A Schedule 5 notice - further information on the impact of releases to air

This appendix addresses the points raised in the Schedule 5 notice dated 22 July 2014. The following issues were highlighted:

1. SCREEN3 is a screening version of the Industrial Source Complex (ISC3) model. Neither SCREEN3 nor ISC3 are a "Preferred/Recommended Model" of the US EPA[1]. SCREEN3 and ISC3 have been replaced by AERSCREEN and AERMOD respectively. Please justify your choice of the US Environmental Protection Agency (EPA) screening model SCREEN3, rather than a detailed model, to assess the impact of pollutants is appropriate.

2. The H1 assessment screened in emissions of short and long-term NO2 and 8 hour CO. The further assessment using SCREEN3 did not include assessment of long-term NO2 emissions from the Reformer flue gas stack. Please either provide this or provide your reasoning as to why you believe this is not necessary.

3. Please confirm if the SCREEN3 predictions relate to normal operation or peak releases.

4. You identified ecological sensitive receptors in your report but you have not provided any assessment of the potential impact against critical levels or any impact of nutrient nitrogen and acid deposition against critical loads, where relevant critical loads are available. Please either provide this or provide your reasoning as to why you believe this is not necessary.

These issues have been addressed in the following sections:

1	The modelling for releases not screened out in the H1 assessment has been repeated using the ADMS 5 modelling system in its screening mode using a recommended meteorological data set.
2	A long term assessment of the NO_2 releases from the reformer stack is now included.
3	The modelling is undertaken using peak releases to ensure a margin of comfort.
4	An assessment of the potential impact on sensitive ecological receptors is included.

This assessment has been made using the ADMS 5 model in screening mode and focuses on the potential impacts on air quality of releases from the proposed hydrogen plant. Impacts have been assessed against current legislation and guidance to determine the significance of their environmental impact.

A.1 Scope of assessment

There are three point sources of releases to atmosphere from the proposed hydrogen plant:

- Reformer stack
- Deaerator vent stack
- Vent gas header stack

The main pollutants of interest are nitrogen oxides, carbon monoxide and sulphur dioxide. Whilst there is potential for emission of other species (carbon dioxide, methane and hydrogen) these are not currently the subject of any air quality objective.

The reformer stack and deaerator vent stack are continuous sources of release. The vent gas header stack has an intermittent function at start up and shutdown and in the event of abnormal operation.

The assessment uses established modelling techniques to investigate the dispersion of releases and the consequent impact on ground level pollutant concentrations. The assessment specifically addresses the following issues:

- Impact on air quality in terms of human health in the locality with reference to applicable air quality standards and existing background concentrations.
- Significance of air quality impact with reference to established measures.
- Impact of releases on statutory designated sites in terms of critical levels for ambient concentrations and critical loads for nutrient nitrogen and acid deposition.

An H1 assessment reported in Section 14.3 screened out the following releases:

Reformer stack	Sulphur dioxide (daily and hourly mean bases) Carbon monoxide (8 hour mean)
Deaerator stack	Carbon monoxide (8 hour mean)

The releases which were not screened out and need to be considered in more detail are:

Reformer stack	Nitrogen dioxide (long and short term bases)
Vent gas header stack	Carbon monoxide (8 hour mean)

Modelling of these releases was undertaken using ADMS 5 in screening mode

A.2 Assessment methodology

The approach taken in this assessment comprised the following main stages:

- Determine a suitable modelling tool for the assessment.
- Collate available operating and process design data for input to the model.
- Establish the location of the proposed development relative to any existing or proposed buildings.
- Obtain information on local background concentrations of important pollutants.
- Model the dispersion of releases of important pollutants from the operations to determine the process contribution to ambient concentrations over the local area with particular attention to locations of human exposure and statutory designated areas.
- Assess the predicted process contributions and established background concentrations with reference to applicable air quality standards to determine compliance.
- Assess predicted process contributions in terms of environmental significance using accepted measures.
- Assess the impact of process contributions at sensitive sites in terms of critical concentration and critical loads associated with nutrient nitrogen and acid deposition.

Details of the approach taken and model input information are provided in the following sections.

A.2.1 Modelling methodology

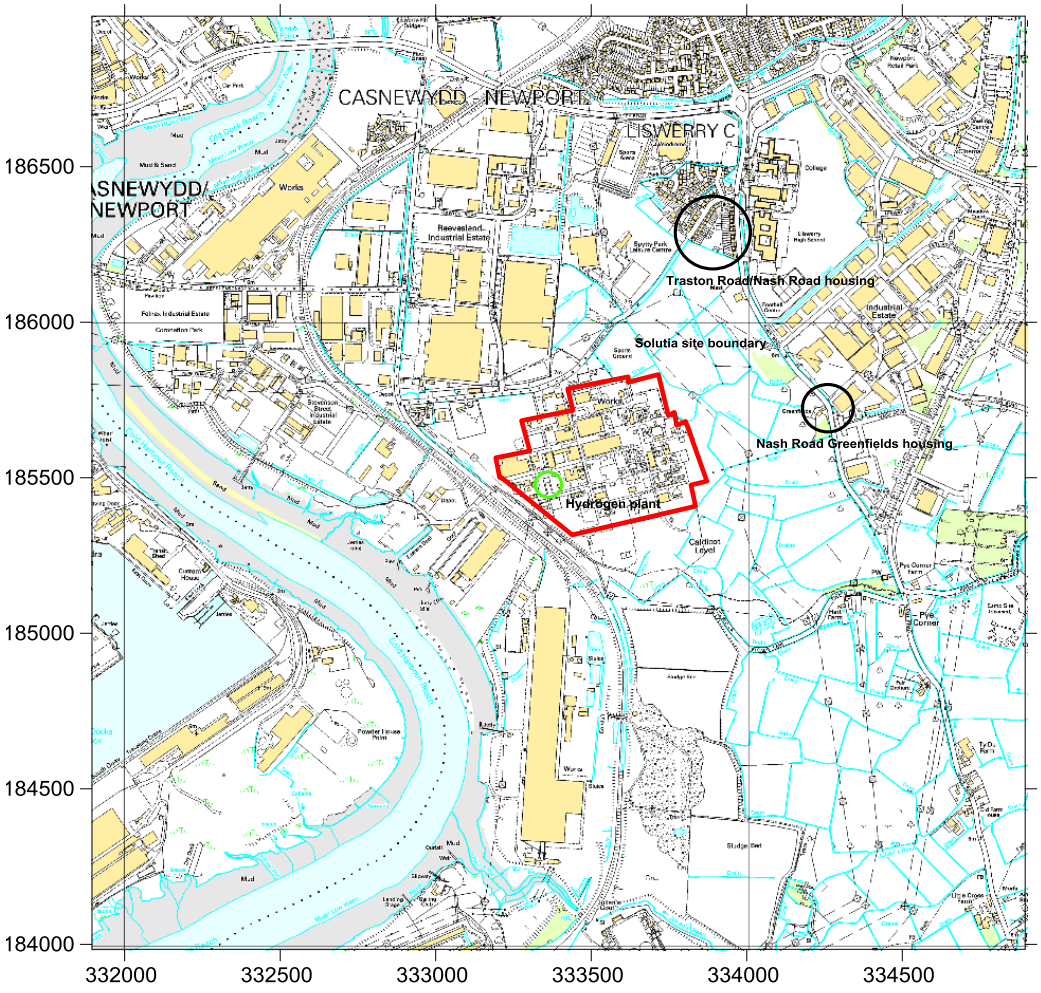
The contributions to ambient concentrations of nitrogen dioxide, carbon monoxide and sulphur dioxide from the proposed hydrogen plant were modelled using the Atmospheric Dispersion Modelling System (ADMS) version 5 in screening mode. The use of this modelling tool is widely accepted by Natural Resources Wales, the Environment Agency and UK Local Authorities.

