7. AIR QUALITY.

7.1 ODOUR.

7.1.1 Introduction.

Two types of odour are usually associated with sewerage treatment works. The most common are biogenic odours which are produced by the decomposition of organic matter in the absence of oxygen and typified by hydrogen sulphide (H_2S), ammonia, amines, thiols (mercaptans) and volatile fatty acids. Non-biogenic odours arise directly from the discharge of odorous trade wastes, frequently dominated by industrial solvents.

The dominant odour from sewerage systems and waste water treatment processes, and a good indicator of the presence of biogenic odours, is commonly H_2S. It is generally present when biogenic odours are detectable even when the smell would not be described as attributable to H_2S. Its prevalence at this site is demonstrated by the results of the ambient odour monitoring (see following section on Ambient Odours) which emphasise the importance of H_2S as an odour indicator.

Hydrogen sulphide has an extremely low odour detection threshold (commonly 5 parts per billion (ppb)) below which the human nose cannot detect its presence, although this also depends on an individual's sensitivity. The World Health Organisation (WHO, Air Quality Guidelines for Europe) gives a nuisance threshold value of 3.5 ppb as an hourly average concentration, i.e. no nuisance will be experienced providing the average concentration of H_2S does not exceed 3.5 ppb. A variety of other naturally occurring gases can be produced, in exceedingly low concentrations, from the biological processes at a STW, however, H_2S is commonly used as an indicator of odour intensity as it is relatively easy to measure and predict.

An odour emission will be dispersed and diluted by horizontal and vertical mixing in the atmosphere. The degree of horizontal mixing is determined by the wind speed and the degree of vertical mixing depends on the atmospheric stability. Therefore, worst case conditions for dispersion are low wind speeds and high atmospheric stability. The frequency of such conditions and their effect on odour dispersion are discussed later under Meteorological Data.

7.1.2 Ambient Odours.

A baseline odour survey has been carried out in the vicinity of the existing works and at representative sensitive receiver locations in the surrounding communities. The full results of the survey were reported in 'Ringsend STW Expansions - EIS, Baseline Odour Study', August 1995. This is contained in Volume 2 Appendix E. In summary, the survey and the resultant ambient odour concentrations from the existing works can be described as follows.

Prior to and during the survey period the potential for odour production and release was considered to be at its highest due to the prevailing dry and warm weather conditions. There are no other industries in close proximity to the STW likely to generate similar odours, though the disused works adjacent to the site was found to be a significant source of odour release due to its state of disrepair.

Measurements of hydrogen sulphide, mercaptans and ammonia were undertaken on the site, at the site boundary and at a grid of receiver positions covering the local development areas. Ammonia and mercaptans were never detected at any point on the site boundary during the survey, therefore, it is evident that the off-site effect of the existing works is largely limited to odours of H_2S.

The odour levels produced on the STW site are dependent on the operations being performed on site which, in turn, affect the odour levels detected off-site. The sludge operations are responsible for the highest releases of odour and, on one occasion during the survey, odour was detected approximately one kilometre from the site. In the past, complaints of odour have been made by residents of Pigeon House in Pigeon House Road.

The highest H_2S level measured at the site boundary was 110 ppb (equivalent to 0.110 parts per million (ppm) as documented in the baseline report). Clearly, this level is significantly higher than the normal detection threshold of 5 ppb and explains the occasional presence of odours in the vicinity of Ringsend STW and at other locations under adverse weather conditions.

The highest concentration measured at Pigeon House during the survey was a level of 42 ppb which coincided with the filling of the consolidation tanks with primary sludge. At a location approximately 650m from the STW, H_2S levels of 10 ppb were recorded,

whilst at the junction between Pigeon House Road and Bremen Grove, approximately 1 km from the site, a level of 7 ppb was recorded, i.e. just above the detection threshold. Therefore, the results of the baseline survey confirm that the operation of the existing works will from time to time, under adverse weather conditions, result in the occurrence of levels of H_2S above the detection threshold at the fringes of existing development closest to the site.

7.1.3 Design Standard.

Based on the threshold of normal detection of H_2S, the design aim for the Ringsend STW is to ensure that levels of H_2S at the site boundary will under normal operation not lead to any detectable smell beyond the site boundary, i.e. a maximum boundary level of about 5 ppb.

7.1.4 Odour Modelling.

The control of odour from the proposed upgraded STW site was assessed using the Industrial Source Complex (ISC3) model which is an air dispersion simulation package developed by the US Environmental Protection Agency (USEPA) and used world-wide as a regulatory tool for atmospheric emissions. The model can be used to predict pollutant concentrations from continuous point, area, volume and open pit sources and is preferred by the USEPA because of the many features that enable the user to estimate concentrations from nearly any type of source emitting non-reactive pollutants. As with most of the USEPA models, ISC3 has been subjected to a performance evaluation using comparisons with observed air quality data and has been approved for regulatory use without the need for further site-specific demonstration of applicability.

There are two versions of ISC3, a short term model ISCST3 and a long term model ISCLT3. Since the presence of odours at any given moment will be dependent, amongst other matters such as the source strength and individual sensitivity, on the prevailing wind conditions at the moment of detection (rather than the annual average conditions) the predictive assessment has used the short term model ISCST3.

Using the BAF process as a representative worst case situation for the possible sewage treatment options on the site, information such as the emission rate of H_2S, flow velocity, location and release height above ground level, were fed into the computer model for each source on the STW site. Other information incorporated into

the model included appropriate meteorological data (see below) and co-ordinate data for receiver locations representing areas of local housing, the site boundary, and a grid of receptors for contour plotting.

The emission rates for the main on-site processes likely to generate H_2S were derived from a number of sources (e.g. from previous studies and from typical ranges of emissions documented in J.CIWEM, 10 June 1996)[12] and can be summarised as follows:

Table 7.1 - Emission Rates

Process	Emission Rate mg $H_2S/s.m^2$
Inlet screens	$1.1 \text{ to } 2.2 \times 10^{-2}$
Primary treatment tanks (2)	$1.8 \text{ to } 3.6 \times 10^{-3}$
BAF tanks (2)	1.8×10^{-5}
Sludge drying & dewatering	0.4 to 0.8
Storm tank	$1.8 \text{ to } 3.6 \times 10^{-3}$

The emission rates are based on an assumed maximum design inlet wastewater sulphide concentration of 1.0 mg/l at a pH of 7.5.

For the purpose of worst case odour prediction, the upper value of the above ranges was used for modelling concentrations of H_2S at each receiver location. The design proposals for the site will incorporate enclosures to the inlet screens and the sludge drying and dewatering in order to minimise the release of odours. These will enable the reduction of H_2S emissions through the use of biofilters, and a reduction of 95% has been assumed. Some sludge treatment processes give rise to particular chemicals e.g. alkaline stabilisation may give rise to ammonia. Odour removal processes including biofilters can target such chemicals in addition to the principal sewer gases. Based on engineering data from other studies which have assumed a ventilation rate of 2,100 m^3/hour for covered sources, and a stack exit concentration of 2.5 ppm H_2S, the resulting emission rate used by the model for enclosed sources was 2.1 mg/s H_2S from a 0.22m diameter stack with an efflux velocity of 15 m/s. Similar emission rates were also used as conservative estimates of emissions from the two pumping stations. The remaining sources were treated as area sources within the model and used the emission rates tabled above.

7.1.5 Meteorological Data.

For ground level releases, higher concentrations occur as wind speeds become lighter and as the atmosphere becomes more stable. Meteorological data is subdivided into different classes of stability referred to as Pasquill Stability Categories, ranging from A, very unstable, to G, very stable. Generally, category F (moderately stable) provides the worst case for sources up to 7 metres in height free of building wake effects. For the purpose of ISCST3 modelling categories F and G are combined, and the data provided by the Meteorological Office likewise combines these classes. The descriptions of the full range of stability categories are listed below:

Table 7.2 - Meteorological Stability Classes

Pasquill Stability Category	Description
A	Very unstable
B	Moderately unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Moderately stable
G	Very stable

Long term meteorological data for the period 1962 to 1984 for the Dublin area was obtained from the Meteorological Service and analysed to derive frequency weighted values of wind direction and wind speed. The frequency weighted values represent the most prevalent wind conditions for the location. Prevailing winds are westerly and, therefore, tend to blow emissions away from the nearest area of development at Irishtown and, therefore, out to sea where emissions will disperse without impact on sensitive development. Analysis of the meteorological data shows that periods of easterly winds blowing directly towards Irishtown, coupled with worst case low wind speeds for odour dispersion, only arise for about 6% of the year, i.e. about 22 days. Taking account of all easterly winds from the north-east through to the south-east, the frequency increases to 16% of the year or about 58 days.

The design aim for the scheme is for there to be no detectable levels of odour beyond the site boundary, therefore, the model has been used to calculate maximum concentrations along the site boundary for, firstly, a scenario without odour control, and

secondly a scenario with 95% odour removal. However, in order to evaluate the worst case impacts on sensitive residential development etc., the model was also used to predict maximum concentrations of H_2S for selected receiver locations, assuming low wind speed (1 m/s), under stability category F, blowing directly towards each receiver.

In addition to the above predictions for selected receiver locations, the model was also run using the annual frequency that low wind speeds (<1.5 m/s) are present within each quadrant, coupled with an assumed worst case stability category F, to show, in effect, a cumulative worst case effect over the area surrounding the site. The predicted concentrations, expressed as H_2S contours in $\mu g/m^3$ (1 $\mu g/m^3$ = 0.66 ppb H_2S) are displayed in Figures 7.1 and 7.2 for the respective scenarios of no odour control and 95% odour removal.

7.1.6 Results.

The range of maximum concentrations along the site boundaries are tabled below:

Table 7.3 - Maximum Concentrations at Site Boundary

Scenario	H_2S ppb
No odour control	1.1 to 8.4
95% odour removal	0.1 to 1.0

Without odour control, maximum levels at the site boundary will exceed the 5 ppb detection threshold and, therefore, exceed the design aim. Some form of odour removal, such as biofiltration, is, therefore, likely to be required on the main on-site sources of odour, such as on the screening plant and the sludge drying/dewatering building. Maximum concentrations following 95% odour removal on the two sources are predicted to be much reduced at the site boundary and comply with the project's design aim of being below the threshold of detection.

