CREST NICHOLSON (SOUTH WEST) LTD

PENARTH HEIGHTS - AIR QUALITY IMPACT ASSESSMENT

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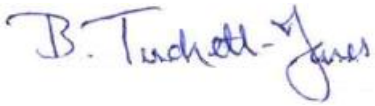
Prepared by	**:**	 **Bethan Tuckett-Jones**
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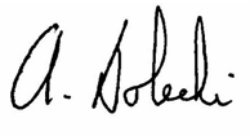
Approved by	**:**	 **Adrian Dolecki**

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EXECUTIVE SUMMARY

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An assessment has been undertaken to quantify the potential local air quality effects of the operation of the residential redevelopment at Penarth Heights, Penarth.

The proposed residential redevelopment has the potential to effect changes in air quality, primarily as a result of changes in traffic on local roads and the consequent changes in vehicle exhaust emissions.

The assessment has been undertaken for pollutants included in the UK's National Air Quality Strategy for which road transport is a significant source, namely carbon monoxide, benzene, 1,3-butadiene, nitrogen dioxide and particulate matter. The air quality assessment methodology followed that set out in the Highways Agency's Design Manual for Roads and Bridges, Volume 11, Section 3.

Concentrations of pollutants were modelled at eighteen selected receptors between Cogan Roundabout in the west, and the Penarth Town Centre Roundabout in the east. The assessment used the DMRB Screening Method, and model results were verified against available observations.

Existing air quality in the vicinity of the redevelopment site is good, with no Air Quality Management Areas declared by the local authority, Vale of Glamorgan Council, and roadside monitoring data indicating pollutant concentrations within the relevant air quality objectives in the baseline year. Model results indicated a risk of exceedence of the daily mean PM_{10} objective in the baseline year along a short section of Windsor Road, near the junction with Pill Street.

With respect to existing pollution levels, the assessment indicated that pollutant concentrations are predicted to decrease in future years, to well within their respective air quality objectives or limit values by the opening year (2012), whether the proposed redevelopment goes ahead or not. This is due, in part, to a general decrease in background pollutant concentrations and also to a predicted decrease in emissions per vehicle as newer, cleaner vehicles enter the fleet. For the pollutants of most concern, nitrogen dioxide and particulate matter, 2012 is the worst case year for air quality in the with development scenario.

In the baseline and future years, the highest pollutant concentrations are predicted for receptors close to the A-road junctions e.g. at Cogan roundabout, the junction of Plassey Street and Windsor Road, etc. With respect to the without development scenario, the operation of the residential redevelopment is predicted to result in an increase in pollutant concentrations due to the predicted increase in vehicle flows on local roads.

The greatest percentage increases in pollutant concentrations with the development occur on roads closest to the development site itself, namely High Street and Arcot Street. However, pollutant concentrations on these roads are well within their air quality objectives in all years assessed.

Along Windsor Road, the redevelopment is predicted to result in increases in concentrations of nitrogen dioxide and particulate matter of less than 1.2% of the 'without development' scenario concentrations in both the opening and completion years, 2012 and 2017 respectively.

The redevelopment also has the potential to affect air quality during the construction period. However, potential off-site air quality effects due to emissions from construction vehicles are not considered to be of significance due to the relatively low number of additional vehicle movements expected during the works.

The air quality impacts of the operation of Penarth Heights are, therefore, considered to be a low priority in the assessment of the effects of the proposed redevelopment.

SECTION 1

INTRODUCTION

1 INTRODUCTION

1.1 General

1.1.1 PB has been commissioned by Crest Nicholson (South West) Limited to prepare an air quality impact assessment for the proposed residential redevelopment at Penarth Heights, Penarth. The development proposal comprises approximately 450 residential units.

1.1.2 This study considers potential changes in air quality associated with the occupation of the proposed residential units, in relation to the human health and the UK National Air Quality Strategy[1,2].

1.1.3 The proposed residential redevelopment has the potential to effect changes in air quality, primarily as a result of changes in traffic on local roads and the consequent changes in vehicle exhaust emissions. Residential properties themselves are not, with the exception of a few localised areas where coal/smokeless fuel burning is the predominant means of domestic heating, significant sources of local air pollutants.

1.1.4 Therefore, this study assesses the effects of the re-development on emissions from road transport and their impact on local air quality. The methodology used to assess the impacts follows that set out in the Design Manual for Roads and Bridges (DMRB, Volume 11, Section 3 – February 2003), published by the Highways Agency.

1.2 Study Area

1.2.1 The extent of the study area for the air quality impact assessment has been determined by identifying the roads potentially affected by the operation of Penarth Heights. Following the methodology set out in DMRB, the study area consists of a corridor extending 200m either side of affected routes. Beyond this distance, the contribution from a particular roadside to local air quality pollution levels is considered to be negligible.

1.2.2 The identification of affected routes has been based on traffic flows provided in the Transportation Assessment (TA) for Penarth Heights redevelopment[3]. The TA did not explicitly examine the effects of the redevelopment on traffic speeds or HGV percentages and, therefore, the assessment of affected routes has been based on changes in traffic flows alone.

1.2.3 The study area, shown schematically in Diagram 1, consists of:-

- Cogan Hill, from and including Barons Court Junction to the Tesco Roundabout,
- Windsor Road, from and including the Tesco Roundabout to the Town Centre Roundabout,
- Terra Nova Way
- Plassey Street
- High Street

[1] Department of the Environment, Transport and the Regions (2000) in partnership with the Scottish Executive, the National Assembly for Wales, and the Department of the Environment for Northern Ireland. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Working together for Clean Air).
[2] Department of the Environment, Transport and the Regions (2003) in partnership with the Scottish Executive, the National Assembly for Wales, and the Department of the Environment for Northern Ireland. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum
[3] Transportation Assessment – Proposed Residential Re-Development, Penarth Heights, Penarth, Cole Easdon Consultants, June 2005

- Arcot Street, from the development site to its intersection with Windsor Road.

1.2.4 The study area lies within the administrative boundary of Vale of Glamorgan Council.

1.3 Legislation

1.3.1 Part IV of the Environment Act 1995 required the Government to develop a National Air Quality Strategy containing standards and objectives for ambient pollutant concentrations, and measures in order to achieve these objectives. The strategy, published in 1997 and subsequently revised in 2000[1] satisfies these requirements. In addition, an addendum[2] to the strategy was published in 2003.

1.3.2 The Act also set out the principles for Local Air Quality Management (LAQM), under which, Local Authorities are required to review current and future air quality within their area against the air quality objectives. Where it is anticipated that an air quality objective will not be met, the Local Authority is required to declare an Air Quality Management Area (AQMA) and to produce an Action Plan in pursuit of the achievement of the air quality objectives.

1.3.3 The air quality standards, on which objectives and limit values are based, are set purely with regard to scientific and medical evidence on the effects of the particular pollutant on health and represent the minimum or zero risk levels. The associated objectives and limit values take into account economic efficiency, practicability, technical feasibility and timescales. The standards and objectives for air quality relating to human health are contained in the Air Quality Regulations[4,5].

1.3.4 In addition, the requirements of the 1996 air quality framework directive[6] and subsequent Daughter Directives[7,8] relevant to this assessment have been transcribed into UK law via the Air Quality Limit Values Regulations[9,10]. These regulations place the Secretary of State under a duty to ensure that air quality limit values are not exceeded within specified zones by relevant dates. Where there is risk of limit values being exceeded, the Secretary of State is required to draw up and implement an action plan to ensure limit values will be met by the dates specified in the Directive.

1.3.5 Table 1 contains details of the air quality objectives and limit values relevant to this study of Penarth Height redevelopment. Of the pollutants included in the strategy and/or Limit Value Regulations for the protection of human health, sulphur dioxide, lead and ozone have been scoped out of the assessment.

1.3.6 UK fuel standards regulations banned the general sale of leaded petrol from 1 January 2000 and also reduced the maximum permissible amount of sulphur in petrol and diesel. As a result, road transport is not a significant contributor to airborne lead or sulphur dioxide concentrations.

1.3.7 Ozone is not emitted in significant quantities by any man-made sources, but is formed from chemical reactions in the atmosphere in the presence of sunlight. These reactions may take place over many hours or even days, and involve ozone pre-

[4] Air Quality (Wales) Regulations 2000 No. 1940 (W. 138)
[5] Air Quality (Amendment) (Wales) Regulations 2002 No. 3182 (W. 298)
[6] European Council (1996) Council Directive 96/62/EC ambient air quality assessment and management (OJ L 296, 21.11.1996, p. 55–63)
[7] European Council (1999) Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air (OJ L163, 29.06.1999, pp.41-60)
[8] European Council (2000) Council Directive 2000/69/EC of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air (OJ L313, 13.12.2000, p.12-21)
[9] Air Quality Limit Values (Wales) Regulations 2002 No. 3183 (W. 299).
[10] Air Quality Limit Values (Wales) (Amendment) Regulations 2005 No. 1157 (W. 74)

cursors emitted many hundreds of kilometres away. As a result of this trans-boundary influence, ozone has not been included in the Regulations for the purposes of Local Air Quality Management and has not been included in the assessment of local air quality for the redevelopment at Penarth Heights.

