Short note

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Subject: Environmental Impact Assessment for proposed Thermal Oxidiser at Tata Steel Colors, Shotton

1. Introduction

It is proposed to install a regenerative thermal oxidiser (RTO) at the Coatings 2 plant at Tata Steel's Shotton site. The new plant will make use of an existing (relocated) stack and this note discusses the potential environmental impact of the RTO emissions.

2. Stack characteristics and nearby buildings

The new location of the stack will be adjacent to 24 Bay in the Coatings 2 plant, as shown in Figure 1. The stack is 23 metres tall and 1.5 metres in diameter.

Buildings in the vicinity of a stack can have a significant effect on pollutant dispersion unless the stack is at least 2½ times as tall as the buildings; thus for a 23 metre stack, buildings lower than 9 metres would not be expected to affect dispersion, but taller ones may. LiDAR data for this area with a 1 metre horizontal resolution are available from the NRW archive[1] and were used to determine the heights of nearby buildings as shown in Figure 2. Several buildings taller than 9 metres were identified and for the purposes of dispersion modelling, these buildings were simplified into the four buildings shown in Figure 1. The heights of the composite buildings were set at the maximum of the height of the main bays included in each group, but the elevated sections shown arrowed in Figure 2 were disregarded as they comprise only a small proportion of the total building area.

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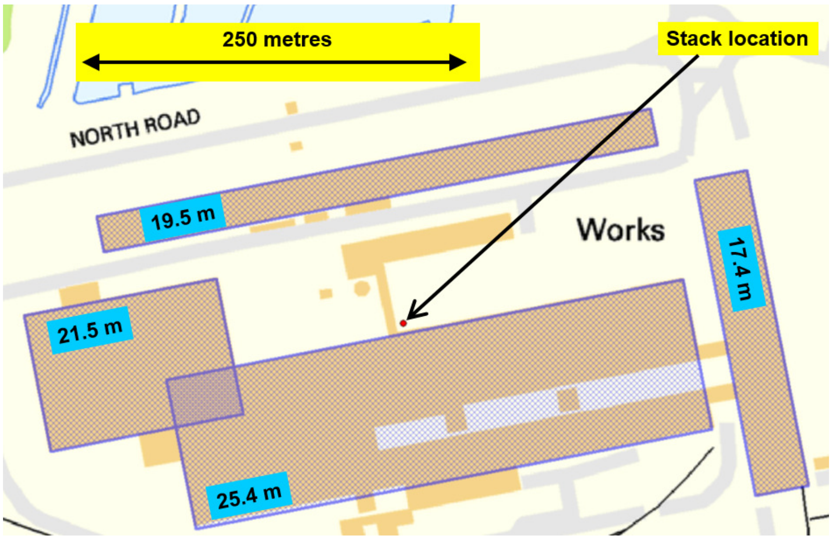

Figure 1: Location of stack and nearby buildings

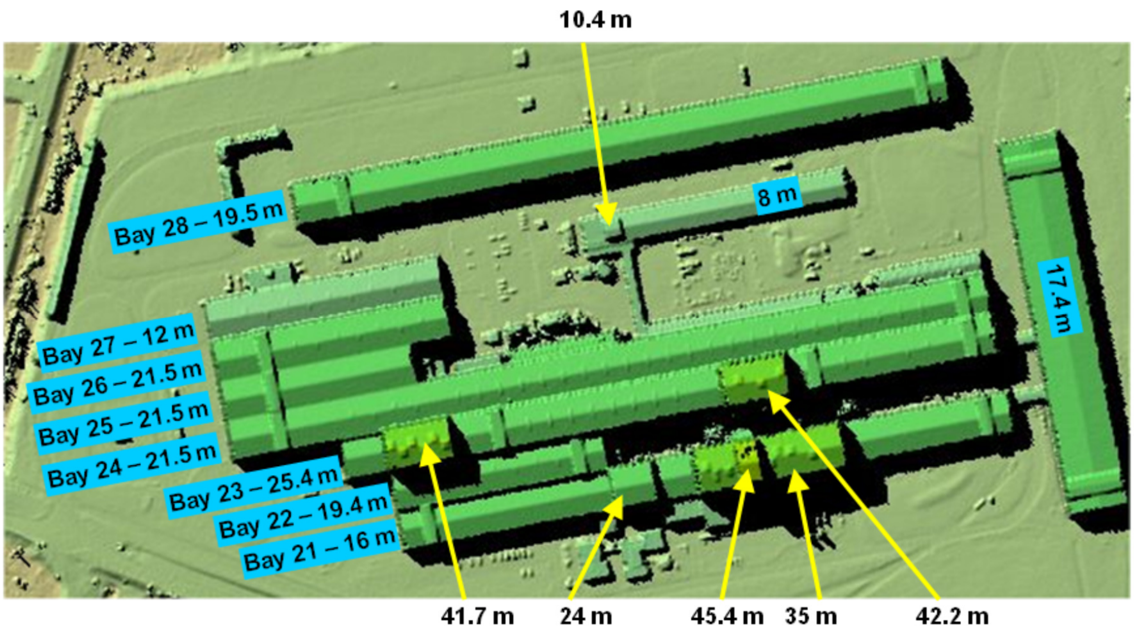

Figure 2: LiDAR image of Coatings 2 buildings and ridge heights

3. Waste gas characteristics and emissions

The waste gas flow and exit temperature will vary with process operations and for the purposes of this assessment a range of scenarios has been modelled. Information from the suppliers[2] indicates that the minimum flow will be around 25,000 Nm^3/hr (which accounts for the coater room extraction volume plus oven ingress and combustion air) and the maximum around 41,000 Nm^3/hr (based on a solvent load of 364 litres/hr, not including any water quench exhausts). The gas temperature after the secondary heat exchanger could range from about 180°C to 300°C depending on process conditions.

The waste gas will be largely air with some combustion products and the specific heat capacity and mean molecular weight are assumed to be 1,012 J/°C/kg and 28.996 kg/kmol respectively (ADMS default values).

The RTO is designed to achieve emissions of no more than:

- 20 mg/Nm^3 residual VOCs
- 100 mg/Nm^3 CO
- 100 mg/Nm^3 NO_x

Solvents from paints used on the Colorcoat Lines at Shotton are a complex mixture of VOCs, the composition of which will vary depending on the formulation of the particular paint; because of the large number of different formulations there is no standard description of the specific VOCs that may be emitted. Defra's guidance[3] on risk assessments for emissions to air states:

> If you release volatile organic compounds into the air and don't know what all the substances in them are, treat them all as 100% benzene in your risk assessment.

For the purposes of this assessment, a worst-case assumption has been made that emissions may be continuously at the Emission Limit Values throughout the year and the pollutant emission rates at different waste gas flowrates would therefore be:

- 25,000 Nm^3/h – 0.14 g/s benzene, 0.69 g/s CO, 0.69 g/s NO_x
- 41,000 Nm^3/h – 0.23 g/s benzene, 1.14 g/s CO, 1.14 g/s NO_x

4. Dispersion modelling

Dispersion modelling has been undertaken using ADMS version 5.2.1, released in February 2017.

4.1 Terrain

The ADMS dispersion model can take account of hills or other significant terrain features, but the accompanying user guide[4] (page 125) indicates that this is usually relevant only if slopes exceed 1:10, which is not the case in the vicinity of the Tata Steel site at Shotton. The complex terrain module has not been used for this assessment.

Surface roughness is dependent on land-use and in heterogeneous terrain no single value will correctly characterise the whole modelling domain. The area surrounding the Tata Steel site is largely flat with relatively few residential and industrial areas and a value of 0.3 metres was selected for this assessment.

4.2 Meteorological data

The Meteorological Office station closest to Shotton where all the data required for the ADMS model have been collected for at least five years is at Shawbury, 50 km SSE of the site. To minimise errors attributable to using such a distant meteorological station, wind speed and direction data from a local site at Hawarden airfield, 7 km SE of Shotton, has been used instead of the wind data from Shawbury. The final dataset input to the dispersion model comprises hourly sequential data covering wind speed and direction from Hawarden along with cloud cover, surface temperature, precipitation and relative humidity from Shawbury. The surface roughness at the meteorological station been assumed to be the same as for the Tata Steel site, i.e. 0.3 metres.

