Figure K-116 Contour plot of change in maximum 24-hour mean $PM_{2.5}$ concentration in 2033 Do Something scenario (all sources, 2033-DS minus 2033-DM)

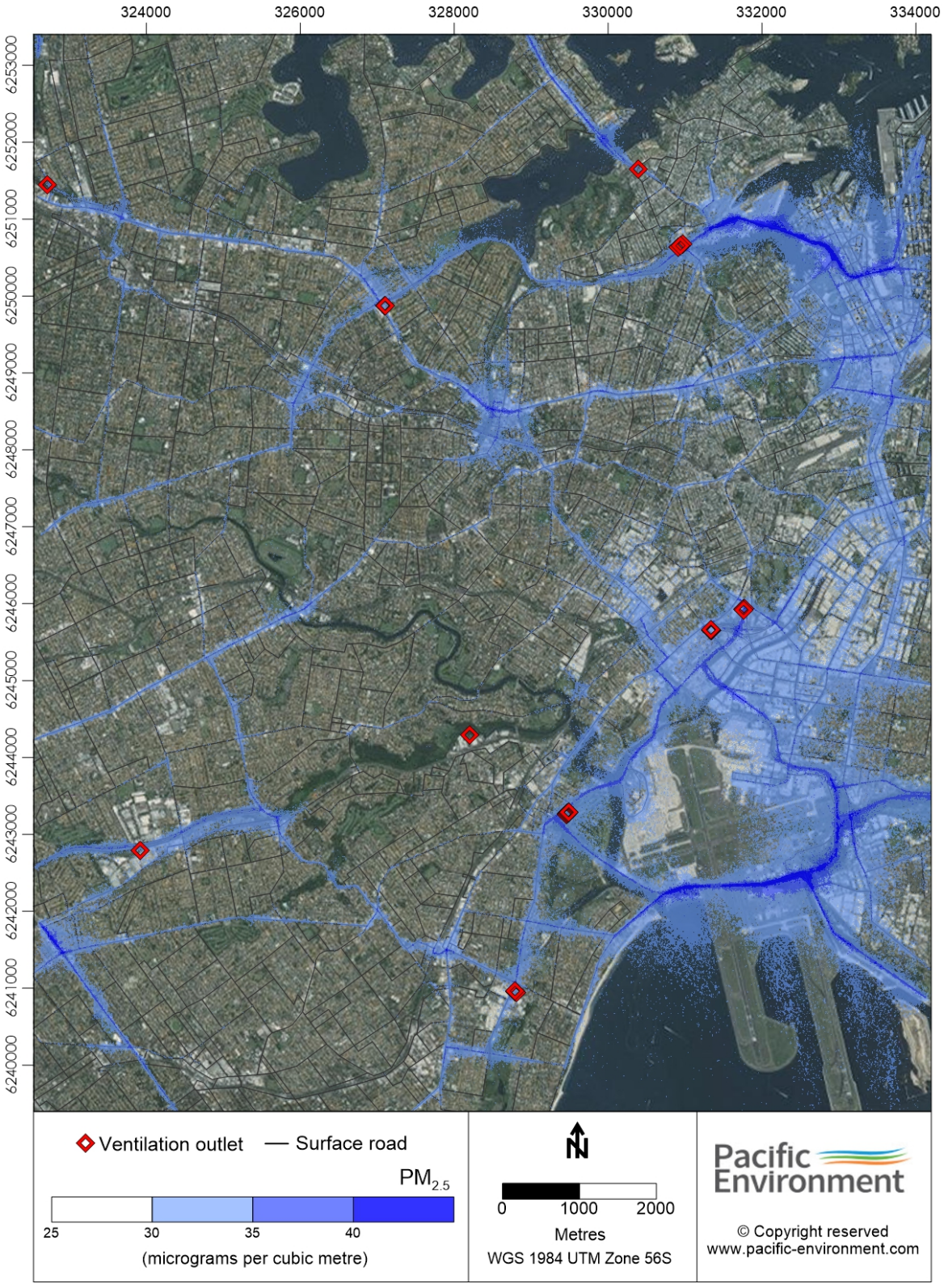

Figure K-117 Contour plot of maximum 24-hour mean $PM_{2.5}$ concentration in 2033 cumulative scenario (all sources, 2033-DSC)

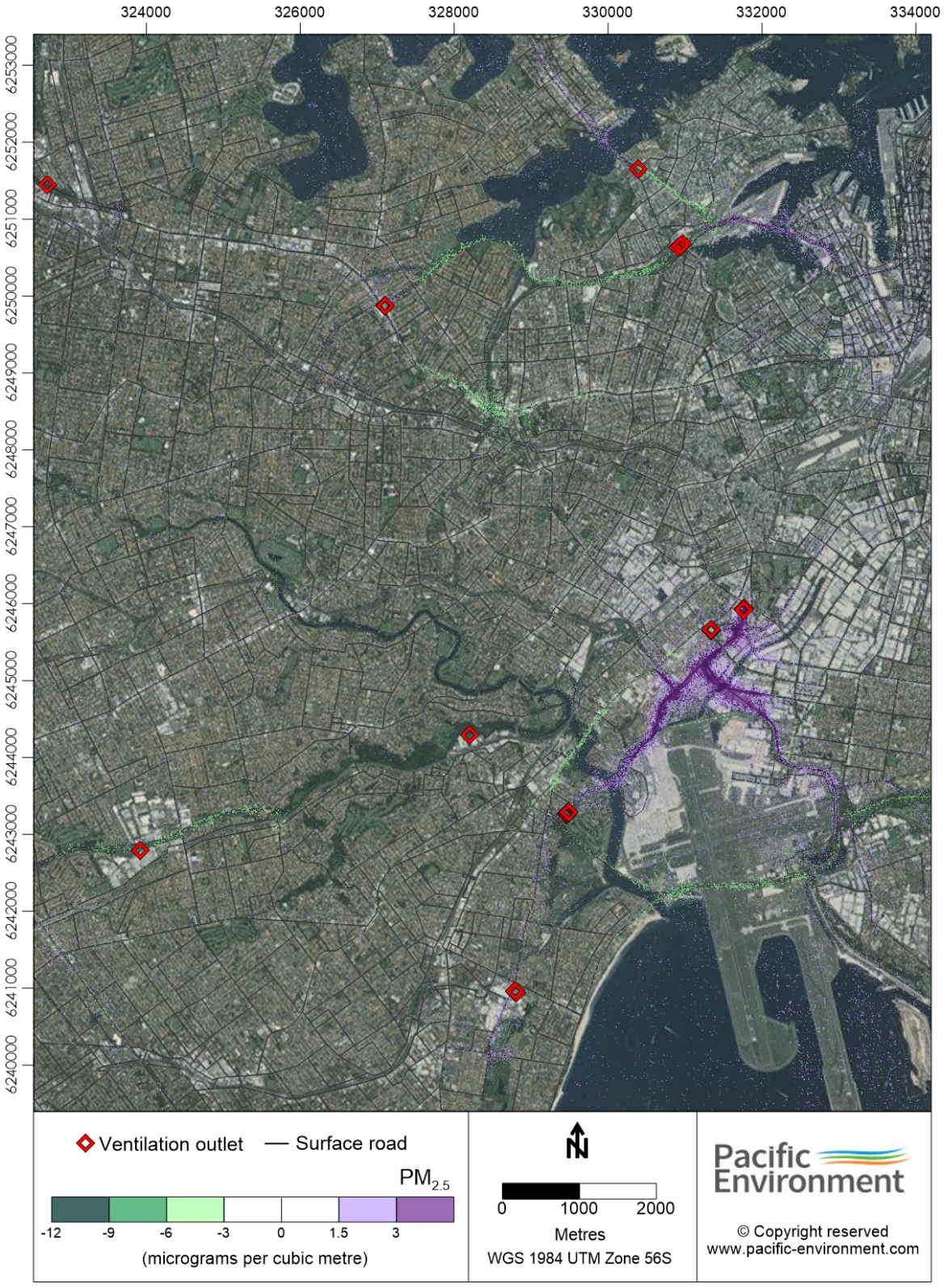

Figure K-118 Contour plot of change in maximum 24-hour mean $PM_{2.5}$ concentration in 2033 cumulative scenario (all sources, 2033-DSC minus 2033-DM)

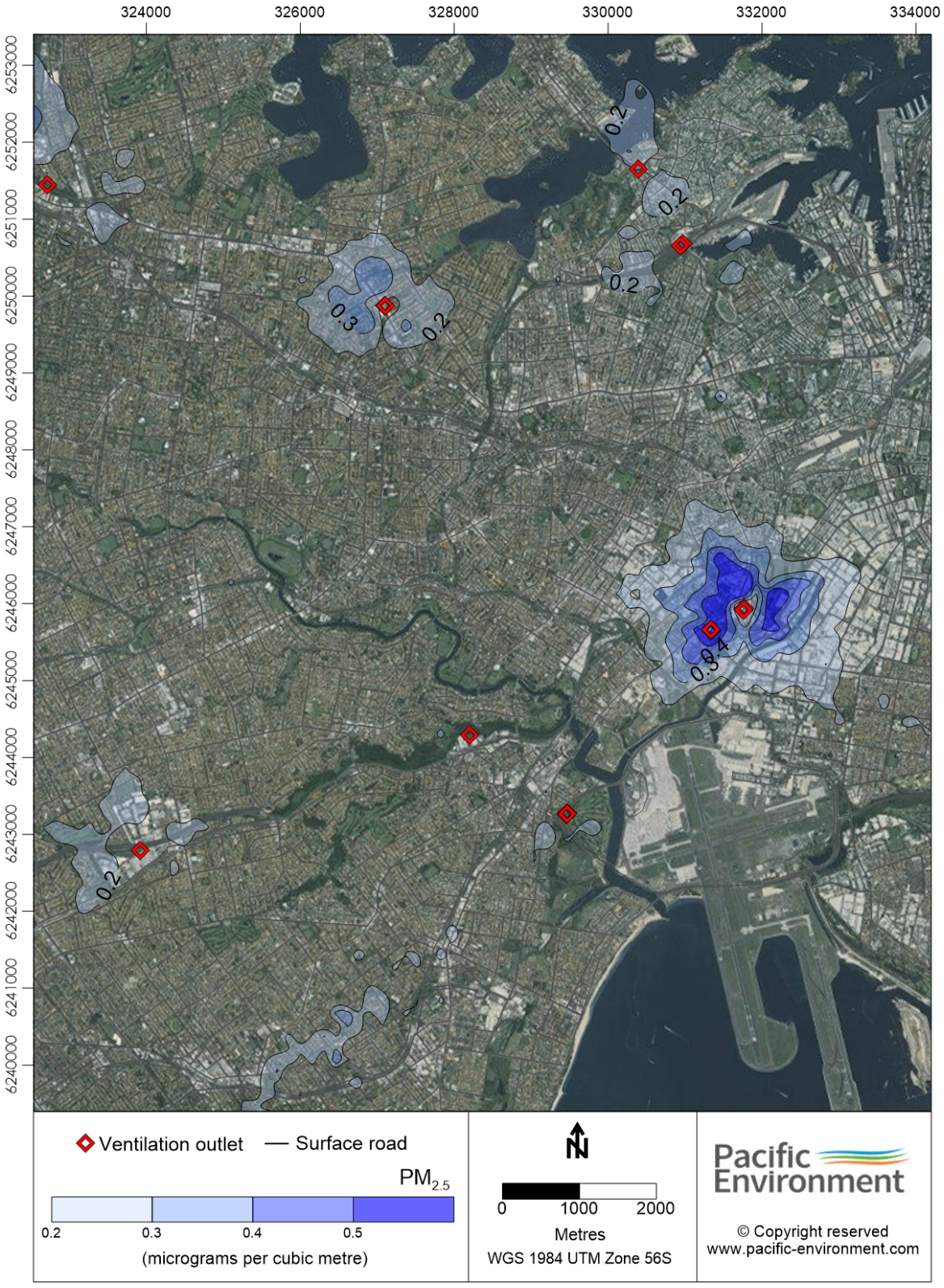

Figure K-119 Contour plot of maximum 24-hour mean $PM_{2.5}$ concentrations (ventilation outlets only, 2023-DS)

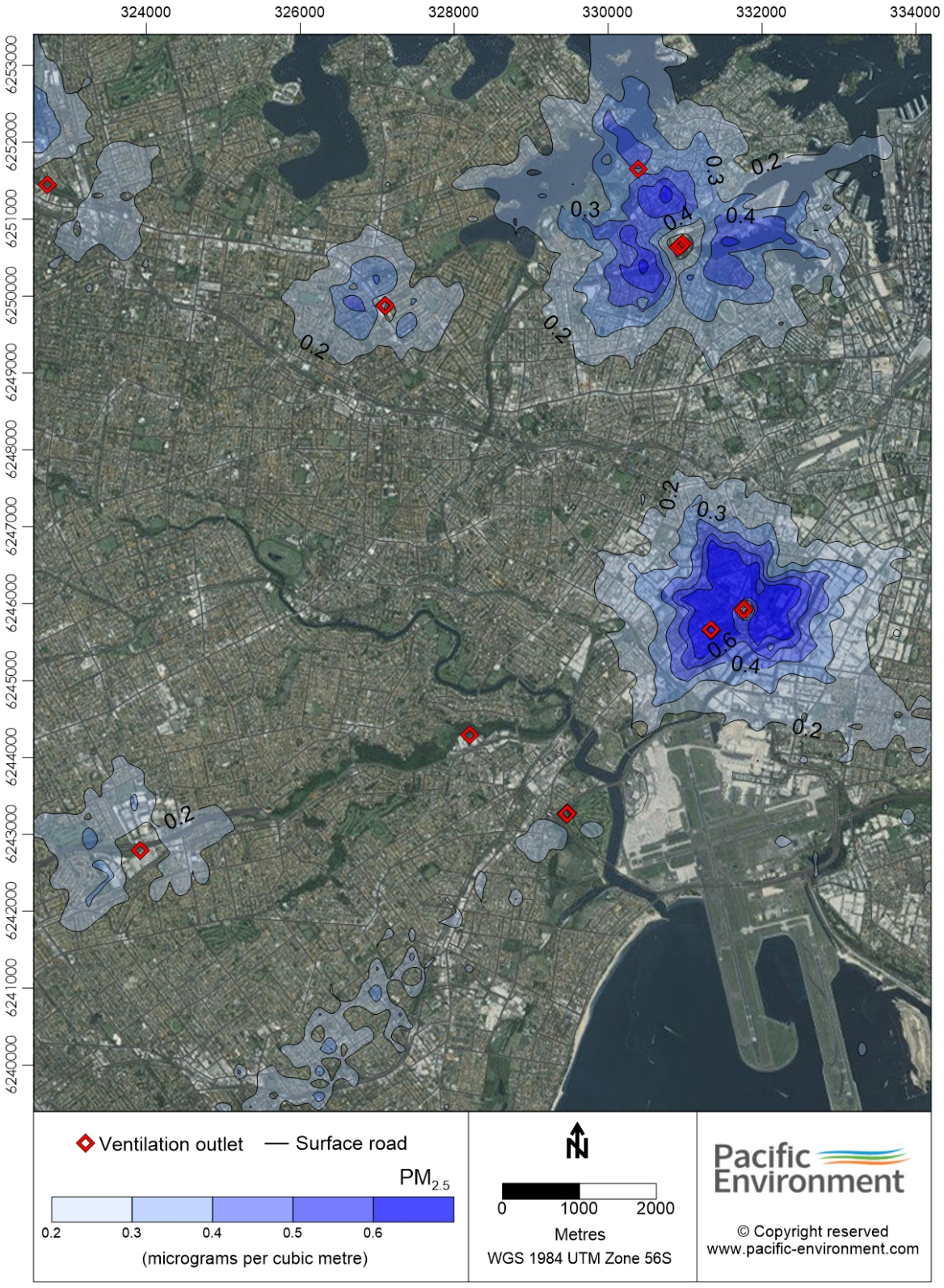

Figure K-120 Contour plot of maximum 24-hour mean $PM_{2.5}$ concentrations (ventilation outlets only, 2023-DSC)

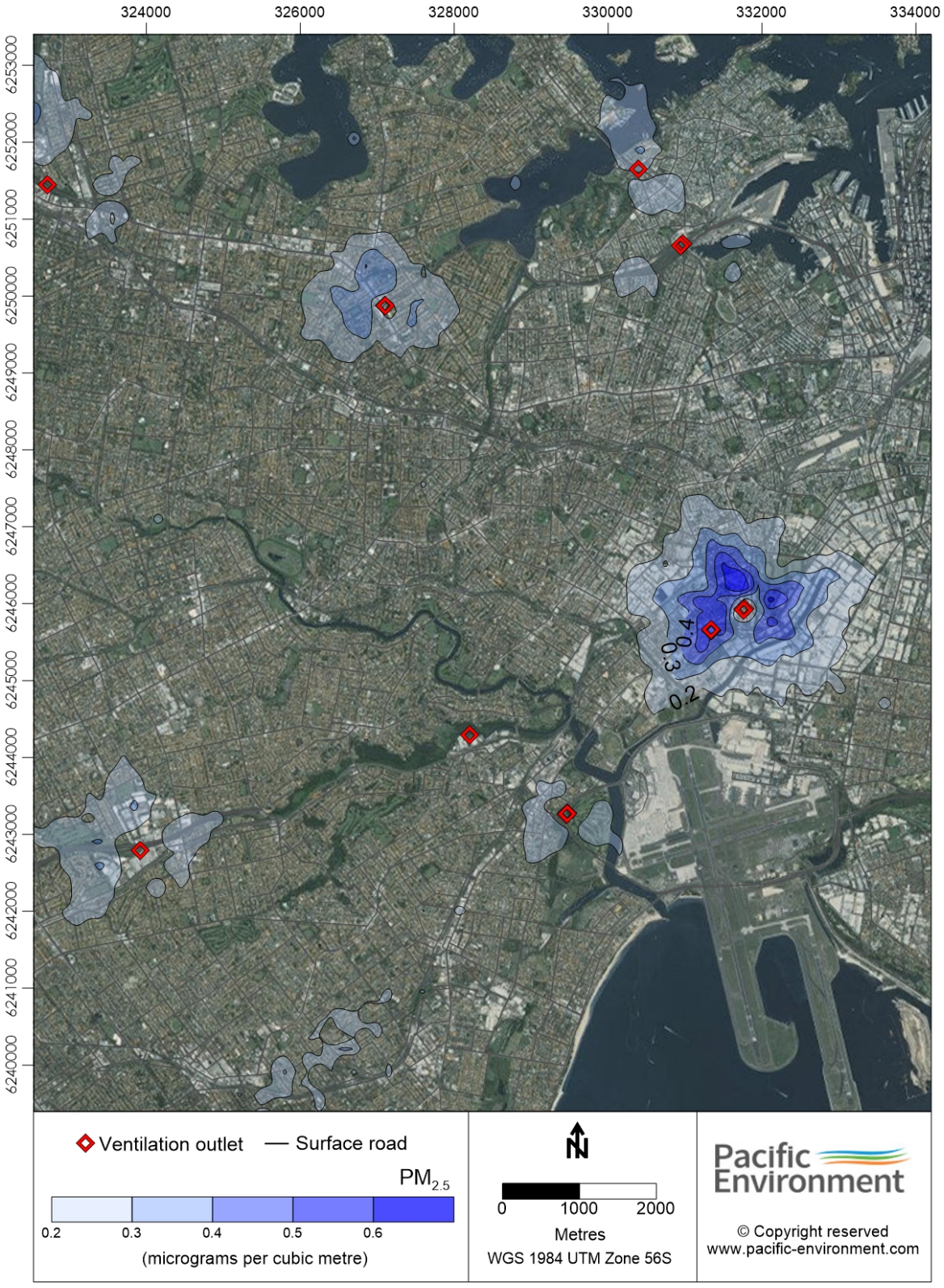

Figure K-121 Contour plot of maximum 24-hour mean $PM_{2.5}$ concentrations (ventilation outlets only, 2033-DS)

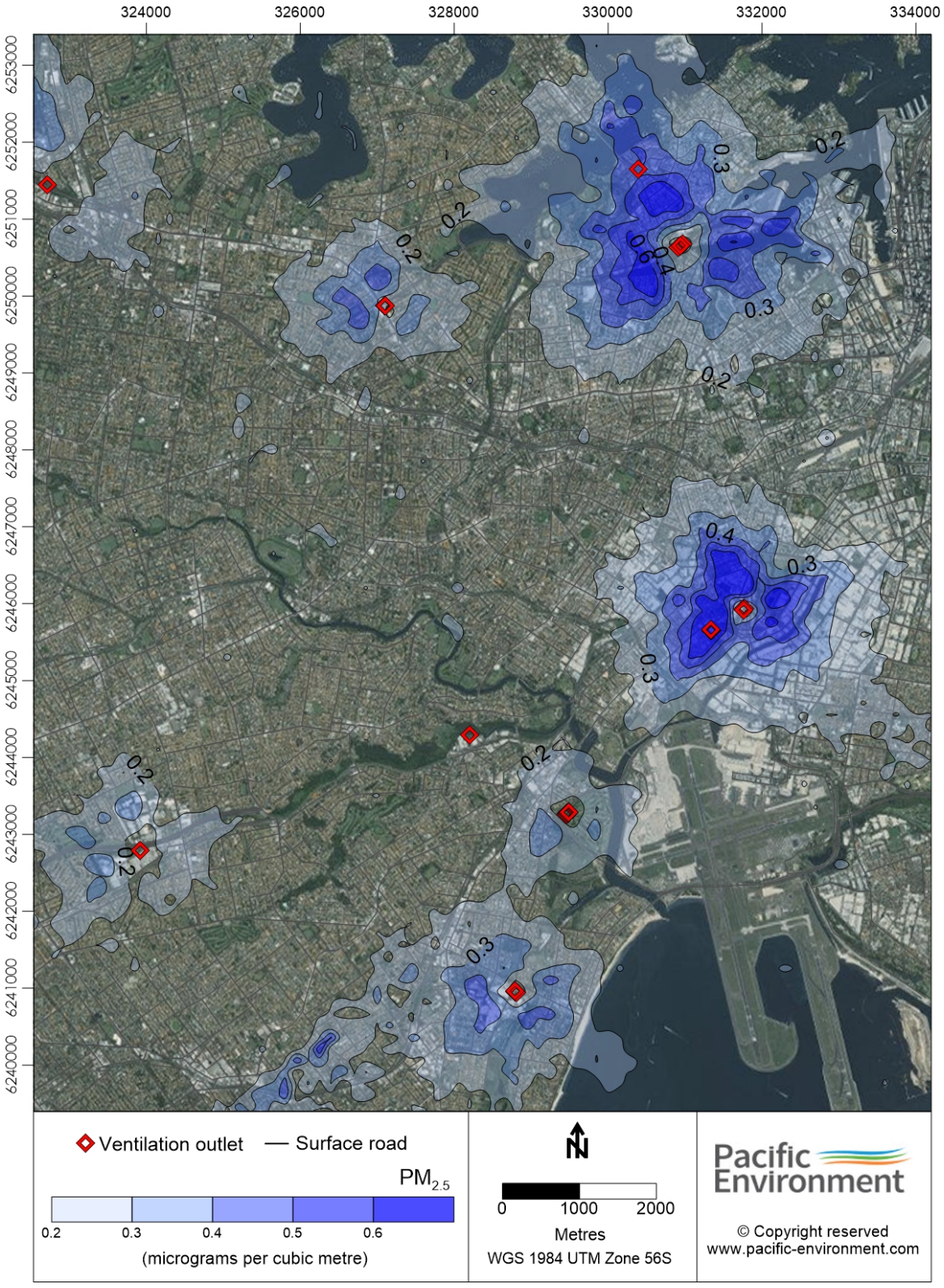

Figure K-122 Contour plot of maximum 24-hour mean $PM_{2.5}$ concentrations (ventilation outlets only, 2033-DSC)

K.9 Air toxics: benzene (maximum 1-hour mean)

Table K-57 Maximum 1-hour mean benzene concentration (excluding background) at community receptors