1.3.8 The strategy made provision for a potential tightening of the objectives for PM10, to an annual mean of 20µg/m^3 across Wales and a reduction in the number of permitted exceedences of the 50µg/m^3 daily mean to 7 per year. Similarly, the EC 1st Daughter Directive included similar Indicative Limit Values, which were to be reviewed. However, to date, neither the provisional objectives nor the indicative limit values have been included in the Regulations, and the indicative limit values are likely to be removed in the forthcoming EU Air Quality Directive.

Table 1. Air quality objectives and limit values for pollutants relevant to the assessment of effects at Penarth Heights

Pollutant	Air Quality Strategy Objective	Limit Value	Measured as	To be Achieved by
Benzene	16.25 µg/m^3		Running annual mean	31/12/2003
	5 µg/m^3		Annual mean	31/12/2010
		5 µg/m^3	Annual mean	01/01/2010
1,3-Butadiene	2.25 µg/m^3		Running annual mean	31/12/2003
Carbon Monoxide	10 mg/m^3		Max daily running 8hr mean	31/12/2003
		10 mg/m^3	Max daily running 8hr mean	01/01/2005
Nitrogen Dioxide	200 µg/m^3		1 hr mean; not to be exceeded more than 18 times per year	31/12/2005
	40 µg/m^3		Annual mean	31/12/2005
		200 µg/m^3	1 hr mean; not to be exceeded more than 18 times per year	01/01/2010
		40 µg/m^3	Annual mean	01/01/2010
Particulates (PM_{10})	50 µg/m^3		24 hr mean not to be exceeded more than 35 times per year	31/12/2004
	40 µg/m^3		Annual mean	31/12/2004
		50 µg/m^3	24 hr mean not to be exceeded more than 35 times per year	01/01/2005
		40 µg/m^3	Annual mean	01/01/2005

SECTION 2

METHODOLOGY

2 METHODOLOGY

2.1 Overview

2.1.1 The methodology used to assess the air quality impacts of the proposed redevelopment follows that set out in DMRB for localised air quality assessment at a Stage 2 (or Stage 3) assessment. The assessment used the DMRB Screening Method.

2.1.2 In summary, the methodology seeks to compare current local air quality (Baseline 2005) with that anticipated in the future if the redevelopment takes place (with Development) or that anticipated if the redevelopment does not take place (no Development).

2.1.3 Following the DMRB methodology, the assessment is undertaken for the opening year of the development (2012). In this study, to ensure that the worst case effects of the redevelopment have been quantified, assessment is also undertaken for the completion year (2017).

2.2 Establishment of Existing Conditions

2.2.1 Existing air quality was determined from information provided by:-

- Local authority (Vale of Glamorgan) air quality reports prepared for LAQM
- Local authority monitoring data (provided by the Welsh Air Quality Archive, www.welshairquality.co.uk)
- 1km x1km Mapped data provided by the National Air Quality Information Archive (www.airquality.co.uk)

2.2.2 These sources and data were used to identify potential areas of exceedence of air quality objectives and to identify Air Quality Management Areas (AQMA). Where relevant, the data were also used in the verification of the DMRB Screening Method predictions and in the estimation of background pollutant concentrations.

2.2.3 Where appropriate, mapped or monitored data relevant to years other than 2005, the baseline year, opening year (2012) or completion year (2017) have been corrected to the relevant year using factors provided in TG(03)[11].

2.2.4 The locations of the local authority monitoring sites, 5 in total, are shown schematically in Diagram 1.

2.3 Receptors

2.3.1 The air quality regulations apply at locations, outside of buildings or other natural or man-made structures, where members of the public are regularly present. TG(03)[11] states that, air quality assessments should focus on areas where members of the public are likely to be regularly present and *likely to be exposed over the averaging period of the objective*. This implies that, for example, the facades of residential properties, schools, hospitals etc are considered relevant receptors for objectives based on annual mean concentrations, whereas kerbside locations are relevant receptors for objectives based on hourly mean concentrations only.

[11] Department for the Environment, Food and Rural Affairs, Local Air Quality Management, Technical Guidance LAQM.TG(03), 2003.

2.3.2 The redevelopment site and the roads affected by the redevelopment lie to the north and north-west of Penarth town centre, in an area of primarily residential housing, with some light industrial/commercial development. Large sections of the residential areas, including areas immediately to the south of the development site e.g. High Street and Arcot Street, comprise dense, terraced housing, with frontages directly onto the kerb. There are also a number of schools in the study area i.e. on Plassey Street/High Street, Pill Street, Fairfield Road and Stanwell Road.

2.3.3 Since it is not possible to assess air quality at all potential relevant receptors for this assessment, a number of sensitive receptors within the study area have been selected to illustrate the effects of the redevelopment on air quality. The details of the selected receptors are provided in Table 2, and are shown schematically in Diagram 1.

2.3.4 The receptors have been selected to represent those properties closest to affected routes i.e. the most affected properties, and also, in some cases, to be co-incident with local authority monitoring sites (denoted by DT in the receptor name).

Table 2. Selected receptors for air quality impact assessment.

ID	Name	Nearest road link	Distance to link centre	Notes
1	Cogan Roundabout (DT)	Barons Court Jct.	7m	Diffusion Tube
2	Cogan Roundabout	Barons Court Jct.	18m	Closest Property to Junction
3	Cogan Hill	Cogan Hill	24m	Midway between Junctions
4	Tesco Roundabout	Cogan Hill	27m	Worst case at roundabout
5	Terra Nova Way	Terra Nova Way	7m	Worst case on road
6	Windsor Road Lamp Post (DT)	Windsor Road	5m	Diffusion Tube
7	Windsor/Andrew Road (DT)	Windsor Road	8m	Diffusion Tube
8	Windsor Road	Windsor Road	9m	Typical property
9	Windsor Road (DT)	Windsor Road	6m	Diffusion Tube
10	Windsor Road (DT)	Windsor Road	8m	Worst case prop./ Diffusion Tube
11	160 Windsor Road (DT)	Windsor Road	6m	Diffusion Tube
12	Plassey Street Roundabout	Plassey Street	11m	Closest Property to roundabout
13	Plassey Street School	Plassey Street	13m	At High Street junction
14	High Street	High Street	6m	Worst case at junction
15	Plassey Street	Plassey Street	6m	At Arcot Street junction
16	Arcot Street	Arcot Street	6m	Worst case at junction
17	Town Centre Roundabout	Windsor Road	5m	Worst case at roundabout
18	Town Centre Roundabout	Stanwell Road	9m	Typical property

2.4 Traffic Data

2.4.1 The traffic data used in the assessment were derived from data provided in the Traffic Assessment[3]. The TA provided estimates of AM and PM Peak Hour flows in 2005, 2012 and 2017 for the roads shown in Diagram 1.

2.4.2 Factoring was used to convert these hourly datasets to the annual average daily traffic (AADT) flows required for the DMRB Screening Method. Local factors relating peak hour to 12 hour traffic flows were obtained from data collected in a traffic survey on 11 November 2004 on Penarth Haven/Windsor Road (Vale of Glamorgan Council

survey, supplied by Cole Easdon Consultants). These local factors were assumed to apply in future years.

2.4.3 In the absence of local factors for converting 12 hour flows to AADT, it was assumed that the 12 hour flow is approximately 85% of the daily flow.

2.4.4 The percentage of Heavy Duty Vehicles (HDV) was estimated from the November 2004 traffic survey. All roads to and from Barons Court Junction were estimated to have 2.3% HDV, based on the survey data on Cogan Hill . Terra Nova way was estimated to have 0.94% HDV, based on the survey data on Terra Nova way. All other routes were estimated to have 2.6% HDV, based on the survey data from Windsor Road. The percentage HDV was kept constant in all years.

2.4.5 Vehicle speeds were not explicitly assessed in the TA. Therefore, it was assumed that at junctions, mean vehicle speeds reduce to 5kph. This is the lowest valid speed that can be used in the DMRB Screening Method and was used to take into account the effects of traffic queuing and stop/start driving at junctions. On free-flowing sections of roads, a speed of 32kph has been assumed. This is equivalent to the speed provided by Vale of Glamorgan for Windsor Road in their Updating and Screening Assessment 2006. Given the road layout in the study area, with numerous cross-roads and cars parked at the roadside, this is considered a realistic estimate of mean speeds along the majority of routes. These speeds were kept constant in all years.

