Department
for Environment
Food & Rural Affairs

Report on measures for 2014 exceedance of the Target Value for Nickel in Swansea Urban Area agglomeration zone (UK0027)

November 2016

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1. Introduction

1.1 Context

Under the EU Directive 2004/107/EC[1], the target value (TV) for nickel (Ni) is an annual mean concentration of 20 nanograms (one billionth of a gram (10^{-9})) per cubic metre (m^{-3}) of ambient air or lower. The Directive requires that Member States shall report on measures in place to address the exceedance of the TV and that all reasonable measures that do not entail disproportionate cost should be taken to ensure this target is not exceeded.

1.2 Status of zone

This is the report on measures required for exceedances of the TV for Ni within the Swansea Urban Area agglomeration zone identified within the 2014 UK air quality assessment. It updates the Report on Measures submitted and published following the 2013 UK air quality assessment[2].

Exceedances within this zone were identified on the basis of measurement data, with model results on a 1 km x 1 km grid resolution providing supplementary information. Fine scale modelling on a 20 m x 20 m grid resolution located around an identified industrial source provided a more detailed local assessment. This exceedance was reported via e-Reporting dataflow G[3] on attainment and Air Pollution in the UK[4].

Table 1 summarises the spatial extent and associated resident population for the exceedances identified in this zone, as reported via e-Reporting.

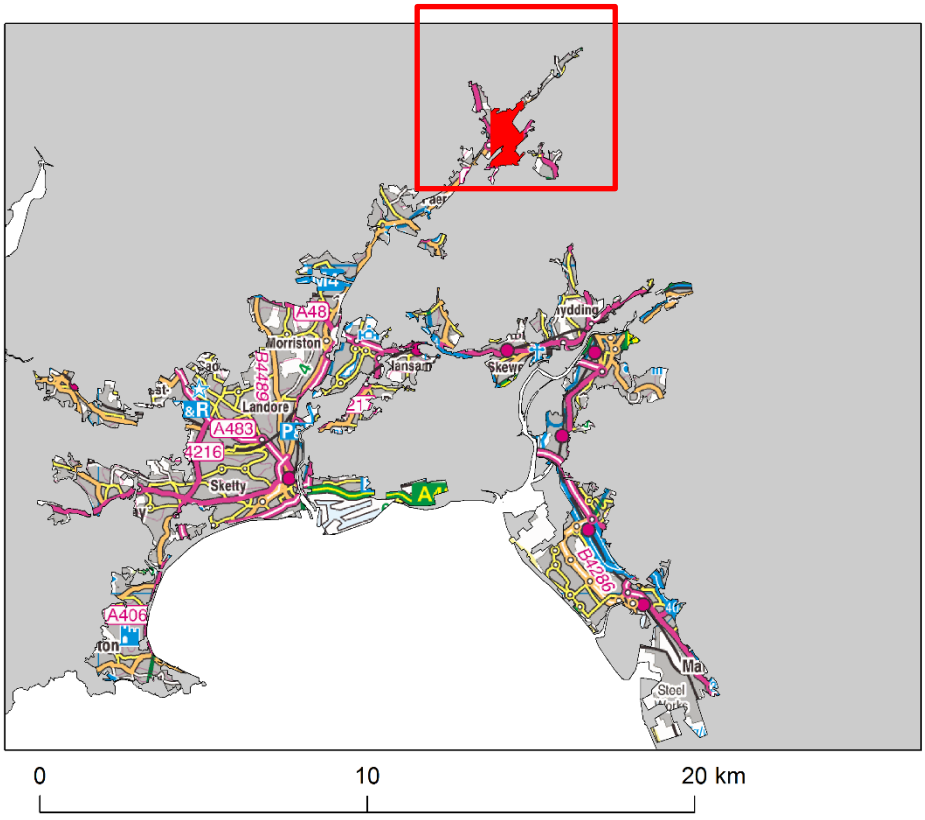
[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:023:0003:0016:EN:PDF
[2] https://uk-air.defra.gov.uk/assets/documents/reports/bap-nickel-measures/ni_swansea_UK0027_reportonmeasures_2013.pdf
[3] http://cdr.eionet.europa.eu/gb/eu/aqd
[4] http://uk-air.defra.gov.uk/library/annualreport/index

Table 1. Area exceeding Ni target value in 2014 and associated resident population for exceeding areas within Swansea Urban Area zone UK0027.

Zone code	Zone Name	Area exceeding TV (km^2)	Population exceeding TV
UK0027	Swansea Urban Area	1	2,102

Figure 1 shows the locations of the exceedances in the context of the zone as a whole.

Figure 1. Location of exceedance of the Ni target value on 2014 in Swansea Urban Area zone UK0027. Areas of the zone in exceeding grid squares are marked red.



An initial source apportionment was carried out and this analysis identified one exceedance situation within this zone related to industrial emissions:

- Swansea [Ni_UK0027_2014_1] related to industrial emissions (area of exceedance 1 km^2)

This report describes the exceedance situation in the zone. The sections below include a description of the exceedance situation, including maps, information on source apportionment and a list of measures already taken or to be taken. Information on measures is reported within e-Reporting dataflow K[5]. This exceedance situation is adjacent to and shares common sources with the exceedance situation South Wales [Ni_UK0041_2014_1] for which further information can be found in the report on measures for South Wales UK0041.

2 Exceedance situation Swansea [Ni_UK0027_2014_1] related to industrial emissions

2.1 Description of exceedance

This exceedance situation has an area of exceedance of 1 km^2 and is located in the Swansea valley in the north of the Swansea Urban Area agglomeration zone. The resident population associated with this exceedance situation is 2,102. This exceedance situation is adjacent to and shares common sources with the exceedance situation South Wales [Ni_UK0041_2014_1].

