APPENDIX 10A: AIR QUALITY AND CLIMATIC FACTORS – TECHNICAL DATA

AMBIENT AIR QUALITY STANDARDS

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health- or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table A1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2002, which incorporate EU Directives 1999/30/EC and 2000/69/EC (see Table A1). Although the EU Air Quality Limit Values are the basis of legislation, other threshold levels are outlined by the EU Directives and are used as triggers for particular actions.

Within the last year, European Commission sponsored report "Second Position Paper on Particulate Matter" (Final, Dec. 2004), prepared by the CAFE sub-group Working Group on Particulate Matter, recommended that the principal metric for assessing exposure to particulates should be PM2.5 rather than PM10, after 2010. The report also suggested that the annual average should be in the range 12 – 20 µg/m3. These indicative limit values were to be reviewed in the light of further information on health and environmental effects, technical feasibility etc.

Following on from this report, proposed Directive COM(2005) 447 on Ambient Air Quality and Cleaner Air for Europe (21/09/2005) has recently outlined proposals to revise and combine several existing Ambient Air Quality Standards including Council Directives 96/62/EC, 1999/30/EC and 2000/69/EC. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. It is however proposed to set new ambient standards for $PM_{2.5}$.

The proposed approach for $PM_{2.5}$ is to establish a target value of 25 µg/m3, as an annual average (to be attained by 2010), coupled with a non-binding target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target is currently proposed at 20% of the average exposure indicator (AEI). The AEI is based on measurements taken in urban background locations averaged over a three year period.

BASELINE AIR QUALITY

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is the "Air Quality Monitoring Report 2005" (EPA, 2006)(A1). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments(A2). A recent monitoring program carried out in Dublin (RESOLUTION, part of the EU LIFE program) in 2001 provides extensive information on NO2 and benzene levels at 146 locations throughout Dublin(A3).

In terms of air monitoring and assessment, the route of the proposed tramway is categorised as Zone A(A1). The long term monitoring data has been used to determine background concentrations for the key pollutants along the route of the proposed tramway. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

Continuous monitoring data for NO_2 from the EPA(A1-A2) is available for three suburban Zone A stations; Rathmines (2005), Crumlin (2003) and Ballyfermot (2004) with results ranging from 22 - 26 µg/m^3 with few exceedences of the one-hour limit value (rarely peaking above 50% of the maximum one-hour limit value). Thus, based on the baseline assessment and taking into account available monitoring data representative of the area, the background concentration for NO_2 is conservatively estimated to be 22 µg/m^3 in 2006.

Continuous PM_{10} monitoring carried out by the EPA and Dublin City Council in the Dublin suburbs of Marino, Ballyfermot and Rathmines in 2005 show average levels ranging from 14 - 17 µg/m^3, with 4 - 7 exceedences of the 24-hour limit value of 50 µg/m^3 (36 exceedences are permitted per year)(A1). In addition, average PM_{10} levels at the urban background monitoring location in the Phoenix Park in 2003 were 12 µg/m^3, with only two exceedences of 50 µg/m^3(A1). A background level representative of locations along the proposed tramway has thus been conservatively estimated at 18 µg/m^3 in 2006 based on the measured Dublin City Council and EPA levels.

The results of $PM_{2.5}$ monitoring in Mountrath, Carlow, Clonmel and Tralee in 2004/05(A2) indicated average $PM_{2.5}/PM_{10}$ ratios ranging from 0.34 to 0.50. Based on this information, a conservative ratio of 0.5 was used to generate a background $PM_{2.5}$ concentration in 2006 of 9.0 µg/m^3.

In terms of benzene, the results of monitoring carried out in 2005 at Winetavern Street in Dublin city centre gave an average of 1.4 µg/m^3, while the suburban station in Rathmines showed an average level of 0.5 µg/m3(A1). Background levels representative of the current location have thus been estimated at 0.8 µg/m^3 currently in 2006 based on the measured levels.