2.5 Background Concentrations

2.5.1 The assessment of air quality requires the specification of background pollutant concentrations. The estimated background concentrations should reflect pollution levels at locations near or within the study area which experience little or no direct influence from the major roads in the area. The total ambient pollutant concentration is estimated by adding the local, roadside contribution to pollutant levels at a receptor to the background concentrations.

2.5.2 The contribution of an individual road to local pollution levels is considered to be negligible at distances greater than 200m from the roadside. Therefore, to avoid overestimating pollutant concentrations through double counting road contributions, suitable background monitoring sites should be located more than 200m from A-Roads or motorways.

2.5.3 The nearest monitoring locations to the study area, classified as background sites, are within the town of Barry, at St Teilo and Gwenog Court, 5km to the south-west. Nitrogen dioxide concentrations at these sites were 14µg/m^3 in 2004 and 2005. This is consistent with the mapped data provided by the National Air Quality Information Archive.

2.5.4 However, the mapped background data indicates that, in general, pollutant concentrations in the region increase towards the urban centre of Cardiff. It is possible, therefore, that using data from a background site in Barry will underestimate background pollutant concentrations in Penarth due to an underestimate of the impact of emissions from roads within Cardiff.

2.5.5 TG(03) recommends that background concentrations be taken from squares 4km either side of the road under assessment, provided these cells to not contain significant local sources. In the case of Penarth Heights, as noted in the previous paragraph, to the east and north of the site, mapped pollutant concentrations are influenced by Cardiff and the M4. To the west of the site, pollutant concentrations

initially decrease, but then increase again as the influence of Aberthaw Power Station and Cement works becomes apparent.

2.5.6 Therefore, in this study, background pollutant concentrations were calculated as an average over all squares within +/- 2km of the site. This is considered to take into account the influence of the rural areas to the west of Penarth and the urban areas to the north-east, without being too heavily influenced by roads within the study area. Table 3 shows the background pollutant concentrations used in the assessment.

Table 3. Background pollutant concentrations, estimated from National Air Quality Information Archive mapped data.

Year	Carbon monoxide mg/m^3	Benzene µg/m^3	1,3-Butadiene µg/m^3	Nitrogen Oxides µg/m^3	Nitrogen Dioxide µg/m^3	Particulate Matter PM_{10} µg/m^3
Baseline 2005	0.20	0.37	0.12	23.82	18.26	17.90
Opening 2012	0.13	0.31	0.08	18.45	15.38	16.25
Completion 2017	0.12	0.32	0.08	17.04	14.78	16.05

2.6 DMRB Screening Method

2.6.1 An integral part of the DMRB assessment is the DMRB Screening Method, provided by the Highways Agency in spreadsheet form. The Screening Method provides an initial estimate of whether roadside pollutant concentrations are likely to exceed the relevant air quality objectives.

2.6.2 The Screening Method requires the input of the distances from receptors to the centreline of relevant road links, traffic data on the road links and the background pollutant concentrations.

2.6.3 Relevant road links are defined as those within 200m of the receptor. The traffic data is input as annual averaged daily traffic, speeds and fleet mix (defined as the percentage of light and heavy duty vehicles). The background pollutant concentrations used in the Screening Method are shown in Table 3.

2.6.4 The road link data used in the Screening Method are provided in Appendix A. The DMRB methodology provided in DMRB for the assessment of relevant road links at junctions requires the averaging of traffic across individual links.

2.6.5 The Screening Method was used to assess concentrations of benzene, 1,3-butadiene, carbon monoxide, nitrogen dioxide and particulate matter (PM_{10}) at the receptors identified in Table 2. Assessments were undertaken for the Baseline (2005), with redevelopment (2012, 2017) and without redevelopment (2012, 2017) scenarios.

2.6.6 The DMRB Screening Method predictions were verified against monitored concentrations of nitrogen dioxide.

SECTION 3

EXISTING CONDITIONS

3 EXISTING CONDITIONS

3.1 Local Authority Monitoring

3.1.1 In 2005, the only pollutant of interest to this assessment which was monitored within the study area was nitrogen dioxide. Table 4 shows the diffusion tube data, published in Vale of Glamorgan's 2006 Updating and Screening Assessment, for sites within the study area. A schematic of the location of these sites is provided in Diagram 1.

Table 4. Nitrogen dioxide diffusion tube monitoring data from local authority sites. The figures in brackets in the site name, give the distance of the monitoring location to the kerb.

Monitoring Site			Annual Mean Nitrogen Dioxide µg/m^3			
Name	**Easting**	**Northing**	**2002**	**2003**	**2004**	**2005**
R1 Cogan Roundabout (3m)	317431	172759	38	39	42	36
R6 Windsor Road/LP (1.5m)	317553	172486				29
R7 Windsor/Andrew Rd (5m)	317550	172483				26
R9 Windsor Road (2m)	317587	172441	42	42	35	31
R10 Windsor Road (5m)	317588	172411		39	34	31
R11 160 Windsor Road (2m)	317636	172370				35

3.1.2 As is to be expected, roadside concentrations of nitrogen dioxide are elevated in relation to the background concentrations (Table 3). However, in 2005, all sites recorded annual mean nitrogen dioxide concentrations well within the air quality objective. This is consistent with the fact that the local authority currently has no Air Quality Management Areas. For the sites with pre-2005 data, there is a general decreasing trend in concentrations with time.

3.1.3 Whilst there is no monitoring data available for the remaining pollutants, the local authority's Updating and Screening Assessment did not identify any risk of exceedence of the air quality objectives for any of benzene, 1,3-butadiene, carbon monoxide or particulate matter within the study area.

3.2 DMRB Screening Method

3.2.1 Concentrations of carbon monoxide, benzene, 1,3-butadiene, nitrogen dioxide and PM_{10} were modelled at the eighteen sensitive receptors (Table 2) for the baseline (2005) scenario. The results of the assessment are provided in Table 5.

3.2.2 The modelled concentrations for carbon monoxide, benzene and 1-3 butadiene are well below their respective air quality objectives in the 2005 baseline scenario for the selected receptors. For carbon monoxide, since annual mean concentrations do not exceed 2mg/m^3, it is considered unlikely that the objective for 8 hour mean carbon monoxide will be exceeded.

3.2.3 Annual mean concentrations of particulate matter are also well within the air quality objective for all receptors. An exceedence of the objective for daily mean PM_{10} is modelled at the Cogan Roundabout diffusion tube site. However, there is no relevant exposure at this location, and no exceedence of the objective is modelled at the nearest residential property to the roundabout, receptor R2.

Table 5. DMRB Screening Model output (uncorrected) for the baseline scenario in 2005.

	Annual Mean Concentration					
Receptor	**Carbon monoxide mg/m^3**	**Benzene µg/m^3**	**1,3-Butadiene µg/m^3**	**Nitrogen dioxide µg/m^3**	**PM_{10} µg/m^3**	**PM_{10} Days > 50µg/m^3**
Objective	**na**	**5µg/m^3**	**2.25µg/m^3**	**40µg/m^3**	**40µg/m^3**	**35 days**
R1. Cogan Roundabout (DT)	1.53	2.29	1.51	35.50	33.27	41.11
R2. Cogan Roundabout	1.28	1.91	1.23	32.92	30.33	28.74
R3. Cogan Hill	0.48	0.77	0.41	25.07	22.12	6.51
R4. Tesco Roundabout	0.50	0.76	0.39	24.84	22.06	6.40
R5. Terra Nova Way	0.72	0.85	0.40	23.74	22.19	6.62
R6. Windsor Road LP (DT)	0.38	0.64	0.32	25.38	21.88	6.10
R7. Windsor/Andrew Road (DT)	0.37	0.62	0.31	25.07	21.68	5.78
R8. Windsor Road	0.36	0.61	0.31	24.90	21.56	5.58
R9. Windsor Road (DT)	0.35	0.57	0.28	24.69	21.40	5.33
R10. Windsor Road (DT)	0.34	0.56	0.27	24.47	21.26	5.12
R11. 160 Windsor Road (DT)	0.88	1.12	0.68	29.26	26.39	15.95
R12. Plassey Street Roundabout	0.85	0.97	0.56	28.36	25.57	13.80
R13. Plassey Street School	0.43	0.58	0.26	22.00	20.34	3.83
R14. High Street	0.46	0.62	0.29	22.50	20.70	4.32
R15. Plassey Street	0.47	0.62	0.29	22.51	20.72	4.34
R16. Arcot Street	0.47	0.62	0.29	22.53	20.74	4.36
R17. Town Centre Roundabout	0.69	0.82	0.44	26.11	23.58	9.25
R18. Town Centre Roundabout	0.64	0.78	0.42	25.50	23.07	8.23

3.2.5 The predicted concentrations of annual mean nitrogen dioxide are within the objective at all locations. Since the annual mean objective is not exceeded, it is considered unlikely that the hourly mean objective will be exceeded.