Table 2 lists measured annual mean concentrations of Ni from monitoring sites in Swansea Urban Area agglomeration zone from 2004 to 2014, and Figure 2 indicates the location of measurement sites. There is one measured exceedance at Pontardawe Tawe Terrace (GB1016A) in 2014 for which this report relates. Figure 3 shows the location of the exceedance situation in detail. This map also shows the locations of the monitoring sites in the vicinity of the exceedance situation and the locations of local industrial sources. The map in Figure 3 shows that Pontardawe Tawe Terrace is located within the exceedance situation Swansea [Ni_UK0027_2014_1]. The measured concentrations of Ni at other national monitoring sites within the Swansea Urban Area agglomeration zone were all below the TV in 2014. However, the measured concentration of Ni at the Local Authority site Pontardawe Leisure Centre was also above the TV in 2014 but did not form part of the 2014 UK air quality assessment.

Figure 3 shows the high resolution zone boundary used to assign the locations of monitoring sites in grey and the zone boundaries for the 1 km grid used to assign

[5] http://cdr.eionet.europa.eu/gb/eu/aqd

exceedance situations and associated populations as black hatching. The local topography and locations of settlements results in the Swansea Urban Area Agglomeration zone extending up the Swansea Valley but only the larger urban areas are assigned to the agglomeration zone within the 1 km gridded data.

Figure 2. Location of monitoring sites in Swansea Urban Area.

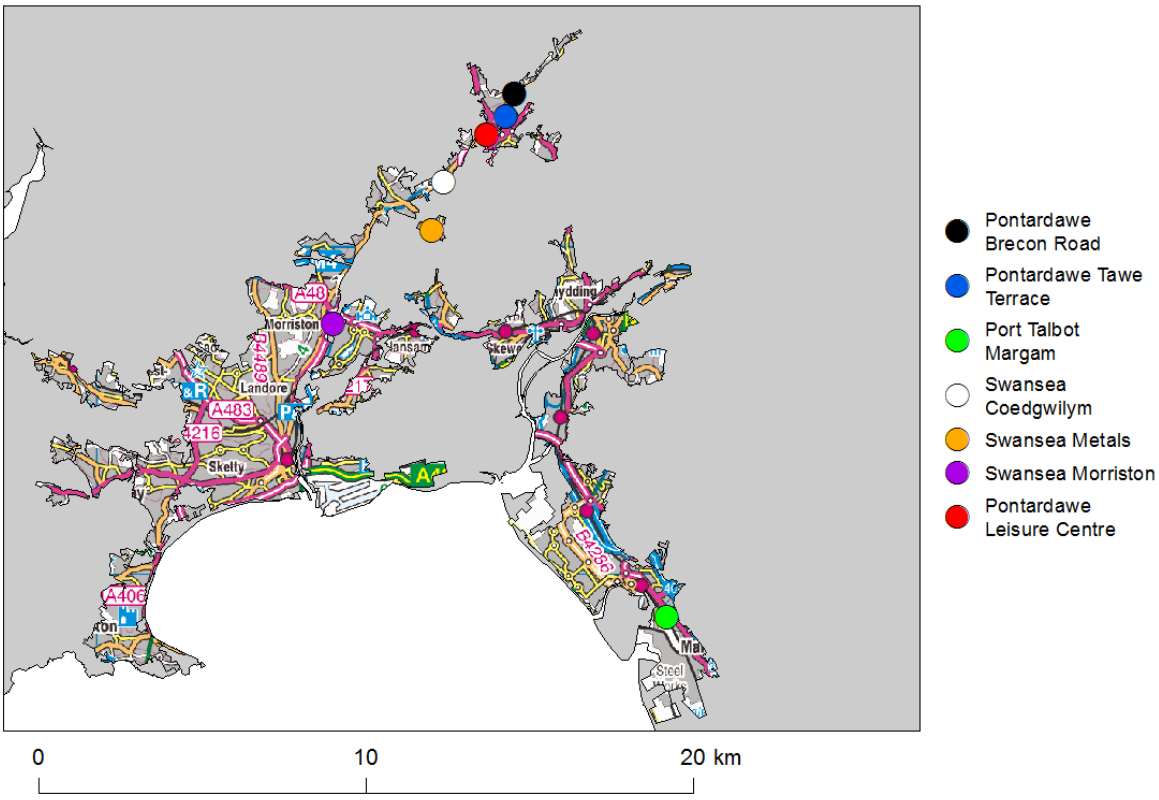
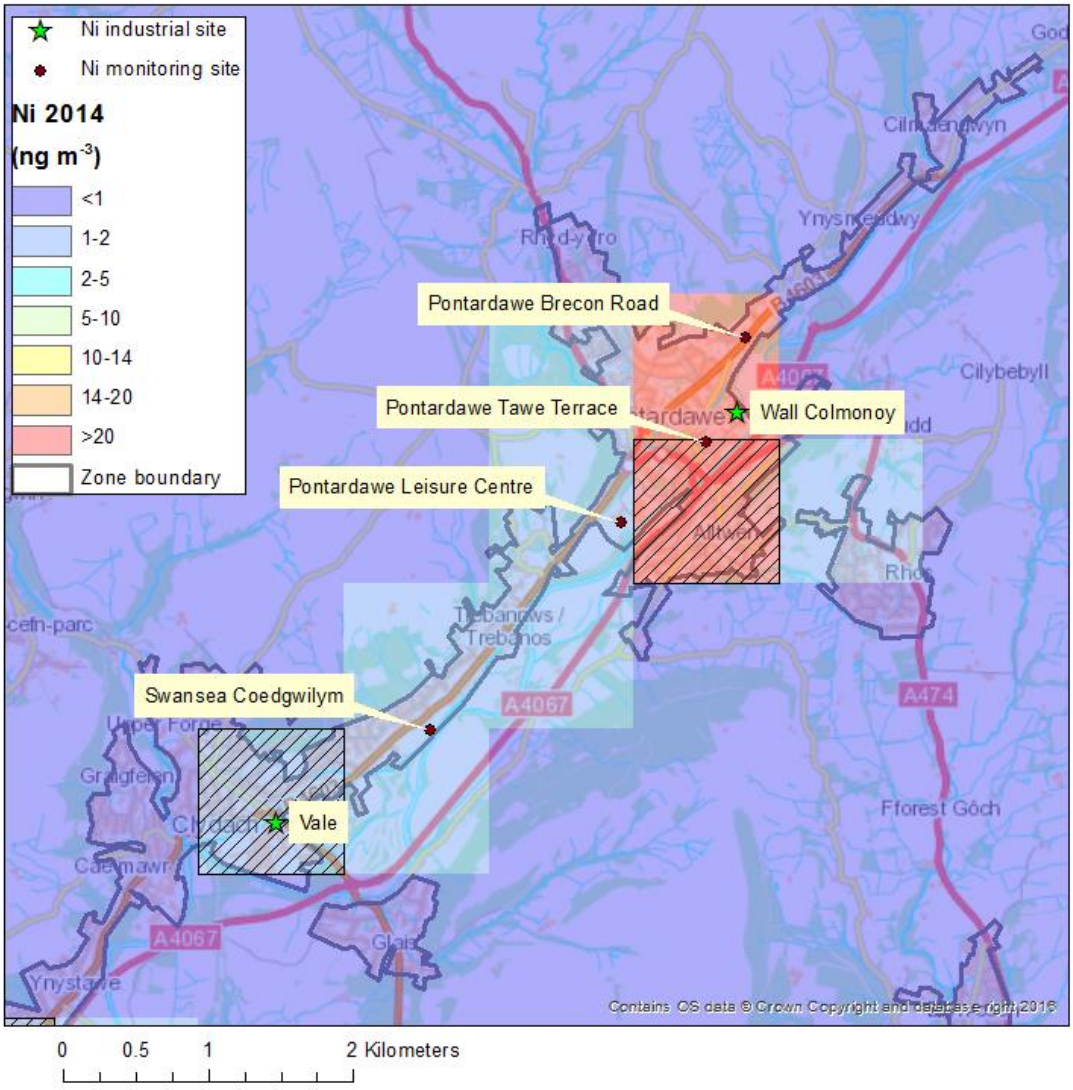


