactness of the landscape, and the extent to which its distinctive character is apparent in a particular area.
- **Landscape value:** an appraisal of the importance of the landscape, with consideration given to any national and local designations which may apply, the perceived value of the landscape to users and other consultees, and any intrinsic aesthetic characteristics of the landscape such as scenic quality or sense of place. These may be derived from literature, films, television programmes and guides. It should be noted that a landscape of high value may not always equate to areas of high landscape quality (particularly if they are designated for other landscape and visual reasons) and that areas of low landscape value may contain areas of higher landscape quality.
- **Development within the landscape:** the ability of the landscape to accommodate the sludge dryer can be influenced by the presence and extent of any existing development within the study area, especially in cumulative views. Landscapes which are already influenced by development similar in some way to the type proposed generally have a greater capacity to accommodate the proposed changes, while those lacking any influence from built form or other human elements may be more susceptible. In this assessment the evaluation of the sensitivity of landscape receptors does assume knowledge of the nature of the development proposed.
- **Scale of the landscape:** this also affects the ability of the landscape to accommodate the sludge dryer. A large scale landscape of simple landform generally has a greater capacity to absorb development than a smaller scale, complex setting where misleading comparisons of scale may occur.
- **Visibility:** whilst visibility is primarily a visual concern, the extent of enclosure and variation in topography has a role to play in determining the sensitivity of a particular landscape to change.

The manner in which these considerations are evaluated to derive a sensitivity category is set out in **Table 9.4**. Nevertheless it is recognised that the categories can only be considered as indicative and there may be situations where due to specific circumstances and the associated need to apply professional judgement result in alternative landscape resource sensitivities being used in an assessment.

Table 9.4 Sensitivity of Landscape Resources

Landscape Resource Categories	Sensitivity
Important components or landscapes of particularly distinctive character and therefore likely to be subject to national designation and be vulnerable to relatively minor changes	High ↓
Moderately valued characteristics reasonably tolerant of change particularly if subject to local landscape designation	Medium ↓
Relatively unimportant/immature or damaged landscapes tolerant of substantial change	Low

Visual

Visual effects are recognised by the Landscape Institute as a subset of landscape effects and are concerned wholly with the affect of the development on views, and the general visual amenity. Visual effects may include the following:

- **Visual obstruction** - physical obstruction or blocking of a view, only likely to occur close to the development or within the application site boundary.
- **Visual effect** - a change in the appearance of the landscape as a result of development appearing in an existing view or the loss of particular landscape elements or features already present in the view.
- **Other visual effects** - The overall visual amenity of an area may be affected to the extent that the visual appearance of a particular landscape character type or the visual setting, ‘sense of place’¹⁷ or of a particular location such as a village is significantly changed. Effects on areas of general amenity are considered in the context of landscape change and may also be either negative or positive.

Viewpoint Assessment

Viewpoint assessment is conducted from particular viewpoints from which the WWTP would be visible. The purpose of this is to assess both the level of visual effect that would be sustained by particular receptors, and to help guide the assessment of the overall effect on visual amenity and areas of particular landscape character or designation within the study area.

Visual Sensitivity

The sensitivity of each view or route is classified as high, medium or low through consideration of:

- Visual quality: an appraisal of the quality of the view available to the visual receptor(s) relating to its amenity and its integrity and intactness;

¹⁷: ‘Sense of Place’ the essential character and spirit of an area or *genius loci*.

- Visual value: an appraisal of the importance given to the view, as indicated by factors such as its recognition as a tourist viewpoint with facilities provided for its enjoyment or its location within an area covered by a landscape designation.

Based on the *Guidelines for Landscape and Visual Assessment. Second Edition*, (The Landscape Institute and Institute of Environmental Management and Assessment, 2002), the different receptor categories identified in the baseline assessment are ranked in order of their sensitivity to visual effects as set out in **Table 9.5**. It should be stressed that this table is indicative only as it would be impossible to rigidly tabulate sensitivity to change.

Table 9.5 Sensitivity of Visual Receptors

Visual Receptor Categories	Sensitivity
Designated long distance footpaths	High
Residential communities (towns, villages & hamlets)	↓
Close distance private residential properties	↓
Close distance isolated private residential properties	Medium
SAMs and Historic Parks & Gardens	↓
Other Public Rights of Way (PRoWs)	↓
Public and private recreational open space	↓
Rights of way associated with highways	↓
Businesses and industry	Low

Magnitude of Change

The magnitude is described as high, medium, low or negligible, to take account of possible landscape changes, which may affect the view. The magnitude and scale of visual change is described by reference to:

- The scale of change in the view and the loss or addition of features in the view and changes in the composition and extent of view affected. The scale of the development relative to its landscape setting may be more or less emphasised by the presence or lack of scale indicators¹⁸;
- The degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of mass, scale, colour and texture;

¹⁸ Scale indicators are familiar objects in the landscape such as buildings which appear in close proximity to the sludge dryer and provide an indication of the true scale and height of the development such as the lighthouse.

- The distance between the visual receptor and the development and the frequency and ease with which the development may be viewed from a particular viewpoint taking into account seasonal factors such as weather conditions, sea fog etc;
- The angle of the main direction of the view and whether the development would be viewed against the skyline or a background landscape;
- The duration, whether temporary or permanent, intermittent or continuous; and
- The potential for indirect effects. The Landscape Institute defines these as effects that are not a direct result of the development, but are often produced away from it or as a result of a complex pathway. An example may include the potential for visual effects as a consequence of increased traffic levels generated by delivery lorries during the sludge dryer construction period.

Visual assessment considers the above factors, together with the mitigation incorporated into the design, to arrive at a judgement on the sensitivity of the view and magnitude of change posed by the development. General guidance for this assessment has been provided in **Table 9.6** which provides examples of how different considerations interact to produce different visual magnitude categories.

Table 9.6 Visual Magnitude

Visual Magnitude Categories	
High	A major change, obstruction of a view or intrusion into a view that is directly visible and likely to appear in the foreground.
Medium	A moderate change or partial view of a new element within the view which may be readily noticed, directly or obliquely visible including glimpsed or intermittent views and appearing in the middle ground partly screened or mitigated.
Low	A low level of change, affecting a small part of the view which may be obliquely viewed or partly screened and or appearing in the background landscape. May include travelling views from roads/rail.
Negligible	Few viewers affected by a small or intermittent change to the view which may be obliquely viewed and mostly screened and or appearing in the distant background or viewed at high speed over short periods and capable of being missed by the casual observer.

Types of Visual Effect

Landscape and visual effects may be positive, neutral, or negative. A positive effect would require development to add to the landscape value, quality, character and or visual amenity of an area. Certain types of development and mitigation associated with some developments such as enhancement of vegetation and the improvement of landscape features could also be regarded as positive.

A neutral landscape and/or visual effect would constitute ‘negligible change’ to the existing landscape or view, and would include changes which may be considered as part of the ‘normal’ landscape processes (such as harvesting) or a negligible magnitude of change affecting a view.

A negative effect may include the loss of landscape elements such as stone walls and hedgerows as part of construction, although usually these types of effects can be avoided.

9.3.2 Significance evaluation methodology

Landscape Effects

Criteria for the Evaluation of Landscape effects

The significance of landscape effects reflect the sensitivity of the landscape to change (see **Table 9.4**) and the magnitude of that change (see **Table 9.3**). The evaluation of criteria and thresholds is primarily based upon professional judgement.

Significance of Landscape Effects

There has been a general consensus in recent landscape assessments on the recognition of three thresholds of significance that are derived from different combinations of landscape resource sensitivity and impact magnitudes, as reflected in the LI / IEMA Guidelines. These are:

- ‘**major**’ meaning high sensitivity or major magnitude;
- ‘**minor**’ meaning medium sensitivity or some magnitude; and
- ‘**not significant**’ meaning low sensitivity or minor magnitude.

The assessment of significance is on a qualitative basis, as a scoring system does not avoid subjectivity and suggests a certainty that may not be present.

Visual Effects Evaluation

Criteria for the Evaluation of Visual effects

Significance is dependent on two criteria:

- the sensitivity of the receptor to the identified impact; and
- the magnitude of the predicted changes as measured along an agreed continuum.

The different receptor categories are ranked in order of their sensitivity to visual impacts as set out in **Table 9.5**.

The magnitude of visual effect is a function of three factors:

- The number of visual receptors affected;
- The distance from receptors to the source(s) of visual impact; and
- The degree of change to existing views and the scale of the proposed extension.

These factors are graded in accordance with **Table 9.6**.

Significance of Visual Effects

There has been a general consensus in recent landscape assessments on the recognition of three thresholds of significance, that are derived from different combinations of sensitivity and magnitude, reflecting the categories and principles laid down by the LI / IEMA. These are:

- ‘**major**’ meaning high sensitivity or high magnitude;
- ‘**minor**’ meaning medium sensitivity or medium magnitude; and
- ‘**not significant**’ meaning low sensitivity or low magnitude.

It is clear that a number of intermediate situations occur with, for example, a receptor of medium sensitivity combined with an effect of high magnitude. Relevant guidelines (The Landscape Institute, 1999) suggest that in such situations, professional judgement should supplement the rigid application of matrix tables. The assessment of significance is on a qualitative basis, as a scoring system does not avoid subjectivity and suggests a certainty that may not be present. The type of effect in the evaluation of the visual effects is categorised as being neutral because the effects constitute negligible change to the view.

9.3.3 Predicted effects and their significance

Predicted effects during construction

Landscape

The predicted landscape effects are concerned with the changes in the fabric, quality and character of the landscape. The evaluation of the landscape effects of the proposals indicate that there will be negligible localised negative landscape effects caused by the construction operations. The mitigation proposed, especially the restriction of construction activities to within the existing, screened site will be highly effective.

Visual

This section of the assessment considers the predicted main visual environmental effects upon identified visual receptors that would result from the construction and operation of the proposed sludge dryer. To minimise repetition, many individual receptors have been grouped together where it is considered that the predicted effects will be substantially the same (e.g. the majority of properties along coastal roads). The principal receptor groups are identified in **Table 9.8** (see **Figure 9.1** for locations).

The main effects on visual receptors during the construction period are the temporary introduction of vertical elements that will break the skyline cranes (e.g. cranes) and an increase in traffic movement on the agreed traffic routes to/from the site and the causeway. However, it is predicted that the upgrade construction works will not have any significant visual effects on any of the identified groups of potential visual receptors along the coast between Salthill and Renmore as well as any boats within the visual envelope.

