

APPENDIX IX

EMISSIONS INVENTORY MODELLING REPORT

FINAL REPORT

**FUEL REID VAPOUR PRESSURE REDUCTIONS
AND CANISTER REPLACEMENT INVENTORY
MODELLING OF THE BRISBANE REGION**

by
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Summary of Results

Two “day specific” scenarios were modelled, an average summer day (20-31°C) and a high oxidant day (20-37°C), for the South East Queensland Region (SEQR) using Reid Vapour Pressure (RVP) fuel of 63.5 and 68.5 kPa. The existing motor vehicle evaporative VOC emissions inventory of SEQR was based on a fuel RVP of 73.5 kPa. The results of the inventory modelling estimated the total magnitude of the evaporative motor vehicle emissions for varying RVP. The reduction in total fleet emission (exhaust and evaporative) was 12 and 17 % from a RVP of 73.5 kPa to 68.5 and 63.5 kPa respectively for a summer day. The equivalent reduction for a high oxidant day was 8 and 15 %.

Replacement of 50% of the carbon canisters on the Brisbane vehicle fleet was estimated to produce a reduction in evaporative emissions of 24 % for both the summer and high oxidant day with a fuel RVP of 73.5 kPa. The reduction in total vehicle emission (exhaust and evaporative) was 11 and 13 % for a summer and high oxidant day respectively.

Fuel RVP Reduction Methodology

Diurnal Loss

The PV Project fuel volatility results were not incorporated into the emission inventory as the diurnal loss emission did not correlate with the emissions estimates predicted by the Reddy equation for either ADR27 or ADR37 vehicles (see Figures 2.1 and 2.2). The vehicles used by the PV Project had adequate purging of the carbon canisters before pre-testing which will restore the canister to an reasonable optimum state. While laboratory conditions allow carbon canisters to be adequately purged, in-service vehicles are unlikely to contain carbon canisters in their optimum conditions and the carbon will be pre-loaded with fuel vapour to varying degrees. Therefore, the purging of canisters is a possible cause of the discrepancy between the PV PROJECT data and the Reddy equation estimates. Another possibility for the difference is the extremely small sample size of the vehicles tested.