Receptor	Maximum 1-hour benzene concentration (µg/m^3)							Change relative to Do Minimum (µg/m^3)			
	2015-BY	2023-DM	2023-DS	2023-DSC	2033-DM	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
CR01	-	5.2	3.3	5.1	2.1	3.0	2.1	-1.9	-0.1	0.9	0.0
CR02	-	4.6	3.6	4.7	1.9	2.1	2.3	-0.9	0.1	0.2	0.4
CR03	-	8.4	7.6	7.6	5.4	4.0	4.8	-0.8	-0.8	-1.4	-0.6
CR04	-	6.3	4.8	5.5	2.5	2.6	2.8	-1.5	-0.8	0.0	0.3
CR05	-	4.4	3.4	3.3	2.6	2.0	1.9	-1.0	-1.1	-0.6	-0.7
CR06	-	6.0	5.1	4.8	3.2	2.9	2.9	-1.0	-1.2	-0.3	-0.3
CR07	-	6.8	6.7	10.6	3.8	5.0	4.2	-0.2	3.8	1.1	0.4
CR08	-	7.0	6.7	4.9	4.9	3.4	3.8	-0.3	-2.1	-1.5	-1.0
CR09	-	4.4	4.2	4.6	2.0	2.2	2.9	-0.1	0.2	0.1	0.9
CR10	-	11.2	12.4	11.0	7.2	6.9	9.4	1.2	-0.3	-0.3	2.2
CR11	-	5.6	5.1	4.3	3.9	2.6	3.8	-0.5	-1.3	-1.3	-0.1
CR12	-	8.6	8.2	8.4	5.2	5.4	5.6	-0.4	-0.2	0.2	0.4
CR13	-	3.2	3.7	4.5	4.5	2.0	2.2	0.5	1.3	-2.6	-2.3
CR14	-	4.9	3.6	5.5	3.4	2.7	2.4	-1.3	0.6	-0.7	-0.9
CR15	-	5.0	4.5	6.3	2.8	2.5	2.0	-0.5	1.3	-0.3	-0.8
CR16	-	4.7	4.0	4.0	1.6	3.1	1.8	-0.7	-0.7	1.4	0.2
CR17	-	4.4	3.5	2.6	2.1	2.4	1.6	-1.0	-1.8	0.3	-0.5
CR18	-	3.2	4.5	3.3	2.7	2.5	1.8	1.4	0.1	-0.2	-0.9
CR19	-	2.7	3.8	3.4	2.4	3.1	1.9	1.1	0.7	0.7	-0.5
CR20	-	5.2	4.0	4.7	2.8	3.7	2.7	-1.1	-0.5	0.9	-0.1
CR21	-	6.0	4.1	5.3	1.9	1.9	2.3	-2.0	-0.8	0.0	0.4
CR22	-	6.0	5.2	5.1	3.4	2.8	2.9	-0.8	-0.9	-0.6	-0.5
CR23	-	8.0	6.4	5.2	3.0	4.6	3.2	-1.6	-2.7	1.5	0.1
CR24	-	6.2	7.6	8.9	4.2	4.2	4.0	1.4	2.7	-0.1	-0.3
CR25	-	5.1	4.0	4.7	4.6	2.5	2.8	-1.1	-0.4	-2.1	-1.8
CR26	-	4.2	4.2	5.1	2.4	3.1	2.1	0.0	0.9	0.7	-0.3
CR27	-	4.7	5.1	5.5	2.9	2.0	2.6	0.3	0.7	-0.8	-0.2
CR28	-	5.7	6.6	5.5	3.7	2.9	2.9	0.9	-0.2	-0.8	-0.8
CR29	-	6.2	6.5	6.6	3.8	3.8	3.1	0.3	0.4	0.0	-0.7
CR30	-	5.0	5.4	5.3	2.6	3.1	2.7	0.4	0.3	0.5	0.2
CR31	-	5.5	3.3	3.5	2.6	2.2	1.7	-2.2	-1.9	-0.4	-0.9
CR32	-	5.0	3.9	2.7	2.5	2.0	2.4	-1.1	-2.3	-0.5	-0.2
CR33	-	6.7	4.3	4.6	2.7	3.2	4.1	-2.5	-2.1	0.5	1.4
CR34	-	6.9	7.1	4.4	2.8	3.3	2.4	0.3	-2.4	0.5	-0.4
CR35	-	3.7	3.7	5.4	2.3	2.1	2.6	0.0	1.7	-0.2	0.2
CR36	-	5.4	4.8	4.8	4.4	2.4	2.5	-0.6	-0.7	-2.1	-1.9
CR37	-	4.7	5.5	4.6	2.8	2.3	3.0	0.8	-0.1	-0.5	0.2
CR38	-	6.4	6.3	6.3	3.1	2.6	3.3	0.0	0.0	-0.5	0.2
CR39	-	5.4	6.3	4.4	3.1	2.8	2.6	0.9	-1.0	-0.3	-0.5
CR40	-	5.1	7.3	8.2	3.3	4.8	3.0	2.3	3.2	1.5	-0.3

Table K-58 Maximum 1-hour mean benzene concentration (excluding background) at community receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	11.2	12.4	11.0	7.2	6.9	9.4
2	-	8.6	8.2	10.6	5.4	5.4	5.6
3	-	8.4	7.6	8.9	5.2	5.0	4.8
4	-	8.0	7.6	8.4	4.9	4.8	4.2
5	-	7.0	7.3	8.2	4.6	4.6	4.1
6	-	6.9	7.1	7.6	4.5	4.2	4.0
7	-	6.8	6.7	6.6	4.4	4.0	3.8
8	-	6.7	6.7	6.3	4.2	3.8	3.8
9	-	6.4	6.6	6.3	3.9	3.7	3.3
10	-	6.3	6.5	5.5	3.8	3.4	3.2

Table K-59 Maximum 1-hour mean benzene concentration (excluding background) at community receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	2.28	3.76	1.54	2.20	-2.47	-2.75	-2.55	-2.28
2	1.36	3.15	1.47	1.36	-2.16	-2.44	-2.10	-1.93
3	1.36	2.72	1.44	0.87	-1.99	-2.31	-2.06	-1.84
4	1.18	1.70	1.13	0.42	-1.91	-2.10	-1.47	-1.04
5	1.12	1.30	0.91	0.42	-1.62	-2.10	-1.41	-0.95
6	0.93	1.27	0.91	0.40	-1.46	-1.93	-1.27	-0.94
7	0.90	0.86	0.68	0.38	-1.28	-1.77	-0.84	-0.92
8	0.77	0.74	0.68	0.26	-1.14	-1.34	-0.82	-0.82
9	0.47	0.69	0.55	0.24	-1.14	-1.18	-0.67	-0.81
10	0.43	0.61	0.53	0.22	-1.10	-1.12	-0.60	-0.71

Table K-60 Maximum 1-hour mean benzene concentration (excluding background) at RWR receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	17.3	21.3	16.5	9.7	9.4	8.3
2	-	16.7	17.4	16.2	9.3	8.9	8.3
3	-	16.7	16.7	15.7	9.3	8.8	8.1
4	-	16.3	15.4	15.7	9.2	8.8	7.9
5	-	16.2	15.4	15.4	8.9	8.7	7.8
6	-	15.8	15.3	14.9	8.9	8.6	7.5
7	-	15.7	15.3	14.7	8.6	8.5	7.4
8	-	15.6	15.1	14.4	8.5	8.5	7.4
9	-	15.4	15.0	14.0	8.4	8.4	7.3
10	-	15.3	14.6	13.9	8.4	8.2	7.3

Table K-61 Maximum 1-hour mean benzene concentration (excluding background) at RWR receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	5.9	5.7	4.0	3.08	-7.2	-6.1	-4.2	-3.5
2	5.7	5.2	3.3	3.1	-6.2	-6.1	-3.7	-3.5
3	5.6	4.9	3.1	2.8	-6.1	-5.8	-3.5	-3.4
4	5.2	4.6	3.1	2.8	-6.0	-5.6	-3.2	-3.4
5	5.1	4.4	3.0	2.7	-5.9	-5.5	-3.2	-3.3
6	5.1	4.4	2.8	2.6	-5.9	-5.5	-3.1	-3.2
7	5.0	4.3	2.8	2.6	-5.8	-5.4	-3.1	-3.2
8	4.9	4.3	2.7	2.6	-5.7	-5.4	-3.1	-3.1
9	4.9	4.3	2.6	2.5	-5.3	-5.4	-3.1	-3.1
10	4.8	4.2	2.6	2.5	-5.3	-5.4	-3.1	-3.1

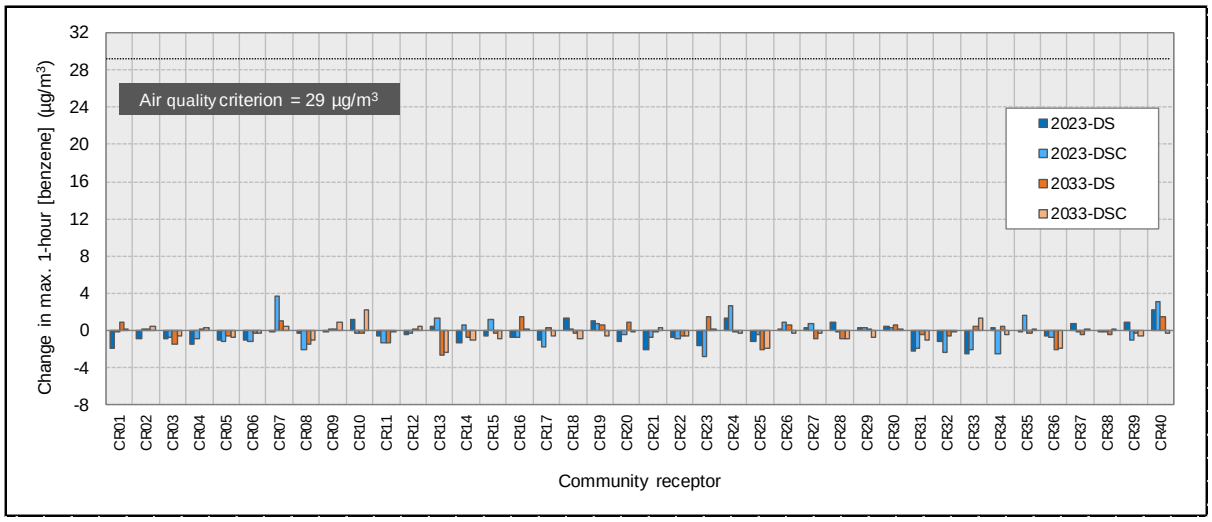

Figure K-123 Change in maximum 1-hour mean benzene concentration at community receptors

K.10 Air toxics: benzo(a)pyrene (maximum 1-hour mean)

Table K-62 Maximum 1-hour mean benzo(a)pyrene concentration (excluding background) at community receptors

Receptor	Maximum 1-hour b(a)p concentration (µg/m^3)							Change relative to Do Minimum (µg/m^3)			
	2015-BY	2023-DM	2023-DS	2023-DSC	2033-DM	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
CR01	-	0.042	0.027	0.041	0.024	0.034	0.024	-0.015	-0.001	0.010	0.000
CR02	-	0.037	0.029	0.037	0.022	0.024	0.027	-0.007	0.001	0.002	0.005
CR03	-	0.067	0.061	0.061	0.062	0.045	0.055	-0.007	-0.006	-0.016	-0.007
CR04	-	0.051	0.039	0.044	0.029	0.029	0.032	-0.012	-0.007	0.000	0.003
CR05	-	0.035	0.028	0.026	0.030	0.023	0.022	-0.008	-0.009	-0.007	-0.008
CR06	-	0.048	0.041	0.039	0.037	0.033	0.033	-0.008	-0.009	-0.004	-0.004
CR07	-	0.055	0.054	0.085	0.044	0.057	0.049	-0.001	0.030	0.013	0.005
CR08	-	0.056	0.054	0.039	0.056	0.039	0.044	-0.003	-0.017	-0.017	-0.012
CR09	-	0.035	0.034	0.037	0.023	0.025	0.033	-0.001	0.002	0.002	0.010
CR10	-	0.090	0.100	0.088	0.083	0.080	0.108	0.009	-0.002	-0.003	0.025
CR11	-	0.045	0.041	0.035	0.044	0.030	0.043	-0.004	-0.011	-0.015	-0.001
CR12	-	0.069	0.066	0.067	0.059	0.062	0.064	-0.003	-0.002	0.002	0.005
CR13	-	0.026	0.030	0.036	0.052	0.023	0.026	0.004	0.010	-0.029	-0.026
CR14	-	0.039	0.029	0.044	0.039	0.031	0.028	-0.010	0.005	-0.008	-0.011
CR15	-	0.040	0.036	0.050	0.032	0.029	0.023	-0.004	0.010	-0.003	-0.009
CR16	-	0.038	0.032	0.032	0.019	0.035	0.021	-0.006	-0.006	0.017	0.002
CR17	-	0.035	0.028	0.021	0.024	0.027	0.018	-0.008	-0.014	0.003	-0.006
CR18	-	0.025	0.036	0.026	0.031	0.029	0.020	0.011	0.001	-0.002	-0.011
CR19	-	0.022	0.031	0.027	0.028	0.035	0.022	0.009	0.006	0.008	-0.006
CR20	-	0.042	0.032	0.038	0.033	0.043	0.031	-0.009	-0.004	0.010	-0.002
CR21	-	0.049	0.033	0.042	0.022	0.022	0.026	-0.016	-0.006	0.000	0.004
CR22	-	0.048	0.042	0.041	0.039	0.033	0.034	-0.006	-0.007	-0.007	-0.006
CR23	-	0.064	0.051	0.042	0.035	0.053	0.036	-0.013	-0.022	0.018	0.002
CR24	-	0.050	0.061	0.072	0.049	0.048	0.046	0.011	0.022	-0.001	-0.003
CR25	-	0.041	0.032	0.038	0.053	0.029	0.032	-0.009	-0.003	-0.024	-0.021
CR26	-	0.034	0.034	0.041	0.027	0.035	0.024	0.000	0.007	0.008	-0.003
CR27	-	0.038	0.041	0.044	0.033	0.023	0.030	0.003	0.006	-0.010	-0.003
CR28	-	0.046	0.053	0.044	0.043	0.033	0.033	0.008	-0.001	-0.009	-0.009
CR29	-	0.050	0.052	0.053	0.043	0.044	0.035	0.002	0.003	0.000	-0.008
CR30	-	0.040	0.043	0.043	0.029	0.036	0.031	0.003	0.003	0.006	0.002
CR31	-	0.044	0.027	0.028	0.030	0.025	0.019	-0.017	-0.016	-0.005	-0.011
CR32	-	0.041	0.032	0.022	0.029	0.023	0.027	-0.009	-0.019	-0.006	-0.002
CR33	-	0.054	0.034	0.037	0.031	0.037	0.047	-0.020	-0.017	0.006	0.016
CR34	-	0.055	0.057	0.036	0.032	0.038	0.028	0.002	-0.020	0.006	-0.004
CR35	-	0.030	0.030	0.044	0.027	0.024	0.029	0.000	0.014	-0.003	0.003
CR36	-	0.044	0.039	0.038	0.051	0.027	0.029	-0.005	-0.005	-0.024	-0.022
CR37	-	0.038	0.044	0.037	0.032	0.027	0.034	0.006	-0.001	-0.005	0.002
CR38	-	0.051	0.051	0.051	0.036	0.030	0.038	0.000	0.000	-0.005	0.003
CR39	-	0.043	0.051	0.036	0.036	0.032	0.030	0.007	-0.008	-0.003	-0.006
CR40	-	0.041	0.059	0.066	0.038	0.055	0.035	0.018	0.025	0.017	-0.003

Table K-63 Maximum 1-hour mean benzo(a)pyrene concentration (excluding background) at community receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	0.090	0.100	0.088	0.083	0.080	0.108
2	-	0.069	0.066	0.085	0.062	0.062	0.064
3	-	0.067	0.061	0.072	0.059	0.057	0.055
4	-	0.064	0.061	0.067	0.056	0.055	0.049
5	-	0.056	0.059	0.066	0.053	0.053	0.047
6	-	0.055	0.057	0.061	0.052	0.048	0.046
7	-	0.055	0.054	0.053	0.051	0.045	0.044
8	-	0.054	0.054	0.051	0.049	0.044	0.043
9	-	0.051	0.053	0.050	0.044	0.043	0.038
10	-	0.051	0.052	0.044	0.044	0.039	0.036

Table K-64 Maximum 1-hour mean benzo(a)pyrene concentration (excluding background) at community receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	0.018	0.030	0.018	0.025	-0.020	-0.022	-0.029	-0.026
2	0.011	0.025	0.017	0.016	-0.017	-0.020	-0.024	-0.022
3	0.011	0.022	0.017	0.010	-0.016	-0.019	-0.024	-0.021
4	0.009	0.014	0.013	0.005	-0.015	-0.017	-0.017	-0.012
5	0.009	0.010	0.010	0.005	-0.013	-0.017	-0.016	-0.011
6	0.008	0.010	0.010	0.005	-0.012	-0.016	-0.015	-0.011
7	0.007	0.007	0.008	0.004	-0.010	-0.014	-0.010	-0.011
8	0.006	0.006	0.008	0.003	-0.009	-0.011	-0.009	-0.009
9	0.004	0.006	0.006	0.003	-0.009	-0.009	-0.008	-0.009
10	0.003	0.005	0.006	0.003	-0.009	-0.009	-0.007	-0.008

Table K-65 Maximum 1-hour mean benzo(a)pyrene concentration (excluding background) at RWR receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	0.139	0.171	0.132	0.112	0.108	0.095
2	-	0.134	0.140	0.131	0.107	0.102	0.095
3	-	0.134	0.134	0.127	0.106	0.101	0.093
4	-	0.131	0.124	0.126	0.105	0.101	0.090
5	-	0.130	0.124	0.124	0.102	0.100	0.089
6	-	0.127	0.123	0.120	0.102	0.098	0.086
7	-	0.127	0.123	0.118	0.099	0.098	0.085
8	-	0.125	0.121	0.116	0.098	0.098	0.085
9	-	0.124	0.120	0.113	0.096	0.097	0.084
10	-	0.123	0.117	0.112	0.096	0.094	0.083

Table K-66 Maximum 1-hour mean benzo(a)pyrene concentration (excluding background) at RWR receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	0.047	0.046	0.046	0.035	-0.058	-0.049	-0.048	-0.041
2	0.046	0.042	0.037	0.035	-0.050	-0.049	-0.043	-0.040
3	0.045	0.039	0.036	0.032	-0.049	-0.046	-0.041	-0.039
4	0.042	0.037	0.036	0.032	-0.048	-0.045	-0.037	-0.039
5	0.041	0.035	0.034	0.031	-0.047	-0.045	-0.037	-0.038
6	0.041	0.035	0.032	0.030	-0.047	-0.044	-0.036	-0.036
7	0.040	0.035	0.032	0.030	-0.047	-0.044	-0.036	-0.036
8	0.040	0.034	0.031	0.030	-0.046	-0.044	-0.036	-0.036
9	0.039	0.034	0.030	0.028	-0.043	-0.044	-0.035	-0.036
10	0.039	0.034	0.030	0.028	-0.042	-0.043	-0.035	-0.036

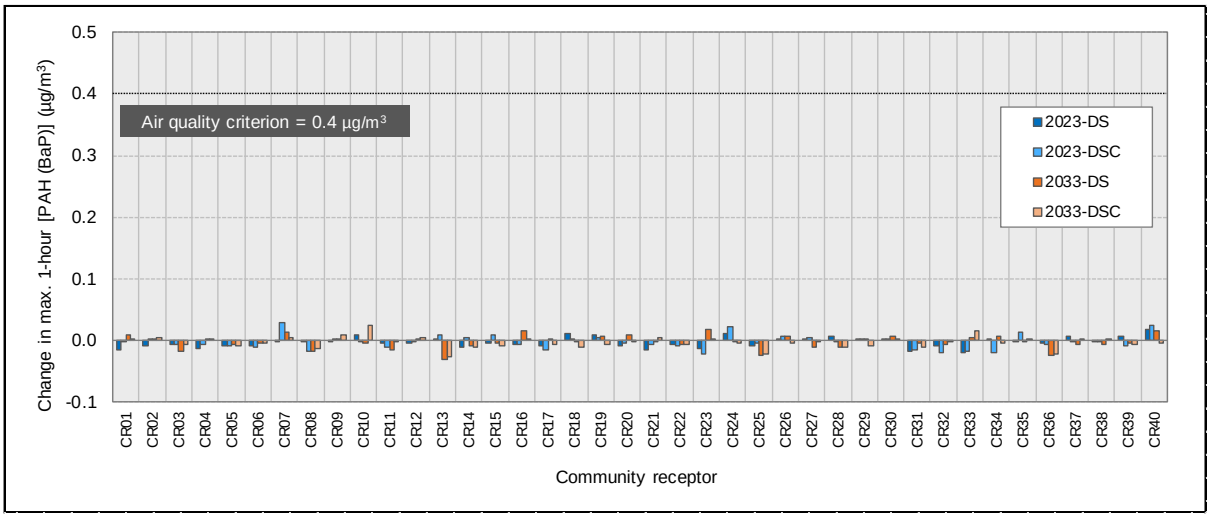

Figure K-124 Change in maximum 1-hour mean b(a)p concentration at community receptors

K.11 Air toxics: formaldehyde (maximum 1-hour mean)

Table K-67 Maximum 1-hour mean formaldehyde concentration (excluding background) at community receptors

Receptor	Maximum 1-hour formaldehyde concentration (µg/m^3)							Change relative to Do Minimum (µg/m^3)			
	2015-BY	2023-DM	2023-DS	2023-DSC	2033-DM	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
CR01	-	3.7	2.3	3.6	2.4	3.5	2.4	-1.3	-0.1	1.1	0.0
CR02	-	3.2	2.6	3.3	2.2	2.5	2.7	-0.6	0.1	0.2	0.5
CR03	-	5.9	5.3	5.4	6.3	4.6	5.6	-0.6	-0.5	-1.6	-0.7
CR04	-	4.4	3.4	3.8	2.9	3.0	3.2	-1.0	-0.6	0.0	0.3
CR05	-	3.1	2.4	2.3	3.0	2.3	2.2	-0.7	-0.8	-0.7	-0.8
CR06	-	4.2	3.5	3.4	3.7	3.4	3.4	-0.7	-0.8	-0.4	-0.4
CR07	-	4.8	4.7	7.5	4.5	5.8	4.9	-0.1	2.6	1.3	0.5
CR08	-	4.9	4.7	3.4	5.7	4.0	4.5	-0.2	-1.5	-1.7	-1.2
CR09	-	3.1	3.0	3.2	2.3	2.5	3.4	-0.1	0.1	0.2	1.0
CR10	-	7.9	8.7	7.7	8.4	8.1	11.0	0.8	-0.2	-0.3	2.6
CR11	-	4.0	3.6	3.0	4.5	3.0	4.4	-0.4	-0.9	-1.5	-0.1
CR12	-	6.0	5.8	5.9	6.0	6.3	6.5	-0.3	-0.2	0.2	0.5
CR13	-	2.3	2.6	3.2	5.3	2.3	2.6	0.3	0.9	-3.0	-2.7
CR14	-	3.4	2.5	3.9	3.9	3.2	2.8	-0.9	0.4	-0.8	-1.1
CR15	-	3.5	3.2	4.4	3.2	2.9	2.3	-0.3	0.9	-0.4	-0.9
CR16	-	3.3	2.8	2.8	1.9	3.6	2.2	-0.5	-0.5	1.7	0.2
CR17	-	3.1	2.4	1.9	2.4	2.8	1.8	-0.7	-1.2	0.3	-0.6
CR18	-	2.2	3.2	2.3	3.1	2.9	2.1	1.0	0.1	-0.2	-1.1
CR19	-	1.9	2.7	2.4	2.8	3.6	2.2	0.8	0.5	0.8	-0.6
CR20	-	3.6	2.8	3.3	3.3	4.4	3.1	-0.8	-0.3	1.1	-0.2
CR21	-	4.2	2.9	3.7	2.2	2.2	2.7	-1.4	-0.5	0.0	0.4
CR22	-	4.2	3.7	3.6	4.0	3.3	3.4	-0.5	-0.6	-0.7	-0.6
CR23	-	5.6	4.5	3.7	3.5	5.3	3.7	-1.1	-1.9	1.8	0.2
CR24	-	4.4	5.3	6.3	5.0	4.9	4.6	1.0	1.9	-0.1	-0.3
CR25	-	3.6	2.8	3.3	5.4	3.0	3.3	-0.8	-0.3	-2.5	-2.1
CR26	-	3.0	3.0	3.6	2.8	3.6	2.5	0.0	0.6	0.8	-0.3
CR27	-	3.3	3.6	3.8	3.3	2.4	3.1	0.2	0.5	-1.0	-0.3
CR28	-	4.0	4.6	3.9	4.4	3.4	3.4	0.7	-0.1	-1.0	-1.0
CR29	-	4.4	4.6	4.6	4.4	4.5	3.6	0.2	0.3	0.1	-0.8
CR30	-	3.5	3.8	3.7	3.0	3.6	3.2	0.3	0.2	0.6	0.2
CR31	-	3.8	2.3	2.5	3.1	2.6	2.0	-1.5	-1.4	-0.5	-1.1
CR32	-	3.5	2.8	1.9	2.9	2.3	2.8	-0.8	-1.6	-0.6	-0.2
CR33	-	4.7	3.0	3.3	3.2	3.8	4.8	-1.7	-1.5	0.6	1.6
CR34	-	4.8	5.0	3.1	3.3	3.9	2.8	0.2	-1.7	0.6	-0.4
CR35	-	2.6	2.6	3.8	2.7	2.4	3.0	0.0	1.2	-0.3	0.3
CR36	-	3.8	3.4	3.3	5.2	2.8	2.9	-0.4	-0.5	-2.4	-2.3
CR37	-	3.3	3.9	3.3	3.2	2.7	3.5	0.5	-0.1	-0.5	0.2
CR38	-	4.5	4.5	4.4	3.6	3.1	3.9	0.0	0.0	-0.5	0.3
CR39	-	3.8	4.4	3.1	3.6	3.3	3.0	0.6	-0.7	-0.3	-0.6
CR40	-	3.6	5.2	5.8	3.9	5.6	3.5	1.6	2.2	1.7	-0.4