Model Verification

3.2.6 Dispersion modelling is an inherently uncertain procedure with potential errors in the model output arising from either, or both, systematic or random errors.

3.2.7 Systematic errors occur where a distinct trend is apparent in the model output i.e. a tendency to under or over predict known values. This type of error may arise where emissions have been underestimated, or unrepresentative meteorological data used. Whilst it is rarely possible to identify a specific reason for the systematic error, the errors can be quantified and allowed for by comparing modelled concentrations against monitored concentrations in order to derive a scaling factor. Monitored data itself has an associated uncertainty. Therefore, in the adjustment for systematic errors, it is best to calculate the scaling factor on the basis of data from 3 or more monitoring stations.

3.2.8 Random errors, as the name suggests, do not show a distinct trend and result in a scatter of modelled concentrations about monitored data even after an allowance for systematic error has been made. The degree of uncertainty i.e. random error, in the model results may be estimated by calculating the standard deviation of the verified modelled results.

3.2.9 The DMRB Screening Model outputs for nitrogen dioxide were verified against the Vale of Glamorgan monitoring data for 2005. Table 6 shows the details of the verification process and the factors generated to scale the model results to correct for systematic errors.

3.2.10 Since the correction of the modelled results relates to the road-side component of the pollutant only, the scaling factor is calculated by first removing the background contribution to the monitored and modelled concentrations (18.26µg/m^3) and then comparing the roadside components only.

3.2.11 The analysis of the systematic error in the DMRB modelling led to the conclusion that a scaling factor need only be applied to receptors along Windsor Road. The model result at Cogan Roundabout was in good agreement with the monitoring data, whereas the model significantly under-predicts the monitored concentrations along Windsor Road.

3.2.12 Whilst Windsor Road does not strictly conform to the definition of a street canyon i.e. a narrow road enclosed by buildings of a height greater than or equal to the road width, it should be noted that the correction factor required, 1.77, is close to that recommended in TG(03)[11] for correcting DMRB Screening Method results in street canyons (TG03 factor = 2).

3.2.13 Taking a conservative approach, it has therefore been concluded that model results at receptors along Windsor Road, High Street, Plassey Street, Arcot Street and Town centre roundabout (R6 to R18) require scaling with a factor of 1.77. These streets have either buildings or dense vegetation along both sides of the route for the majority of their length. The receptors on Cogan Hill, Cogan Roundabout, Tesco Roundabout and Terra Nova way (R1 to R5) are assumed to be represented by the diffusion tube at Cogan Roundabout and are not scaled.

3.2.14 Since no monitoring data is available for the verification of concentrations of pollutants other than nitrogen dioxide, it is assumed that the nitrogen dioxide factors apply to all pollutants.

3.2.15 For all pollutants, except PM_{10}, the correction of the model results does not significantly alter the initial assessment of baseline air quality at the sensitive receptors, i.e. pollutant concentrations are well within their air quality objectives.

3.2.16 For particulate matter, at 160 Windsor Road, the estimated number of exceedences of 50µg/m^3 as a daily mean is 39, which exceeds the air quality objective. However, it should be noted that this figure is subject to significant uncertainty due to the lack of monitored PM_{10} data against which to verify the model results.

Table 6. Verification of DMRB Screening Model Output

Diffusion tube location	Modelled Nitrogen dioxide µg/m^3	Modelled Roadside Contri-bution µg/m^3	Monitored Nitrogen dioxide µg/m^3	Monitored Roadside Contri-bution µg/m^3	Ratio of Monitored to Modelled Roadside Contri-bution	Corrected Modelled Nitrogen Dioxide µg/m^3
R1. Cogan Roundabout	35.50	17.24	36	17.74	1.03	35.50
No adjustment necessary, since ratio of monitored to modelled roadside nitrogen dioxide is close to unity						
R6. Windsor Road LP	25.38	7.12	29	10.74	1.51	30.83
R7. Windsor/Andrew Road	25.07	6.81	26	7.74	1.14	30.29
R9. Windsor Road	24.69	6.43	31	12.74	1.98	29.61
R10. Windsor Road	24.47	6.21	31	12.74	2.05	29.23
R11. 160 Windsor Road	29.26	10.99	35	16.74	1.52	37.68
				Mean correction factor	***1.77***	

Table 7. Verified DMRB Screening Model output for the baseline scenario in 2005

	Annual Mean Concentration					PM_{10} Days > 50µg/m^3
Receptor	Carbon monoxide mg/m^3	Benzene µg/m^3	1,3-Butadiene µg/m^3	Nitrogen dioxide µg/m^3	PM_{10} µg/m^3	
Objective	na	5µg/m^3	2.25µg/m^3	40µg/m^3	40µg/m^3	35 days
R1. Cogan Roundabout (DT)	1.53	2.29	1.51	35.50	33.27	41.11
R2. Cogan Roundabout	1.28	1.91	1.23	32.92	30.33	28.74
R3. Cogan Hill	0.48	0.77	0.41	25.07	22.12	6.51
R4. Tesco Roundabout	0.50	0.76	0.39	24.84	22.06	6.40
R5. Terra Nova Way	0.72	0.85	0.40	23.74	22.19	6.62
R6. Windsor Road LP (DT)	0.52	0.84	0.48	30.83	24.92	12.21
R7. Windsor/Andrew Road (DT)	0.50	0.81	0.46	30.29	24.58	11.40
R8. Windsor Road	0.49	0.80	0.45	29.99	24.36	10.92
R9. Windsor Road (DT)	0.46	0.72	0.40	29.61	24.08	10.29
R10. Windsor Road (DT)	0.45	0.71	0.39	29.23	23.83	9.78
R11. 160 Windsor Road (DT)	1.41	1.68	1.12	37.68	32.89	39.37
R12. Plassey Street Roundabout	1.35	1.42	0.89	36.09	31.45	33.16
R13. Plassey Street School	0.60	0.75	0.38	24.86	22.21	6.66
R14. High Street	0.66	0.80	0.41	25.75	22.85	7.82
R15. Plassey Street	0.67	0.81	0.42	25.76	22.88	7.88
R16. Arcot Street	0.67	0.81	0.42	25.81	22.91	7.93
R17. Town Centre Roundabout	1.06	1.16	0.69	32.12	27.94	20.49
R18. Town Centre Roundabout	0.98	1.09	0.64	31.05	27.03	17.75

SECTION 4

OPERATIONAL IMPACTS

4 OPERATIONAL IMPACTS

4.1 Opening Year (2012)

4.1.1 The modelled concentrations of the relevant air quality pollutants for the selected receptors for the 'with development' and 'without development' scenarios in the opening year are shown in Table 8 and respectively. Annual mean concentrations of nitrogen dioxide are also shown in Diagram 2.

4.1.2 The predicted concentrations of all pollutants in the opening year, 2012, are lower than those in the baseline year (2005) in both scenarios. This decrease is due, in part, to the predicted general decrease in background concentrations and also to the predicted decrease in total vehicle emissions with time.

4.1.3 The concentrations of all pollutants are within their respective EU limit values and/or air quality objectives. For carbon monoxide, since the annual mean concentrations do not exceed 1mg/m^3 it is considered unlikely that the objective for 8 hour mean carbon monoxide will be exceeded.