ADMS 5 requires a range of information in order to perform the modelling. The primary information used to perform the modelling is discussed below.

A.2.1.1 Assessment area

The proposed installation will be located on the existing Solutia UK Limited site in Newport towards the western boundary of the site as shown in Figure A.1. The nearest residential properties are around 800 m to the east on Nash Road at Greenfields. There is an estate of about 150 homes at a distance of around 900 m to the north east of the proposed site on Traston Road/Nash Road. The nearest industrial premises is around 200 m to the south west.

Figure A.1 Proposed hydrogen plant location and assessment area for modelling



The area over which the assessment was undertaken is a 3000m x 3000m area with the hydrogen plant site (333343,185467) located approximately at the centre (see Figure A.1).

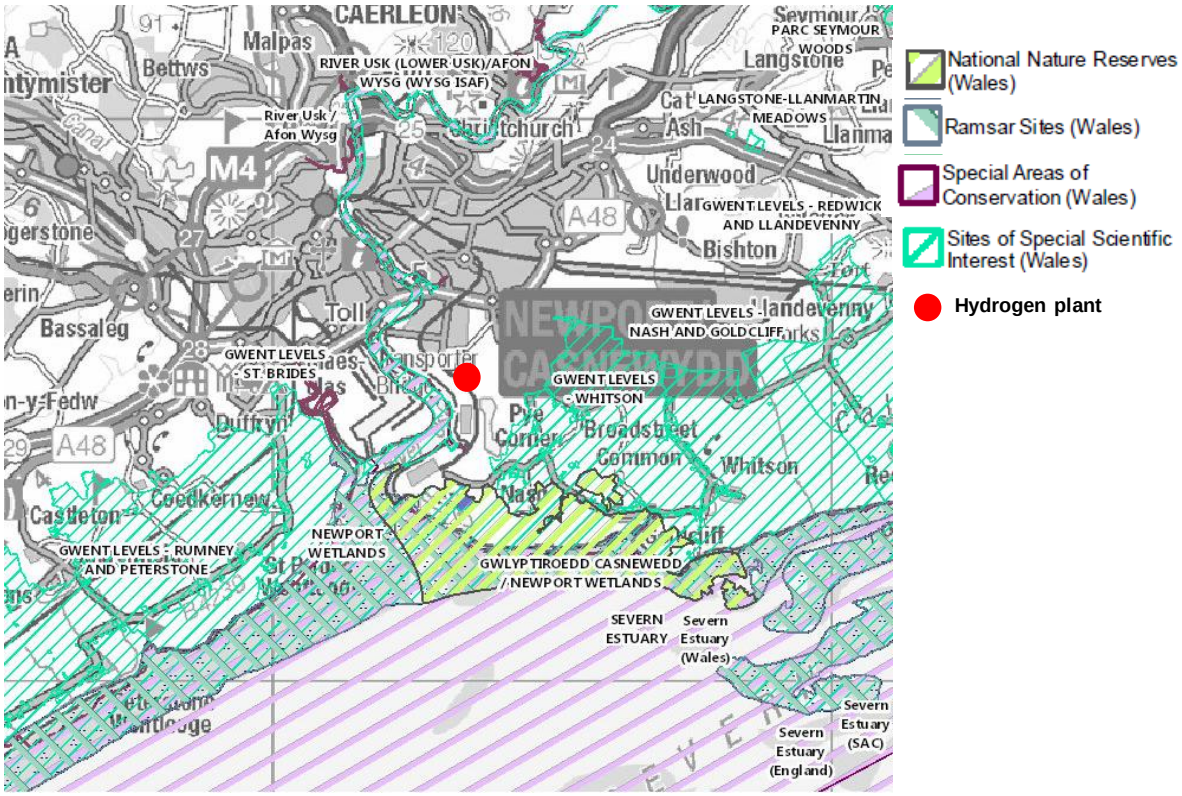
A general grid with receptors spaced at 30 m intervals (i.e. 10201 points for a 101 x 101 grid) was used to assess the process contribution to ground level concentrations over the area.

Some special receptors, as identified in Table A.1 and Figure A.2, were considered at several of the closest statutory designated sites and other sites of local importance. These were generally located beyond the assessment area but were considered as point receptors within the modelling.

Table A.1 Local sensitive nature conservation sites

Site	Designation	Position	
		Easting	Northing
Gwent Levels – St Brides	SSSI	330872	184631
River Usk	SSSI	332957	185181
Uskmouth	RSPB Reserve	336851	182895
Gwent Levels – Rumney & Peterstone	SSSI	330819	184631
Newport Wetlands	SSSI, NNR	333221	183615
Severn Estuary	SSSI, RAMSAR, SAC	331814	183615
Plas Machen Wood	SSSI	324225	186896
Gwent Levels – Whitson	SSSI	334491	185118
Solutia Meadows	SINC	333921	185620

Figure A.2 Local sensitive nature conservation sites



In addition receptors were considered within the nine air quality management areas (AQMAs) declared by Newport City Council.

A.2.1.2 Buildings

The presence of buildings close to an exhaust stack can have a significant impact on the dispersion of releases. The most significant impact can be the downwash of a plume around a building causing increased concentrations in the immediate area around the building. Buildings can also disturb the wind flow causing turbulent wake downwind which can also affect dispersion. It is normally considered that buildings within 5 times the height of release should be considered in any modelling.

