6. Conclusions and Recommendations

The following conclusions were gathered from the study:

1. The odour measurement and dispersion modelling assessment was carried out in line with recommended guidance include EPA AG4. Odour sampling and measurement survey was carried out over a three day sampling period on the 5th, 6th and 10th August 2021. Dispersion modelling assessment was carried out utilising the latest USEPA regulatory model Aermod Prime 21112 with five years of hourly sequential meteorological data and appropriate topographical data for the site and surrounding area.

2. With regards to the odour emission rate for the existing Drogheda WwTP, the overall odour emission rate was 103,274 OuE/s with PST 2 and 3 in operation. The most significant odour sources in terms of odour character, intensity and hedonic tone were the Primary settlement tanks, Outflow chamber from the Primary settlement tanks, Inlet flow distribution chamber to the Anoxic / Aerobic tanks, Sludge holding tanks, Sludge thickening building, Sludge storage skips and AD tank leakage. With regards to these odour sources, these contribute to 61% of the overall odour load to atmosphere from the existing facility.

3. With regards to Scenario 1 – Model 1 and Model 2 – Existing operations with 3 PST tanks in operation, as can be observed, it is predicted that the levels of odours from the existing Drogheda Waste water Treatment Plant is likely to generate odour impact in the vicinity of the facility. Residential and commercial receptors located to the North, West, East and South of the operational facility will experience odour levels which are likely to give rise to odour complaints (*see Figures 7.3 & 7.4*). Given the nature of the predominant odours on site and given their odour character and hedonic tone, these are likely to elicit strong negative reactions from receptors that detect the odours. Given this fact, stricter odour impact criteria are required to assess this odour impact during existing operations. With regards to detectable odour levels, residential and commercial receptors will perceive maximum odour levels up to 3.58 Ou_E/m^3 for the 98th percentile of hourly averages for worst case meteorological year Dublin 2019 and 9.96 Ou_E/m^3 for the 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019. This is in excess of the proposed odour impact criterion of less than or equal to 1.0 Ou_E/m^3 and 1.50 Ou_E/m^3 for the 98th and 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019 for existing operations.

4. With regards to Scenario 1 – Model 3 and Model 4 – Existing operations with 2 PST tanks in operation (current situation on site as PST 1 is not in use at present), as can be observed, it is predicted that the levels of odours from the existing Drogheda Waste water Treatment Plant is likely to generate odour impact in the vicinity of the facility. Residential and commercial receptors located to the North, West, East and South of the operational facility will experience odour levels which are likely to give rise to odour complaints (*see Figures 7.5 & 7.6*). Given the nature of the predominant odours on site and given their odour character and hedonic tone, these are likely to elicit strong negative reactions from receptors that detect the odours. Given this fact, stricter odour impact criteria are required to assess this odour impact during existing operations. With regards to detectable odour levels, residential and commercial receptors will perceive maximum odour levels up to 3.09 Ou_E/m^3 for the 98th percentile of hourly averages for worst case meteorological year Dublin 2019 and 8.96 Ou_E/m^3 for the 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019. This is in excess of the proposed odour impact criterion of less than or equal to 1.0 Ou_E/m^3 and 1.50 Ou_E/m^3 for the 98th and 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019 for existing current operations.

5. With regards to Scenario 1 – Model 5 and Model 6 – Existing contributions of PST 2 and 3 to overall odour plume (i.e. odour emissions from PST 2 and 3 only as PST 1 is not in use at

present), as can be observed, it is predicted that the levels of odours from the operation of PST 2 and 3 is likely to generate odour impact in the vicinity of the facility. Residential and commercial receptors located to the North, West, East and South of the operational facility will experience odour levels which are likely to give rise to odour complaints (*see Figures 7.7 & 7.8*). Given the nature of the predominant odours on site and given their odour character and hedonic tone, these are likely to elicit strong negative reactions from receptors that detect the odours. Given this fact, stricter odour impact criteria are required to assess this odour impact during existing operations. With regards to detectable odour levels, residential and commercial receptors will perceive maximum odour levels up to 1.41 Ou_E/m^3 for the 98th percentile of hourly averages for worst case meteorological year Dublin 2019 and 3.82 Ou_E/m^3 for the 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019. This is in excess of the proposed odour impact criterion of less than or equal to 1.0 Ou_E/m^3 and 1.50 Ou_E/m^3 for the 98th and 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019 for existing current operations.

6. With regards to Scenario 1 – Model 7 and Model 8 – Existing contributions of AD Tank leakage to overall odour plume (i.e. odour emissions from one AD tank only), as can be observed, it is predicted that the levels of odours from the operation of AD tank is not likely to generate odour impact in the vicinity of the facility. All residential and commercial receptors located to the North, West, East and South of the operational facility will perceive maximum odour levels up to 0.41 Ou_E/m^3 for the 98th percentile of hourly averages for worst case meteorological year Dublin 2019 and 0.21 Ou_E/m^3 for the 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019 (*see Figures 7.9 & 7.10*). This is within the proposed odour impact criterion of less than or equal to 1.0 Ou_E/m^3 and 1.50 Ou_E/m^3 for the 98th and 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019 for existing current operations.

7. With regards to Scenario 1 – Model 9 and Model 10 – Existing contributions of odour leakage from Sludge handling processes to overall odour plume (i.e. odour emissions from Sludge thickening building, Sludge holding tank and Storage skips), as can be observed, it is predicted that the levels of odours from the operation of the facility is not likely to generate odour impact in the vicinity of the facility although the odour plume encroaches upon the industrial neighbour due North of the facility. All residential and commercial receptors located to the North, West, East and South of the operational facility will perceive maximum odour levels up to 0.52 Ou_E/m^3 for the 98th percentile of hourly averages for worst case meteorological year Dublin 2019 and 1.19 Ou_E/m^3 for the 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019 (*see Figures 7.11 & 7.12*). This is within the proposed odour impact criterion of less than or equal to 1.0 Ou_E/m^3 and 1.50 Ou_E/m^3 for the 98th and 99.5th percentile of hourly averages for worst case meteorological year Dublin 2019 for existing current operations.