This is principally because the existing WWTP on Mutton Island is already a small to moderate element in the current views available to many of these receptors. Most construction activities will take place within the existing site boundary with only a very small number of plant (e.g. cranes etc.) visible from receptors. Additionally, traffic numbers are predicted to be relatively low. Hence, the construction will only represent a small, incremental increase in the extent of existing visual elements as opposed to the introduction of completely new visual elements. This factor will reduce its potential visual intrusiveness in addition to the key factor that Mutton Island is off-shore and has a minimum separation distance of almost 1 km from the closest visual receptors (except for boats).

Predicted effects during operation

Landscape

The predicted landscape effects during the operational period will come about due to the introduction of new vertical elements into the landscape. However, the identified mitigation to minimise the number and scale of these elements will be highly successful in reducing the effect to a negligible negative change to the landscape character in the locality which is already dominated by the mass of the existing WWTP and the lighthouse on Mutton Island.

Visual

The main effect on visual receptors after the upgraded WWTP becomes operational is the introduction of a small number of vertical elements that will break the skyline to a very small degree. **Figure 9.2** is indicative of the changes that will occur, and this figure is based on a worst case situation with respect to a 2m high, 3.5m wide increase in the visible structure on-site due to the introduction of a possible sludge dryer.

It is predicted that the upgraded WWTP will not have any significant visual effects on any of the identified groups of potential visual receptors. This is principally because the existing WWTP on Mutton Island is already a small to moderate element in the current views available to many of these receptors. The upgrade will primarily be located within the existing site boundary using material and an architectural style that will reflect that of the existing WWTP, hence it will only represent a small, incremental increase in the extent of existing visual elements as opposed to the introduction of a completely new visual element. This factor will reduce its potential visual intrusiveness in addition to the key factor that Mutton Island is off-shore and has a minimum separation distance of almost 1 km from the closest visual receptors (except for boats).

9.3.4 Compensation

No compensation has been identified.

9.3.5 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

9.3.6 Summary of significance evaluation

The results of the landscape assessment are presented in **Table 9.7** and the visual assessment in **Table 9.8**.

Table 9.7 Effects on landscape and evaluation of significance

Landscape Impact	Type of Effect	Probability of Effect Occurring	Sensitivity	Magnitude of Effect	Significance Level	Significance Rationale
Construction						
Construction activities	Negative / Temporary	Certain	Low	Low	Not significant	Minimal landtake by construction plant, temporary for the duration of construction
Operation						
Operation	Negative / Permanent	Certain	Low	Low	Not Significant	Minor change to the landscape character of the Island through the incremental increase in the mass and volume of operational plant on the Island

Table 9.8 Effects on visual receptors and evaluation of significance

Visual Receptor	Type of Effect	Probability of Effect Occurring	Sensitivity	Magnitude of Effect	Significance Level	Significance Rationale
R1: Residential receptors on the Long Walk/Dock Road	Neutral	Likely	High	Low	Not Significant	Residents, especially those located on the edge of the harbour, will have long distance views of the construction and operation of the WWTP on Mutton Island. They will experience a negligible incremental change in their views as the introduction of the sludge dryer will visually only represent a small scale increase in the extent of an existing feature (the WWTP) which in itself is a relatively minor element in the extensive seaward views available to these receptors.
R2: Residential	Neutral	Likely	High	Low	Not Significant	Most residents along this road are in properties that are orientated to have

Visual Receptor	Type of Effect	Probability of Effect Occurring	Sensitivity	Magnitude of Effect	Significance Level	Significance Rationale
receptors on Grattan Road north of the causeway						eastern views and as such will have only oblique middle distance views of the sludge dryer.
<u>R3:</u> Residential receptors on Grattan Road to the west of the causeway	Neutral	Certain	High	Low	Not Significant	The majority of the residential receptors at this location will sustain direct middle distance views in the context of the existing WWTP
<u>R4:</u> Residential receptors along Seaport Promenade	Neutral	Certain	High	Low	Not Significant	Views across Galway Bay towards Mutton Island. At 1.4km any changes to the skyline will be difficult to distinguish
<u>R5:</u> Residential receptors along Salthill Road Upper	Neutral	Unlikely	High	Negligible	Not Significant	Oblique views over a minimum distance of 2.3km in which the WWTP will be difficult to clearly discern.
<u>R6:</u> Recreational users at Cromwell's Fort	Neutral	Certain	Medium	Low	Not Significant	Long distance views from the north east in which Mutton Island is only a small-scale component within the extensive views available
<u>R7</u> Recreational users at Nimmo's Pier	Neutral	Likely	Medium	Low	Not Significant	The WWTP is a minor element in long distance southern views
<u>R8</u> Recreational users at South Park, Claddagh	Neutral	Likely	Medium	Low	Not Significant	The existing WWTP is already visible from South Park so the predicted, minor changes would only represent a small, incremental increase in the scale of this existing visual element.
<u>R9</u> Recreational users at Grattan Beach	Neutral	Certain	Medium	Low	Not Significant	The effects from the proposed upgrade development will not significantly effect recreational users of Grattan Beach due to the distance to the proposals
<u>R10</u> Recreational users near the Atlantiquarium	Neutral	Certain	Medium	Low	Not Significant	Mutton Island and the existing WWTP are already a focal point in the middle distance in seaward (eastern) views from this area.
<u>R11</u> Recreational	Neutral	Certain	Medium	Negligible	Not Significant	Mutton Island and the existing WWTP are only visible in oblique long

Visual Receptor	Type of Effect	Probability of Effect Occurring	Sensitivity	Magnitude of Effect	Significance Level	Significance Rationale
users of Salthill Beach						distance eastern views and its lack of prominence in views from this location will not be modified by an incremental increase in the extent of the Island's built development
<u>R12</u> Recreational users at Galway Golf Club	Neutral	Certain	Medium	Negligible	Not Significant	At a separation distance of 3 km the scale of the proposed visual changes cannot exceed a negligible magnitude of change.
<u>R13</u> Road users along Grattan Road	Neutral	Likely	Low	Low	Not Significant	Incremental increase in the amount of built development on Mutton Island likely to generate negligible magnitude of change in the composition of views available to these motorists
<u>R14</u> Road users along Seaport Promenade Road	Neutral	Likely	Low	Low	Not Significant	Long distance views of Mutton Island are fleeting and the proposed changes will have negligible visual effects upon the present views
<u>R15</u> Road users along Salthill Road Upper	Neutral	Likely	Low	Low	Not Significant	Scale of visual change in south-eastern views will be too small to generate any significant visual effects
<u>R16</u> Industrial users of the Galway Harbour	Neutral	Certain	Low	Medium	Not Significant	Boats and maritime traffic using the harbour may receive closer distance views than land receptors but their low sensitivity categorisation will ensure that overall the effects will not be significant
<u>R17</u> Industrial users of Galway Harbour Enterprise Park	Neutral	Certain	Low	Low	Not Significant	As with all other middle distance receptor groups the magnitude of change in present views as a consequence of the construction and operation of the sludge dryer will be very low in the overall context of their views across the expanse of Galway Bay
Key	Effect	Probability	Sensitivity	Magnitude of Effect	Significance	
	Positive	Certain	High	High	Major	
	Negative	Likely	Medium	Medium	Minor	
	Neutral	Uncertain	Low	Low	Not Significant	
				Negligible		

9.4 References

Department of the Environment and Local Government, (2002), Landscape and Landscape Assessment (Draft).

The Landscape Institute, (1999), *Practice Note (01/99)*.

The Landscape Institute and Institute of Environmental Management and Assessment, (2002), *Guidelines for Landscape and Visual Impact Assessment: Second Edition*. Spon Press, London.

TOBIN, O'Dwyer and Entec. (2004). *Mutton Island Wastewater Treatment Works Upgrade – Scoping Report*.

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10. Water Quality

10.1 Existing Environment

10.1.1 Introduction

Mutton Island WWTP discharges directly into Galway Bay, a large coastal embayment located on the west coast, receiving fresh water inflows from the River Corrib. The water environment comprises both surface and groundwater bodies and the proposals have the potential to affect identified waters, and their legitimate uses. A source-pathway-receptor approach is used and therefore where any one of these elements is missing, no effects will result.

10.1.2 Scope

The main receptor has been identified as Galway Bay and the particular water quality designations at various locations within it, and the baseline situation with regard to this water is presented.

The extent of the existing treated effluent plume discharged from the Mutton Island WWTP will vary in extent and spatial coverage under the influence of tides and wind, therefore a large radius (5km) of coverage has been used within Galway Bay to identify receptors.

10.1.3 Methodology

The baseline state of the water environment is determined using a wide range of data and published material, along with the use of a 2-dimensional water quality model to represent the current discharge from Mutton Island WWTP. Additionally, consultations with bodies relating to the local and wider water environment have been undertaken. The data collected and other sources of information are listed in **Table 10.1**.

Table 10.1 Sources of Information: Water Environment

Topic	Sources of Information
Geology	Geological Survey of Ireland Map 14
Rainfall	Environmental Protection Agency, Hydrological Data, July 1997.
Wind	Wind data from Belmullet has been used in the water quality modelling undertaken.

Topic	Sources of Information
Bathing Waters	
Standards/Directives	EPA (2005), The Quality of Bathing Waters in Ireland 2004
Measured Quality	Galway City Council (2005) Electronic data – water quality monitoring results 2003 and 2004
Shellfish Waters	
Standards/Directives	SI No. 200 of 1994 – Quality of Shellfish Water Regulations, 1994, giving effect to Council Directive 79/923/EEC.
Locations of farms	Department of Communication, Marine, and Natural Resources. AutoCAD plan of bay and aquacultural activities
River Corrib	
Chemical Quality	EPA (2005) Hydrometric Area 30 Corrib (Ref location no: 30/C/02)
Flows	Office of Public Works (2005), Hydro-data Web Site (http://www.opw.ie/hydro/index.asp?mpg=main.asp)
Galway Bay	
Tides, currents and bathymetry	Reeds Nautical Almanac (2004) and Admiralty Chart No. 1984
Trophic Status	EPA (2001) An assessment of the Trophic Status of Estuaries and Bays in Ireland
Mutton Island Treatment Works	
Various flow and load data	Galway Main Drainage Phase 3 Preliminary Report (TOBIN and O'Dwyer, 2006)

10.1.4 Existing Situation

The existing situation is presented in terms of the baseline for:

- the local climate and weather, which affect hydrology and treated effluent transport (via wind induced advection and turbulent mixing);
- Mutton Island geology and groundwater;
- the River Corrib (as a main input to Galway Bay);
- other discharges to the bay (which may affect water quality); and
- the quality of the water in Galway Bay itself (including specifically identified receptors for water quality).