Concentrations of H_2S predicted to occur at the selected sensitive receiver locations, under worst case weather conditions but with 95% odour removal, are shown below. For reference purposes the receiver locations have been included on the H_2S contour plots (Figures 7.1 and 7.2), together with the site boundary co-ordinates, locations 1 to 4. Apart from site 5, all of the sensitive locations are some considerable distance from the STW site, generally more than 1 km, and, even under the worst case weather conditions, predicted levels of H_2S at all sites are well below the detection threshold

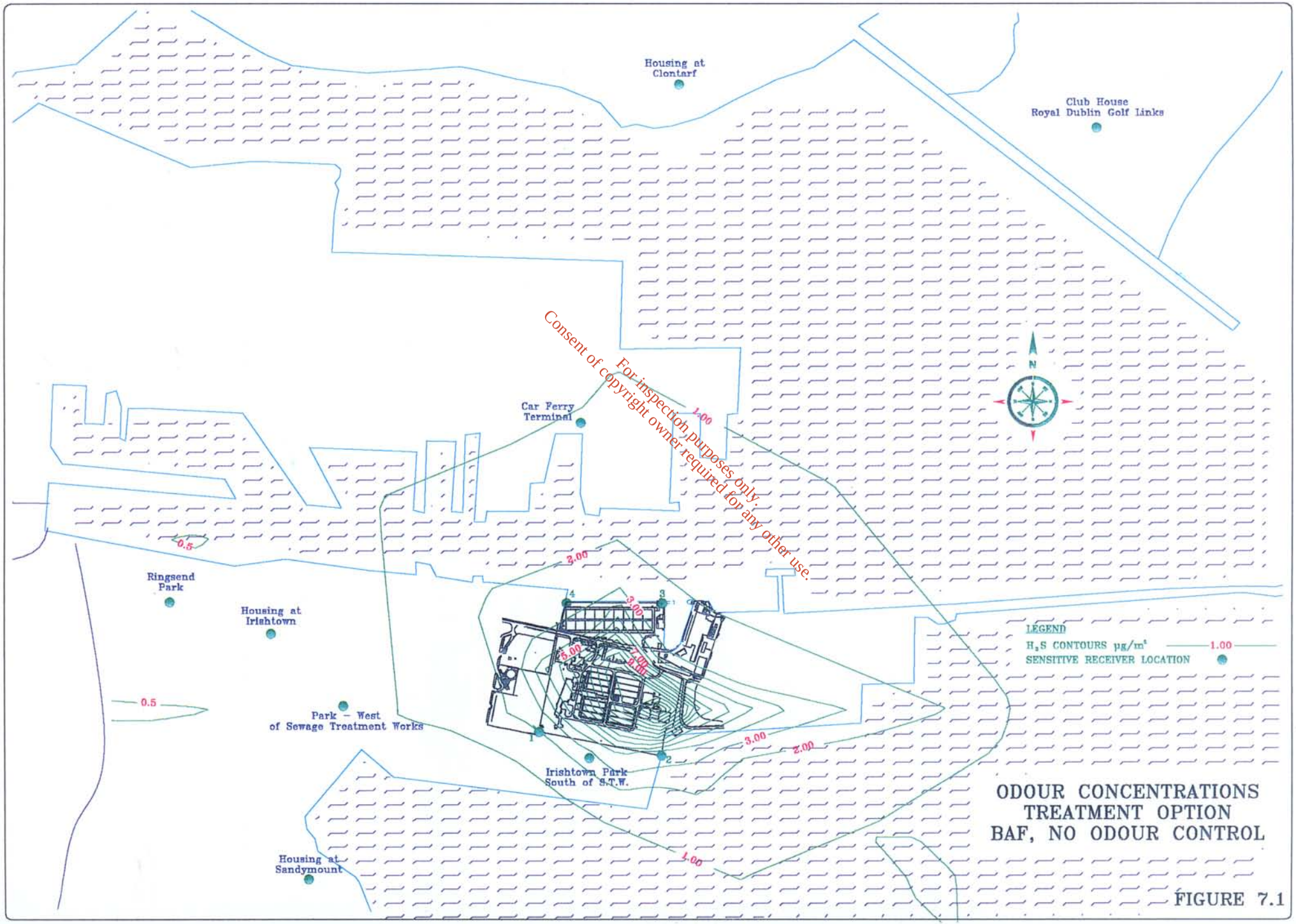

FIGURE 7.1

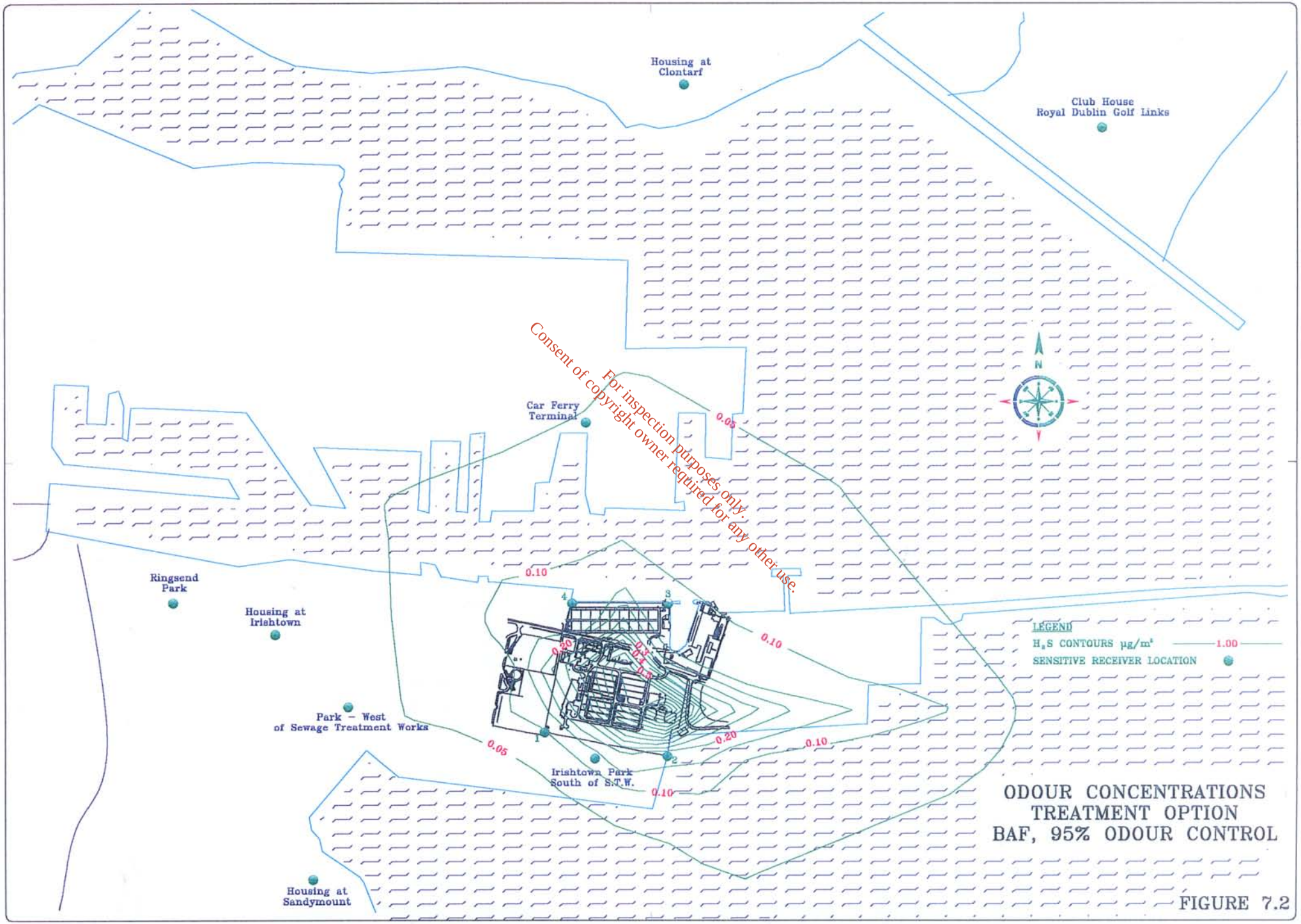

FIGURE 7.2

and demonstrate a significant improvement over measured levels in the vicinity of the existing works.

Table 7.4 - Maximum Concentration Outside the Site

Site No.	Location	Maximum H_2S ppb
5	Irishtown Park, south of STW	0.65
6	Housing at Sandymount	0.08
7	Park, west of STW	0.14
8	Housing at Irishtown	0.13
9	Ringsend Park	0.09
10	Car ferry terminal	0.09
11	Housing at Clontarf	0.05
12	Club House, Royal Dublin Golf Links	0.04

The ISCST3 model predicts H_2S concentrations in units of $\mu g/m^3$ and these have been plotted as H_2S contours on Figures 7.1 for the 'no odour control' scenario and Figure 7.2 for the '95% odour removal' scenario. The contours reflect a cumulative impact by plotting concentrations resulting from the combination of low wind speeds and frequency of occurrence for each wind quadrant. Figure 7.1 shows a level, without odour control, approaching 1 $\mu g/m^3$ (0.66 ppb) at the nearest housing (location 7 - Irishtown) and a similar level of 1 $\mu g/m^3$ at location 10, the car ferry terminal. These levels reduce significantly under the scenario with 95% odour removal, to values of about 0.05 $\mu g/m^3$. The plots also demonstrate the greater spread of emissions to the east, i.e. away from sensitive development, due to the prevailing westerly wind conditions.

For comparison purposes, a third plot, Figure 7.3, shows contours for a possible alternative option based on an activated sludge process without odour control. The concentrations are slightly lower than for the BAF option, demonstrating that the choice of the BAF process for assessment purposes represents a worst case impact.

7.1.7 Summary.

In the absence of odour control, levels of H_2S at the site boundary are predicted to exceed the threshold level of detection, 5 ppb. Therefore, the use of odour control mechanisms, such as biofilters or other effective methods, will be required for particular

odour sources such as the screening plant and sludge drying/dewatering building. With the use of odour control, boundary levels are predicted to be below the threshold of detection and, therefore, to comply with the project's design aim.