Table 8. Verified DMRB Screening Model output for the 'without development' scenario in the opening year, 2012

	Annual Mean Concentration					
Receptor	**Carbon monoxide mg/m^3**	**Benzene µg/m^3**	**1,3-Butadiene µg/m^3**	**Nitrogen dioxide µg/m^3**	**PM_{10} µg/m^3**	**PM_{10} Days > 50µg/m^3**
Objective	**na**	**5µg/m^3**	**2.25µg/m^3**	**40µg/m^3**	**40µg/m^3**	**35 days**
R1. Cogan Roundabout (DT)	1.00	1.69	0.95	26.53	23.40	8.88
R2. Cogan Roundabout	0.84	1.42	0.78	24.76	22.03	6.36
R3. Cogan Hill	0.32	0.60	0.26	19.77	18.44	1.76
R4. Tesco Roundabout	0.33	0.60	0.25	19.63	18.42	1.75
R5. Terra Nova Way	0.47	0.66	0.25	18.87	18.49	1.81
R6. Windsor Road LP (DT)	0.36	0.65	0.31	23.62	20.02	3.42
R7. Windsor/Andrew Road (DT)	0.34	0.63	0.30	23.25	19.83	3.20
R8. Windsor Road	0.34	0.62	0.30	23.04	19.72	3.07
R9. Windsor Road (DT)	0.32	0.57	0.26	22.80	19.57	2.89
R10. Windsor Road (DT)	0.31	0.56	0.25	22.53	19.44	2.75
R11. 160 Windsor Road (DT)	0.92	1.26	0.71	27.55	23.09	8.27
R12. Plassey Street Roundabout	0.89	1.07	0.56	26.65	22.56	7.28
R13. Plassey Street School	0.40	0.59	0.24	19.60	18.39	1.72
R14. High Street	0.44	0.63	0.26	20.18	18.71	2.01
R15. Plassey Street	0.45	0.63	0.26	20.18	18.72	2.02
R16. Arcot Street	0.45	0.63	0.27	20.21	18.74	2.03
R17. Town Centre Roundabout	0.70	0.88	0.44	24.17	21.00	4.74
R18. Town Centre Roundabout	0.65	0.83	0.41	23.46	20.57	4.14

Table 9. Verified DMRB Screening Model output for the 'with development' scenario in the opening year, 2012

	Annual Mean Concentration					
Receptor	**Carbon monoxide mg/m^3**	**Benzene µg/m^3**	**1,3-Butadiene µg/m^3**	**Nitrogen dioxide µg/m^3**	**PM_{10} µg/m^3**	**PM_{10} Days > 50µg/m^3**
Objective	**na**	**5µg/m^3**	**2.25µg/m^3**	**40µg/m^3**	**40µg/m^3**	**35 days**
R1. Cogan Roundabout (DT)	1.01	1.74	0.98	26.66	23.50	9.09
R2. Cogan Roundabout	0.85	1.46	0.80	24.88	22.12	6.50
R3. Cogan Hill	0.32	0.62	0.27	19.88	18.50	1.81
R4. Tesco Roundabout	0.34	0.61	0.26	19.75	18.50	1.81
R5. Terra Nova Way	0.49	0.68	0.26	19.03	18.61	1.92
R6. Windsor Road LP (DT)	0.36	0.67	0.33	23.84	20.13	3.57
R7. Windsor/Andrew Road (DT)	0.35	0.66	0.32	23.46	19.94	3.33
R8. Windsor Road	0.34	0.64	0.31	23.25	19.82	3.19
R9. Windsor Road (DT)	0.32	0.59	0.27	23.00	19.67	3.01
R10. Windsor Road (DT)	0.32	0.58	0.27	22.73	19.54	2.86
R11. 160 Windsor Road (DT)	0.95	1.33	0.76	27.86	23.30	8.68
R12. Plassey Street Roundabout	0.96	1.16	0.62	27.54	23.15	8.39
R13. Plassey Street School	0.47	0.66	0.28	20.57	18.93	2.22
R14. High Street	0.52	0.71	0.31	21.31	19.35	2.65
R15. Plassey Street	0.50	0.68	0.29	20.89	19.12	2.41
R16. Arcot Street	0.50	0.68	0.30	20.92	19.14	2.43
R17. Town Centre Roundabout	0.72	0.90	0.45	24.38	21.13	4.93
R18. Town Centre Roundabout	0.66	0.84	0.42	23.65	20.69	4.30

4.1.6 Table 10 shows the pollutant concentration change at the receptors between the 2012 'with development' and 'without development' scenarios, as both an absolute value and as a percentage of the relevant air quality objective or limit value. Pollutant concentrations increase with the development as a result of the predicted increase in vehicle flows on the network.

4.1.7 Whilst the highest pollutant concentrations occur at junctions or near cross-roads on the main roads e.g. Cogan roundabout, Plassey roundabout and 160 Windsor Road, the greatest percentage change in pollutants occurs at receptors closest to proposed development e.g. at the junctions of Plassey Street and High Street and Plassey Street and Arcot Street.

4.1.8 At receptors close to these latter two junctions, the increase in nitrogen dioxide concentration with the development is greater than 5%. However, as stated previously, the concentrations of pollutants remain well within their respective air quality objectives or limit values.

4.1.9 Along Windsor Road, the development of Penarth Heights is predicted to increase concentrations of nitrogen dioxide and particulate matter by less than 1.2% of the 'without development' scenario concentrations.

Table 10. Difference and percentage difference between the opening year 'with development' and 'without development' scenarios

Receptor	CO		Benzene		1,3-butadiene		NO_2		PM_{10}		
	Difference mg/m^3	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Days Difference >50 g/m^3
R1. Cogan Rdbt	0.01	1.3%	0.05	3.0%	0.03	3.4%	0.13	0.5%	0.10	0.4%	0.21
R2. Cogan Rdbt	0.01	1.3%	0.04	2.9%	0.03	3.3%	0.11	0.5%	0.09	0.4%	0.15
R3. Cogan Hill	0.01	1.6%	0.02	2.7%	0.01	4.0%	0.11	0.6%	0.06	0.3%	0.05
R4. Tesco Rdbt	0.01	2.2%	0.02	2.8%	0.01	4.1%	0.12	0.6%	0.07	0.4%	0.06
R5. Terra Nova Way	0.02	3.8%	0.02	2.8%	0.01	3.5%	0.17	0.9%	0.12	0.6%	0.11
R6. Windsor Road LP	0.01	2.0%	0.03	3.9%	0.02	5.5%	0.22	0.9%	0.11	0.6%	0.14
R7. Windsor/Andrew	0.01	2.0%	0.02	3.8%	0.02	5.5%	0.21	0.9%	0.11	0.5%	0.13
R8. Windsor Road	0.01	1.9%	0.02	3.7%	0.02	5.4%	0.21	0.9%	0.10	0.5%	0.12
R9. Windsor Road	0.01	1.8%	0.02	3.5%	0.01	5.3%	0.20	0.9%	0.10	0.5%	0.11
R10. Windsor Road	0.01	1.8%	0.02	3.4%	0.01	5.2%	0.19	0.9%	0.10	0.5%	0.11
R11. 160 Windsor Road	0.02	2.6%	0.07	5.8%	0.05	6.9%	0.31	1.1%	0.21	0.9%	0.41
R12. Plassey St Rdbt	0.08	8.6%	0.09	8.6%	0.06	9.8%	0.89	3.3%	0.59	2.6%	1.11
R13. Plassey St School	0.07	17.6%	0.07	12.0%	0.04	16.9%	0.97	5.0%	0.54	2.9%	0.50
R14. High Street	0.08	18.9%	0.08	13.3%	0.05	18.1%	1.13	5.6%	0.64	3.4%	0.64
R15. Plassey Street	0.05	11.7%	0.05	8.2%	0.03	11.2%	0.71	3.5%	0.40	2.1%	0.39
R16. Arcot Street	0.05	11.7%	0.05	8.3%	0.03	11.3%	0.71	3.5%	0.40	2.1%	0.40
R17. Town Centre Rdbt	0.02	2.2%	0.01	1.7%	0.01	2.2%	0.21	0.9%	0.13	0.6%	0.19
R18. Town Centre Rdbt	0.01	2.1%	0.01	1.6%	0.01	2.1%	0.19	0.8%	0.12	0.6%	0.16

4.2 Completion Year (2017)

4.2.1 The modelled concentrations of the relevant air quality pollutants for the selected receptors for the 'with development' and 'without development' scenarios in the completion year are shown in Table 11 and Table 12 respectively.

4.2.2 The predicted concentrations of all pollutants in the completion year, 2017, are lower than those in the baseline year (2005) in both scenarios. As in 2012, this decrease in due, in part, to the predicted general decrease in background concentrations and also to the predicted decrease in total vehicle emissions with time. Concentrations of all pollutants remain well within their respective objectives or limit values.

4.2.3 In comparison to 2012, concentrations of nitrogen dioxide and PM_{10} exhibit a decrease by 2017 with respect to the equivalent with or without development scenario.

4.2.4 However, at receptors closest to the development i.e. along Arcot street, concentrations of 1,3-butadiene, carbon monoxide and benzene show small increases in concentrations between 2012 and 2017 with the operation of the development. These receptors are close to those road links showing the greatest percentage increase in traffic volumes between the development opening and completion years. However, as stated above, the pollutant concentrations remain well within their respective objectives or limit values.