Table 2. Measured annual mean Ni concentrations in Swansea Urban Area agglomeration zone UK0027 from 2004 to 2014 (ngm^{-3}). (Percentage data capture is shown in brackets).

Station (EoI code)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Pontardawe Brecon Road (GB1015A)								6.5 (37)	6.6(94)	5.7 (98)	8.1 (96)
Pontardawe Tawe Terrace (GB1016A)								28 (93)	30 (98)	37 (98)	43 (100)
Port Talbot Margam (GB0906A)					2.0 (98)	1.4 (92)	1.5 (100)	1.7 (97)	1.4 (99)	1.5 (100)	1.7 (100)
Swansea Metals (GB0876A)	34 (96)	20 (97)	26 (97)	28 (64)							
Swansea Coedgwilym (GB0981A)					20 (100)	16 (96)	10 (98)	11 (92)	8.5 (84)	7.8 (100)	12 (100)
Swansea Morriston (GB0979A)					7.6 (87)	9.3 (98)	15 (98)	8.2 (95)	5.6 (98)	6.5 (100)	9.4 (100)
Pontardawe Leisure Centre*	76	47	74	70	43	29	8.5	15	14	12	22

* Pontardawe Leisure Centre is a Local Authority monitoring site. It is included here as the site was operated continuously between 2004 and 2014. Data capture statistics were not available for this site.

Figure 3. Exceedance situation Swansea [Ni_UK0027_2014_1]. Exceeding grid squares are marked red. Locations of local industrial sites Wall Colmonoy works at Pontardawe and Vale Europe Ltd Clydach refinery and the locations of local monitoring stations are also shown. Non-hatched grid squares are assigned to the South Wales zone UK0041 and do not form part of this exceedance situation.



2.2 Source apportionment

Modelling has been used to determine the annual mean Ni source apportionment for the exceedance situation. National modelling on a 1 km x 1 km grid resolution apportions the Ni concentration to background sources. Additional fine scale modelling has also been carried out to characterise local industrial emissions for the

Wall Colmonoy site located within the exceedance situation, this is described in Appendix 1.

Table 3 provides a breakdown of the main emission sources (source apportionment) that have contributed to the grid square in this exceedance situation. It is clear that industrial sources are the main source associated with this exceedance situation. The penultimate column in the table is the total from all emissions sources. The values in this column have been rounded to integers for consistency with the values in the compliance assessment. The values in the other columns have not been rounded. The other shaded columns are the subtotals for the regional, urban background and local contributions.

Table 4 gives a more detailed source apportionment for the industry sector and shows that the main source associated with this exceedance situation is fugitive emissions attributed to local unidentified industrial activities. Appendix 1 discusses the uncertainties in the identification of this source of Ni in air and the activities that have been undertaken by the Welsh Government to understand this emissions source. Stack emissions from the Wall Colmonoy works contributed to the exceedance situation, although the contribution was small compared with the assumed unidentified fugitive emissions. The emissions from Wall Colmonoy are regulated by the Neath Port Talbot County Borough Council and measures undertaken (see section 2.3) describe how these stack emissions have been reduced by a factor of ten since 2009.

Table 3. Source apportionment for exceedance situation Ni_UK0027_2014_1. Annual mean Ni concentration (ngm^{-3}).