In this case the hydrogen plant release stacks are free standing and not directly connected to any significant structures. The nearest building of any significance is the CHP complex around 50 m from the hydrogen plant. The CHP plant building is considered in the modelling.

A.2.1.3 Meteorology

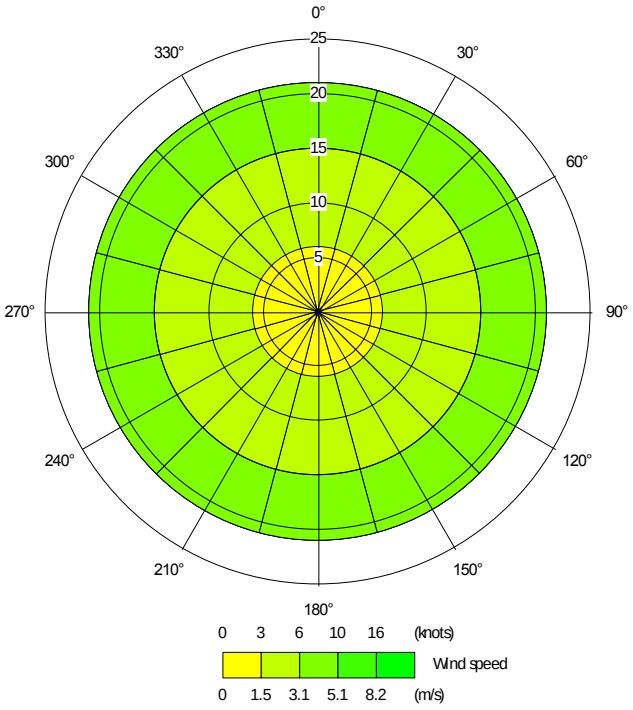
For this screening modelling assessment a general meteorological data set recommended by CERC[A1] was employed. The data set uses data corresponding to the stability classes A to G (i.e. describing most unstable or turbulent to most stable) and is recommended for use where a preliminary assessment of maximum air quality impact from a process release is required.

The stability classes in ADMS 5 are defined in terms of wind speed, boundary layer height and Monin Obukhov length (measure of the effect of buoyancy on turbulent flow) as shown in Table A.2.

Table A.2 Stability class description for screening purposes

Pasquill-Gifford stability class	Stability	Velocity (m/s)	Boundary layer height (m)	Monin Obukhov length (m)
A	extremely unstable	1	1300	-2
B	moderately unstable	2	900	-10
C	slightly unstable	5	850	-100
D	neutral	5	800	∞
E	slightly stable	3	400	100
F	moderately stable	2	100	20
G	extremely stable	1	100	5

Figure A.3 Screening meteorological data wind rose



A.2.1.4 Terrain

The area of the assessment around the Solutia site features general industrial buildings to the north, the River Usk to the west and an area of open meadow to the south and east (Solutia Meadows SINC). Section 3.1 describes the site setting in detail. For the purposes of this assessment the general area is considered to fall into the category of grassland and as such a surface roughness of 0.02, as defined in ADMS 5, has been assigned. A sensitivity analysis indicated no significant change in predicted contributions to ground level concentrations of nitrogen dioxide between surface roughness values of 0.02 and 0.1 (root crops).

Terrain data was obtained for the assessment area from the Ordnance Survey Land-form Panorama DTM data base. The complex terrain option was employed such that modelling considered ground elevation, although there is little significant change in elevation over the assessment area.

A.2.1.5 Legislation and guidance

The UK Air Quality Standard Regulations of 2010 specify air quality standards for a range of species. Those considered applicable to this development are summarised in Table A.3.

Table A.3 UK Air Quality Standards (AQS)

Pollutant	Basis	Concentration
Carbon monoxide (CO)	running 8 hour mean	10 mg/m^3
Nitrogen dioxide (NO_2)	1 hour mean (99.79 percentile – 18 exceedences per year)	200 $\mu g/m^3$
	annual mean	40 $\mu g/m^3$
Sulphur dioxide (SO_2)	1 hour (99.72 percentile – 24 exceedences per year)	350 $\mu g/m^3$
	24 hour (99.18 percentile – 3 exceedences per year)	125 $\mu g/m^3$

The Environment Agency's guidance note H1provides a methodology for assessing the impact and determining the acceptability of emissions to atmosphere on ambient air quality. H1 provides Environmental Assessment Levels (EALs) for each pollutant such that impact may be assessed.

The EALs relevant to this development are summarised in Table A.4. The EALs employed are based on the more stringent of the EAL, where specified, and the corresponding air quality standard.

Table A.4 Environmental Assessment Levels

Pollutant	Long term EAL	Short term EAL
	$\mu g/m^3$	
CO	-	10000
NO_2	40	200
SO_2	-	350

The contribution of the process (PC) to the ambient concentration of a given pollutant is considered insignificant if:

- 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

A.2.1.6 Background pollutant concentrations

In considering the overall impact of an operation, such as this herein, on local air quality and compliance with limit values, it is necessary not only to consider the contribution from the source of interest, but also the existing levels of pollutants of interest. Background air quality data for the Newport area are

available from DEFRA's air quality archive (http://uk-air.defra.gov.uk/data/pcm-data). The archive provides estimated background concentrations of important pollutants for 1km^2 areas for the UK. The latest background levels of nitrogen dioxide (2011), carbon monoxide (2010) and sulphur dioxide (2012) for the areas considered were used for this assessment as shown in Table A.5.

Table A.5 Background pollutant concentrations (2010/11)

Pollutant	Concentration (µg/m^3)
Nitrogen dioxide (annual mean)	31.8
Sulphur dioxide (annual mean)	5.0
Carbon monoxide (maximum 8 hour average)	1644

Carbon monoxide values are for 2010, whilst others relate to 2011

When considering the combination of estimated process contributions and background concentrations it should be noted that background concentrations are generally available as annual mean values and as such simple addition when considering short term air quality standards may not be appropriate. Guidance from the Environment Agency[A2] suggests a simplified method for combining estimated process contributions and background concentrations. For comparison with short term standards the Environment Agency suggest the sum of the process contribution (hourly or daily mean) and twice the background concentration (annual mean). This methodology has been employed in this assessment. Table A.6 summarises the background concentrations applied in this assessment.