The meteorological data used for this assessment is for the years 1996 to 2000. The use of five years' data is expected to include enough variability to ensure that worst-case conditions are identified in the assessment. Although climate change is a major global concern, this relates to changes over many decades and data from 1996 to 2000 are still valid for the purposes of this assessment.

To account for the heat generated from the urban areas and industrial activities in the area, which limits the stability of the atmosphere (the "urban heat island" effect), the option within ADMS to specify a minimum value of the Monin-Obukhov length was used. The default value for "Mixed urban/industrial" of 30 metres was selected. The values of the surface albedo and the Priestley-Taylor parameter were left at the default values of 0.23 and 1.0 respectively.

The latitude of Shotton, which is used within the ADMS model to calculate surface heat flux, is approximately 53 °N.

4.3 Receptors

To illustrate patterns of dispersion, the impacts of emissions from the proposed RTO stack over an area of 5 km x 3½ km have been assessed and Figure 3 shows the extent of this grid. In addition, a number of specific points were selected to assess the worst-case exposure at different types of receptor where relevant exposure may occur. Section 4.3.1 describes the specific receptors used for assessing potential impacts on human health and section 4.3.2 the receptors relevant to the protection of vegetation and natural ecosystems.

4.3.1 *Receptors – human health*

Figure 3 illustrates the locations where human exposure has been assessed. They can be divided into three types:

- Residential areas (Yellow) – twelve receptors in Connah's Quay and one in Garden City – short-term and long-term exposure assessed
- Commercial premises (Red) – three receptors along the south bank of the Dee in Connah's Quay and nine in an arc from north to south-east of the Coatings 2 plant – only short-term exposure assessed
- Other receptors (Blue) – eight receptors along the A548 to the north and north-west of the Coatings 2 plant and one at the Tata Steel gatehouse – only short-term exposure assessed

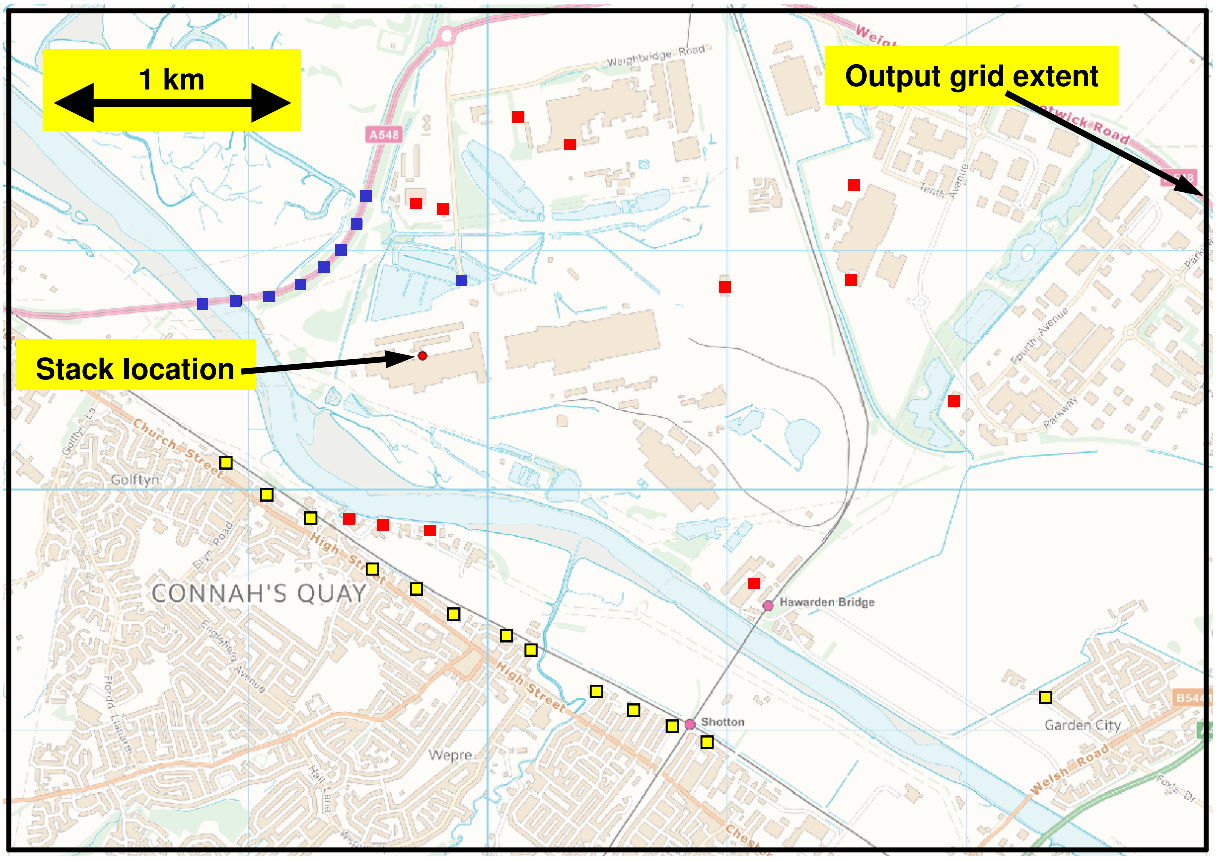

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Figure 3: Extent of the output grid and specific receptors relevant to human health

The overall patterns of dispersion, as illustrated in Figures 5 and 6, confirm that the specific receptors are correctly located to capture the peak population exposure.

4.3.2 Receptors – wildlife and habitat sites

The Appendix to this report lists sites in the vicinity of the proposed RTO stack that are relevant to the protection of vegetation and natural ecosystems. This includes Special Areas of Conservation, Special Protection Areas and Ramsar sites (protected wetlands) within 10 km and Sites of Special Scientific Interest and local nature sites (ancient woods, local wildlife sites and national and local nature reserves) within 2 km.

Figure 4 illustrates the locations where the potential impact of emissions from the RTO on such sites has been assessed – more detailed maps are included as Figures A1 to A4 in the Appendix.

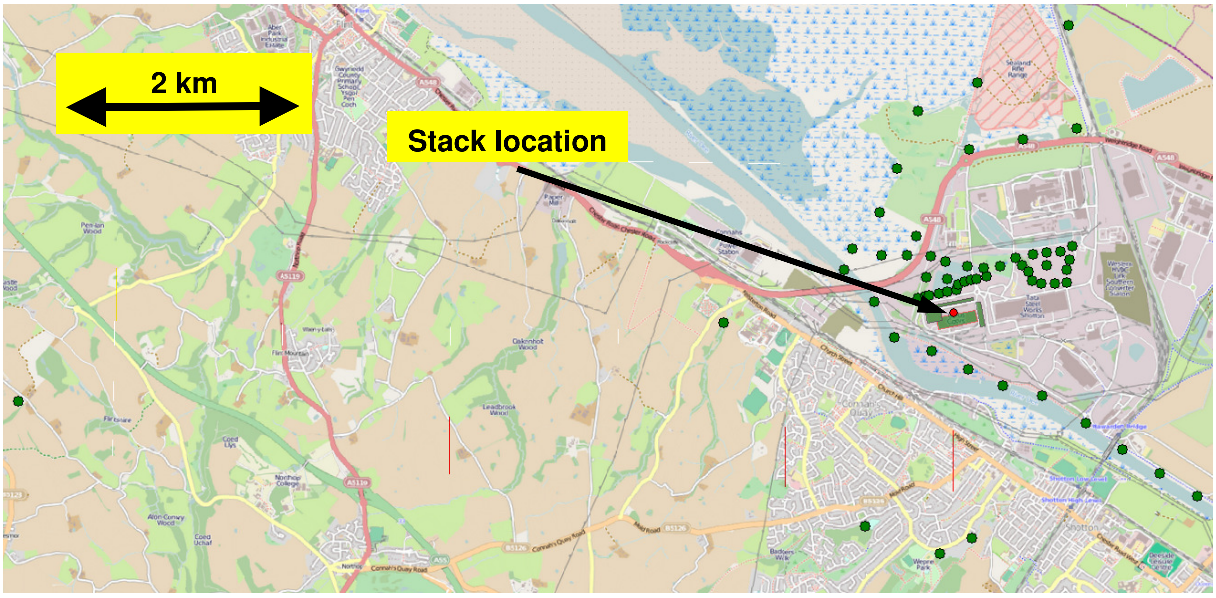

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Figure 4: Specific receptors relevant to wildlife and habitats