8. A number key mitigation technique will be considered for implemented within the Waste water Treatment Plant. These include:

    a. Fix all leaks on the existing AD tank providing an odour reduction of 7,311 Ou_E/s.

    b. Consider how odour reductions can be achieved on the current operational Primary settlement tanks 2 and 3. In this report it is considered that they will be covered and negatively ventilated to a two stage odour control unit. Other alternative methods can be considered and include:
        i. Reducing septicity in the network, primarily by chemical dosing
        ii. Reducing/addressing odours in the network pumping stations by introducing aeration which will control and prevent further generation of septicity and provide increased odour control on the pumping stations
        iii. Install a pre-aeration tank upstream of the PSTs designed to actively strip out the odours and provide odour control on the off gases

iv. Cover the primary tanks and provide odour control on the head space.

There are various operational, maintenance and H&S issues to be evaluated with each of the above options and a combination of options may be the most optimal. The application of mitigation on the Primary settlement tanks (PST) 2 and 3, Primary outflow chambers 2 and 3 and Aeration tanks inlet flow distribution chamber will result in an overall odour reduction of 54,656 Ou_E/s. It is assumed that PST1 will remain not in use and if brought into use, the same considered odour mitigation will be applied to PST 1.

c. Consider how odour reductions can be achieved on the current sludge process activities to include the Sludge thickening building, Sludge holding tanks and Sludge storage skips. In this report it is considered that further negative ventilated will be applied to the Sludge thickening building, Sludge storage tanks and Sludge storage skips. It is also considered that leaks on each of the Sludge holding tanks 1 to 3 will be repaired. All odours will be collected and treated in a to a two stage odour control unit. Other alternative methods can be considered. For example, instead of fully ventilating the sludge thickening building, each centrifugal thickener can be contained within a valance hood and the air around the enclosure can be ventilated at a high rate. The application of mitigation on the Sludge processing activities will result in an overall odour reduction of 16,654 Ou_E/s.

9. Following the implementation of all considered odour mitigation on the existing Drogheda WwTP, the predicted overall odour emission rate from the proposed Drogheda WwTP will be 24,653 Ou_E/s. This equates to an overall odour reduction of 79.31% following the implementation of proposed odour mitigation. It shall be noted that the implementation of odour mitigation will eliminate predominately odour sources which would be considered hedonically extremely offensive and unpleasant

10. With regards to Scenario 2 – Model 3 and Model 4 – Proposed operations, as can be observed, following the implementation of proposed odour mitigation, it is predicted that the levels of odours from the proposed Drogheda Waste water Treatment Plant is not likely to generate odour impact in the vicinity of the facility. Residential and commercial receptors located to the North, West, East and South of the operational facility will experience odour levels which are not likely to give rise to odour complaints. Given the fact that the implementation of odour mitigation in the proposed Drogheda WwTP will minimise the emission of odours which are hedonically very unpleasant (i.e. untreated odours from the Primary settlement tanks, Outlet flow chambers from Primary settlement tanks, Inlet flow distribution chamber to Anoxic and Oxic tanks, Sludge thickening building, Sludge holding tanks and Sludge skips), the guideline odour limit value requires to be less strict (i.e. solely as a result of the hedonic nature of the odours being emitted from the facility). The assessment criterion can revert to a normal assessment criteria of less than or equal to 1.50 Ou_E/m^3 and 3.0 Ou_E/m^3 for the 98^{th} and 99.5^{th} percentile of hourly averages for worst case meteorological year Dublin 2019. With regards to detectable odour levels, residential and commercial receptors will perceive maximum odour levels up to 1.10 Ou_E/m^3 for the 98^{th} percentile of hourly averages for worst case meteorological year Dublin 2019 and 2.68 Ou_E/m^3 for the 99.5^{th} percentile of hourly averages for worst case meteorological year Dublin 2019. This is well within the proposed odour impact criterion of less than or equal to 1.50 Ou_E/m^3 and 3.0 Ou_E/m^3 for the 98^{th} and 99.5^{th} percentile of hourly averages for worst case meteorological year Dublin 2019. The implementation of odour mitigation will result in a significant reduction in perceived odour levels in the vicinity of the proposed operational facility and given the fact that hedonically offensive odours will be abated; the likelihood of complaints risk is greatly reduced.

The following high level recommendations were formed from the study. Such recommendation maybe implemented in a staged approach over a period of time. Although an approach is discussed within this document, alternative justified mitigation methods can be used to achieve odour reduction whether process change related or other forms of proven technology implementation.

- With regards to the AD tank leakage, repairs / reconstruction of the digester will be required to eliminate this odour source and potential impact of same. When in operation following repairs, it is highly unlikely that any emissions will occur from the digester. This will lead to a reduction in the odour plum spread by approximately 40 to 60 m. More significantly, the nature of the odour been emitted from the digester is very offensive and very detectable and repair should lead to a reduction in odour complaints.