Table A.6 Background concentrations compared with Air Quality Standards

Pollutant	AQS averaging basis	Concentration	
		µg/m^3	%AQS
Nitrogen dioxide	annual mean	31.8	80
	hourly mean	63.6	32
Carbon monoxide	maximum 8 hour mean	1644	16
Sulphur dioxide	hourly mean	10.0	3
	daily mean	5.0	4

A.2.1.7 Pollutant releases and conditions

Table A.7 summarises the releases of pollutants of interest from the three release points as detailed in Chapter 6.

For the continuous releases the values assume worse case conditions as expected at 100% load. The intermittent releases from the vent gas header stack occur during start up and during a blockage of the PSA. The major release in likely to be in the event of a PSA blockage in which case up to 10 t of carbon monoxide could be released over a period of around 3 hours. Such incidents are expected to occur no more than annually based on design information and less frequently when operation at Dalry is considered.

Plant point source release conditions are based on the plant design information available from BOC and are summarised in Table A.8.

Table A.7 Emissions Inventory - Point Source Releases, Normal and Abnormal Operation

Release point	Substance	Annual release (kg)	Normal release rate (kg/h)	Peak release rate (kg/h)	Flow rate peak (Nm^3/s)
Reformer furnace flue gas stack	CO_2	6587520	752	1110	0.50
	NOx (as NO_2)	788.4	0.09	0.144	0.50
	SO_2	26.3	0.003	0.003	0.50
	CO	52.6	0.006	0.006	0.50
	Methane	15.8	0.0018	0.049	0.50
De-aerator vent	CO_2	14892.0	1.7	1.7	-
	CO	10.5	0.001	0.001	-
	Ammonia	trace	trace	trace	-
	Methanol	trace	trace	trace	-
	Methane	0.0	0.000	0.000	-
	H_2	13.3	0.002	0.002	-
Vent header – Start-up	H_2	20.3	0.002	61.0	0.28
	CO_2	133.3	0.015	40.0	0.28
	CO	17.3	0.002	52.0	0.28
	Methane	0.1	0.000	0.3	0.28
Vent header – Shut-down	H_2	29	0.003	86.0	0.28
	CO_2	0	0.000	0.4	0.28
	CO	0	0.000	0.0	0.28
	Methane	0	0.000	0.0	0.28
Vent header – Hydrogen balancing	H_2	21000	2.40	403.8	-
Vent header – PSA blockage	H_2	13000	1.48	4333	-
	CO_2	65000	7.42	21667	-
	CO	10000	1.14	3333	-
	Methane	7000	0.80	2333	-
Vent header – Gas regulator failure	Methane	1300	0.15	20000	-
Vent header – cumulative releases (all scenarios)	H_2	34049	3.89	-	-
	CO_2	65133	7.44	-	-
	CO	10017	1.14	-	-
	Methane	8300	0.95	-	-

Vent gas header release scenarios are described in 5.1.3

For the continuous releases the values assume worse case conditions as expected at 100% load.

Plant point source release conditions are based on the plant design information available from BOC and are summarised in Table A.8.

Table A.8 Design discharge characteristics

Point		Reformer stack	Deaerator vent stack	Vent gas header stack
Discharge height	m	10.5	8.2	16.2
Discharge temperature	^{o}C	168	108	38
Discharge gas velocity	m/s	9.6	15	15
Easting		333343	333341	333347
Northing		185472	185479	185482

Whilst the emission of nitrogen oxides is mostly in the form of nitrogen monoxide, subsequent reactions in the atmosphere produce nitrogen dioxide. As nitrogen dioxide (NO_2) is of considerably more importance to air quality than nitrogen monoxide (NO), it is essential that a representative measure of the conversion from NO to NO_2 is employed. H1 Annex F suggests that a worst case scenario for screening assessments is to assume:

- 50% conversion of NO to NO_2 for short term averaging
- 100% conversion of NO to NO_2 for long term averaging

The conversion factor for the short term averaging has been employed within this assessment.

A.3 Modelling results

Modelling using ADMS 5 in screening mode was undertaken for the following conditions:

Reformer stack	Releases of nitrogen dioxide at the peak release rates indicated in Table A.7 assessed on a short term basis
Reformer stack	Releases of nitrogen dioxide at the peak release rates indicated in Table A.7 assessed on a long term basis
Vent gas header stack	Releases of carbon monoxide at the release rate relating to PSA blockage as described in Table A.7
Vent gas header stack	Releases of carbon monoxide at the release rate relating to PSA start up as described in Table A.7

A.3.1 Reformer stack – nitrogen dioxide on the short term averaging basis

In order to assess the impact of the release of nitrogen dioxide from the reformer stack on a short term basis the release characteristics in Table A.9 have been assumed.

Table A.9 Reformer stack discharge characteristics (nitrogen dioxide short term basis)

Point		Reformer stack
Discharge height	m	10.5
Discharge temperature	^{o}C	168
Discharge gas velocity	m/s	9.6
Discharge rate[1]	gNO_2/s	0.02

1. Discharge rate is based on a peak nitrogen oxides release of 0.144 kg/h (Table A.7) and a NO to NO_2 conversion rate of 50%.

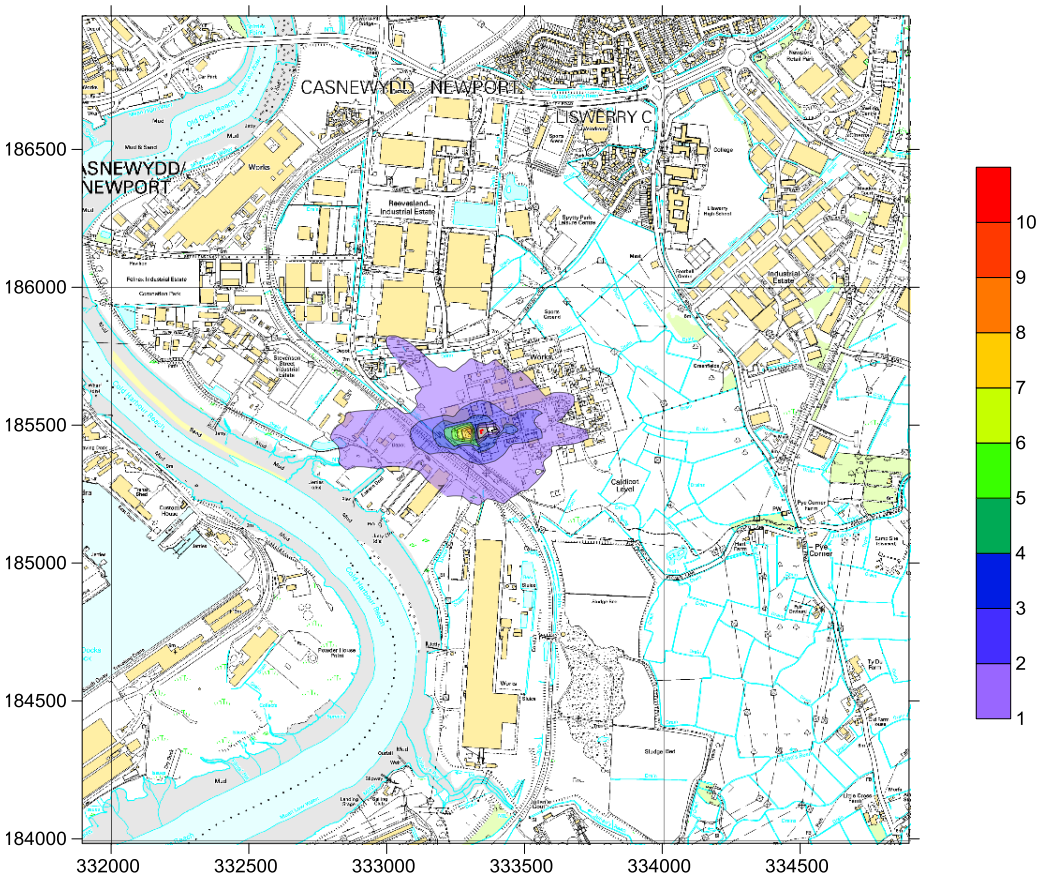
Table A.10 presents the results of the modelling assessment.

