

SECTION 7: Odour

7.1 Introduction

This Section of the Environmental Impact Assessment Report (EIAR) assesses the potential odour impact of the Proposed Development during the Construction and Operational Phases. This odour impact assessment has been prepared to assess the potential odour impact of the Proposed Development on the sensitive residential and educational receptors in the vicinity of the Proposed Development site. The construction activities of the Proposed Development will not give rise to odour emissions. The assessment and evaluation of the potential odour impact arising from the Proposed Development involved the following:

- Baseline odour surveys in accordance with EPA Air Guidance Note 5 (AG5) Odour Impact Assessment Guidance for EPA Licensed Sites (EPA 2021); and
- Identification and assessment of potential odour emissions released from the operation of the Proposed Development.

A full description of the Proposed Development including the detailed design information for the EIAR is provided in **Section 4**, The Proposed Development.

7.1.1 Study Area

The Castletroy Wastewater Treatment Plant (WwTP) is located within the Dromroe townland, immediately northwest of the University of Limerick (UL). It is located on the banks of the Lower River Shannon and is accessed via the road system that traverses through the university campus, off Plassey Park Road.

The nearest sensitive receptors are located as follows;

- Properties to the north-east of the WwTP site, at a distance of approximately 130m – 200m from the WwTP site boundary;
- At Dromroe Student Village (Rowan House) to the east of the WwTP site, at a distance of approximately 130m from the WwTP site boundary;
- At Thomond Village (Heron House) to the north-east of the WwTP site, at a distance of approximately 280m from the WwTP site boundary;
- At Stanford Close to the south of the WwTP site, at a distance of approximately 275m from the WwTP site boundary;
- The nearest non-residential receptors to the WwTP site are UL Western Carpark 25m south of the WwTP and UL Boathouse approximately 60m west of the WwTP. Various University of Limerick educational buildings are located in excess of 175m to the south-east from the WwTP site boundary; and
- The Castletroy WwTP site area is approximately 3.166 ha.

7.1.2 Relevant Guidelines, Policy and Legislation

Odour Impact Assessment Guidelines

Odour is the property of a substance that activates the human sense of smell. The human olfactory system is a sensory system used for the detection of odours. It is highly sensitive and as such is capable of detecting extremely low concentrations of a wide range of odorous chemicals. Due to the complex nature of odour perception by the human olfactory system, levels of sensitivity to odour within a population will vary from person to person. In addition, the context in which the odour occurs will affect the nuisance value of the odour.

To put odour concentrations and odour impact assessment criteria guidelines into context, an odour threshold of 1 European Odour Unit per metre cubed (ouE/m^3) is the level at which an odour is detectable by 50% of screened panellists. The recognition threshold is about 5 times this concentration i.e. $5\text{ouE}/\text{m}^3$. Furthermore, an odour concentration of between 5 and $10 \text{ouE}/\text{m}^3$ above background will give rise to a faint

odour and concentrations greater than 10 ouE/m³ constitute a distinct odour and are likely to give rise to nuisance complaints. The exposure of the population to a particular odour consists of two factors; the concentration and the length of time that the population may perceive the odour.

The common EPA licence conditions used for the control of odours include:

'The licensee shall ensure that all operations on-site shall be carried out in a manner such that air emissions and/or odours do not result in significant impairment of, or significant interference with amenities or the environment beyond the site boundary', and/or "The licensee shall ensure that [...] odours do not give rise to nuisance at the facility or in the immediate area of the facility. Any method used by the licensee to control any such nuisance shall not cause environmental pollution'.

Failure to comply with a condition of an EPA licence is an offence under the EPA and Waste Management Acts (for Integrated Pollution Control (IPC), Industrial Emissions (IE) and waste licences respectively). Under these legislative documents odour nuisance equals pollution.

The Chartered Institution of Water and Environmental Management (CIWEM) is of the opinion that dispersion modelling of odorous emissions to ascertain the extent of off-site impact represents a widely accepted method of assessing potential risk of unacceptable impacts (CIWEM 2012). This technique allows the comparison of changes to the sources of odour (i.e. likely improvement to be achieved by mitigation works) and the likely acceptability of different land uses. It is the view of CIWEM that odour impact criteria should be regarded as indicative guidelines and cannot be applied as over-arching statutory numerical standards. CIWEM considers that the following framework is the most reliable that can be defined on the basis of research undertaken in the UK:

- Concentration as a 98th percentile of hourly averages (C98, 1-hour) 10 ouE/m³ - complaints are highly likely and odour exposure at these levels represents an actionable nuisance;
- C98, 1-hour 5 ouE/m³ - complaints may occur and depending on the sensitivity of the locality and nature of the odour this level may constitute a nuisance; and
- C98, 1-hour 3 ouE/m³ - complaints are unlikely to occur and exposure below this level are unlikely to constitute significant pollution or significant detriment to amenity unless the locality is highly sensitive or the odour unpleasant in nature.

The Northern Ireland (NI) Water Odour Policy (NI Water 2016) outlines an assessment criterion of 5 ouE/m³ as the 98th percentile of hourly averages as a standard for the determination of odour nuisance at receptor locations.

Currently there is no general statutory odour standard in Ireland relating to industrial installations. The EPA has issued guidance specific to intensive agriculture which has outlined the following standards:

- Target value for new pig-production units of 1.5 ouE/m³ as a 98th %ile of 1-hour averaging periods;
- Limit value for new pig-production units of 3.0 ouE/ m³ as a 98th %ile of 1-hour averaging periods; and
- Limit value for existing pig-production units of 6.0 ouE/ m³ as a 98th %ile of 1-hour averaging periods.

The Guidance on the Assessment of Odour for Planning (Version 1.1 - July 2018), issued by the IAQM (IAQM 2018), states that 'an appropriate criterion could lie somewhere in the range of 1 to 10 ouE/m³ as a 98th percentile of hourly mean odour concentrations'.

The UK Environment Agency guidance, Additional guidance for H4 Odour Management, how to comply with your environmental permit, outlines that odour benchmarks should be based on the 98th percentile of hourly average concentrations of odour as follows:

- 1.5 odour units for most offensive odours;

- 3 odour units for moderately offensive odours; and
- 6 odour units for less offensive odours.