In terms of CO, results at two city centre Zone A stations (Winetavern Street and Coleraine Street) are low, peaking at 46% of the maximum 8-hour limit value (10 mg/m^3)(A1) in 2005. The annual average in 2005 ranged from 0.2 - 1.1 mg/m^3. Based on the above information, conservative estimates of the background CO concentration in 2005 is 0.50 mg/m^3.

In summary, existing baseline levels of NO_2, PM_{10}, $PM_{2.5}$, CO and benzene based on extensive long-term data from the EPA are below ambient air quality limit values in the vicinity of the proposed tramway. A summary of the background concentrations is detailed in Table A2.

IMPACT ASSESSMENT RESULTS

a) Cheeverstown Stop Park and Ride Facility

Location Used For Modelling Assessment

For the modelling assessment, one worst-case location in the region of the proposed Park and Ride facility was modelled. This receptor represents the worst-case impact of the proposed Park and Ride facility and was located opposite the entrance to the facility. An assessment was also carried out at two different average traffic speeds, typical of worst-case peak-hour (10 km/hr) and typical (40 km/hr) driving conditions. The results reported in the following sections assume average daily speeds of 40 km/hr. The modelling results for the worst-case rush hour speed of 10 km/hr are discussed separately.

"Do Nothing" Modelling Assessment

PM_{10}, CO and Benzene

The results of the "do nothing" modelling assessment for PM_{10}, CO and benzene in the opening year are shown in Table A5. Concentrations are well within the limit values under all scenarios at all worst-case receptors. Levels of all three pollutants range from 18 - 46% of the respective limit values in 2010.

NO_2

The results of the "do nothing" assessment for NO_2 in the opening year are shown in Table A5. Concentrations are below the annual limit value under all scenarios at all locations. "Do nothing" annual average levels of NO_2 reach at most 58% of the annual limit value in 2010.

The EU limit value for the maximum one-hour standard for NO_2 is based on a one-hour mean not to be exceeded more than 18 times per year (99.8 percentile). "Do nothing" levels in 2010 are below this limit value, with levels at the worst-case receptor 58% of the EU limit value.

$PM_{2.5}$

The results of the "do nothing" modelling assessment for $PM_{2.5}$ in the opening year are shown in Table A5. The annual average $PM_{2.5}$ concentration peaks at 10.0 $\mu g/m^3$ in 2010. Hence levels are predicted to reach at most 40% of the $PM_{2.5}$ target value of 25 $\mu g/m^3$ which is likely be set after 2010.

Modelled Impact of the Park and Ride facility Once Operational ("Do Something")

PM_{10}, CO and Benzene

The results of the modelled impact of the Park and Ride facility for PM_{10}, CO and benzene in the opening year are shown in Table A5. The cumulative impact of both "do nothing" traffic levels and additional traffic due to the Park and Ride facility are presented. Concentrations are below the ambient standards under all scenarios. Levels of all three pollutants range from 19 - 46% of the respective limit values in 2010.

The impact of the Park and Ride facility can be assessed relative to "do nothing" levels in the opening year (see Table A5). For PM_{10}, CO and benzene, relative to "do nothing" levels, the impact of the Park and Ride facility at individual receptors will generally lead to some slight increases as a result of the Park and Ride facility. As a worst-case, levels will increase by only 1% of the respective limit values.

Thus, using the assessment criteria outlined in Tables A3 and A4 for PM_{10}, and applying the same criteria for CO and benzene, the impact of the Park and Ride facility in terms of PM_{10}, CO and benzene is negligible.

NO_2

The result of the assessment of the impact of the Park and Ride facility for NO_2 in the opening year is shown in Table A5. The annual average concentration is within the annual limit value for all scenarios. Levels of NO_2 reach at most 58% of the annual limit value in 2010. The impact of the Park and Ride facility will account for at most 0.3% of the annual limit values in 2010.

Maximum one-hour NO_2 levels in 2010 (as a 99.8 percentile), with the Park and Ride facility in place, will be significantly below the limit value, with levels at the worst-case receptor 58% of the limit value.