Table 11. Verified DMRB Screening Model output for the 'without development' scenario in the completion year, 2017

	Annual Mean Concentration					
Receptor	**Carbon monoxide mg/m^3**	**Benzene µg/m^3**	**1,3-Butadiene µg/m^3**	**Nitrogen dioxide µg/m^3**	**PM_{10} µg/m^3**	**PM_{10} Days > 50µg/m^3**
Objective	**na**	**5µg/m^3**	**2.25µg/m^3**	**40µg/m^3**	**40µg/m^3**	**35 days**
R1. Cogan Roundabout (DT)	0.97	1.69	0.93	24.24	21.96	6.24
R2. Cogan Roundabout	0.81	1.42	0.76	22.71	20.83	4.50
R3. Cogan Hill	0.31	0.60	0.26	18.57	17.91	1.34
R4. Tesco Roundabout	0.32	0.60	0.25	18.47	17.92	1.34
R5. Terra Nova Way	0.46	0.66	0.25	17.88	18.05	1.44
R6. Windsor Road LP (DT)	0.35	0.65	0.31	21.91	19.27	2.57
R7. Windsor/Andrew Road (DT)	0.33	0.63	0.30	21.59	19.11	2.40
R8. Windsor Road	0.33	0.62	0.29	21.41	19.02	2.30
R9. Windsor Road (DT)	0.31	0.57	0.26	21.19	18.88	2.17
R10. Windsor Road (DT)	0.30	0.56	0.25	20.97	18.77	2.07
R11. 160 Windsor Road (DT)	0.89	1.26	0.69	24.95	21.64	5.71
R12. Plassey Street Roundabout	0.87	1.07	0.55	24.26	21.27	5.13
R13. Plassey Street School	0.40	0.59	0.24	18.39	17.88	1.31
R14. High Street	0.44	0.63	0.26	18.89	18.16	1.53
R15. Plassey Street	0.44	0.64	0.26	18.88	18.16	1.53
R16. Arcot Street	0.44	0.64	0.26	18.91	18.18	1.54
R17. Town Centre Roundabout	0.70	0.89	0.44	22.28	20.06	3.47
R18. Town Centre Roundabout	0.64	0.84	0.40	21.67	19.69	3.04

Table 12. Verified DMRB Screening Model output for the 'with development' scenario in the completion year, 2017

	Annual Mean Concentration					
Receptor	**Carbon monoxide mg/m^3**	**Benzene µg/m^3**	**1,3-Butadiene µg/m^3**	**Nitrogen dioxide µg/m^3**	**PM_{10} µg/m^3**	**PM_{10} Days > 50µg/m^3**
Objective	**na**	**5µg/m^3**	**2.25µg/m^3**	**40µg/m^3**	**40µg/m^3**	**35 days**
R1. Cogan Roundabout (DT)	0.98	1.75	0.96	24.36	22.05	6.39
R2. Cogan Roundabout	0.82	1.46	0.79	22.81	20.90	4.60
R3. Cogan Hill	0.31	0.62	0.27	18.66	17.97	1.38
R4. Tesco Roundabout	0.33	0.61	0.26	18.57	17.98	1.39
R5. Terra Nova Way	0.48	0.68	0.26	18.02	18.15	1.52
R6. Windsor Road LP (DT)	0.35	0.68	0.33	22.10	19.37	2.67
R7. Windsor/Andrew Road (DT)	0.34	0.66	0.31	21.77	19.21	2.50
R8. Windsor Road	0.33	0.65	0.31	21.59	19.10	2.39
R9. Windsor Road (DT)	0.31	0.59	0.27	21.36	18.97	2.25
R10. Windsor Road (DT)	0.31	0.58	0.26	21.13	18.85	2.14
R11. 160 Windsor Road (DT)	0.92	1.33	0.74	25.21	21.80	5.98
R12. Plassey Street Roundabout	0.94	1.16	0.61	25.00	21.75	5.89
R13. Plassey Street School	0.47	0.66	0.28	19.22	18.35	1.68
R14. High Street	0.52	0.72	0.31	19.85	18.71	2.00
R15. Plassey Street	0.55	0.75	0.33	20.19	18.91	2.20
R16. Arcot Street	0.55	0.75	0.33	20.22	18.92	2.21
R17. Town Centre Roundabout	0.71	0.90	0.44	22.45	20.16	3.60
R18. Town Centre Roundabout	0.66	0.85	0.41	21.83	19.79	3.15

4.2.7 Table 13 shows the pollutant concentration change at the receptors between the 2017 'with development' and 'without development' scenarios, as both an absolute value and as a percentage of the relevant air quality objective or limit value. Pollutant concentrations increase with the development as a result of the predicted increase in vehicle flows on the network.

4.2.8 As in the opening year, the highest pollutant concentrations occur at junctions or near cross-roads on the main roads, but the greatest percentage change in pollutants occurs at receptors closest to proposed development.

Table 13. Difference and percentage difference between the completion year 'with development' and 'without development' scenarios

Receptor	CO		Benzene		1,3-butadiene		NO_2		PM_{10}		
	Difference mg/m^3	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Difference $\mu g/m^3$	Percentage Difference	Days Difference >50 g/m^3
R1. Cogan Rdbt	0.01	1.3%	0.05	3.1%	0.03	3.4%	0.11	0.5%	0.09	0.4%	0.15
R2. Cogan Rdbt	0.01	1.3%	0.04	2.9%	0.03	3.4%	0.10	0.4%	0.07	0.3%	0.10
R3. Cogan Hill	0.01	1.6%	0.02	2.7%	0.01	3.9%	0.09	0.5%	0.05	0.3%	0.04
R4. Tesco Rdbt	0.01	2.1%	0.02	2.7%	0.01	4.0%	0.10	0.6%	0.06	0.3%	0.05
R5. Terra Nova Way	0.02	3.7%	0.02	2.7%	0.01	3.4%	0.14	0.8%	0.10	0.6%	0.08
R6. Windsor Road LP	0.01	2.0%	0.02	3.7%	0.02	5.3%	0.19	0.9%	0.10	0.5%	0.10
R7. Windsor/Andrew	0.01	1.9%	0.02	3.7%	0.02	5.3%	0.18	0.8%	0.09	0.5%	0.09
R8. Windsor Road	0.01	1.9%	0.02	3.6%	0.02	5.2%	0.17	0.8%	0.09	0.5%	0.09
R9. Windsor Road	0.01	1.8%	0.02	3.4%	0.01	5.1%	0.17	0.8%	0.08	0.4%	0.08
R10. Windsor Road	0.01	1.7%	0.02	3.3%	0.01	5.1%	0.16	0.8%	0.08	0.4%	0.08
R11. 160 Windsor Road	0.02	2.5%	0.07	5.7%	0.05	6.6%	0.26	1.0%	0.16	0.8%	0.27
R12. Plassey St Rdbt	0.07	8.4%	0.09	8.3%	0.05	9.5%	0.74	3.1%	0.48	2.3%	0.76
R13. Plassey St School	0.07	17.7%	0.07	12.0%	0.04	16.7%	0.83	4.5%	0.46	2.6%	0.37
R14. High Street	0.08	19.0%	0.08	13.3%	0.05	18.0%	0.96	5.1%	0.55	3.0%	0.48
R15. Plassey Street	0.11	25.6%	0.11	18.0%	0.06	24.3%	1.30	6.9%	0.74	4.1%	0.66
R16. Arcot Street	0.11	25.6%	0.11	18.0%	0.06	24.3%	1.31	6.9%	0.74	4.1%	0.67
R17. Town Centre Rdbt	0.01	2.1%	0.01	1.6%	0.01	2.1%	0.17	0.8%	0.10	0.5%	0.13
R18. Town Centre Rdbt	0.01	2.1%	0.01	1.6%	0.01	2.0%	0.16	0.7%	0.09	0.5%	0.11

SECTION 5

CONCLUSIONS

5 CONCLUSIONS

5.1 Summary

5.1.1 An assessment of the effects of the occupation of the proposed residential redevelopment at Penarth Heights on local air quality has been undertaken. Pollutant concentrations in the baseline year (2005), and the development opening and completion years, 2012 and 2017 respectively, have been estimated using the DMRB Screening Method.

5.1.2 The main pollutants of concern are nitrogen dioxide and particulate matter, PM_{10}. At locations of relevant exposure, no exceedences of the air quality objectives for either pollutant are modelled in the baseline year, although there is a risk of exceedence of the daily mean objective for PM_{10}. Concentrations of benzene, 1,3-butadiene and carbon monoxide are modelled to be well within their respective objectives in the base year and in future years.

5.1.3 Pollutant concentrations are predicted to decrease with time due to both decreasing background concentrations and reduced emissions per vehicle. In the scheme opening year, there are unlikely to be any exceedences of air quality objectives or limit values, whether the redevelopment proceeds or not.