Climate and Weather

The climate and weather patterns in Galway Bay are dominated by the Atlantic Ocean, with this coastal location receiving an annual average of 1331mm of precipitation per year. (EPA, 1997).

Geology and Groundwater

Geology Sheet 14 shows Mutton Island composed of rocks of the 'metagabbro and orthogneiss suite', that is, undifferentiated quartz diorite gneiss, granitic gneiss and hornblende metagabbro. It is considered that these metamorphic rocks do not have potential as groundwater aquifers.

Physical and Tidal Characteristics

Galway Bay is a transitional water body, receiving freshwater inflows from the River Corrib, as well as the flows from Mutton Island WWTP.

The bathymetry around Mutton Island is markedly different to the north than to the south (as shown in **Figure 10.1**). To the north, a rocky inter-tidal zone links the island to the mainland shore at South Park, just off Grattan Road. Water entering (on a flood tide) or exiting (on an ebb tide) the entrance to the Corrib estuary (and Galway Dock) will flow to the east and south of Mutton Island, as the causeway linking the island to the mainland provides a physical barrier to flow to the north of Mutton Island.

To the south of Mutton Island the water quickly deepens to over 10.0m bCD (below Chart Datum). This deeper water extends to the south-west, deepening further towards the outer bay.

Summary tidal elevation data for Galway Bay is presented in **Table 10.2**. Tides are mesotidal and semi-diurnal in character.

The wave climate in inner Galway Bay can be considered to be sheltered from that of the Atlantic due to the protective presence of the Aran Islands, partially blocking incoming waves.

Table 10.2 Galway Tidal Elevations

Lever	Spring Tide Height (m above CD)	Neap Tide Height (m above CD)
Mean High Water	5.1	3.9
Mean Low Water	0.6	2.0

Heights are referenced to Chart Datum which is approximately the level of Lowest Astronomical tide.

River Corrib

The River Corrib has a catchment area of 3,111 km² and drains Lough Corrib, which is the Republic of Ireland's largest freshwater lake. Hydrometric data derived at Wolfe Tone Bridge (Station 30061 at National Grid Reference M 296 249), the bridge over the River Corrib closest to its mouth, yields a mean annual flow of 108.7m³/s for the period 1987-2001, with a highest recorded annual maximum of 381m³/s, recorded on 27th January 1995.

Figure 10.1 indicates the locations at which hydrometric data, biological quality and chemical quality parameters have been monitored.

- Biological Quality

Biological Quality Ratings (Q-values¹⁹) have been derived at Salmon Weir Bridge in Galway City, (located upstream of the hydrological station at Wolfe Tone Bridge). For the 1985 to 2000 monitoring period this site has received a Q-value of 4 (which indicates a generally unpolluted status, with ‘fair’ water quality leading to ‘satisfactory’ status).

- Chemical Quality

Chemical analyses of the River Corrib has been undertaken at Waterside, central Galway. Waterside is located upstream of both Wolfe Tone Bridge and Salmon Weir Bridge. Data is available from 1998 to 2003. At this location the river is designated as a EC Freshwater Fish Directive (78/659/EEC) salmonid fishery.

Parameters collected include pH, conductivity, temperature, dissolved oxygen, biochemical oxygen demand (BOD₅), chloride, total ammonia, un-ionised ammonia, oxidised nitrogen, ortho-phosphate and colour. For comparative purposes the minimum, median and maximum values for each period have been included in **Table 10.3**.

Table 10.3 River Corrib selected water quality data (1998-2003)

Year	Chemical Analyses											
	BOD ₅ (mg/l O ₂)			Total ammonia (mg/l N)			Oxidised nitrogen (mg/l N)			Ortho-phosphate (mg/l P)		
	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
1998 - 2000	0.5	1.1	2.2	0.01	0.02	0.06	<0.1	2.4	9.1	0.01	0.01	0.04
2001	0.4	0.9	1.4	0.01	0.02	0.04	0.1	0.5	1.3	0.005	0.009	0.023
2002	0.3	0.6	2.7	0.01	0.01	0.28	<0.1	0.2	2.0	<0.005	0.012	0.036
2003	<1	<1	1.3	<0.03	<0.03	0.04	0.4	<0.4	1.1	<0.012	<0.012	0.017

Source: Environmental Protection Agency

The BOD results are characteristic of waters with a very low organic loading, as are the total ammonia results (with the exception of the maximum value of 0.28mg/l N which

¹⁹ The Q-value of a stretch of river is assessed by the EPA during National River Monitoring Programmes.

could result from a pollution incident but is nevertheless well within salmonid water standards²⁰). The nutrient concentrations in the river (oxidised nitrogen and ortho-phosphate) are, in general, not excessive. However, the loadings of nutrients to Galway Bay are important, and the contribution of the River Corrib is discussed below.

The 2002 OSPAR direct riverine loads report (OSPAR Commission, 2004) states that the Corrib delivered a nitrogen load of 3.456 tonnes/day (as N), an ammonia load of 51 kg/day (as N) and suspended sediment load of 15.444 tonnes/day to Galway Bay in 2002²¹. The report states that:

“Pollutant loads in most rivers [in Ireland] in 2002 were generally substantially greater than the comparable figures for 2001, and average for the 1990-2000 period. This was largely attributable to above normal rainfall in 2002. Mean annual flows in the rivers in 2002 were on average 115 per cent of the respective averages for the period 1990 to 2000.”

Examination of the concentrations given in **Table 10.3** suggests that nitrogen loads have reduced since 2002.

Other Discharges

There are a number of Combined Sewer Overflows (CSOs) which discharge to the River Corrib. Some of these CSOs discharge directly to the River while others are thought to spill indirectly into the River Corrib through cross connections into the surface water system.

Additional to the CSOs discharging to the Corrib Estuary, there are also another 12 CSOs discharging directly to the north coast of North Bay in/near Galway City within a 5km radius of Mutton Island. Again it is possible that there are more CSOs which discharge to the bay which have not been identified at time of writing.

Apart from these CSO discharges there are no other, major point source discharges within 5km of Mutton Island WWTP.

Water Quality in Galway Bay

Water quality in Galway Bay is monitored at a number of locations for a variety of purposes (see **Figure 10.1**). A 5km search area has been used to identify relevant data within Galway Bay. Beyond 5km it is felt that the influence of the treated effluent plume from the discharge will be small.

The approach to determining the current influence of the Mutton Island WWTP is presented below, followed by identification of water quality receptors and how they are affected by the current discharge.

²⁰ See *European Communities (Quality of Salmonid Waters) Regulations*, S.I. 293 of 1988

²¹ The loads were derived from flow-weighted annual mean concentrations and annual flow.

Mutton Island WWTP Discharge

The existing Mutton Island WWTP began receiving flows in the latter half of 2003 and has been fully operational in its present state since April 2004. Previous to this a large number of raw sewage discharges occurred from Galway City, along its immediate coastline and into the River Corrib. The original design loads for the existing WWTP are as outlined in **Table 10.4**.

Table 10.4 Design loads for Mutton Island WWTP

Parameter	Load
WWTP influent	
Biochemical Oxygen Demand (BOD ₅)	5,500 kg/d
Total Suspended Solids (TSS)	6,412 kg/d
Chemical Oxygen Demand (COD)	13,177 kg/d
Dry Weather Flow (DWF)	28,800 m ³ /d
Max flow to full treatment (3DWF)	86,400 m ³ /d
Max flow to Preliminary treatment (6DWF)	172,800 m ³ /d
WWTP effluent	
Biochemical Oxygen Demand (BOD ₅)	720 kg/d
Total Suspended Solids (TSS)	1,008 kg/d
Chemical Oxygen Demand (COD)	3,600 kg/d

Source: Galway Main Drainage Stage 3 Preliminary report (TOBIN and O'Dwyer, 2006)

The effluent standards applied to the existing WWTP represent the statutory requirement to comply with the Urban Wastewater Treatment Regulations (UWWTR), which implement Directive 91/271/EEC. The effluent concentrations in **Table 10.5** therefore apply. The concentration standards and percentage removal standards are presented as alternatives in the Directive but the approach adopted in Ireland has been based on use of the concentration standards for compliance assessment.

Table 10.5 UWWTR effluent concentrations (Second Schedule, Part 1, S.I. 254/2001)

Parameter	Maximum concentration (mg/l)	Minimum % Reduction
Biochemical Oxygen Demand (BOD ₅)	25	70-90
Total Suspended Solids (TSS)	35	75

Parameter	Maximum concentration (mg/l)	Minimum % Reduction
Chemical Oxygen Demand (COD)	125	90

Currently, although there is no legal requirement to do so, Mutton Island is designed to operate as a nitrifying plant, meaning that incoming nitrogen in the form of ammonia (NH_3) is converted to nitrate (NO_3^-). As a result, ammonia concentrations are typically around 5mg/l (as N) and the modelling of the baseline situation has been undertaken using this concentration in the discharge.

The main discharge is made approximately 500m to the south of the Mutton Island High Water level, via a manifold diffuser system (which is designed to maximise the initial dilutions of the treated effluent by discharging through 10 discrete outlets spread over a distance of 100 m on the sea bed). The discharge is into water 10m below Chart Datum.

Dilution and dispersion of the treated effluent plume

Treated effluent discharged from the outfall will undergo mixing as the buoyant effluent rises from the outfall exit to the sea surface. This process results in an ‘initial dilution’ of the treated effluent as it meets the surface. The principal criteria affecting initial dilution are the discharge rate, the effluent buoyancy, water depth and the ambient current. The initial dilution may be further influenced by the angle of discharge, port size and stratification of the receiving waters. Calculation of the initial dilutions achieved by the current WWTP (under existing 3DWF flow conditions) over the tidal range experienced at the outfall location indicate that under near worst case conditions (95 percentile) a dilution of 30:1 is achieved with dilutions of >60:1 achieved for 50% of the time.

After initial dilution has taken place further mixing of the treated effluent with the receiving water takes place, ‘secondary mixing’, and the effect of the discharge in the medium- and far-field has been modelled using a two-dimensional hydraulic dispersion model. The modelling determines the behaviour of the existing treated effluent plume under a range of tidal and wind conditions. Modelling of the existing (baseline) scenario was based on a scenario involving maximum flow through full treatment at the WWTP (i.e. 3DWF). Under the UWWTR the effluent is limited to a BOD_5 of 25mg/l and this concentration has been used as the concentration within the discharge, with an ammonia discharge concentration of 5mg/l (as N), as identified above. A more complete description of the modelling process undertaken is contained in **Appendix E**.