4.4 Conversion of NO_x to NO_2

In the case of NO_x, most of the emission will be in the form of NO, whereas the most significant human health impacts are associated with NO_2. NO will naturally oxidise to NO_2 in the atmosphere, but this process will take place over timescales of hours to days, and over the short distances and timescales in this study the conversion will be far from complete. Although the ADMS dispersion model includes a module to account for NO_x chemistry, this requires detailed data on hourly average background levels of NO, NO_2 and ozone, which are not readily available for the area around Shotton. As an alternative to detailed treatment of NO_x chemistry, the guidance[3] on risk assessments for emissions to air provides the following recommendations for a conservative assessment:

- For assessment of short-term impacts, assume 50% conversion of total NO_x to NO_2
- For assessment of long-term impacts, assume 100% conversion of total NO_x to NO_2

These factors have been applied to the modelled total NO_x concentrations predicted by the dispersion model in this study.

4.5 Deposition

For the assessment of impacts on wildlife and habitats sites, nitrogen deposition and acid deposition rates are required. Since there are no significant emissions of species such as SO_2 or ammonia, the only pollutant for which deposition has been considered in this assessment is NO_x, which contributes to both nitrogen deposition and acidification. Both dry deposition and wet deposition have been modelled in ADMS.

The rate of dry deposition is assumed to be the product of the ground-level concentration of the substance under consideration and an effective “dry deposition velocity”. This velocity will depend on the species and the surface on which it is depositing and page 99 of the ADMS User Guide[4] suggests values for deposition on short grassland; for the species relevant to this assessment they are:

- NO_2 = 0.0015 m/s
- NO = 0.00015 m/s

Although, as discussed in section 4.4, most of the NO_x emitted will still be in the form of NO close to the release point, for a conservative assessment a dry deposition velocity of 0.0015 m/s has been used for all NO_x.

Wet deposition occurs when pollutants within the plume are washed out in rainfall or other precipitation. Within ADMS, for all species other than SO_2, CO_2 and HCl, this is modelled using a washout coefficient (Λ), defined as:

$$\Lambda = A.P^B$$

where P is the precipitation rate in mm/hour
A and B are parameters specific to the pollutant under consideration

Page 106 of the ADMS User Guide[4] suggests these values for NO_2:

- A= 0.0001 and B = 0.64

NO has such a low solubility that wet deposition is insignificant. As for dry deposition, although most of the NO_x will still be in the form of NO close to the release point, for a conservative assessment the wet deposition parameters for NO_2 have been used for all NO_x.

As suggested in the ADMS User Guide, and to add a further conservative assumption, deposition in this assessment has been modelled without plume depletion.

5. Modelling results

Four emission scenarios were included in this modelling study (maximum and minimum waste gas flowrate coupled with maximum and minimum waste gas temperature). The dispersion model was run with five different years' meteorological data for each scenario and the results summarised in the following sections are the maximum modelled values for any of the five years.

5.1.1 Assessment of human health impacts

Table 1 shows the highest Process Contribution (PC) at each human exposure receptor type attributable to the potential emissions from a new thermal oxidiser at the Coatings 2 plant at Tata Steel's Shotton site. Also in the table are the Air Quality Standards and Environmental Assessment Levels relevant to human health taken from Defra's risk assessment guidance[3].

				Highest modelled Process Contribution (µg/m³)			
		AQS or EAL	Flowrate:	41,000 Nm³/h		25,000 Nm³/h	
Species	Statistic	(µg/m³)	Temperature:	300°C	180°C	300°C	180°C
Benzene	Annual average	5	Residential receptors	0.023	0.028	0.020	0.020
	Maximum hourly average	195		1.2	1.4	0.8	1.1
CO	Maximum 8-hour running average	10,000		4.8	6.4	3.6	4.7
	Maximum hourly average	30,000		5.7	6.8	3.7	5.3
NO_2	Annual average	40		0.12	0.14	0.10	0.10
	99.8th percentile of hourly averages	200		1.8	1.9	1.1	1.5
Benzene	Annual average	5	Commercial receptors	0.10	0.13	0.08	0.09
	Maximum hourly average	195		1.5	1.8	1.1	1.8
CO	Maximum 8-hour running average	10,000		5.3	5.9	3.5	6.2
	Maximum hourly average	30,000		7.5	8.9	5.3	8.8
NO_2	Annual average	40		0.50	0.62	0.37	0.46
	99.8th percentile of hourly averages	200		2.8	2.7	1.7	2.3
Benzene	Annual average	5	Other receptors	0.17	0.21	0.12	0.15
	Maximum hourly average	195		2.6	3.2	1.9	2.3
CO	Maximum 8-hour running average	10,000		10	14	8	9
	Maximum hourly average	30,000		13	16	9	11
NO_2	Annual average	40		0.84	1.03	0.62	0.74
	99.8th percentile of hourly averages	200		6.0	7.2	4.4	5.3

Table 1: Modelled Process Contributions – human health impacts

In all cases, the potential impact is small compared to the environmental standards. Defra's guidance[3] on risk assessments for emissions to air states that an emission can be screened out as insignificant if the Process Contribution meets both of the following criteria:

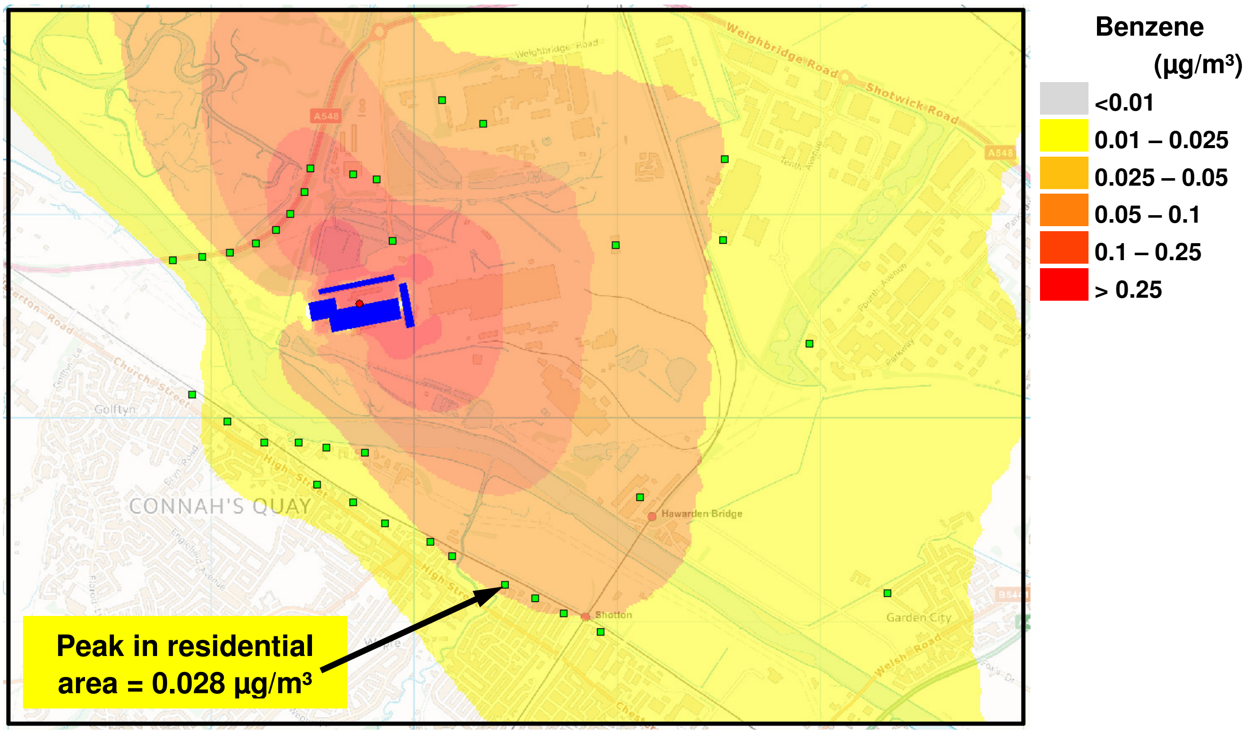
- the long-term PC is less than 1% of the long-term environmental standard
- the short-term PC is less than 10% of the short-term environmental standard

For the residential receptors, the most significant long-term impact is for benzene. Taking a worst-case assumption that 100% of the residual VOCs emitted are benzene, the annual average may be up to 0.028 µg/m³ (0.6% of the Air Quality Standard) in Connah's Quay.