- With regards to the Primary settlement tanks 2 and 3, these will require mitigated. A number of considered options are presented and these can be used in combination to achieve the same odour reduction outcomes that is required to minimise odour impact. These include:

    - Option 1 - Primary settlement tanks 2 and 3 (and also 1 if brought back into duty) to be covered with tight fitting covers with a leakage rate of less than 1 m^3 / m^2 of cover surface at 50 Pa pressure. Primary settlement tank 1 is currently not in use and will remain same for the foreseeable future. Primary settlement tanks 2 and 3 will also require to be negatively ventilated to an odour control system and maintained at a negative pressure of at least negative 50 Pa suction pressure. It is estimated that a ventilation volume of at least 2,100 m^3/hr shall be extracted and this collected air will require to be treated in an odour control system capable of achieving an exhaust odour threshold concentration of less than 500 Ou_E/m^3 (see OCU 1 in *Table 4.2*). It is expected that a two stage odour control system will be required to achieve this requirement (e.g. first stage biological treatment followed by second stage carbon polishing).
    - Option 2 - Reducing septicity in the network, primarily by chemical dosing
    - Option 3 - Reducing/addressing odours in the network pumping stations by introducing aeration which will control and prevent further generation of septicity and provide increased odour control on the pumping stations
    - Option 4 - Install a pre-aeration tank upstream of the PSTs designed to actively strip out the odours and provide odour control on the off gases

- With regards to the Outflow chamber from each of the Primary settlement tanks and Inlet flow distribution chamber to Anoxic / Aerobic tanks, these are located in close proximity to the primary settlement tanks and therefore extracted air from these sources can be treated in this system. In order to be successful in ensure no fugitive odour emissions from these sources, the existing covers will need to be made air tight. In addition, these sources will require to be placed under negative pressure by means of air extraction. It is estimate that a minimum extraction rate of 1,587 m^3/hr of odourous air will be required and treated in OCU 1.

- With regards to the Sludge holding tanks, these tanks are covered but the covers will require to be assessed with respect to integrity. Visual inspection of the covers indicate a number of gaps in the covers which will require to be repaired and / or replaced. These tank cover shall be processed proved to ensure they can achieve a sealing efficiency of 1 m^3 / m^2 of cover surface at 50 Pa pressure. These will also require to be negatively ventilated to an odour control system and maintained at a negative pressure of at least negative 50 Pa suction pressure. It is estimated that a ventilation volume of at least 1,200 m^3/hr shall be extracted from the three tanks and this collected air will require to be treated in an odour control system capable of achieving an exhaust odour threshold concentration of less than 500 Ou_E/m^3 (see OCU 2 in *Table 4.2*). It is expected that a two stage odour control system will be required to achieve this requirement (e.g. first stage biological treatment followed by second stage carbon polishing).

- With regards to the Sludge centrifudge building, this building is currently leaking odours due to the nature of the building fabric and doors. The building shall be made air tight and processed proved to achieve a leakage rate of less than 1.50 m^3 / m^2 clad surface / hr @ 50 Pa. In addition, improved and focused ventilation shall be implemented within the building to improve occupational air conditions within the building. It is estimated that an additional ventilation volume of at least 4,328 m^3/hr shall be extracted and this collected air will require to be treated in an odour control system capable of achieving an exhaust odour threshold concentration of less than 500 Ou_E/m^3 (see OCU 2 in *Table 4.2*). It is expected that a two stage odour control system will be required to achieve this requirement (e.g. first stage biological treatment followed by second stage carbon polishing). Other considered approaches can be utilised to include enclosing around the centrifudge and ventilating these to an odour control system.

- With regards to the Sludge storage skips and conveying system, odours are currently leaking / displaced from this process. In order to prevent / minimise the leakage of odour from these processes, odour extraction shall be applied to the conveying system and sludge storage skips. It is estimated that an additional ventilation volume of at least 1,500 m^3/hr shall be extracted and this collected air will require to be treated in an odour control system capable of achieving an exhaust odour threshold concentration of less than 500 Ou_E/m^3 (see OCU 2 in *Table 4.2*). It is expected that a two stage odour control system will be required to achieve this requirement (e.g. first stage biological treatment followed by second stage carbon polishing).

- Therefore in order to treat the extracted air from these processes, it is proposed that two new odour control systems will be required to treat the collected odourous air. These are noted as new OCU 1 and new OCU 2 within *Table 4.2*. The total minimum treatment capacity of new OCU 1 and new OCU 2 shall be 4,887 m^3/hr and 7,028 m^3/hr, respectively. This minimum ventilation rate may change following detailed design studies of the various options.