Table 10.6 outlines the combination of wind and tide conditions for which the plume modelling was undertaken. It should be noted that neither a north nor north-easterly wind has been modelled, as it is not anticipated that a wind from this direction would cause pollutant problems at either the bathing waters or the shellfish waters within Galway Bay.

Table 10.6 Water quality modelling scenarios

Wind Strength	Wind Direction						Tidal Conditions
	NW	W	SW	S	SE	E	
Calm							x
Force 3 (F3)	x	x	x	x	x	x	Mean Neap
Force 6 (F6)	x	x	x	x	x	x	
Calm							x
Force 3 (F3)	x	x	x	x	x	x	Mean Spring
Force 6 (F6)	x	x	x	x	x	x	

Modelling of the effects of the existing discharge from Mutton Island WWTP has been undertaken for a range of parameters and each is discussed below.

Biochemical Oxygen Demand (BOD₅) and Dissolved Oxygen

The BOD₅ of an effluent represents the organic component of the discharge. The organic fraction is important because it exerts an oxygen demand, which results primarily from the microbial breakdown of the organic fraction, although some chemical processes will be taking place (hence Bio-Chemical Oxygen Demand). Much of the organic matter is likely to be in the particulate form (referred to as suspended solids).

Oxygen is, of course, critical for all higher organisms, and the fate and behaviour of the dissolved oxygen in waters is crucial to the wellbeing of marine organisms. BOD₅ is a useful comparative measure for risk to dissolved oxygen concentrations.

Figure 10.2a shows the maximum concentration envelope of BOD₅ concentrations around the Mutton Island outfall under the current, baseline scenario (over a whole tidal cycle). It should be noted that the maximum concentration envelope does not represent the situation for any one point in time but represents the worst case concentration of the substance being modelled over a whole semi-diurnal tide. This representation allows determination of the influence of the whole plume without resorting to assessment of individual scenarios for differing times during the tidal cycle. If an issue arises, further assessment of the tidal timing and its duration can be made.

Whilst there is no BOD₅ standard for coastal waters, there are several standards available for freshwaters, as set out in **Table 10.7**. Reference to the table and the maximum concentration envelope shows that the BOD concentrations in Galway Bay do not cause any of the standards identified to be breached, or even approached, apart from a very small area immediately around the surface boil from the discharge. Furthermore, the current BOD concentrations from the discharge can be considered

unlikely to significantly alter the dissolved oxygen in the area immediately outside of the initial dilution mixing zone.

Table 10.7 Available BOD standards

Legislation	Description	Standard
Freshwater Fish Directive (78/659/EEC) (Freshwaters)	Guideline value: Salmonid waters	3 mg/l
Salmonid Water Regulations (Freshwaters)	Maximum value:	5mg/l

Ammonia

Ammonia is the pollutant most commonly released to the aquatic environment and is present in crude sewage in high concentrations. In natural waters ammonia is present in equilibrium between un-ionised ammonia (NH_3) and the ammonium ion (NH_4^+). Under all normal conditions, the bulk of the ammonia encountered in estuaries and coastal waters will be as the ammonium ion²². However un-ionised ammonia exerts the main toxic impact on aquatic life.

The equilibrium between un-ionised ammonia and the ammonium ion is influenced by many external factors, in particular pH, temperature and salinity. The proportion of un-ionised ammonia increases with increasing temperature and pH, but decreases with increasing salinity. However, the ammonia/ammonium equilibrium responds in a non-linear way to these variables, and complex algorithms have been developed to calculate the un-ionised fraction. These are required as there is no routine method currently available for measuring un-ionised ammonia concentrations directly. It is therefore necessary to analyse for total ammonia, subsequently deriving the un-ionised ammonia from the salinity, pH and temperature at the time of sampling (UK Environment Agency, 2005). The proportion of ammonia in the un-ionised form has been calculated for inner Galway Bay and the Corrib Estuary, with the results presented in **Table 10.8**.

²² The fraction of un-ionised ammonia is normally sufficiently low that total ammonia concentration is a good approximation of the concentration of the ammonium ion.

Table 10.8 Worst case proportion of un-ionised ammonia

Location	Factors affecting the result			% Un-ionised ammonia
	Salinity (psu)*	Temperature (Deg C) **	pH (pH units)***	
Corrib Estuary				
• Winter	14.7	5	8.5	3.42
• Summer	28.6	20	8.5	9.49
Inner Galway Bay				
• Winter	30.8	5	8.5	3.07
• Summer	31.1	20	8.5	9.36

*Salinity values taken from *An assessment of the Trophic Status of Estuaries and Bays in Ireland* (EPA 2001)

**Worst case assumed temperature.

***Worst case assumed pH.

Figure 10.3a shows the maximum concentration envelope of total ammonia concentrations around the Mutton Island outfall under the current, baseline scenario (over a whole tidal cycle). It can be seen that there is no discernible effect on ammonia concentrations in Galway Bay. This is a product of the nitrification within the treatment process lowering discharged ammonia concentrations to approximately 5mg/l (as N) plus the initial dilutions available.

Water quality standards for ammonia are presented in **Table 10.9**. The Freshwater Fisheries Directive standard relates to freshwaters but recent work in the UK by the Environment Agency (UK Environment Agency, 2005) has identified standards to assist with assessment of discharges in relation to the EU Habitats Directive (92/43/EEC).

Reference to the table and the maximum concentration envelope shows that the ammonia concentrations in Galway Bay do not cause any of the standards identified to be breached, or even approached, apart from a very small area consisting of the surface boil from the discharge.

Table 10.9 Available ammonia standards

Legislation / Guidance	Description	Standard
Total Ammonia		
Freshwater Fish Directive (78/659/EEC)	Maximum value:	1mg/l (as NH ₄ ⁺) (equivalent to 0.78mg/l as N)
(Freshwaters)	Guideline value:	0.16mg/l
Salmonid Water Regulations	Maximum value:	1mg/l (as NH ₄ ⁺) (equivalent to 0.78mg/l as N)
(Freshwaters)		
UK Environment Agency operational standard for ammonia in saline waters*	Annual Average	1.1 mg/l (as N)
	Maximum Allowable Concentration	8.0 mg/l (as N)
Un-ionised ammonia		
Salmonid Water Regulations	Maximum value:	20µg/l
(Freshwaters)		
UK Environment Agency operational standard for un-ionised ammonia in saline waters **	Annual Average	21 µg/l (as N)

* This total ammonia limit is based on recommendations from the US Environmental Protection Agency (USEPA, 1989) and USEPA 1999)

** based on Seager J, Wolff E W & Cooper V A (1988) Proposed environmental quality standards for List II substances in water. WRC report TR260, May 1988

Other Toxic contaminants

There are many substances which are considered to be toxic to marine life and therefore have water quality standards set, with the EU Dangerous Substances Directive (74/464/EEC) setting out two lists of compounds for which standards are set by either the EU (List I) or each member state (List II).

A Dangerous Substances monitoring programme is being initiated during 2005 in Ireland as part of the EU Water Framework Directive (2000/60/EC) implementation. This programme will sample for the presence of over 200 substances which were prioritised as persistent, toxic and liable to bio-accumulate. Specifically the programme will include monthly water sampling and annual sediment and biota sampling in the vicinity of Mutton Island causeway.

No data have been made available from this programme to date.

Bathing Waters

Table 10.10 and **Figure 10.1** identifies all recognised bathing areas within a 5km of radius of Mutton Island WWTP.

Table 10.10 Bathing Waters

Location	Status		
	National Bathing Water	EU Directive Bathing Water (Compliance Data)	2005 Blue Flag Beach
Salthill	Yes	2003 – Did not comply with guideline standard for faecal coliforms 2004 – Complied with mandatory and guideline levels	No
Silver Strand (near Barna)	Yes	2003 – Complied with mandatory and guideline levels 2004 – Complied with mandatory and guideline levels	Yes
Grattan	Yes	Not designated	No
Ballyloughane (at Renmore)	Yes	Not designated	No

Note: The 2005 EU Bathing Water Directive compliance data is not currently available from the EPA but indicative assessment indicates that both Salthill and Silver Strand should pass the EU and Blue Flag limits for the 2006 bathing season.

The standards against which bathing waters are assessed are outlined in **Table 10.11**.

Table 10.11 Bacterial Water Quality Standards for Bathing Waters

Regulation/ Standard	Faecal Coliforms (No./100ml)		Total Coliforms (No./100ml)		Faecal Streptococci (No./100ml)	
	Mandatory	Guideline	Mandatory	Guideline	Mandatory	Guideline
EU Bathing Water Directive	2,000*	100**	10,000*	500**		100**
National Bathing Water Regulations ²³	2,000*		10,000*		300*	
	1,000**		5,000**			
Blue Flag Award Scheme	100		500			

²³ *Quality of Bathing Waters Regulations* S.I. 155 of 1992 (as amended by *Quality of Bathing Waters (Amendment) Regulations* S.I. 145 of 1994; S.I. 230 of 1996; S.I. 177 of 1998 and S.I. 22 of 2001)

Regulation/ Standard	Faecal Coliforms (No./100ml)		Total Coliforms (No./100ml)		Faecal Streptococci (No./100ml)	
	Mandatory	Guideline	Mandatory	Guideline	Mandatory	Guideline
* To be conformed with by 95% of samples and not exceeded by any two consecutive samples						
** To be conformed with by 80% of samples and not exceeded by any two consecutive samples						

A variety of factors affect bacterial concentrations in the environment and sources other than point source sewage inputs can affect concentrations (e.g. diffuse inputs from agricultural and urban sources). Each beach will be subject to differing influences but, the removal of crude sewage inputs at various outfalls around Galway City as Mutton Island WWTP came on line in late 2003 may be obscured as bacteriological data at bathing waters are notoriously ‘noisy’ and often large data sets are required to determine responses to removal of potential sources in the marine environment.

The potential impact from the discharge of faecal coliforms from the Mutton Island outfall has been assessed by modelling the dilution and dispersion of the treated effluent in Galway Bay and producing plots from the discrete scenarios modelled²⁴ (as identified in **Table 10.6**). These results are presented in **Appendix F**. The modelling shows that no designated beach will fail the rigorous Blue Flag standard for faecal coliforms (a sewage indicator bacteria) and that aquaculture production areas will not be degraded due to the influence of the treated effluent.