For all receptor locations, whether at the site boundary or atareas of local housing, H_2S concentrations predicted to arise from the proposed upgrade to the Ringsend STW do not exceed a maximum level of about 1 ppb assuming 95% odour control on the enclosed sources. This level is below relevant criteria such as the normal threshold of detection of H_2S, the WHO guideline and the scheme's design aim. **The operation of the upgraded STW will, therefore, have no adverse odour impact on the existing environment and its users, and it will represent a significant improvement over the operation of the existing works.**

7.2 AEROSOLS.

7.2.1 Introduction.

This assessment considers the impact of aerosols on human health as a result of the Ringsend Sewage Treatment Works expansion, employing Biological Aerated Filters (BAF) and Sludge Drying with Digestion. The assessment firstly considers relevant legislation before identifying the sewage treatment processes where generation of aerosols occurs and the subsequent health implications. A review of the existing aerosol generation at Ringsend Sewage Treatment Works is then undertaken before categorising the risks associated with the new works in the absence of mitigation. The potential risks are ranked in order to identify where appropriate mitigation would be required.

Legislation relevant to Ringsend Sewage Treatment Works expansion is the European Community Council Directive of 26 November 1990 (90/679/EEC) on the protection of workers from risks related to exposure to biological agents at work (seventh individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC).

The Directive states 'employers must keep abreast of new developments in technology with a view to improving the protection of workers' health and safety'.

It places a duty on employers to provide protection against the risks of injury or illness to employees, contractors and members of the public who might be affected by the

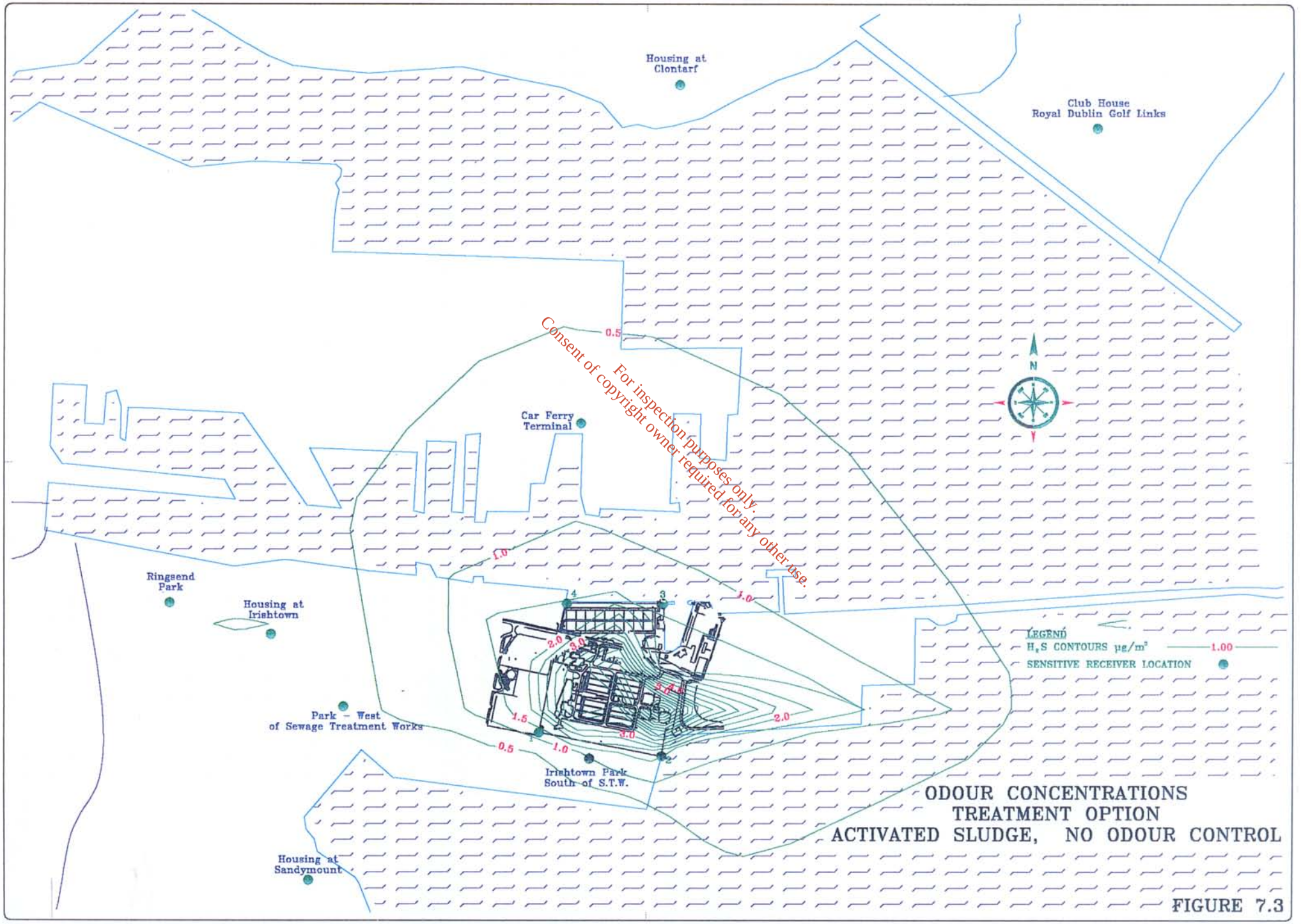

FIGURE 7.3

work activity. The indicative list of activities to which the directive applies includes 'work in sewage purification installations'. The regulations identify a need to undertake determination and assessment of the hazards and risks from sewage works. The definition of hazard and risk is provided below.

A **hazard** presented by a substance or process is its potential to cause harm. Some substances can cause harm in several different ways e.g., if swallowed, inhaled or contact with skin.

The **risk** from a substance/process is the likelihood that it will harm you in the actual circumstances of use. This will depend on:

- the hazard presented;
- how it is used;
- how it is controlled;
- who is exposed ... to how much ... for how long; and
- the activity being undertaken.

Poor control can create a substantial risk even from a substance with low hazard, however, with proper precautions the risk of being harmed by even the most hazardous substance/process can be adequately controlled.

7.2.2 Description of Aerosols.

An aerosol is a droplet of liquid that is capable of remaining airborne, which in the case of water is usually less than 10µm in diameter. Aerosols are formed when a water surface is broken; the greater the disturbance to the water surface the greater the quantity of aerosol produced. The physical characteristics of the aerosol, particularly the mean size of the droplets, influence the pattern of dispersal from the point of generation. Larger aerosol droplets readily settle out; smaller droplets can remain suspended for much longer periods of time.

Transmission of Pathogens in Wastewater/Sewage Aerosols.

A pathogenic micro-organism is one that is capable of causing disease. Infection is defined as the establishment and multiplication of a pathogen in a host, disease is the expression of the symptoms caused by infection.

The pathogenic microorganisms most prevalent in sewage are predominately faecal in origin including enteric pathogens such as bacteria, viruses and parasitic protozoa.

Microorganisms become encapsulated within droplets when aerosols are generated from contaminated liquids. Inactivation of bacteria in aerosol droplets follows similar kinetics to the inactivation of bacteria on exposure to any foreign environment. Immediately following the generation of a contaminated aerosol there is rapid reduction in the number of viable organisms. This is followed by a period of stabilisation and then a slow die off of the more resistant organisms.

Weather conditions determine the survival of microorganisms in aerosols. The absence of sunlight, high relative humidity and low temperature tend to promote the survival of microorganisms (Adams and Spendlove 1970)[13]. When these conditions are constant, the distance travelled by pathogens in an aerosol is dependent upon the wind velocity.

The principal health risk associated with aerosols is from pathogens which can initiate infections in the respiratory tract. Frequently, infection follows exposure to a low number of organisms. However, the majority of pathogens carried by waste water cause gastrointestinal infections. These may be present at reasonably high levels in the liquid but, while they can be carried in aerosols, their numbers are usually too low to cause human disease. Some strains of gastrointestinal and respiratory viruses have a low infectious dose. When this is combined with the resistance of many of these viruses to environmental stress, there is potential long-term health risk from contact with contaminated materials or aerosols.

Exposure to Allergens, Endotoxins and Exotoxins.

Microorganisms can cause disease symptoms without necessarily initiating an infection. Cellular components and metabolic by-products may stimulate an allergic response in exposed individuals or may themselves be toxic by one or more routes of exposure. Microbial allergens, endotoxins and exotoxins are capable of stimulating allergic responses.

i) **Allergens.**

Dead microorganisms or their cellular components may cause allergic reactions in susceptible people. Inhalation of microbial allergens can cause asthma attacks or other symptoms of respiratory distress, such as rhinitis and

extrinsic allergic alveolitis. Extrinsic allergic alveolitis or hypersensitivity pneumonitis is caused by the inflammation of the alveoli as a result of exposure to an inhaled allergen. The symptoms include fever, shortness of breath, chest tightness, chills, coughs and general malaise. Tolerance to the allergen does not develop. Therefore, as long as a person is in contact with the allergen, they will continue to experience symptoms. Removing the source of the allergen will relieve the symptoms.

ii) Endotoxins.

Endotoxins are complex molecules that are structurally part of the cell envelope of gram negative bacteria. They produce severe health effects when inhaled. Upon first exposure, subjects may suffer acute fever, dyspnoea, coughing and a reduction in lung function. With repeated exposure, the symptoms become progressively milder and will eventually disappear. The symptoms may recur if the individual is removed from the source of exposure for a period of time and then re-exposed. The effect of long term exposure is not known although the results of some experimental work suggests that repeated exposure may cause a syndrome similar to chronic bronchitis.

The existing and proposed methods of treating sewage at Ringsend Sewage Treatment Works will not remove or inactivate endotoxins.

iii) Exotoxins.

Many bacteria including sewage bacterium produce extra cellular substances, during normal growth or sporulation, that may be toxic in very low concentrations. These substances are referred to as exotoxins. Exotoxins that affect the gastrointestinal tract are called enterotoxins. There are many types of enterotoxins and they vary widely according to the species from which they are derived.