Table A.10 Short term maximum process contributions and environmental concentrations (NO_2)

Pollutant	AQS	Background[2]	PC	PEC	PC/AQS	PEC/AQS
		µg/m^3			%	
Nitrogen dioxide	200	64	9	73	5	37

Figure A.4 illustrates the dispersion pattern. In all cases the process contribution is below the level of significance (10% of the AQS) and the predicted environmental concentration is well within the applicable AQS. It may be seen that the location of maximum concentration is predicted to occur around 50 m from the release point within the site boundary. At locations beyond the site boundary process contributions are significantly less than the maximum.

Figure A.4 Process contributions to ground level concentrations of nitrogen dioxide (short term averaging basis)



A.3.2 Reformer stack – nitrogen dioxide on the long term averaging basis

In order to assess the impact of the release of nitrogen dioxide from the reformer stack on a long term basis the release characteristics in Table A.11 have been assumed.

Table A.11 Reformer stack discharge characteristics (nitrogen dioxide long term basis)

Point		Reformer stack
Discharge height	m	10.5
Discharge temperature	^{o}C	168
Discharge gas velocity	m/s	9.6
Discharge rate[1]	gNO_2/s	0.0015

1. Discharge rate is based on a peak nitrogen oxides release of 0.144 kg/h (Table A.7), a NO to NO_2 conversion rate of 100% and a one hour to one year averaging basis conversion factor of 0.0379 determined from H1 Annex F, Table 3.1 for an effective stack height of 0m.

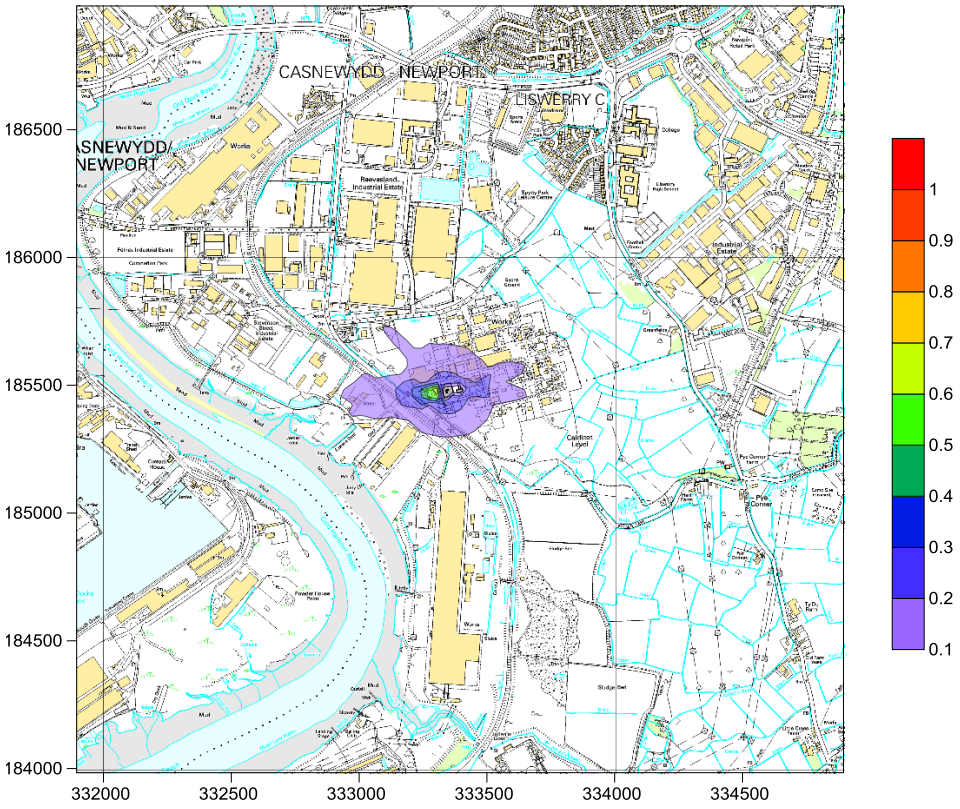
Table A.12 presents the results of the modelling assessment.

Table A.12 Long term maximum process contributions and environmental concentrations (NO_2)

Pollutant	AQS	Background[2]	PC	PEC	PC/AQS	PEC/AQS
	$\mu g/m^3$				%	
Nitrogen dioxide	40	31.8	0.7	32.5	2	81

Figure A.5 illustrates the dispersion pattern. In all cases the process contribution is below the level of significance (1% of the AQS) and the predicted environmental concentration is within the applicable AQS.

Figure A.5 Process contributions to ground level concentrations of nitrogen dioxide (long term averaging basis)



It may be seen that the location of maximum concentration is predicted to occur around 50 m from the release point within the site boundary. At locations beyond the site boundary process contributions are significantly less than the maximum.

A.3.3 Vent gas header stack – carbon monoxide during start up

In order to assess the impact of the release of carbon monoxide from the vent gas header stack during start up the release characteristics in Table A.13 have been assumed.