This guidance outlines example odour sources in terms of offensiveness, as follows:

Most offensive -

- processes involving decaying animal or fish remains
- processes involving septic effluent or sludge
- biological landfill odours

Moderately offensive -

- intensive livestock rearing
- fat frying (food processing)
- sugar beet processing
- well aerated green waste composting
- Most odours from the processes we regulate fall into this category i.e. any odours which do not obviously fall within the “more offensive” or “less offensive” categories

Less offensive -

- Brewery
- Confectionery
- coffee roasting
- baker

The Institute of Air Quality Management Guidance on the assessment of odour for planning (Version 1.1 - July 2018) states that ‘odours from sewage treatment works plant operating normally, i.e. non-septic conditions, would not be expected to be at the ‘most offensive’ end of the spectrum (Table 7.1) and can be considered on par with ‘moderately offensive’ odours such as intensive livestock rearing’.

Table 7.1: Benchmark Odour Criteria (Extracted from Table 5 from 2018 IAQM Odour Guidance)

Criterion, C_{98} ou _E /m ³	Offensiveness	Odour Emission Sources
1.5	Most Offensive	Processes involving decaying animal or fish remains Processes involving septic effluent or sludge Biological landfill odours
3.0	Moderately Offensive	Intensive livestock rearing Fat frying (food processing) Sugar beet processing Well aerated green waste composting
6.0	Less Offensive	Brewery Confectionery Coffee

The IAQM Odour Guidance has considered odour concentration change descriptors together with impact descriptors for odours at the ‘most offensive’ and ‘moderately offensive’ end of the spectrum, as outlined in Table 7.2 and

Table 7.3. These criteria are consistent in format and concept with other guidance, adopt the C98 as the appropriate frequency metric, encompass the 1 to 10 ouE/m³ concentration range referred to above and also consider the potential sensitivity of different receptors. Examples of receptors that fall into the above sensitivity categories are contained in Table 7.4.

Table 7.2: Proposed Odour Effect Descriptors for Impacts Predicted by Modelling – “Most Offensive” Odours (Table 6 from 2018 IAQM Odour Guidance)

Odour Exposure Level C_{98} , ou _E /m ³	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5-10	Moderate	Moderate	Substantial
3-5	Slight	Moderate	Moderate
1.5-3	Negligible	Slight	Moderate
0.5-1.5	Negligible	Negligible	Slight
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms “adverse” or “beneficial” should be added to the descriptors.

Table 7.3: Proposed Odour Effect Descriptors for Impacts Predicted by Modelling – “Moderately Offensive” Odours (Table 7 from 2018 IAQM Odour Guidance)

Odour Exposure Level $C_{98}, \text{ou}_E/\text{m}^3$	Receptor Sensitivity		
	Low	Medium	High
≥ 10	Moderate	Substantial	Substantial
5-<10	Slight	Moderate	Moderate
3-<5	Negligible	Slight	Moderate
1.5-<3	Negligible	Negligible	Slight
0.5-<1.5	Negligible	Negligible	Negligible
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms “adverse” or “beneficial” should be added to the descriptors.

Table 7.4: Receptor Sensitivity to Odours (Table 2 from 2018 IAQM Odour Guidance)

For the sensitivity of people to odour, the IAQM recommends that the Air Quality Practitioner uses professional judgement to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the following general principles:

High sensitivity receptor	<p>Surrounding land where:</p> <ul style="list-style-type: none"> users can reasonably expect enjoyment of a high level of amenity; and people would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. <p>Examples may include residential dwellings, hospitals, schools/education and tourist/cultural.</p>
Medium sensitivity receptor	<p>Surrounding land where:</p> <ul style="list-style-type: none"> users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or people wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. <p>Examples may include places of work, commercial/retail premises and playing/recreation fields.</p>
Low sensitivity receptor	<p>Surrounding land where:</p> <ul style="list-style-type: none"> the enjoyment of amenity would not reasonably be expected; or there is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. <p>Examples may include industrial use, farms, footpaths and roads.</p>

Adopted Odour Impact Assessment Criteria

Based on a review of the relevant guidance in terms of odour impacts from wastewater treatment sources and the criteria outlined in Table 7.2,

Table 7.3 and Table 7.4 the following odour thresholds are recommended to be achieved by the Proposed Development :

- The odour concentration at the sensitive receptors close to the existing Castletroy WwTP and Proposed Development shall not exceed 3 ouE/m³ as the 98th percentile of hourly averages.

7.1.3 Data Collection and Collation

Site visits to undertake the relevant baseline odour surveys and assess the proximity of the nearest residential properties were arranged with JB Barry & Partners and the operators of the site.

Site visits were undertaken during suitable meteorological conditions to allow for potentially worst-case conditions to prevail during the baseline odour surveys. The forecasted weather conditions were carefully assessed prior to undertaking the site visits.

All site notes and recordings were noted in accordance with the EPA, Odour Impact Assessment Guidance for EPA Licensed Sites (AG5) (2021).

7.2 Assessment Methodology

7.2.1 Assessment of Odour Impacts

Baseline Odour Surveys

Odour surveys were undertaken in accordance with the site inspection procedures outlined in the EPA approved Site Inspection Procedure methodologies contained in Odour Impact Assessment Guidance for EPA Licensed Sites (AG5) (EPA 2021). Subjective odour surveys were undertaken both within the existing WwTP site and at sensitive receptor locations in proximity to the Proposed Development site (see Odour Survey Sheets in EIA **Volume 3, Appendix 7A, Table 7.2**). The odour survey findings are discussed in **Section 7.2.2**.

Odour Dispersion Modelling

The American Meteorological Society (AMS) / EPA Regulatory Model (AERMOD) is the current US EPA regulatory model used to predict pollutant concentrations from a wide range of sources that are present at typical industrial facilities and wastewater treatment plants. The model estimates the concentration or deposition value for each source and receptor combination for each hour of meteorological data and calculates user-selected short-term averages. Since most air quality standards are stipulated as averages or percentiles, AERMOD allows further analysis of the results for comparison purposes. Percentile analysis for emissions is calculated for the maximum averages using the AERMOD-percent post-processing utility. This utility calculates the maximum concentration of a pollutant from all receptors at a specific percentile, for a specific period. Employing the percentile facilitates the omission of unusual short-term meteorological events that cause elevated pollutant concentrations and hence a more accurate representation of the likely average pollutant concentrations over an averaging period of 1 hour, for example.

