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MEMORANDUM

TO: Murray Thompson, URS Canada 33900-92

FROM: Sandy Willis March 13, 2009

CC: Doug Chambers, SENES, Harriet Phillips, SENES, Dave Wake, MTO

SUBJ: Response to Submission by City of Windsor, February 27, 2009

This memo addresses the following statement in the submission by Gowlings and Associates, on behalf of the City of Windsor, provided to the Ministry of the Environment (MOE) on February 27, 2009.

"DRIC has failed, from the outset of the air quality assessment and throughout the balance of the EA process, to properly document the protective effect of the Full Tunnel on air quality. DRIC also failed to assess air quality impacts in the greenspace entirely, and fails to assess the human health impacts of PM_{10} anywhere inside the ROW or outside the ROW".

This memorandum is organized into the following sections:

- How the DRIC Study Team documented the assessment of the full tunnel;
- Whether tunnels are protective of air quality;
- The assessment of air quality impacts in the green space.

A separate memorandum is issued for the assessment of human health impacts for PM_{10}.

The Assessment of the Full Tunnel

The Estrin comments suggest that the work conducted by SENES fails to adequately document the results and the protective nature of the assessment of the Tunnel alternative. The Practical Alternatives Evaluation Working Paper: Air Quality Impact Assessment (May 2008) assessed several alternatives to determine the impacts of road alignments that were at grade, below grade, and fully tunneled and followed the structure identified in the DRIC Air Quality Workplan, (February 2006) which was circulated to regulatory agencies for review and comment prior to publication in 2006.

More than 2400 receptors were included in the modelling conducted for the assessment, however, for the Practical Alternatives report, the analysis presented in the report focused on the near field

impacts at 50 m, 100 m, and 250 m from the Right of Way (ROW). Modelled conditions were very conservative as they incorporated a higher silt loading than generally used for the traffic volumes for the $PM_{2.5}$ assessment and, following customary MOE practice and the Work Plan, a 90^{th} percentile ambient concentration was used as the background to which the predicted increments are added..

The amount of contamination released to the air would be no different for the tunnel alternatives than for any other alternative, regardless of tunnel length. The Practical Alternative reports show that tunnels, regardless of length, only provide a means of moving emissions from one location to another (i.e., from one neighbourhood to another). Thus, while very local concentrations near tunnels i.e. within 50-100 m of roadways and towards the middle of tunnels might be lower, the concentrations near tunnel portals would be higher. Moreover, tunnels offer no benefit in terms of regional air quality in the Windsor airshed.

One of the alternatives for the tunnel studied during the development of the Practical Alternatives Report and briefly described was a tunnel with jet fans which served to emit the contaminants from the tunnel portals. This analysis was not discussed in detail in the Practical Alternatives report as the concentrations of contaminants at the tunnel portals were deemed to be exceedingly high with maximum hourly NO_x concentrations five to 10 times higher than the criteria and 24 hour NO_x concentrations in exceedances for most segments. $PM_{2.5}$ levels were also elevated and maximum concentrations were more than three times higher than the other alternatives. Therefore, jet fans were not considered a feasible solution for tunnel ventilation in the long (six kilometre) tunnel proposed as Alternative 3.

Chapter 4 of the Practical Alternatives Report focused on the comparative analysis of the ***maximum impacts*** of the alternatives as they compared to the future "No Build" scenario. For the purpose of this analysis, the corridor was divided into a series of "road segments." Thus the maximum impacts of each alternative were compared to the future "No Build" scenario on a road segment by road segment basis. The purpose of the document was to perform a comparative basis between the alternatives to assist in the selection of an environmentally preferred alternative. Consistent with the Workplan, data were presented for each road segment comparing NO_x and $PM_{2.5}$ relative maximum concentrations and exceedances for all alternatives at 50 m, 100 m, and 250 m from the Right of Way (ROW). These distances were chosen as indicators due to multiple traffic studies (including the MOE's studies) that indicate that impacts are typically limited to the first few hundred metres. Therefore, distances of up to 250 m were considered within the zone of influence of the traffic corridor.

As a refresher, one of the tables from the Practical Alternative Report is included in Table 1. In the Practical Alternatives report the Tunnel is also referred to as Alternative 3.