Table A.13 Vent gas header stack discharge characteristics (carbon monoxide 8 hour mean)

Point		Vent gas header stack
Discharge height	m	16.2
Discharge temperature	^{o}C	38
Discharge gas velocity	m/s	15
Discharge rate[1]	gCO/s	10.1

1. Discharge rate is based on a peak carbon monoxide release during start up of 52 kg/h and a 1 hour to 8 hour averaging basis conversion factor of 0.7 as in H1 Annex F, Table 2.1.

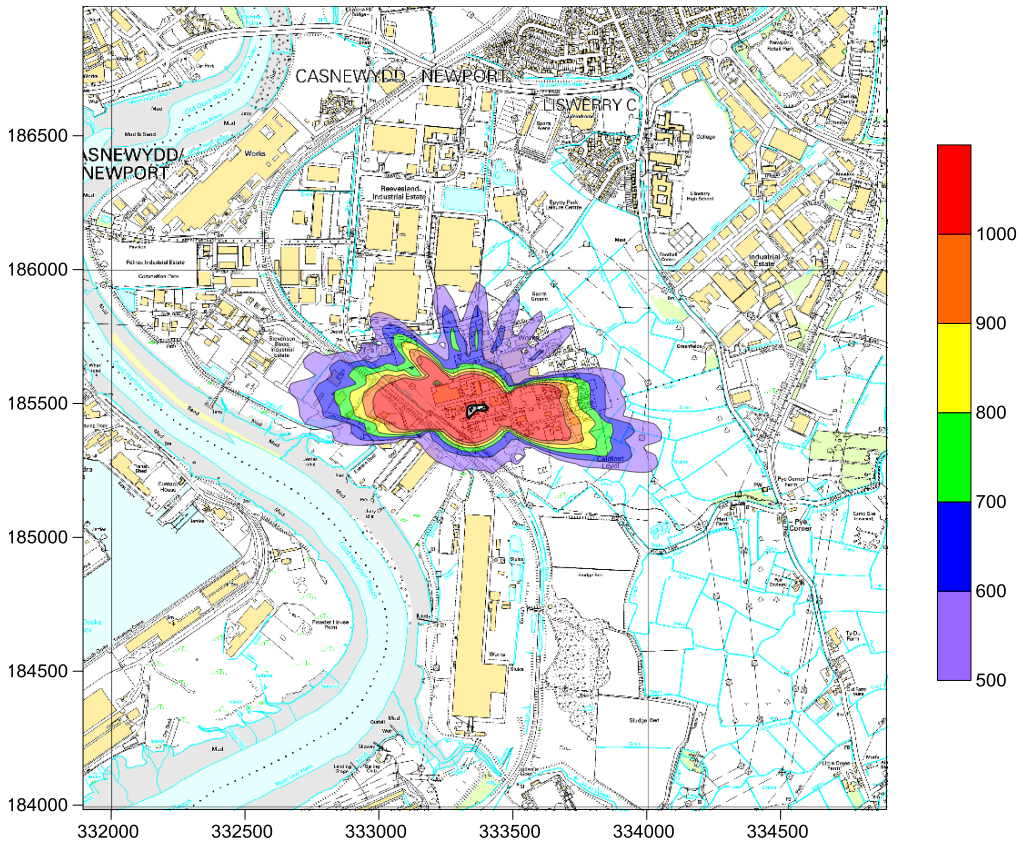
Table A.14 presents the results of the modelling assessment.

Table A.14 Maximum process contributions and environmental concentrations of carbon monoxide outside of site boundary during start up

Pollutant	AQS	Background[2]	PC	PEC	PC/AQS	PEC/AQS
	µg/m^3				%	
Carbon monoxide	10000	1644	1320	3455	13	35

Figure A.6 illustrates the dispersion pattern. Maximum process contributions occur within the site boundary. The maximum process contribution at the site boundary is equivalent to around 13% of the applicable AQS with a predicted environmental concentration of around 35% of the AQS. The maximum process contribution falls below the level of significance (10 % of AQS) within 100 m from the site boundary.

Figure A.6 Process contributions to ground level concentrations of carbon monoxide (start up)



A.3.4 Vent gas header stack – carbon monoxide during PSA blockage

In order to assess the impact of the release of carbon monoxide from the vent gas header stack during a PSA blockage the release characteristics in Table A.15 have been assumed.

Table A.15 Vent gas header stack discharge characteristics (carbon monoxide 8 hour mean)

Point		Vent gas header stack
Discharge height	m	16.2
Discharge temperature	^{o}C	38
Discharge gas velocity	m/s	15
Discharge rate[1]	gCO/s	252

1. Discharge rate is based on a peak carbon monoxide release during PSA blockage of 3333 kg/h, a 1 hour to 8 hour averaging basis conversion factor of 0.7 as in H1 Annex F, Table 2.1 and a3 hour release period.

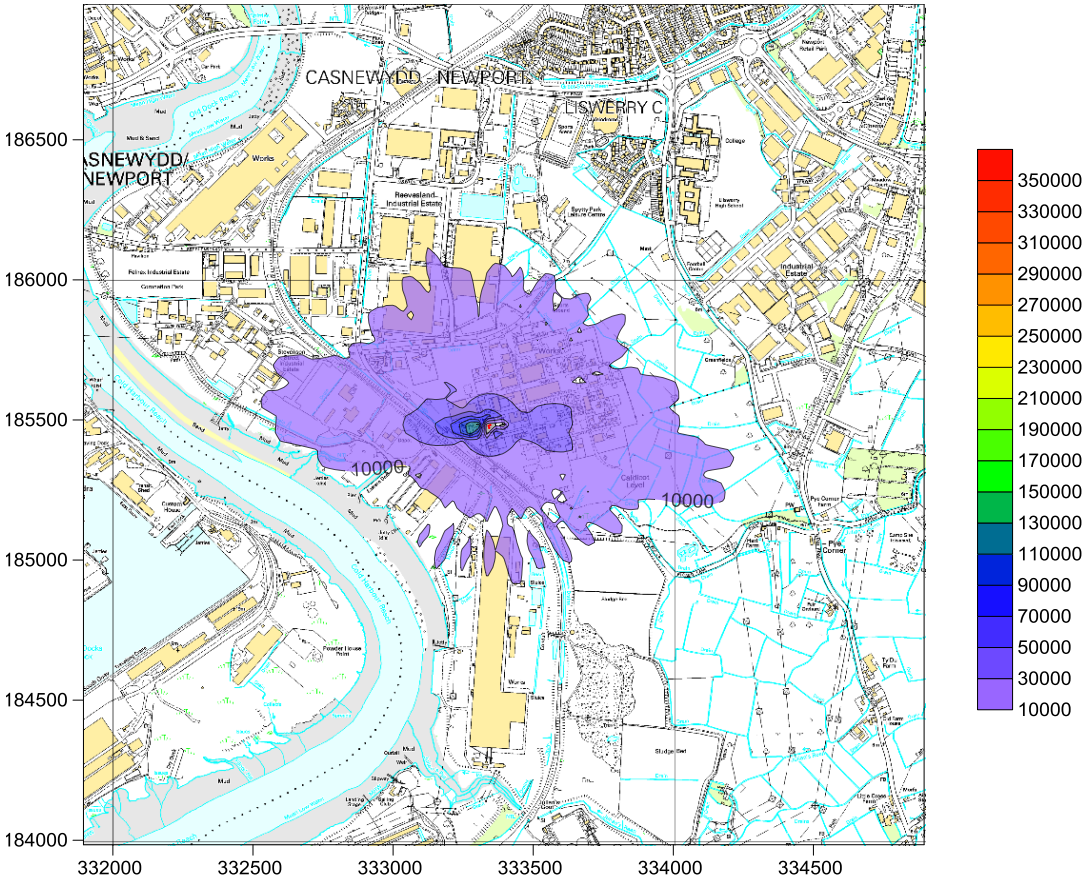
Table A.16 presents the results of the modelling assessment.