5.1.4 The redevelopment is predicted to result in an increase in pollutant concentrations as a result of increased traffic flows. However, as stated above, pollutant concentrations are predicted to remain within their relevant objectives.

5.1.5 The assessment has been carried out at eighteen receptors in the vicinity of the redevelopment site. These receptors were selected to include examples of the most affected properties. Since no exceedences of air quality objectives were predicted in the opening year and/or future years at these receptors, it is reasonable to assume that the redevelopment will not result in exceedences of objectives at any locations.

5.1.6 There are no universally agreed significance criteria for assessing the air quality impacts of a development and, as such, air quality assessments will typically refer simply to whether there are any predicted exceedences of air quality objectives or limit values.

5.1.7 However, taking into consideration the scale of the predicted impacts of the operation of Penarth Heights and the available headroom in future years i.e. the difference between the background concentrations and the relevant air quality objectives, it is considered that air quality should be a low priority consideration in the assessment of the impacts of the redevelopment.

5.2 Construction

5.2.1 The redevelopment also has the potential to affect ambient air quality, in relation to human health and the National Air Quality Strategy, during the construction period. However, potential off-site air quality effects due to emissions from construction vehicles are not considered to be of significance due to the relatively low number of additional vehicle movements expected during the works. It is, therefore, not considered necessary to undertake a quantitative assessment of construction impacts on the local roads.

5.2.2 Construction activities also have the potential to generate nuisance air quality effects, such as dust and odours. There are sensitive receptors within 200m of the proposed

re-development i.e. on High Street, Arcot Street etc, and potential dust impacts could be significant at residential properties without the implementation of mitigation measures. However, it is concluded that, with the application of Best Practicable Means, adverse impacts due to construction dust or nuisance effects are unlikely to occur

5.3 Discussion

5.3.1 The DMRB Screening Method results for the baseline year, 2005 have been verified against the available, ratified, monitored data for 2005 as published by Vale of Glamorgan council in their 2006 Updating and Screening Assessment (USA).

5.3.2 However, in this USA report it was noted that the recently installed continuous monitoring station for nitrogen dioxide and oxides of nitrogen at Windsor Road (close to location R6/R7) was recording pollutant concentrations significantly higher than those previously recorded by the network of diffusion tubes in the area.

5.3.3 Provisional data, downloaded from the Welsh Air Quality Database website, suggest that the 2006 annual mean nitrogen dioxide concentration was 68µg/m^3 , with 148 recorded exceedences of the hourly mean nitrogen dioxide objective, exceeding the relevant objectives by some considerable margin. However, it should be stressed that this data is, as of the date of writing, provisional.

5.3.4 Since the five diffusion tube monitoring locations along Windsor Road gave pollutant concentrations of a consistent magnitude in 2005 i.e. 26-35µg/m^3, there is little reason to conclude that these tubes were significantly underestimating pollution levels in 2005 and previous years.

5.3.5 Furthermore, within the accepted accuracy of the DMRB Screening Method, the pollutant concentrations modelled in Windsor Road in the baseline year are consistent with these monitored data.

5.3.6 Therefore, it is reasonable to conclude that, provided the assumptions on which the traffic assessment were based remain valid, that the predicted concentrations of ambient air pollutants following the opening of residential redevelopment will also remain valid.

5.3.7 The step change in pollutant concentrations seen in Windsor Road between 2005 and 2006 is most likely related to either a step change in local traffic conditions or the start of operation of a major new industrial process. The operation of a major new industrial process can, however, be ruled out on the basis of the local authority's USA, which would have identified any such development.

5.3.8 A potential reason for a step change in traffic conditions relates to the start of highway works at Cogan Roundabout, and a resulting increase in congestion on Windsor Road. The works are, however, a temporary feature, and it is considered likely that following the completion of works, traffic congestion and pollutant concentrations will return to the more typical 2005 levels along Windsor Road. The provisional 2006 monitoring data are not, therefore, considered relevant to the assessment of the air quality effects of the operation of Penarth Height residential development.

DIAGRAMS

Diagram 1. Schematic of study area, selected receptors and local authority monitoring sites

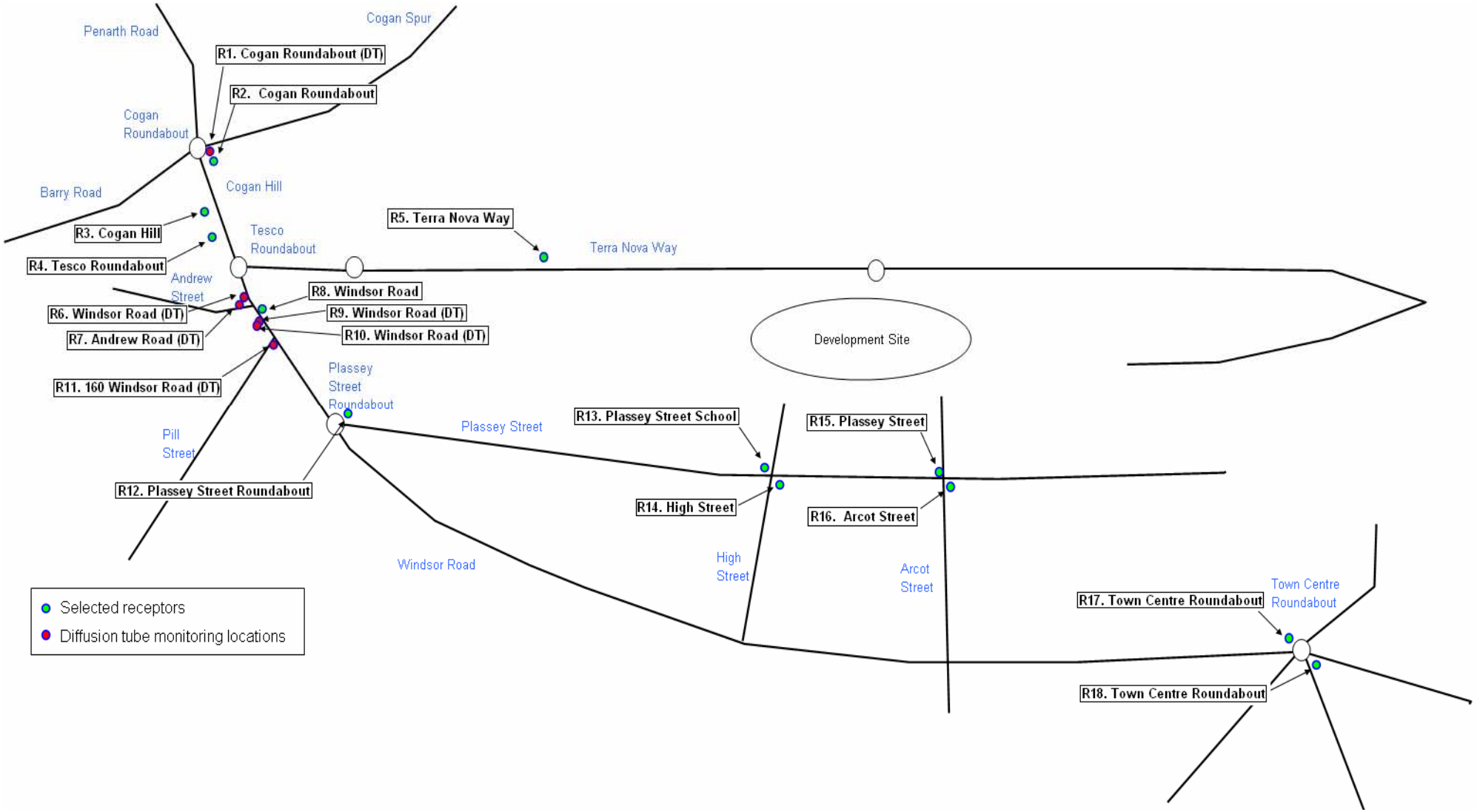
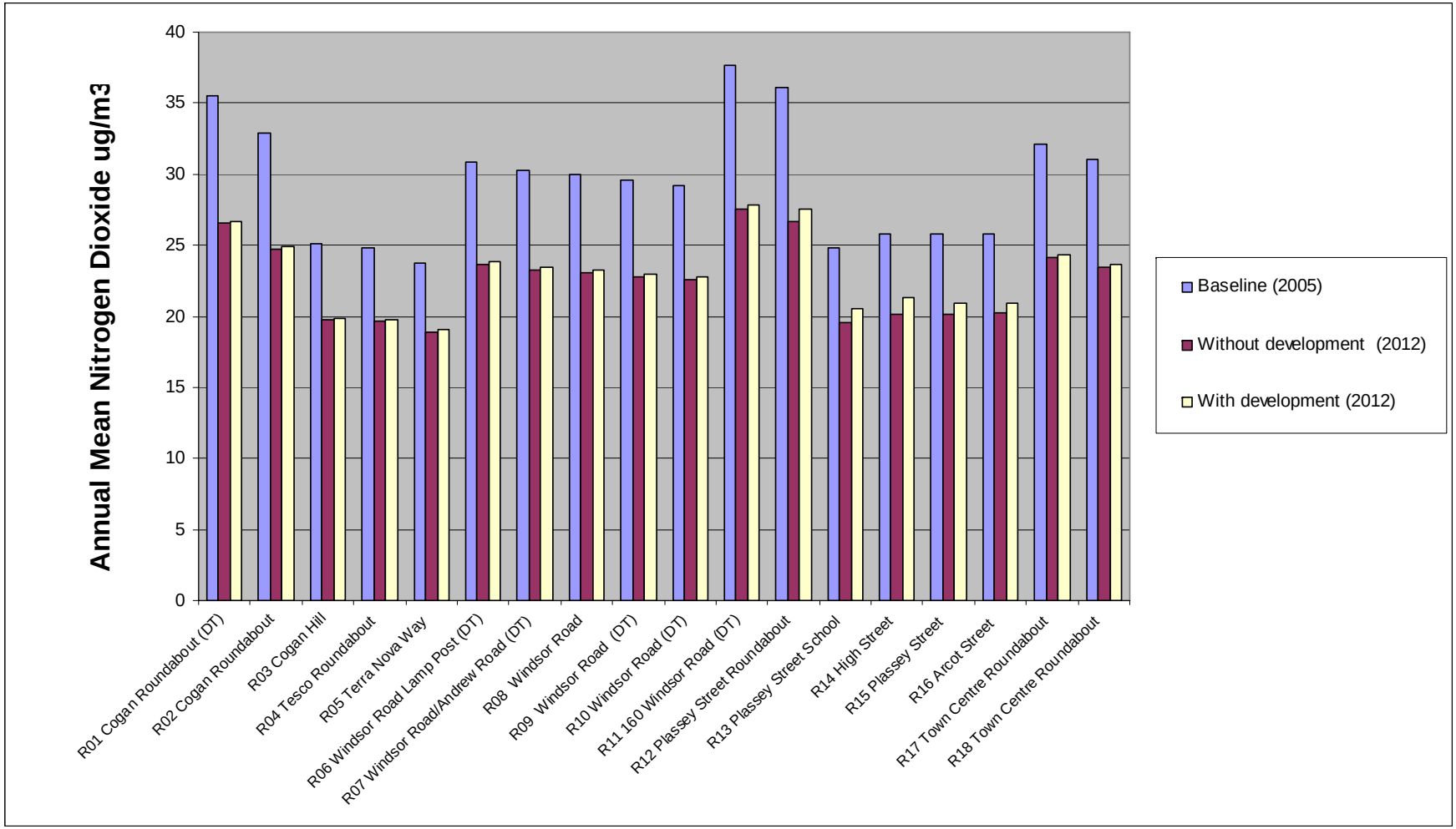