Results were discussed for each road segment and some segments identified that the tunnel offered improvements. Section 4.1.3 (which correlates to the sample table provided in Table 1 below) states:

Alternative 3 generally offers a notable improvement in $PM_{2.5}$ 24-hour concentrations relative to No Build within 100 m of ROW, primarily due to the emissions being vented through vent buildings which allows for better dispersion. All other alternatives generally show a marginal reduction in maximum $PM_{2.5}$ 24-hour concentrations relative to No Build within 50 m from ROW and are similar to each other in overall reduction with the Parkway and Alternative 2B showing slightly greater reductions. Exceedances of the CWS $PM_{2.5}$ 24-hour standard are predicted to be reduced or eliminated for all alternatives. Both the Parkway and Alternative 3 show notable to marginal reductions of annual $PM_{2.5}$ concentrations. NO_x concentrations are lower with all alternatives than for the No Build scenario; however, even the No Build scenario concentrations are lower than the applicable criteria.

Table 1 – Sample $PM_{2.5}$ Table from Practical Alternatives Chapter 4

Alternative	Distance from ROW (m)	Pulford North of Lennon Drain								
		2015			2025			2035		
		24 Hour	Annual	> CWS	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances
Alternative 1A	50	89%	100%	-11	85%	100%	-22	90%	100%	-21
	100	90%	100%	0	97%	100%	-5	100%	100%	-3
	250	100%	100%	0	100%	100%	0	108%	109%	0
Alternative 1B	50	86%	92%	-17	79%	93%	-33	80%	93%	-42
	100	87%	100%	0	87%	92%	-5	94%	100%	-10
	250	100%	100%	0	96%	100%	0	100%	100%	0
Alternative 2A	50	80%	92%	-17	82%	93%	-29	88%	93%	-37
	100	83%	92%	0	94%	92%	-5	100%	100%	-5
	250	96%	100%	0	104%	100%	0	104%	109%	0
Alternative 2B	50	77%	92%	-17	79%	93%	-33	76%	87%	-54
	100	83%	92%	0	90%	92%	-5	91%	92%	-10
	250	96%	100%	0	104%	100%	0	100%	100%	0
Alternative 3 (VBIA)	50	63%	77%	-17	56%	71%	-38	56%	67%	-58
	100	73%	83%	0	71%	77%	-5	72%	77%	-10
	250	92%	91%	0	88%	91%	0	85%	91%	0
The Parkway	50	83%	85%	-17	77%	79%	-38	76%	80%	-44
	100	87%	83%	0	84%	77%	-5	84%	85%	-10
	250	96%	82%	0	92%	91%	0	92%	91%	0

Alternative 1A – At grade freeway with one-way local access service roads located along each side;
Alternative 1B – Below grade freeway with one-way local access service drives located at grade along each side;
Alternative 2A – At grade freeway with two-way local access service roads located along the approximate existing Huron Church Road / Highway 3 corridor;
Alternative 2B – Below grade freeway with two-way local access service roads located at grade along the approximate Huron Church Road / Highway 3 corridor;
Alternative 3 – Tunneled freeway with two-way local access service roads located at-grade along the approximate Huron Church Road / Highway 3 corridor; and
Parkway Alternative - A below grade six-lane freeway with a series of tunnels ranging in length from 120 m to 240 m. Service roads include both two-way and one-way segments located adjacent to the freeway.

The overall access road assessment in Section 4.1.7 of the Practical Alternatives report states:

> *NO_x concentrations do not exceed any applicable standards for all horizon years, averaging periods, and distances to ROW for No Build and any of the alternatives. Generally any of the alternatives will show decreases in NO_x relative to No Build. This could be due to the alternatives having decreased idling due to the reduction of signalized intersections for international traffic. Air quality related to NO_x is expected to improve relative to No Build; however, the impacts are most notable within 100 m of ROW.*
>
> *$PM_{2.5}$ concentrations generally do not show the same improvements as NO_x concentrations, primarily due to the large road dust component and increased traffic. However, in general, from 50 - 100 m from ROW there is a marginal to not appreciable reduction in concentrations relative to No Build for all alternatives other than Alternative 3 and the Parkway which can show appreciable differences in the relative maximum concentrations. The reductions shown for Alternative 3 are dependent on proper ventilation building design.*
>
> *As mentioned previously in Section 4.0, none of the alternatives result in a sufficient enough change to impact the Air Quality Index.*

Chapter 5 of the Practical Alternatives assesses the alternatives as a whole and compares the different configurations to each other. Table 5.1 issues the following conclusions for $PM_{2.5}$ and specifically refers to locations near to the roads:

> *The Tunnel (Alternative 3) and the Parkway are slightly preferred within the first 50 m from the Right of Way, primarily due to a greater reduction in exceedances. However, all Alternatives result in similar AQ conditions at 100 m and beyond from the right of way. The Below Grade options result in fewer exceedances and lower maximum concentrations than the At Grade alternatives within 50 m from the Right of Way. There is no notable difference between Option 1 and Option 2. Exceedances are reduced with all Alternatives relative to No Build. Changes relative to each alternative are typically limited to within 20% and therefore none of the alternatives are considered significantly different from each other.*

And the final conclusions from the report are:

> *All alternatives offer benefits due to the decrease in traffic idling, particularly from diesel trucks.*
>
> *For the Access Road Alternatives Alternative 3 [the full tunnel] and the Parkway are slightly preferred over the other options as they have the greatest potential for reduction of exceedances of the $PM_{2.5}$ standard and $PM_{2.5}$ concentrations. However, the impacts are limited to within 50 m from ROW and beyond 50 m from ROW the differences between any of the alternatives become less notable. NO_x concentrations for all alternatives are reduced relative to No Build, however, even the No Build concentrations are below acceptable standards and less weight is given to the reduction in NO_x concentrations than the $PM_{2.5}$ exceedances.*

An analysis of the tables presented in the Practical Alternatives Report

Another way of supporting the conclusions in the report is to examine the tables in Chapter 4 to determine whether there are significant differences between any of the alternatives. To simplify the issue, the focus of the following discussion is on the comparison of the Parkway to the Full Length Tunnel. In the Practical Alternatives Report differences of less than 10% were considered negligible and differences between 10%-20% were considered marginal, while differences of more than 20% were considered notable when comparing differences between the different alternatives. For exceedances, differences of more than 8 days were considered as appreciable. For the analysis presented here, any difference greater than 10% or differences of 8 days or more were considered to be sufficient to indicate that one alternative is preferred to another. For the analysis presented here, any difference greater than 10% or differences of 8 days or more were considered to be sufficient to indicate that one alternative is preferred to another.

Each table within Chapter 4 was compared to determine the differences. A sample analysis for two different road segments is presented in Table 2. In the table below, the Parkway is the preferred option for 2035 for the Malden to Labelle Road Segment for distances of up to 100 m for Plaza B for $PM_{2.5}$ hourly, annual, and exceedance criteria. At 250 m there is no clear preference for any of the criteria. The Tunnel is preferred in Labelle to Pulford Road Segment for the 24 hr criteria at 50 and 100 m and for exceedances at 50 m with no clear distinction beyond those distances for both Plaza alignments.

Each of the comparisons below is considered a "point of distinction". Therefore, for the Malden to Labelle Road Segment there are 3 different distances (50 m, 100 m, and 250 m), 2 different alignments (Plaza A and Plaza B), and 3 criteria (24 hr, Annual, and Exceedances), or a total of 18 possible points of distinction. And for the Labelle to Pulford Road Segment there are also 18 Points of distinction. In the sample below, of the 36 points of distinction, there are nine instances or points of distinction where the Parkway would be preferred over the Tunnel, 6 instances where the Tunnel would be preferred over the Parkway, and the balance of the points of distinction show No Difference.

Table 2 - Sample Table of $PM_{2.5}$ Comparison

Alternative in 2035		Malden Rd to Labelle						Labelle to Pulford					
		Plaza A			Plaza B			G-H - Plaza A			G-H - Plaza B / C		
2035	Distance from Roadway (m)	24 Hour	Annual	Excee dances	24 Hour	Annual	Exceed ances	24 Hour	Annual	Excee dances	24 Hour	Annual	Excee dances
Tunnel	50	95%	94%	-44	100%	94%	-25	67%	75%	-74	70%	81%	-74
	100	103%	93%	-16	115%	115%	-3	77%	79%	-15	77%	86%	-15
	250	100%	100%	0	107%	117%	2	89%	92%	0	93%	92%	0
Parkway	50	81%	75%	-47	81%	75%	-51	88%	75%	-51	86%	81%	-54
	100	88%	86%	-23	100%	86%	-19	94%	79%	-9	94%	86%	-12
	250	97%	92%	0	100%	92%	0	93%	83%	0	93%	83%	0
Differences	**50**	**P**	**P**	**ND**	**P**	**P**	**P**	**T**	**ND**	**T**	**T**	**ND**	**T**
	100	**P**	**ND**	**ND**	**P**	**P**	**P**	**T**	**ND**	**ND**	**T**	**ND**	**ND**
	250	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**