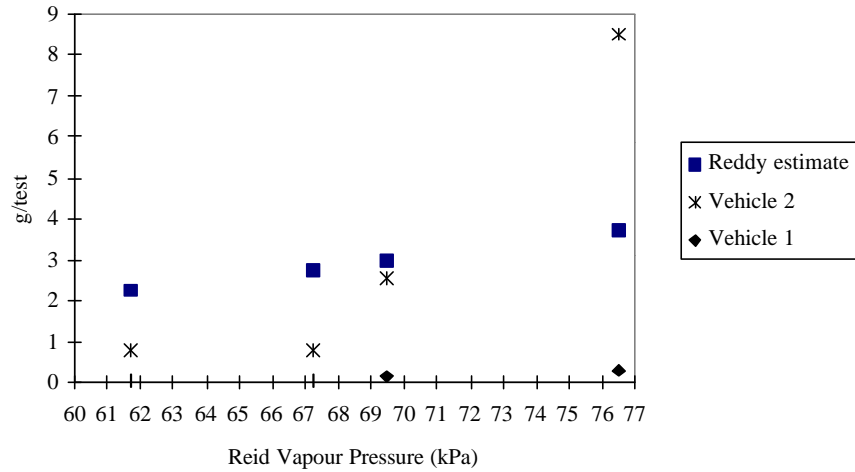


Figure 2.1
Diurnal PV PROJECT Data versus Reddy Equation Estimates, ADR37

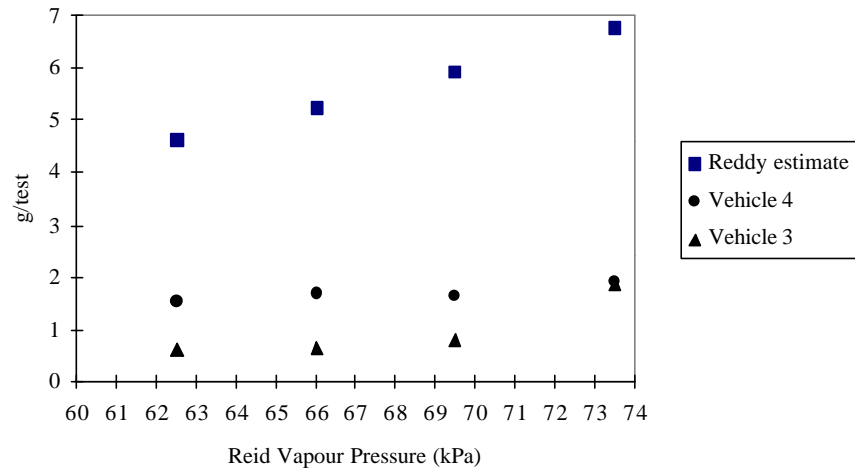


Figure 2.2
Diurnal PV PROJECT Data versus Reddy Equation Estimates, ADR27

Diurnal emissions from uncontrolled vehicles (ie. vehicles without carbon trap canisters or with inoperative vapour control systems) may be predicted under real-world conditions using a semi-empirical equation developed by Reddy (1989) that describes fuel tank vapour generation. The Reddy equation has been verified against experimental data and may be expressed as:

$$\text{Tank Vapour Generation (g/gal vapour space)} = A \times e^{B \times \text{RVP}} \times (e^{C T_2} - e^{C T_1})$$

where $A = 0.00817$ T_1 is initial tank temperature ($^{\circ}\text{F}$)
 $B = 0.2357$ T_2 is final tank temperature ($^{\circ}\text{F}$)
 $C = 0.0409$ RVP is in psi

The Reddy equation has been used to estimate diurnal losses from uncontrolled vehicles in SEQR for an average summer day, average winter day and high oxidant day. For vehicles parked in the open, the final fuel temperature (T_2 as above) is considered to be 10°C higher than the ambient temperature under summer and high oxidant conditions and the corresponding temperature difference for winter conditions is taken to be 5°C as recommended by Carnovale et al. (1995). The other assumptions were a tank size of 60 litres and a fuel line volume of 6 litres with a total vapour space of 33 litres, representing an average tank fill level of 50% (Carnovale et al., 1995). The calculations show that the diurnal losses from a parked vehicle can vary substantially depending on ambient temperature and parking location.

With later model vehicles, it is necessary to consider the effect of evaporative emission standards which apply to all vehicles manufactured after 1976, namely ADR27A (for model years 1976-1985) and ADR37 (for post 1985 vehicles). For both ADR27A and ADR37 the evaporative emission limit is 2 grams per test. It is important to note, however, that the ADR27A procedure entailed the use of a carbon trap method for the measurement of vapour which has been found to be inaccurate due to collection inefficiency and reverse-purge problems (Brooks et al., 1992). ADR37 uses a SHED for its determination of vapour loss. The ADR37 procedure is estimated to represent a reduction of about 90% in evaporative emissions when compared to ADR27A (Concawe, 1994).

The 2 gram evaporative emission test procedure using a carbon trap canister in ADR27A is equivalent to the standard which applied to US vehicles manufactured between 1972 and 1977. The diurnal emission from these vehicles under ADR conditions is estimated to be approximately 40% of the diurnal emission from uncontrolled vehicles (USEPA, 1989). The current 2 gram limit for evaporatives measured in a SHED is equivalent to the US standard that was in force between 1981 and 1993. Vehicles manufactured in the US during this period have shown approximately 80% control of diurnal loss relative to uncontrolled vehicles (USEPA, 1989). The emission factors for diurnal loss are presented in Table 2.1.

Table 2.1
Diurnal Loss from the Passenger Fleet in SEQR for 1993

RVP (kPa)	Emission factor (g/km)	
	Average summer day	High oxidant day
63.5	0.21	0.37
68.5	0.25	0.44
73.5	0.29	0.51

Hot Soak Loss

The measurement of hot soak loss involves operation of the vehicle followed by a one hour SHED test. This hourly result is then multiplied by the number of trips per day taken by the average vehicle to give the daily hot soak loss. Similarly to diurnal loss measurement, testing occurs under ADR conditions and as such is unlikely to reflect actual hot soak loss under SEQR conditions. To derive our estimates of hot soak emissions we have considered the relative magnitudes of diurnal and hot soak losses in response to varying fuel RVP and temperature.