The most significant short-term impact is for NO_2 – the 99.8th percentile of hourly averages in residential areas may be up to 1.9 µg/m³ (1% of the AQS). Thus for the residential receptors, the insignificance criteria are met.

In the case of the commercial and other receptors, annual average PCs are not relevant as there is no long-term population exposure. The most significant short-term impact is for NO_2 – the 99.8th percentile of hourly averages may be up to 7.2 µg/m³ (3.6% of the AQS) at the gatehouse. This is still less than the 10% criterion for screening out short-term impacts.

Figures 5 and 6 illustrate the pattern of dispersion in the vicinity of the Tata Steel site. Figure 5 shows the long-term benzene concentrations (assuming all VOCs are benzene) attributable to the potential emissions from the new thermal oxidiser at the Coatings 2 plant using the dataset giving the highest PC at any of the residential receptors.



Background map © openstreetmap.org contributors

Figure 5: Annual average benzene concentration

41,000 Nm³/h waste gas flow, 180 °C waste gas temperature, 1998 meteorological data

Figure 6 shows the short-term NO_2 concentrations using the dataset giving the highest PC at the gatehouse.

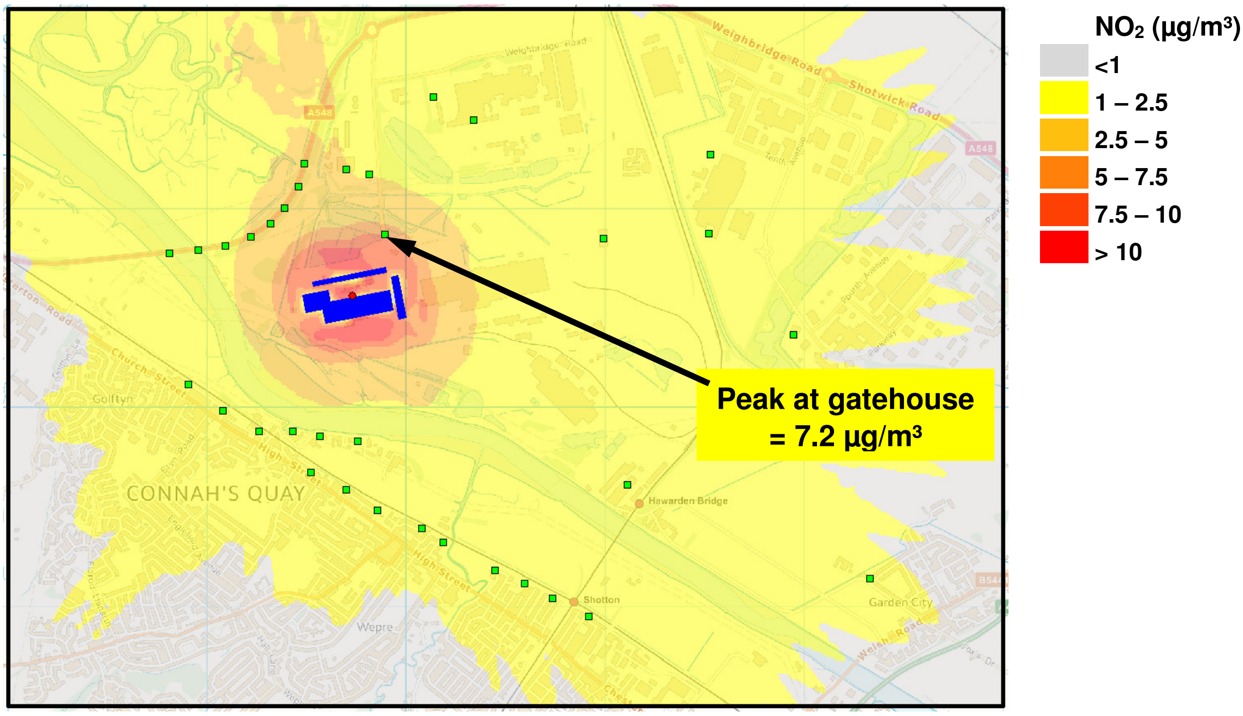


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Figure 6: 99.8th percentile of hourly average NO_2 concentrations
41,000 Nm³/h waste gas flow, 180 °C waste gas temperature, 1997 meteorological data

In all cases, the greatest impacts occur for the maximum waste gas flow and minimum waste gas temperature scenario. It should be noted that the results quoted in Table 1 and illustrated in Figures 5 and 6 represent a conservative assessment, as a number of worst-case assumptions have been made in the analysis:

- The waste gas flowrate is at the maximum value (41,000 Nm³/h) throughout the year
- The waste gas temperature is at the minimum value (180°C) throughout the year
- Pollutant emissions are continuously at the Emission Limit Value throughout the year
- VOC emissions are 100% benzene
- 100% of NO_x emitted from the RTO is converted to NO_2 for the assessment of long-term impacts and 50% for short-term impacts
- Results are quoted for whichever year of meteorological data gave the highest figure

5.1.2 Assessment of impacts on vegetation and natural ecosystems

In this section, only results for the maximum waste gas flow and minimum waste gas temperature scenario have been presented, since the assessment in the previous section demonstrated that this was the scenario giving the greatest impacts.

Table 2 shows the highest Process Contribution (PC) at each of the sites relevant to the protection of vegetation and natural ecosystems. NO_x is the only pollutant released from the proposed stack that could impact on the ecology of these sites, and the table includes annual average and maximum daily mean concentrations and annual mean deposition rates for nitrogen and acidity attributable to the potential emissions from a new thermal oxidiser at the Coatings 2 plant at Tata Steel's Shotton site.

		Highest modelled Process Contribution at each site			
		Annual average total NO_x concentration	Maximum daily total NO_x concentration	Annual average nitrogen deposition rate	Annual average acid deposition rate
Site	Type	µg/m³	µg/m³	kg N/ha/year	keq/ha/year
Dee Estuary	SAC, SPA, Ramsar and SSSI	0.87	14	0.24	0.0172
River Dee	SAC, SSSI and LWS	0.40	7.2	0.10	0.0069
Shotton Lagoons and Reedbeds	SPA and SSSI	2.7	37	0.80	0.057
Deesside and Buckley Newt Sites	SAC and SSSI	0.026	3.8	0.013	0.00091
Halkyn Mountain	SAC and SSSI	0.0039	0.76	0.0012	0.000085
Shotton Steelworks	LWS	0.60	8.1	0.14	0.0099
Top-y-fron Dingle and Kelserton Brook	LWS	0.030	4.1	0.0078	0.00056
Connah's Quay Ponds and Woodland	SSSI and ancient woodlands	0.030	3.8	0.013	0.00091

Table 2: Modelled Process Contributions – impacts on wildlife and habitats

To assess whether these Process Contributions (PCs) are acceptable, they have been compared to relevant critical levels (pollutant concentrations) and critical loads (deposition rates) in the following sections. In the first instance, the Defra guidance[3] on risk assessments for emissions to air has been used to identify sites where the potential impact of the emission can be screened out as insignificant, i.e. those sites where the Process Contribution meets both of the following criteria:

- the long-term PC is less than 1% of the long-term environmental standard
- the short-term PC is less than 10% of the short-term environmental standard

Where the PC cannot be screened out as insignificant, site-specific background concentrations and deposition rates have been used to determine the overall Predicted Environmental Concentration (PEC) or the total deposition rate and these have been compared to critical levels and site-specific critical loads.