OS easting (m)	OS Northing (m)	Zone	a) Regional background: Total	Regional background: From within Member State	b) Urban background increment: Total	Urban background increment: Traffic	Urban background increment: Industry including	Urban background increment: commercial and	Urban background increment: Shipping	Urban background	Urban background increment: Other	c) Local increment: Total	Local increment: Industry including heat and power production	Total emissions for all sources (a+b+c)	Resident population
272500	203500	27	1.48	1.48	0.77	0.01	0.18	0.54	0.01	0.02	0.00	40.75	40.75	43	2102

Table 4. Detailed source apportionment for industrial sources only for exceedance situation Swansea [Ni_UK0027_2014_1]. Annual mean Ni concentration (ngm^{-3}).

OS easting (m)	OS Northing (m)	Zone	Wall Colmonoy stack emissions	Fugitive emissions	Local increment: Industry including heat and power production
272500	203500	27	3.49	37.26	40.75

2.3 Measures

Improving air quality is a high priority for the Welsh Government, including the attainment of EU target values. The Welsh Government brings together the regulators and local industrial operators with emissions of Ni to air in pursuit of this aim. Regular meetings have enabled:

- the Welsh Government to communicate to the industrial regulators and operators the extent of the issue and the seriousness with which it is taken;
- the regulators to demonstrate that the operators are applying all cost-effective measures, and in particular are applying best available techniques as required by Council Directive 2010/75/EU (IED);
- the operators to cooperate and share best practice in managing their operations; and
- the development of the latest evidence in understanding the predominant sources.

Table 5 presents measures that have been taken and are to be taken at the Wall Colmonoy and Vale industrial sites. The regulator for the Vale site, Natural Resources Wales, has assessed that the measures that have already been taken by Vale constitute BAT for the industrial site. The regulator for the Wall Colmonoy site, Neath Port Talbot County Borough Council, has assessed that the measures that have been taken at the Wall Colmonoy site also constitute BAT.

The measures introduced by Wall Colmonoy in 2014 have resulted in significant reductions in the stack emissions resulting in a ten-fold reduction in stack emissions since 2009.

Despite significant reductions in stack emissions from the Wall Colmonoy site, annual mean concentrations of Nickel at the Pontardawe Tawe Terrace site have not reflected this trend. Given the level of uncertainty and the cause and spatial extent of this local exceedance, the Welsh Government have undertaken further measurement studies to help identify the predominant sources (more information is provided at the end of this report).

Table 5. Table of measures taken or to be taken at Wall Colmonoy and Vale industrial sites.

Measure code	Measure Description	Classification	Implementation dates	Other information		Comment
Wall Colmonoy_1	Water wash cyclone filtration for casting foundry	Permit systems and economic instruments: Other measure	Start: 2010 Expected end: 2010 Status: Implementation	Source affected:	Industry including heat and power production	Regulator (Neath Port Talbot County Borough Council) have assessed that this system meets BAT. This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Nickel concentration in emissions test: October 2014 results of 0.01 mgm-3 against limit specific in environmental permit of 15 mgm-3	
				Target emissions reduction:	Not available	
Wall	New local exhaust	Permit systems and	Start: 2014	Source affected:	Industry including	This measure is

Colmonoy_2	ventilation system and filter unit installed in the powders section	economic instruments: Other measure	Expected end: 2014 Status: Implementation		heat and power production	complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_3	Deep clean of powders section	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	

Wall Colmonoy_4	Install new centralised vacuum system in powders section	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2015 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_5	New LEV and filter in fettling section	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions	Not available	

				reduction:		
Wall Colmonoy_6	Deep clean of atomising section	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_7	Flap curtains installed between the powder room and driers to minimise escape of dust from powder room	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	

				Target emissions reduction:	Not available	
Wall Colmonoy_8	Nutating inlets (containment at transfer points) fitted on lockers (screens) 7 & 8	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2015 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_9	New enclosure and Local Exhaust Ventilation (LEV) filter on blenders dispense into sieve	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	

				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_10	Lip extraction fitted to furnaces feeding atomising (powder manufacture) Tower 4	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_11	Dalamatic filter system upgraded with bags to same specification as Vale A1 site	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	

				Cost:	Not available	
				Indicator:	Nickel concentration in emissions test. November 2014 results of 0.01 mgm-3 against limit specific in environmental permit of 15 mgm-3	
				Target emissions reduction:	Not available	
Wall Colmonoy_12	Russell sieve enclosed with curtains	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	

Wall Colmonoy_13	Cut off saw bag filters installed	Permit systems and economic instruments: Other measure	Start: 2012 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_14	Cyclone followed by bag filter (Dalamatic) arrestment used in powder manufacturing (atomising)	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions	Not available	

				reduction:		
Wall Colmonoy_15	High-efficiency particulate arrestance (HEPA) filters used on drier units where air is emitted to internal atmosphere	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_16	Workplace nickel monitoring to take place to identify hot spots.	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2016 Status: Implementation	Source affected:	Industry including heat and power production	Results from this monitoring will be used to identify and prioritise future improvements The second tranche of workplace monitoring is
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	

				Target emissions reduction:	Not available	complete.
Wall Colmonoy_17	Ambient (external) monitoring is to take place to help identify any hot spots	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2015 Status: Preparation	Source affected:	Industry including heat and power production	Hourly monitoring study by King's College London in November/December 2015 is now complete. Monitoring by Wall Colmonoy and at Pontardawe Tawe Terrace is on-going.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_18	Modify hoods in castings 450kg furnaces. Only extract from two working furnaces instead of all four	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2016 Status: Preparation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	

				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_19	Install water flow alarms on Aqualine filter system	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2015 Status: Preparation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_20	Roll out of differential pressure gauges on all Local Exhaust Ventilation (LEVs) including those < 50m3/min	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2015 Status: Preparation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	

				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_21	Air drier pans LEV to be improved	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2016 Status: Preparation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_22	Extraction for maintenance area. Likely to involve welding fume only,	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2015	Source affected:	Industry including heat and power production	This is not a nickel issue.

	no nickel		Status:	Preparation	Spatial scale:	Local	
					Cost:	Not available	
					Indicator:	Not available	
					Target emissions reduction:	Not available	
Wall Colmonoy_23	Door closures for existing maintenance area	Permit systems and economic instruments: Other measure	Start:	2015	Source affected:	Industry including heat and power production	This has been dealt with by additional training and improved working practices.
			Expected end:	2015			
			Status:	Planning	Spatial scale:	Local	
					Cost:	Not available	
					Indicator:	Not available	
					Target emissions reduction:	Not available	
Wall Colmonoy_24	Improve powder decanting arrangements on	Permit systems and economic instruments: Other	Start:	2015	Source affected:	Industry including heat and power production	Dependent on results of workplace nickel monitoring.