Stebar et al. (1985) found that carbureted cars (representative of pre 1976 and 1976-1985 Australian vehicles) displayed hot soak losses that varied from approximately one half to one third as large as the measured diurnal losses for fuels with RVP levels typical of SEQR. Fuel-injected cars (representative of post 1985 Australian vehicles) were found to have hot soak losses ranging from one third to one quarter of diurnal losses. It is important to note that the hot soak results reported were SHED data and represent the hot soak loss occurring after a single trip.

Stump et al. (1992a, b) reported diurnal and hot soak emissions from late model US vehicles for different temperature ranges using a fuel of constant RVP. Even though much variability in the data is evident, the results indicate that diurnal loss is more affected by changes in temperature than is hot soak loss. The diurnal to hot soak ratio for a 4-cylinder vehicle fuelled by TBI (Throttle Body Injection) for example, increased by 40% when moving from a temperature range of 16-29°C to 23-36°C.

The ratio of diurnal loss to hot soak loss from motor vehicles will vary from 2 to 4 depending on fuel system type (ie. carbureted or fuel injected), the event day (ie. summer, high oxidant or winter) and the park location (ie. under cover or open). Details of the calculations are shown in Appendix A-F. A summary of diurnal and hot soak emissions from pre 1976, 1976-1985 and post 1985 cars for different event days in SEQR for 1993 is presented in Table 2.2

**Table 2.2
Hot Soak Losses from the Passenger Fleet in SEQR for 1993**

RVP (kPa)	Emission factor (g/km)	
	Average summer day	High oxidant day
63.5	0.25	0.45
68.5	0.30	0.53
73.5	0.34	0.55

Running Loss

Running loss in the original SEQR inventory was estimated from a software package called MOBILE5. The literature shows that running losses increase with increasing fuel RVP and ambient temperature. Running loss emission factors were obtained from research conducted by the USEPA (1989) which was linearly interpolated to cover the average ambient temperatures of a summer (25.5°C) and high oxidant day (28.5°C). These emission factors were scaled back to the running loss emission factor of a fuel RVP of 73.5 kPa and are presented in Table 2.3.

**Table 2.3
Running Loss Emission Factors for SEQR, 1993**

RVP (kPa)	Emission factor (g/km)	
	Summer day	High oxidant day
63.5	0.17	0.61
68.5	0.25	0.79
73.5	0.64	1.10

Resting Loss

There is limited information available from the literature about the effect of RVP on resting losses. Therefore, the estimates of resting loss for was assumed to be constant with varying RVP. The values used are for the SEQR emission inventory (Morrell, et.al.,1995). The resting losses for a summer day and high oxidant day were 0.23 and 0.30 g/km respectively.

The emission factors for the four components of evaporative emission for the two scenarios are presented in Table 2.4 and Table 2.5

**Table 2.4
Emission Factors for Evaporative Loss on a Summer Day, SEQR 1993**

RVP (kPa)	Hot Soak	Emission factor (g/km)			
		Diurnal	Running	Resting	Total
63.5	0.21	0.25	0.17	0.23	0.85
68.5	0.25	0.30	0.25	0.23	1.02
73.5	0.29	0.34	0.64	0.23	1.50

Table 2.5
Emission Factors for Evaporative Loss on a High Oxidant Day, SEQR 1993

RVP (kPa)	Emission factor (g/km)				
	Hot Soak	Diurnal	Running	Resting	Total
63.5	0.37	0.45	0.61	0.30	1.73
68.5	0.44	0.53	0.79	0.30	2.06
73.5	0.51	0.55	1.10	0.30	2.46

Vehicle Fleet Evaporative Emission Rates

EPA (1991) have previously used detailed data on vehicle fleet composition, fuel use and VKT mix for different categories of roads (eg. arterial, freeway and residential) to estimate fleet evaporative emission rates for the Melbourne region. Fleet emission rates were found to be within 5-10% of the passenger car estimates for all road categories. Given the considerable variation in evaporative emissions with ambient temperature and RVP and the lack of data on local commercial and heavy duty vehicles (eg. number of trips per day) it was considered that to a good approximation, evaporative emissions for the passenger car fleet as discussed above are representative of the total vehicle fleet in SEQR.