Enterotoxins may be carried in aerosols from sewage treatment plants. Symptoms of exposure to exotoxins include, skin disorders, diarrhoea and other gastrointestinal symptoms. It is unlikely that the symptoms are due to infection with bacteria as the symptoms appear within two hours and disappear by the next day.

Generation of Aerosols at Sewage Treatment Works.

The extent to which aerosols are formed depends on the treatment process and the rate of decrease in size of droplets which is influenced by the prevailing environmental conditions. Relevant identified sources of aerosol emission at Sewage Treatment Works are biological treatment units (through forced aeration), sludge pressing and hosing down of contaminated surfaces.

Disease Transmission by Wastewater Aerosols.

The composition of sewage is a mixture of microorganisms and chemicals diluted in water which is undefined since it is derived from many domestic and industrial sources. The initial pathogen level in wastewater is highly uncertain and depends on several factors such as population of wastewater catchment, socio-economic condition of people, eating habit of people and percentage of disease infected people. The principal sources of microorganisms in sewage are those present in the community and which are derived from human faeces. Microbial contamination of sewage by microorganisms of animal origin can occur through run-off of rain-water or infestation by rodents.

Operation of processes for the treatment of sewage provides the potential for exposure of individuals to these microorganisms. Contamination may occur by direct contact with sewage through ingestion, inhalation or penetration of broken skin. Indirect routes of transmission may exist when contaminated surfaces are touched, creating the potential for transfer of microorganisms to the body.

Sewage treatment processes generating aerosols have the potential to release particles containing microorganisms which are dispersed from the source. Inhalation of these particles may expose workers, contractors and neighbouring communities to the microorganisms present in sewage.

Although the biological content of sewage and the spread of pathogens can be measured, the relationship between sewage contact and recognised health effects is difficult to prove.

7.2.3 Existing Aerosol Generating Processes within Ringsend Sewage Treatment Works.

The existing treatment sequence at Ringsend Sewage Treatment Works consists of unit processes for grit removal, primary sedimentation, sludge storage, supernatant removal and pumping to the sludge dumping ship.

At the inlet to Ringsend STW the raw sewage enters the site. At Ringsend this is a ratio of domestic and industrial effluent from the city catchment via the main lift pumping station at Ringsend, Dodder Valley system by siphons from U.C.D and Dun Laoghaire drainage via the West Pier Pumping Station.

The effluent includes hospital and commuter waste, residential and local industry. The residential population have been calculated and are illustrated in Table 7.4.

Table 7.5 - Maximum Concentrations at Site Boundary

Catchment	Year 1991	Year 2015	Year 2040
Ringsend Catchment	652,092	724,552	804,000
North Dublin Catchment	219,850	336,947	374,000
TOTAL	871,942	1,061,499	1,178,000

Of these processes undertaken at the existing sewage treatment works, the release of aerosols and thus the highest numbers of bacteria, endotoxins and exotoxins in the air would be generated in regions of turbulent flow. Regions of turbulent flow are limited at the existing works as no aeration is currently employed. However the inlet to Ringsend STW is likely to release aerosols with the greatest numbers of bacteria, furthermore the use of treated effluent for the hose down of machinery is also likely to release aerosols. Of these bacteria the majority would be detected close to the source of emission and would decrease as distance from the source increased. The distance travelled, and survival would depend upon the meteorological condition as outlined in Section 7.2.2.

7.2.4 Potential Aerosol Effects with Ringsend Sewage Treatment Works Expansion.

The chosen expansion option for this assessment is that of Biological Aerated Filters (BAFs) with Sludge Drying and Dewatering.

Biological aerated filters (BAFs) differ from conventional secondary treatment processes such as percolating filters and activated sludge processes in that the fixed film media is submerged and forcibly aerated by air or oxygen. BAFs use a medium of small diameter or a high surface area rigid medium and therefore have a larger effective surface area than conventional filters.

The proposed treatment would therefore consist of primary settlement and secondary treatment. The individual processes involved would be as follows:

- Inlet of raw sewage to Ringsend Sewage Treatment Works.
- Screens to remove waste material such as paper, cloth, plastics and other objects.
- Detritors for grit removal.
- Primary settlement tanks.
- Secondary treatment by BAFs.
- Sludge Drying and Dewatering.
- Washing Down of Screens using Treated Effluent i.e. Maintenance Work.

The potential aerosol effect with the proposed scheme is considered to pose higher aerosol production than the existing situation, as the treatment process utilised in BAFs has the potential to generate aerosol production greater than or equivalent to the other options and as such is considered an appropriate yardstick for all the options.

The assessment has been undertaken by categorising the foreseen risks of aerosol generation from each of the proposed processes. At present there is no formal method for categorising risks to human health as a result of exposure to aerosols. Consequently a subjective assignment has been devised based on previous scientific research. Without mitigation each area of treatment has been assigned a risk category as follows:

The risk categories have been assigned to individual processes as High, Medium or Low and the control of hazard outlined.

HIGH	Significant aerosol generation and potential health risks.
MEDIUM	Moderate aerosol generation and health risks.
LOW	Minimum or negligible aerosol generation and low health risks.

Table 7.6

Aerosol Production and Assigned Risk Categories at Proposed Expansion to Ringsend Sewage Treatment Works

PROCESS	RISK CATEGORY		
	High	**Medium**	**Low**
Inlet			✓ Minimum or negligible aerosol generation and low health risks.
Screens			✓ Minimum or negligible aerosol generation and low health risks.
Detritors			✓ Minimum or negligible aerosol generation and low health risks.
Primary Settlement Tanks			✓ Minimum or negligible aerosol generation and low health risks.
Secondary Treatment by BAFs		✓ moderate aerosol generation and health implications.	
Washing Down of Screens using Treated Effluent		✓ moderate aerosol generation and health implications.	
Sludge Drying and Dewatering		✓ moderate aerosol generation and health implications.	

7.2.5 Mitigation Measures.

This section defines the mitigation measures appropriate to the proposed expansion to Ringsend Sewage Treatment Works by BAFs and sludge drying and dewatering.

In Section 7.2.4 it was determined that some of the proposed treatment processes could, in the absence of mitigation, potentially lead to moderate aerosol generation and health risks. However, these risks could be reduced with the implementation of rational mitigation measures. The relevant mitigation measures assigned are dictated by the individual processes undertaken.

In order to reduce the potential risks on human health the following measures could be employed:

- Hygienic measures such as the use of protective clothing, hand washing before eating and smoking, and a shower after work would offer a more cost effective method of reducing daily exposure to bacteria and endotoxins.

- The Sludge Dewatering and Drying phase again could be located indoors through the use of steel cladding. Personal protective equipment would be appropriate for prolonged exposure close to the source of emission, particularly at enclosed locations.

- Potential maintenance work could involve the use of treated effluent for washing down of screens to remove waste material. This could increase the exposure of workers to bacterial aerosols produced in droplets from the hose. Personal protective equipment would be appropriate for exposure close to the source of emission, particularly at enclosed locations.

- All other phases of the process are considered to have negligible aerosol generation and health risks. Best practice for good hygienic measures, such as the use of protective clothing, hand washing before eating and smoking, and a shower after work could further reduce daily exposure to bacteria and endotoxins.

The mitigation measures suggested have taken into account relevant European Community legislation that states 'precaution should be taken to prevent exposure to biological agents at work'. The potential mitigation measures outlined above would aid compliance with this legislation.

7.2.6 Summary of Aerosol Significance.

A comparison of the existing Ringsend STW with the proposed expansion scheme found that the potential risk from aerosols would be increased due to the change in process from primary sedimentation.

An aerosol risk assessment of the proposed expansion found that in the absence of mitigation moderate risks to workers health could occur due to the introduction of BAFs and sludge drying and dewatering. No risks to residents or users of the Irishtown Nature Park are predicted due to distance from the process and anticipated duration of exposure respectively.

In order to prevent health risks associated with aerosol release to workers at the proposed works, mitigation measures including covering of process buildings (inlet works, sludge drying and dewatering and pumping stations) provision of adequate protective equipment and personal hygiene programs will be implemented. Adoption of these measures will ensure that Ringsend STW meets the requirements of the relevant European Community Directive.

7.3 DUST.

Thermal Drying.

A risk of dust explosion exists where inflammable material is present at high temperature with sufficient oxygen to support combustion. Suitable safety measures will be taken for drying and storage of sludge. These include drying in low oxygen conditions below 6% or high humidity (inertising), cooling the dried sludge before storage, controlling the maximum product temperature and maintaining a closed system under negative pressure to minimise gas quantities.

8. VISUAL.

8.1 BASIS FOR THE LANDSCAPE IMPACT ASSESSMENT.

The following structure for assessing the landscape impact of any development, is based on draft guidelines prepared by the Environmental Protection Agency (EPA)[1].

8.1.1 Landscape in the Existing Environment.

The effects of any development on the landscape have two separate but closely related aspects, visual aspects and character aspects:

a. Visual Aspects.

The visual effects of any development can be defined as the extent to which the new development can be seen. Visual effects generally arise through visual intrusion and/or obstruction. In order to demonstrate systematically the approach used in this EIS, the following classification terms of visibility have been used:

- High visibility occurs when the development is not screened by the existing topography, vegetation or built environment, or where the viewer is at such a distance that the development becomes a dominant visual feature.

- Medium visibility occurs when the development is partially screened by the topography, vegetation or built environment or where the distance of the viewer prevents a detailed view of the development.

- Low visibility occurs where much of the development is screened by the existing topography, vegetation or built environment or where the distance of the viewer generally obscures the development from the visual environment.

The significance of the visual effects, which can be defined as the visual impacts, can be determined by a number of objective criteria:

- Magnitude and intensity: any development which can cause effects over a wide area, to a large number of people, or effects which are of an intensity which is significantly in excess of those normally experienced.

- Duration: any development which can cause impacts over a long period of time or which may cause permanent alterations in the environment

Degree of Visual Impact: Visual impact in contrast to character is less subjective and the following objective scale is used to assess the significance of visual impact. Visual impact may occur by means of intrusion and/or obstruction, where visual intrusion is impact on a view without blocking and visual obstruction is impact on a view involving blocking thereof.

In either case, impacts may be viewed as neutral, positive or negative where:

Neutral - represents a change which does not affect the quality of the environment.

Positive - represents a change which improves the quality of the environment.