The following information was input into the odour dispersion model for the prediction of odour concentrations at the nearest sensitive receptors in proximity to the Castletroy WwTP and the Proposed Development.

Site Map and Cartesian Grid

The site layout map was supplied to the EIA team in .dwg format, which was imported into the model. The map included the site boundary and all relevant buildings and tanks. The boundary and all relevant structures were traced accurately, and the relevant wastewater treatment plant odour emission sources were included.

Buildings

When one or more buildings or tanks in the vicinity of an odour source interrupt wind flow, an area of turbulence known as a building wake is created. Pollutants emitted from a relatively low level can be caught in this turbulence, affecting their dispersion. This phenomenon is called building downwash. In order to conduct an extensive analysis of downwash effects of all point sources, the dimensions (including heights) of all significant buildings or tanks on-site were obtained from drawings supplied by the client and inputted into the model. The downwash effects are determined using the building profile input programme (BPIP) which is run prior to all modelling runs.

Meteorological Data

Three years of hourly sequential meteorological data from the Shannon Meteorological Station (2019-2021) was used in the AERMOD dispersion modelling assessment. This is considered to be a representative meteorological station for the Castletroy area as the meteorological station is located approximately 22Km west of the Castletroy WwTP site. This allows for the prediction of a worst-case impact due to odour emissions from the Proposed Development. All meteorological data has been pre-processed using the AERMET programme with the following land use classifications:

- Albedo 0.29
- Bowen Ratio 0.925
- Surface Roughness 0.04025

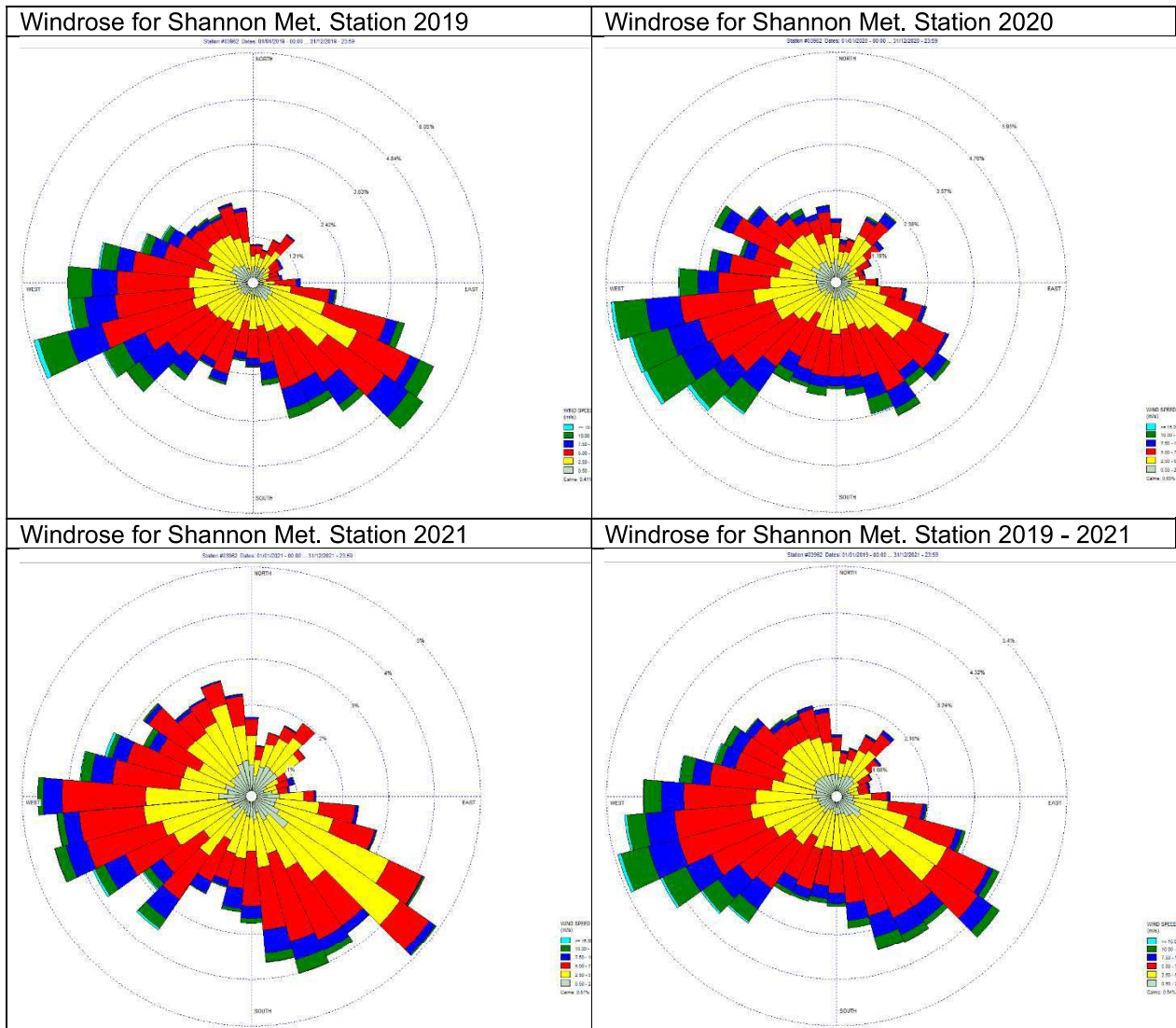


Figure 7-1: Meteorological data from the Shannon Meteorological Station (2019-2021)

Sources

The site layout map was used as a template for the locations of the proposed wastewater treatment plant odour sources. Wastewater treatment plant odour sources are modelled as area (open tank) and point (Odour Control Unit stack) sources. A point source is one that releases pollutants from an opening, such as a stack or vent. An area source is one that releases pollutants from an open tank or flat surface.

Odour Emission Rate Calculations

The rate of production of a pollutant or odour emission is best quantified as an emission rate.

For a stack or vent, this is equivalent to the odour concentration (ouE/m^3) multiplied by the air flow rate (m^3/s). It is the mass of odorous pollutant emitted from a source per second and is expressed in ouE/s . On a WwTP, such a stack source (or point source) would typically relate to an Odour Control Unit stack.