Diurnal, hot soak and resting emissions on arterial, commercial and residential/minor roads are considered to be similar (EPA, 1991). Running losses, however, are reported to decrease with increasing speed (USEPA, 1991) and consequently evaporative emissions may be expected to be lower for free-flowing freeways and highways. Cadle et al. (1993) report that a preliminary analysis of samples collected in the Ft. McHenry Tunnel in the USA suggests low running losses under high speed driving. Similarly, a study of six European vehicles under high speed conditions (Morgan et al., 1992) found negligible running losses during higher-speed driving (90-130 kph). The recommendation of Carnovale et al. (1995) that running losses under free-flow drive conditions on freeways/highways are 10% of those under arterial flow have been adopted. From the same study it was also assumed that running losses under congested flow conditions are assumed to be 50% greater than under free-flow arterial drive.

A summary of evaporative VOC emission rates for the SEQR fleet in 1993 according to road category is presented in Table 2.6 and Table 2.7. It should be noted that these estimates of running and resting losses are not supported by experimental data for conditions typical of SEQR and consequently should be used with due caution.

Table 2.6
Motor Vehicle Evaporative VOC Emission Rates According to Road Category for a Summer Day, SEQR 1993

Road category emission (g/km)	RVP (kPa)		
	63.5	68.5	73.5
Arterial	0.85	1.02	1.50
Freeway/Highway	0.70	0.80	0.92
Residential/Minor	0.85	1.02	1.50
Congested -Arterial/Residential.	0.94	1.14	1.82
Total	3.34	3.98	5.74

Table 2.7
Motor Vehicle Evaporative VOC Emission Rates According to Road Category
for a High Oxidant Day, SEQR 1993

Road category emission (g/km)	RVP (kPa)		
	63.5	68.5	73.5
Arterial	1.73	2.06	2.46
Freeway/Highway	1.18	1.35	1.47
Residential/Minor	1.73	2.06	2.46
Congested -Arterial/Residential.	2.03	2.46	3.01
Total	6.66	7.93	9.40

The estimated evaporative and total emissions from the motor vehicle fleet are presented in Tables 2.8 and 2.9. The total emissions are the product of the emission factors and vehicle kilometre travelled (VKT) for the Brisbane car fleet. The VKT used was estimated by Morrell et al. (1995). The results show a reduction of evaporative emission on a summer day of 26 and 37 % when moving from a fuel RVP of 73.5 kPa to 68.5 and 63.5 kPa respectively. The equivalent reduction in evaporative emission of a high oxidant day was 14 and 26 %.

The exhaust emission used in generating Table 2.9 was obtained from Morrell et al. (1995). It was assumed for this study that changes in fuel RVP has no effect on exhaust emissions. When considering both the exhaust and evaporative emission, the reduction from a fuel RVP of 73.5 kPa to 68.5 and 63.5 kPa were 12 and 17 % respectively for a summer day. The equivalent reduction for a high oxidant day was 8 and 15 %.

Table 2.8
Estimated Evaporative Emissions from the Vehicle Fleet in SEQR, 1993

RVP	Summer day tonnes/day	High oxidant day tonnes/day
63.5	34	64
68.5	40	75
73.5	54	87

Table 2.9
Total Motor Vehicle Emission (Exhaust and Evaporative) from the Vehicle Fleet in SEQR, 1993

RVP	Summer day tonnes/day	High oxidant day tonnes/day
63.5	101	131
68.5	107	142
73.5	121	154

Canister Replacement Methodology

The NISE data (FORS, 1996) were used to determine the relative evaporative loss reduction on replacement of a carbon canister. The relative reduction in evaporative loss for ADR27 and ADR37 cars were 80 and 439 % respectively. The daily emission estimated by Morrell et al. (1995) for a day specific scenario was split by vehicle age categories, pre 1975, 1976-1985 (ADR27) and post 1985 (ADR37). The reduction in evaporative loss was calculated for canister replacement of 50 and 100 % of the total Brisbane fleet and presented in Tables 3.1 and 3.2. There is no reduction in evaporative VOC emission for the pre 1975 age category since these vehicles were assumed not to contain carbon canisters. The reduction in the daily evaporative VOC emission for 50 and 100 % replacement of canisters for a summer day was 24 and 48 % respectively. The equivalent reduction for a high oxidant day is 23 and 47 %.