ND = 10% or less difference between alternative, P = Parkway < Tunnel by more than 10% or more than 8 days, T = Tunnel < Parkway by more than 10% or more than 8 days

The analysis of the differences between the Tunnel and the Parkway for all years, all road segments, and all road alignments, is presented in Table 3. From Table 3 it is clear that the majority of the comparisons result in no difference with 246 points of distinction of No Difference relative to 77 points of the Parkway being preferred and 37 points of the Tunnel being preferred.

Table 3 - Summary of Analysis of Points of Distinction by Horizon Year

	No Difference		**Parkway Preferred**		**Tunnel Preferred**	
	NO_x	**$PM_{2.5}$**	**NO_x**	**$PM_{2.5}$**	**NO_x**	**$PM_{2.5}$**
2015	23	64	23	4	2	4
2025	32	47	15	13	1	12
2035	36	44	12	10	0	18
Total	91	155	50	27	3	34
	246		77		37	

As stated several times in the Practical Alternatives report, the most appreciable differences are within the first 50-100 m of the Right of Way. Accordingly, a separate comparison was conducted for distances to roadway. Results are presented in Table 4 and show that within the first 50 m in most cases there is no difference in the alternatives. However, the Tunnel is a stronger alternative for $PM_{2.5}$ within 50 m than the Parkway while the Parkway is a stronger alternative for NO_x.

Table 4 - Summary of Analysis of Points of Distinction by Distance to Right of Way

	No Difference		Parkway Preferred		Tunnel Preferred	
	NO_x	$PM_{2.5}$	NO_x	$PM_{2.5}$	NO_x	$PM_{2.5}$
50	29	35	18	15	1	22
100	33	53	13	8	2	11
250	29	67	19	4	0	1
Total	91	155	50	27	3	34
	246		77		37	

As NO_x is below criteria even under the No Build option, it might be suggested that $PM_{2.5}$ should be the only indicator as to whether one alternative should be preferred to another. $PM_{2.5}$ points of distinction are highlighted in Table 5 and Table 6. For each horizon year there is generally no difference between the Parkway and the Tunnel. Both the Parkway and the Tunnel show instances of improvement relative to each other but when compared to the overall total of instances, these differences are not sufficient to say that the Tunnel is absolutely the preferred alternative.

As previously stated, impacts are most notable within 50-100 m of the ROW. Therefore, if an alternative has a higher total number of points of distinction, it could be argued that that alternative is the better option for very near field distances. When comparing the differences for distances to ROW, there are a higher number of points of distinction that are in the No Difference category than with the Parkway Preferred or in the Tunnel Preferred as is shown in Table 6.

Table 5 - Summary of Analysis of Points of Distinction for $PM_{2.5}$ by Horizon Year

Year	No Difference	Parkway Preferred	Tunnel Preferred
2015	64	4	4
2025	47	13	12
2035	44	10	18

Table 6 - Summary of Analysis of Points of Distinction for $PM_{2.5}$ by distance to ROW

Distance	No Difference	Parkway Preferred	Tunnel Preferred
50	35	15	22
100	53	8	11
250	67	4	1

This assessment supports the conclusions in the Practical Alternatives that no one alternative is consistently the preferred option and that in general, differences between the alternatives are marginal.

The ranking in Table 5.1 of the Practical Alternatives report used a (qualitative relative) ranking system where a score of "1" represented a "High Impact", a score of "2" represented "Medium Impact", a score of "3" represented a "Low Impact", and a score of "4" represented a "Neutral/No Impact" with higher scores representing benefits. All alternatives were below criteria for the annual concentrations of $PM_{2.5}$. All alternatives were below the applicable NO_x criteria. All alternatives had locations where the CWS was exceeded for $PM_{2.5}$ 24 hour averaging time according to the conservative modelled conditions. The differences for each alternative were in the locations of the exceedances. Tunnels do not clean the air, they move the impact from one location to another.