	Tower 4. Better enclosure & LEV	measure	Expected end: 2015 Status: Planning	Spatial scale:	Local	Options are currently being investigated.
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_25	TD100 discharge under positive pressure. Can put strain on neoprene at transfer points	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2016 Status: Implementation	Source affected:	Industry including heat and power production	Dependent on results of workplace nickel monitoring. This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall	Enclose vibratory	Permit systems and	Start: 2015	Source affected:	Industry including	Dependent on results

Colmonoy_26	feeders	economic instruments: Other measure	Expected end: 2016 Status: Planning		heat and power production	of workplace nickel monitoring
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Wall Colmonoy_27	DSB mill LEV solution to be established before installation. Although this is already within an enclosed room	Permit systems and economic instruments: Other measure	Start: 2015 Expected end: 2015 Status: Planning	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	
				Target emissions reduction:	Not available	

Wall Colmonoy_28	Possible replacement of Aqualine system with Vent-Tech filters	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Other	Source affected:	Industry including heat and power production	Current system already meets BAT, assessment has shown little potential for improvement, high cost and uncertainty as to likely performance of alternative system. Emissions are already at detection limit. This measure is not to be progressed while the system is still at BAT.
				Spatial scale:	Local	
				Cost:	£165.5K	
				Indicator:	Nickel concentration in emissions test.	
				Target emissions reduction:	Not available	
Wall Colmonoy_29	Waste from bag filters are collected in enclosed drums, which are sealed prior to disposal by licenced carrier. Dust collected by the Aqualine system is saturated with water and is placed in Intermediate Bulk	Permit systems and economic instruments: Other measure	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	Not available	
				Indicator:	Not available	

	Containers before disposal by registered waste carrier.			Target emissions reduction:	Not available	
Vale_1	Installation of stack filtration plant (bag house) to replace electrostatic precipitators	Permit systems and economic instruments: IPPC permits	Start: 2007 Expected end: 2007 Status: Implementation	Source affected:	Industry including heat and power production	This was the most significant measure for this source. This measure is complete.
				Spatial scale:	Local	
				Cost:	£1.8M	
				Indicator:	Monthly average particulate concentration from main stack reduced from ~10 mgm-3 to less than 1 mgm-3	
				Target emissions reduction:	3: Annual stack emission reduced from 2855 kg in 2007 to less than 100 kg by 2009, value in 2013 was 42 kg	

Vale_2	Undertook soil remediation on abandoned parcel of contaminated land to render contained nickel inert	Permit systems and economic instruments: IPPC permits	Start: 2011 Expected end: 2011 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	£90K	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Vale_3	Consolidated 3 emission points from Powder Plant Storage Hoppers into 1 emission point and installed HEPA filer at outlet	Permit systems and economic instruments: IPPC permits	Start: 2012 Expected end: 2012 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	£100K	
				Indicator:	Not available	
				Target emissions	Not available	

				reduction:		
Vale_4	Replaced cladding and added belt enclosure on feed conveyors	Permit systems and economic instruments: IPPC permits	Start: 2013 Expected end: 2013 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	£600K	
				Indicator:	Not available	
				Target emissions reduction:	Not available	
Vale_5	Replaced all 1700 filter bags on the Stack Filtration Plant as part of planned preventative maintenance	Permit systems and economic instruments: IPPC permits	Start: 2014 Expected end: 2014 Status: Implementation	Source affected:	Industry including heat and power production	This measure is complete.
				Spatial scale:	Local	
				Cost:	£160K	
				Indicator:	Not available	

				Target emissions reduction:	Not available	

A comparison between the reported annual Ni emissions from Vale works in Table 6 and annual Ni concentrations recorded at local monitoring sites in Table 2 shows good agreement between the timing of reductions of reported emissions at Vale site and the trend in measured annual mean Ni concentrations at the long running Pontardawe Leisure Centre site – although an increase was seen at this site in 2014. In particular the timing of the large drop in measured concentrations at this site between 2007 and 2010 coincides with the large reduction in reported stack emissions from the Vale works.

A similar comparison between reported annual Ni emissions from Wall Colmonoy site in Table 7 and Ni concentrations at local monitoring sites shows that there is a lack of agreement between the reductions in reported emissions from the Wall Colmonoy site and measured annual mean Ni concentrations at Pontardawe Tawe Terrace. Given the level of uncertainty in the cause and spatial extent of this local exceedance, the Welsh Government has undertaken further measurement studies to help identify the predominant sources.

Table 6. Reported annual Ni emissions to air from Vale works (kg year^{-1}).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Stack	1934	763	1382	3154	2855	193	56	96	25	31	42	11
Other	54	280	31	12	116	93	45	16	11	29	37	12

Table 7. Reported annual stack emissions of Ni from Wall Colmonoy site (kg year^{-1}).

	2008	2009	2010[a]	2011	2012	2013	2014
Stack	157.57	157.57	89.93	37.25	74.48	15.82	3.73

[a] Abatement measures implemented mid-2010. Reported emissions assume 6 months emissions at 2009 levels and six months at post abatement emissions level of 22.29 kg year^{-1}.