Table A.16 Maximum process contributions and environmental concentrations of carbon monoxide outside of site boundary during start up

Pollutant	AQS	Background[2]	PC	PEC	PC/AQS	PEC/AQS
	µg/m^3				%	
Carbon monoxide	10000	1644	41000	421644	410	422

Figure A.7 illustrates the dispersion pattern. Maximum process contributions occur within the site boundary. The maximum process contribution at the site boundary is equivalent to around 4 times the AQS. It should be noted however that this is an infrequent release of no more than once per year persisting for a maximum period of 3 hours. In addition as seen in Figure A.7 within 500 m of the site boundary the process contribution drops below the AQS.

Figure A.7 Process contributions to ground level concentrations of carbon monoxide (PSA blockage)



A.3.5 Significance of process contributions

It is evident from above that the releases of nitrogen dioxide, both on a short term and long term averaging basis have an impact below the level of significance.

For carbon monoxide the impact of releases during start up is below the level of significance just beyond the site boundary. The large release during the event of a PSA blockage can cause off site exceedences of the AQS up to 2 km from the site. However both events are relatively infrequent and releases are confined to a very short period of around 3 hours.

Environment Protection UK (EPUK) have published guidance which assists in the description of the magnitude of change and impact on air quality of developments. Of particular relevance in this case are the descriptors for the impact magnitude of changes in ambient concentrations of nitrogen dioxide. Table A.17 summarises the EP UK descriptors for the impact of a process contribution of nitrogen dioxide on an annual mean basis.

Table A.17 Impact magnitude of process contributions

Magnitude of change	Annual mean process contribution of nitrogen dioxide
Large	>4 µg/m^3
Medium	2-4 µg/m^3
Small	0.4-2 µg/m^3
Imperceptible	<0.4 µg/m^3

Table A.18 summarises the descriptors for the impact associated with the changes in nitrogen dioxide concentration when taking into account the total environmental concentration (PEC).

Table A.18 Descriptors for changes to annual mean concentrations

Absolute concentration (annual mean PEC) with respect to AQS	Changes in concentration of nitrogen dioxide		
	Small	Medium	Large
Above objective (>40 µg/m^3)	Slight adverse	Moderate adverse	Substantial adverse
Just below objective (36-40 µg/m^3)	Slight adverse	Moderate adverse	Moderate adverse
Below objective (30-36 µg/m^3)	Negligible	Slight adverse	Slight adverse
Well below objective (<30 µg/m^3)	Negligible	Negligible	Slight adverse

The maximum process contribution of nitrogen dioxide from the reformer stack on an annual basis is 0.7 µg/m^3. The background at this location is around 32 µg/m^3, which suggests a PEC of around 33 µg/m^3. On this basis the maximum impact of process contributions of nitrogen dioxide would be described as negligible.

For all off site locations and at the sensitive sites identified (see Table A.1) all PCs are in the small to imperceptible range and the overall impact would be described as negligible based on the criteria in Table A.18.

A.3.3 Critical levels for the protection of vegetation and ecosystems

H1 Annex F provides concentration based critical levels for pollutants in respect of the protection of vegetation and ecosystems in nature conservation sites. Whilst these levels are not considered to apply in this case, due to the proximity of the sites to Newport, industrial sources and motorways, a comparison is still undertaken in order to provide confidence in the significance of the impact of the proposed plant on local sensitive sites.

Table A.19
7 Maximum process contributions at nature conservation sites
Nitrogen dioxide

Site	Critical level	Background	PC[1]	PEC	PC/CL	PEC/CL
	µg/m^3				%	
Gwent Levels – St Brides	30	18.4	0.01	18.4	<1	61
River Usk		20.6	0.03	20.6	<1	69
Uskmouth		10.8	0.01	10.8	<1	36
Gwent Levels – Rumney & Peterstone		18.4	0.01	18.4	<1	61
Newport Wetlands		14.1	0.01	14.1	<1	47
Severn Estuary		15.3	0.01	15.3	<1	51
Plas Machen Wood		12.8	<0.01	12.8	<1	43
Gwent Levels – Whitson		17.1	0.02	17.1	<1	57
Solutia Meadows		31.8	0.01	31.8	<1	106

1. Process contribution is a maximum annual mean value at the edge of the habitat closest to the proposed hydrogen plant site.

Table A.20 Short term maximum process contributions at nature conservation sites Sulphur dioxide

Site	Critical level[2]	Background	PC[1]	PEC	PC/CL	PEC/CL
	µg/m^3				%	
Gwent Levels – St Brides	100	3.0	0.01	3.0	<1	3
River Usk		3.2	0.04	3.2	<1	3
Uskmouth		1.7	0.01	1.7	<1	2
Gwent Levels – Rumney & Peterstone		3.0	0.01	3.0	<1	3
Newport Wetlands		2.3	0.01	2.3	<1	2
Severn Estuary		2.7	0.01	2.7	<1	3
Plas Machen Wood		1.9	0.00	1.9	<1	2
Gwent Levels – Whitson		3.3	0.02	3.3	<1	3
Solutia Meadows		3.0	0.01	3.0	<1	2

1. Process contribution is a maximum hourly value, whilst the background concentration and critical level are expressed on an annual basis.
2.Critical level is most stringent annual mean value applicable for sensitive lichen communities & bryophytes.