Because exceedances were predicted with the conservative modelling conditions for all alternatives, including the Tunnel, none of the alternatives were deemed to have "No Impact". It then became a choice of whether the alternatives should be considered to have a "Medium" or "Low" impact. With no exceedances of the annual $PM_{2.5}$ criteria, a notable improvement of the NO_x concentrations, and with limited exceedances under conservative modelling conditions of the $PM_{2.5}$ criteria within the first 50 m of the ROW for all alternatives, the impacts were deemed to be "Low Impact" for all alternatives.

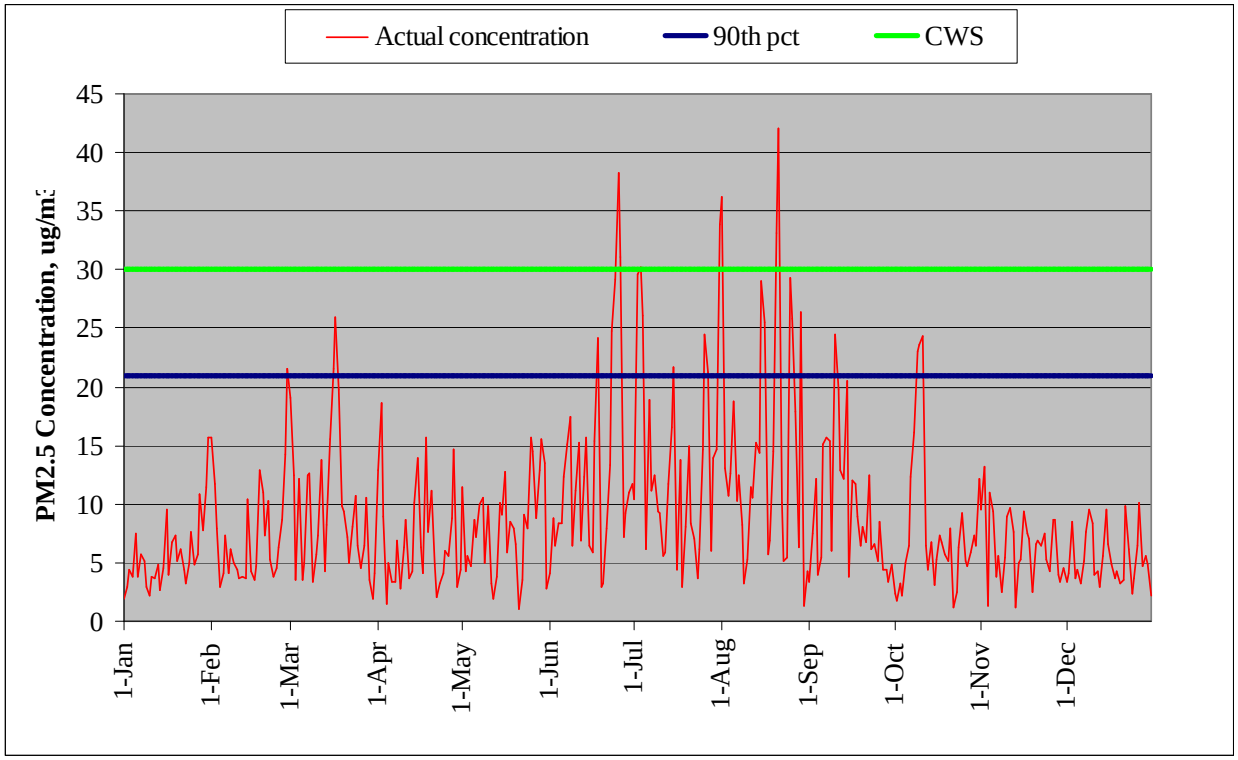
The Protective Effect of the Full Tunnel on Air Quality – The Importance of Background Concentrations

Transboundary pollution is the driver of air quality in Windsor as has been recognized by the Ministry of the Environment (MOE) in their publications "*Preliminary Air Quality Assessment Related to Traffic Congestion at Windsor's Ambassador Bridge, 2004*", "*Transboundary Air Pollution in Ontario, 2005"*, and the annual Air Quality in Ontario publications. The Preliminary Air Quality Assessment Related to Traffic Congestion at Windsor's Ambassador Bridge states:

> *"Transboundary air pollutants from the United States account for up to 50 per cent of smog in Southwestern Ontario. In Windsor, this value may be as high as 90 per cent."*

Monitoring data from the MOE Windsor stations for $PM_{2.5}$ is also indicative of periodic episodes of excursions of the Canada Wide Standard (CWS) 24 hour criteria of 30 $\mu g/m^3$ as shown in Figure 1 below. As there are excursions of the CWS of $PM_{2.5}$, no traffic related solution will be fully protective of air quality. As stated earlier in this memorandum, a tunnel merely serves to relocate emissions from one location to another or to redistribute emissions in the airshed.