Galway City Council monitors for *Salmonella* in the bathing waters identified in **Table 10.10**. The 2003 and 2004 results showed two occurrences of Salmonella being present in the one litre samples, comprising one sample at Salthill and one sample at Grattan beach. The mandatory Bathing Water standard is no detections in 95% of samples and not to be exceeded in any two consecutive samples and therefore the standard is complied with.

Viruses

The Bathing Waters Regulations require monitoring for enteroviruses where an investigation shows, or where there are other grounds for believing, that there has been a deterioration in respect of the parameter or substance in the quality of the bathing water. The specified test detects polio, coxsackie and echo viruses. No such data have been identified for the local Galway Bay beaches.

²⁴ Bacteria are considered a non-conservative parameter, in that they die-off in the environment. This has been built in to the model, with the time for 90% of the bacteria to die-off (the ‘T90’ time) set to 12 hours.

Shellfisheries

A number of shellfish farms, that are regulated by the Sea Fisheries Division of the Department of Marine under the Live Bivalve Molluscs (Health Conditions for Production and Placing on the Market) Regulations 1996,²⁵ are located in eastern/southern Galway Bay. These farms harvest a mixture of Mussels, Oysters and Clams. Although it is not known which farms are located on naturally occurring beds, guidance from the Department of Marine indicates that farms have been established where naturally occurring beds were found, however it is also prudent to assume that produce has also been introduced to these locations.

The Sea Fisheries Control and Management Division implements EU Directives on the quality of shellfish waters. The Division operates a monitoring programme in all shellfish production areas. The programme allows shellfish from each area to be given a health classification before they are placed on the market. The Live Bivalve Molluscs Regulations 1996 require that certain bacteriological standards must be met for shellfish that are to be used for human consumption. These standards are summarised in **Table 10.12** and the 2005 production area classifications are shown in **Table 10.13**.

Table 10.12 Bacteriological standards for Shellfish Flesh Quality

Classification/Category	Faecal Coliforms per 100g of flesh	<i>E. coli</i> per 100g of flesh
Class A - Sale for direct human consumption permitted	<300	<230
Class B - Consumption after purification for 48 hours in an approved plant	<6,000	<4,600
Class C - Consumption after relaying in clean seawater for 2 months at least prior to sale for human consumption	<60,000	-

²⁵ The European Communities (Live Bivalve Molluscs) (Health Conditions for Production and Placing on the Market) Regulations, 1996 (SI 147:1996) implement Council Directive No. 914/92/EEC laying down the health conditions for the production and placing on the market of live bivalve molluscs.

Table 10.13 Galway Bay Live Bivalve Molluscs (Production Areas) Designations 2005

Bed Name	Species	Previous Classification (as per Table 10.12)	May 2005 Classification (as per Table 10.12)
Mweeloon Bay	Oysters	A	A
	Mussels	A	B
Clarenbridge	Oysters and Mussels	A	B
	Clams	A	A
Kinvara Bay	Oysters and Mussels	B	B
Aughinis	Oysters	A	B
Poul-na-clough Bay	Oysters and Mussels	B	B

Note: Locations in grey are >5km from Mutton Island but have been included for completeness.

It can be seen that no production areas require significant relaying, compatible with class C status. Some beds fell a grade during 2005 although it is not known why this was (e.g. natural influences or otherwise). Most of the beds are at distances much greater than 5km from Mutton Island and will be subject to various influences relating to bacterial quality e.g. the beds at Clarenbridge will be influenced to a much greater degree by the River Clarin than by Mutton Island WWTP. **Figure 11.1** shows the location of the Mweeloon Bay mussel and oyster beds.

As shellfish are filter feeders, filtering relatively large volumes of water daily, there may be a higher concentration of faecal coliform concentrations within the shellfish than the surrounding water. It is difficult to definitively say what faecal coliform concentrations in open water will result in which classification. However, the Department of Marine has adopted the Shellsan Classification System which relates directly to the faecal coliform concentration in the water in which the shellfish live. The system classifies shellfish waters into three categories, as follows:

- Approved – No further purification necessary;
- Conditional – Purification necessary by relaying the shellfish in uncontaminated seawater; and
- Restricted – Pressure cooking essential.

The Shellfish Regulations (Third Schedule, parameter 10) is less rigorous than the Shellsan Classification System where for “Approved”, geometric mean faecal coliform concentrations must be less than 14/100ml and 90% of samples must have <46 faecal coliforms/100ml.

Additional to those waters designated under the Live Bivalve Molluscs Regulations 1996, two locations in Galway Bay are formally classified under the EC Directive on the Quality of Shellfish Waters 79/923/EEC²⁶:

- Clarinbridge/Kinvara Bay; and
- The Bay at Aughinish.

At sites designated under the implementing Regulations²⁷, limits are imposed on several parameters including faecal coliforms. Both of the above sites are greater than 5km from Mutton Island.

A biotoxin programme of sampling (to comply with Council Directive 91/492) is also in operation, but samples are only taken when shellfish are being harvested (in some places such as Clarinbridge this would be continuous and sampled on a weekly basis). The most recent data from the Food Safety Authority of Ireland (www.fsai.ie) shows that both Mweeloon Bay (Oysters) and Killeenaran, Clarinbridge (Mussels) have been open shellfisheries throughout 2005 to date (September 2005) and within prescribed limits for biotoxins.

Suspended Sediments

No data on suspended sediments within Galway Bay have been identified but the Mutton Island discharge complies with the UWWTR discharge standard of 35mg/l Total Suspended Solids (see **Table 10.5**) and the 10 port diffuser will reduce concentrations further by the time the treated effluent reaches the surface. Most of the particulate matter discharged from WWTPs is fine and will not settle immediately in the proximity of a marine discharge due to tidal transport. Any settling at slack water is likely to be minimal once flood or ebb tide velocities increase re-suspending the finer particulates and dispersing them.

It is useful to identify the primary sources of suspended sediment (particulate matter) to inner Galway Bay under the baseline situation to identify the contribution of the current WWTP. These calculations are presented in **Table 10.14**.

Table 10.14 Suspended Sediment Loadings to Inner Galway Bay

Source	Methodology	Loading (tonnes/day)
River Corrib	The loads were derived from 2002 flow-weighted annual mean Suspended Particulate Matter and annual flow (OSPAR Commission, 2004)	15.444

²⁶ 79/923/EEC (as amended) by 91/692/EEC – EC Shellfish Waters Directive

²⁷ Implemented by the Quality of Shellfish Waters Regulations, 1994 (SI 200:1994)

Source	Methodology	Loading (tonnes/day)
Mutton Island WWTP	91,600 p.e. using 200 litres/day at 35mg/l	0.802

Comparing the contributions from the River Corrib and the WWTP, the two sources input 95.1% and 4.9% of the suspended sediment loading to the bay respectively. This highlights that the River Corrib is the dominant source of suspended sediment into Galway Bay over a year, although there will be some seasonal variation.

There are no standards for suspended sediment in marine waters generally, but to set the discharge in context under the EC Freshwater Fishery Directive (78/659/EEC), there is a 20mg/l suspended sediment standard for the protection of migratory fish.

Compliance with the UWWTR limit of 35mg/l suspended sediment ensures that, after initial dilution (which the existing 95-percentile has been calculated as 30:1), the concentrations in Galway Bay are reduced to significantly lower levels than 20mg/l. It is considered that the dominating influence of the River Corrib will affect the local sediment loading regime and that any effect from the Mutton Island WWTP will be localised to a small area around the discharge point.

Trophic Status and Nutrients

The issue of eutrophication has come to prominence in the last 10 or so years within the European Union and is considered one of the greatest pressures facing the water environment in general. There are various definitions of eutrophication (including those from the EU Urban Wastewater Treatment Directive and EU Nitrates Directive) but in general, a water body may be considered eutrophic if it exhibits three distinct characteristics (EPA, 2001):

- enrichment by the stated nutrients;
- accelerated growth of algae and higher forms of plants; and
- ‘undesirable disturbance’ to the balance of organisms present and to the quality of the water concerned.

The EPA has undertaken an assessment of the trophic status of key tidal waters bodies in Ireland which receive nutrient inputs either directly or via rivers (EPA, 2001). This assessment was based on survey data collected from 1995 until 1999 and a set of quantitative criteria developed for comparison purposes relating to the three characteristics of eutrophication shown above:

- exceedance of criteria for either molybdate reactive phosphate (MRP) or dissolved inorganic nitrogen (DIN);
- exceedance of criteria for chlorophyll *a*; and
- exceedance of criteria for dissolved oxygen.

Table 10.15 shows the results from the two coastal waters sites assessed for Galway Bay and the Corrib Estuary. It should be noted that the data were collected prior to the current Mutton Island WWTP being on-line and thus do not represent the current baseline situation.

This review concluded that Galway Bay was **neither eutrophic nor potentially eutrophic**.

Additionally, Galway Bay is not currently designated as sensitive under the Urban Wastewater Treatment Regulations²⁸ (UWWTR) and is classified as a “non problem area” in relation to eutrophication (OSPAR Report 2003).

Since these data were collected, inputs of crude sewage to the River Corrib and along the coast in/near Galway City will have ceased and thus their influence on the area reduced (due to a reduction in near shore nutrient loading and removal of discharge to a location which receives considerably greater dilution and dispersion). The reaction of local, coastal waters to this change (in terms of trophic status) has not been enumerated but is considered that the data presented in **Table 10.15** present a worst case baseline condition.

Table 10.15 Eutrophication water quality parameters summary

Parameter	Period	Corrib Estuary	Inner Galway Bay
Salinity (psu)	Winter	14.7	30.8
	Summer	28.6	31.1
Dissolved Inorganic Nitrogen (DIN) (mg/l N)	Winter Limit	1.562	0.519
	Winter Actual	0.701	0.187
	Summer Limit	0.659	0.499
	Summer Actual	0.044	0.018
(MRP) (µg/l P)	Winter Limit	60	44.4
	Winter Actual	27	24
	Summer Limit	47.4	43.9
	Summer Actual	8	8
Chlorophyll a (mg/m ³)	Summer: median limit	11.78	11.07
	Summer Actual	5.4	4.7
	Summer: 90-percentile limit	23.38	22.15
	Summer Actual	10.0	10.3

²⁸ Which implement Directive 91/271/EEC

Parameter	Period	Corrib Estuary	Inner Galway Bay
Dissolved Oxygen (% saturation)	Summer: 5-percentile limit	76.46	77.85
	Summer Actual	89	120
	Summer: 95-percentile limit	123.0	122.15
	Summer Actual	86	116

Source: EPA (2001)

Note: The limits have been interpolated from information contained in the EPA report.