7. *Appendix I* - Odour dispersion modelling contour results

7.1. Facility layout and receptor locations

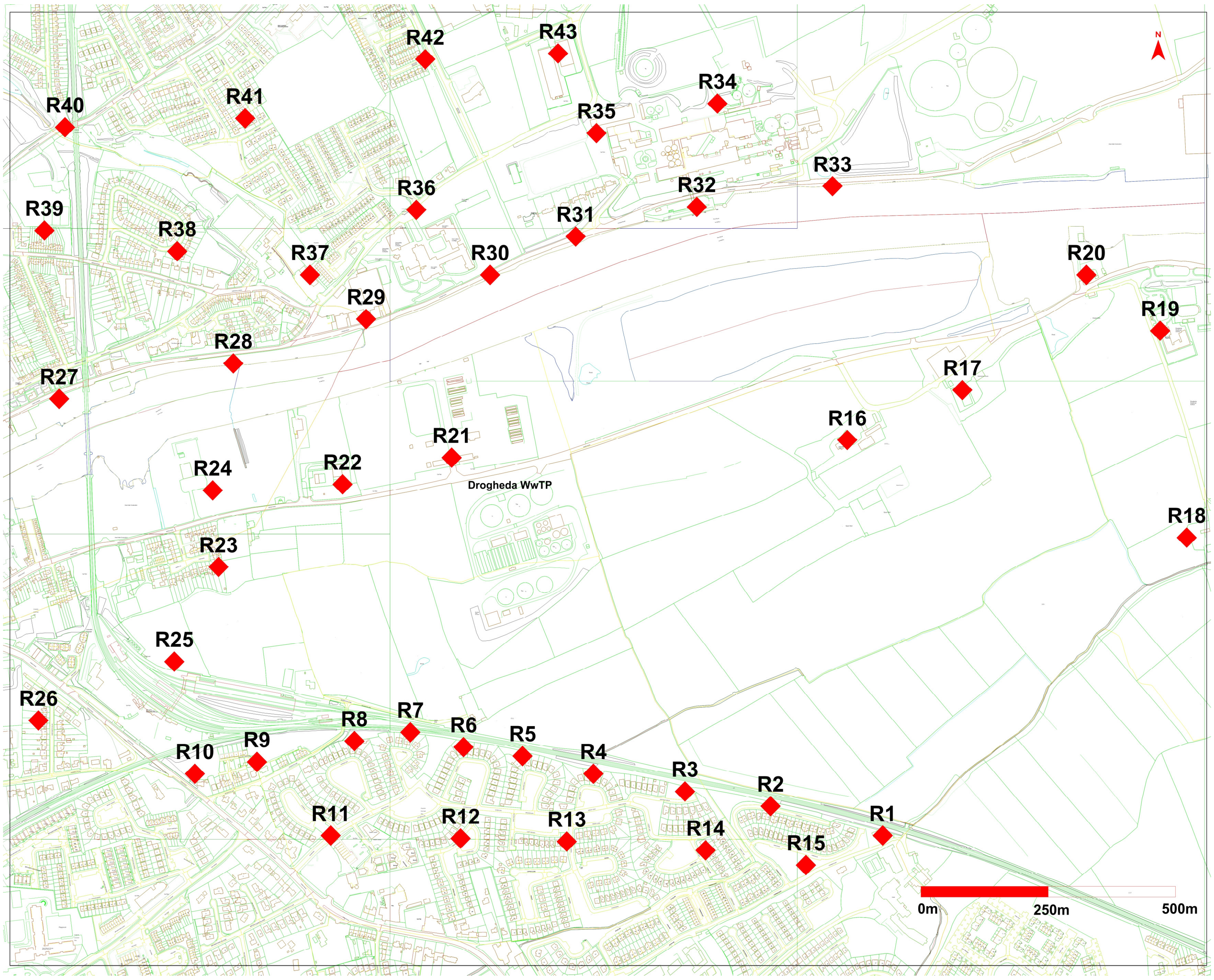

Figure 7.1. Drogheda WwTP facility layout and receptor locations.