Appendix

A1 Assessment of industrial source

A1.1 Local scale modelling of the industrial point source

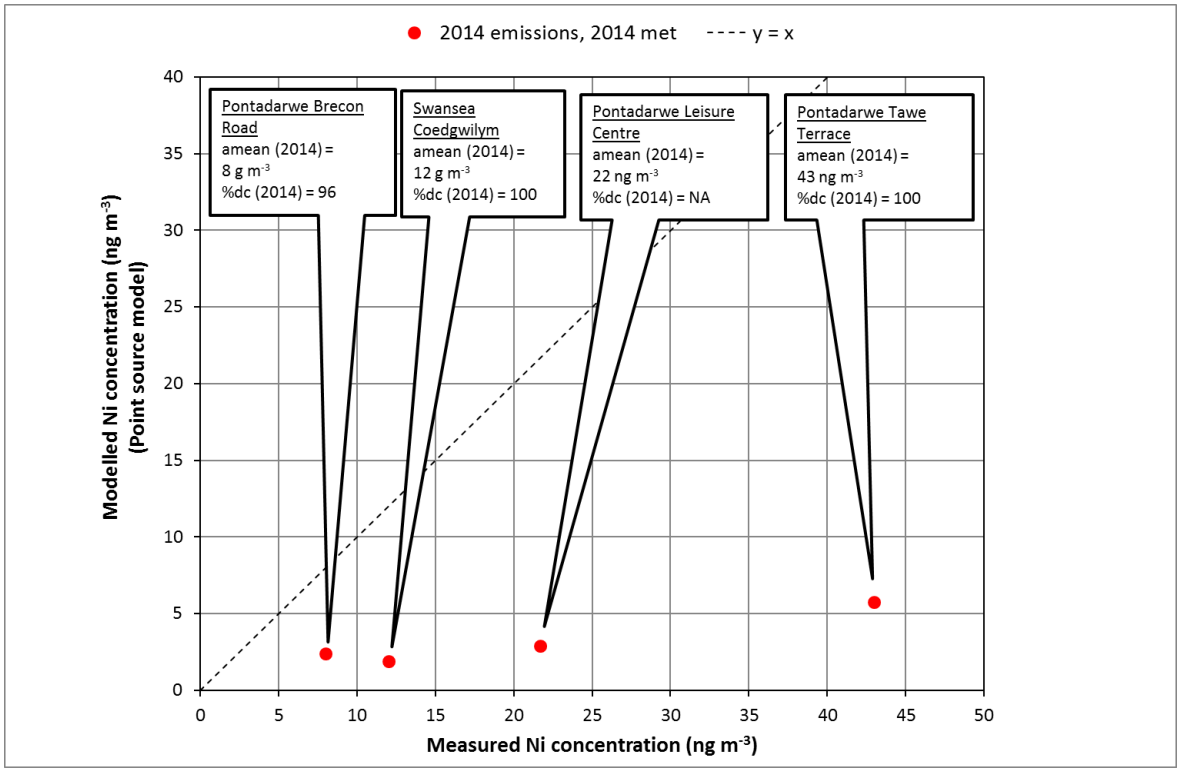
Detailed dispersion modelling has been undertaken using ADMS 5.0 for the area in South Wales where exceedances of the annual mean TV of 20 ngm^{-3} have been measured. This small scale modelling has been used to assess the likely magnitude and spatial scale of the exceedance.

Modelling was carried out at a spatial resolution of 20 m x 20 m over an area of 2 km x 2 km centred on the industrial point source. Information on the Ni emissions from the principal Ni point source were provided by the site operator. Ni emissions were taken to be 3.73 kg $year^{-1}$ for 2014, emitted from six emission points distributed across the site. This annual emission took into account recent abatement measures put in place on-site. Building effects were included in the model, and a 6 km x 6 km area was extracted OS Terrain 50 dataset to allow the effect of the topographical features of the valley to be included in the model. The height of the terrain was specified at the centre of each 50 m x 50 m grid square.

The results of this point source modelling were assessed at the location of three nearby national monitoring stations Pontardawe Tawe Terrace, Pontardawe Brecon Road and Swansea Coedgwilym and one Local Authority monitoring station Pontardawe Leisure Centre. Figure A1 shows the correspondence between measured concentrations and modelled concentrations. The modelled concentration presented is the sum of the point source component from the local model and the background component from the national model. There is poor agreement between the measured and modelled concentrations at Pontardawe Brecon Road, Swansea Coedgwilym and Pontardawe Leisure Centre. Modelled concentrations are substantially under predicted at each of these monitoring stations.

The modelled concentration of Ni at Pontardawe Tawe Terrace which results from this local modelling was 3.4 ngm^{-3} in 2014. The national model provides a background Ni concentration of 2.3 ngm^{-3} which is added to the results of the point source model. The sum of the point source and background contributions is 5.7 ngm^{-3} and is well below the annual mean Ni concentration of 43 ngm^{-3} measured at the monitoring station.

Figure A1. Comparison between measured and modelled Ni concentrations. Modelled concentrations are the sum of contributions from the local point source model and the national background model.



A1.2 Investigation of unknown source

The reason for the difference between the measured and modelled Ni concentrations is not known. Possible reasons include uncertainties in the assumed model inputs including the emission rate, the inherent dispersion model uncertainty and the presence of unidentified sources. In light of this uncertainty, the following discussion summarises details of a modelling scenario with conservative assumptions, undertaken to assess the impact of potential fugitive emissions of Ni in the Swansea Valley on modelled Ni concentrations. This modelling is carried out to provide a precautionary assessment of the possible spatial extent of the measured exceedance.