Within a marine environment (i.e. with no, or limited, freshwater influence) it is generally accepted that nitrogen is the bio-limiting nutrient (MacGarvin, 1995). Within freshwaters, phosphorus is usually the limiting nutrient, with transitional waters falling somewhere in between. The salinities presented in **Table 10.8** show that inner Galway Bay is approximately 89% full seawater (if full seawater is assumed to be 35 practical salinity units [psu]). Nitrogen, (measured as dissolved inorganic nitrogen²⁹ (DIN)) is very likely to be the limiting nutrient in these conditions.

As for the suspended sediment baseline previously described, it is useful to identify the primary sources of nitrogen to inner Galway Bay under the baseline situation to identify the contribution of the current WWTP. These calculations are presented in **Table 10.16** assuming dry weather loads from the WWTP.

Table 10.16 Nitrogen Loadings to Inner Galway Bay

Source	Methodology	Loading (tonnes N/day)
River Corrib	The loads were derived from 2002 flow-weighted annual mean concentrations and annual flow (OSPAR Commission, 2004)	3.456
Mutton Island WWTP	Population equivalent of 90,000 contributing 9.0 g person/day (reduced by 54.4% due to secondary treatment) as per the methodology set out in Marine Direct Impacts Risk Assessment (Methodology Applied to Ireland's River Basin Districts) Second Draft	0.37

²⁹ DIN is the sum of the concentrations of nitrate, nitrite and ammonia and is considered the most relevant form of nitrogen to monitor in coastal waters in relation to nutrient enrichment, as nitrate and ammonia are both important as nutrient sources for algae.

Comparing the contributions from the River Corrib and the WWTP, the two sources input 90.3 % and 9.77% of the nitrogen to the bay respectively. This highlights that the River Corrib is the dominant source of nitrogen into Galway Bay over a year.

Figure 10.4a shows the modelling results of a discharge from the River Corrib (under mean flow conditions) on total nitrogen concentrations within Galway Bay.

Water Framework Directive

December 2000 saw the introduction of one of the most significant pieces of water-related legislation in Europe to date: The Water Framework Directive (WFD) (2000/60/EC).

The WFD is the first Directive that fully embraces certain key environmental management principles. Firstly, it adopts a holistic approach; covering ALL waters - rivers, lakes, transitional waters (estuaries), coastal waters and groundwater as well as their dependant wetlands. Secondly, it recognises that water systems do not stop at administrative boundaries, such as county boundaries, requiring waters to be managed at a catchment or River Basin District (RBD) level.

The targets set in the WFD are ambitious. By 2015 all waters should have ‘good status’ and deterioration in existing water quality status is not acceptable.

The main aims of the WFD are to:

- protect/enhance all surface and ground waters;
- achieve ‘good status’ for all waters by December 2015;
- manage water bodies based on river basins (catchments);
- use a ‘combined approach’ of emission limit values and quality standards;
- involve the public; and
- streamline legislation.

Ireland completed the first step in implementing the WFD in December 2003 by making the European Commission (Water Policy) Regulations, (S.I. No. 722 of 2003) which transposed the WFD into Irish Law. Eight River Basin Districts (RBD) have been identified within the island of Ireland with Galway and its environs situated in the Western River Basin District.

The WFD schedule, indicates that one of the Directive’s first major deliverables is a Summary Characterisation Report (Article 5) for each River Basin District in European Union Member States jurisdictions. This requires:

- an analysis of River Basin District characteristics,

- a review of the impact of human activity on the status of surface waters and on groundwater, and
- an economic analysis of water use.

The Article 5 analysis for the Western RBD was completed in December 2004 by the Western River Basin District Project. The Results for the various RBDs was compiled into a national report. This Report, entitled “*The characterisation and analysis of Ireland’s river basin districts in accordance with Section 7(2 & 3) of the European Communities (Water Policy) Regulations 2003 (SI 722 of 2003)*”, was completed in May, 2005.

The characterisation process highlights the following:

- the Galway outfall is located in a transitional water body named Corrib Estuary which is characterised as mesotidal and sheltered;
- the risk assessment of human activities identifies that the Corrib Estuary’s overall risk condition is “at risk”, i.e. it is unlikely that this water body will achieve its WFD objective of good status by the year 2015 unless action is taken to manage the water body;
- the pressures which have resulted in this “at risk” description are morphological (i.e. man-made physical alterations) due to shipping activities and intensive land use;
- in terms of pollution pressures (point and diffuse) the water body is identified as “probably not at risk” – the point source assessment considers the discharge from the existing WWTP; and
- the “probably not at risk” description results from assessment of the existing plant discharge sampling data in accordance with the UWWTD standards and indicates that treated effluent complies with quality standards.

The WFD is an umbrella directive in that it incorporates the requirements of some other earlier pieces of European legislation. The Urban Waster-water Treatment Directive (91/271/EEC) will continue to remain in force in parallel with the WFD. The compliance with the emission control standards set by the UWWTD is identified within the WFD as one of the “basic measures” to be included in the river basin management process. Consequently it remains valid to assess the effluent standards in relation to the UWWTD.

In 2006, the WFD will introduce new classification schemes to describe the status of water bodies. The classification schemes will include biological indicators not currently routinely monitored in Ireland which will result in additional future monitoring requirements and may necessitate more stringent management measures. For transitional waters, the WFD status biological elements will include phytoplankton,

macroalgae (e.g. seaweeds), angiosperms (e.g. sea grasses), benthic invertebrate fauna and fish fauna.

10.1.5 Predicted Trends

The main changes to the water quality of Galway Bay may well stem from increased human populations in Galway City and its immediate hinterland. Without adequate wastewater treatment provision, unsatisfactorily treated effluent will reach Galway Bay. This would result in degradation of local water quality and potential breach of water quality standards if sufficient treatment capacity is not available. Accordingly, it is proposed to develop a new Galway East WWTP in the Galway County Council area, in the context of a strategic overview of Galway Main Drainage.

10.1.6 Information Gaps

Several small gaps in baseline data have been identified (i.e. no suspended sediment data for Galway Bay or data on toxic substances) but these are not critical to the assessments undertaken in **Section 10.3**.

10.2 Potential Effects and Incorporated Mitigation

10.2.1 Potential Effects During Construction and Incorporated Mitigation

The Scoping Report (TOBIN, O'Dwyer and Entec, 2004) has identified that no assessment of the construction phase will be progressed in relation to water quality (see **Table 4.1**). Although construction can lead to accidental releases of fuels/oils and soils/sediments to Galway Bay the limited construction being undertaken, entirely within a previously developed site, reduces the risk to a level where no likely significant effects will result.

The construction phase of the development is contained entirely within the existing WWTP site, although access to the site by construction and delivery vehicles will take place across the adjoining causeway.

Potential sources of construction phase pollution include:

- excavations, exposed ground and stockpiles (especially pumping of water from excavations);
- plant and wheel washing; and
- spillages of oils, fuels, cement and concrete from site operations.

There is a general prohibition on entry of polluting matter to waters³⁰ under the Local Government (Water Pollution) Act 1977 (as amended). The entry of any of these pollutants to a water body during construction has the potential to result in significant

³⁰ 'waters' include, 'any tidal waters'.

effects on the water quality in the immediate vicinity, and if spill volumes are large at a significant distance from the site e.g. if fuels/oils enter coastal waters.

However, the area for construction is contained within the existing WWTP site. The surface water run-off from paved areas on Mutton Island goes into gullies that drain to individual high level surface water outfalls in the rock armour. There are tideflex valves on the outfalls and they are located intermittently between 15 and 25m around the perimeter of the works. This well contained environment allows for good control of any spillages which can easily be contained within this impermeable site and diverted to treatment tanks, if appropriate (e.g. for turbid water collected in excavations).

A range of site practices will be established to reduce the potential for pollution to reach Galway Bay to the lowest practicable level, including:

- any stockpiled material will be kept to a minimum and nearby drains will be temporarily isolated to remove pollutant pathways. Any turbid water will be collected and treated at the WWTP;
- refuelling and maintenance of equipment will be carried out within contained areas (e.g. on hardstanding) with nearby drains temporarily isolated and oil spill prevention kits available (with staff trained in their use); and
- any areas where cement or concrete use is being undertaken will have nearby drains identified and temporarily isolated to remove pollutant pathways.

Following best practice construction guidelines on this well contained site will ensure that no significant effects are likely during the construction phase.

10.2.2 Predicted Effects During Operation and Incorporated Mitigation

Sewage has a number of potential effects in receiving waters:

- nutrient enrichment leading to eutrophication;
- organic loading leading to oxygen depletion;
- bacterial loading leading to potential effects on users such as bathers and consumers of shellfish;
- toxic effects on aquatic biota, the most notable of which in sewage is that from high ammonia concentrations; and
- sediment loading leading to effects on ecology due to reduction in light penetration and (if excessive) abrasion and smothering.

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 identified uses within it (e.g. bathing waters and shellfish waters).

Urban Wastewater Treatment Regulations

The Urban Wastewater Treatment Regulations (UWWTR) implement Directive 91/271/EEC and govern the planning and design of all sewage infrastructure. The treated effluent discharged from Mutton Island WWTP must be compliant with the UWWTR, and the effluent concentrations in **Table 10.5** therefore continue to apply.

The UWWTR classifies several areas as sensitive to eutrophication and requires nutrient removal for those areas. As identified under the ‘eutrophication’ baseline description in **Section 10.1.4**, Galway Bay is not currently designated as sensitive and therefore the effluent concentrations in **Table 10.5** apply. However, Galway Bay may, at a future time, be designated as sensitive. Nevertheless the parameters listed in **Table 10.17** could additionally apply. Given that the treated effluent is discharged to the marine environment, it is likely that only the nitrogen limit would apply.

Table 10.17 UWWTR effluent nutrient concentrations (Second Schedule, Part 2, S.I. 254/2001) if Galway Bay Designated as Sensitive

Parameter	Concentration (mg/l) (annual mean)	Minimum % reduction ¹
Total nitrogen	10	70-80
Total phosphorus	1	80

Adherence to the UWWTR standards is seen as the main mitigation measure for the operational phase.

Avoidance / Reduction

Table 10.18 summarises the incorporated mitigation measures.

Table 10.18 Avoidance/reduction measures – likely effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Waters of Galway Bay	Increase in polluting matter discharged to receiving waters with subsequent deterioration of water quality.	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		
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

No compensation has been identified or is relevant.