For all sites the process contribution is less than 1% of the critical level for both nitrogen dioxide and sulphur dioxide. It should be noted that the PC reported for sulphur dioxide is the maximum hourly average and it is being compared with annual mean critical level. It would be expected that PCs expressed on an annual mean basis would be significantly lower than those reported in Table A.20.

It is considered that the impact of the contribution of the proposed hydrogen plant to levels of nitrogen dioxide and sulphur dioxide at local sensitive sites is insignificant in the context of protection of vegetation and ecosystems.

A.3.4 Critical loads for statutory designated habitat sites

The UK Air Pollution Information System (APIS) provides estimated critical loads for statutory designated habitat sites in the UK. The critical load is seen as a quantitative estimate of the exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge. Compliance with these guide values is likely to result in no significant adverse effects on the natural environment at these locations.

Tables A.21 and A.22 summarise the predicted process contribution to nitrogen and acid deposition at sensitive sites in the context of the applicable critical loads.

Table A.21 Critical loads and process contribution for Nitrogen Deposition

Site	Critical load (CL)[1]	Background[2]	PC	PEC	PC/CL	PEC/CL
	kgN/ha/year[2]				%	
Gwent Levels – St Brides	10	12.5	0.0005	12.5	<0.1	125
River Usk	10	17.2	0.0019	17.2	<0.1	172
Uskmouth	20	12.6	0.0003	12.6	<0.1	63
Gwent Levels – Rumney & Peterstone	20	12.5	0.0005	12.5	<0.1	63
Newport Wetlands	20	12.5	0.0007	12.5	<0.1	63
Severn Estuary	20	12.5	0.0005	12.5	<0.1	63
Plas Machen Wood	20	18.2	0.0001	18.2	<0.1	91
Gwent Levels – Whitson	20	17.2	0.0009	17.2	<0.1	86
Solutia Meadows	20	17.2	0.0005	17.2	<0.1	86

1. Nitrogen critical load is the minimum of the range listed.
2.Background deposition is taken at the habitat edge and provided within the SCAIL system.

All process contributions at the edge of the habitat closest to the proposed hydrogen plant site are less than 0.1% of the minimum critical load. H1 Annex F indicates that process contributions for nitrogen deposition exceeding 20% of the critical load may not be acceptable for the most sensitive sites (e.g. SAC, SPA, RAMSAR). On this basis it is considered that the process contribution to nitrogen deposition at local sensitive sites is not significant.

Table A.22 Critical loads and process contribution for Acid Deposition

Site	Critical load[1]	Background[2]	PC	PEC	PC/CL	PEC/CL
	kgeqH$^+$/ha/year				%	
Gwent Levels – St Brides	4	1.0	<0.001	1.0	<0.1	25
River Usk	4	1.4	<0.001	1.4	0.1	38
Uskmouth	4	1.0	<0.001	1.0	<0.1	25
Gwent Levels – Rumney & Peterstone	4	1.0	<0.001	1.0	<0.1	25
Newport Wetlands	4	1.0	<0.001	1.0	<0.1	25
Severn Estuary	n.a.	1.0	<0.001	1.0	<0.1	-
Plas Machen Wood	0.75	1.5	<0.001	1.5	<0.1	200
Gwent Levels – Whitson	4	1.4	<0.001	1.4	<0.1	35
Solutia Meadows	4	1.4	<0.001	1.4	<0.1	35

1 Acid deposition critical load is the sum of CLmaxS and CLminN.
2.Background deposition is taken at the habitat edge and provided within the SCAIL system.

A.3.5 Impact of process releases at Air Quality Management Areas

Newport City Council have declared nine air quality management areas (AQMAs) These are areas where the annual mean objective for nitrogen dioxide are considered to have not been met. It is important to ensure that any development does not have significant adverse impacts on air quality in these already sensitive areas. Table A.23 summarises the maximum process contribution to hourly concentrations of nitrogen dioxide within the nine AQMAs.

Table A.23 Process contributions of nitrogen dioxide at AQMAs

AQMA	Maximum hourly nitrogen dioxide PC µg/m^3	% AQS
St Julians	0.10	0.05
Glasllwch	0.06	0.03
Shaftsbury/Crindau	0.06	0.03
Malpas Road	0.07	0.03
Caerleon Road	0.11	0.06
Royal Oak Hill	0.08	0.04
High Street, Caerleon	0.09	0.04
Malpas Road (Craig Park to Pillmawr Road)	0.05	0.02
Chepstow Road	0.16	0.08

The maximum process contribution to hourly concentrations of nitrogen dioxide in all AQMAs is predicted be equivalent to less than 0.1% of the short term air quality standard. On this basis the impact of releases from the proposed hydrogen plant development on local AQMAs is considered insignificant.

A.4 Conclusions

The modelling undertaken has sought to determine the likely significance of releases to air from the proposed process in the context of current legislation and guidance.

The assessment has employed screening modelling techniques and the necessary assumptions made regarding releases have been conservative with the aim of covering worse case scenarios. As a result the results obtained are considered to be over estimates.

In respect of applicable air quality standards the maximum process contribution of nitrogen dioxide, carbon monoxide and sulphur dioxide was determined to generally have an insignificant impact on air quality. The only exception was the infrequent releases of carbon monoxide from the vent gas header stack during plant start up or following a PSA blockage. These vents are infrequent and of a relatively short duration. For nitrogen dioxide at the location of maximum impact the process releases were considered to have negligible effect which dropped to imperceptible beyond the site boundary based on EPUK criteria.

The impact at local and statutory designated nature conservation sites on the natural environment was found to be insignificant in terms of critical levels of nitrogen dioxide and sulphur dioxide and nitrogen and acid deposition.

Process contributions to ambient concentrations of nitrogen dioxide at the nine air quality management areas declared within the Newport area were considered to be insignificant in relation to the applicable air quality standard.

Necessary assumptions made to undertake the modelling are considered to have the effect of overestimating the process contribution to ambient concentrations, particularly in the case of nitrogen dioxide. It is therefore considered that the predicted process impact on ambient pollutant concentrations reported herein is a conservative assessment and the conclusions reached therefore incorporate a reasonable margin of comfort in spite of the inevitable uncertainty of such modelling studies.

In view of the insignificant nature of the impact of releases to air from the proposed hydrogen plant it is not considered that further detailed modelling is necessary.

A.5 Additional references

A.1 CERC, ADMS 5 Atmospheric dispersion modelling system user guide

A.2 Environment Agency, ‘Review of background air quality data and methods to combine these with process contributions: technical modelling aspects’, Science report SC030174/1SR2, October 2006