7.2. Odour source key

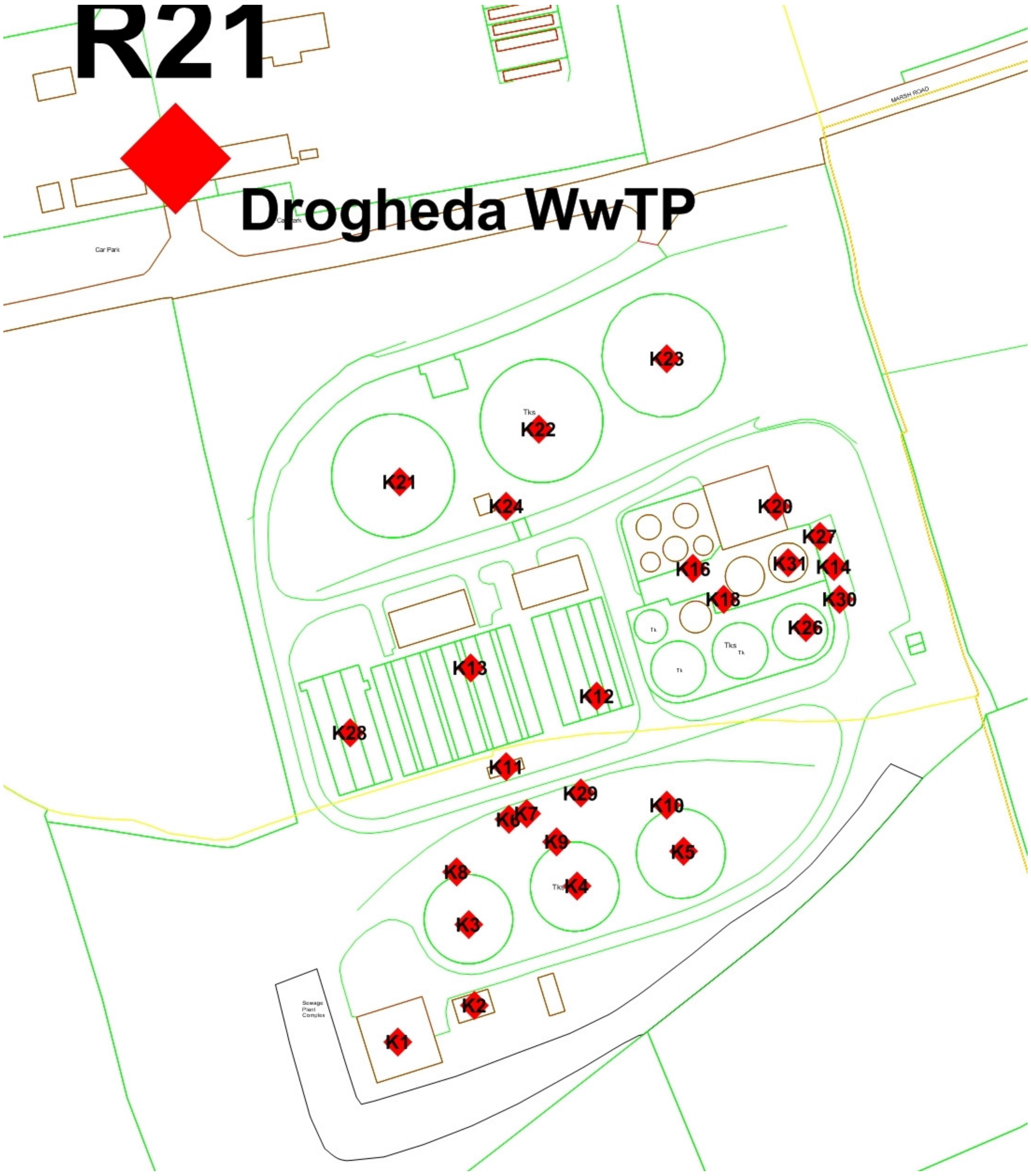

Figure 7.2. Odour source key – *see Table 4.1 and 4.2*

7.3. Predicted odour contour plots for odour emissions for Scenario 1 – Model 1

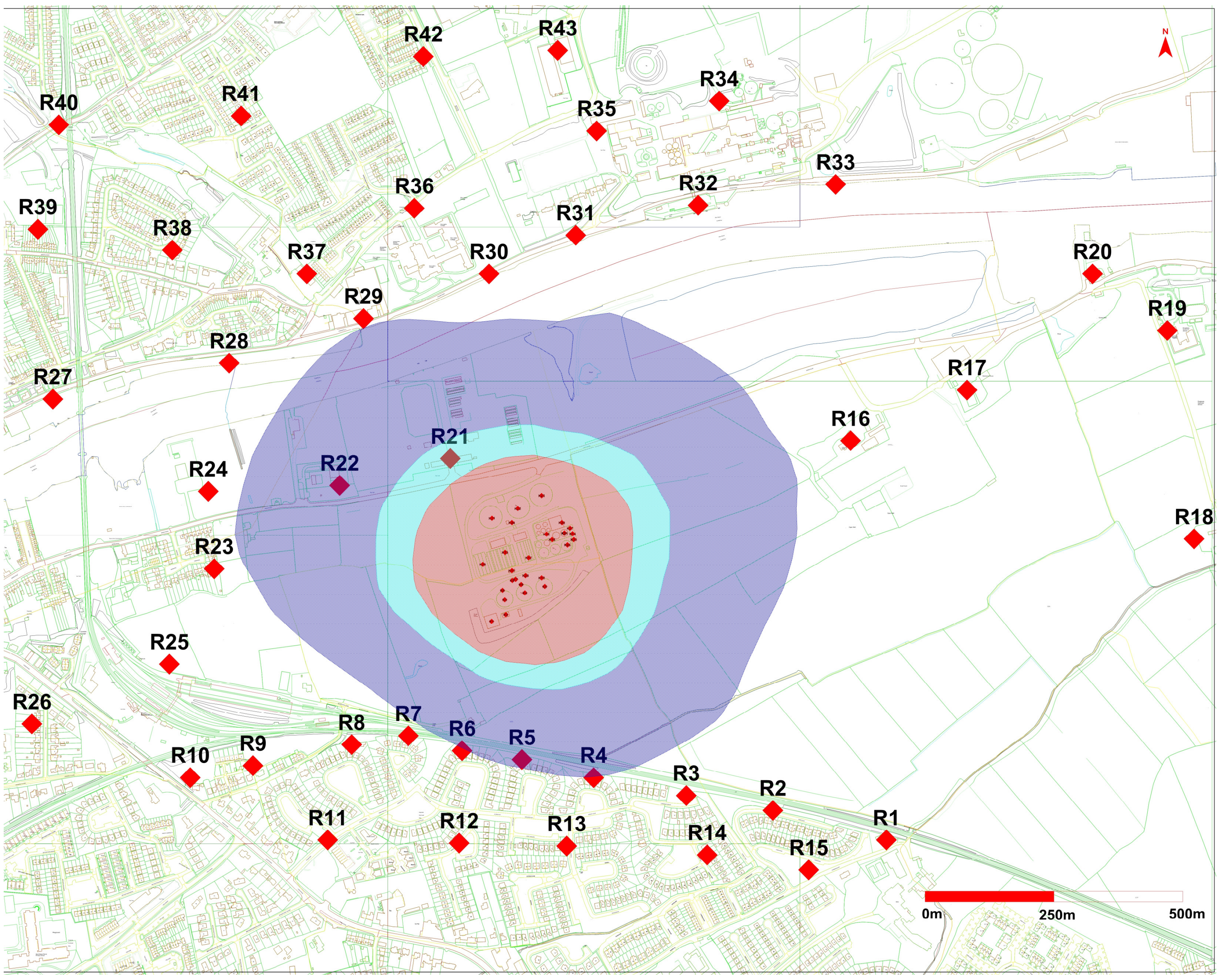

Figure 7.3. Predicted odour emission contribution of existing Drogheda WwTP odour sources for Model 1 to odour plume dispersal for an odour concentration of less than or equal to 1.0 Ou_E/m^3 ( ), 3.0 Ou_E/m^3 ( ) & 5.0 Ou_E/m^3 ( ) for the 98th percentile of hourly averages for worst case meteorological year Dublin Airport 2019.