Negative - represents a change which reduces the quality of the existing environment.

With either positive or negative impacts, the significance of each may be rated as:

Imperceptible impact: arises where the proposal is adequately screened due to existing landform, vegetation and/or constructed features.

Slight impact: occurs where the view affected forms only a small element in the overall panorama, or alters the view in a way that only marginally detracts from its quality.

Moderate impact: is one where an appreciable segment of the panorama is affected, or where there is an intrusion into the foreground of a view.

Significant impact: is one where the view is obstructed, significantly affected by the development that it forms a new focus of attention.

Profound impact: is one where a view of significance is completely obscured or altered.

Note: Moderate impacts are not included in the EPA Glossary of Impacts. We have included them in our scale of impacts to cover a substantial gap between slight and significant impacts as they will relate to landscape assessments.

b. Character Aspects.

Impacts on the character of the landscape include responses which are felt towards the combined effects of the new development. The significance of impacts on the perceived landscape character will depend partly on the number of people affected, the perceived context of the landscape, but also on judgments about how much the change will matter and in relation to other senses like sound, smell, feelings etc., experienced by those concerned.

Context; gives a description of the existing situation including areas from which the existing site can be seen. Furthermore, areas of distinctive or different characters together with the principal landscape features are described and mapped.

Character; gives a description of the existing situation including the natural and man-made features which create distinctive areas within the landscape. It differentiates between responses felt towards the landscape features of the site from within the site itself and responses from the larger landscape beyond. It gives a description of the intensity and type of land use both within the site and the surrounding landscape. The description uses systematic approaches which clearly differentiate between subjective and objective descriptions.

Significance; the significance of the site is described, in that, the development site may intrude upon designated views, may be within or adjacent to designated landscape amenity areas or may have historic or cultural associations. Furthermore, the site or part thereof may be visible from a wide area or used for activities in which character or views are important. Finally,

any trends of change which may be identified or reasonably inferred in the landscape are noted.

8.1.2 Photomontages.

At an early stage of the assessment it was considered that a number of photomontages of the proposed development would be a very useful indicator of the visual and landscape impacts. The impact of the development upon Sandymount was considered to be particularly critical due its residential nature, its high amenity value, its use as a busy thoroughfare and its relatively close proximity (900m) to the site. Two locations of viewpoints along Sandymount were chosen, one from Seafort Ave., the other from the Martello Tower. Photomontages for the principal development options were constructed. The existing viewpoint and the photomontages for each of the development options are represented in Figures 8.2 to 8.7 inclusive.

The photomontages were also used throughout the evaluation process to establish the optimum locations and arrangements for the various elements of the proposal, subject to engineering constraints.

8.1.3 Mitigating Impacts on Landscape.

Mitigation proposes measures to avoid developments in sensitive or prominent landscapes, avoid insensitive or visually intrusive designs, reduce the visual intrusiveness of the design and the general visibility of the project.

8.1.4 Timing.

The assessment was carried out by visiting the site and its surrounds in the period of August to November 1996, by analysis of the proposals through plans, sections etc., and by referring to the 1991 Dublin City Development Plan.

Visits to the area were also made over a number of years during the preliminary assessment of the site and during the design process up to the present date. Knowledge of the general area is also based on previous experience of the locality over many years.

8.2. THE RECEIVING ENVIRONMENT.

8.2.1 Context.

The general area is part of Dublin Docklands along the sweeping arc of Dublin Bay. The site is obscured from the city centre by the industrial and commercial infrastructure of the port. The surrounding landscape is generally flat before rising to the prominent headland features of Howth Head to the north-east and Killiney Hill to the south. Viewed from the north side of the city, the Dublin Mountains act as a background to the area. The site is currently used as a sewage treatment plant.

8.2.2 Site Location.

The approx. 15 hectare site is located on the southern promontory of reclaimed lands that extend into Dublin Bay from Ringsend to the South Wall. The port area is predominantly used for industrial and commercial use. The area is dominated by the ESB Poolbeg electricity generating station with its massive bulk of buildings and two 210m high exhaust chimneys which are well known Dublin landmarks. There are a number of other physical developments which dominate the area in the vicinity of the site;

- the Dublin Port complex with its warehouses, cranes and storage tanks along the northern and southern sides of the River Liffey;
- the older Ringsend Power station;
- the former and now derelict Pigeon House Generating station; and the recently restored Pigeon House Hotel building.

Further notable features are the South and North Bull seawalls that extend out into Dublin Bay and the extensive areas of estuary at Sandymount and Clontarf which dry out at low tide. The North Bull Wall, Bull Island, Clontarf Promenade, South Wall and Sandymount Strand are intensively used as leisure and recreational amenities.

Existing ground levels around the site are generally between 3.0 and 6.0M O.D., with the exception of Irishtown Nature Park immediately to the south of the site, where ground levels have been artificially made up to 20M O.D. in height, with pulverised fuel

ash (PFA) from the older coal powered Ringsend Power Station. A berm some 7-10M O.D. in height extends west from the park along the coastline as far as Sean Moore public park at Ringsend.

The promontory nature of the area into Dublin Bay leads to extreme levels of climatic exposure with the result that there is limited tree vegetation in the area. Only the hardiest species have established in the area. There are belts of screen planting around the Poolbeg Power Station. Species include Leylandii, Pines, Olearia and Tamarisk

Vehicular and pedestrian access to the site is via Pigeon House road which also serves as the access road to the Poolbeg generating station and to the much used public walking amenity along the South Wall that extends into Dublin Bay. There is also pedestrian access to the south of the site through Irishtown Nature Park, which links Sean Moore Park in Ringsend to Pigeon House Road (east of the site). Shelly Banks, a small, sandy beach between Poolbeg Power Station and the South Bull Wall has a small car park which is a popular viewing point. The beach is also widely used for active watersports, particularly boardsailing.

8.2.3 Landscape Character.

The landscape character of the area is essentially dominated by the elements of the intensive industrial infrastructure in the area and the expansive presence of water surrounding the area with the Liffey to the north and Dublin Bay to the south and east with a backdrop of Howth Head to the north and the Dublin and Wicklow mountains to the south.

There is a general air of unkemptness with many buildings, such as the Old Pigeon House Generating Station in an apparent state of dilapidation. In the areas of limited open space such as Irishtown Nature Park, illegal dumping of waste has increased the sense of unkemptness. None the less it is a popular area for passive recreation for the residents of Dublin.

8.2.4 Site Description.

The proposed site is presently in use as a waste water treatment plant under the control of Dublin Corporation. The site is divided in two by Pigeon House Road. The larger portion of the site is to the south of the road. It is in this portion of the site that most of the existing treatment processes take place. It is here that the screens, detritors, primary settlement tanks, pumping station, administration, workshop buildings etc. are located. The administration and workshop buildings are relatively recent developments and are some 13.4 and 19.6 M O.D. in height, respectively. A single chimney flue some 24.9M O.D. in height is attached to the workshop building.

The smaller northern portion of the site is currently the location for eighteen stormwater tanks and a jetty where a ship, the Sir Joseph Bazalgette removes the sludge material from the plant and disposes of it to sea. There are a number of taller elements in this area adjacent to Pigeon House Harbour which are now disused buildings.

Portions of both the north and south segments of the site consist of the old and now derelict Pigeon House Fort, which dates back to 1813. Pigeon House Road now bisects the fort, however, portions of the original walls and structures are evident. The greater part of the Fort lies in the southern portion of the site. The walls of the fort and the open area adjoining the road are in an unkempt and derelict condition.

The site boundary consists of 2m high chain link fencing. Along the western boundary of the site which is adjacent to extensive coal yards and a site where molasses is stored there is a 3-4m high steel clad fence. An internal access road runs around the site. There are relatively extensive areas of cut grass surrounding the elements of the treatment plant.

8.2.5 Significance.

The importance of Dublin Bay area to the life and amenities of the city is recognised by the 1991 Dublin City Development Plan and it is a policy of the Plan to utilise and promote the maritime theme of the Bay (Policy TL2). It is an objective of the Corporation to continue the seafront promenade at Sandymount through Irishtown Nature Park as far as Shelly Banks, a small beach near Poolbeg Power Station (Objective 14.4.1.A).

The Dublin Bay Water Quality Management Plan carried out in 1991 recognised the importance of the area in the vicinity of the site, i.e. Sandymount Strand, Irishtown Nature Park, Shelly Banks and the South Wall, in terms of recreation and amenity to the city. Important recreational activities include boardsailing, angling, beach activities, walking, jogging etc.

8.2.6 Site Visibility.

The site generally is not visually distinct within the greater Dublin Bay area due to the surrounding built environment. There are distant views from Howth Head, Dun Laoghaire Pier, Killiney Hill and Three Rock Mountain but their distance prevents detailed views of the site. The larger industrial elements of Dublin Port Docks, Poolbeg Generating Station and Ringsend Generating station are more visually dominant than the existing treatment site, whose built elements are low in height relative to the surrounding built environment. To the south of the site, Irishtown Nature Park situated on elevated ground, prevents views of the existing treatment plant, with the exception of the seafront around Seafort Avenue in Sandymount where Irishtown Park does not block views of the site. There are also a number of long range oblique views past the eastern portion of Irishtown Park into the site from Seapoint in Blackrock to Dun Laoghaire Pier. The extent of the site's visibility is represented in Fig. 8.1.

There are a number of important views into or across the site from the general vicinity, where the site is in close proximity to public traffic, important public amenities and a small number of historic buildings. The principal viewpoints of the site are as follows:

Viewpoint A - Distant Views from Sandymount.

The busy thoroughfare along Sandymount Strand lies at its nearest approximately 900m distant to the south west of the site. There are residences along the entirety of the road which face the Strand and have views towards the site, but direct views are blocked by Irishtown Nature Park. An amenity walkway along the foreshore extends from Merrion Gates to a car-park/viewing area at the junction of Strand Road and Lea Road. Generally, views of the site from all of these locations are limited, due to the 20m O.D. high ridge of Irishtown Park, which screens the site, the exception being the area adjoining Seafort Avenue as mentioned above. The only indication of the location of the site is evident from the roofline of the site workshop and its associated chimney flue alongside it. However, these features are visually indistinct, because of their proximity to the visually dominant Poolbeg and Ringsend Generating Stations (see fig.