The impact of the Park and Ride facility on maximum one-hour NO_2 levels can be assessed relative to "do nothing" levels in both the opening and design year (see Table A5). Levels are similar with the Park and Ride facility in place, with a slight increase of 0.3% of the limit value.

Thus, using the assessment criteria outlined in Tables A3 and A4, the impact of the Park and Ride facility in terms of NO_2 is negligible.

$PM_{2.5}$

The result of the assessment of the impact of the Park and Ride facility for $PM_{2.5}$ in the opening year is shown in Table A5. The annual average $PM_{2.5}$ concentration peaks at 10.1 $\mu g/m^3$ in 2010. Hence levels are predicted to reach at most 40% of the $PM_{2.5}$ target value of 25 $\mu g/m^3$ which is likely be set after 2010.

The impact of the Park and Ride facility on annual average $PM_{2.5}$ levels can be assessed relative to "do nothing" levels in the opening year (see Table A5). Levels are similar with the Park and Ride facility in place, with an slight increase of at most 0.4% of the $PM_{2.5}$ target value which is likely be set after 2010. Thus, by applying the assessment criteria for NO_2 and PM_{10} outlined in Tables A3 - A4 to $PM_{2.5}$, the impact of the Park and Ride facility in terms of $PM_{2.5}$ is negligible.

Worst-case Traffic Speed Scenario

An assessment of the effect of changing the traffic speed on all roads from an average speed of 40 km/hr to a worst case peak hour speed of 10 km/hr indicates that pollutant levels will be slightly higher at the worst-case traffic speed. However, levels are still below the respective limit values for each pollutant (see Tables A5). Levels of PM_{10}, $PM_{2.5}$, NO_2, CO and benzene, with the proposed Park and Ride facility in place, range from 21 - 61% of the respective limit values in 2010 at the worst-case traffic speed.

b) Increased Traffic Levels at Road Traffic Junctions

Location Used For Modelling Assessment

For the modelling assessment, one worst-case road traffic junction along the route of the proposed tramway was modelled. This receptor represents the worst-case impact resulting from junction modification along the route of the proposed tramway and was located at the Fortunestown Lane / N82 Citywest junction. An assessment was also carried out at two different average traffic speeds, typical of worst-case peak-hour (10 km/hr) and typical (15-40 km/hr) driving conditions. The results reported in the following sections assume average daily speeds of 40 km/hr. The modelling results for the worst-case rush hour speed of 10 km/hr are discussed separately.

"Do Nothing" Modelling Assessment

PM_{10}, CO and Benzene

The results of the "do nothing" modelling assessment for PM_{10}, CO and benzene in the opening year are shown in Table A6. Concentrations are well within the limit values under all scenarios at all worst-case receptors. Levels of all three pollutants range from 18 - 46% of the respective limit values in 2010.

NO_2

The results of the "do nothing" assessment for NO_2 in the opening year are shown in Table A6. Concentrations are below the annual limit value under all scenarios at all locations. "Do nothing" annual average levels of NO_2 reach at most 60% of the annual limit value in 2010.

The EU limit value for the maximum one-hour standard for NO_2 is based on a one-hour mean not to be exceeded more than 18 times per year (99.8 percentile). "Do nothing" levels in 2010 are below this limit value, with levels at the worst-case receptor 60% of the EU limit value.

$PM_{2.5}$

The results of the "do nothing" modelling assessment for $PM_{2.5}$ in the opening year are shown in Table A6. The annual average $PM_{2.5}$ concentration peaks at 10.1 $\mu g/m^3$ in 2010. Hence levels are predicted to reach at most 40% of the $PM_{2.5}$ target value of 25 $\mu g/m^3$ which is likely be set after 2010.

Modelled Impact of the Junction Modification Once Operational ("Do Something")

PM_{10}, CO and Benzene

The results of the modelled impact of the junction modification for PM_{10}, CO and benzene in the opening year are shown in Table A6. The cumulative impact of both "do nothing" traffic levels and additional traffic due to the junction modification are presented. Concentrations are below the ambient standards under all scenarios. Levels of all three pollutants range from 19 - 46% of the respective limit values in 2010.