Table 3.1
Daily Total Evaporative VOC Emission on Canister Replacement (RVP, 73.5 kPa) for a Summer Day, SEQR 1993

Vehicle age (tonne/day)	% of Canister Replacement		
	0	50	100
Pre 1975	10.7	10.7	10.7
1976-1985	25.0	19.5	13.9
Post 1985	17.9	10.6	3.3
Daily emission	53.6	40.8	28.0

Table 3.2
Daily VOC Emission on Canister Replacement (RVP, 73.5 kPa) for High Oxidant Day, SEQR 1993

Vehicle age (tonne/day)	% of Canister Replacement		
	0	50	100

Pre 1975	18.0	18.0	18.0
1976-1985	42.0	32.7	23.4
Post 1985	27.0	16.0	5.0
Daily emission	86.9	66.6	46.4

A summary of evaporative VOC emission rates for the SEQR fleet in 1993 according to road category is presented in Table 3.3 and 3.4.

Table 3.3
Motor Vehicle Evaporative VOC Emission Rates According to Road Category
for a Summer Day, SEQR 1993

Road category	g/km	
	No canister replacement	50% Canister replacement
Arterial	1.50	1.14
Freeway/Highway	0.92	0.70
Residential/Minor	1.50	1.14
Congested -Art./Resid.	1.82	1.38
Total	5.74	4.37

Table 3.4
Motor Vehicle Evaporative VOC Emission Rates According to Road Category
for a Summer Day, SEQR 1993

Road category	g/km	
	No Canister replacement	50% Canister replacement
Arterial	2.46	1.89
Freeway/Highway	1.47	1.13
Residential/Minor	2.46	1.89
Congested -Art./Resid.	3.01	2.31
Total	9.40	7.21

The estimated emission for evaporative and total vehicle fleet are presented in Tables 3.5 and 3.6. The reduction in evaporative emission resulting from 50% canister replacement for a summer day was 24 % and for a high oxidant day was 23 %. The equivalent reduction in total vehicle emission (exhaust and evaporative) of 11 and 13 % for a summer and high oxidant day respectively.

Table 3.5
Evaporative Motor Vehicle Emission from the Vehicle Fleet in SEQR, 1993

	tonnes/day	
	Summer day	High oxidant day
No replacement	54	87
50% Canister Replacement	41	67

Table 3.6
Total Motor Vehicle Emission (Exhaust and Evaporative) from the Vehicle Fleet in SEQR, 1993

	tonnes/day	
	Summer day	High oxidant day
No replacement	121	154
50% Canister Replacement	108	134

References

Brooks D. J., Baldus S. L., Diegel H. L., Gorse R. A. and Sherby R. D. (1992) Running Loss Test Procedure Development, SAE 920322.

Cadle, S. H., Carlock M., Cullen K., Gorse R. A., Knapp K. T., Lawson D. R. (1993) Real World Vehicle Emissions: A Summary of the Fourth Annual CRC - APRAC On-Road Vehicle Emission Workshop. J. Air and Waste Manage. Assoc. 44, 1180-1187.

Carnovale F., Tilly K., Stuart A., Carvalho C., Summers M. and Erickson P. (1995) Metropolitan Air Quality Study, Air Emissions Inventory. Consultants' report to the NSW Environment Protection Authority, unpublished.

Concawe (1994) Motor Vehicle Emission Regulations and Fuel Specifications 1994 Update. Report No. 4/94, Brussels.

Environment Protection Authority (1991) Air Emissions Inventory, Port Phillip Control Region : Planning for the Future. SRS 91/001.

FORS (Federal Office of Road Safety) (1996) Motor Vehicle Pollution in Australia: Report on the National In-service Vehicle Emission Study, Canberra.

Morrell, A., Stuart A. and Tope H. (1995) South East Queensland Air Emissions Inventory. Consultants' report to the Queensland Department of Environment and Heritage, unpublished.

Morgan T.B.D., Betts W.E., Hutcheson R.C., McArragher J.S., Schmeidel H.P. and Snelgrove D.G. (1993) A Study of VOC Running Losses from European Canister-equipped Vehicles. SAE 930945.

Reddy S. R. (1989) Prediction of Fuel Vapor Generation From a Vehicle Fuel Tank as a Function of Fuel RVP and Temperature. SAE 892089.

Stump F., Knapp K. T., Ray W. D., Snow R. and Burton C. (1992a) The Composition of Motor Vehicle Organic Emissions under Elevated Temperature Summer Driving Conditions (75 to 105 F). J. Air Waste Manag., 42, 152-158.