Table K-68 Maximum 1-hour mean formaldehyde concentration (excluding background) at community receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	7.9	8.7	7.7	8.4	8.1	11.0
2	-	6.0	5.8	7.5	6.3	6.3	6.5
3	-	5.9	5.3	6.3	6.0	5.8	5.6
4	-	5.6	5.3	5.9	5.7	5.6	4.9
5	-	4.a9	5.2	5.8	5.4	5.3	4.8
6	-	4.8	5.0	5.4	5.3	4.9	4.6
7	-	4.8	4.7	4.6	5.2	4.6	4.5
8	-	4.7	4.7	4.4	5.0	4.5	4.4
9	-	4.5	4.6	4.4	4.5	4.4	3.9
10	-	4.4	4.6	3.9	4.5	4.0	3.7

Table K-69 Maximum 1-hour mean formaldehyde concentration (excluding background) at community receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	1.60	2.64	1.80	2.57	-1.73	-1.93	-2.98	-2.66
2	0.96	2.22	1.72	1.58	-1.52	-1.72	-2.46	-2.25
3	0.96	1.91	1.68	1.01	-1.40	-1.63	-2.40	-2.15
4	0.83	1.20	1.32	0.49	-1.34	-1.48	-1.72	-1.22
5	0.79	0.91	1.06	0.49	-1.14	-1.47	-1.64	-1.10
6	0.66	0.89	1.06	0.47	-1.03	-1.35	-1.48	-1.10
7	0.64	0.60	0.80	0.44	-0.90	-1.25	-0.98	-1.07
8	0.54	0.52	0.79	0.30	-0.80	-0.94	-0.96	-0.96
9	0.33	0.49	0.64	0.28	-0.80	-0.83	-0.78	-0.95
10	0.30	0.43	0.62	0.26	-0.77	-0.79	-0.70	-0.83

Table K-70 Maximum 1-hour mean formaldehyde concentration (excluding background) at RWR receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	12.1	15.0	11.6	11.4	11.0	9.7
2	-	11.7	12.2	11.4	10.9	10.4	9.6
3	-	11.7	11.7	11.1	10.8	10.3	9.5
4	-	11.5	10.8	11.0	10.7	10.2	9.2
5	-	11.4	10.8	10.8	10.4	10.1	9.1
6	-	11.1	10.7	10.5	10.3	10.0	8.8
7	-	11.1	10.7	10.3	10.1	10.0	8.6
8	-	11.0	10.6	10.1	10.0	9.9	8.6
9	-	10.8	10.5	9.9	9.8	9.8	8.5
10	-	10.8	10.2	9.7	9.8	9.6	8.5

Table K-71 Maximum 1-hour mean formaldehyde concentration (excluding background) at RWR receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	4.1	4.0	4.6	3.59	-5.0	-4.3	-4.8	-4.1
2	4.0	3.6	3.8	3.6	-4.4	-4.3	-4.4	-4.1
3	4.0	3.4	3.7	3.3	-4.3	-4.1	-4.1	-4.0
4	3.6	3.2	3.7	3.2	-4.2	-3.9	-3.7	-3.9
5	3.6	3.1	3.5	3.1	-4.1	-3.9	-3.7	-3.8
6	3.6	3.1	3.3	3.0	-4.1	-3.8	-3.7	-3.7
7	3.5	3.0	3.2	3.0	-4.1	-3.8	-3.7	-3.7
8	3.5	3.0	3.1	3.0	-4.0	-3.8	-3.6	-3.6
9	3.4	3.0	3.1	2.9	-3.8	-3.8	-3.6	-3.6
10	3.4	3.0	3.1	2.9	-3.7	-3.8	-3.6	-3.6

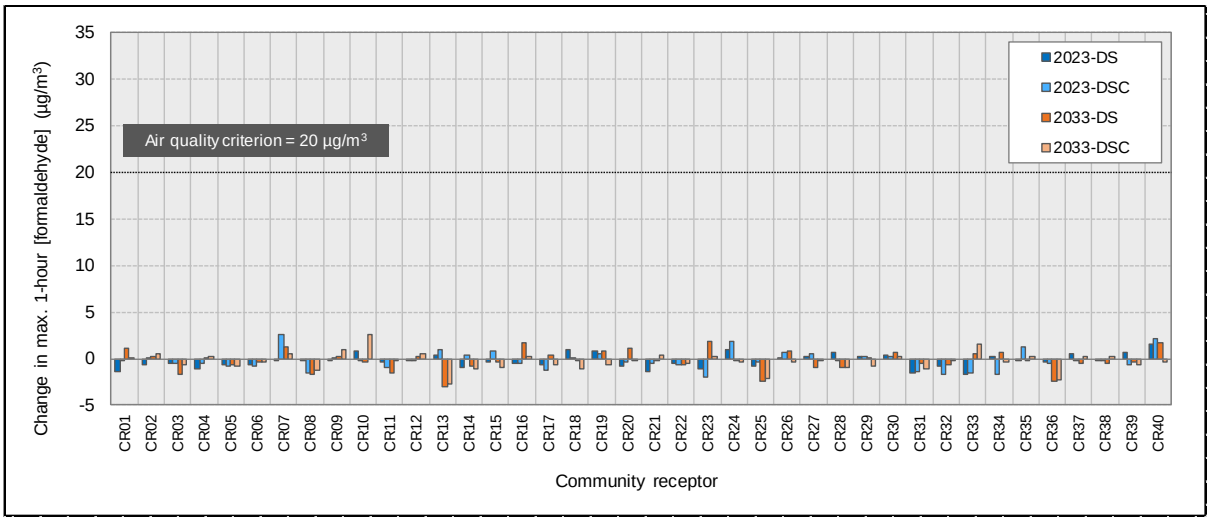

Figure K-125 Change in maximum 1-hour mean formaldehyde concentration at community receptors

K.12 Air toxics: 1,3-butadiene (maximum 1-hour mean)

Table K-72 Maximum 1-hour mean 1,3-butadiene concentration (excluding background) at community receptors

Receptor	Maximum 1-hour 1,3-butadiene concentration (µg/m^3)							Change relative to Do Minimum (µg/m^3)			
	2015-BY	2023-DM	2023-DS	2023-DSC	2033-DM	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
CR01	-	1.4	0.9	1.4	0.6	0.8	0.6	-0.5	0.0	0.2	0.0
CR02	-	1.2	1.0	1.2	0.5	0.6	0.6	-0.2	0.0	0.0	0.1
CR03	-	2.2	2.0	2.0	1.5	1.1	1.3	-0.2	-0.2	-0.4	-0.2
CR04	-	1.7	1.3	1.4	0.7	0.7	0.8	-0.4	-0.2	0.0	0.1
CR05	-	1.2	0.9	0.9	0.7	0.5	0.5	-0.3	-0.3	-0.2	-0.2
CR06	-	1.6	1.3	1.3	0.9	0.8	0.8	-0.3	-0.3	-0.1	-0.1
CR07	-	1.8	1.8	2.8	1.0	1.3	1.1	0.0	1.0	0.3	0.1
CR08	-	1.9	1.8	1.3	1.3	0.9	1.0	-0.1	-0.6	-0.4	-0.3
CR09	-	1.2	1.1	1.2	0.5	0.6	0.8	0.0	0.1	0.0	0.2
CR10	-	3.0	3.3	2.9	2.0	1.9	2.6	0.3	-0.1	-0.1	0.6
CR11	-	1.5	1.4	1.1	1.1	0.7	1.0	-0.1	-0.4	-0.3	0.0
CR12	-	2.3	2.2	2.2	1.4	1.5	1.5	-0.1	-0.1	0.1	0.1
CR13	-	0.9	1.0	1.2	1.2	0.5	0.6	0.1	0.3	-0.7	-0.6
CR14	-	1.3	1.0	1.5	0.9	0.7	0.7	-0.3	0.2	-0.2	-0.3
CR15	-	1.3	1.2	1.7	0.8	0.7	0.5	-0.1	0.3	-0.1	-0.2
CR16	-	1.3	1.1	1.1	0.4	0.8	0.5	-0.2	-0.2	0.4	0.1
CR17	-	1.2	0.9	0.7	0.6	0.6	0.4	-0.3	-0.5	0.1	-0.1
CR18	-	0.8	1.2	0.9	0.7	0.7	0.5	0.4	0.0	-0.1	-0.2
CR19	-	0.7	1.0	0.9	0.7	0.8	0.5	0.3	0.2	0.2	-0.1
CR20	-	1.4	1.1	1.2	0.8	1.0	0.7	-0.3	-0.1	0.2	0.0
CR21	-	1.6	1.1	1.4	0.5	0.5	0.6	-0.5	-0.2	0.0	0.1
CR22	-	1.6	1.4	1.4	0.9	0.8	0.8	-0.2	-0.2	-0.2	-0.1
CR23	-	2.1	1.7	1.4	0.8	1.2	0.9	-0.4	-0.7	0.4	0.0
CR24	-	1.6	2.0	2.4	1.2	1.1	1.1	0.4	0.7	0.0	-0.1
CR25	-	1.4	1.1	1.3	1.3	0.7	0.8	-0.3	-0.1	-0.6	-0.5
CR26	-	1.1	1.1	1.3	0.6	0.8	0.6	0.0	0.2	0.2	-0.1
CR27	-	1.3	1.3	1.5	0.8	0.5	0.7	0.1	0.2	-0.2	-0.1
CR28	-	1.5	1.7	1.5	1.0	0.8	0.8	0.2	0.0	-0.2	-0.2
CR29	-	1.7	1.7	1.8	1.0	1.0	0.8	0.1	0.1	0.0	-0.2
CR30	-	1.3	1.4	1.4	0.7	0.8	0.7	0.1	0.1	0.1	0.1
CR31	-	1.4	0.9	0.9	0.7	0.6	0.5	-0.6	-0.5	-0.1	-0.3
CR32	-	1.3	1.0	0.7	0.7	0.5	0.6	-0.3	-0.6	-0.1	0.0
CR33	-	1.8	1.1	1.2	0.7	0.9	1.1	-0.7	-0.6	0.1	0.4
CR34	-	1.8	1.9	1.2	0.8	0.9	0.7	0.1	-0.6	0.1	-0.1
CR35	-	1.0	1.0	1.4	0.6	0.6	0.7	0.0	0.5	-0.1	0.1
CR36	-	1.4	1.3	1.3	1.2	0.6	0.7	-0.2	-0.2	-0.6	-0.5
CR37	-	1.3	1.5	1.2	0.8	0.6	0.8	0.2	0.0	-0.1	0.1
CR38	-	1.7	1.7	1.7	0.8	0.7	0.9	0.0	0.0	-0.1	0.1
CR39	-	1.4	1.7	1.2	0.8	0.8	0.7	0.2	-0.3	-0.1	-0.1
CR40	-	1.3	1.9	2.2	0.9	1.3	0.8	0.6	0.8	0.4	-0.1

Table K-73 Maximum 1-hour mean 1,3-butadiene concentration (excluding background) at community receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	3.0	3.3	2.9	2.0	1.9	2.6
2	-	2.3	2.2	2.8	1.5	1.5	1.5
3	-	2.2	2.0	2.4	1.4	1.3	1.3
4	-	2.1	2.0	2.2	1.3	1.3	1.1
5	-	1.9	1.9	2.2	1.3	1.2	1.1
6	-	1.8	1.9	2.0	1.2	1.1	1.1
7	-	1.8	1.8	1.8	1.2	1.1	1.0
8	-	1.8	1.8	1.7	1.2	1.0	1.0
9	-	1.7	1.7	1.7	1.1	1.0	0.9
10	-	1.7	1.7	1.5	1.0	0.9	0.9

Table K-74 Maximum 1-hour mean 1,3-butadiene concentration (excluding background) at community receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	0.61	1.00	0.42	0.60	-0.66	-0.73	-0.69	-0.62
2	0.36	0.84	0.40	0.37	-0.57	-0.65	-0.57	-0.52
3	0.36	0.72	0.39	0.24	-0.53	-0.61	-0.56	-0.50
4	0.31	0.45	0.31	0.11	-0.51	-0.56	-0.40	-0.28
5	0.30	0.34	0.25	0.11	-0.43	-0.56	-0.38	-0.26
6	0.25	0.34	0.25	0.11	-0.39	-0.51	-0.34	-0.26
7	0.24	0.23	0.19	0.10	-0.34	-0.47	-0.23	-0.25
8	0.20	0.20	0.18	0.07	-0.30	-0.36	-0.22	-0.22
9	0.12	0.18	0.15	0.07	-0.30	-0.31	-0.18	-0.22
10	0.11	0.16	0.14	0.06	-0.29	-0.30	-0.16	-0.19

Table K-75 Maximum 1-hour mean 1,3-butadiene concentration (excluding background) at RWR receptors, ranked by concentration

Rank	Ranking by concentration (µg/m^3)						
	2015-BY	2023-DM	2023 DS	2023-DSC	2033-DM	2033-DS	2033-DSC
1	-	4.6	5.7	4.4	2.6	2.6	2.3
2	-	4.4	4.6	4.3	2.5	2.4	2.2
3	-	4.4	4.4	4.2	2.5	2.4	2.2
4	-	4.3	4.1	4.2	2.5	2.4	2.1
5	-	4.3	4.1	4.1	2.4	2.4	2.1
6	-	4.2	4.1	4.0	2.4	2.3	2.0
7	-	4.2	4.1	3.9	2.3	2.3	2.0
8	-	4.1	4.0	3.8	2.3	2.3	2.0
9	-	4.1	4.0	3.7	2.3	2.3	2.0
10	-	4.1	3.9	3.7	2.3	2.2	2.0

Table K-76 Maximum 1-hour mean 1,3-butadiene concentration (excluding background) at RWR receptors, ranked by increase and by decrease in concentration

Rank	Ranking by increase in concentration relative to Do Minimum (µg/m^3)				Ranking by decrease in concentration relative to Do Minimum (µg/m^3)			
	2023-DS	2023-DSC	2033-DS	2033-DSC	2023-DS	2023-DSC	2033-DS	2033-DSC
1	1.6	1.5	1.1	0.8	-1.9	-1.6	-1.1	-1.0
2	1.5	1.4	0.9	0.8	-1.7	-1.6	-1.0	-0.9
3	1.5	1.3	0.9	0.8	-1.6	-1.5	-1.0	-0.9
4	1.4	1.2	0.9	0.8	-1.6	-1.5	-0.9	-0.9
5	1.4	1.2	0.8	0.7	-1.6	-1.5	-0.9	-0.9
6	1.4	1.2	0.8	0.7	-1.6	-1.4	-0.9	-0.9
7	1.3	1.1	0.8	0.7	-1.5	-1.4	-0.9	-0.9
8	1.3	1.1	0.7	0.7	-1.5	-1.4	-0.8	-0.8
9	1.3	1.1	0.7	0.7	-1.4	-1.4	-0.8	-0.8
10	1.3	1.1	0.7	0.7	-1.4	-1.4	-0.8	-0.8

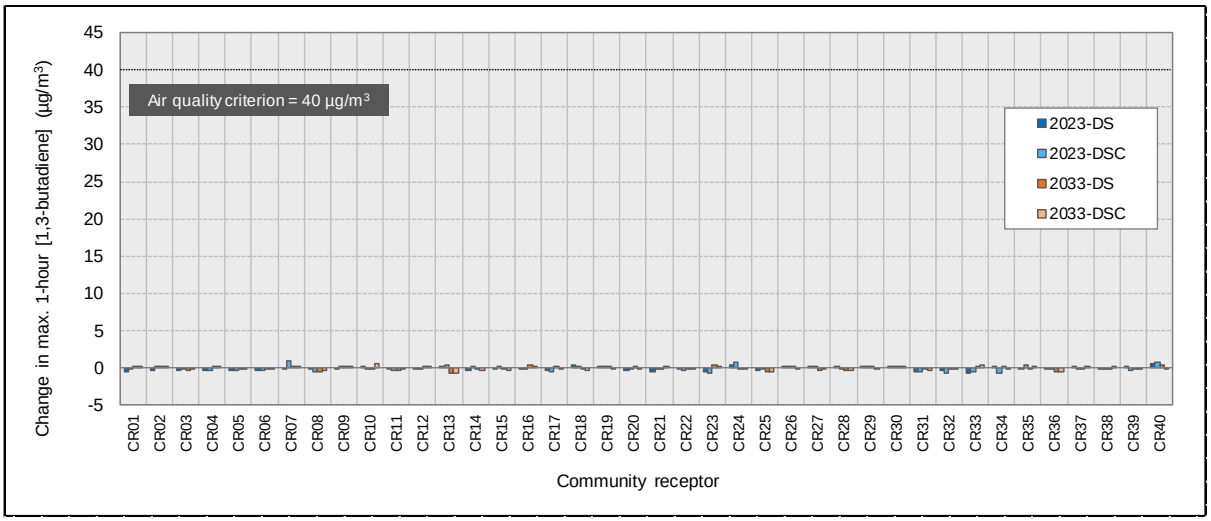

Figure K-126 Change in maximum 1-hour mean 1,3-butadiene concentration at community receptors

Annexure L – Ventilation report

Stacey Agnew

SMC

M4-M5 LINK – VENTILATION REPORT FOR ENVIRONMENTAL IMPACT STATEMENT

for SMC

26TH JULY 2017

REVISION HISTORY			
No.	**Date**	**Comment**	**Signed**
9	26th July 2017	Final for EIS exhibition	

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EXECUTIVE SUMMARY

This report describes the ventilation system concept design and performance for the M4-M5 Link tunnel (the project) and integrated operations of the WestConnex tunnel system, in the context of the Environmental Impact Statement (EIS) for the project. As well as explaining the design, later sections give the analysis results necessary for inclusion in the EIS. In support of the outcomes presented, this report includes the assumptions made, the treatment of analysis inputs, and the analysis methodology.

The M4-M5 Link is currently the third stage of the WestConnex program of works (the 'system'). Once completed, traffic will be able to travel completely underground between the M4 East and New M5 tunnels, which are both currently under construction

All three stages must be controlled together for a successful ventilation outcome. Designing the ventilation for M4-M5 Link is really the task of designing the ventilation for the entire WestConnex system, within the provisions of the already contracted M4 East and New M5.

The report documents the ventilation design of the project as an integral part of the combined WestConnex tunnel ventilation scheme. The interface plants under construction for the M4 East and New M5 projects are integral to the combined scheme.

The project (like the M4 East and New M5) is based on a longitudinal ventilation arrangement. Ventilation plants will be required at all traffic exit portals to ensure net inflow of air, to prevent portal emissions. Traffic entry portals will naturally have net portal inflow due to vehicle driven airflows. The interface points with M4 East and New M5 each have provisions for extracting tunnel air and replacing it with fresh air ('mainline air exchange') in both directions of travel.

It is expected that ventilation of the combined stages of WestConnex under most traffic conditions does not involve air exchange at the project interfaces. Vehicle driven airflows at the interchange ramps will provide effective exchange of air along the mainline, maintaining the in-tunnel conditions within the set air quality criteria. Tunnel air that is drawn along the exit ramps with the traffic will be extracted by the portal ventilation plants. A similar flowrate of fresh air will be drawn into entry ramps, diluting the mainline air that continued past the exit ramp. This is outlined diagrammatically in Figure E.1. The WestConnex system has on and off-ramps in both directions connecting with Rozelle interchange, St Peter's interchange, and Wattle St interchange at Haberfield.

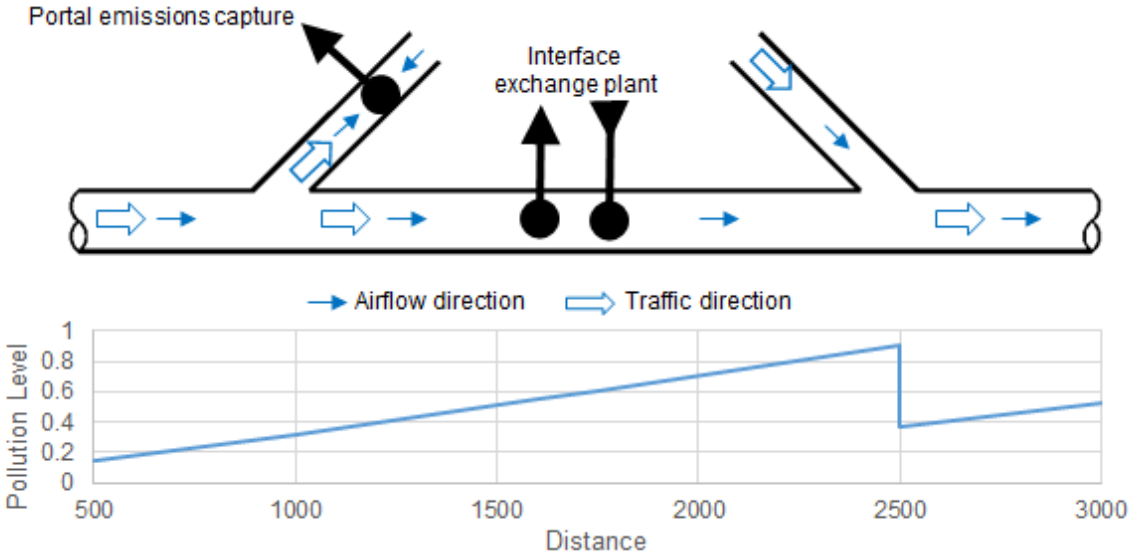

Figure E.1. Example, no interface exchange.

In the event of very slow traffic conditions throughout large portions of the tunnel system, complete air exchange at the interface plants will be required to maintain in-tunnel air quality. That is; all air approaching the interface exhaust point would be extracted and replaced with outside air. In that case (slow traffic) the exchange flowrates will be comparatively low, corresponding to the lower vehicle driven air flow along the tunnels. Mainline air exchange is shown diagrammatically in Figure E.2.

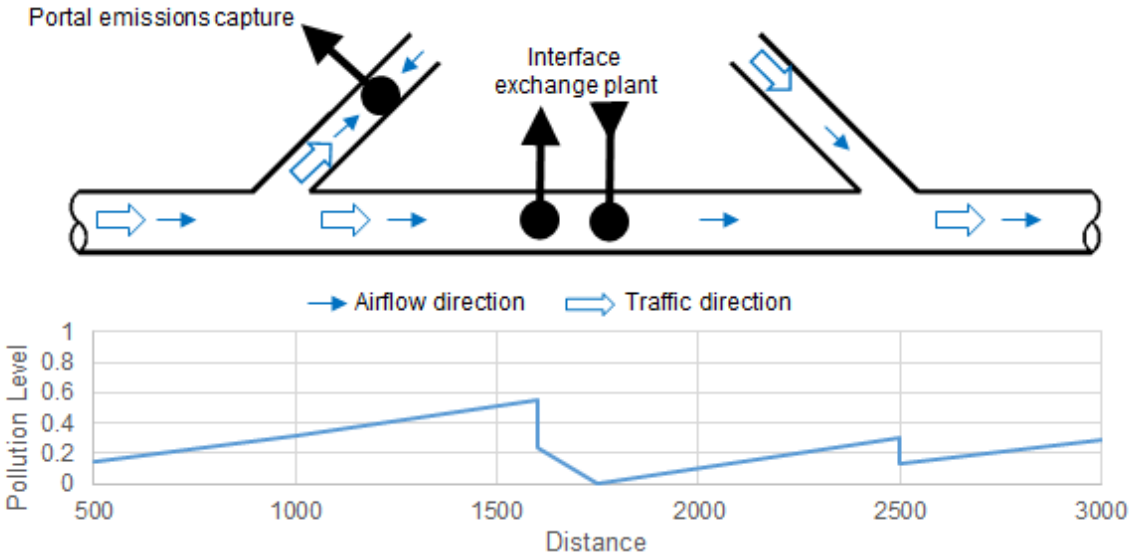

Figure E.2. Example, complete interface exchange.