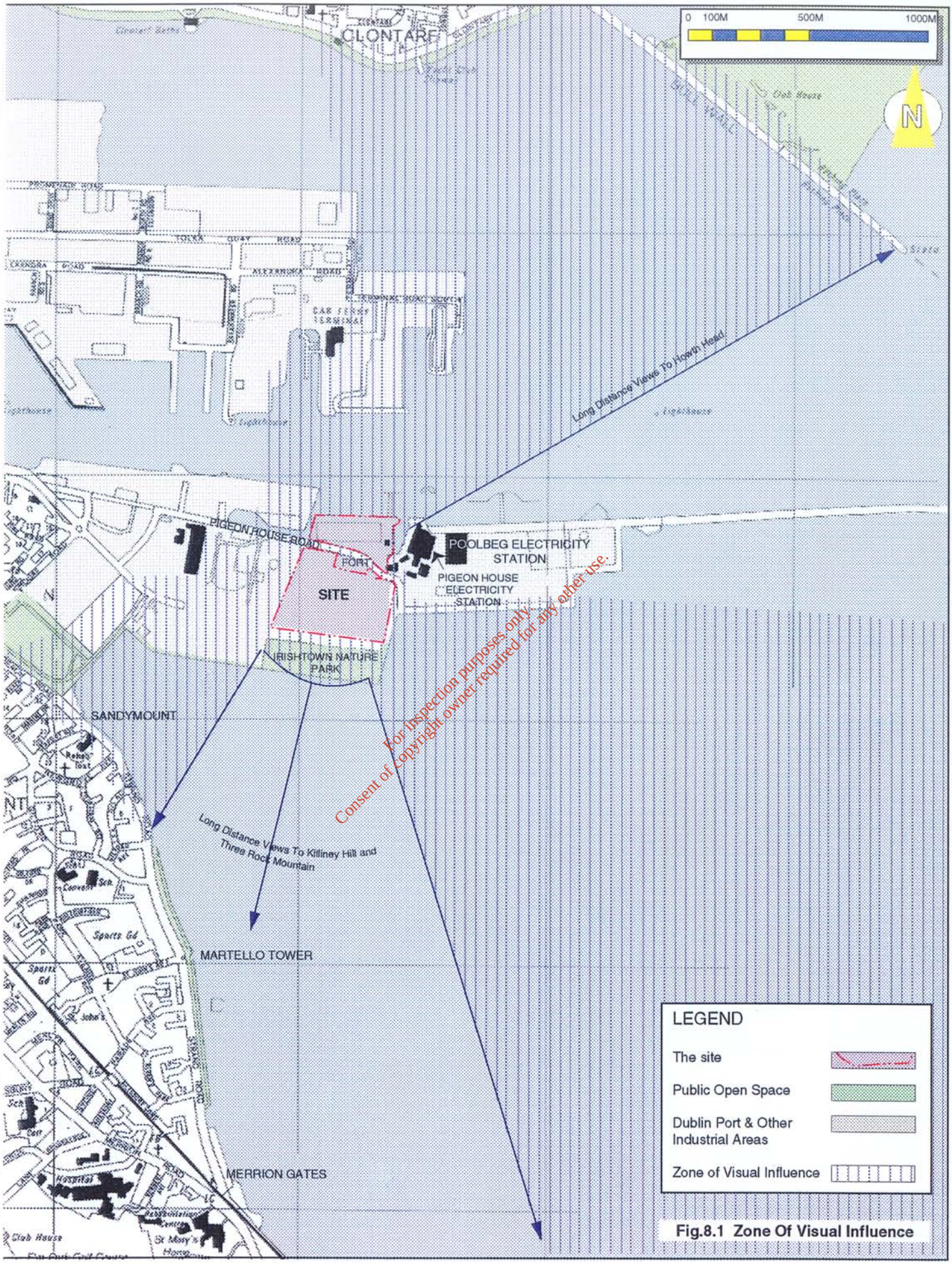

Fig.8.1 Zone Of Visual Influence

8.2, existing photo-view from Seafort Road, Sandymount). Sandymount beach is a popular public amenity. Views are dominated by the expanse of sea, Howth Head, Poolbeg Station, and the coastline. The taller elements of the existing treatment plant are visible above Irishtown Park.

Viewpoint B - Views From Irishtown Nature Park.

Irishtown Nature Park is an area of land immediately south of the site. It consists of a long, dome-shaped ridge. It's southern slopes have attractive views over Sandymount Strand as far as Killiney Hill. On the northern slopes of the park there are open views into the site, with all of the elements of the existing treatment works visible. The most dominant visual foci from the Park are the Poolbeg, Pigeon House and Ringsend Generating stations, the various petroleum storage tanks and cranes of the Port and the Primary Settlement Tanks of the treatment plant on the site.

Viewpoint C - Pigeon House Road (East of the Site).

This access road runs to the south of the Poolbeg Generating Station along the seashore and eventually leads to the South Wall, a much used public walking amenity. The main visual elements on the road are the Poolbeg Generating Station, with its large palisade security fence running along its perimeter and the open views over Sandymount Strand and Dublin Bay. Secondary visual elements include Irishtown Nature Park and elements of the existing treatment plant.

Viewpoint D - Pigeon House Hotel.

This beautifully restored three storey granite building is situated beside the old Pigeon House Generating Station, a large red brick building with the remnants of the original chimney. The "Hotel", now used as offices, faces and overlooks Pigeon House Harbour. The northern portion of the present treatment plant lies on the other side of Pigeon House harbour. The views and setting of the building are very much diminished by the dilapidated nature of the adjoining properties and the palisade fence along its frontage with Pigeon House Harbour.

Viewpoint E - Pigeon House Road (North and West of the Site).

This is the only vehicular access route to the site and Poolbeg Generating Station. The alignment of the road is such that the Poolbeg Generating Station is the main visual focus. To the foreground of the station, there is the smaller Pigeon House Generating Station and Pigeon House Hotel. There are open views to the right and left along the road into the site. The administration, workshop buildings and remnants of Pigeon

House Fort are the more dominant visual features in the southern portion of the site. The eighteen stormwater tanks, though low in level, are the main visual foci in the northern portion of the site, due to their coverage of a large area of land.

Viewpoint F - Clontarf and the North Bull Wall.

There are a number of views across the site from the promenade at Clontarf and the North Bull Wall, which are framed by the Poolbeg and Ringsend Generating Station. The intervening distance of 2km and built environment surrounding the site prevents detailed views of the site.

8.3 SIGNIFICANT LANDSCAPE AND VISUAL EFFECTS.

8.3.1 Introduction.

The proposal to upgrade the existing treatment plant is represented by three typical developments, each of which involve different treatment processes which will result in different end products. These are as follows;

- Activated sludge with alkaline stabilisation
- BAF with drying and digestion
- Sequencing batch reactor (SBR) with drying

These are as shown on Figures 3.1 to 3.3 and as described in Tables 3.8 to 3.10 respectively.

However, the final decision for the choice of treatment plant will be subject to a design and build tender, that is, a specialist contractor will design, build and maintain the development. Therefore, it is possible that elements of each processing system may be included in each of the above proposals, e.g. sludge drying may be included in the Activated Sludge or SBR systems. The proposals assessed in this EIS represent the outer permissible parameters and the general location for each of the built elements of the development. The assessment makes a reasonable assumption as to the "worst case scenario" for each of the options in terms of visual and landscape impacts for the final design of treatment plant which would include the most visible elements for each of the options. This "worst case scenario" is represented as follows:

- Activated sludge with sludge drying and digestion
- BAF with sludge drying and digestion
- Sequencing batch reactor (SBR) with sludge drying

8.3.2 Significant Impacts.

The proposal to up-grade and extend the existing plant will inevitably have some degree of impact on the landscape and visual character of the surrounding areas. These impacts will arise, in the case of each of the alternative proposals, from changes such as:

- Alterations to ground levels
- Building and plant (tanks, silos etc.) development
- Associated developments, e.g., access roads, carparking etc.
- Proposed screen planting
- Site lighting

and these changes will impact primarily upon views from:

- Sandymount Strand
- Adjoining properties
- Nearby public vehicular and pedestrian access routes
- Irishtown Nature Park
- Long range views from Killiney Hill to Howth Head

8.3.3 Impacting Features.

A number of the elements of the proposal will give rise to particular visual impacts and these are discussed below. The description of the principal impacting features follows a progression in time as opposed to significance of impact.

Alterations To Ground Levels.

Currently the ground levels within this flat site vary from a low of 2.4m O.D. in the northern portion of the site to a high point of 5.93m O.D. along the south eastern boundary in the south portion of the site.

With the exception of minor regrading works, it is not proposed to significantly alter the existing ground levels, though some blending between existing and proposed levels will be required in the case of all three options.

Though no major alteration of existing ground levels is envisaged, major excavation works will be necessary for the construction period for all of the options proposed.

Building Development.

A number of built elements will be a common feature for each of the three alternative proposals. The screen and odour building will be in all three options. The tallest elements of the proposals are the digestion tanks which are common to the Activated Sludge and BAF options only. It will be these built elements that will cause the most significant visual impact from Sandymount and Irishtown Nature Park. However, with reference to the photomontages (Figures 8.2 to 8.7) it is considered that views from Sandymount will have a slight to moderate visual impact due to the intervening distance, topography and surrounding landscape context.

The other built elements in the north and east portions of the site will impact upon views on Pigeon House Road and its vicinity. This will lead to some increase in the sense of industrialisation in the area. These visual impacts will be heightened during the construction phase of the development due to increased activity and unfamiliarity. However given the existing industrial character of the area with substantial buildings, stacks, tanks, and gantries the overall impact arising from completed development will not be significant.

Associated Development.

Each of the proposals will have a number of associated developments of which the most significant in each case will be:

- Additional internal access roads to the south and east of the site, which will link in with the existing access road, to provide necessary circulation.

- Additional carparking/service vehicle turning points in association with the new buildings.

As part of the development it is not intended that the existing structures comprising the remains of the Pigeon House Fort will be affected in any significant way. It will be a

condition of the development that the remains of the fort will be retained in a condition comparable with its current state or better.

Proposed Screen Planting.