For an area source, this is the mass of odorous pollutant emitted per m^2 of surface area per unit time and is expressed in $\text{ouE}/\text{m}^2/\text{s}$. Such an area source would typically relate to uncovered tanks such as inlet works, primary settlement tanks, aeration tanks, final settlement tanks, etc.

To determine the odour impact from WwTP sources using dispersion modelling, odour emission rates from individual sources are required. It is possible to undertake odour monitoring at individual odour sources on site, derive an odour emission rate from each source and input the derived odour emission rates directly into an odour dispersion model. However, the issue with such an approach is that odour emission rates from typical WwTP sources can vary considerably on a WwTP site from day to day, month to month and season to season for a variety of reasons, including volume throughput, meteorological conditions, operational issues, etc.

The primary aim of the odour impact assessment is to predict the potential effect of odour emitted from the Proposed Development at the nearest sensitive receptor locations. As source-specific odour monitoring has not been undertaken at the WwTP, typical odour emission rates from various sources and the NI Water 'Example Odour Emission Rates for WwTW Sources' outlined in Operational Technical Support Guidance Notes – Odour Assessment Standard (NI Water 2016) have been referenced for use in the odour dispersion model.

The selected odour emission rates were inserted into the odour dispersion model to predict odour concentrations at the nearest sensitive receptor locations due to the operation of the existing Castletroy WwTP and the Proposed Development. This approach allowed for the following:

- A comparison of worst-case odour concentrations as a 98th percentile of hourly averages and annual mean due to the existing Castletroy WwTP and the Proposed Development;
- A comparison of worst-case odour concentrations against the suggested odour criterion of 3 ouE/m^3 as a 98th percentile of hourly averages at the nearest residential properties; and
- Determine a worst-case relative odour impact with the Proposed Development in operation in accordance with the proposed odour effect descriptors for impacts for "Most Offensive" odours as outlined in the 2018 IAQM Odour Guidance.

Table 7.5 is taken from Operational Technical Support Guidance Notes – Odour Assessment Standard (NI Water 2016) and shows typical emission rates for processes based on monitoring data collected in Northern Ireland.

Table 7.5: Example Odour Emission Rates for WwTP Sources (Source; NI Water)

Process Source	Odour Emission Rate ($\text{ouE}/\text{m}^2/\text{s}$) Northern Ireland Sites
Inlet works	5.65
Primary Settlement Tank (PST)	4.18
Activated Sludge Plant (ASP)	1.49
Final Settlement Tank (FST)	0.62
Stormwater storage tank	1.17
Sludge Cake Storage	2.19 *

Note: * Odour Emission Rate ($\text{ouE}/\text{m}^2/\text{s}$) UK Average.

The following odour sources and odour emission rates have been used in the 'existing' and 'proposed' odour models in the odour dispersion modelling based on the sources identified during the odour surveys and the proposed design drawings and project description. **Table 7.6** outlines the 'Existing' odour sources and odour emission rates from the Existing Castletroy WwTP. **Table 7.7** outlines the 'Proposed' odour sources and odour emission rates after the installation of the Proposed Development at the Castletroy WwTP.

Table 7.6: 'Existing' odour sources and odour emission rates - Odour Emission Rates from the Main Sources Identified During the Course of the Baseline Survey on the Existing Castletroy WwTP.

Emission Source	Surface Exposed Area (m ²)	Efflux Velocity (m/s)	Odour Emission Concentration (ouE/m ³ or ouE/m ² /s)	Odour Emission Rate (ou/s)	Notes
Inlet Works	145m ²	<0.1m/s	25 ouE/m ² /s	3,625 ou/s	Realistic emission rate based on site survey
Aeration Tanks	1,050m ²	<0.1m/s	2 ouE/m ² /s	2,100 ou/s	Realistic emission rate based on site survey
Clarifier 1	315m ²	<0.1m/s	0.5 ouE/m ² /s	158 ou/s	Realistic emission rate based on site survey
Clarifier 2	315m ²	<0.1m/s	0.5 ouE/m ² /s	158 ou/s	
Clarifier 3	495m ²	<0.1m/s	0.5 ouE/m ² /s	248 ou/s	
PFT Tank 1	50m ²	<0.1m/s	2.8 ouE/m ² /s	140 ou/s	Realistic emission rate based on site survey
PFT Tank 2	120m ²	<0.1m/s	1.15 ouE/m ² /s	140 ou/s	Realistic emission rate based on site survey
Sludge Building	20m ²	<0.1m/s	460 ouE/m ² /s	9,260 ou/s	
Skip Screenings	3m ²	<0.1m/s	15 ouE/m ² /s	45 ou/s	Realistic emission rate based on site survey
Total Odour Emission Rate				15,874 ou/s	

Three Odour Control Units (OCU) will be included in the proposed design as follows;

OCU 1 – the volumetric odour emission rate should be equivalent to the incoming flow - Main Pump Station 3,000 m³/hr plus the Inlet Works 3,000 m³/hr (6,000 m³/hr in total - worst case) x a factor of safety (of 1.333), implies a volumetric emission rate of 8,000 m³/hr. The 8,000 m³/hr shall be extracted and will be treated in an odour control system capable of achieving an exhaust odour threshold concentration of less than 500 ouE/m³.

OCU 2 - the volumetric emission rate should be equivalent to the incoming flow for the Splitter + Salsnes Filters x 4 and the Covered Sludge Tank = c. 2,500 m³/hr. This does not include the new building. The c. 2,500 m³/hr shall be extracted and will be treated in an odour control system capable of achieving an exhaust odour threshold concentration of less than 500 ouE/m³.

OCU 3 - The sludge dewatering building leaks odours due to the open vents and doors. The building will be made airtight and ventilated under negative pressure. The volumetric emission rate should be equivalent to the volume of the existing sludge building with an estimated 12 air changes per hour plus the volume going through the sludge dewatering machines, implies a volumetric emission rate of 8,000 m³/hr. The 8,000 m³/hr shall be extracted and will be treated in an odour control system capable of achieving an exhaust odour threshold concentration of less than 500 ouE/m³.