The impact of the junction modification can be assessed relative to "do nothing" levels in the opening year (see Table A6). For PM_{10}, CO and benzene, relative to "do nothing" levels, the impact of the junction modification at individual receptors will generally lead to some slight increases as a result of the junction modification. As a worst-case, levels will increase by only 4% of the respective limit values.

Thus, using the assessment criteria outlined in Tables A3 and A4 for PM_{10}, and applying the same criteria for CO and benzene, the impact of the junction modification in terms of PM_{10}, CO and benzene is negligible.

NO_2

The result of the assessment of the impact of the junction modification for NO_2 in the opening year is shown in Table A6. The annual average concentration is within the annual limit value for all scenarios. Levels of NO_2 reaches at most 63% of the annual limit value in 2010. The impact of the junction modification will account for at most 3% of the annual limit values in 2010.

Maximum one-hour NO_2 levels in 2010 (as a 99.8 percentile), with the junction modification in place, will be significantly below the limit value, with levels at the worst-case receptor 63% of the limit value.

The impact of the junction modification on maximum one-hour NO_2 levels can be assessed relative to "do nothing" levels in both the opening and design year (see Table A6). Levels are generally marginally higher with the junction modification in place, by up to 3% of the limit value.

Thus, using the assessment criteria outlined in Tables A3 and A4, the impact of the junction modification in terms of NO_2 is negligible.

$PM_{2.5}$

The result of the assessment of the impact of the junction modification for $PM_{2.5}$ in the opening year is shown in Table A6. The annual average $PM_{2.5}$ concentration peaks at 10.9 $\mu g/m^3$ in 2010. Hence levels are predicted to reach at most 44% of the $PM_{2.5}$ target value of 25 $\mu g/m^3$ which is likely be set after 2010.

The impact of the junction modification on annual average $PM_{2.5}$ levels can be assessed relative to "do nothing" levels in the opening year (see Table A6). Levels are slightly higher with the junction modification in place, with an increase of at most 3% of the $PM_{2.5}$ target value which is likely be set after 2010. Thus, by applying the assessment criteria for NO_2 and PM_{10} outlined in Tables A3 - A4 to $PM_{2.5}$, the impact of the junction modification in terms of $PM_{2.5}$ is negligible.

Worst-case Traffic Speed Scenario

An assessment of the effect of changing the traffic speed on all roads from an average speed of 40 km/hr to a worst case peak hour speed of 10 km/hr indicates that pollutant levels will be slightly higher at the worst-case traffic speed. However, levels are still below the respective limit values for each pollutant (see Tables A6). Levels of PM_{10}, $PM_{2.5}$, NO_2, CO and benzene, with the proposed junction modification in place, range from 21 - 67% of the respective limit values in 2010 at the worst-case traffic speed.

Table 10.A1 Air Quality Standards Regulations 2002 (based on EU Council Directive 1999/30/EC)