7.4. Predicted odour contour plots for odour emissions for Scenario 1 – Model 2.

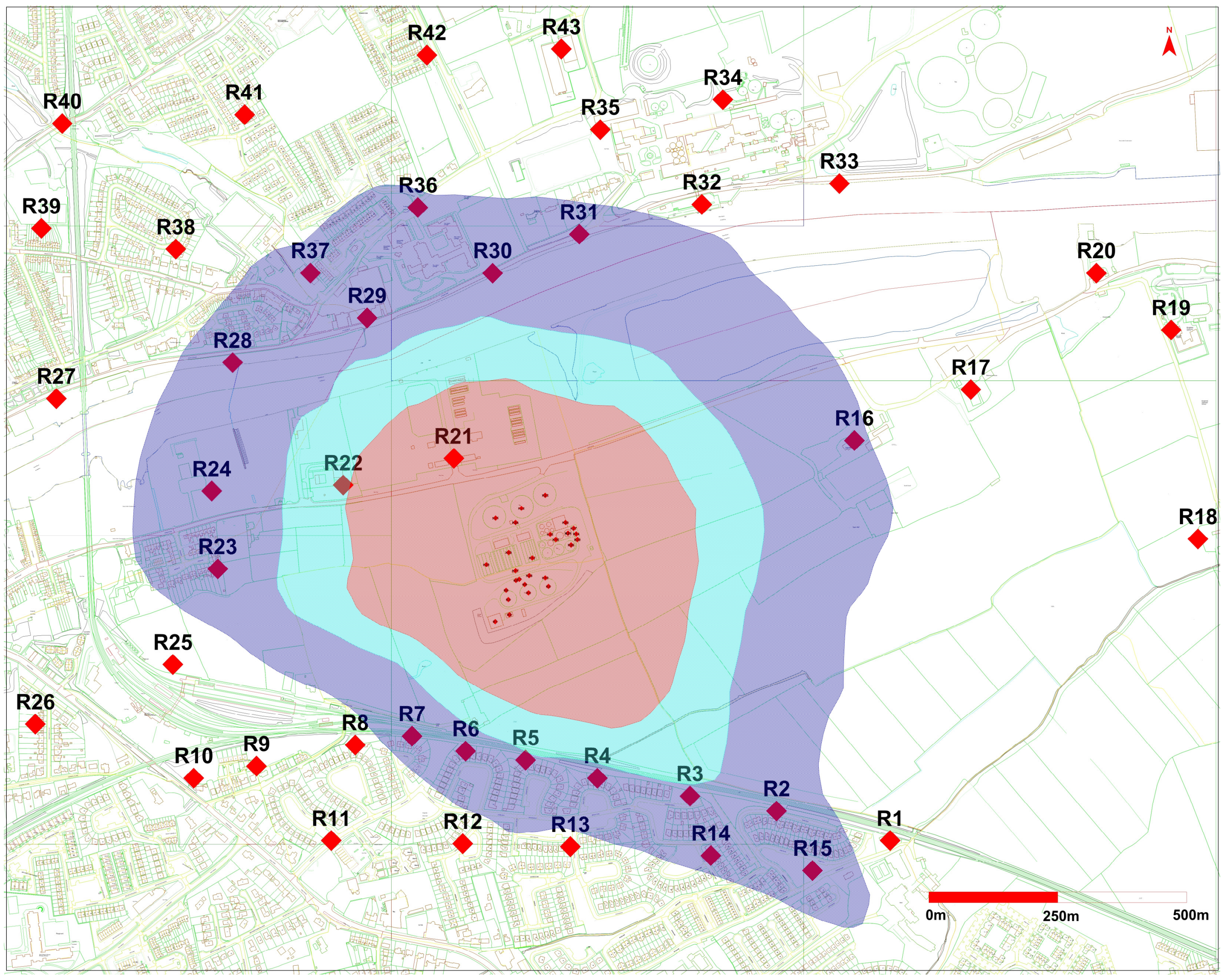

Figure 7.4. Predicted odour emission contribution of existing Drogheda WwTP odour sources for Model 2 to odour plume dispersal for an odour concentration of less than or equal to 1.0 Ou_E/m^3 (), 3.0 Ou_E/m^3 () & 5.0 Ou_E/m^3 () for the 99.5th percentile of hourly averages for worst case meteorological year Dublin Airport 2019.