10.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 10.19**

Table 10.19 Implementation of incorporated mitigation and enhancement measures

Description of measures including any monitoring requirement	Responsibility for implementation	Implementation mechanism
Construction		
A range of best practice mitigation measures will be employed to reduce the likelihood of pollution reaching Galway Bay.	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

10.3 Assessment of Effects

10.3.1 Scope and Methodology

Construction

As identified in **Table 4.1** no assessment has been carried out in relation to construction effects on the water environment. However, **Section 10.2** identifies that the current WWTP site (which is well contained), along with the proposed construction scale will not result in significant, adverse effects on water quality in Galway Bay (or elsewhere).

Operation

Operational effects comprise those associated with the treated effluent discharge from the upgraded works. Following the adoption of the UWWTR standards (presented in **Table 10.5**) the discharge from the site has the potential to cause degradation of water quality in Galway Bay and this has been assessed.

Within the bay there are many designations in place to protect water quality for a variety of users and reasons, and these are set out in **Section 10.1** (in the baseline case). A two-dimensional hydraulic dispersion model has been used to predict the effect of the increased discharges to Galway Bay (specifically the identified receptors and their associated water quality standards) under a variety of conditions, in particular to identify the extent and scale of the plume's influence and its potential to cause breaches of identified standards. A more complete description of the modelling is contained in **Appendix E**.

10.3.2 Significance evaluation methodology

The following significance descriptors are used in this section of the ES:

- Major – effects of the development which cause breaches of statutory EU or national water quality standards; or which provide the basis for undesirable disturbance of associated marine ecosystems (e.g. with respect to eutrophication); or are important on a scale greater than local (in this context 'local' is defined as Galway Bay) that cannot be mitigated;
- Minor – effects of the development which cause breaches of guideline EU or national water quality standards that cannot be mitigated; and
- Non-Significant: effects that cause changes to water quality in a localised area which are perceptible but do not breach any mandatory or guideline standards; or any effects which are below normal levels of detection.

The following terms are used to identify the time scale of effects

- Short term - < 12 months
- Medium term – 1-5 years

- Long term - > 5 years

10.3.3 Predicted effects and their significance

Construction

No significant effects have been identified.

Operation

As stated in **Section 3.3**, effluent will be secondary treated to a standard designed to comply with the UWWTR and protect the receiving water environment (associated users and ecology). Assessment of the residual effects of the discharge have been made using the modelling process outlined in **Appendix E**. As for the future situation, modelling has assumed 3DWF through full treatment at the WWTP, a maximum concentration of 25mg/l BOD₅ allowed under the UWWTR and an effluent concentration of 25mg/l (as N) for ammonia. This represents a realistic worst-case situation and has been used as the basis for this assessment. Realistically, the flows will not reach 3DWF very often and the quality of the treated effluent will be better than the licenced limits. These factors will combine so that the effect of the discharge will be much reduced from that outlined here on a more normal, daily basis.

Predicted initial dilutions achieved by the WWTP (under future 3DWF flow conditions) over the tidal range experienced at the outfall location indicate that under near worst case conditions (95 percentile) a dilution of 18:1 will be achieved, with an initial dilution of >32:1 achieved for 50% of the time. A maximum dilution of 136:1 has been calculated under a spring tide scenario.

An initial discussion is presented in relation to the movement of the plume followed by a discussion of the effects broken down by component.

The results of the modelling are generally presented as ‘maximum concentration plots’ for a whole tidal cycle. It should be noted that this does not therefore represent the situation for any one point in time but represents the worst case concentration of the substance being modelled over a whole semi-diurnal tide. This representation allows determination of the influence of the whole plume without resorting to assessment of individual scenarios for differing times during the tidal cycle. If an issue arises, as evidenced by the maximum concentration plot, further assessment can be made.

Biochemical Oxygen Demand (BOD₅) and Dissolved Oxygen

Figure 10.2b presents the maximum concentration plot for BOD based on a predicted discharge from 170,000 p.e. under 3 times the dry weather conditions (3DWF) (over a whole tidal cycle). This result is directly comparable to the baseline (current) scenario shown in **Figure 10.2a**.

It can be seen that although the influence of the discharge increases BOD concentrations in the area under the influence of the discharge, concentrations still remain below 1mg/l

(as O) except in the surface boil itself under near worst case (95-percentile) predicted initial dilutions with flows of 3DWF³¹. Under the best operating and environmental conditions these levels of BOD are significantly below both of the BOD standards highlighted in **Table 10.7** and it can therefore be considered unlikely that the discharge will significantly alter the dissolved oxygen in the area immediately outside of the initial dilution mixing zone. No significant effects are therefore predicted on dissolved oxygen levels in Galway Bay above the baseline scenario (i.e. considering the current discharge).

Ammonia

Figure 10.3b presents the maximum concentration plot for total ammonia based on a predicted discharge from 170,000 p.e. under dry weather conditions (over a whole tidal cycle). This result is directly comparable to the baseline (current) scenario shown in **Figure 10.3a**.

It can be seen that higher total ammonia concentrations arise in Galway Bay as a result of the upgrade compared to the current situation. This is a result of a higher ammonia loading, which is a function of a higher p.e. load and the decision to increase throughput of the WWTP by changing the treatment from a nitrifying to non-nitrifying plant (see **Section 3.3.1**).

In terms of environmental effect, a number of standards are set out in **Table 10.9**. It is considered that those recently identified by the UK's Environment Agency (UK Environment Agency, 2005) to assist in assessment of discharges in relation to the EU Habitats Directive (92/43/EEC) are the most useful. These standards are shown below:

- total ammonia annual average concentration of 1.1 mg/l (as N);
- total ammonia maximum concentration of 8.0 mg/l (as N); and
- un-ionised ammonia annual average concentration of 21 µg/l (as N).

If it is assumed that the maximum concentration plot presented in **Figure 10.3b** represents annual average conditions³², then no significant effects are identified with respect to the total ammonia standards. Concentrations approaching 8.0mg/l (as N) will only be present in, or very close to, the surface boil and the 1.1mg/l (as N) annual average concentration is present over a very small area surrounding the surface boil. Indeed, concentrations of total ammonia decrease rapidly away from the discharge point so that at the entrance to the Corrib Estuary (at Nimmo's Pier) levels are below 10% of the annual average standard (i.e. <0.11mg/l (as N)).

³¹ The UWWR standard of 25mg/l diluted by 18 parts of water from Galway Bay results in a surface concentration of 1.31 mg/l BOD. Under the best dilutions available 25mg/l diluted by 136 parts of water from Galway Bay results in a surface concentration of 0.18 mg/l BOD.

³² This represents a worst case assessment as the plot represents maximum concentrations not averages.

The residual total ammonia concentrations can be considered therefore not to breach the chosen criteria away from the surface boil of the discharge and no significant effects have therefore been identified.

With respect to the un-ionised ammonia standard of 21 µg/l (as N), by averaging out the winter and summer proportions the average un-ionised ammonia proportion is 6.22% of the total. Using these data, the 21 µg/l (as N) un-ionised ammonia standard equates to a total ammonia concentration of 0.337 mg/l (as N) for an annually averaged scenario.

Figure 10.3b shows that this concentration is exceeded for a very small area around the discharge's surface boil and therefore no extensive breaches of the standard have been identified. No significant effects are therefore predicted in relation to un-ionised ammonia within Galway bay as a result of the discharge.

Other toxic contaminants

It is important that input of persistent toxic contaminants to the WWTP are minimised, as some compounds/chemicals can have a deleterious effect on the effectiveness of the biological secondary treatment stage, as well as causing potential ecological damage in the receiving environment. The dilutions of very small concentrations of substances within the treatment processes will reduce residual concentrations even further. There is no evidence that the treated effluent from the WWTP is likely to contain elevated levels of any particular toxic and persistent substances, so this aspect has not been considered further.

Bacterial levels in relation to Bathing Waters

A 'maximum concentration envelope' of faecal coliforms over a complete tidal cycle has been produced (**Figure 10.5**) with the individually modelled scenarios presented in **Appendix G**.

The standards for assessment are set out in **Table 10.11** and show that the most stringent mandatory standard for faecal coliforms is the 1,000/100ml National Bathing Water standard (to be confirmed by 95% of samples and not exceeded by any two consecutive samples). **Figure 10.5** shows that maximum faecal coliform concentrations soon reduce to below this level due to secondary dilution and dispersion. The area where maximum concentrations exceed this level extends in a north-easterly direction (on a flood tide) less than 1 km from the discharge point and to the west (on an ebb tide) for approximately 1 km, with no portion of coastline on the mainland affected.

A guideline concentration under the EU bathing waters directive of 100/100ml exists (to be confirmed by 80% of samples and not exceeded by any two consecutive samples). This standard also applies to Blue Flag beaches but as a mandatory standard. **Figure 10.5** shows that this value can be exceeded (as a maximum) along a small portion of the coastline to the north of Mutton Island (to the east and west of the causeway). This area includes Grattan Beach which is designated as a National Bathing Water. With reference to the scenarios shown in **Appendix G**, it can be seen that it is only when a strong (Force 6) southerly or south-easterly wind prevails that concentrations of faecal coliforms increase at Grattan Beach as a result of the discharge. It is considered highly

unlikely that anyone would actually be bathing at this location under these high wind conditions.

To determine the effect of the discharge on the Grattan Beach bathing water further, a probability assessment of the 100/100ml faecal coliform standard being breached has been undertaken. The frequency of wind strength and direction combinations was determined using data from Belmullet and this was then multiplied with the number of hours that the standard would be breached per tidal-cycle under the differing conditions. This was then converted into compliance as a proportion of a year. The results of this assessment are presented in **Table 10.20**

Table 10.20 Probability of faecal coliforms exceeding 100/100ml at Grattan Beach

Wind Condition	% Occurrence	Time 100/100ml exceeded during one tidal cycle (h)				
		Spring	Neap	Average	% of Tidal Cycle	% of Year
Calm	32.03	0.00	0.00	0.00	0.00	0.00
F3 East	4.59	0.00	0.00	0.00	0.00	0.00
F6 East	0.75	0.00	0.00	0.00	0.00	0.00
F3 South East	5.24	0.00	0.00	0.00	0.00	0.00
F6 South East	1.63	3.75	3.50	3.63	29.39	0.48
F3 South	6.66	0.00	0.00	0.00	0.00	0.00
F6 South	6.33	3.75	3.00	3.38	27.36	1.73
F3 South West	9.51	0.00	0.00	0.00	0.00	0.00
F6 South West	8.76	0.00	0.00	0.00	0.00	0.00
F3 West	9.50	0.00	0.00	0.00	0.00	0.00
F3 West	5.77	0.00	0.00	0.00	0.00	0.00
F3 North West	6.63	0.00	0.00	0.00	0.00	0.00
F6 North West	2.60	0.00	0.00	0.00	0.00	0.00
Percent of time 100/100ml exceeded in a typical year						2.21
Compliance during a typical year						97.79

It can be seen that in a typical year compliance with the 100/100ml faecal coliform standard is 97.79%. This exceeds the requirement for the standard to be complied with, of 80% of the time, by a large margin.