Table 7.7: 'Proposed' odour sources and odour emission rates - Odour Emission Rates from the Main Sources after the Proposed Development

Emission Source	Surface Exposed Area (m ²)	Efflux Velocity (m/s)	Odour Emission Concentration	Odour Emission Rate (ou/s)	Notes
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			(ou/m ³ or ou/m ² /s)		
Inlet Works	-	-	-	-	To be covered and ventilated thru OCU 1 (See below)
Aeration Tanks	1,050m ²	<0.1m/s	1.49 ou _E /m ² /s	1,565 ou/s	Emission rate reduced to 1.49 ou _E /m ² /s (Ref. NI Water) – Improvement due to Salsnes Filter
Clarifier 1	315m ²	<0.1m/s	0.4 ou _E /m ² /s	127 ou/s	Realistic emission rate based on site improvements
Clarifier 2	315m ²	<0.1m/s	0.4 ou _E /m ² /s	127 ou/s	
Clarifier 3	495m ²	<0.1m/s	0.4 ou _E /m ² /s	198 ou/s	
PFT Tank 2 (existing)	120m ²	<0.1m/s	1.15 ou _E /m ² /s	140 ou/s	Assume unchanged emission rate Plus new PFT Tank added
PFT Tank (new)	120m ²	<0.1m/s	1.15 ou _E /m ² /s	140 ou/s	Same emission rate as existing PFT Tank
Thickened Sludge Storage Tanks	-	-	-	-	PFT Tank 1 (existing) to be covered and OCU provided – extracted to OCU 3 (See below)
Sludge Building	-	-	-	-	Enclosed and negative pressure ventilation – extracted to OCU 3
Stormwater storage tank	800m ²	<0.1m/s	0.5 ou _E /m ² /s	400 ou/s	Variable emission rate depending on weather (See below)
Skip Screenings	-	-	-	-	Covered – extracted to OCU 1
Total Odour Emission Rate				2,697 ou/s	Assuming emissions from stormwater storage tank (not constant)

Table 7.8: Odour Control Unit Specifications

OCU No.	Stack Diameter (m)	Stack Exit Velocity (m/s)	Volume Flow (m ³ /hr)	Odour Emission Conc. (ou/m ³)	Odour Emission Rate (ou/s)	Notes
1	0.5	11.4	8054.1	500	1,118.6	New OCU for Main Pump Station plus Inlet Works (~8,000 m ³ /hr)
2	0.3	10	2543.4	500	353.3	New OCU for Splitter + Salsnes Filters x 4 and new Covered Sludge Tank (~2,500 m ³ /hr)
3	0.5	11.4	8054.1	500	1,118.6	New OCU for Sludge building (x 12 air changes / hour plus sludge dewatering ~8,000 m ³ /hr)
Total Odour Emission Rate					2,590.5	

Receptors

The following receptor locations in proximity to the Castletroy WwTP have been selected for detailed assessment in the odour dispersion model. All other receptors in the wider area surrounding the Castletroy WwTP site will experience a lower odour impact. These locations are shown in Figure 7-2. SR1 – SR15 represent residential receptor locations. SR16 – SR19 represent University of Limerick receptor locations.

Table 7.9: Nearest Sensitive Residential Receptor Locations to the Castletroy WwTP

Receptor Reference	ITM Grid Reference		Distance to Nearest Site Boundary (m)
	X (m)	Y (m)	
SR1	560847.5	658623.5	130m
SR2	560865.9	658624.4	142m
SR3	560883.9	658620.5	152m
SR4	560899.3	658625.2	165m
SR5	560919	658626.9	183m
SR6	560946.8	658630.4	202m
SR7	560872.4	658806.8	268m
SR8	560934.1	658781.5	295m
SR9	560981.9	658789.1	338m
SR10	560957.1	658487.4	130m
SR11	560954.5	658443.3	130m
SR12	560782.3	658095.2	275m
SR13	560680.8	658086.9	280m
SR14	560101.5	658848.1	580m
SR15	560145.8	658929.4	585m
R16 (Car park to south)	560799.9	658379.2	30m
R17 (UL Boathouse)	560556.9	658466.3	75m
R18 (Nexus Innovation Centre)	560950.6	658317.2	170m
R19 (UL Building)	560917.5	658244.7	210m

Ground level pollutant concentrations were also predicted at every node on Cartesian grids as follows:

- Cartesian Grid 1 – 1,250m x 1,250m @ 50m spacing, ITM Grid Centre Coordinates – 560700, 658500;
- Cartesian Grid 2 – 500m x 500m @ 25m spacing, ITM Grid Centre Coordinates – 560700, 658500; and
- Boundary fence line receptors were also assessed at 5m intervals along the WwTP boundary.