Diagram 2. Verified prediction of annual mean nitrogen dioxide in the baseline year (2005) and the opening year with development and without development scenarios.



APPENDIX A

TRAFFIC DATA

Link Description	Scenario	AADT	Speed	% HDV	Relevant Receptors
Cogan Spur, at Cogan Roundabout	Baseline 2005	36465	5	2.31	R1, R2, R3, R4
	Without development 2012	37122	5	2.31	
	With development 2012	38387	5	2.31	
	Without development 2017	38319	5	2.31	
	With development 2017	39684	5	2.31	
Cogan Hill / Barry Road merged link	Baseline 2005	29322	5	2.31	R1, R2
	Without development 2012	29866	5	2.31	
	With development 2012	31182	5	2.31	
	Without development 2017	30836	5	2.31	
	With development 2017	32153	5	2.31	
Penarth Road, at Cogan Roundabout	Baseline 2005	18384	5	2.31	R1, R2, R3, R4
	Without development 2012	18731	5	2.31	
	With development 2012	19494	5	2.31	
	Without development 2017	19351	5	2.31	
	With development 2017	20114	5	2.31	
Cogan Hill (free flow)	Baseline 2005	29530	32	2.31	R3, R4
	Without development 2012	30066	32	2.31	
	With development 2012	32447	32	2.31	
	Without development 2017	31037	32	2.31	
	With development 2017	33418	32	2.31	
Terra Nova Way, at Tesco Roundabout	Baseline 2005	13034	5	0.94	R3, R4, R6, R7, R8
	Without development 2012	13285	5	0.94	
	With development 2012	13987	5	0.94	
	Without development 2017	13734	5	0.94	
	With development 2017	14436	5	0.94	
Terra Nova Way (free flow)	Baseline 2005	13034	5	0.94	R5
	Without development 2012	13285	5	0.94	
	With development 2012	13987	5	0.94	
	Without development 2017	13734	5	0.94	
	With development 2017	14436	5	0.94	
Windsor Road/Cogan Hill merged link (free flow)	Baseline 2005	24842	32	2.62	R6, R7, R8
	Without development 2012	25299	32	2.62	
	With development 2012	27227	32	2.62	
	Without development 2017	26119	32	2.62	
	With development 2017	28047	32	2.62	
Windsor Road between Tesco & Plassey St (free flow)	Baseline 2005	20126	32	2.62	R9, R10
	Without development 2012	20501	32	2.62	
	With development 2012	22098	32	2.62	
	Without development 2017	21166	32	2.62	
	With development 2017	22763	32	2.62	

Link Description	Scenario	AADT	Speed	% HDV	Relevant Receptors
Windsor Road between Tesco & Plassey St (at crossing)	Baseline 2005	20126	5	2.62	R11
	Without development 2012	20501	5	2.62	
	With development 2012	22098	5	2.62	
	Without development 2017	21166	5	2.62	
	With development 2017	22763	5	2.62	
Windsor Road, at Plassey Street Roundabout	Baseline 2005	15065	5	2.62	R12
	Without development 2012	15358	5	2.62	
	With development 2012	16157	5	2.62	
	Without development 2017	15861	5	2.62	
	With development 2017	16660	5	2.62	
Plassey Street, at Plassey Street Roundabout	Baseline 2005	5758	5	2.62	R12
	Without development 2012	5894	5	2.62	
	With development 2012	7492	5	2.62	
	Without development 2017	6109	5	2.62	
	With development 2017	7706	5	2.62	
Plassey Street, at Junction with High Street	Baseline 2005	5306	5	2.62	R13, R14
	Without development 2012	5446	5	2.62	
	With development 2012	6589	5	2.62	
	Without development 2017	5661	5	2.62	
	With development 2017	6844	5	2.62	
High Street, at Junction with Plassey St	Baseline 2005	1328	5	2.62	R13. R14, R15, R16
	Without development 2012	1409	5	2.62	
	With development 2012	2106	5	2.62	
	Without development 2017	1502	5	2.62	
	With development 2017	2230	5	2.62	
Windsor Road between Plassey and Town Centre Rdbts	Baseline 2005	9615	32	2.62	R13. R14, R15, R16
	Without development 2012	9825	32	2.62	
	With development 2012	9990	32	2.62	
	Without development 2017	10169	32	2.62	
	With development 2017	10335	32	2.62	
Arcot Street, at Junction with Plassey St	Baseline 2005	1870	5	2.62	R13. R14, R15, R16
	Without development 2012	1953	5	2.62	
	With development 2012	2663	5	2.62	
	Without development 2017	2053	5	2.62	
	With development 2017	2757	5	2.62	
Plassey St, at Junction with Arcot St	Baseline 2005	4611	5	2.62	R15, R16
	Without development 2012	4738	5	2.62	
	With development 2012	5123	5	2.62	
	Without development 2017	4927	5	2.62	
	With development 2017	6741	5	2.62	
Windsor Avenue/Stanwell St, merged link at Roundabout	Baseline 2005	7498	5	2.62	R17, R18
	Without development 2012	7674	5	2.62	
	With development 2012	7914	5	2.62	
	Without development 2017	7959	5	2.62	
	With development 2017	8199	5	2.62	
Albert Road/Windsor Terrace, merged link at Roundabout	Baseline 2005	4100	5	2.62	R17, R18
	Without development 2012	4220	5	2.62	
	With development 2012	4303	5	2.62	
	Without development 2017	4398	5	2.62	
	With development 2017	4480	5	2.62	
Bradenham Place, at Town Centre Rdbt	Baseline 2005	583	5	2.62	R17, R18
	Without development 2012	632	5	2.62	
	With development 2012	632	5	2.62	
	Without development 2017	682	5	2.62	
	With development 2017	682	5	2.62	