With moderate levels of congestion throughout the tunnel system, the effective exchange occurring at the interchanges may not be sufficient on their own to maintain in-tunnel air quality. Under these circumstances, partial exchange may be required at the interface plants. That is, only part of the air approaching the exhaust point is extracted, with a similar amount of fresh air re-supplied. In this case, the tunnel airflows may be high, but only a fraction of this air is required to be exchanged by the interface plant. See Figure E.3 for a representation of the effects of partial exchange.

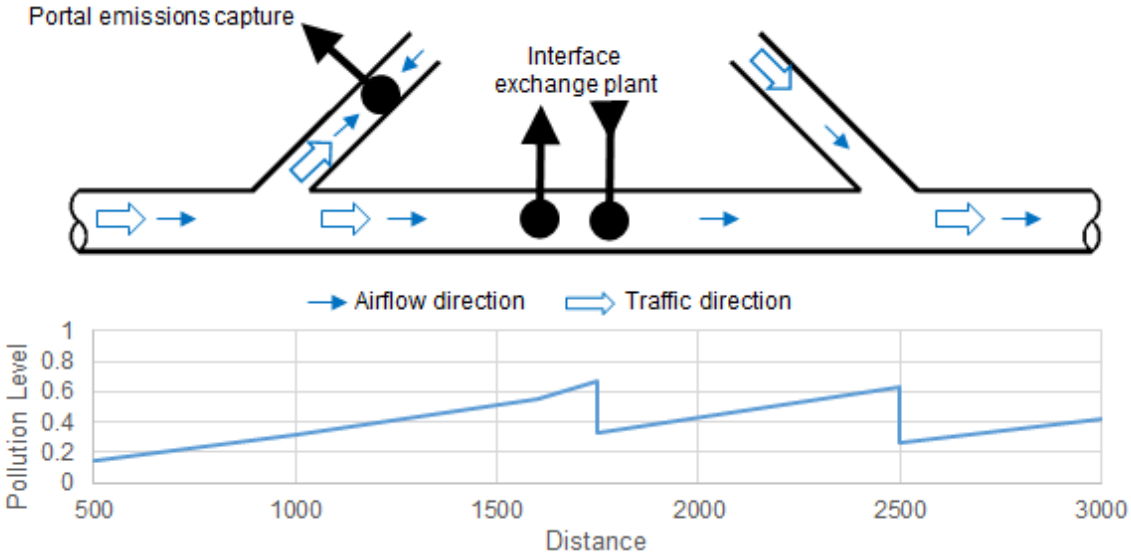

Figure E.3. Example, partial interface exchange.

This report includes the detailed analysis outputs necessary for environmental assessment, including the outlet emission parameters that are inputs to pollutant dispersion analysis. In line with other EIS components, in-tunnel air quality and external emissions have been assessed at 2023 and 2033, corresponding to opening year and 10 years after opening.

The design meets the in-tunnel pollution criteria for all traffic conditions. The limiting design traffic scenarios (severe congestion) are more onerous than the anticipated traffic flows, and so the criteria are met comfortably for the expected 2023 and 2033 traffic.

Figure E.4 below shows the overall ventilation scheme for WestConnex including the project. Possible future connections to F6 Extension and Western Harbour Tunnel are also indicated.

Analyses of tunnel ventilation for the M4 East and the New M5 EISs were undertaken in 2015 and these tunnels are now under construction. Changes to the analysis approach from those earlier studies, introduced for the project analysis, are noted in Section 6.12.

For the project, the PIARC-based method for estimating pollution and hence designing ventilation has been validated against 2015 M5 East data. That validation exercise is reported separately (Comparison of PIARC-based pollution estimates with measurements in the M5 East tunnel, Stacey Agnew, 2017). The conclusion is that the pollutant which controls ventilation design, NO_2, is well predicted by the approach that has been used for the project to date and so the current design procedure should continue to be used for design and system validation.

In-tunnel airflow, pollution levels and temperature, are simulated and analysed using software called IDA Tunnel, developed by EQUA AB in Sweden.

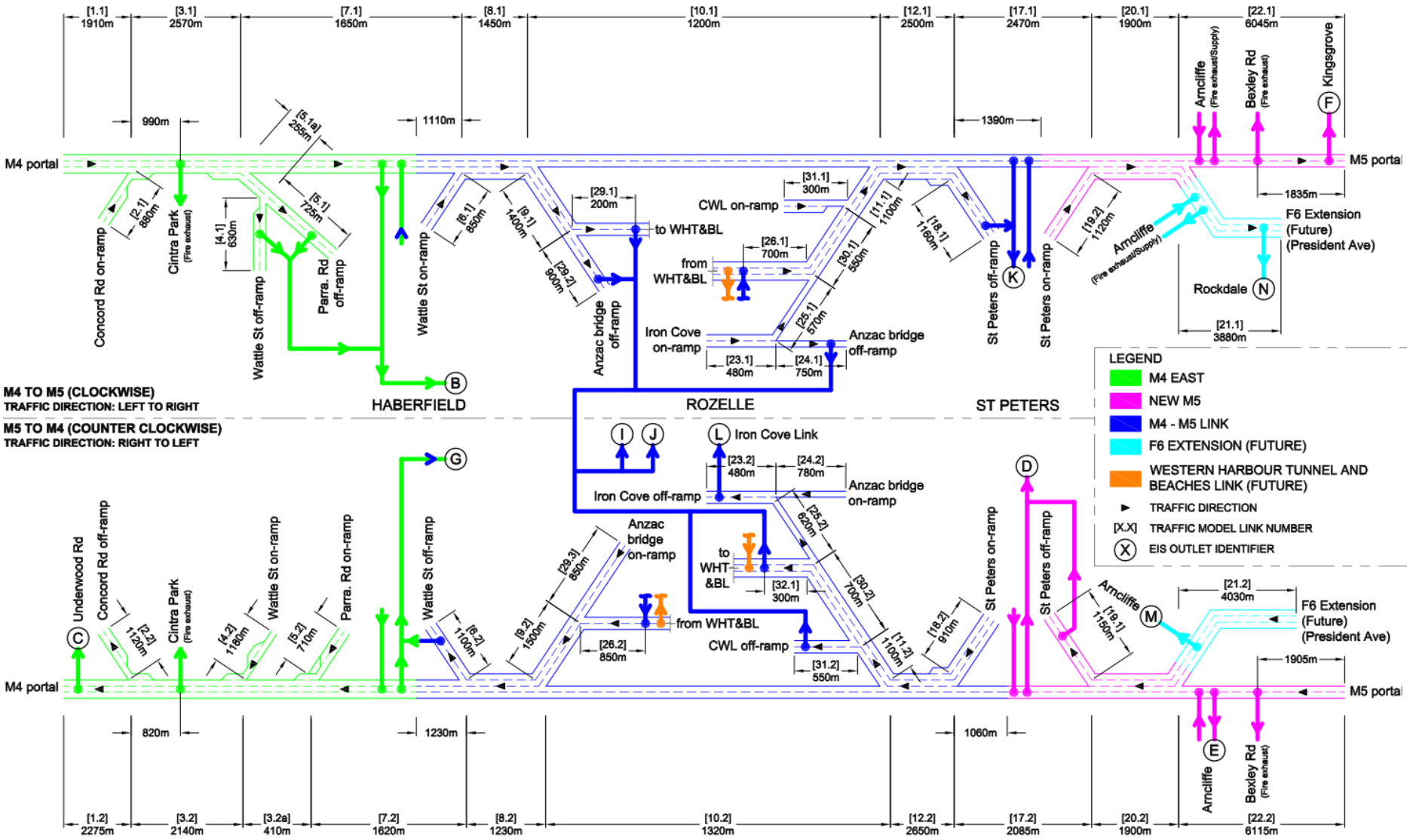

Figure E.4. WestConnex ventilation schematic including proposed future connections.

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1 DEFINITIONS, ABBREVIATIONS AND NOMENCLATURE

Term	Explanation
ACTAQ	Advisory Committee on Tunnel Air Quality. A committee chaired by the Chief Scientist and Engineer of NSW.
BOM	(Australian) Bureau of Meteorology. The source of climate and weather data.
Do minimum	A model or analysis scenario without M4-M5 Link. M4 East and New M5 operate in isolation.
Do something	A model or analysis scenario for the tunnel system with M4 East, New M5 and M4-M5 Link.
CASA	Civil Aviation Safety Authority.
CCW	The counter-clockwise traffic direction, see “M5 to M4”.
CO	Carbon monoxide.
CW	The clockwise traffic direction, see “M4 to M5”.
Cumulative	A model or analysis scenario for the tunnel system with M4 East, New M5, M4-M5 Link, proposed future Sydney Gateway (surface road from St Peters), and proposed future Western Harbour Tunnel. Includes proposed future Beaches Link and proposed future F6 Extension in some scenarios.
Expected (traffic)	The 24 hr traffic profiles based on demand predicted by WRTM v2.3.
F6 Extension	A proposed motorway link between the New M5 at Arncliffe and the existing M1 Princes Highway at Loftus, generally along the alignment known as the F6 corridor.
HGV	Heavy Goods Vehicle, generally aligned with PIARC HGV vehicle category.
Hour	Hour of the day, with the value representing the start time for the hour. That is, Hour 0 is the period midnight to 1 am, Hour 1 is the period 1 am to 2 am, etc.
Jet fan	A fan hung under the tunnel ceiling to add momentum to the tunnel air via a high-speed outlet air stream, and hence promote longitudinal airflow.
LDV	Light Duty Vehicle, generally aligned with PIARC LDV vehicle category.
PC	Passenger Car, generally aligned with PIARC PC vehicle category.
PCU	Passenger Car Unit. A unit used to represent an equivalent number of passenger cars for each real vehicle.
PIARC	Permanent International Association of Road Congresses, the global body which develops, collects and disseminates information about all aspects of road design and operation. Also known as the World Road Association. http://www.piarc.org/en/.
PIARC Australian tables	Tables in Section 3.1 of document 2012R05EN “Road tunnels: vehicle emissions and air demand for ventilation” by PIARC Technical

Term	Explanation
	Committee C4, December 2012. Used in a simplified estimation of vehicle emissions in Australian tunnels.
PIARC detailed method	The method for estimating vehicle emissions using the base emission tables in PIARC document 2012R05EN noted above.
Piston effect	Common term used to describe the effect of the vehicle aerodynamic drag force acting on the tunnel air to promote longitudinal air flow.
M4 East	A component of the WestConnex program of works. Located from Homebush Bay Drive, Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield (under construction).
M4 to M5	The general direction of traffic heading clockwise (CW) in the WestConnex project. This includes routes generally in the direction: • From the M4 East portal at Underwood Rd to the New M5 portal at Kingsgrove. • From the M4 East portal at Underwood Rd to Rozelle (including WHT, Anzac Bridge and Iron Cove link) • From Rozelle (including WHT, Anzac bridge and Iron Cove link) to the New M5 portal at Kingsgrove.
M5 to M4	The general direction of traffic heading counter clockwise (CCW) in the WestConnex project. This includes routes generally in the direction: • From the New M5 portal at Kingsgrove to the M4 East portal at Underwood Rd. • From the New M5 portal at Kingsgrove to Rozelle (including WHT and Iron Cove link). • From Rozelle (including WHT and Iron Cove link) to the M4 East portal at Underwood Rd.
New M5	A component of the WestConnex program of works. Located from Kingsgrove to St Peters (under construction).
NO_2	Nitrogen dioxide.
NO_X (NO_2 equivalent)	Oxides of Nitrogen. Within this report, is assumed as NO + NO_2 only and expressed as NO_2 equivalent.
PM	Particulate matter. Within this report means either vehicle exhaust or roadway based (non-exhaust).
Regulatory demand (traffic)	The demand traffic scaled up to the theoretical traffic capacity of the system.
Roads and Maritime	NSW Roads and Maritime Services.
SEARs	Secretary's Environmental Assessment Requirements.
The project	The M4-M5 Link project.
Worst case (traffic)	The traffic case(s) which result in the most onerous requirements for the tunnel ventilation system.
WHT	Western Harbour Tunnel.
WHT&BL	Western Harbour Tunnel and Beaches Link.

Term	Explanation
WRTM	WestConnex Road Traffic Model, the source of the traffic forecast used in this work.

1.1 Schematic nomenclature

To assist the reader, schematic diagrams throughout this report have been prepared in a uniform manner wherever practicable. Figure 1.1 outlines the nomenclature used.

The schematics within this report are intended only to show the overall connectivity between the tunnel and ventilation outlet and supply plant. They do not represent the physical layout and/or connections.

Colour coding is used to represent, at a broad level, the scope elements of the various projects. For the M4-M5 Link and WHT interface, the following colour coding has been adopted:

- Exhaust: The project that generated the vehicle emissions
- Supply: The project that required the fresh air supply

The colour coding may generally follow the contractual scope responsibility but is not guaranteed to be an exact representation.

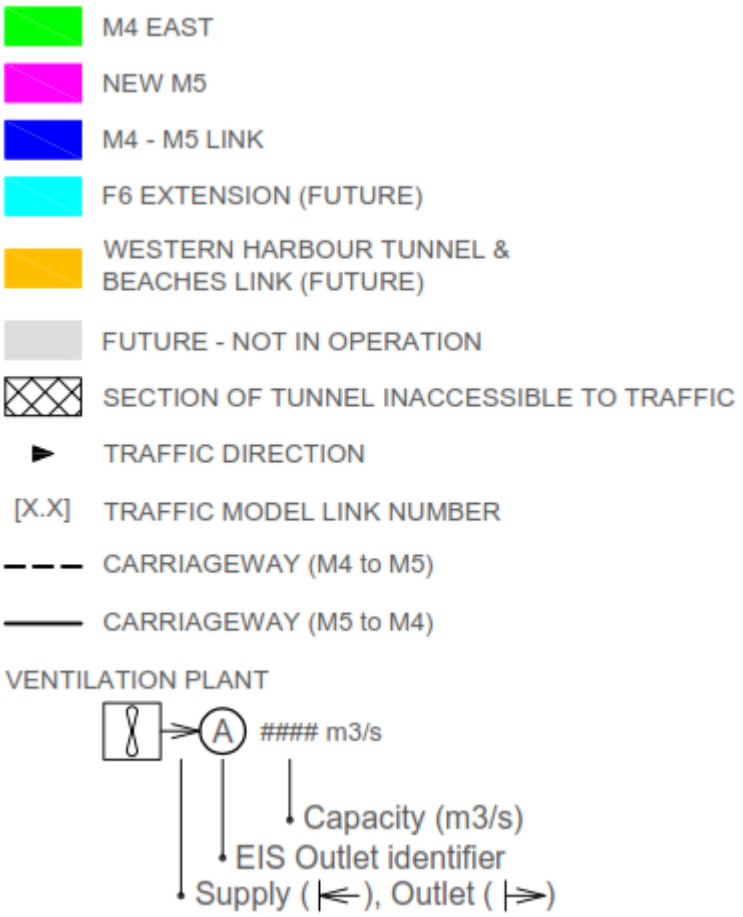


Figure 1.1 Schematic nomenclature

2 INTRODUCTION

The tunnel ventilation system must continuously, reliably and efficiently provide a safe environment for tunnel users and external communities. Techniques for achieving these in simple tunnels are well known. However, the WestConnex tunnel network will be one of the largest motorway tunnel networks in the world. Figure 2.1 shows the layout of the whole WestConnex tunnel system, including the proposed future Western Harbour Tunnel and F6 Extension projects. The WestConnex system has 23 km of twin-tube tunnel, 13 underground merge zones, 10 ramp diverges, 10 on-ramps and 11 off-ramps.

With the number of underground intersections, there is a significant number of different potential incidents requiring effective ventilation. Even without an incident, the random variation in traffic requires a robust and responsive ventilation system. The ventilation will be controlled as one system across WestConnex, both for safe emergency responses and for minimizing power costs for day to day coordinated operations.

This report discusses a range of analyses and presents the associated results for a number of different tunnel configurations (scenarios). As a guide to the content, Table 2.1 outlines the matrix of analysis completed and identifies the location of the associated results within this report.

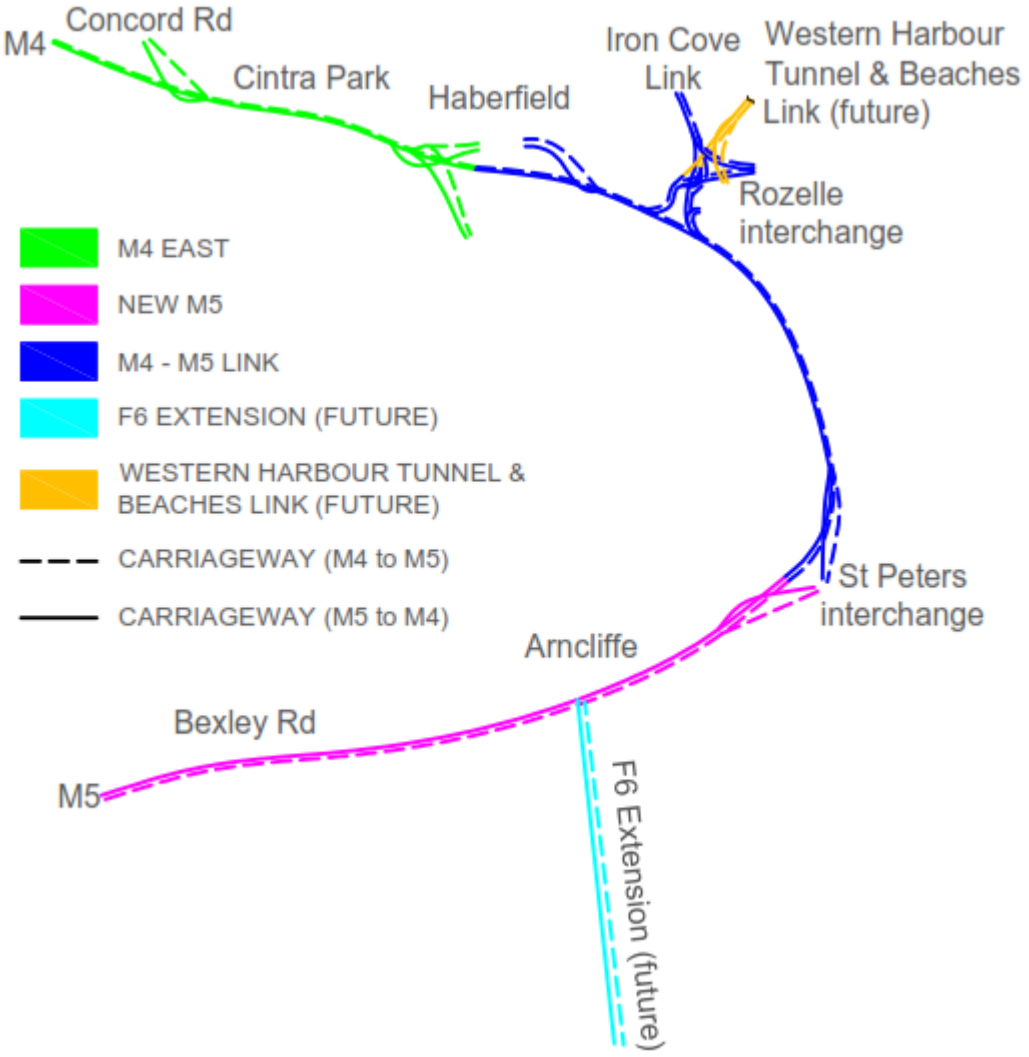


Figure 2.1. Layout of the WestConnex tunnel network.

Table 2.1. Summary of analysis scenarios.

Scenario	**Do minimum**		**Do something**		**Cumulative**	
Year (traffic and vehicle emissions)	**2023**	**2033**	**2023**	**2033**	**2023**	**2033**
Tunnel arrangement						
M4 East	X		X		X	
New M5	X		X		X	
M4-M5 Link			X		X	
Sydney Gateway*					X	
Western Harbour Tunnel					X	
Beaches Link						X
F6 Extension						X
Expected traffic (24 hr) operations	Section 9.1.1	Section 9.1.3	Section 9.2.1	Section 9.2.3	Section 9.3.1	Section 9.3.2
Regulatory demand traffic (24 hr) operations	Section 9.1.2	Section 9.1.4	Section 9.2.2	Section 9.2.4		
Worst case traffic operations	n/a	n/a	Section 10, Section 10.1		n/a	Section 10, Section 10.2
Temperature estimates - Expected traffic (24 hr) operations	n/a	n/a	n/a	n/a	Section 11.1	Section 11.2

* surface road that does not form part of the tunnel network but forms part of the WRTM traffic predictions.

Expected traffic (24 hr) operations: Represents the expected operation of the tunnel ventilation system under day-to-day conditions of expected traffic demand. Vehicle emissions are based on the design fleet in the corresponding year, with results presented both for in-tunnel air quality and for outlet emissions for use by others in assessing ambient air quality.

Regulatory demand traffic (24 hr) operations: Represents the same as expected traffic (24 hr) operations, but with the traffic demand scaled up to reach the theoretical capacity of the system.

Worst case traffic operations: The range of traffic cases which result in the most onerous requirements for the tunnel ventilation system. This encompasses traffic conditions such as congestion (with average speed >20 km/h) and vehicle breakdowns as well as free-flowing traffic at maximum capacity.

Temperature estimates: The predicted outlet temperatures and variability based on expected traffic (24 hr) operations.

3 PROJECT OVERVIEW

3.1 M4-M5 Link

As shown in Figure 2.1, the project will connect three other motorway tunnel projects; two of which are already under construction (New M5 and M4 East), and the proposed future Western Harbour Tunnel and Beaches Link (WHT&BL). The project must be designed for compatibility with the known designs of New M5 and M4 East and provide flexibility for possible future connection to WHT&BL. Figure 3.1 shows the Rozelle interchange incorporating a future WHT&BL. Figure 3.2 shows the Rozelle interchange without the future WHT&BL project.

The project may be constructed and opened to traffic in two stages:

1) Mainline tunnels between the M4 East at Haberfield and the New M5 at St Peters including entry and exit ramps to the Wattle Street interchange at Haberfield and the St Peters interchange at St Peters.
2) Rozelle interchange to connect the mainline tunnels with a) the surface road network and Anzac Bridge, b) the Iron Cove Link and c) the future WHT&BL.

Throughout this report, the project is analysed with both stages noted above completed.

For interim operation with only the mainline tunnel between M4 East and New M5, restricting all tunnel sections within the project to a maximum of two lanes occupancy would not require any increase in the installed ventilation capacity over and above that required for the completed project.