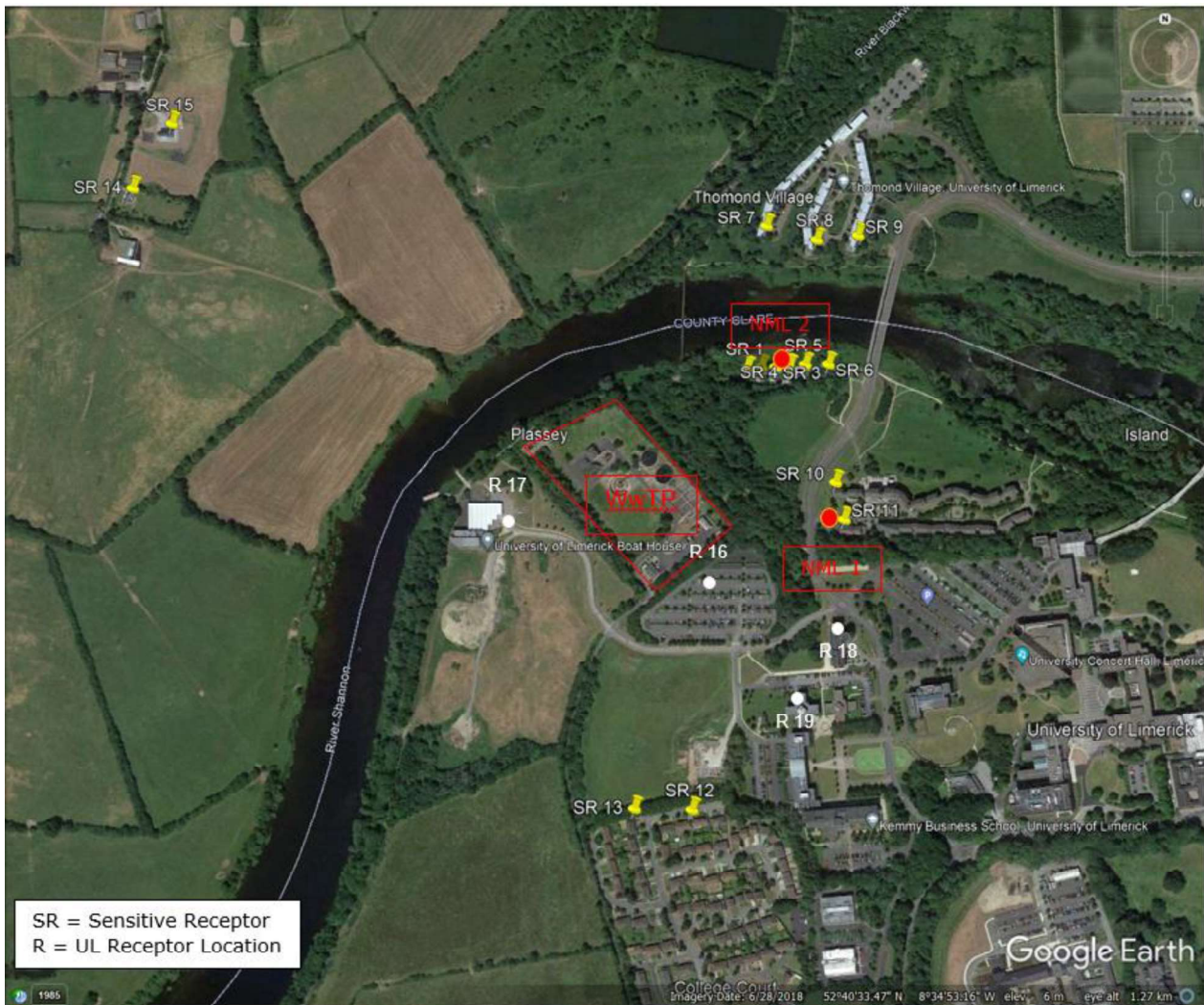


Figure 7-2: Nearest Sensitive Residential Receptor Locations to the Proposed Development

7.3 Baseline Conditions

7.3.1 Baseline Odour Surveys

On Tuesday 21st September 2021 Mervyn Keegan of AONA Environmental Consulting Ltd. visited the Castletroy WwTP site in order to review the existing WwTP and assess the strength of odours emanating from the main odour sources on site.

During the on-site odour surveys, it was noted that the odours emitted from the uncovered inlet works and sludge building were a source of particularly and immediately detectable strong odours. Strong odours were immediately detected in proximity to the inlet works. This consisted of a string sickly sweet odour with surfactants present. Strong odours were immediately detected in proximity to the sludge building which is naturally ventilated through a large roller-door on the western façade of the building as well as through small vents on the building façade. Throughout the remainder of the WwTP site, faint to moderate odours were detected in proximity to the aeration tanks, the clarifiers and the sludge thickening tanks.

On Tuesday 21st September 2021 Mervyn Keegan of AONA Environmental Consulting Ltd. undertook odour surveys in proximity to the nearest residential properties to the Castletroy WwTP site during the following periods and weather conditions:

- Afternoon on Tuesday 21st September 2021 (12:45 – 15:45) - weather conditions during the assessment period were dry and warm (~18°C), wind direction was from a west – south westerly direction and wind strength was characterised as “Light Air” using the Beaufort scale;
- Night-time on Tuesday 21st September 2021 (22:50 – 23:35) - weather conditions during the assessment period were dry and mild (~13°C), wind direction was from a south westerly direction and wind strength was characterised as “Light Breeze” using the Beaufort scale; and
- During both survey periods, Castletroy WwTP was in operation. The odour surveys were undertaken during periods when the prevailing weather conditions were most likely to allow for odours to disperse across the nearest residential properties. The forecasted weather conditions were carefully assessed prior to undertaking the site visits. During each site visit, a number of individual subjective odour assessment surveys were undertaken in accordance with the EPA AG5 Guidance (EPA 2021).

During the odour surveys, a series of 5-minute individual observations at each location were conducted. The objective of each observation, which included locations upwind and downwind of the Castletroy WwTP, was to assess for the presence of typical WwTP type odours and for the presence of odours from any other source.

During the odour surveys, odours from the existing Castletroy WwTP sources were noted to be detectable at the boundary of the Proposed Development site. During the off-site odour surveys, it was noted that faint WwTP-type odours were detected in proximity to nearby residential properties. The odours were noted to have the potential to give rise to odour nuisance in proximity to the nearest residential properties. During the odour assessment surveys, no odours were detected to be coming from any other source.

The Odour Survey Reporting Forms and relevant locations maps used for recording on-site conditions during each survey period are included in Appendix 8A in Volume 4 of this EIAR for reference.

7.4 Characteristics of the Proposed Development

Details of the Proposed Development are provided in the EIAR **Part A , Section 4**.

7.5 Likely Significant Effects

7.5.1 Do Nothing’ Scenario

The ‘Do Nothing’ scenario will result in the existing Castletroy WwTP continuing to operate without any changes. The nearest residential properties are located within approximately 130m from the Castletroy WwTP boundary. University of Limerick student accommodation buildings are located downwind of the Castletroy WwTP for in excess of 50% of the year when the windrose presented for Shannon Meteorological Station (2019 – 2021) is reviewed.

7.5.2 Construction Phase

The Proposed Development will not give rise to any significant odour impacts during construction. If any such impacts do occur these will be a short duration and temporary.

7.5.3 Operational Phase

Odour Impact Assessment

The results of the odour dispersion modelling assessment based on worst-case odour emissions from the existing Castletroy WwTP and the Proposed Development are presented in Table 7.10 and Figure 7-3 and Figure 7-4. Table 7.10 indicates the 98th percentile of maximum 1 hour ground level odour concentrations at the nearest sensitive residential properties (SR1 – SR15) and at the nearest receptor locations (R16 – R19) for each of the three years of Shannon Airport meteorological data used in the assessment for the

existing and upgraded Castletroy WwTP. It can be seen that odour units at the highly sensitive receptors do not exceed the 0.5 – 1.5 OU/m³ range following the upgrade works, hence achieving of 3 OU/m³ standard.