5.1.2.1 Critical levels

Critical levels, which are set for the protection of vegetation, are not specific to habitat type and for total NO_x the values are:

- Annual mean = 30 µg/m³
- 24-hour mean = 75 µg/m³

The Process Contributions at Deeside and Buckley Newt Sites SAC, Halkyn Mountain SAC, Top-y-fron Dingle and Kelsterton Brook LWS and Connah's Quay Ponds and Woodland SSSI fall below the insignificance criteria for both long-term and short-term critical levels and have not been assessed further.

Background NO_x concentrations for the receptor giving the highest PC at each of the remaining sites have been obtained from the APIS web site[5]. Table 3 shows the calculation of the maximum PEC for each site.

			Total NO_x (µg/m³)		
Averaging period	**Site**	Grid Reference of receptor with highest PC	Maximum Process Contribution	Background Concentration (from APIS)	Max. Predicted Environmental Concentration
Annual average	Dee Estuary	329402,371237	0.87	18.99	19.9
	River Dee	330500,369840	0.40	22.42	22.8
	Shotton Lagoons and Reedbeds	329671,370743	2.69	26.81	29.5
	Shotton Steelworks LWS	330327,370981	0.60	19.29	19.9
Maximum daily average	Dee Estuary	329537,370225	14.46	as above	33
	River Dee	330500,369840	7.21		30
	Shotton Lagoons and Reedbeds	329828,370837	36.77		64
	Shotton Steelworks LWS	330327,370981	8.09		27

Table 3: Maximum Predicted Environmental Concentrations for NO_x

Thus for all these sites, the maximum PECs are lower than the long-term and short-term critical levels and hence no significant impact on vegetation would be expected. Furthermore, the modelled PCs and PECs represent a conservative assessment, as a number of worst-case assumptions have been made in the analysis:

- The waste gas flowrate is at the maximum value (41,000 Nm³/h) throughout the year
- The waste gas temperature is at the minimum value (180°C) throughout the year
- Pollutant emissions are continuously at the Emission Limit Value throughout the year
- Results are quoted for whichever year of meteorological data gave the highest figure
- Results are quoted for the receptor giving the highest PC and are not representative of the whole of the protected site

5.1.2.2 Critical loads for nutrient nitrogen

Critical loads for nutrient nitrogen depend on the habitat type that may be affected and a comprehensive list[6] is included on the APIS site. The lowest critical load included is 3 kg N/ha/year and this has been used as an initial screening value (even though it is not applicable to any of the sites in the vicinity of the Tata Steel site). The modelled nitrogen deposition rates at Deeside and Buckley Newt Sites SAC, Halkyn Mountain SAC, Top-y-fron Dingle and Kelsterton Brook LWS and Connah's Quay Ponds and Woodland SSSI all fall below 1% of this value and so these sites have not been assessed further.

For the remaining sites, current nitrogen deposition rates for the receptor giving the highest PC have been obtained from the APIS web site[5] to calculate an overall deposition figure, which has then been compared to critical loads[7] for all the habitat types at each site (in some cases, the particular habitat will not be present at the parts of the site closest to the proposed stack, where the highest PCs are predicted). Table 4 shows the results of this assessment.

	Nitrogen deposition rate (kg/ha/year)				
Site	Process Contribution	Existing nitrogen deposition rate	Predicted overall deposition rate	**Habitat type**	**Critical Load (kg N/ha/year)**
Dee Estuary	0.241	13.86	14.1	Coastal stable dune grasslands - acid type	8-10
				Coastal stable dune grasslands - calcareous type	10-15
				Moist to wet dune slacks - acid type	10-15
				Moist to wet dune slacks - calcareous type	15-20
				Shifting coastal dunes	10-20
				Pioneer, low-mid, mid-upper saltmarshes	20-30
				Mudflats and sandflats not covered by seawater at low tide	*
				Annual vegetation of drift lines	**
				Vegetated sea cliffs of the Atlantic and Baltic Coasts	*
				Rivers and streams	*
River Dee	0.096	20.16	20.3	Rivers and streams	*
Shotton Lagoons and Reedbeds	0.804	13.86	14.7	Valley mires, poor fens and transition mires	10-15
				Rich fens	15-30
				Standing open water and canals	*
Shotton Steelworks LWS	0.139	19.32	19.5	Not available from APIS	

* No comparable habitat with established critical load estimate available

** Not sensitive to nitrogen deposition

Table 4: Critical Loads for nitrogen deposition

The only habitat type for which the critical load may be exceeded would be acid dune grasslands, and in this case the critical load is already exceeded by the current nitrogen deposition rates and the proposed RTO emissions would add less than 2% to the existing load.

It should be noted that this represents a very conservative assessment of the potential impact of the RTO emissions, as a number of worst-case assumptions have been made in the analysis:

- The waste gas flowrate is at the maximum value (41,000 Nm^3/h) throughout the year
- The waste gas temperature is at the minimum value (180°C) throughout the year
- Pollutant emissions are continuously at the Emission Limit Value throughout the year
- Deposition rates are calculated assuming that 100% of NO_x emitted from the RTO is converted to NO_2 (deposition rates for NO are less than 10% of those for NO_2)
- Results are quoted for whichever year of meteorological data gave the highest figure
- Results are quoted for the receptor giving the highest PC and are not representative of the whole of the protected site
- Critical loads for the most sensitive habitat type have been used, regardless of whether this habitat is present at the receptor giving the highest PC

Taking into account all the worst-case assumptions above, it is likely that the actual additional nitrogen deposition attributable to emissions from the proposed RTO will be less than 1% of the relevant critical load, and hence can be deemed insignificant.

5.1.2.3 Critical loads for acid deposition

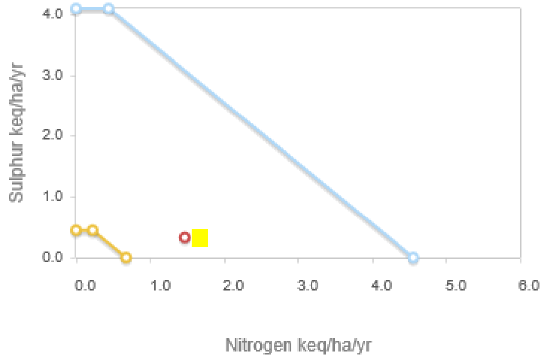
Critical loads for acid deposition also vary with habitat type and cannot be expressed as a single number as acidity from nitrogen and acidity from sulphur deposition are calculated separately. For the purposes of screening, the modelled acid deposition (from NO_x emissions) has been compared to the existing acid deposition from nitrogen at each site. At all but two of the sites, the modelled deposition rates are less than 1% of the existing levels and so these sites have not been assessed further.

For the other sites, the additional acidity attributable to emissions from the proposed RTO has been compared to the relevant critical loads. The critical load function is described by three parameters – $CL_{max}S$, $CL_{min}N$ and $CL_{max}N$ and APIS includes both minimum and maximum values of each parameter for each habitat type. For the Dee Estuary SAC, APIS illustrates[8] the minimum and maximum critical load functions for different habitat types and this is reproduced in Figure 7 for those habitats for which the critical load has been defined. On each plot, the brown line represents the minimum critical load, the blue line the maximum critical load, the red circle is the current level of acid deposition and the yellow square is the predicted acid deposition including the impact of the proposed RTO.

In the case of calcareous grassland, there is no exceedance of the critical load when the potential impact of the proposed RTO is added to the current acid deposition. In the case of acid grassland, current deposition levels are between the minimum and maximum critical loads, but the additional acid deposition from the RTO would make only a small difference to the overall situation and can be deemed insignificant.