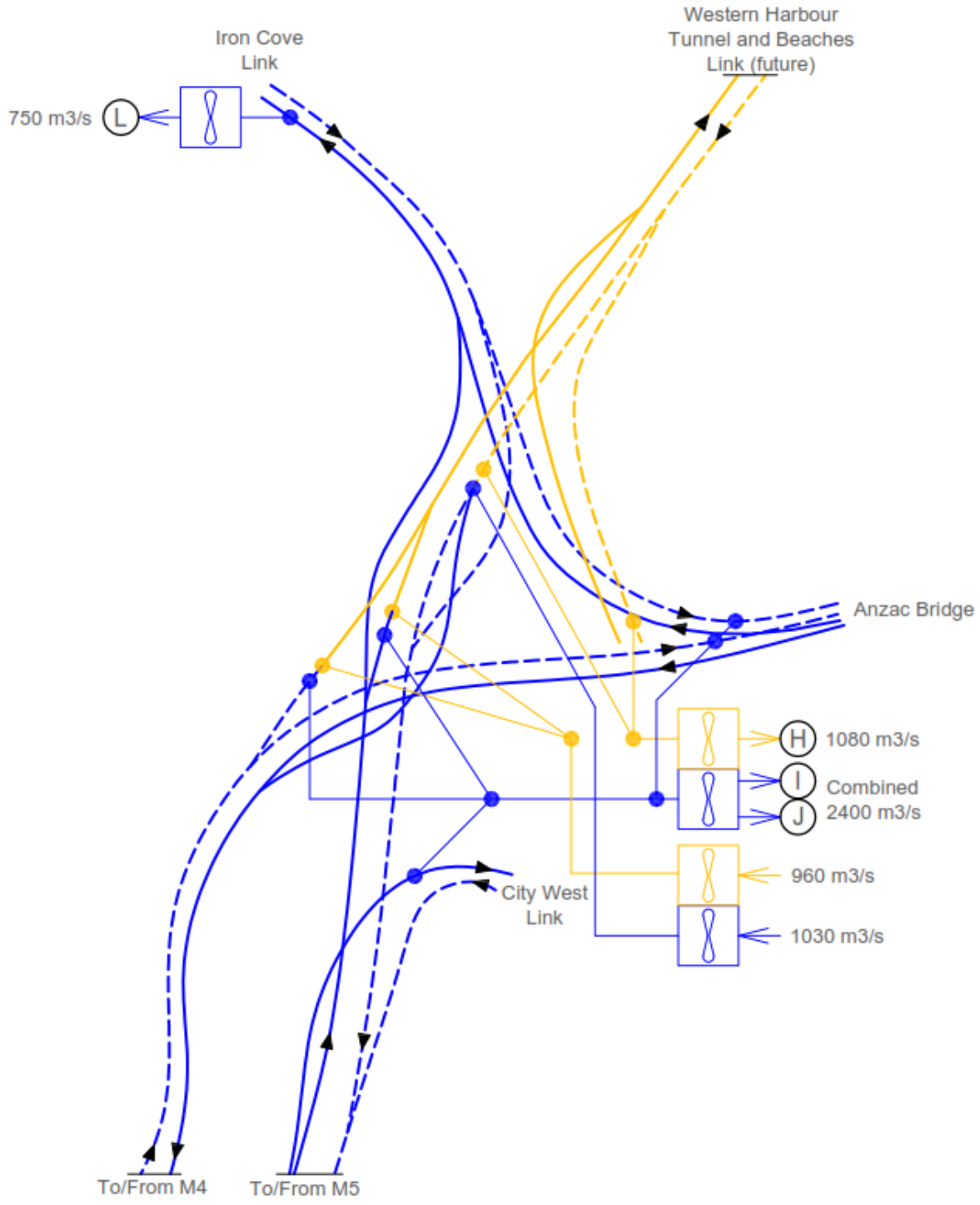


Figure 3.1. Schematic of Rozelle interchange with future Western Harbour Tunnel and Beaches Link.

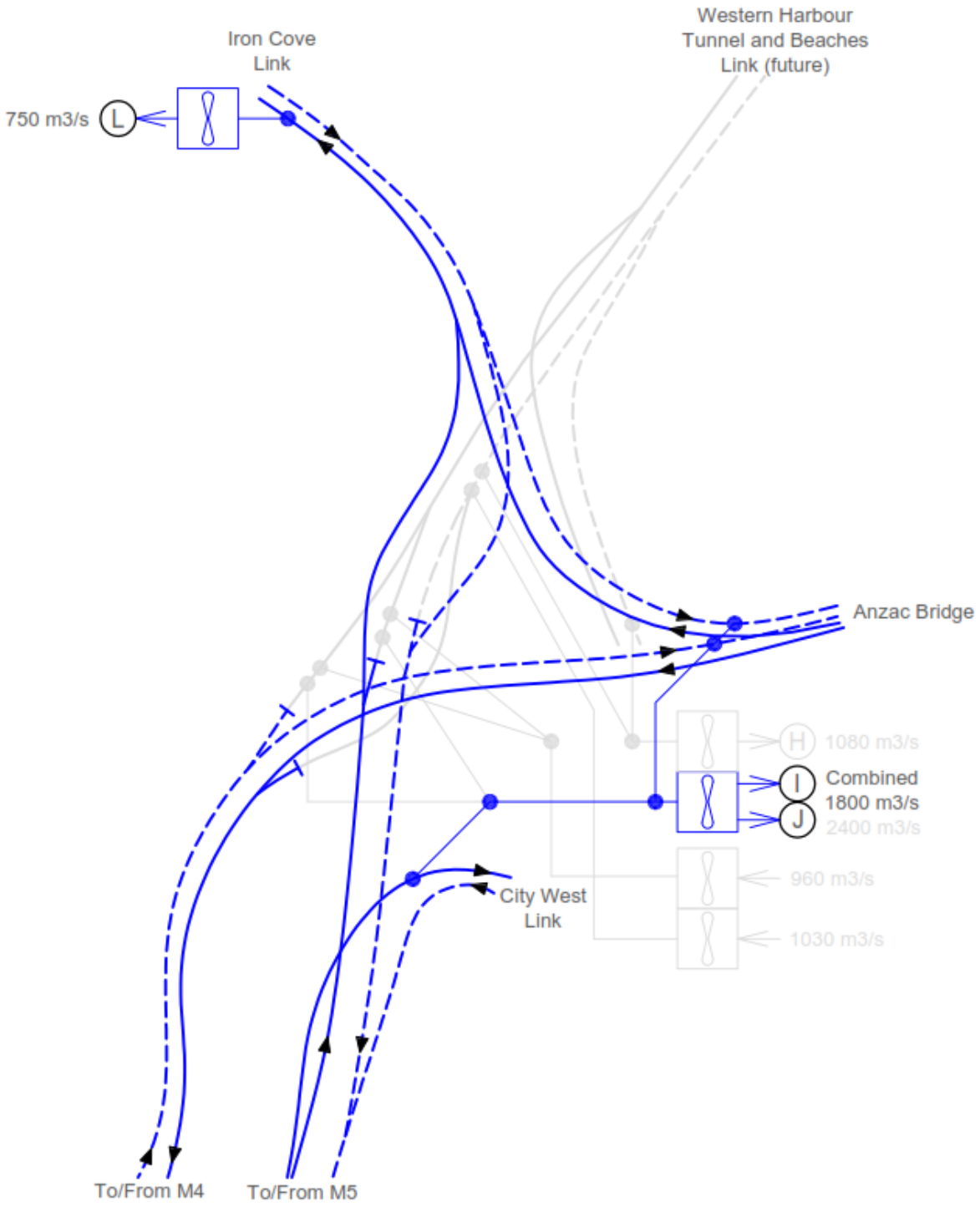


Figure 3.2. Schematic of Rozelle interchange without future Western Harbour Tunnel and Beaches Link.

3.3 New M5

The New M5 tunnels connect to the project between the two sets of ramps at St Peters Interchange (SPI). Figure 3.3 shows the ramps and the construction interface. Provision for mainline air exchange is being made by the New M5 contractor for the northbound tube, and by the project for the southbound tube. The reasoning behind splitting the ventilation plant between the projects was to allow the interface exhaust plant to be co-located with exhaust plant capturing the exit ramp flows.

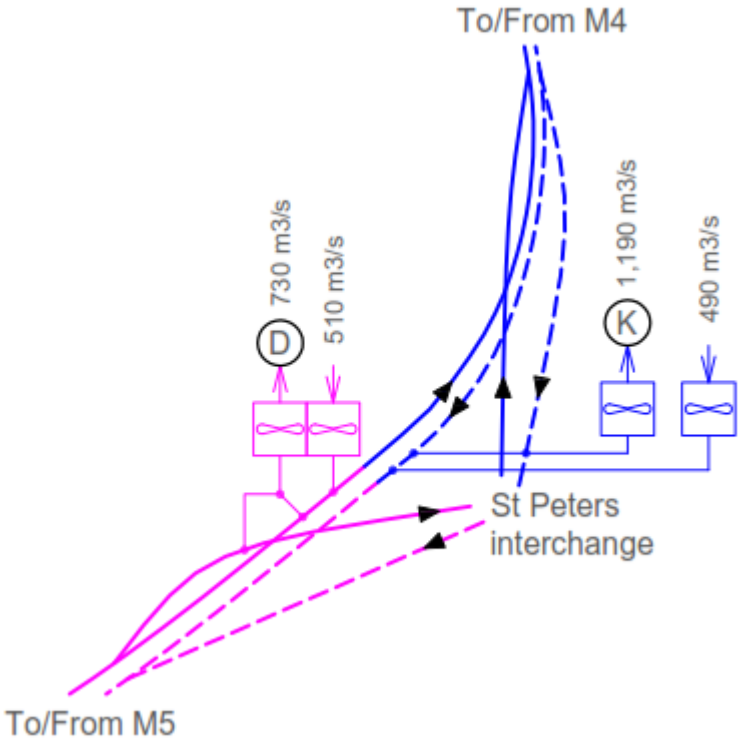


Figure 3.3. Schematic of the St Peters interchange (M4-M5 Link / New M5 interface).

3.4 M4 East

The M4 East tunnels connect to the project between the two sets of ramps which connect to Wattle Street, Haberfield. Figure 3.4 shows that interface. Buildings to house the ventilation plant for mainline air exchange and portal capture from exit ramps in both directions are being constructed by the M4 East contractor. The eastbound supply fans and the westbound exhaust fans will be provided and installed in those buildings by the project.

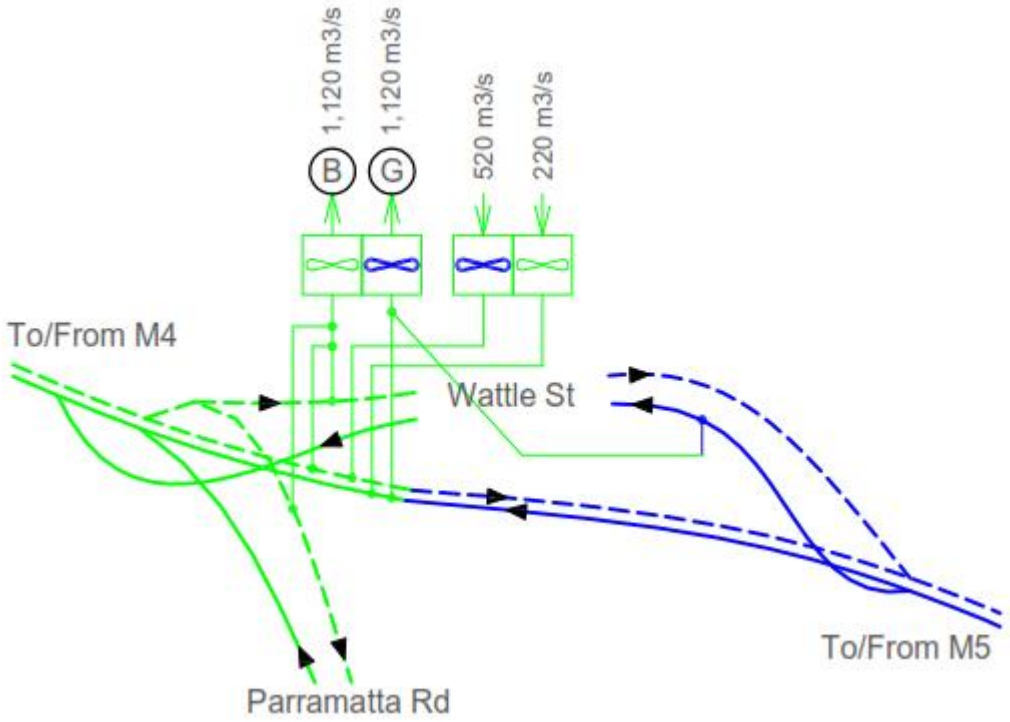


Figure 3.4. Schematic of the Wattle St interchange (M4-M5 Link / M4 East interface).

3.5 Potential Future Tunnel connections

3.5.1 Western Harbour Tunnel and Beaches Link

The future Western Harbour Tunnel and Beaches Link connects Sydney's northern suburbs to the WestConnex system at Rozelle interchange as shown in Figure 3.1.

It is assumed that all air is exhausted and fresh air re-supplied at the M4-M5 Link / WHT&BL interface points in both directions at all times. That is, there is no carry-over of pollution between the two projects. This is the most conservative assumption that can be made for sizing of the interface ventilation plant.

In calculating the emissions from the southbound WHT&BL to be captured by the interface plant in Rozelle, it is assumed there is no carry-over of polluted air from any tunnel section upstream of North Sydney. That is, the tunnel section heading southbound from North Sydney to M4-M5 Link receives only fresh air at North Sydney.

With overall details of WHT&BL alignment, geometry and traffic demand unknown to the authors at the time of this report, the above assumptions are the only practical basis of analysis. If the WHT&BL ventilation system adopts a scheme with some carry-over past North Sydney, this may increase emissions from the WHT&BL outlet within Rozelle compared to the estimates in this report.

Any changes to the assumptions herein would need to be considered separately as part of the WHT&BL project.

3.5.2 F6 Extension

The proposed F6 Extension links the southern Sydney road network to the WestConnex tunnels part way along New M5. Interface requirements for F6 Extension included within the scope of the New M5 tunnel contract are shown in Figure 3.5. This work assumes the following at the interface with F6 Extension:

- In the northbound direction of travel, all air arriving at Arncliffe from both M5 and F6 Extension is exhausted and the tunnel re-supplied with fresh air.
- In the southbound direction, no air is exhausted during normal operations and passes through the interface to both New M5 and F6 Extension.

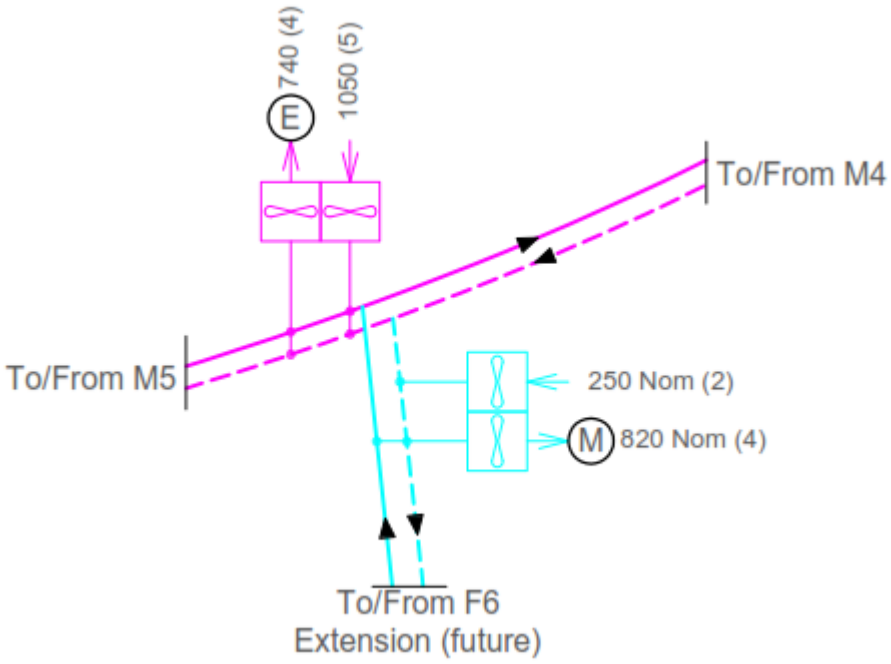


Figure 3.5. Schematic of F6 Extension interface with New M5.

It is assumed that F6 Extension tunnels connecting to New M5 effectively start and finish at President Ave from a ventilation perspective. That is, F6 Extension is assumed to perform complete exchange of air at President Avenue with no-carry over of pollution in either direction. Any emissions arriving at President Avenue from tunnels south of President Avenue have not been assessed.

Any changes to the assumptions herein would need to be considered separately as part of the F6 Extension project.

4 SCOPE AND STRUCTURE

4.1 Purpose of Report

This report documents the ventilation design and analysis for the purposes of the Environmental Impact Statement (EIS). It records the input data used in the tunnel ventilation analysis, and the predicted air flow, temperature and pollution levels, both in-tunnel and at the ventilation outlets. The important outputs are the predicted emissions for both demand and limiting capacity traffic cases, pollution levels along the tunnel and the ventilation plant capacity. The ventilation design for emergency response is also described in this report.

4.1.1 M4 East EIS Ventilation Report

The M4 East EIS Ventilation Report (Appendix L to the Air Quality Impact Assessment in Appendix H of the M4 East EIS) is largely superseded by this report and the M4 East project. The current geometry and alignment of the project differs from that foreseen in the M4 East contract and the M4 East EIS. The significant changes include:

- The project now incorporates a continuous underground connection between M4 East and New M5. Previously the M4-M5 Link surfaced at Rozelle, which from a ventilation perspective meant the M4 East and New M5 were isolated from each other.
- Increase in the size of the mainline the project carriageways linking Rozelle to Haberfield from 3 to 4 lanes; links 8.1 and 8.2 of Figure 5.1.

Responsibility for design and construction of the M4 East ventilation plant now lies with the M4 East project, superseding all plant capacity and other requirements outlined in the M4 East EIS report.

This report:

- supplements the M4 East project, reviewing interface plant capacity for the coordinated operation of the WestConnex tunnel system, incorporating revised tunnel geometry for the project and additional traffic demand for differing years of operation, and;
- supersedes the M4 East EIS Ventilation report for analysis and results associated with operation after connection of the project.

4.1.2 New M5 EIS Ventilation Report

The New M5 EIS Ventilation Report (Appendix L to the Air Quality Impact Assessment in Appendix H of the New M5 EIS) is largely superseded by this report and the New M5 project. The current geometry and alignment of the project differs from that foreseen in the New M5 project and New M5 EIS. The significant changes include:

- The project now incorporates a continuous underground connection between M4 East and New M5. Previously the project surfaced at Rozelle, which from a ventilation perspective meant the M4 East and New M5 were isolated from each other.
- Increase in the mainline project carriageways, linking Rozelle to St Peters, from 3 to 4 lanes; links 12.1 and 12.2 of Figure 5.1.

Responsibility for design and construction of the New M5 ventilation plant now lies with the New M5 project, superseding all plant capacity and other requirements outlined in the New M5 EIS report.

This report:

- supplements the New M5 project, reviewing interface plant capacity for the coordinated operation of the WestConnex tunnel system, incorporating revised tunnel geometry for the project and additional traffic demand for differing years of operation.
- Supersedes the New M5 EIS Ventilation report for analysis and results associated with operation after connection of the project.

5 TUNNEL VENTILATION OVERVIEW

5.1 Objectives

The primary objectives of the ventilation system for WestConnex are:

1) Maintain in-tunnel air quality within the adopted criteria under the range of plausible traffic conditions. Within the context of the concept design, this means all traffic conditions where the vehicle speed is above 20 km/h.
2) Maintain a net inflow of air into all traffic portals to prevent emissions from these locations during normal operations.
3) During a fire, control the spread of smoke to support both the safe evacuation of occupants from the tunnel and access for emergency response personnel. The primary goal is to achieve critical velocity at the fire site to prevent back layering of smoke.

5.2 Concept design scheme

The tunnel ventilation scheme for the WestConnex project is based on longitudinal ventilation. The overall scheme is shown in Figure 5.1. Longitudinal ventilation is driven by the vehicle piston effect, supplemented with jet fans if the traffic were to become too slow such that the piston effect was insufficient. The ventilation plant for the concept design scheme consists of three major elements, each with a different general purpose:

1) Portal emissions capture plant: Ventilation plant (exhaust) will be provided at approaches to all vehicle exit portals, to ensure a net inflow of air, preventing portal emissions. As the vehicle piston effect results in a natural inflow of air for vehicle on-ramps, there is no requirement to provide ventilation plant at vehicle entry portals.
2) Project interface plant: Ventilation plant (exhaust and supply) will also be provided at the interface points between the various WestConnex projects and also with future (external) connecting tunnel projects. The purpose of these facilities is twofold:
    a. Provide smoke separation between the projects during emergency scenarios, minimising the smoke affected portions of the network as far as practicable.
    b. Assist in maintaining air quality criteria across the network if the traffic was to become slow across significant portions of the network.
3) Jet fans: Jet fans are used to supplement the vehicle piston effect if the traffic is slow.

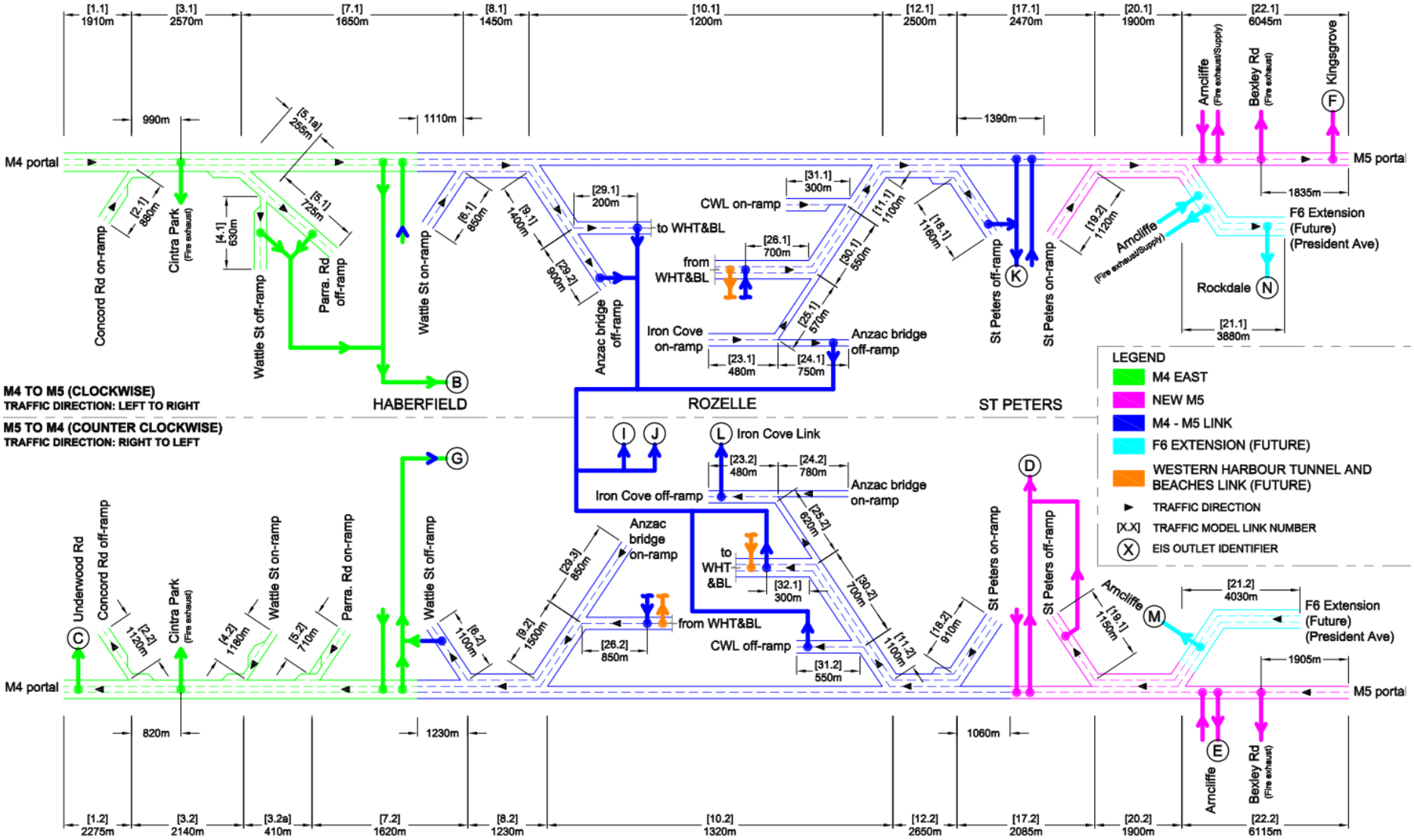


Figure 5.1. WestConnex tunnel network geometry in schematic form.

The operation, and consequently the required plant capacity, of the ventilation equipment is dependent on the traffic conditions within the tunnel. In practice, operating requirements will depend on traffic speed, traffic flows and their variation across the network. At a conceptual level, the ventilation equipment needed during normal operations is correlated with the traffic speed as shown in Table 5.1.

Table 5.1. Indicative ventilation plant requirements for normal operations.

<table>
<tr><th>Traffic speed (km/hr)</th><th>Portal capture ventilation plant</th><th>Interface ventilation plant</th><th>Jet fans</th></tr>
<tr><td>80</td><td rowspan="3">Maximum demand</td><td>Not required</td><td rowspan="2">Not required</td></tr>
<tr><td>70</td><td rowspan="2">Minimal demand</td></tr>
<tr><td>60</td><td rowspan="3">Minimum demand</td><td rowspan="2">Minimal demand</td></tr>
<tr><td>40</td><td rowspan="3">Maximum demand</td></tr>
<tr><td>30</td><td rowspan="2">Moderate demand</td><td>Moderate demand</td></tr>
<tr><td>20</td><td>Maximum demand</td></tr>
</table>

Considering both normal and emergency operations, the installed capacity of the various plant is governed as follows:

Portal emissions capture:

1) The highest volume of free-flowing traffic at 80 km/hr.