7.5. Predicted odour contour plots for odour emissions for Scenario 1 – Model 3

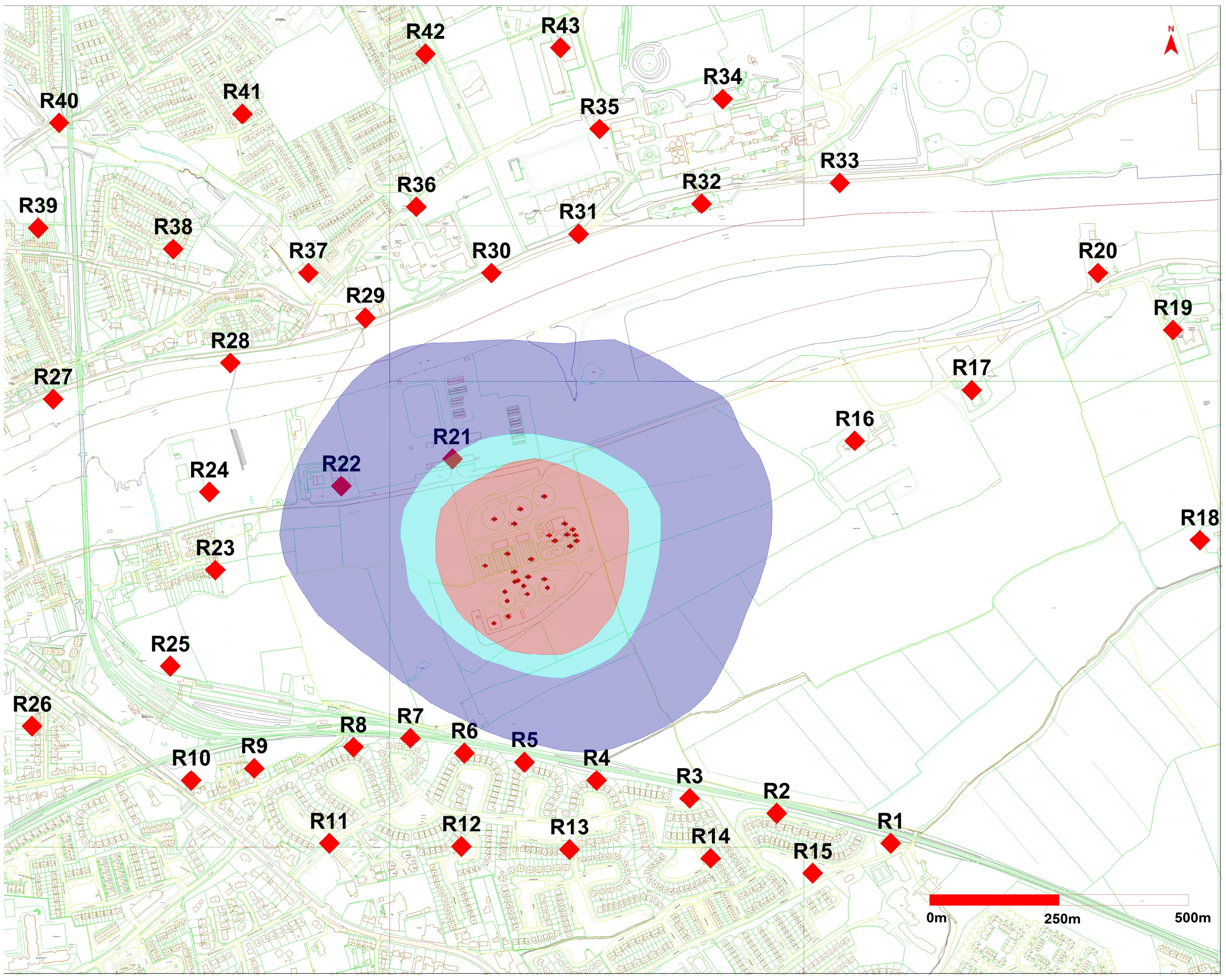

Figure 7.5. Predicted odour emission contribution of existing Drogheda WwTP odour sources for Model 3 to odour plume dispersal for an odour concentration of less than or equal to 1.0 Ou_E/m^3 (blue line), 3.0 Ou_E/m^3 (light blue line) & 5.0 Ou_E/m^3 (red line) for the 98th percentile of hourly averages for worst case meteorological year Dublin Airport 2019.