Stump F., Knapp K. T., Ray W. D., Snow R. and Eudy L. (1992b) The Composition Of Motor Vehicle Organic Emissions under Elevated Temperature Summer Driving Conditions (75 to 105 F). - Part II. J. Air Waste Manag., 42, 1328-1335.

USEPA (1989) Supplement (dated 1989) to Compilation of Air Pollutant Emission Factors, Vol II, Mobile Sources. Fourth Edition, Research Triangle Park, North Carolina USA.

USEPA (1991a) User's guide to MOBILE4.1. Report No. EPA-AA-TEB-91-01. Research Triangle Park, North Carolina, USA.

USEPA (1991b) Nonroad Engine and Vehicle Emission Study Report. Ann Arbor, Michigan, USA.

Appendices

Appendix A

Diurnal And Hot Soak Losses From Motor Car Fleet On An Average Summer Day, RVP 63.5, SEQR 1993

Under Cover Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/ Day	km/ day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	12.93	6.47	3.5	41.1	0.067	0.02	0.04	0.06
'76-'85	5.17	2.59	3.5	41.1	0.397	0.05	0.09	0.14
Post '85	2.59	0.86	3.5	41.1	0.536	0.03	0.04	0.07
					Total g/day ->	0.10 4.31	0.16 6.73	0.27 11.04

Open Air Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/ Day	km/ day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	38.28	12.76	3.5	41.1	0.067	0.06	0.07	0.14
'76-'85	15.31	5.10	3.5	41.1	0.397	0.15	0.17	0.32
Post '85	7.66	1.91	3.5	41.1	0.536	0.10	0.09	0.19
					Total g/day ->	0.31 12.75	0.33 13.68	0.64 26.43

Assumptions

Vehicle Vintage	Diurnal	Hot Soak Cover	Hot Soak Open/High Ox.
Pre '76	Reddy	2	3
'76-'85	0.4	2	3
'86-'93	0.2	3	4

		VKT Fraction	
trips / day	3.5	Pre '76	0.067
		'76-'85	0.397
km/day	41.1	'86-'93	0.536

Appendix B

Diurnal And Hot Soak Losses From Motor Car Fleet On A High Oxidant Day, RVP 63.5, SEQR 1993

Under Cover Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/Day	km/day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	25.87	12.94	3.5	41.1	0.067	0.04	0.07	0.12
'76-'85	10.35	5.17	3.5	41.1	0.397	0.10	0.17	0.27
Post '85	5.17	1.72	3.5	41.1	0.536	0.07	0.08	0.15
					Total g/day ->	0.21	0.33	0.54
						8.62	13.46	22.08

Open Air Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/Day	km/day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	65.30	21.77	3.5	41.1	0.067	0.11	0.12	0.23
'76-'85	26.12	8.71	3.5	41.1	0.397	0.25	0.29	0.55
Post '85	13.06	3.27	3.5	41.1	0.536	0.17	0.15	0.32
					Total g/day ->	0.53	0.57	1.10
						21.75	23.33	45.08

Assumptions

Vehicle Vintage	Diurnal	Hot Soak Cover	Hot Soak Open/High Ox.
Pre '76	Reddy	2	3
'76-'85	0.4	2	3
'86-'93	0.2	3	4

		VKT Fraction	
trips / day	3.5	Pre '76	0.067
		'76-'85	0.397
km/day	41.1	'86-'93	0.536

Appendix C

Diurnal And Hot Soak Losses from Motor Car Fleet On a Summer Day, RVP 68.5, SEQR 1993

Under Cover Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/Day	km/day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	15.38	7.69	3.5	41.1	0.067	0.03	0.04	0.07
'76-'85	6.15	3.08	3.5	41.1	0.397	0.06	0.10	0.16
Post '85	3.08	1.03	3.5	41.1	0.536	0.04	0.05	0.09
					Total g/day ->	0.12	0.19	0.32
						5.12	8.00	13.12

Open Air Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/Day	km/day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	45.52	15.17	3.5	41.1	0.067	0.07	0.09	0.16
'76-'85	18.21	6.07	3.5	41.1	0.397	0.18	0.21	0.38
Post '85	9.10	2.28	3.5	41.1	0.536	0.12	0.10	0.22
					Total g/day ->	0.37	0.40	0.76
						15.16	16.26	31.42

Assumptions

Vehicle Vintage	Diurnal	Hot Soak Cover	Hot Soak Open/High Ox.
Pre '76	Reddy	2	3
'76-'85	0.4	2	3
'86-'93	0.2	3	4