As part of the overall development of the site, it is proposed to plant belts of hardy shrub vegetation that will withstand the harsh maritime conditions that prevail on the site. It is proposed that these plantings shall be along all of the site boundaries of the site and throughout the site where the building layout allows such plantings.

Site Lighting.

The proposed development includes for the provision of lighting along and around the proposed new access roads and buildings. Flood lights will be required adjacent to and within sumps and tanks in the case of emergencies and for on-site monitoring periods. These lighting proposals, which differ in layout for each of the three options, will not result in any significant additional light pollution due to the site's location within a high density urban area.

8.3.4 Landscape Impacts.

8.3.4.1 Introduction.

Any change in a landscape has a corresponding impact on the character of a particular area. However, the extent of any impact depends on the associations with, uniqueness of and degree of change in a particular landscape.

In any assessment of possible impacts upon the environment, it is accepted practice to assess the impact of the proposed developments against a "baseline". The "baseline" represents a "do-nothing scenario". In the case of landscape elements, this is not fixed but is a dynamic one. All landscapes are in a process of continuing change due to natural processes, changes in the type and intensity of land use and alterations in social norms and values concerning the landscape.

The Ringsend site will continue under its present use as a sewage treatment plant. The surrounding setting will continue in port related and industrial development.

8.3.4.2 Impact On Landscape Character.

The most appreciable effect of the extension of the sewage treatment plant in the case of all three proposals, will be the intensification of the "industrial" character of the site within an already industrial environment. This intensification will result from increases in the nature, scale and site coverage of the building units, e.g., screen and odour control building, sludge holding tanks etc. Given the industrial character of the area, this intensification will not lead to any significant impact on its character.

During the construction of the proposal, there will be significant and negative impact on Pigeon House Road and Irishtown Nature Park due to the increased traffic and building activity. However, these impacts will lessen to moderate negative impact when construction is completed and the plant is operational. There will also be significant and negative impacts during the construction on Pigeon House Hotel. The proposal to remove the existing disused buildings alongside Pigeon House Harbour will have a moderate and positive impact on Pigeon House Harbour with increased visibility over the general port area. From Sandymount, there will be moderate to significant, negative impact during the construction phase, when construction equipment such as cranes will be visible and this will lessen to slight to moderate visual impact, depending on the location, when the plant is operational, due to the screening afforded by Irishtown Nature Park and the existing industrial skyline around the site.

Due to the high intensity of large industrial built elements that surround the site, all three options will only have a slight to moderate negative impact on the wider landscape. The development will have a slight impact upon the greater Dublin Bay area. Portions of the higher structures will be visible but will not be significant given the site's location within the general port area.

8.3.4.3 Visual Effects And Impacts.

The visual effects of any proposal generally arise through visual intrusion and/or obstruction of any view. The visual impacts of any proposal are an assessment of the significance of the effect in relation to the frequency of public viewing, to the landscape context and perceptions of the landscape. In the case of each of the proposals, there will be different visual effects and impacts in both scale and nature. Tables 8.3.1, 8.3.2 and 8.3.3 give an outline summary of the visual effects and visual impacts for each of the "worst case scenarios" of the development which would include the larger elements

of the proposals. An indication of the visual impact of the development on Sandymount is represented in the photomontages in figs. 8.2 to 8.7.

Table 8.3.1

OPTION 1 • Activated Sludge With Sludge Drying and Digestion

VIEWPOINTS	Impacting Elements	Visual Effect Rating	Magnitude	Duration	Visual Impact Significance
A Sandymount	• Screen & Odour Building	Medium	Local	Permanent	Moderate
	• Sludge drying and dewatering building	Medium	Local	Permanent	Moderate
	• Sludge digestors	Medium	Local	Permanent	Slight
B Irishtown Nature Park	• Screen and Odour Building	high	Local	Permanent	Significant
	• Sludge Digestors	High	Local	Permanent	Significant
	• Primary Settlement Building	Medium	Local	Permanent	Slight
	• Pumping Station	Medium	Local	Permanent	Slight
	• Concrete Settlement Tanks	Medium	Local	Permanent	Slight
C Pigeon House Road and Beach (east of site)	• Concrete Tanks	Medium	Local	Permanent	Slight
	• Sludge Digestors	High	Local	Permanent	Moderate
	• All Other Buildings	Low	Local	Permanent	Imperceptible
D Pigeon House Hotel	• Storm-water Pumping Station	Medium	Local	Permanent	Slight
	• Secondary Settlement tanks	High	Local	Permanent	Moderate
	• All other buildings	Low	Local	Permanent	Slight
E Pigeon House Road (north and east of site) include fort	• Storm-water Pumping Station	High	Local	Permanent	Slight
	• Secondary Settlement	High	Local	Permanent	Slight
	• Primary Settlement	Low	Local	Permanent	Slight
	• Aeration Building	Medium	Local	Permanent	Slight
	• Concrete Settlement tanks	High	Local	Permanent	Slight
F Clontarf Strand and Bull Wall	• Entire Treatment Plant & Site	Low/ Medium	District	Permanent	Imperceptible/ Slight

Table 8.3.2

OPTION 2 • BAF and Sludge Drying and Digestion

VIEWPOINTS	Impacting Elements	Visual Effect Rating	Magnitude	Duration	Visual Impact Significance
A Sandymount	• Screen & Odour Building	Medium	Local	Permanent	Moderate
	• Sludge digestors	Medium	Local	Permanent	Slight
	• Sludge Dewatering Building	Medium	Local	Permanent	Moderate
B Irishtown Nature Park	• Screen & Odour Building	High	Local	Permanent	Significant
	• Sludge holding/digestor tanks	High	Local	Permanent	Significant
	• Sludge Dewatering Building	High	Local	Permanent	Significant
	• All other tanks	High	Local	Permanent	Moderate
	• BAF Tanks	Medium	Local	Permanent	Slight
Pigeon House Road and Beach (east of site)	• Sludge digestors	High	Local	Permanent	Moderate
	• BAF tanks	Low	Local	Permanent	Slight
D Pigeon House Hotel	• Storm-water Pumping Station	Medium	Local	Permanent	Slight
E Pigeon House Road (north and east of site) include fort	• Storm-water Pumping Station	Medium	Local	Permanent	Moderate
	• Primary Settlement	Low	Local	Permanent	Slight
	• Aeration Building	Medium	Local	Permanent	Slight
	• BAF Tanks	Medium	Local	Permanent	Slight
	• All other buildings	Medium	Local	Permanent	Slight
F Clontarf Strand and Bull Wall	• Entire Treatment Plant & Site	Low/ medium	District	Permanent	Imperceptible/ Slight

Table 8.3.3

OPTION 3 • Sequencing Batch Reactor With Sludge Drying

VIEWPOINTS	Impacting Elements	Visual Effect Rating	Magnitude	Duration	Impact Rating
A Sandymount	• Screen & Odour Building • Sludge Dewatering Building • SBR System Building	Medium Medium Low	Local Local Local	Permanent Permanent Permanent	Moderate Moderate Slight/ Imperceptible
B Irishtown Nature Park	• Screen & Odour Building • Sludge Dewatering Building • SBR System Building	High High High	Local Local Local	Permanent Permanent Permanent	Significant Significant Significant
Pigeon House Road and Beach (east of site)	• SBR System Building	High	Local	Permanent	Significant
D Pigeon House Hotel	• Air Blower Building • SBR System Building	Low Medium	Local Local	Permanent Permanent	Slight Moderate
E Pigeon House Road (north and east of site) include fort	• Air Blower Building • SBR System Building	Medium Medium	Local Local	Permanent Permanent	Slight Moderate
F Clontarf Strand and Bull Wall	• Entire Treatment Plant & Site	Low/ medium	District	Permanent	Imperceptible/ Slight

In the case of all three proposals, impacts will be especially heightened during the construction and early operational stages of the development, when the initial site disturbance and unfamiliarity will accentuate the development.

In summary, options 1 and 2, which share a number of common structures, such as sludge digestors will generally result in similar moderate to significant visual and landscape impacts in the vicinity of the site. In the case of option 3 there will be greater visual and character impacts in the vicinity of the site due to the scale and size of the SBR structure. In the case of all options there are common structures, such as the Screen and Odour Building and the Sludge Dewatering Building which will result in a moderate visual and landscape impact upon views from Sandymount, particularly from the area adjoining Seafort Avenue (see Figures. 8.2, 8.3 and 8.4, existing photo-view and photomontages from Seafort Ave). These will have a significant impact when viewing north from the ridge of Irishtown Nature Park. There will also be long range

views of the development throughout Dublin Bay. The backdrop of the existing port and surrounding industry will help to incorporate the development into the landscape.

8.4 MITIGATION MEASURES.

8.4.1 General.

This section gives a brief outline of the landscape and visual mitigation measures which were considered at the design stage and which will be addressed at the construction stage.

8.4.2 Project Layout.

During the design and layout of the proposal likely negative impacts were considered and a number of preliminary assessments including landscape visibility and engineering aspects were considered with the aid of sections and photomontages. These were carried out both prior to and during the environmental impact assessment and the information utilised in the detailed design and layout. As such, the options as proposed reflect the following considerations:

- Careful consideration for the locations of the more visually intrusive elements of the proposals.

- Careful consideration was given to the profile, colour and finish of the building units to ensure a quality, modern appearance that will visually recede the development into the surrounding landscape of industry (see Figures 8.2 to 8.7).

Further to the above, the appearance of the development will be both mitigated and enhanced at close viewing through a series of quality landscape proposals consisting of hardy, mass screen shrub plantings together with quality grass seeding. These proposals are detailed in the following sections.