Interface:

1) Exhaust capacity to ensure pollution criteria is achieved across the network.
2) Exhaust capacity to ensure smoke capture from the upstream project.
3) Supply capacity to support the downstream project air quality criteria.
4) Supply capacity as required for a fire case in the downstream project.

Jet fans:

1) The highest volume of the slowest traffic (20 km/hr).
2) The design fire size and the length of stopped queue behind the fire.

Under most traffic conditions (free-flowing traffic) ventilation of WestConnex does not involve operation of the interface plants. Vehicle driven airflows at the interchange ramps located at Rozelle, St Peter's and Wattle St (Haberfield), would provide effective dilution of pollutants to maintain in-tunnel air quality criteria. Tunnel air that is drawn along the exit ramps with the traffic would be extracted by the portal ventilation plant. A similar flowrate of fresh air would be drawn into entry ramps, diluting the mainline air that continued past the exit ramp. This is outlined diagrammatically in Figure 5.2. Under these traffic conditions, tunnel airflows are at their highest, the portal capture plants would be operating at their peak capacity, and no jet fans would be required to supplement vehicle drawn airflows.

With moderate levels of congestion, the effective exchange occurring via the interchange ramps may not be sufficient to maintain in-tunnel air quality across the network. Under these circumstances, partial exchange may be required at the interface plants to supplement the ramp exchange. That is, part of the air approaching the interface plant exhaust point would be extracted, with a similar amount of fresh air re-supplied. In this case, the tunnel airflows may still be relatively high, but only a fraction of this air is required to be exchanged by the interface plant. See Figure 5.3 for a representation of the effects of partial exchange. Under these traffic conditions, tunnel airflows are at least at moderate levels, not requiring assistance from jet fans. The portal emissions capture plants would be operating below their peak capacity and the interface plant would be operating at or near its peak capacity.

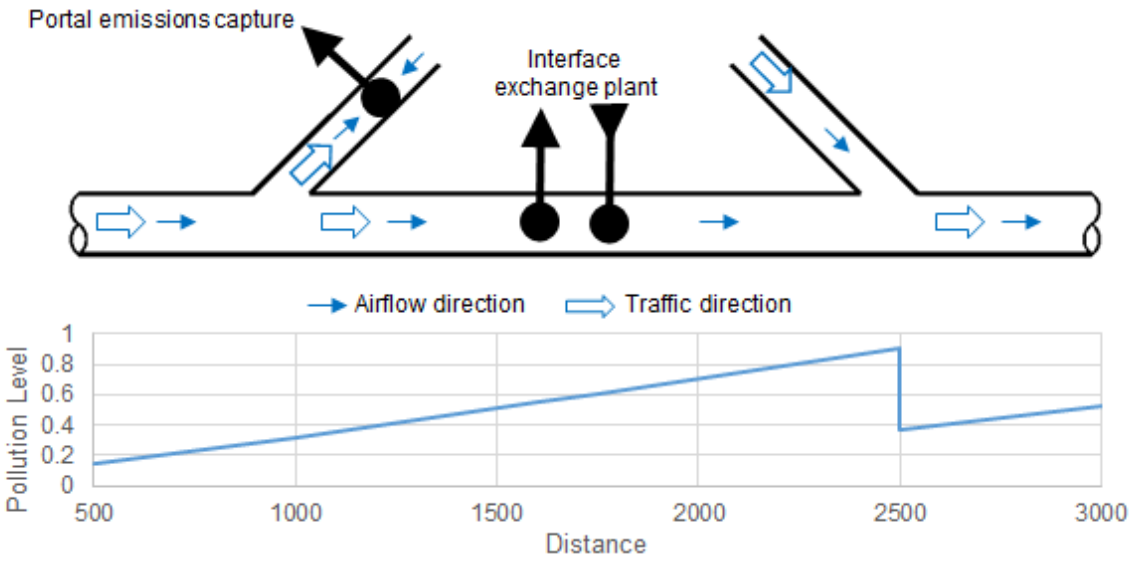


Figure 5.2 Diagramatic effect of mainline pollution levels with no interface exchange

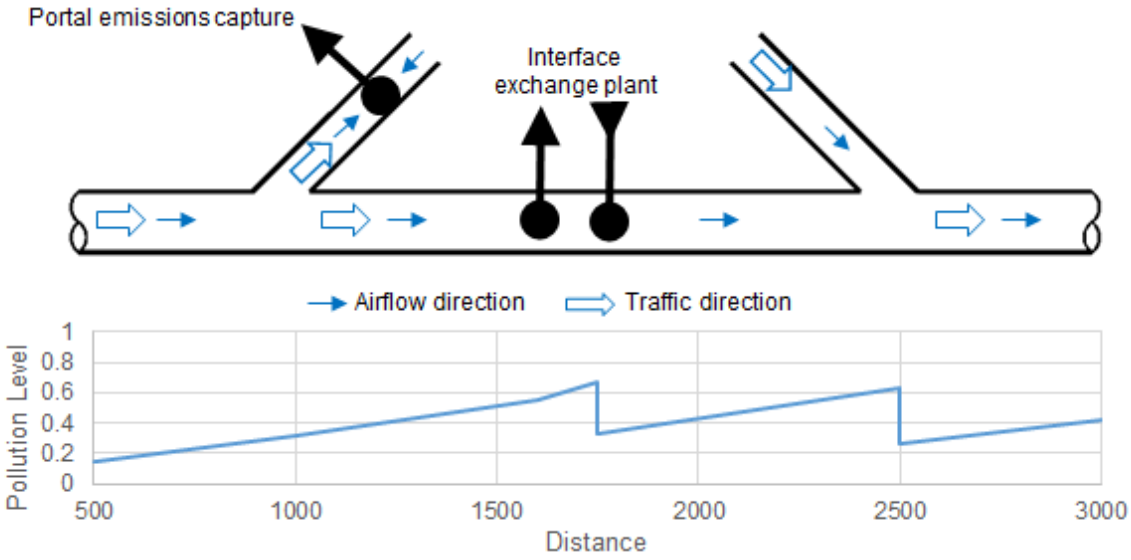


Figure 5.3 Diagramatic effect of mainline pollution levels with partial interface exchange

With very slow traffic conditions (congestion) throughout large portions of tunnel system, complete air exchange at the interface plants may be required to maintain in-tunnel air quality. That is; all air approaching the interface exhaust point would be extracted and fresh air re-supplied in similar quantity. In that case, the piston effect of vehicles may also be insufficient, requiring jet fans to operate to increase the tunnel airflows. This is shown diagrammatically in Figure 5.4.

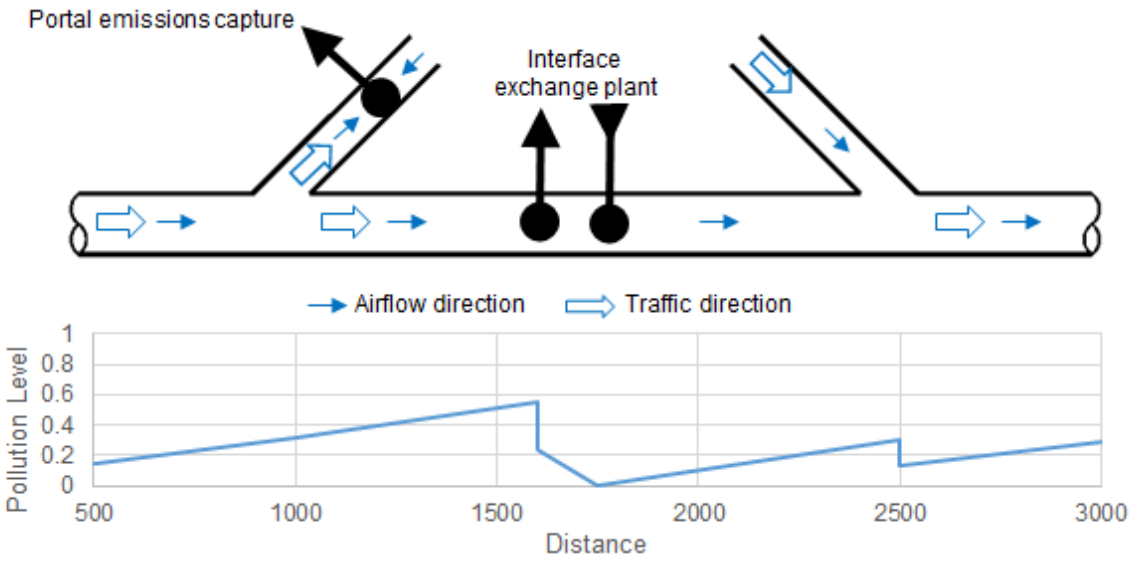


Figure 5.4. Diagramatic effect of mainline pollution levels with complete interface exchange.

5.3 Ventilation control and operating philosophy

The control of the ventilation has to successfully respond to behaviours on a wide range of timescales. The traffic in normal operation may vary slowly, and with the inertia of the long tunnels, changes will be seen over minutes. The presence of ramps shortens the tunnel sections and so allows flows to change more rapidly in response to lower numbers of vehicles. In considering the change in flow of a tunnel section, together with the need for flow to obey continuity, it is seen that the time constant of flow variation is set by the second shortest path to atmosphere. Where a short ramp comes off a mainline with long tunnel sections either side, it is not the ramp inertia, but the inertia of the shortest mainline section that determines the likely rates of change of flow. There is only one pair of short ramps in the system, being the Wattle St and Parramatta Road off-ramps at Haberfield. The M4 East Contractor is addressing the control of total flow and flow split in those ramps. Some other short tunnel sections may be introduced by the Rozelle Interchange.

Jet fan control of flow in short tunnels was successfully implemented recently on the Terrace Tunnel in Wellington, NZ. It is a 460 m long bidirectional road tunnel, with strong and varying external wind, and traffic which surges in one direction due to upstream traffic lights. Recent validation has confirmed successful achievement of a minimum flow in either direction with low power consumption[1]

5.3.1 Normal operations

Figure 5.5 outlines the typical control block diagram and operating philosophy used in the concept design for the project, and for analysis of the WestConnex system normal operations. The exception to this philosophy is the Concord Road westbound off-ramp, which is ventilated as an on-ramp, using jet fans to direct air back into the mainline.

[1] Abstract submitted to 16th Australasian Tunnelling Conference, Sydney, 30 Oct to 1 Nov 2017.

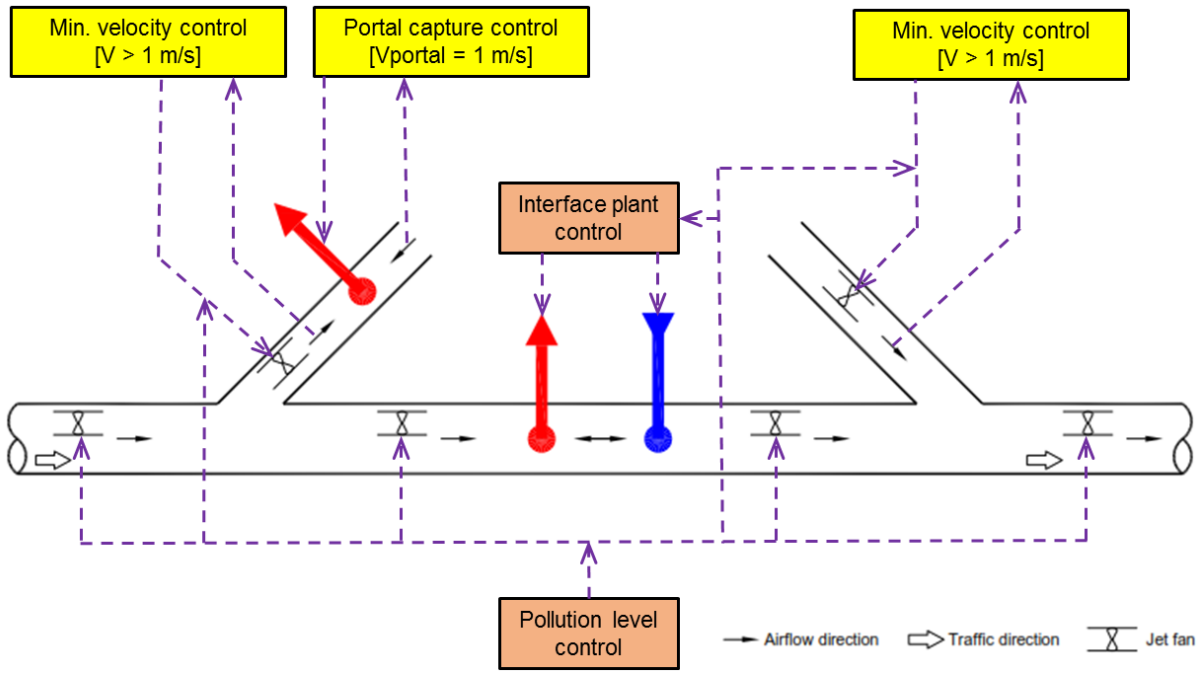


Figure 5.5. Overview of ventilation control.

The control philosophy consists of two primary actions during normal operations indicated by different highlighted colours in Figure 5.5. The ventilation design has adopted the following targets across all normal operations simulations for the project, consistent with previous stages of WestConnex.

Minimum requirements (yellow):

- Minimum velocity: A minimum velocity of 1 m/s intended to avoid possible situations of stagnation and flow reversal. Jet fans are used in control loops in the simulations to ensure that these minimum airflow requirements are respected in on and off-ramps.
- Portal emissions capture: A target portal inflow of 1 m/s, measured at the nominal cross-section of the off-ramp is ensured by setting the extraction rate prior to the portal.

Under most traffic conditions, the ventilation system can be operated in a number of ways to achieve the required outcomes. Ventilation plant (exhaust and supply) plants generally offer better efficiency and controllability compared to using jet fans to achieve the required air quality. For these reasons, the following philosophy has been adopted throughout the ventilation design, with the control actions listed in order of first preference in operation to achieve maximum overall efficiency:

1) Portal emissions capture plant is operated to ensure net portal inflow of the natural vehicle-driven airflows. That is; jet fans are not used to actively control system airflow. An exception to this is M4 East Concord Rd off-ramp, which does not have a portal capture facility and jet fans are used to drive airflow from the exit portal back to the mainline for exhaust at the M4 portal.
2) Where in-tunnel pollution needs to be further controlled, interface plant is operated to exchange air, in preference to using jet fans to increase tunnel airflows.
3) Only the most downstream interface plant is operated when necessary. That is to say, if pollution levels within the downstream section (to the next interface plant) are within criteria, then the interface plant is not operated. If required to operate, the interface plant is operated only to the level required to achieve pollution criteria along

the routes to the next downstream interface plant. This ensures that pollution is extracted from the system at the highest efficiency. Exceptions to this are:

a. Interface plants to and from WHT&BL are operated to achieve complete exchange for all simulations. With WHT&BL not yet a developed concept, that is an appropriate conservative assumption.
b. The interface plant at Arncliffe (eastbound from both M5 and F6 Extension) is operated to achieve complete exchange for all simulations. This assumption is based on minimising plume rise and external air quality issues at the New M5 St Peter's outlet.

4) Jet fans are operated to increase tunnel airflows as required to limit pollution, after other available actions are fully taken.

5.3.2 Emergency operations

Except for Concord Road off-ramp and short sections between portal flow capture plants and the exit portals themselves, prior to an incident the air will be flowing with the traffic. At the onset of a fire, any exit portal flow against traffic will be reversed, with the pre-incident flow direction maintained for the rest of the tunnel. Exit portal inflows can be reversed quickly by turning off the ventilation station fans which extract the tunnel air prior to the portal. Concord Road will take a little longer to reverse, using jet fans in adjacent tunnel sections.

Jet fans will maintain an air flow in the traffic direction in order to prevent people held behind the fire from being affected by smoke. Sufficient jet fans will be provided to control back-layering of the smoke at the fire-site.

Under normal operation, traffic control measures will be applied to ensure that the traffic speed in the tunnel does not drop below 20 km/h for any significant period. This will ensure that, if a vehicle ignites, the smoke movement does not overtake downstream traffic.

Depending on the fire location, the smoke may be discharged through the ventilation outlet, using the ventilation station fans. The alternative is to drive the smoke out of the exit portal. The adjacent non-incident tube will be closed to traffic and the airflow in that tube will be reversed using jet fans. This is to ensure that smoke issuing from a portal is not drawn into the adjacent entry portal of the non-incident tube. The jet fans will also be used to maintain the adjacent non-incident tube at a higher pressure than the incident tube, to prevent smoke flow through cross passages.

6 INPUT DATA AND DESIGN ASSUMPTIONS

6.1 Summary

References to design inputs and assumptions in this report are listed in Table 6.1 below.

Table 6.1. Summary of key design inputs and assumptions used.

Input	Value	Reference
NO_2 limits	0.5 ppm averaged over any route, 15 min rolling average.	Section 6.11, Table 6.25
CO limits	87 ppm averaged over any route, 15 min rolling average. 50 ppm averaged over any route, 30 min rolling average.	Section 6.11, Table 6.25
Extinction coefficient limits	0.005 /m at any location, 15 min rolling average	Section 6.11, Table 6.25
Vertical alignment	Concept design drawings	Section 6.3
Cross section	Concept design drawings	Section 6.4
Vehicle sizes	Roads and Maritime Services design criteria	Section 6.10
Fleet fuel mix	Roads and Maritime Services design criteria	Section 6.6.1, Table 6.12 (2023) Table 6.13 (2033)
Fleet age profile	Roads and Maritime Services design criteria	Section 6.6.1, Table 6.12 (2023) Table 6.13 (2033)
HGV mass	21 tonne	Section 0
Traffic demand	Roads and Maritime Services design criteria	Section 6.5.1
Vehicle aerodynamic drag coefficients	Roads and Maritime Services design criteria	Section 6.10, Table 6.24
Vehicle parameters for heat generation		Section 6.6.6, Table 6.16
Vehicle emission factors, for NO_X, CO and PM.	PIARC (2012) detailed Euro method	Section 6.6.8, Table 6.17. (PC 2023) Table 6.18. (LDV 2023) Table 6.19. (HGV 2023) Table 6.20. (PC 2033) Table 6.21 (LDV 2033) Table 6.22. (HGV 2033)
Vehicle emission factors, for NO_2	PIARC NO_X above with NO_2:NO_X ratio based on NSW Government "In-Tunnel Air Quality (Nitrogen Dioxide) Policy" Advisory Committee on Tunnel Air Quality (ACTAQ 2014)	
Background air quality	Roads and Maritime Services design criteria	Section 6.8, Table 6.23.

6.2 Tunnel schematic

Figure 6.1 shows the tunnel schematic for the WestConnex system in the Cumulative arrangement (including F6 Extension and interfaces with Western Harbour Tunnel and Beaches Link). Tunnel schematics specific to each scenario analysed are included in Section 9 of this report. Figure 6.2 shows the tunnel schematic assumed for Western Harbour Tunnel and Beaches Link. Note that the interface plants between M4-M5 Link and Western Harbour Tunnel and Beaches Link are intentionally repeated within both schematics. Figure 6.3 to Figure 6.7 show the vertical alignments of the network sections graphically.

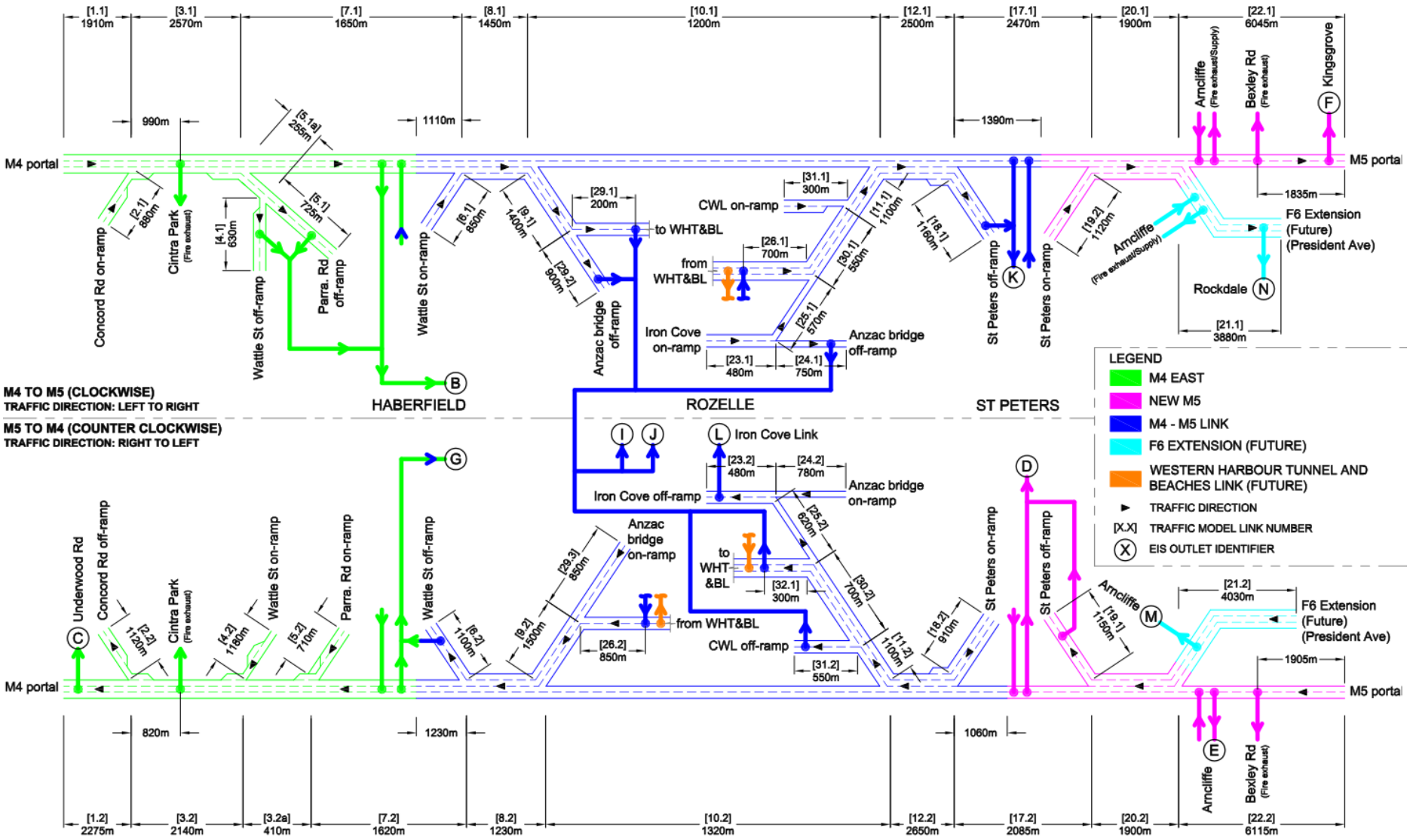


Figure 6.1. WestConnex tunnel ventilation schematic.