Although there will be other influences on bacterial concentrations at the Grattan bathing water it can be seen that the proposed Mutton Island discharge will meet the

requirements of the mandatory and guideline / Blue Flag standards. Overall, compliance with all guideline and mandatory standards is expected following upgrading of the WWTP.

Viruses

No information on sewage related viruses in Galway Bay has been identified, either for the enteroviruses typically measured in relation to the Bathing Water Directive or for norovirus, the most common cause of gastric upsets after sea bathing. However, the high level of compliance predicted with the most stringent bacterial standards suggests that risks of elevated levels of any sewage derived viruses at the bathing waters will be very low.

Bacterial levels in relation to Shellfish Waters

It is considered that the oyster and mussel beds at Mweeloon Bay are the most sensitive shellfish bed receptors in relation to treated effluent discharged from Mutton Island due to their proximity to the discharge compared to other beds which are located in the side embayments of Galway Bay which are probably influenced by other, local sources of contamination.

A 'maximum concentration envelope' of faecal coliforms over a complete tidal cycle using contours based on the Shellsan Classification System has been produced (**Figure 10.6**). It can be seen that in Mweeloon Bay (the most sensitive shellfish water in relation to Mutton Island WWTP) the maximum predicted faecal coliform concentrations are well below the allowable 99-percentile level of 46/100ml and also below the allowable geometric mean of 14/100ml. Therefore the predicted influence of the future 170,000 p.e. treated discharge is deemed not to significantly affect shellfish concerns in Mweeloon Bay, or indeed any other designated area within Galway Bay.

Suspended sediments

Table 10.14 shows that, under the baseline case, the current Mutton Island WWTP contributes 0.802 tonnes/day of suspended sediment to Galway Bay (4.9% of the combined loading with the River Corrib). Undertaking the same calculations for the proposed WWTP up to its design maximum of 170,000 p.e. increases the loading to 1.488 tonnes/suspended sediment day. This equates to 8.8% of the combined loading with the River Corrib. Overall the total loading of suspended sediment from these two sources will increase by 4.2% over the current baseline situation. Other inputs will occur but no data is available on these and they are likely to be small in comparison.

As the discharge will be limited to the UWWTR standard of 35mg/l, residual suspended sediment contributions at the surface will be <2mg/l above background levels (under 3DWF 95-percentile initial dilution conditions) and this level will rapidly reduce due to secondary dilution and dispersion. This is a low level compared with the 20mg/l EC Freshwater Fish Directive Standard used as a guideline for assessing impacts. Additionally, the dominant Corrib loading and natural background (marine sourced) concentrations within Galway Bay will mean that no significant effects in relation to suspended sediment are likely from the upgrading of the WWTP.

Trophic status and nutrients

Figure 10.4b shows the modelling results of the combined discharge from the River Corrib and the proposed Mutton Island WWTP on total nitrogen concentrations within Galway Bay. In comparison with the River Corrib's contribution alone (**Figure 10.4a**), which is not quite the baseline case, it can be seen that only a very slight increase in the spatial area of Galway Bay affected is apparent due to the proposed upgrade of the WWTP, specifically the area to the west of Mutton Island.

Table 10.16 identifies that under the baseline case the current Mutton Island WWTP contributes 0.37 tonnes/Nitrogen day to Galway Bay (9.77% of the combined loading with the River Corrib). Undertaking the same calculations for the proposed WWTP up to its design maximum of 170,000 p.e. increases the loading to 0.70 tonnes/nitrogen day. This equates to 16.8% of the combined loading with the River Corrib. Overall the total loading of nitrogen from these two sources will increase by 8.6% over the current baseline situation. Other inputs will occur but no data is available on these and they are likely to be small in comparison.

Table 10.15 shows that the water quality indicators for eutrophication are, at present, easily complied with in inner Galway Bay (and the Corrib Estuary) even considering the large loading of nitrogen from the river. If the dissolved inorganic nitrogen (DIN) were to increase by 8.6% from those presented in **Table 10.15** in inner Galway Bay, due to the Mutton Island WWTP upgrade then the winter concentration would rise to 0.203 mg/l N (the winter limit is 0.519mg/l N) and the summer concentration would rise to 0.020 mg/l N (the summer limit is 0.499mg/l N). Neither the winter nor summer limit would be breached, or even approached, and it is considered highly unlikely that the trophic status of inner Galway Bay will change.

No significant effects are therefore predicted in relation to changes in nutrient concentrations and the trophic status of Galway Bay.

Water Framework Directive

The proposed upgrade at Mutton Island has the capacity to change the risk of the Corrib Estuary transitional water achieving its good status by the year 2015. The assessment criterion with respect to point source pollution pressures is compliance with emission control standards set by the Urban Waster-water Treatment Directive (91/271/EEC). As identified in **Section 10.2.2** the Urban Wastewater Treatment Regulations (UWWTR), which implement the Directive in Ireland, will be complied with and as such the risk of failing the WFD remains at the current level with respect to point source pollution i.e. "probably not at risk". No significant change is therefore predicted in the potential to conform with the requirements of the Directive.

10.3.4 Cumulative Effects

With regard to cumulative effects, the only significant factor identified is the contribution of dominant loads of nitrogen and suspended sediment from the River Corrib. Modelling studies have identified the cumulative effect on nitrogen

concentrations and assessment shows that in relation to suspended sediments the Corrib inflow to the Bay will dominate.

Local bathing waters will be influenced by bacterial concentrations other than those from the Mutton Island WWTP but modelling has shown that only under highly limited wind and tide conditions will the Mutton Island WWTP affect any identified bathing water (i.e. Grattan). The large margin of compliance with the guideline faecal coliform standard predicted identifies that the influence of the Mutton Island discharge is not significant in terms of causing guideline level breaches in a typical year.

In relation to bacterial concentrations at designated shellfish waters, other inputs from local watercourses around Galway Bay are likely to have a greater affect on bacterial concentrations in shellfish waters than the Mutton Island discharge.

10.3.5 Compensation

No compensation has been identified.

10.3.6 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

10.3.7 Summary of significance evaluation

Table 10.21 Effects on water quality and evaluation of significance

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Construction						
Exceedance of water quality standard caused by a pollution event from construction operations	-	Unlikely	Local	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						
Increase in organic pollution leading to increased BOD and reduced dissolved oxygen in Galway Bay causing failure to comply with identified standards	-	Unlikely	Local	Minor	Not Significant	Water quality modelling has shown that the influence of the proposed discharge is small and that the identified BOD standard will not be breached apart from in the discharge boil itself. No associated significant effects on dissolved

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Significance Rationale
						oxygen are therefore likely.
Increase in ammonia leading to increased ammonia in Galway Bay and exceedance of identified standards	-	Unlikely	Local	Minor	Not Significant	Water quality modelling has shown that the influence of the proposed discharge is small and that the identified ammonia standards (total and unionised) will not be breached apart from in a small area surrounding the discharge location.
Increase in toxic contamination within Galway Bay and exceedance of identified standards	-	Unlikely	Local	Minor	Not Significant	Toxic contaminants are restricted at entry to the sewerage system under a strict licensing regime
Increase in bacterial loading leading to breaches of bathing water standards at identified locations within Galway Bay	-	Unlikely	International	Minor	Not Significant	Water quality modelling has shown that no identified bathing water will have the mandatory or guideline / Blue Flag faecal coliform standard breached at any time as a result of the proposals.
Increase in bacterial loading leading to a fall in shellfish standards at identified locations within Galway Bay	-	Unlikely	International	Minor	Not Significant	The contribution of Mutton Island WWTP to faecal coliform concentrations in designated shellfish waters is predicted to be very small and is unlikely to cause deterioration in current standards.
Increase in suspended sediment loading leading to detrimental suspended sediment concentrations in Galway Bay	-	Unlikely	Local	Minor	Not Significant	Compliance with the UWWTR standard and the high initial dilutions from the outfall will ensure no issues arise. The Corrib provides the dominant, local loading of sediment.
Increase in the loading of nutrients to Galway Bay causing an unacceptable change to its trophic status.	-	Unlikely	International	Minor	Not Significant	The River Corrib provides the dominant nitrogen loading to Galway Bay and assessment of the predicted DIN levels show easy compliance with identified eutrophication limits. The increased load is

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
						unlikely to cause a change of trophic status.
No-compliance with the Water Framework Directive due to point source pollution effects.	-	Unlikely	International	Minor	Not Significant	The WWTP will conform to the UWWTR standards and as such it has been identified that the WFD's target of 'good status' is probably not at risk from this point source pollution.
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			

10.4 References

Environment Agency, 2005, *Ammonia Standards in Estuaries* (a paper for the Habitats Directive Technical Advisory Group on Water Quality).

Environmental Protection Agency, July 1997, *Hydrological Data*.

Environmental Protection Agency, 2001, *An assessment of the Trophic Status of Estuaries and Bays in Ireland*

MacGarvin, M., 1995, *Marine Eutrophication in the UK: A Discussion Document* – Report for the WWF.

Ospar Commission, 2004, *Data report on the Comprehensive Study of Riverine Inputs and Direct Discharges 2002*.

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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.

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 Conservation (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 eu littoral 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 pidcock 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 Finavarra, 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	<i>Lagenorhynchus</i> 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	
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°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.

- *Lagenorhynchus* 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 understory 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.

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, *Lithothamnium 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 Plate 19. 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 groyne 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 groyne 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 furoid (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- (<i>Phoca vitulina</i>)	Nearest haul out sites 3 – 3.5km from outfall
Bottlenose dolphin (<i>Tursiops truncatus</i>)	Frequently recorded in Galway Bay
Harbour porpoise (<i>Phocoena phocoena</i>),	Present in Galway Bay
Other species:	
Grey seal (<i>Halichoerus grypus</i>)	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:	Biотopes recorded typical of region. Maerl (IGS.Lgla) and <i>Sabellaria alveolata</i> (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.BLit	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
<i>The following mitigation should also be noted to protect water quality in general:</i>		
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 and 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			

11.4 References

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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 Area³³ (SPA) and a Ramsar site³⁴ 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 2002/03³⁵. 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*.

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	MA 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	

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Appendices

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