However due to the discrepancy between the measured and modelled concentrations of Ni at the known location of exceedance (Pontardawe Tawe Terrace), further measurement campaigns have been undertaken, as described below. This will help to improve the confidence in the source apportionment and identification of the predominant sources, and confirm the spatial extent of the exceedance. With new evidence obtained from new measurement campaigns the

assumptions made within the modelling described below will be reassessed and the extent of the exceedance re-evaluated.

Modelling

In light of the difference between the measured and modelled Ni concentrations, as a precautionary approach, further modelling was carried out to understand the impact of fugitive emissions from an unconfirmed source on ambient Ni concentrations in the Swansea Valley. The modelling scenario assumes that the fugitive emissions were located at the site of the local industrial point source. However, it should be noted that there is currently no direct evidence to support the location of this fugitive source at this site.

Fugitive emissions were modelled as a rectangular unit volume source emission of width 16 m, length 43 m and height 3 m and located at the site of the local industrial point source. Dispersion modelling of the volume source was carried out using ADMS 5.0 with the same methodology as described for the Ni point source emissions. The resulting calculated Ni concentrations were scaled so that the sum of contributions from the point source modelling, the fugitive emissions and the ambient background modelling matches the measured annual mean concentration of 43 ngm^{-3} at Pontardawe Tawe Terrace. From this scaling the annual mean fugitive emissions can be estimated to be 6.9 kg $year^{-1}$ in 2014. Figure A2 shows a comparison between measured and modelled concentrations of Ni including the volume source model. Concentrations of Ni are over predicted at Pontardawe Brecon Road and are under predicted at Pontardawe Leisure Centre and Swansea Coedgwilym.

Figure A3 shows the modelled annual mean Ni concentrations resulting from the local industrial point source in Pontardawe and including fugitive source emissions. The Ni concentrations in Pontardawe were strongly influenced by the terrain in the area, as can be seen in Figure A3. The Swansea Valley runs south-west to north-east through the village of Pontardawe, where the point source is located. Figure A3 shows that the distribution of the Ni concentrations in the vicinity of Pontardawe corresponded with the local topography. This is believed to be due to channelling of the local wind flow by the Swansea Valley.

The conclusions from this dispersion modelling scenario are that there was an exceedance of the Ni TV in the Swansea urban area zone in 2014, and it is likely there was also an exceedance in the adjacent South Wales zone. This exceedance was likely to have extended over a spatial area of relevance to the directive (at least 250 m x 250 m for industrial locations).

Figure A2. Comparison between measured and modelled Ni concentrations. Modelled concentrations are the sum of contributions from the local point source and volume source model and the national background model.

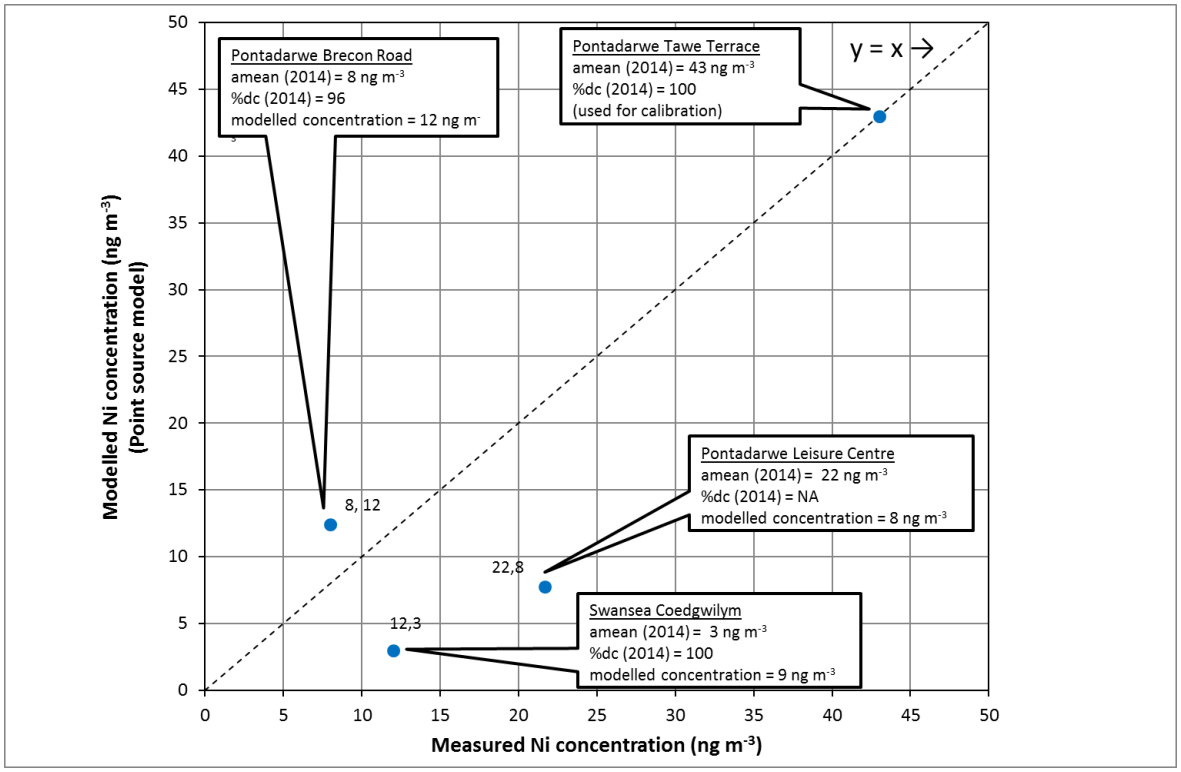
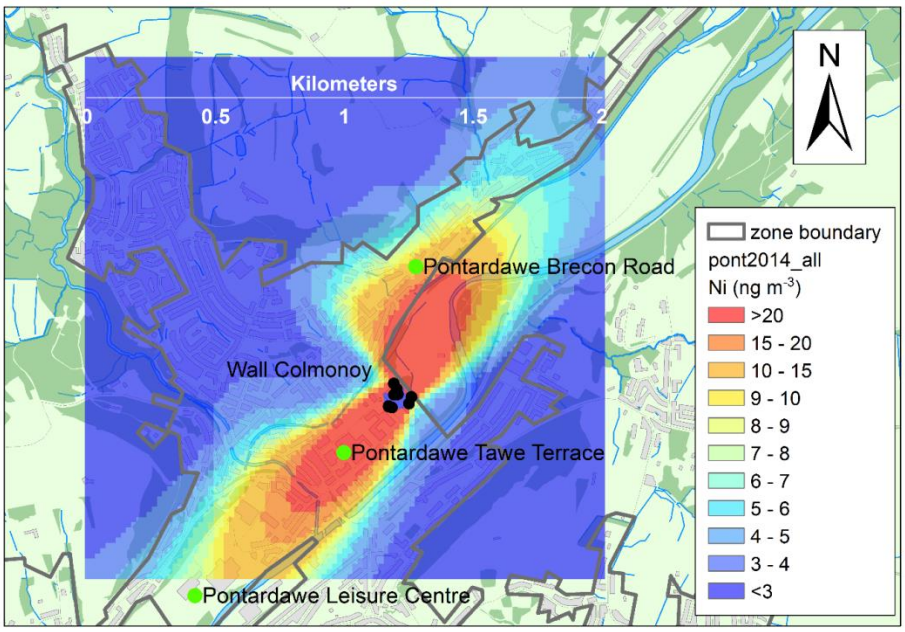