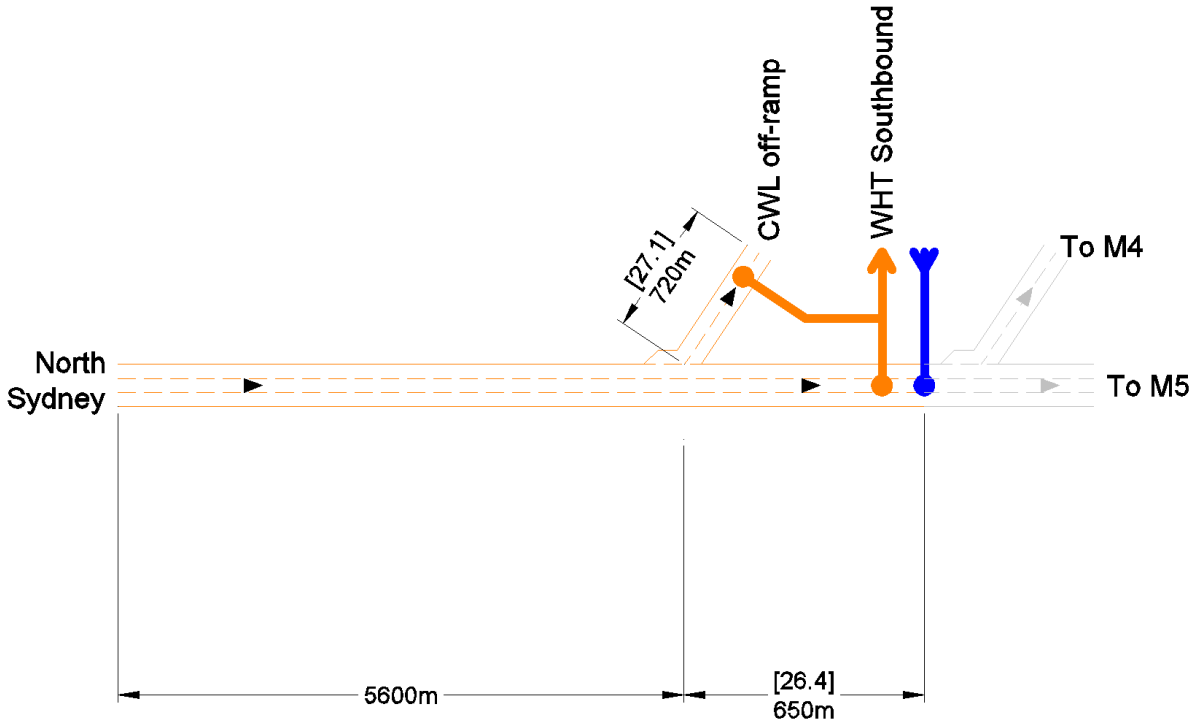


Figure 6.2. Western Harbour Tunnel and Beaches Link schematic (southbound from North Sydney).

6.3 Tunnel vertical alignment

The following figures show the vertical alignment adopted. It should be noted that different vertical and horizontal scales are used within the graphs and as such tunnel gradients are exaggerated in the graphs.

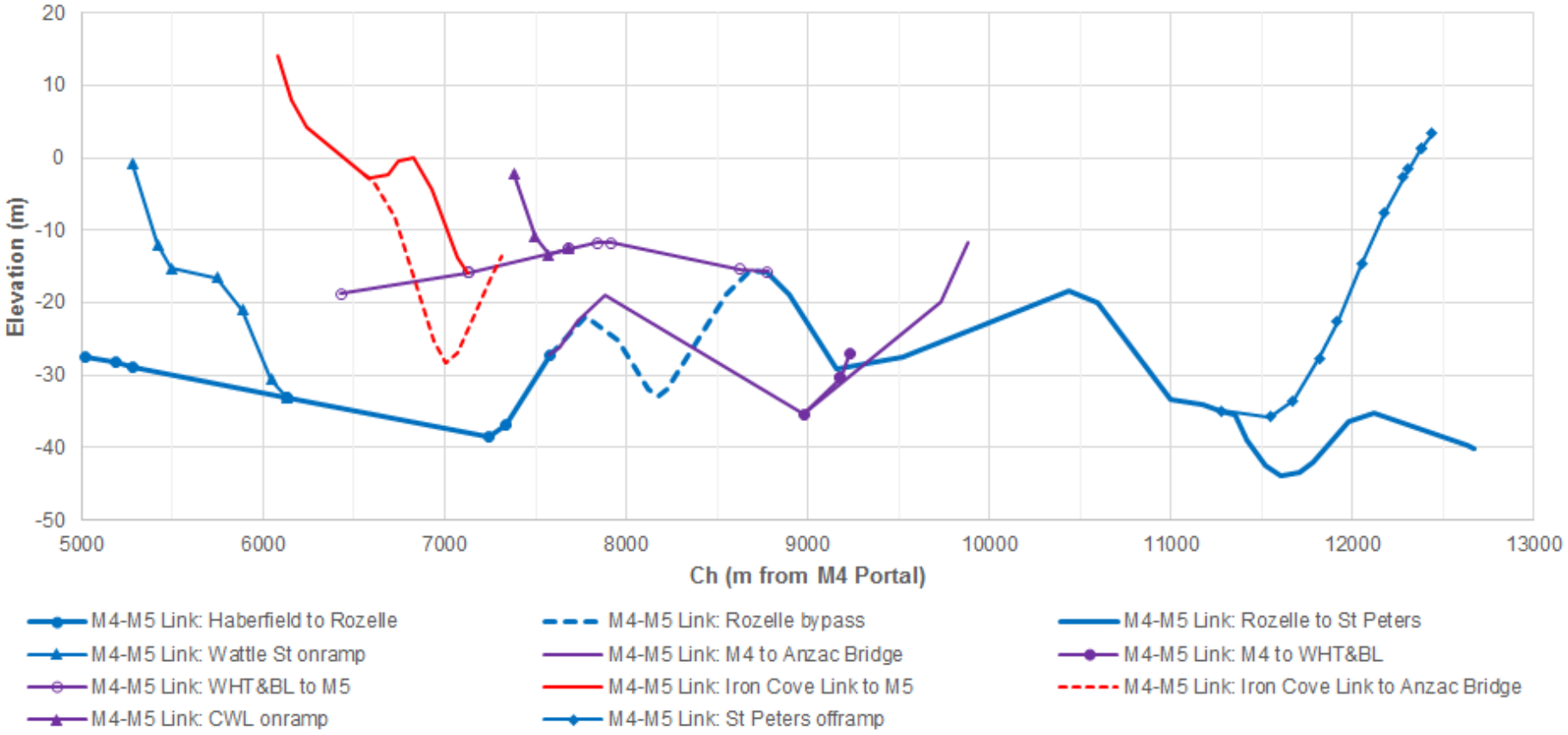


Figure 6.3. M4-M5 Link vertical alignment for M4 to M5 direction (traffic travels left to right).

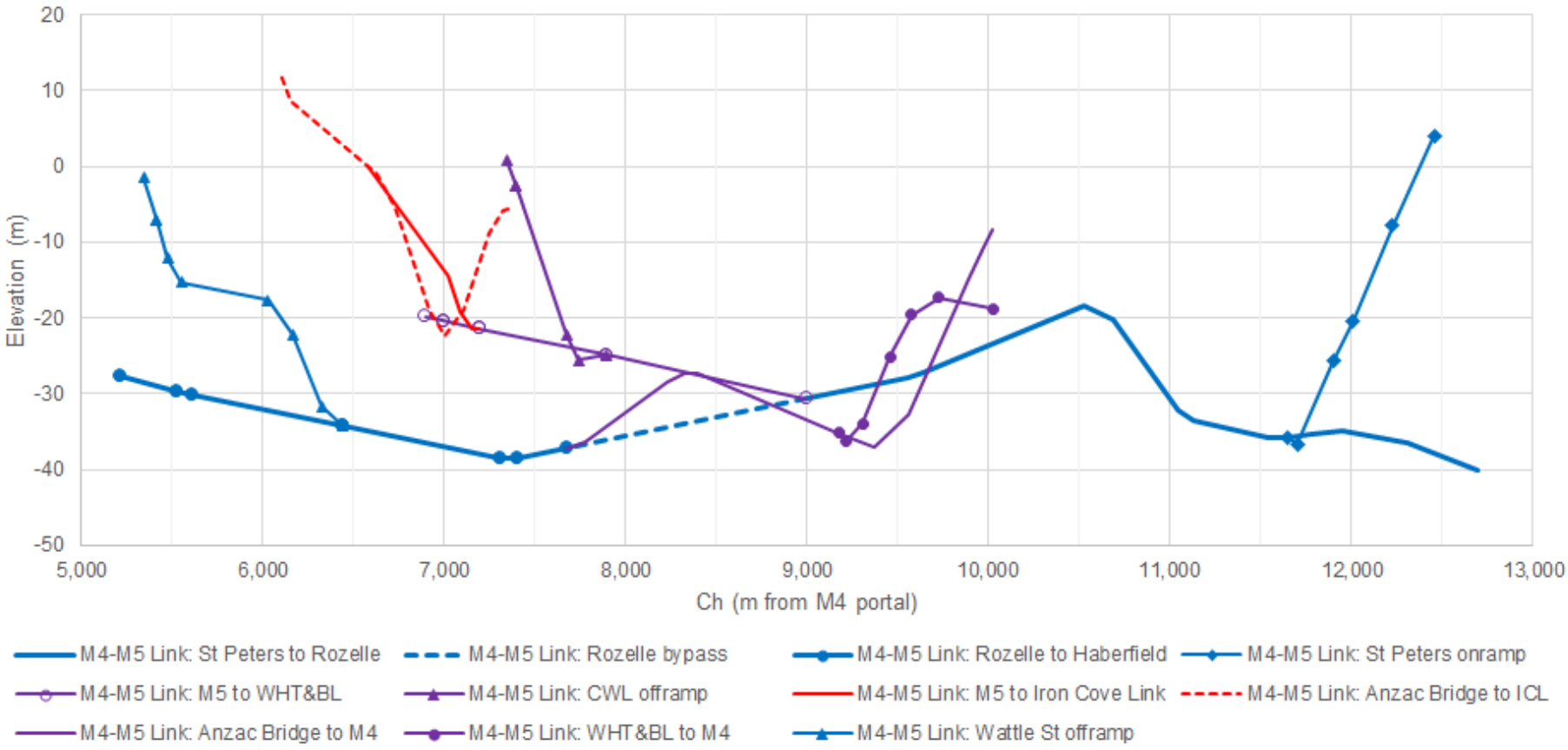


Figure 6.4. M4-M5 Link vertical alignment for M5 to M4 direction (traffic travels right to left).

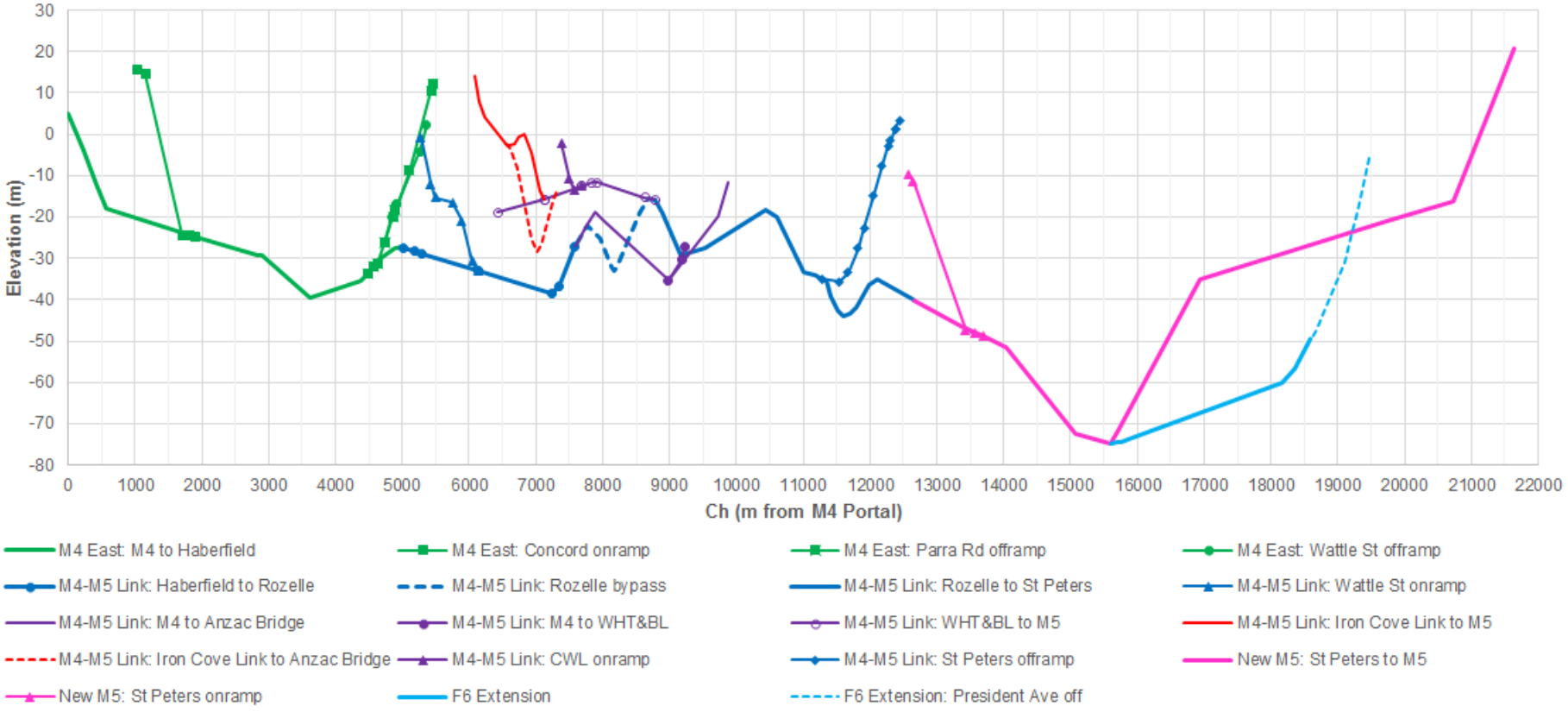


Figure 6.5. WestConnex overall vertical alignment for M4 to M5 direction (traffic travels left to right).

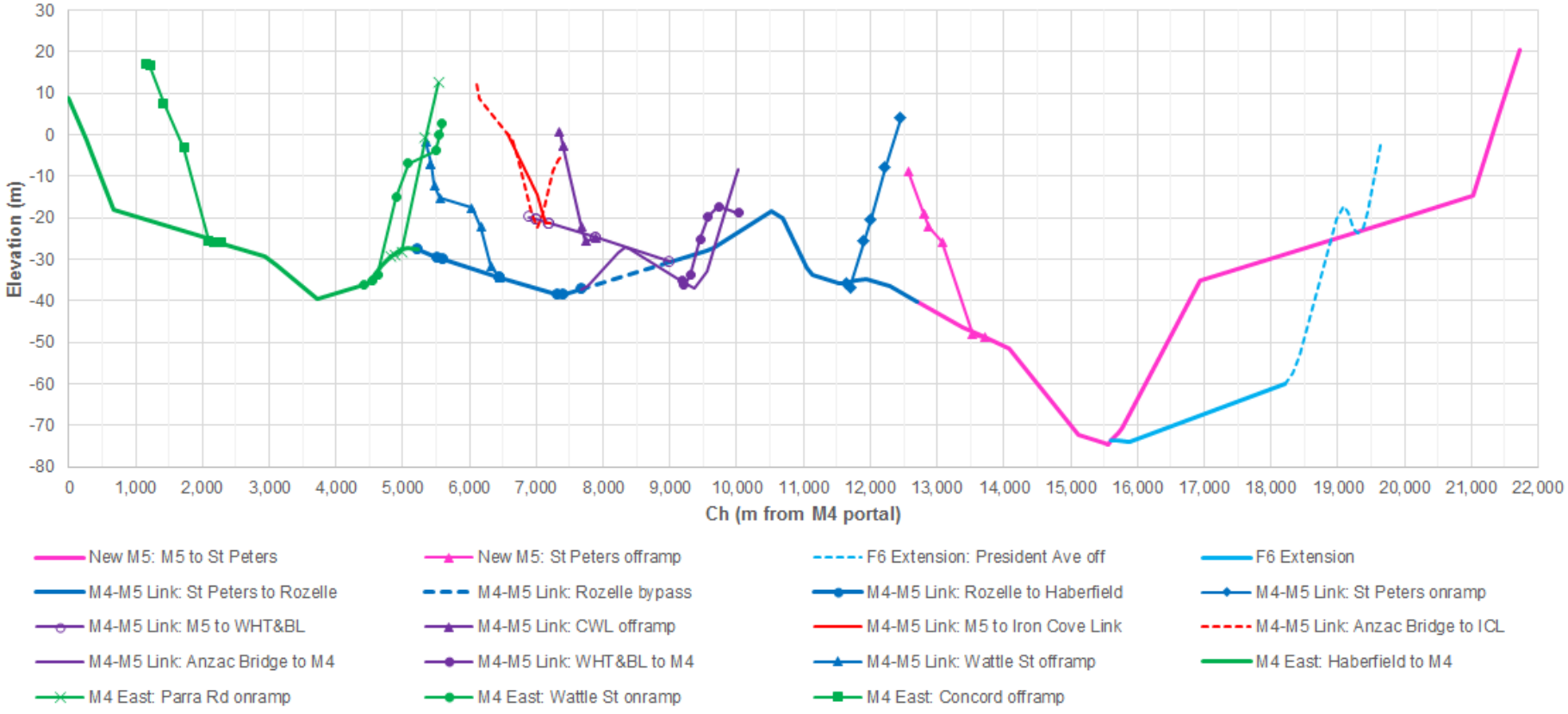


Figure 6.6. WestConnex overall vertical alignment for M5 to M4 direction (traffic travels right to left)

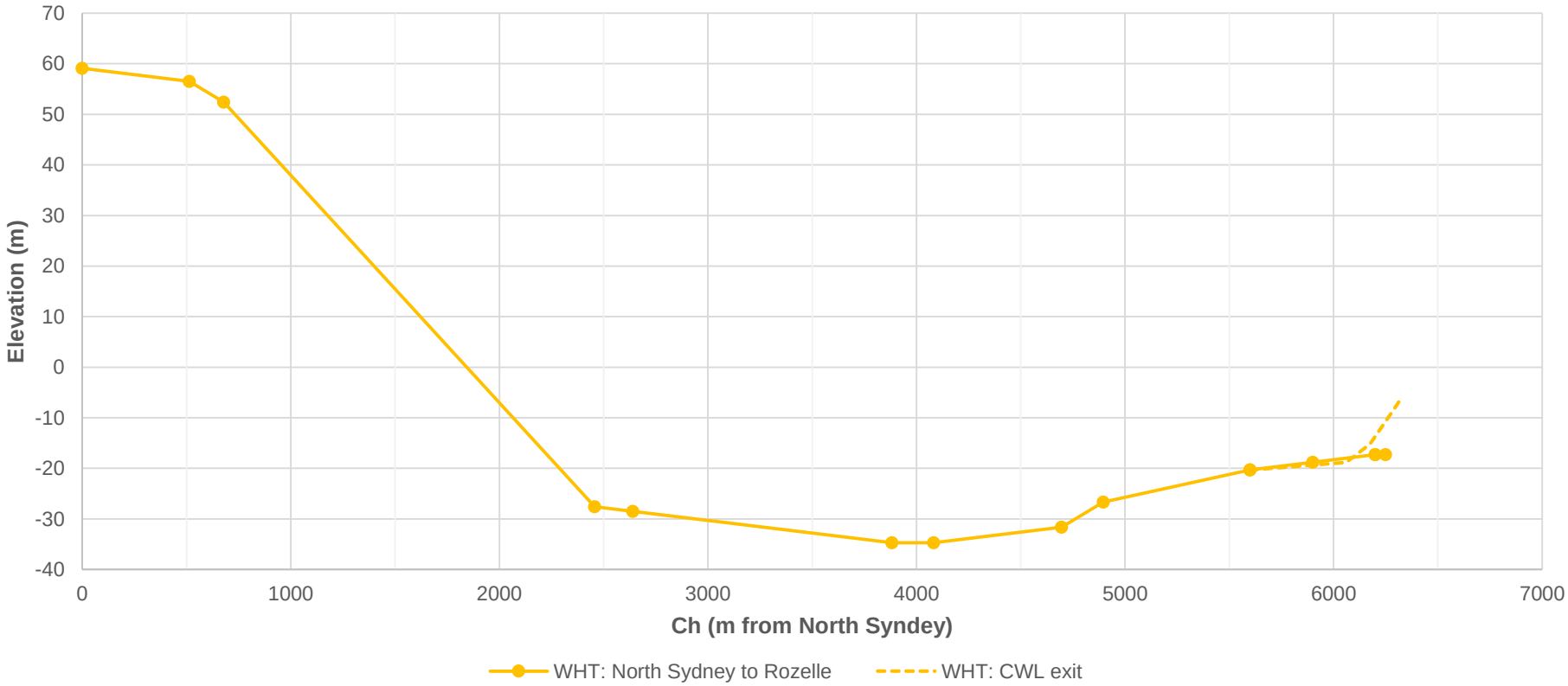


Figure 6.7. Western Harbour Tunnel and Beaches Link vertical alignment (southbound, North Sydney to Rozelle).

6.4 Tunnel attributes

Table 6.2 to Table 6.8 give the geometric and lane configuration parameters for the tunnel sections. The link numbers referred to are the traffic link designations shown on the schematics. Subsections within links are ordered with left to right corresponding to the direction of traffic within the link.

Table 6.2. M4-M5 Link: M4 to M5 direction model parameters.

Link		[6.1]	[7.1]	[8.1]	[9.1]	[29.2]	[29.1]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]		[11.1]	[12.1]		[17.1]	[18.1]	
Length	m	850	1110	1450	1400	900	250	1200	480	750	570	700	550	150	150	1100	2350	150	1390	1030	130
Area	m2	66	91	114	91	66	66	76.2	66	60	60	91	91	66	60	91	114	138	76.2	91	130
Hydraulic Dia	m	7.9	8.9	9.7	8.9	7.9	7.9	8.3	7.9	7.6	7.6	8.9	8.9	7.9	7.6	8.9	9.7	10.2	8.3	8.9	9.8
Traffic lanes	No.	2	3	4	3	2	2	2	2	1	1	3	3	2	1	3	4	5	2	3	3

Table 6.3. M4-M5 Link: M5 to M4 direction model parameters.

Link		[17.2]	[18.2]		[12.2]		[11.2]	[31.2]	[30.2]	[32.1]		[25.2]	[24.2]	[23.2]	[10.2]	[29.3]	[26.2]		[9.2]	[8.2]	[7.2]	[6.2]
Length	m	1000	130	680	550	2100	1100	550	700	200	100	620	780	480	1320	850	300	550	1500	1230	1230	1100
Area	m2	76.2	96	91	138	114	91	66	91	91	91	60	60	66	76.2	66	91	60	91	114	91	66
Hydraulic Dia	m	8.3	8.7	8.9	10.2	9.7	8.9	7.9	8.9	8.9	8.3	7.6	7.6	7.9	8.3	7.9	8.9	7.6	8.9	9.7	8.9	7.9
Traffic lanes	No.	2	3	3	5	4	3	2	3	3	3	1	1	1	2	2	2	2	2	4	3	2

Table 6.4. M4 East: M4 to M5 direction model parameters.

Link		[1.1]		[2.1]			[3.1]			[5.1a]	[5.1]		[4.1]			[7.1]
Length	m	415	1494	172	510	197	170	2105	295	255	590	135	60	496	74	540
Area	m2	124	94.1	138.6	66.7	46.3	137.1	94.1	137.1	66.7	66.7	76.6	46.3	66.7	66.4	94.1
Hydraulic Dia	m	10.2	8.9	10.44	7.6	6.6	10.3	8.9	10.3	7.6	7.6	7.7	6.6	7.6	6.8	8.9
Traffic lanes	No.	3	3	2	2	1	4	3	4	2	2	2	1	2	2	3

Table 6.5. M4 East: M5 to M4 direction model parameters.

Link		[7.2]	[5.2]		[3.2a]		[4.2]				[3.2]			[2.2]			[1.2]	
Length	m	390	165	545	150	260	45	490	438	205	140	1910	90	290	687	143	1762	513
Area	m2	94.1	60.3	66.7	137.1	94.1	50.3	46.3	66.7	46.3	137.1	94.1	137.1	43.2	66.7	144.1	94.1	111.8
Hydraulic Dia	m	8.9	7.4	7.6	10.3	8.9	6.4	6.6	7.6	6.6	10.3	8.9	10.3	6.5	7.6	9.7	8.9	9.5
Traffic lanes	No.	3	2	2	4	3	1	1	2	1	4	3	4	1	2	2	3	3

Table 6.6. New M5 and F6 Extension: M4 to M5 direction model parameters.

Link		[17.1]	[19.2]		[20.1]	[22.1]		[21.1]
Length	m	1000	270	850	1900	5720	325	3880
Area	m2	72.4	161.6	72.4	127	72.4	154	94
Hydraulic Dia	m	8.2	9	8.2	10.4	8.2	11.8	9.7
Traffic lanes	No.	2	2	2	4	2	2	3

Table 6.7. New M5 and F6 Extension: M5 to M4 direction model parameters.

Link		[22.2]		[20.2]	[19.1]		[17.2]	[21.1]
Length	m	295	5820	1900	950	196	1015	4030
Area	m2	154	72.4	127	72.3	151	72.4	94
Hydraulic Dia	m	11.8	8.2	10.4	8.2	9.4	8.2	9.7
Traffic lanes	No.	2	2	4	2	3	2	3

Table 6.8. Western Harbour Tunnel model parameters.