Figure 1 - Daily variability of $PM_{2.5}$



The assessment methodology recommended by the MOE requires the use of the 90th percentile background to calculate maximum concentrations and exceedances. A 90th percentile background occurs only 10% of the year as 90% of the time the ambient conditions are lower. For $PM_{2.5,}$ the 90th percentile background is 21 $\mu g/m^3$ on a 24 hour basis for the Windsor area as shown in Figure 1. Using the 90th percentile background concentration artificially inflates the number of exceedances to the point where it is possible to show more than 200 exceedances per year of the coarser fractions of particulate matter (PM).

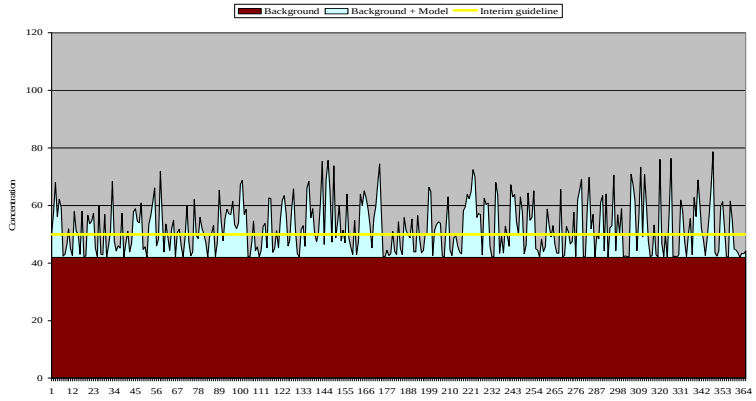
When daily background is considered, the number of exceedances attributed to the highway drops significantly. A sensitivity test performed by SENES illustrates the differences in exceedances when the daily background is considered for PM_{10}. While these examples are for PM_{10}, it can also be assumed that similar exceedance changes would occur for $PM_{2.5}$. Figure 2 illustrates the differences in exceedances when variable background is considered for a receptor in close proximity to a roadway and a receptor further away from the roadway.

The burgundy colour in Figure 2 is the background and the turquoise colour is the background combined with the model results. As can be seen in the figure, background concentrations predominate for both the 90th percentile and the daily background. At a receptor closer to the road, the traffic increment is more obvious in both the 90th percentile and daily background than for the receptor located further away. At a receptor further from the road (the lower charts in Figure 2), the traffic increment appears to be artificially inflated with the 90th percentile background; however, the number of exceedances actually increases with the daily background because there are 24 exceedances predicted by background concentrations alone, without traffic.

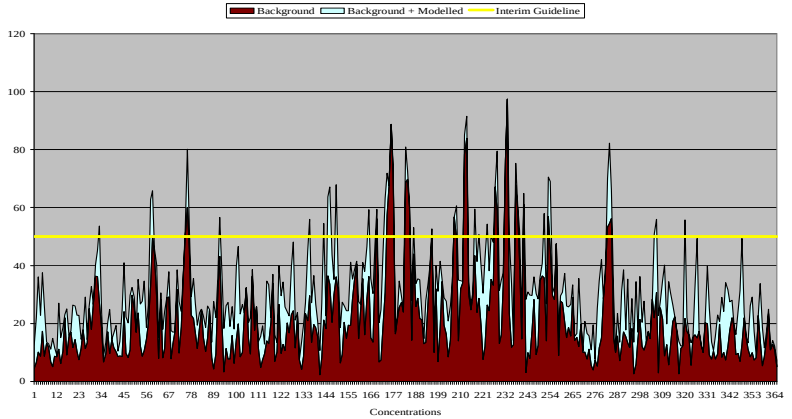
Accordingly, modelled concentrations presented in both the TEPA and the Practical Alternatives report are strongly determined by the baseline background concentration to which the relatively small increments due to traffic are added and no road configuration will change this conclusion.