Figure A3: Modelled annual mean Ni concentration resulting from the local industrial point source in Pontardawe in 2014.



Measurement campaigns

Given the level of uncertainty in the extent and cause of this local exceedance, the Welsh Government undertook further measurement studies to help identify the predominant sources.

The sampling frequency of the NPL Partisol Monitor (part of the Urban and Rural metals monitoring network) at Pontardawe Tawe Terrace was increased from weekly to daily between August 2015 and February 2016. The assessment of the data measured looked at the relationship between local meteorological data, the levels of Ni compared with other metals and industrial activity to help identify and disaggregate local and regional sources.

Measurements identified a strong correlation between Ni and Manganese (Mn) a combination of elements used within processes at Wall Colmonoy. In addition, when combined with meteorological data (particularly wind direction from the north east) measurements indicated that Wall Colmonoy was a significant source of Ni at the Tawe Terrace monitoring station. The increase from weekly to daily measurements also highlighted variation in Ni levels depending on the day of the week. Tuesdays and Fridays recorded the highest levels while the weekends (when the plant is not operational) showed the lowest. This information could potentially highlight operational factors which may be contributing to a peak in emissions during certain working days.

To strengthen the evidence base further, the Welsh Government procured a source apportionment assessment by the Environmental Research Group at King's College London (KCL), which was undertaken during November and December 2015.This involved the deployment of King's Mobile Atmospheric Research Platform (MARPL) to undertake high time resolution metal monitoring using state-of-the-art assessment techniques to provide evidence of the sources contributing to the exceedance situation.

In addition to the NPL study a key aim of the KCL assessment was to identify the contribution of suspected unknown sources outside of the local area, given the discrepancy between measured and modelled data for Ni levels at Tawe Terrace, Pontardawe

The monitoring campaign recorded hourly levels of chemical components of particulate matter, with specific focus on Ni and other metallic elements associated with the processes undertaken at the nearby Wall Colmonoy plant. Hourly measurements were combined with meteorological data to allow comparison with the timing of specific activities at the plant. The composition of the metallic compounds

used within processes at the plant was also made available to the KCL monitoring team.

Pollution measurements and meteorological data underwent further analysis using bivariate polar plots and cluster analysis to show the mean concentration measured against wind direction and wind speed at the time of the measurement. This data when coupled with meteorological data as well as local activity data, enabled local and regional sources to be identified and disaggregated.

Results of the Kings College London Monitoring Campaign and Assessment

The measurement period was characterised by winds from the south west with a relatively small number of measurements from the north east; the direction in which Wall Colmonoy is located relative to the measurement site. However, high levels of Ni were recorded at low wind speeds from the north and east demonstrating that high Ni concentrations were associated with low dispersion conditions of local sources, probably Wall Colmonoy. Ni and chromium levels showed a strong correlation suggesting they are co-emitted and supporting the assumption of Wall Colmonoy being the local source during this wind direction. The contribution to total Ni levels recorded during the monitoring period identified as being from Wall Colmonoy ranged from 21.4 to 23.8%.

Ni emissions from Wall Colmonoy were found to be of the ultrafine fraction and principally less than 50 nanometre (nm) in diameter. At this size range they will most likely be emitted from high temperature sources within the foundry, rather than from any mechanical sources such as grinding and fettling. This was also confirmed by Ni concentrations being higher during melting periods than during non-melting periods. Emissions abatement should therefore be focused on high temperature processes. In addition the high time resolution monitoring also identified that concentrations were heavily influenced by a relatively small number of transient high concentration events.

Importantly, the highest contribution to mean ambient Ni during the campaign period was from the south west (66.7%). Measurements were characterised by different emission ratios of metals than that identified at Wall Colmonoy, in particular depleted chromium. Despite a relatively low frequency of transient plume events from this wind direction their contribution to Ni levels measured at Tawe Terrace were highest. Further analysis identified the Ni contribution as being of a very fine particles size and therefore also likely to be from a combustion source. The findings suggest that there is a significant contribution from the Vale nickel refinery site down the valley to the south west of Tawe Terrace.

The report recommends that the identification of peak concentrations from the south west should be cross checked with the emissions measurements systems operated by Vale Refinery as these would suggest either an inadequacy in emissions abatement design or a temporary failure (such as filter bag failures) during the monitoring campaign.