Figure **8.2**; View 1: View as existing from Seafort Road *(whole image)*

Figure **8.3**; View 1: View from Seafort Road *(whole image)*

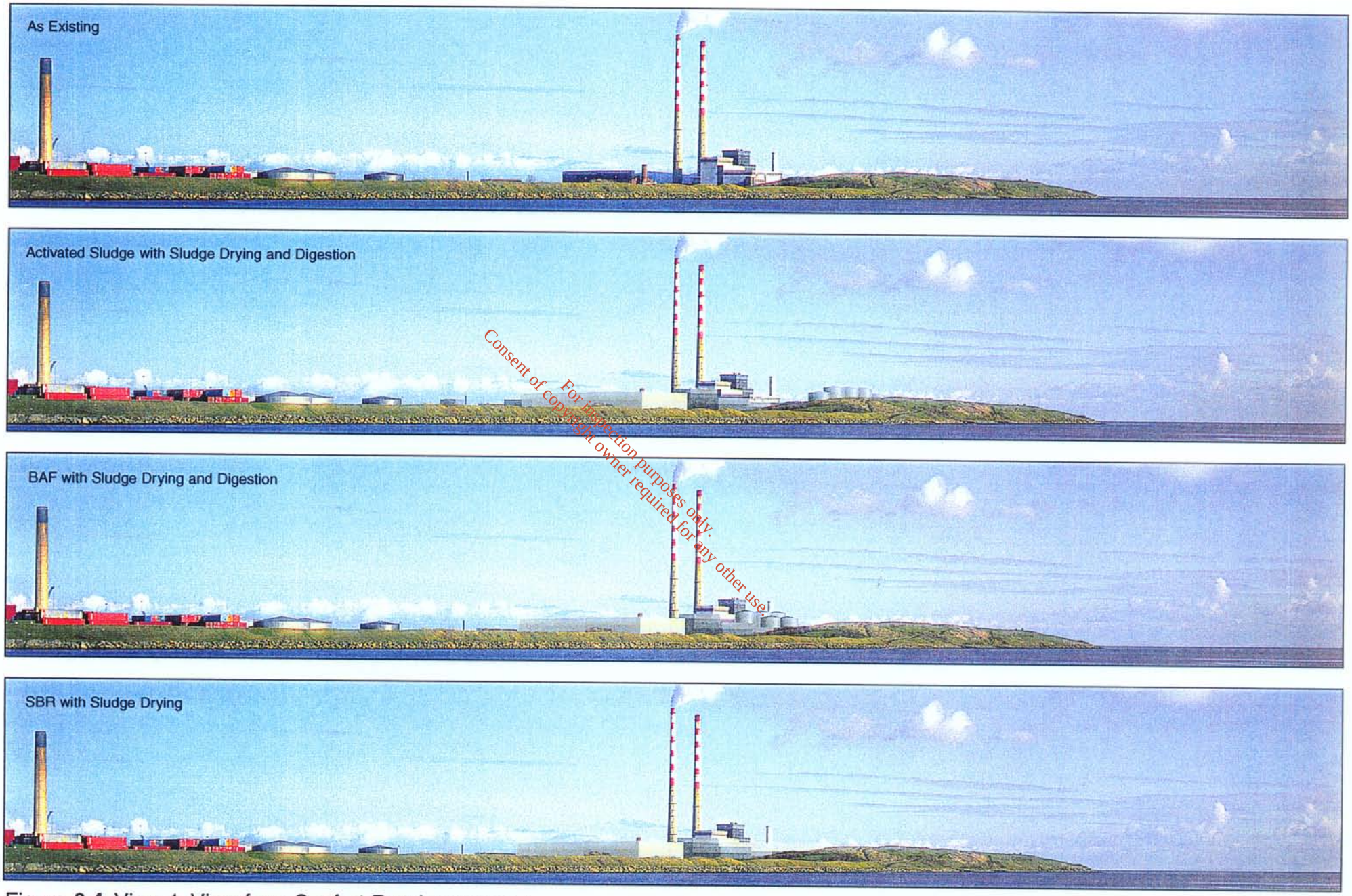

Figure **8.4**; View 1: View from Seafort Road *(4 images)*

8.4.3 Materials and Colour.

Low level tanks etc. will generally be of concrete. One storey and taller units will not be entirely screened from all vantage points, and as such, building and landscape appearance and finish will be most important in mitigating impact. In these instances, the buildings will be detailed with horizontal colour banding similar to those shown in the photomontages, which will help to visually recede the development. Materials will be concrete and non-reflective steel cladding. Tanks will be finished in a non-reflective, grey colour.

8.4.4 Landscaping.

The impact and appearance of the development will also be ameliorated and enhanced through landscape proposals consisting of planting depending on the final arrangement and disposition of the site.

8.4.4.1 Landscape Objectives.

In order to appropriately address the landscape development of the proposed works, objectives were formulated, namely;

- The physical and visual integration of the development into its wider landscape.
- The introduction of the maximum amount of screening into the site to minimise visual intrusion and aim to reduce the negative impacts of the development.

These objectives are reflected in the following:

- Selection and planting of large, hardy shrubs around the perimeter and within the site to reduce visibility into the site.
- Improved presentation of the boundary fence surrounding the site and in particular in the vicinity of Pigeon House Fort.

8.4.4.2 Planting Specification.

The proposed planting will be established through accepted landscape planting techniques, i.e., bare-root transplants and container grown plants.

The species utilised will be selected from a list which will include *Olearia traversii, Tamarix gallica, Escallonia macrantha, Grisselina littoralis, Salix alba, Hippophae rhamnoides* and other plants found surviving in the vicinity of the site.

Grass areas will be topsoiled and seeded with a general (grade II) seed mix.

8.5 RESIDUAL IMPACT.

8.5.1 General.

The site is located in an industrial landscape dominated by the Poolbeg, Ringsend and Pigeon House Generating Stations. The promontory nature of the Poolbeg area results in residential areas being located at the least 900 metres from the site thus reducing impacts upon residential areas.

The significant zone of visibility is generally confined to the immediate site vicinity, with a number of long range views along the south coast of Dublin Bay from Killiney Hill, Dun Laoghaire Pier, Seapoint, Merrion Gates and Sandymount Strand to Clontarf and the Bull Wall to the north.

With the three options, given the appropriate location of elements on the site there is little to differentiate between the three options in terms of visual or landscape impacts save that option 3, the SBR system, will result in a greater site coverage than the other two options.

In conclusion, with completion of construction, familiarity of operation and establishment of planting, the development will be generally harmonious with the area's existing industrial context. This is clearly indicated in the photomontages (see Figures 8.2 to 8.7). In addition, locating the facility at the existing treatment plant site will have substantially lower levels of visual and character impacts, than locating the proposal in a less industrialised area.

Figure **8.5**; View 2: View as existing from Martello Tower *(whole image)*

Figure **8.6**; View 2: View from Martello Tower*(whole image)*

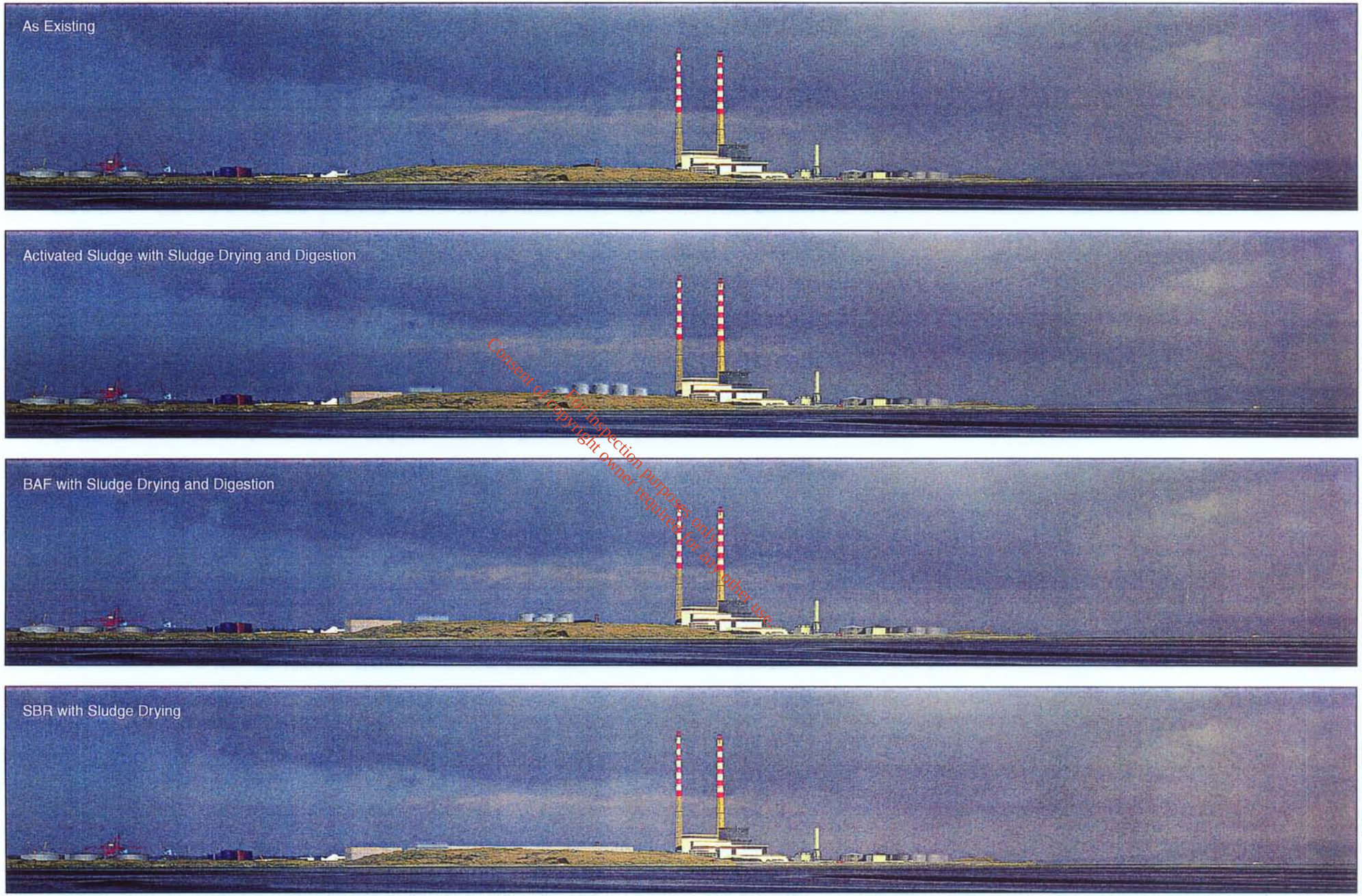

Figure **8.7**; View 2: View from Martello Tower *(4 images)*