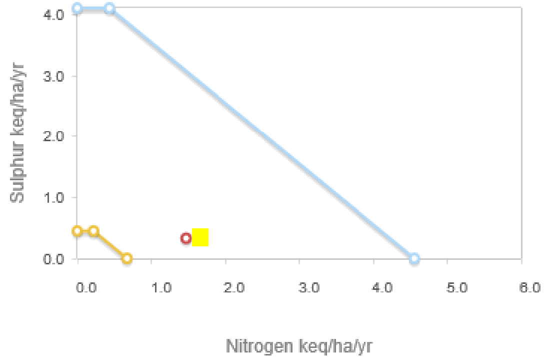
Feature: Humid dune slacks - Humid dune slacks
Critical Load Class: Acid grassland
Critical Load (keq/ha/yr):
Maximum: CLminN: 0.438 CLmaxN: 4.558 CLmaxS: 4.120
Minimum: CLminN: 0.223 CLmaxN: 0.673 CLmaxS: 0.450

Acid Deposition Nitrogen|Sulphur (keq/ha/yr):
Maximum: 1.47|0.33 Minimum: 0.46|0.15 Average: 0.78|0.21



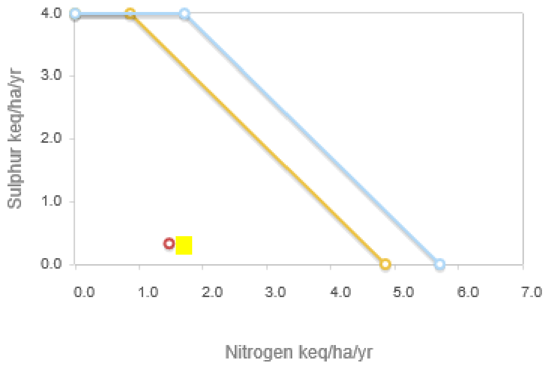
Feature: Fixed coastal dunes with herbaceous vegetation ("grey dunes") - Dune grassland
Critical Load Class: Acid grassland
Critical Load (keq/ha/yr):
Maximum: CLminN: 0.438 CLmaxN: 4.558 CLmaxS: 4.120
Minimum: CLminN: 0.223 CLmaxN: 0.673 CLmaxS: 0.450

Acid Deposition Nitrogen|Sulphur (keq/ha/yr):
Maximum: 1.47|0.33 Minimum: 0.46|0.15 Average: 0.78|0.21



Feature: Humid dune slacks - Humid dune slacks
Critical Load Class: Calcareous grassland (using base cation)
Critical Load (keq/ha/yr):
Maximum: CLminN: 1.710 CLmaxN: 5.710 CLmaxS: 4.000
Minimum: CLminN: 0.856 CLmaxN: 4.856 CLmaxS: 4.000

Acid Deposition Nitrogen|Sulphur (keq/ha/yr):
Maximum: 1.47|0.33 Minimum: 0.46|0.15 Average: 0.78|0.21



Feature: Fixed coastal dunes with herbaceous vegetation ("grey dunes") - Dune grassland
Critical Load Class: Calcareous grassland (using base cation)
Critical Load (keq/ha/yr):
Maximum: CLminN: 1.710 CLmaxN: 5.710 CLmaxS: 4.000
Minimum: CLminN: 0.856 CLmaxN: 4.856 CLmaxS: 4.000

Acid Deposition Nitrogen|Sulphur (keq/ha/yr):
Maximum: 1.47|0.33 Minimum: 0.46|0.15 Average: 0.78|0.21

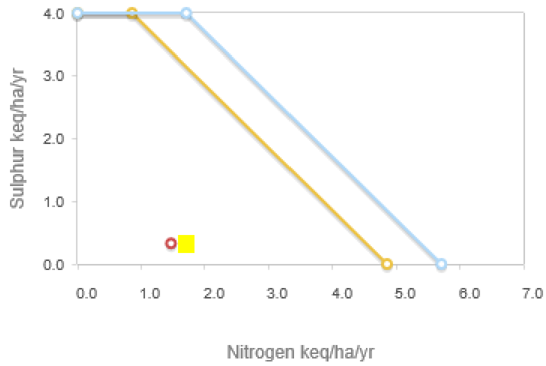


Figure 7: Critical Load Function for acid deposition at Dee Estuary SAC

For the Shotton Lagoons and Reedbeds site, Figure 8 illustrates the critical load function for acid grassland.

Acidity Class: Acid grassland

Exceedance Impacts: Leaching will cause a decrease in soil base saturation, increasing the availability of Al3+ ions, mobilisation of Al3+ may cause toxicity to plants and mycorrhiza, may have direct effect on lower plants (bryophytes and lichens).

Acidity Critical Loads: (keq N or S /ha/year)

MaxCLminN: 0.438 MaxCLMaxN: 4.548 MaxCLMaxS: 4.11

MinCLminN: 0.438 MinCLMaxN: 1.298 MinCLMaxS: 0.86

Total Acid Deposition Nitrogen|Sulphur: 1.38|0.29 (max); 0.99|0.28 (min); 1.01|0.28 (avg) keq/ha/yr

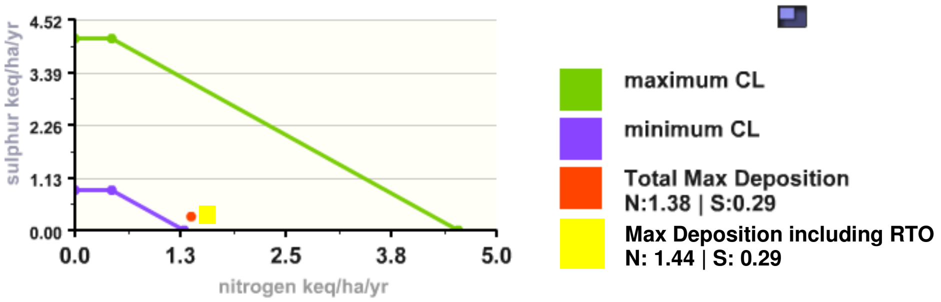


Figure 8: Critical Load Function for acid deposition at Shotton Lagoons and Reedbeds SSSI

As for the Dee Estuary, current deposition levels are between the minimum and maximum critical loads, but the additional acid deposition from the RTO would make only a small difference to the overall situation and can be deemed insignificant.

6. Conclusion

Dispersion modelling suggests that the impacts on human health of potential emissions from a new RTO at Tata Steel Shotton will be insignificant – long-term Process Contributions will not exceed 0.6% of the relevant air quality standards and short-term PCs will be no more than 1% of the standard.

Impacts at nearby sites that are relevant to the protection of vegetation and natural ecosystems are more significant, but it would not be expected that the potential RTO emissions would lead to any exceedance of critical levels for NO_x concentration or critical loads for nitrogen or acid deposition. In some cases, critical loads are already exceeded, but the additional impact of the RTO is small in comparison to the existing deposition levels.

It is concluded that the reuse of the existing stack for the proposed thermal oxidiser will provide adequate dispersion for the likely pollutant emissions and there will be no significant environmental impact.

7. References

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Appendix: Receptors relevant to the protection of vegetation and natural ecosystems

There a number of different designations of sites where assessment of the potential impact of industrial emissions on vegetation and natural ecosystems should be undertaken. The maps in Figures A1 to A4 show the location and extent of any such sites in the vicinity of Tata Steel's Shotton Works and the location of specific receptors used in the ADMS dispersion model. Defra's guidance[3] on risk assessments for emissions to air states that Special Areas of Conservation, Special Protection Areas and Ramsar sites (protected wetlands) within 10 km should be included in the assessment, along with Sites of Special Scientific Interest and local nature sites (ancient woods, local wildlife sites and national and local nature reserves) within 2 km.