Table 7.10: Predicted Worst-Case 98th Percentile of Hourly Average Odour Concentrations for 2019 – 2021, at the nearest Sensitive Residential Properties (SR1 – SR15) and the receptor locations (R16 – R19) Including ‘Odour Effect Descriptor’ in Accordance with IAQM

Predicted Odour Concentrations from Existing & Proposed Castletroy WWTP											
Receptor	2019 - Existing	2020 - Existing	2021 - Existing	Maximum - Existing	2019 – Proposed Upgrade	2020 - Proposed Upgrade	2021 - Proposed Upgrade	Maximum- Proposed Upgrade	Receptor Sensitivity	Exposure Level C ₉₈ , ou/m ³	Odour Effect Descriptor
SR1	2.52	2.61	2.70	2.70	0.70	0.65	0.73	0.73	High	0.5 - 1.5	Slight
SR2	2.45	2.36	2.54	2.54	0.64	0.59	0.68	0.68	High	0.5 - 1.5	Slight
SR3	2.10	2.20	2.37	2.37	0.58	0.55	0.67	0.67	High	0.5 - 1.5	Slight
SR4	1.95	2.01	2.19	2.19	0.53	0.52	0.59	0.59	High	0.5 - 1.5	Slight
SR5	1.80	1.82	2.02	2.02	0.49	0.48	0.54	0.54	High	0.5 - 1.5	Slight
SR6	1.56	1.71	1.83	1.83	0.43	0.46	0.47	0.47	High	0.5 - 1.5	Slight
SR7	0.96	0.94	1.04	1.04	0.24	0.25	0.28	0.28	High	0.5 - 1.5	Slight
SR8	0.94	0.91	0.97	0.97	0.23	0.21	0.25	0.25	High	0.5 - 1.5	Slight
SR9	0.81	0.78	0.90	0.90	0.19	0.18	0.23	0.23	High	0.5 - 1.5	Slight
SR10	2.35	2.53	2.71	2.71	0.69	0.78	0.85	0.85	High	0.5 - 1.5	Slight
SR11	2.38	2.79	2.94	2.94	0.68	0.72	0.79	0.79	High	0.5 - 1.5	Slight
SR12	0.73	0.93	1.36	1.36	0.16	0.25	0.30	0.30	High	0.5 - 1.5	Slight
SR13	0.57	0.78	1.20	1.20	0.10	0.17	0.22	0.22	High	0.5 - 1.5	Slight
SR14	0.58	0.53	0.67	0.67	0.12	0.11	0.13	0.13	High	0.5 - 1.5	Slight
SR15	0.58	0.46	0.78	0.78	0.12	0.10	0.16	0.16	High	0.5 - 1.5	Slight
R16	9.58	10.21	11.50	11.50	1.49	1.67	2.07	2.07	Low	0.5 - 1.5	Slight
R17	3.16	4.15	5.53	5.53	0.44	0.54	0.69	0.69	Medium	0.5 - 1.5	Slight
R18	2.12	2.21	2.04	2.21	0.56	0.61	0.57	0.61	Medium	0.5 - 1.5	Slight
R19	1.83	1.74	1.95	1.95	0.49	0.47	0.51	0.51	Medium	0.5 - 1.5	Slight

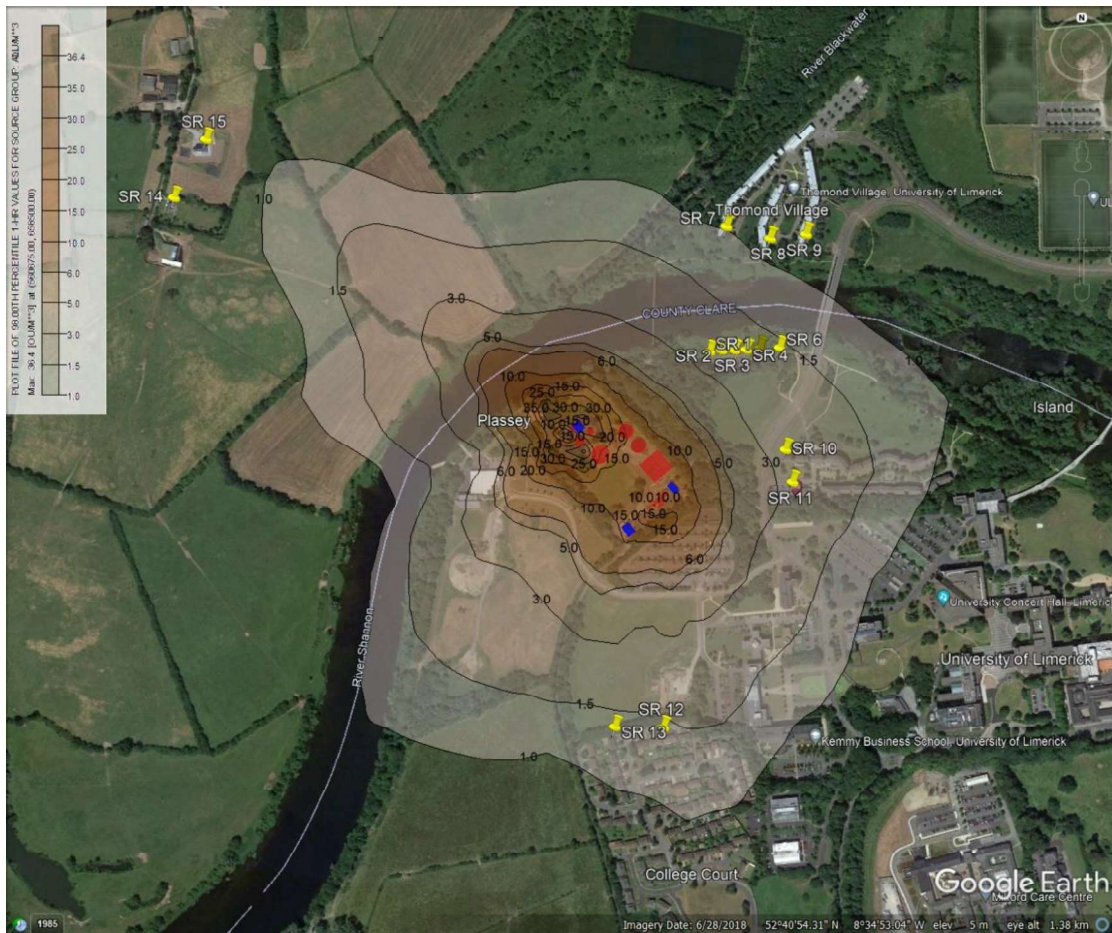


Figure 7-3: Existing Castletroy WwTP - Predicted Worst-Case 98th Percentile of Hourly Average Odour Concentrations 2021.