7.6. Predicted odour contour plots for odour emissions for Scenario 1 – Model 4

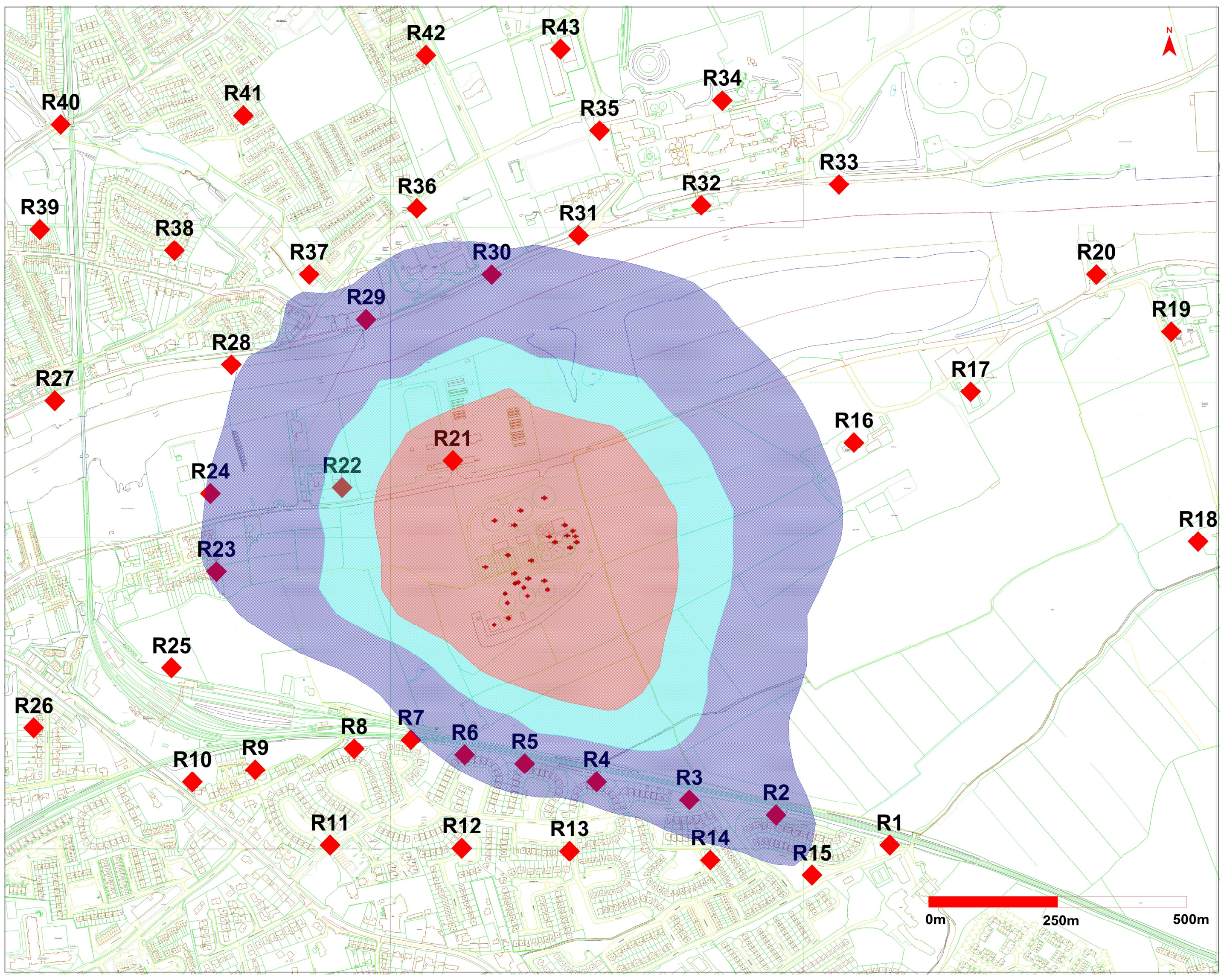

Figure 7.6. Predicted odour emission contribution of existing Drogheda WwTP odour sources for Model 4 to odour plume dispersal for an odour concentration of less than or equal to 1.50 Ou_E/m^3 ( ), 3.0 Ou_E/m^3 ( ) & 5.0 Ou_E/m^3 ( ) for the 99.5th percentile of hourly averages for worst case meteorological year Dublin Airport 2019.

7.7. Predicted odour contour plots for odour emissions for Scenario 1 – Model 5

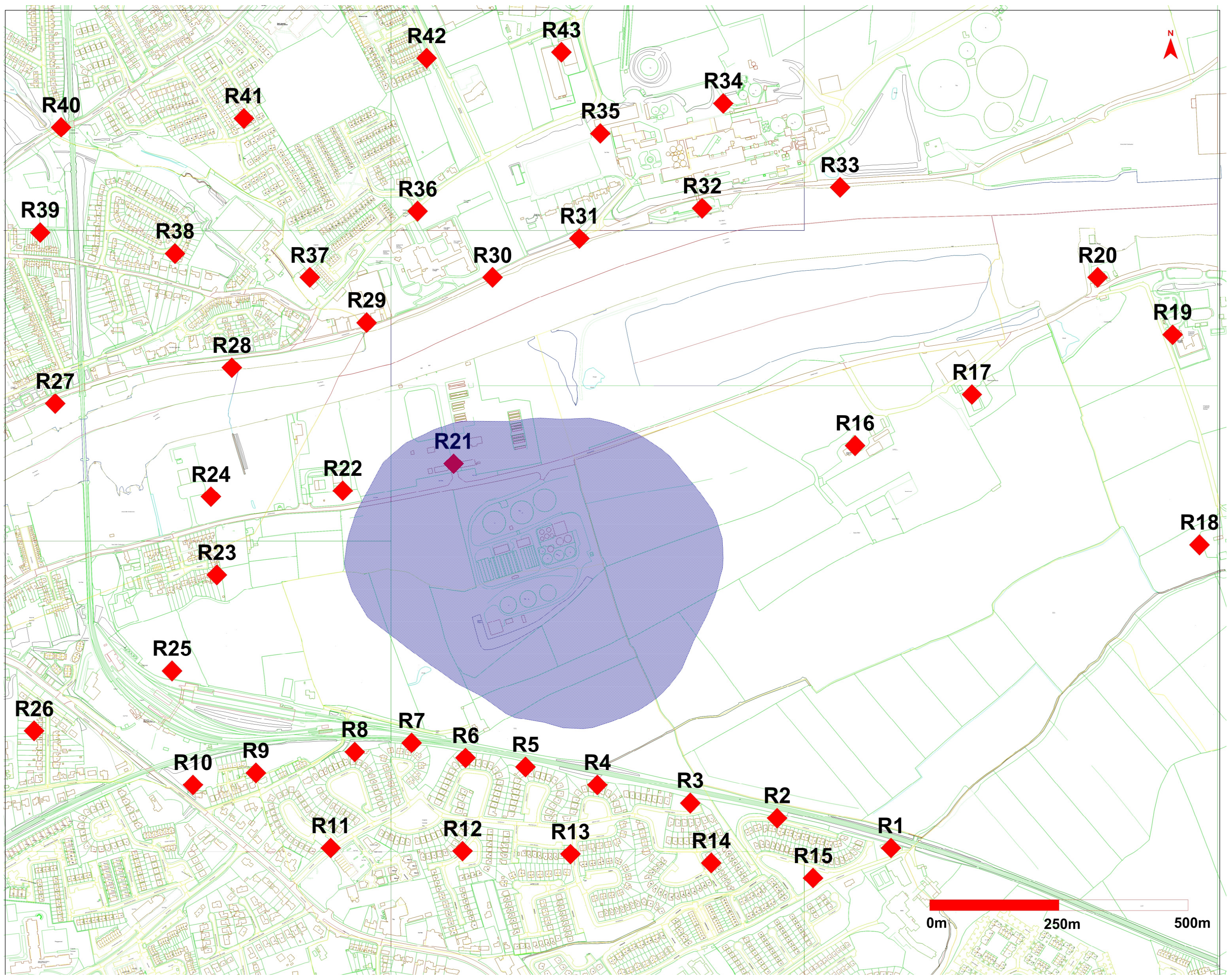

Figure 7.7. Predicted odour emission contribution of existing Drogheda WwTP odour sources for Model 5 to odour plume dispersal for an odour concentration of less than or equal to 1.0 Ou_E m^{-3} (▬) for the 98th percentile of hourly averages for worst case meteorological year Dublin Airport 2019.