Special Areas of Conservation – see Figures A1 and A4:

- Alyn Valley Woods SAC. This SAC lies more than 10 km from the proposed stack location and has not been included in the ADMS model.
- Dee Estuary SAC. Figure A4 illustrates the receptors used to assess impacts at the parts of the estuary closest to the proposed stack location.
- Deeside and Buckley Newt Sites SAC. There are several different elements to this site and two receptors, at the elements closest to the proposed stack (2 km away) have been included in the ADMS model and are shown on Figure A1.
- Halkyn Mountain SAC. One receptor, at the closest point of the SAC to the proposed stack (8 km away) has been included in the ADMS model and is shown on Figure A1.
- River Dee and Bala Lake SAC. Figure A4 illustrates the receptors used to assess impacts at the parts of the river closest to the proposed stack location.

Special Protection Areas – see Figures A2 and A4:

- Dee Estuary SPA. Figure A4 illustrates the receptors used to assess impacts at the parts of the estuary closest to the proposed stack location.
- Mersey Estuary SPA. This SPA lies more than 10 km from the proposed stack location and has not been included in the ADMS model.

Ramsar sites

- Dee Estuary Ramsar site. This is covered by the corresponding SAC and SPA and Figure A4 illustrates the receptors used to assess impacts at the parts of the estuary closest to the proposed stack location.
- Mersey Estuary Ramsar site. This lies more than 10 km from the proposed stack location and has not been included in the ADMS model.

Sites of Special Scientific Interest – see Figures A3 and A4:

- Connah's Quay Ponds and Woodland SSSI. The closest part of the SSSI is 2 km from the proposed stack location and two receptors have been included in the ADMS model and are shown on Figure A3.
- Dee Estuary SSSI. Figure A4 illustrates the receptors used to assess impacts at the parts of the estuary closest to the proposed stack location.
- Inner Marsh Farm SSSI. This SSSI lies more than 2 km from the proposed stack location but it is also part of the Dee Estuary SPA and so has been included in the ADMS model (see Figure A4).
- River Dee SSSI. Figure A4 illustrates the receptors used to assess impacts at the parts of the river closest to the proposed stack location.
- Shotton Lagoons and Reedbeds SSSI. Figure A4 illustrates the receptors used to assess the impacts at this SSSI.

Ancient Woodlands

- The only ancient woodlands within 2 km of the proposed stack location are within the Connah's Quay Ponds and Woodland SSSI and are covered by the receptors shown in Figure A3.

Local wildlife sites – see Figures A3 and A4

- River Dee LWS. The location of the site is shown on Figure A3 and Figure A4 illustrates the receptors used to assess impacts at the parts of the river closest to the proposed stack location.
- Shotton Steelworks LWS. The location of the site is shown on Figure A3 and Figure A4 illustrates the receptors used to assess the impacts.
- Top-y-fron Dingle and Kelsterton Brook LWS. The closest part of this site is 2 km from the proposed stack location and a receptor has been included in the ADMS model and is shown on Figure A3.

Receptors for Dee Estuary, River Dee, Shotton Lagoons and Reedbeds SSSI and Shotton Steelworks LWS – see Figure A4

- The Dee Estuary includes several different types of protected site, which often overlap (SAC, SPA, Ramsar site and SSSI). Eighteen receptors have been included in the ADMS model (excluding those for the Shotton Lagoons and Reedbeds element, which is part of the SPA).
- The River Dee includes several different types of protected site, which often overlap (SAC, SSSI and LWS). Five receptors have been included in the ADMS model.
- Eighteen receptors have been included in the ADMS model to cover Shotton Lagoons and Reedbeds SSSI and fourteen for Shotton Steelworks LWS.

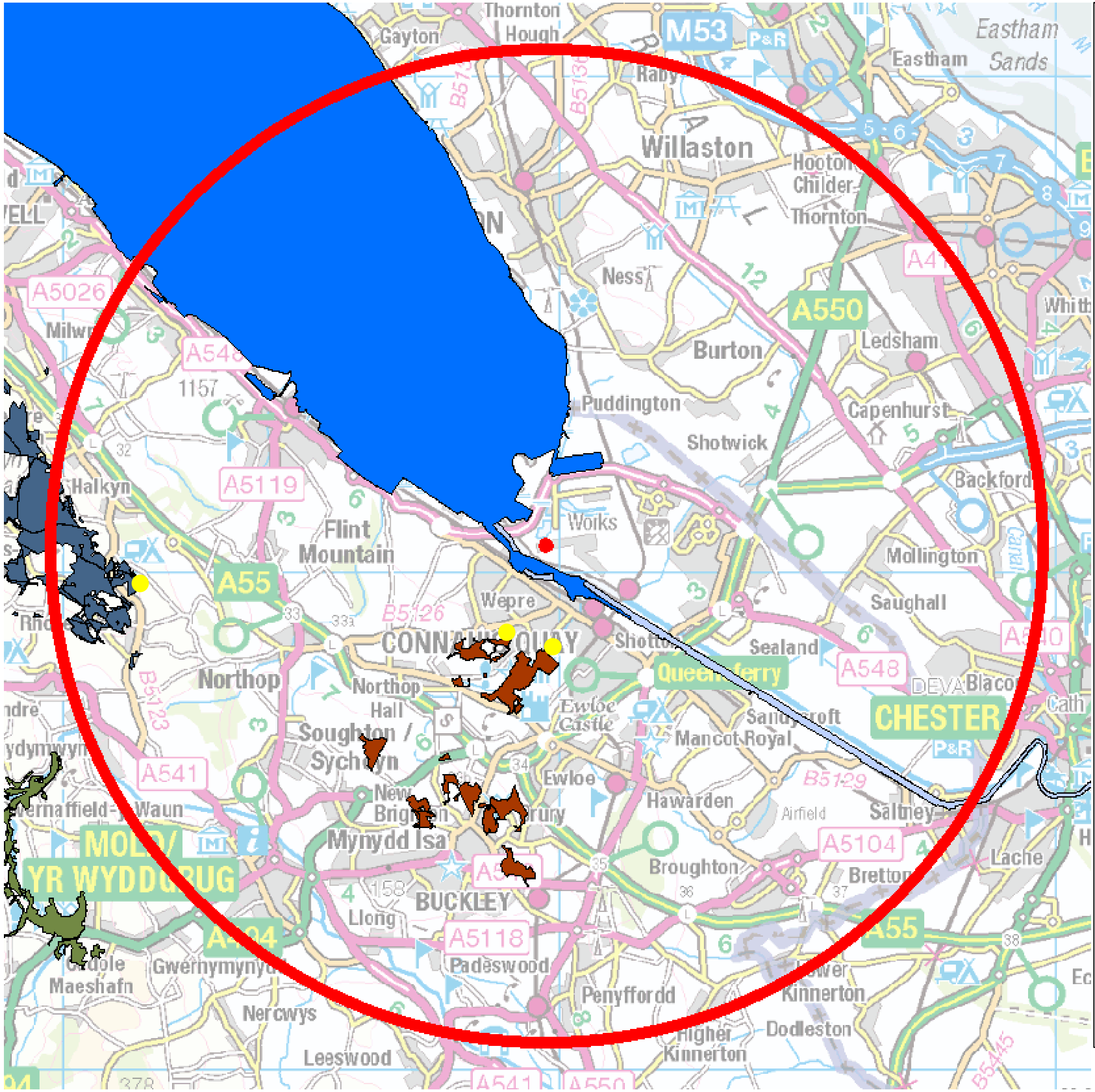

Figure A1: Special Areas of Conservation

Key:

Stack location

10 km radius from stack

Specific receptors in model

Special Areas of Conservation

- Alyn Valley Woods/ Coedwigoedd Dyffryn Alun
- Dee Estuary/Aber Dyfrdwy
- Deeside and Buckley Newt Sites
- Halkyn Mountain/ Mynydd Helygain
- River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid

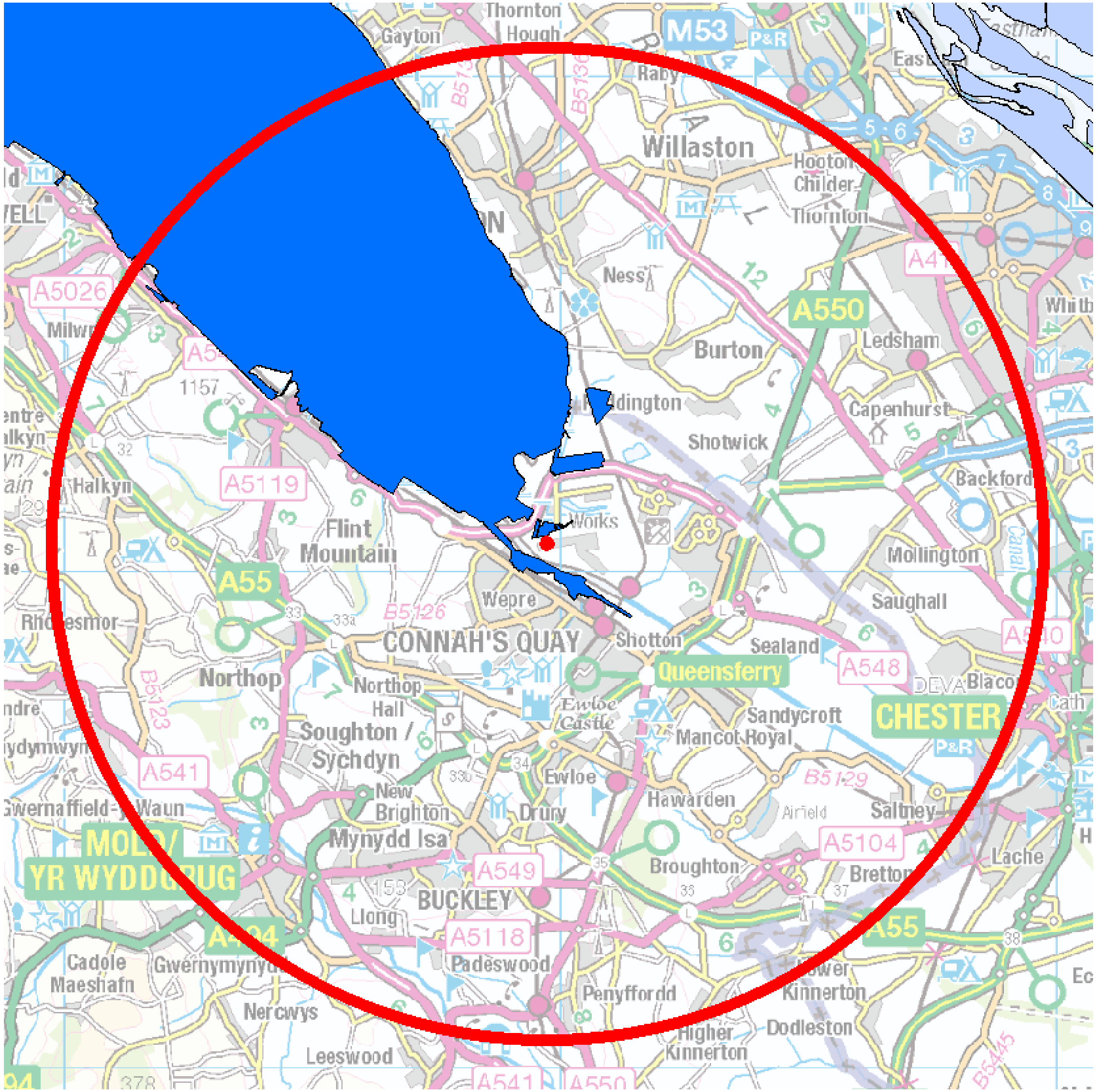

Figure A2: Special Protection Areas (SPAs)

Key:

Stack location

10 km radius from stack

Special Protection Areas

- The Dee Estuary
- Mersey Estuary

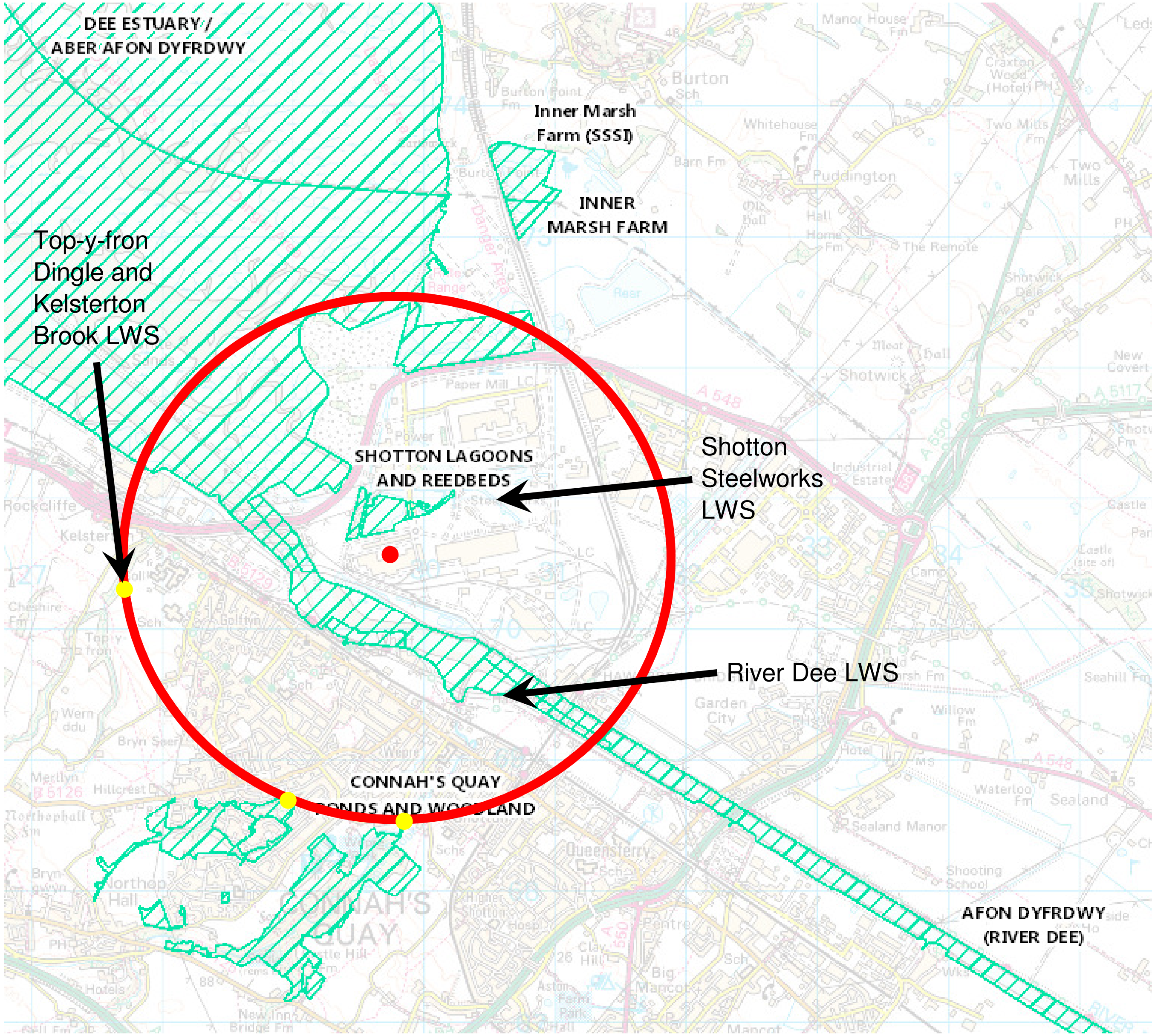

Figure A3: Sites of Special Scientific Interest, ancient woodlands and local wildlife sites

Key:

Stack location

2 km radius from stack

Specific receptors in model

Map and SSSI data from www.magic.gov.uk

Figure A4: Receptors used for River Dee, Dee Estuary, Inner Marsh Farm, Shotton Lagoons and Reedbeds and Shotton Steelworks LWS

Key:

- Stack location
- Protected sites - SACs/SPAs/SSSIs
- Specific receptors in model