Figure 2 – Comparison of 90th Percentile and Daily Background for 365 Days

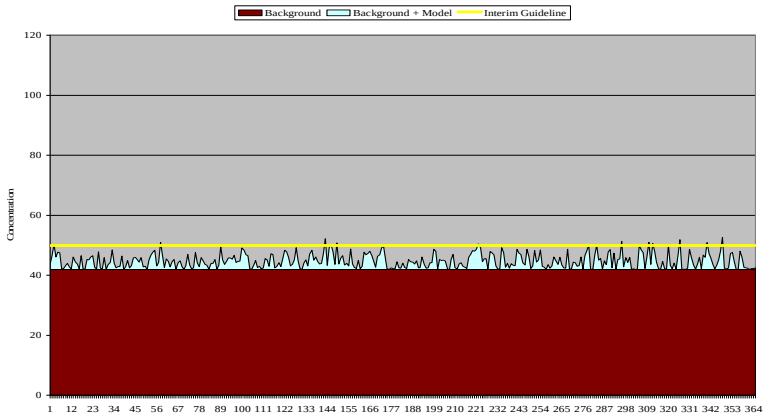
Receptor at 50 m, as modelled for TEPA, 191 exceedances



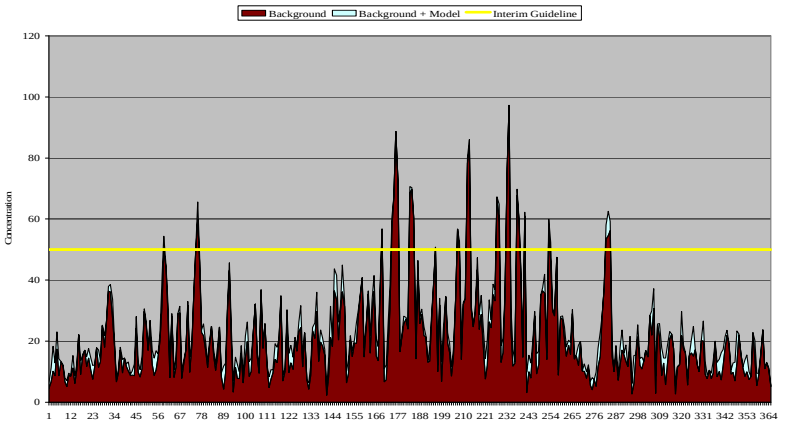
Receptor at 50 m, modelled with daily background, 49 exceedances



Receptor at 350 m, as modelled for TEPA, 16 exceedances



Receptor at 350 m, as modelled with daily background, 28 exceedances



Assessment of Air Quality within the Green Spaces

The comments in the City of Windsor's submission imply that the Air Quality Assessment: Technically and Environmentally Preferred Alternative, December 2008 (TEPA) report did not assess air quality within the green spaces of the Parkway. As with most environmental assessment studies, the focus of the report was on the assessment of locations of permanent sensitive receptors such as residential areas, hence most of the tables presented in the TEPA report are for receptors beyond the green spaces within the ROW.

The green spaces were not ignored however, and were included as a description in the TEPA report under section 4.5.2 where concentrations at the tunnel portals were discussed. As exceedances are predicted for the particulate contaminants an additional comparison with the Ministry of Labour criteria for short term exposure was also included. As with other sections of the TEPA report, the analysis examined the ***maximum concentrations*** that are predicted to occur once per year. Section 4.5.2 of the TEPA report states that all gaseous contaminants are below criteria (with the exception of NO_x). Table 7 summarizes the results for gaseous contaminants.

Table 7 - Other contaminant concentrations, µg/m^3 within ROW

	1,3 butadiene, 24 hr	Benzene 24 hr	Acetaldehyde 1 hr	Acrolein 24 hr	CO 1 hr	Formaldehyde, 24 hr	SO_x 1 hr	VOCs
Criteria	No criteria	No Criteria	500.	0.08	36200	65.0	690.0	No Criteria
TEPA Background	0.17	2.7	2.4	0.16	897	4.1	43	147
Max within ROW but not on road	0.27	3.3	3.7	0.20	3109	4.8	46	169
Max in usable spaces	0.24	3.2	3.2	0.18	2815	4.5	45	164

Less emphasis was provided on the air quality impacts within the ROW as the receptors were considered transient in nature and were exposed for limited time frames.

Summary

Tunnels were discussed and documented with the same level of detail as all of the alternatives in the Practical Alternatives report. The analysis indicates that the tunnel would not appreciably change the air quality even under conservative modelling assumptions of the 90th percentile background and silt loadings.

Air quality in Windsor is driven by background concentrations and no alternative will be fully protective of air quality.