		VKT Fraction	
trips / day	3.5	Pre '76	0.067
		'76-'85	0.397
km/day	41.1	'86-'93	0.536

Appendix D

Diurnal And Hot Soak Losses From Motor Car Fleet On A High Oxidant Day, RVP 68.5, SEQR 1993

Under Cover Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/Day	km/day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	30.77	15.38	3.5	41.1	0.067	0.05	0.09	0.14
'76-'85	12.31	6.15	3.5	41.1	0.397	0.12	0.21	0.33
Post '85	6.15	2.05	3.5	41.1	0.536	0.08	0.09	0.17
					Total g/day ->	0.25	0.39	0.64
						10.25	16.01	26.25

Open Air Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/Day	km/day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	77.65	25.88	3.5	41.1	0.067	0.13	0.15	0.27
'76-'85	31.06	10.35	3.5	41.1	0.397	0.30	0.35	0.65
Post '85	15.53	3.88	3.5	41.1	0.536	0.20	0.18	0.38
					Total g/day ->	0.63	0.67	1.30
						25.86	27.74	53.60

Assumptions

Vehicle Vintage	Diurnal	Hot Soak Cover	Hot Soak Open/High Ox.
Pre '76	Reddy	2	3
'76-'85	0.4	2	3
'86-'93	0.2	3	4

		VKT Fraction	
trips / day	3.5	Pre '76	0.067
		'76-'85	0.397
km/day	41.1	'86-'93	0.536

Appendix E

Diurnal And Hot Soak Losses From Motor Car Fleet On A Summer Day, RVP 73.5, SEQR 1993

Under Cover Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/ Day	km/ day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	17.86	8.93	3.5	41.1	0.067	0.03	0.05	0.08
'76-'85	7.14	3.57	3.5	41.1	0.397	0.07	0.12	0.19
Post '85	3.57	1.19	3.5	41.1	0.536	0.05	0.05	0.10
Total g/day ->						0.14 5.95	0.37 15.24	0.51 21.19

Open Air Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/ Day	km/ day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	52.86	17.62	3.5	41.1	0.067	0.09	0.10	0.19
'76-'85	21.14	7.05	3.5	41.1	0.397	0.20	0.24	0.44
Post '85	10.57	2.65	3.5	41.1	0.536	0.14	0.12	0.26
Total g/day ->						0.43 17.30	0.46 18.88	0.89 36.49

Assumptions

Vehicle Vintage	Diurnal	Hot Soak Cover	Hot Soak Open/High Ox.
Pre '76	Reddy	2	3
'76-'85	0.4	2	3
'86-'93	0.2	3	4

		VKT Fraction	
trips / day	3.5	Pre '76	0.067
		'76-'85	0.397
km/day	41.1	'86-'93	0.536

Appendix F

Diurnal And Hot Soak Losses From Motor Car Fleet On A High Oxidant Day, RVP 73.5, SEQR 1993

Under Cover Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/ Day	km/ day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	35.72	11.91	3.5	41.1	0.067	0.06	0.17	0.13
'76-'85	14.29	4.76	3.5	41.1	0.397	0.14	0.16	0.30
Post '85	7.14	1.79	3.5	41.1	0.536	0.09	0.08	0.17
Total g/day ->						0.29 11.90	0.31 12.76	0.60 24.66

Open Air Park

Vehicle Vintage	Diurnal g/day	Hot Soak g/trip	Trips/ Day	km/ day	VKT Fraction	Diurnal g/km	Hot soak g/km	Total HS + D g/km
Pre '76	90.17	30.06	3.5	41.1	0.067	0.15	0.17	0.32
'76-'85	36.07	12.02	3.5	41.1	0.397	0.35	0.41	0.75
Post '85	18.03	4.51	3.5	41.1	0.536	0.24	0.21	0.44
Total g/day ->						0.73 30.03	0.78 32.21	1.51 62.24

Assumptions

Vehicle Vintage	Diurnal	Hot Soak Cover	Hot Soak Open/High Ox.
Pre '76	Reddy	2	3
'76-'85	0.4	2	3
'86-'93	0.2	3	4

		VKT Fraction	
trips / day	3.5	Pre '76	0.067
		'76-'85	0.397
km/day	41.1	'86-'93	0.536