Figure 7-4: Proposed Development to Castletroy WwTP - Predicted Worst-Case 98th Percentile of Hourly Average Odour Concentrations 2021.

As outlined in Table 7.10, the predicted worst-case odour concentrations as a 98th percentile of hourly averages for the three years of meteorological data assessed for the existing Castletroy WwTP and the Proposed Development indicate a 'slight' odour effect at the nearest Sensitive Residential Properties (SR1 – SR15) and the receptor locations (R16 – R19) when assessed in accordance with IAQM Guidance on the Assessment of Odour for Planning (2018).

The predicted 'difference' in the worst-case odour concentrations as a 98th percentile of hourly averages for the three years of meteorological data assessed between the existing Castletroy WwTP and the Proposed Development indicate a 68% - 81% reduction in odour concentrations at the nearest Sensitive Residential Properties (SR1 – SR15).

An increase or decrease in odour concentration of $1\text{ou}_E/\text{m}^3$ is not detectable to the human nose in ambient conditions. By definition in terms of olfactometry panels, $1\text{ou}_E/\text{m}^3$ is the odour concentration *recognized or identified* by 50% of an odour panel ($1\text{ou}_E/\text{m}^3$ corresponds to the detection threshold). Therefore, the concentration at which the odour is *identified* by 50% of a panel is higher than $1\text{ou}_E/\text{m}^3$. It is also important to note that this is in idyllic laboratory conditions for odour detection.

According to research, the recognition threshold for ambient odours is about five times this concentration i.e. $5\text{ou}_E/\text{m}^3$. Furthermore, odour concentrations of between 5 and $10\text{ou}_E/\text{m}^3$ above background will give rise to a faint odour and concentrations greater than $10\text{ou}_E/\text{m}^3$ constitutes a distinct odour and are likely to give rise to nuisance complaints.

Therefore, the predicted worst-case odour concentrations from the existing Castletroy WwTP and the Proposed Development are below the CIWEM and the NI Water Odour Policy assessment criterion of 5 ou_E/m³ as the 98th percentile of hourly averages as a standard for the determination of odour nuisance at receptor locations. It is considered that the worst-case assessment of the Proposed Development indicates that potential future odour impact should not be considered to be a development constraint for the Proposed Development.

Based on the odour dispersion model of the Proposed Development of the Castletroy WwTP, it is concluded that the adopted Odour Impact Assessment Criteria of 3 ou_E/m³ as the 98th percentile of hourly averages, will be achieved at all of the nearest sensitive locations in proximity to the Castletroy WwTP site.

Based on the odour dispersion model of the Proposed Development of the Castletroy WwTP, it is concluded that there will be no potential to give rise to significant nuisance, or to significant impairment of, or significant interference on the environment of future residents due to the operations of the Proposed Development.

Table 7.11: Summary of Predicted Operational Phase Impacts

Assessment Topic	Predicted Impact
Odour	Slight, Permanent Positive Impact with proposed design WwTP upgrade improvements

7.6 Mitigation Measures and Monitoring

7.6.1 Construction Phase

There are no odour mitigation measures applicable to the construction phase of the Proposed Development.

7.6.2 Operational Phase

In terms of the Operational Phase of the Proposed Development there are no specific mitigation measures to be applied to the proposed design. The predicted operational impact of the Proposed Development will be a 'slight' odour effect at the nearest residential properties (SR1 – SR15) when assessed in accordance with IAQM Guidance on the Assessment of Odour for Planning (IAQM 2018).

7.7 Residual Effects

7.7.1 Construction Phase

No residual odour impacts were identified during or as a result of the Construction Phase of the Proposed Development.

7.7.2 Operation Phase

No significant residual impacts were identified after implementation of the Proposed Development.

The predicted worst-case odour concentrations as a 98th percentile of hourly averages for the three years of meteorological data assessed for the existing Castletroy WwTP and the Proposed Development indicate a 'slight' odour effect at the nearest Sensitive Residential Properties (SR1

– SR15) and the receptor locations (R16 – R19) when assessed in accordance with IAQM Guidance on the Assessment of Odour for Planning (2018).

The predicted ‘difference’ in the worst-case odour concentrations as a 98th percentile of hourly averages for the three years of meteorological data assessed between the existing Castletroy WwTP and the Proposed Development indicate a 68% - 81% reduction in odour concentrations at the nearest Sensitive Residential Properties (SR1 – SR15).

The adopted Odour Impact Assessment Criteria of 3 ouE/m³ as the 98th percentile of hourly averages, will be achieved at all of the nearest sensitive locations in proximity to the Castletroy WwTP site. Based on the odour dispersion model of the existing Castletroy WwTP and the Proposed Development, it is concluded that there will be no potential to give rise to significant nuisance, or to significant impairment of, or significant interference on the environment of future residents due to the operations of the Proposed Development.

As outlined, there will be a “Slight, Permanent Positive Impact” with proposed design WwTP upgrade improvements.

7.8 References

Chartered Institute of Water and Environmental Management (CIWEM) (2012). Position Statement - Control of Odour

Environment Agency, Environment and Heritage Service & Scottish Environmental Protection Agency (2002). Integrated Pollution Prevention and Control (IPPC) - Draft Horizontal Guidance for Odour - Part 1, Regulation and Permitting

Environmental Protection Agency (EPA 2021). Odour Impact Assessment Guidance for EPA Licensed Sites Air Guidance Note 5 (AG5)

Environmental Protection Agency (EPA) (2020). Air Dispersion Modelling from Industrial Installations Guidance Note Air Guidance Note 4 (AG4)

Institute of Air Quality Management (IAQM) (2018). Guidance on the Assessment of Odour for Planning

Northern Ireland Water (2016). Operational Technical Support Guidance Notes – Annex B, Odour Assessment Standard