POLLUTANT	REGULATION	LIMIT TYPE	MARGIN OF TOLERANCE	VALUE
Nitrogen Dioxide	1999/30/EC	1999/30/ECHourly limit for protection of human health - not to be exceeded more than 18 times/year	40% until 2003 reducing linearly to 0% by 2010	200 µg/m^3 NO_2
		Annual limit for protection of human health	40% until 2003 reducing linearly to 0% by 2010	40 µg/m^3 NO_2
		Annual limit for protection of vegetation	None	30 µg/m^3 NO + NO_2
Lead	1999/30/EC	Annual limit for protection of human health	60% until 2003 reducing linearly to 0% by 2005	0.5 µg/m^3
Sulphur dioxide	1999/30/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	90 µg/m^3 until 2003, reducing linearly to 0 µg/m^3 by 2005	350 µg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	None	125 µg/m^3
		Annual & Winter limit for the protection of ecosystems	None20	µg/m^3
Particulate Matter (as PM_{10}) Stage 1	1999/30/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	30% until 2003 reducing linearly to 0% by 2005	50 µg/m^3 PM_{10}
		Annual limit for protection of human health	12% until 2003 reducing linearly to 0% by 2005	40 µg/m^3 PM_{10}
Particulate Matter (as PM_{10}) Stage 2 Note 1	1999/30/EC	24-hour limit for protection of human health - not to be exceeded more than 7 times/year	Not to be exceeded more than 28 times until 2006, 21 times until 2007, 14 times until 2008, 7 times until 2009 and zero times by 2010.	50 µg/m^3 PM_{10}
		Annual limit for protection of human health	50% from 2005 reducing linearly to 0% by 2010	20 µg/m^3 PM_{10}
$PM_{2.5}$	COM (2005) 447	Annual target value designed to limit unduly high risks to the population	None. Limit value applicable in 2010	25 µg/m^3 $PM_{2.5}$
Benzene	2000/69/EC	Annual limit for protection of human health	100% until 2006 reducing linearly to 0% by 2010	5 µg/m^3
Carbon Monoxide	2000/69/EC	8-hour limit (on a rolling basis) for protection of human health	60% until 2003 reducing linearly to 0% by 2005	10 mg/m^3 (8.6 ppm)

Note 1: *EU 1999/30/EC states "Indicative limit values to be reviewed in the light of further information on health and environmental effects, technical feasibility and experience in the application of Stage 1 limit values in the Member States". Proposed EU Directive COM (2005) 447 will "replace the indicative limit values for PM_{10} for the year 2010 by a legally binding "target value" for the annual average concentrations of $PM_{2.5}$ of 25 µg/m^3 to be attained by 2010".*

Table 10.A2 Summary of background concentrations used in the air dispersion model.

Background Values	2006 Existing	2010 Opening Year Note 1
Nitrogen Oxides	34.0 µg/m^3	29.2 µg/m^3
Nitrogen Dioxide	22.0 µg/m^3	19.7 µg/m^3
Benzene	0.8 µg/m^3	0.71 µg/m^3
Particulates (PM_{10})	18.0 µg/m^3	16.6 µg/m^3
Particulates ($PM_{2.5}$) Note 2	9.0 µg/m^3	8.3 µg/m^3
Carbon Monoxide (CO)	0.50 mg/m^3	0.38 mg/m^3

Note 1 *DEFRA(A4) background methodology used to extrapolate to 2010 backgrounds.*
Note 2 *A conservative ratio of 0.5 has been used for the ratio of $PM_{2.5}/PM_{10}$.*

Table 10.A3 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean NO^2 / PM_{10}	Days PM_{10} > 50 µg/m^3
Very Large	Increase / decrease >25%	Increase / decrease >25 days
Large	Increase / decrease 15-25%	Increase / decrease 15-25 days
Medium	Increase / decrease 10-15%	Increase / decrease 10-15 days
Small	Increase / decrease 5-10%	Increase / decrease 5-10 days
Very Small	Increase / decrease 1-5%	Increase / decrease 1-5 days
Extremely Small	Increase / decrease <1%	Increase / decrease <1 days

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (Consultation Draft) - National Roads Authority (2006)

Table 10.A4 Air Quality Impact Significance Criteria

Absolute Concentration in Relation to Standard Note 1	Change in Concentration					
	Extremely Small	Very Small	Small	Moderate	Large	Very Large
Decrease with Scheme						
Above Standard with Scheme	slight beneficial	slight beneficial	substantial beneficial	substantial beneficial	very substantial beneficial	very substantial beneficial
Above Standard in Do-min, below with Scheme	slight beneficial	moderate beneficial	substantial beneficial	substantial beneficial	very substantial beneficial	very substantial beneficial
Below Standard in Do-min, but not well Below	negligible	slight beneficial	slight beneficial	moderate beneficial	moderate beneficial	substantial beneficial
Well Below Standard in Do-min	negligible	negligible	slight beneficial	slight beneficial	slight beneficial	moderate beneficial
Increase with Scheme						
Above Standard in Do-min	slight adverse	slight adverse	substantial adverse	substantial adverse	very substantial adverse	very substantial adverse
Below Standard in Do-min, Above with Scheme	slight adverse	moderate adverse	substantial adverse	substantial adverse	very substantial adverse	very substantial adverse
Below Standard with Scheme but not well Below	negligible	slight adverse	slight adverse	moderate adverse	moderate adverse	substantial adverse
Well Below Standard with Scheme	negligible	negligible	slight adverse	slight adverse	slight adverse	moderate adverse

Note 1 *Well Below Standard = <75% of limit value.*
Source: *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (Consultation Draft) - National Roads Authority*

Table 10.A5: Air Quality Assessment, proposed Luas Red Line A1. Summary of Predicted Air Quality at a Worst Case Location in the Region of the Proposed Cheeverstown Stop Park & Ride Facility

Scenarios	Traffic Speed (km/hr)	Carbon Monoxide (mg/m³)	Benzene (µg/m³)	Nitrogen Dioxide (µg/m³)		Particulates (µg/m³)		
		Maximum 8-hour	Annual Average	99.8th%ile of 1-hr	Annual Average	Annual Average PM_{10}	PM_{10}: No Days >50 µg/m³	Annual Average $PM_{2.5}$
2010 Do Nothing	10	3.0	0.93	119	23.8	19.0	2	10.7
	40	2.4	0.84	115	23.0	18.3	2	10.0
2010 Do Something	10	3.1	0.94	120	23.9	19.1	2	10.8
	40	2.5	0.84	116	23.1	18.4	2	10.1
Standards		10 Note 1	5 Note 1	200 Note 2,3	40 Note 2	40 Note 3	35 Note 2,4	25 Note 5

Note 1 EU Council Directive 2000/69/EC (S.I. 271 of 2002)
Note 3 1-hr limit of 200 µg/m³ not to be exceeded > 18 times/year (99.8th %ile)
Note 5 *Proposed EU Directive COM(2005) 447*

Note 2 EU Council Directive 1999/30/EC (S.I. 271 of 2002)
Note 4 24-Hr limit of 50 µg/m³ not to be exceeded >35 times/year (90.1th %ile)

Table 10.A5: Air Quality Assessment, proposed Luas Red Line Extension. Summary of Worst Case Predicted Air Quality in the Region of the Fortunestown Lane / N82 Citywest Junction

Scenarios	Traffic Speed (km/hr)	Carbon Monoxide (mg/m³)	Benzene (µg/m³)	Nitrogen Dioxide (µg/m³)		Particulates (µg/m³)		
		Maximum 8-hour	Annual Average	99.8th%ile of 1-hr	Annual Average	Annual Average PM_{10}	PM_{10}: No Days >50 µg/m³	Annual Average $PM_{2.5}$
2010 Do Nothing	10	3.1	0.93	133	26.5	20.0	3	11.7
	40	2.3	0.80	121	24.2	18.4	2	10.1
2010 Do Something	10	3.1	0.94	133	26.7	20.0	3	11.7
	40	2.7	0.86	127	25.3	19.2	3	10.9
Standards		10 Note 1	5 Note 1	200 Note 2,3	40 Note 2	40 Note 3	35 Note 2,4	25 Note 5

Note 1 EU Council Directive 2000/69/EC (S.I. 271 of 2002)
Note 3 1-hr limit of 200 µg/m³ not to be exceeded > 18 times/year (99.8th %ile)
Note 5 *Proposed EU Directive COM(2005) 447*

Note 2 EU Council Directive 1999/30/EC (S.I. 271 of 2002)
Note 4 24-Hr limit of 50 µg/m³ not to be exceeded >35 times/year (90.1th %ile)

APPENDIX REFERENCES

(A1) Environmental Protection Agency (2006) Air Quality Monitoring Report 2005 (& previous annual reports 1997-2004)

(A2) EPA Website (2005) http://www.epa.ie/ourenvironment/air/accessmaps

(A3) European Commission (2003) EU/LIFE RESOLUTION project - Final Report

(A4) UK DEFRA (2003) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. TG(03)