Link		[26.4+27.1]	[26.4]	[27.1]
Length	m	5600	650	720
Area	m2	91	91	66
Hydraulic Dia	m	8.9	8.9	7.9
Traffic lanes	No.	3	3	2

6.5 Traffic and tunnel occupancy

It is generally acknowledged that traffic flow is a complex topic. While some of the complexity can be addressed in ventilation design by modelling traffic behaviours with ventilation operation, there is a need to simplify the traffic behaviour down to some reasonable worst case scenarios which then give a design suitable for all reasonable operation. This subsection records those bounding scenarios and any assumptions made to arrive at them.

The anticipated (demand) daily traffic profile not only forms the basis for prediction of environmental impacts, it may also inform, along with the lane geometry and the adopted operational rules, the congested and free-flowing scenarios that are likely to occur and those which cannot occur or which can realistically be prevented.

All these traffic regimes were addressed in the modelling.

Table 6.9. Description of traffic cases.

Term	Explanation
Expected traffic (24 hr)	Tunnel ventilation operations with 24 hourly expected traffic forecast by WRTM. This is intended to represent the (average) day-to-day operations of the ventilation system subjected to forecast traffic demand. Simulations were completed for all six traffic scenarios shown in Table 6.9.
Regulatory demand traffic (24 hr)	Tunnel ventilation operations with 24 hourly expected traffic forecast by WRTM scaled up to the tunnel capacity. That is, the expected traffic is uniformly scaled by a common factor such that at one hour of the day, the traffic in one section is at the theoretical capacity of that section. This is intended to represent an upper bound on daily operations of the ventilation system, subjected to expected traffic demand increased as noted. Simulations were completed for 'Do minimum' and 'Do something' traffic scenarios shown in Table 6.9. Simulation of the 'Cumulative' scenarios (both 2023 and 2033) were not completed, as the demand traffic is already at or above the theoretical capacity of the tunnel.
Worst case traffic	Tunnel ventilation operations with the most onerous traffic conditions for the ventilation system. These simulations are based on simplified bounding case traffic conditions between 20 and 80 km/h that encompass: • Congestion (down to 20 km/h on average) • Breakdown or minor incident • Accident closing a tube • Free-flowing traffic at maximum capacity
Normal (operations)	Means any of "Expected traffic", "Regulatory demand traffic" or "Worst case traffic". That is, all non-emergency operations.
Emergency (operations)	Fire.

6.5.1 Traffic demand

Demand traffic profiles for each section of the tunnel network were sourced from the WestConnex Road Traffic Model (WRTM) version 2.3. WRTM is developed and operated by Roads and Maritime Services (Roads and Maritime). It provides a platform to understand changes in future year travel patterns under different land use, transport infrastructure and pricing scenarios. Although the WRTM is a network-wide model that encompasses existing and future road network coverage in the Sydney Greater Metropolitan Area (GMA), it was principally developed and enhanced to assess infrastructure improvements associated with the WestConnex projects; both in isolation and combination.

The data supplied are hourly flows for cars, LCVs and HCVs in each of the tunnel network links, for a total of six scenarios as shown in Table 6.10.

Table 6.10. Expected traffic scenarios.

Description	Year	Arrangement
Do minimum	2023	M4 East + New M5
Do minimum	2033	M4 East + New M5
Do something	2023	M4 East + New M5 + M4-M5 Link
Do something	2033	M4 East + New M5 + M4-M5 Link
Cumulative	2023	M4 East + New M5 + M4-M5 Link + Sydney Gateway + Western Harbour Tunnel
Cumulative	2033	M4 East + New M5 + M4-M5 Link + Sydney Gateway + Western Harbour Tunnel + Beaches Link + F6 Extension

Fleet characterization used in the WRTM is set to reflect tolling classes, for traffic study and economic purposes, not vehicle classes for pollution and ventilation design. WRTM uses the following classification of vehicles:

- Cars are light vehicles (AustRoads Classes 1 and 2) that are privately registered;
- LCV are “light commercial vehicles” (AustRoads Classes 1 and 2) that are not privately registered (i.e. the class that cannot claim toll cashback on M5), and;
- HCV are “heavy commercial vehicles” AustRoads Classes 3 and above.

For ventilation design, Roads and Maritime Tunnel Technology concluded that: 1) the PIARC description of HGV is consistent with AustRoads Classes 3 and above, generally having a vehicle mass greater than 3.5 t, and; 2) the remaining AustRoads Classes 1 and 2 could be classified 84% PCs and 16% LDVs in the PIARC definitions. The proportion of PCs and LDVs was based on review of the Automatic Number Plate Recognition (ANPR) data that informed the development of WRTM.

For the purposes of ventilation analysis, WRTM traffic flows are converted to PIARC pollution categories using the following formulae:

$$HGV = HCV_{WRTM}$$

$$LDV = 0.16 \times (LCV_{WRTM} + PC_{WRTM})$$

$$PC = 0.84 \times (LCV_{WRTM} + PC_{WRTM})$$

All vehicle flows within this report refer to PIARC pollution categories unless expressly stated otherwise.

6.5.2 Speed limits

The posted speed limit in mainline tunnels and in motorway to motorway connections will be 80 km/h. It is assumed that traffic will not go faster than that. This assumption may be violated when traffic is very light, but that is not a controlling case for ventilation. When traffic is very heavy, the speed may drop below 80 km/h as suggested by traffic flow models.

On and off-ramps that connect to local roads rather than other motorways will have a posted speed of 60 km/h, with that also taken as a maximum speed on such ramps.

6.5.3 Lane capacity

The average density of vehicles within the tunnel under the various traffic conditions is a key parameter in the ventilation design. Vehicle dimensions, dynamics and driver behaviour vary greatly. In looking at lane capacity, the Passenger Car Unit (PCU) is a unit used to represent an equivalent number of passenger cars for each real vehicle. It is used in describing lane capacity. For the current analysis, both PC and LDV correspond to one PCU. HGVs are generally much longer vehicles and travel more slowly uphill, and therefore occupy more lane space than a PC or LDV. In slow speed traffic, the 'pitch' (front bumper to front bumper spacing) between vehicles is closely related to vehicle length. As traffic moves faster, the vehicle to vehicle pitch is set more by the need to provide adequate reaction and stopping distance and so vehicle length is relatively less important. The lane occupancy of HGVs can be described by a ratio to the lane occupancy of PCs. This ratio is a function of traffic speed as tabulated below.

Work by Roads and Maritime has shown that upper limit at 80 km/h was seen to be 1900 PCU/lane/h, with flowrate peaking at 2060 PCU/lane/h at 70 km/h. The values in Table 6.11, measured for Sydney traffic, are adopted in lieu of the more generic PIARC recommendations.

Table 6.11. Adopted maximum lane capacity as a function of speed. The ratios in the third column are the equivalence between HGVs and PCUs in terms of lane space used at each speed.

Traffic speed (km/h)	PCU/lane/h	HGV:PCU ratio
0	165 PCU/km	3:1
20	1350	3:1
30	1650	2.5:1
40	1860	2:1
50	1990	2:1
60	2050	2:1
70	2060	2:1
80	1900	2:1

6.5.4 Traffic scaling

For regulatory demand traffic cases, scaling is performed on the corresponding expected traffic profile to uniformly increase flows such that the traffic reaches the theoretical capacity of the tunnel (at one hour of the day and in one section of the tunnel).

The intent of the method used is to scale traffic flows to uniformly increase traffic across the network while maintaining the HGV fractions, preserving continuity of vehicle flows and keeping the flow distributions for the various on and off-ramps in the same relative proportions as the base traffic data.

Scaling has been performed on the following basis with a single scaling factor (f_s) calculated considering all links with underground connections in each particular demand traffic scenario.

$Q_{PC\|LDV\|HGV}$	Traffic flow for each vehicle category based on expected traffic, calculated for each section and every hour.
PCU_{flow}	PCU flow for each section based on the expected traffic, calculated for each section and every hour. $PCU_{flow} = Q_{PC} + Q_{LDV} + Q_{HGV} \times (HGV{:}\,PCU\ ratio)$
$PCU_{lane\ cap}$	Theoretical lane capacity at scenario design speed, see Table 6.11.
PCU_{cap}	Maximum theoretical section capacity, calculated for each section. The smallest lane count in each tunnel section (traffic link) is adopted, as this constrains the effective capacity of the traffic link. Refer Section 6.4 for the number of lanes in each link. $PCU_{cap} = PCU_{lane\ cap} \times No.of\ lanes$
f	Section fullness, the ratio of expected traffic volume to its theoretical capacity, calculated for each section and every hour. $f = \frac{PCU_{flow}}{PCU_{cap}}$

f_{hour} The maximum section fullness over all tunnel sections at each hour of the day, calculated for every hour.

$$f_{hour} = \max(f)$$

f_s The maximum section fullness for all tunnel section at any hour of the day. A single factor calculated for an expected traffic profile and associated tunnel configuration.

$$f_s = \max(f_{hour})$$

$QS_{PC|LDV|HGV}$ The scaled traffic flow, calculated for every section and every hour.

$$QS_{PC|LDV|HGV} = \frac{1}{f_s} \times Q_{PC|LDV|HGV}$$

Figure 6.8 shows the scaling effect for the most congested link (3 lane capacity), with the system wide scaling factor determined at hour 7. Figure 6.9 shows the scaling effect for a different 3 lane link for the same scenario.

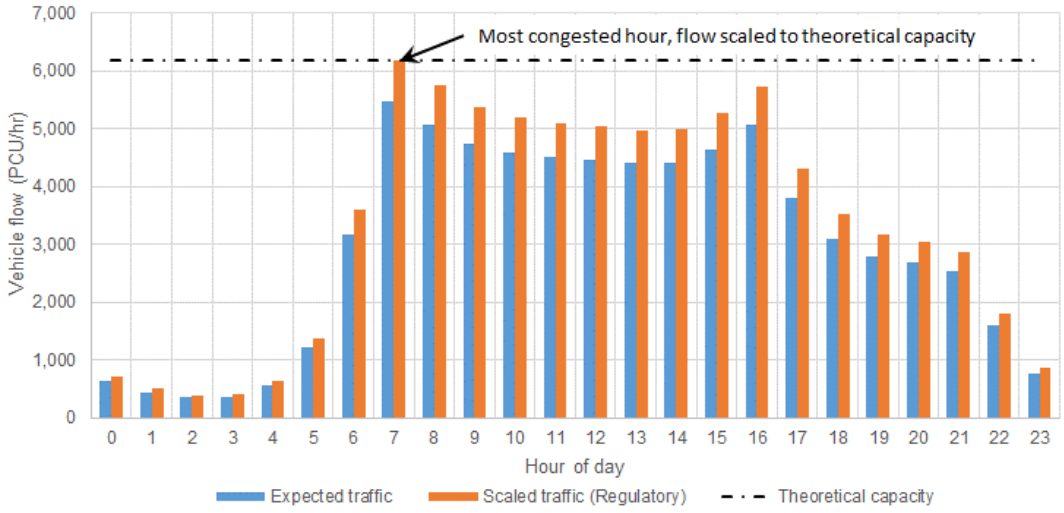


Figure 6.8. Example result of traffic scaling for the most congested link.

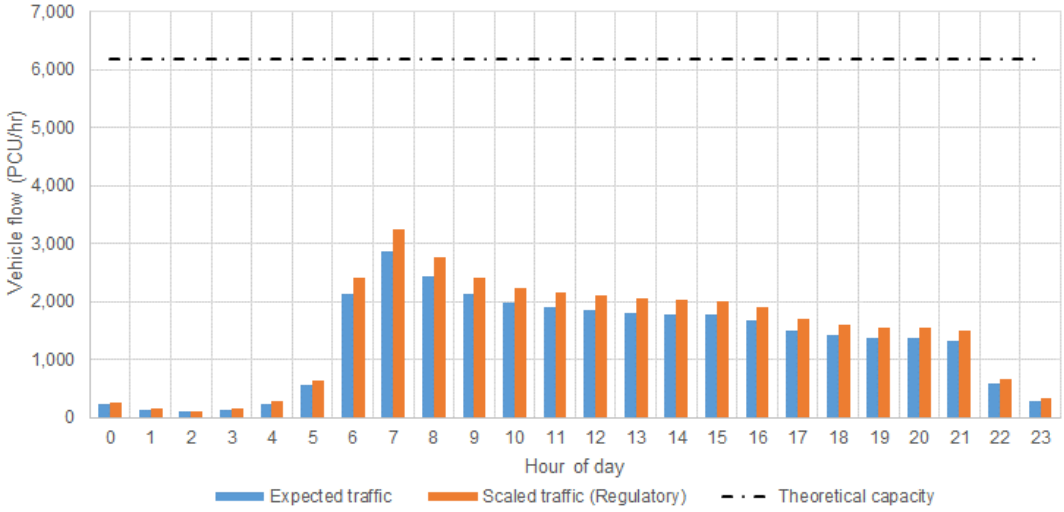


Figure 6.9. Example results of traffic scaling for another link.

6.5.5 Normal operations

From a tunnel ventilation perspective, normal (traffic) operations means the range of possible traffic conditions, including such conditions as the expected traffic, congestion, vehicles breakdowns and the like.

The problem with analysing the pollution for real traffic cases is that real traffic flow prediction is time consuming and is a significant modelling exercise in itself. This is particularly so for random events such as a breakdown, whether they be within the tunnel or external to it. For the expected and regulatory demand traffic cases, we use the WRTM outputs and the traffic model in IDA Tunnel to estimate the in-tunnel traffic conditions.

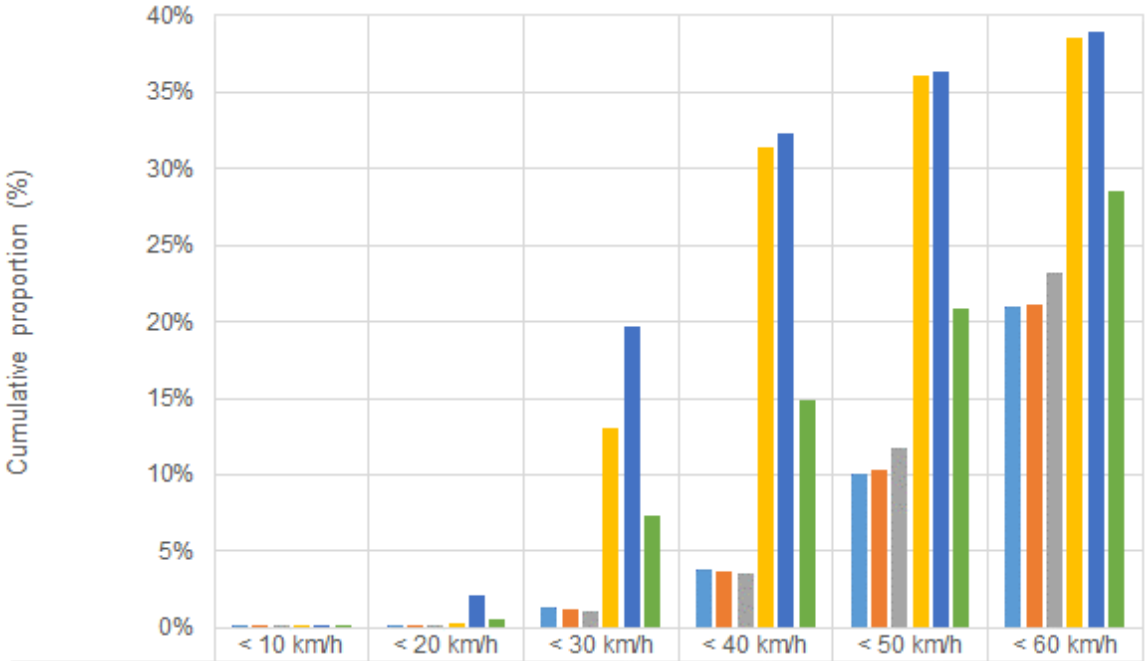
For other traffic conditions, we do the analysis for conservative (worst case operations, Section 7.1.4) but simple cases, even if they are physically impossible to achieve and/or highly unlikely to occur in practice. In the concept design, we analyse a number of traffic patterns that seek to push the limits of each element of the ventilation system at a range of fixed speeds (20 to 80 km/h) throughout the network.

If those conservative cases meet the criteria, then no further assessment is required. Only if the criteria are not met in the conservative view, or require disproportionate ventilation equipment capacities, we need to look in more detail at the real traffic for the situation of concern. The use of unrealistically onerous traffic cases for the analysis in this report should not be interpreted as adding those cases to the design criteria for the project, they serve only as a simplified method to demonstrate the capability of the concept design ventilation system.

Live travel time data gathered from the M5 East tunnel for the period January 2016 through September 2016 has been used to review the average speeds for an inner Sydney road tunnel without active traffic control measures. The data were generated by Google using an application written by NGIS, and consisted of average transit times through M5 East at five minute intervals between 12th January 2016 and 1st September 2016 for the following routes:

1) EBMainline: eastbound mainline entrance to mainline exit.
2) EBMarshSt: easbound mainline entrance to Marsh St exit.
3) EBPrincessHwy: eastbound mainline entrance to Princess Hwy exit.
4) WBMainline: westbound mainline entrance to mainline exit.
5) WBMarshSt: westbound Marsh St entrance to mainline exit.

Figure 6.10 below shows the cumulative proportion of time that average vehicle speed falls below certain speeds for each route. It is important to highlight that for the westbound routes, WBMarshSt and WBMainline are identical except for the short distance before they merge. The higher proportions for WBMarshSt route at slow speeds compared to WBMainline indicates that the average speed in the Marsh St on-ramp is below that in the mainline entry and from the merge to the exit portal. As the Marsh St on-ramp forms only a small proportion of the total westbound tunnel length (300 m in 4 km), from an overall emissions perspective, the average traffic condition within the westbound sections of the M5 East are actually closer to the WBMainline data.



	< 10 km/h	< 20 km/h	< 30 km/h	< 40 km/h	< 50 km/h	< 60 km/h
EBMainline	0.0%	0.2%	1.3%	3.8%	10.0%	20.9%
EBMarshSt	0.0%	0.2%	1.3%	3.6%	10.3%	21.2%
EBPrincessHwy	0.0%	0.1%	1.1%	3.6%	11.7%	23.3%
WBMainline	0.0%	0.3%	13.0%	31.3%	36.0%	38.6%
WBMarshSt	0.0%	2.2%	19.7%	32.3%	36.4%	38.9%
All routes	0.0%	0.6%	7.3%	14.9%	20.9%	28.6%

Figure 6.10. Cumulative proportion of time average travel speed is below nominated values for M5 East tunnel (January 2016 to September 2016).

Based on the M5 East data, the likelihood of average traffic speed throughout the tunnel being less than 20 km/h is of the order of 0.5%. Traffic management plans will be developed during the detailed design phase, to provide the capability to further reduce the likelihood of slow moving traffic with the project. Traffic management plans may include active and/or passive control measures to influence driving behaviours to maintain the speed of traffic through the tunnel.

Controlling the traffic speed to not fall below 20 km/h in any section of the tunnel is also a safety measure to minimise the chance of a fire at the back of a line of stopped traffic and allow vehicles in front of any fire to drive out of the tunnel without being overrun by smoke. That is; such control is required for fire safety.

All of this supports the adoption of 20 km/h as a design basis for minimum average traffic speed when assessing pollution.

6.5.6 Breakdown or minor accident

Analysis has assumed only that traffic control is exercised so as to maintain a minimum traffic speed of 20 km/h in all tunnel sections. The pollution criteria can still be met under that conservative simplifying assumption, with required jet fan numbers being similar to those required for the fire cases.

6.5.7 Accident closing a tube

The simplifying assumption for an accident closing a tube is that on-ramps just upstream of the incident will be closed, all drivers upstream of an exit ramp will use that ramp as instructed, and a reasonable fraction of drivers will comply with an instruction to turn engines

off. That will take the pressure off ventilating for pollution, such that tube closure is no longer a defining design case for pollution control.

6.5.8 Emergency operations (fire)

When in operation, the project will create a tunnel network with a mainline portal-to-portal length of some 23 km and 10 or more on or off-ramps in each direction. The traffic occupancy of the various sections during a fire scenario will affect the ventilation plant required to handle such design scenarios.

The "defacto" standard previously adopted for projects is to assume that the tunnel behind the fire is completely full of stopped vehicles during a fire scenario. Adopting the same design scenario for the project (incorporating the M4 East and New M5) would result in design scenarios with potentially up to 37 km (the approximate length of the mainline and on/off ramps in either direction) of queued traffic at standstill, a very onerous requirement for any ventilation system. It would also take several hours to fill the tunnel to that level, even with high traffic flows.

For a tunnel system with multiple exit paths and traffic control systems that actively prevent additional vehicles from entering the tunnel, allowing the entire tunnel to become completely choked with vehicles (with an active emergency) does not appear a plausible scenario. It is also the case that sections of tunnel away from the incident may continue to be safely operated.

For concept design capacity purposes it is assumed that the upstream tunnel sections are full of stopped vehicles, with all downstream sections cleared of vehicles. This may be slightly conservative, but not grossly so. The reason is that it is only the flow in the incident section that is critical, and the vehicle drag in the tunnel sections upstream of the incident section (the other side of intersections), has a reducing influence on flow in the incident section.

6.6 Emissions factors

Average emission factors for the Australian vehicle fleet are continually decreasing as new emissions control technologies are supplied on new vehicles, and old vehicles pass out of service. PIARC[2] provides Australian fleet emissions tables valid up to and including year 2020 which has been the approach generally adopted within Australia and was used for both the M4 East and New M5 EIS analyses. However, a number of factors give rise to uncertainty in adopting this approach for estimating in-tunnel vehicle emissions for the M4-M5 Link:

- No methodology for estimating beyond 2020 is provided,
- The LDV fleet is fixed at 50% petrol and 50% diesel whereas it is forecast to be dominated by diesel vehicles by the time the M4-M5 link opens.

The primary, more general PIARC methodology, and the supporting data to estimate fleet average emissions, are based on more detailed breakdown of the expected fleet, referred herein as the "PIARC detailed method". Relevant input parameters used for estimating emissions using the detailed method are outlined in the following sections.

Together with the other inputs recorded here, this analysis adopts the following basis for estimating vehicle emissions using the PIARC information:

1) PIARC 2012 detailed Euro method for CO, NOx and Exhaust PM;
2) PIARC 2012 for Non-exhaust PM;

[2] PIARC Technical Committee C4 Road Tunnels Operation. Road Tunnels: Vehicle Emissions and Air Demand for Ventilation, World Road Association, document 2012R05EN, revised December 2012.

3) Fleet Euro classification provided by NSW Roads and Maritime;
4) NO_2:NO_X ratios based on NSW Government "In-Tunnel Air Quality (Nitrogen Dioxide) Policy"[3]

The appropriateness of this approach has been verified using data recorded from M5 East Tunnel in 2015, refer to Section 6.12.1.

6.6.1 Fleet characteristics

Roads and Maritime have determined the age and fuel type distribution within each class of vehicle (PC, LDV and HGV) for 2023 and 2033[4] as tabulated below. These fleet characteristics have been used in estimating average vehicle emissions (CO, NO_X, exhaust PM) in each vehicle category using the PIARC detailed methodology.

[3] In-Tunnel Air Quality (Nitrogen Dioxide) Policy, Advisory Committee on Tunnel Air Quality (NSW), February 2016.

[4] Roads & Maritime Services, NSW Fleet forecast for future road tunnel projects (TT-TN-16-12) Rev 3 dated 12th September 2016.

Table 6.12. Fleet emission standards characteristics, year 2023.

Emission standard	PC		LDV		HGV
	Petrol (%)	Diesel (%)	Petrol (%)	Diesel (%)	Diesel (%)
Pre-Euro	0.10	0.00	1.12	0.19	5.19
Euro 1	0.78	0.01	1.45	0.18	2.78
Euro 2	1.15	0.21	1.01	0.92	0.00
Euro 3	5.44	0.00	3.29	0.00	6.08
Euro 4	13.25	2.98	5.00	12.02	13.99
Euro 5	26.43	6.48	5.46	25.37	71.96
Euro 6	31.63	11.53	4.58	39.39	
Total	**78.78**	**21.21**	**21.91**	**78.07**	**100.00**

Table 6.13. Fleet emission standards characteristics, year 2033.

Emission standard	PC		LDV		HGV
	Petrol (%)	Diesel (%)	Petrol (%)	Diesel (%)	Diesel (%)
Pre Euro	0.00	0.00	0.04	0.01	0.83
Euro 1	0.01	0.00	0.07	0.01	0.98
Euro 2	0.01	0.00	0.05	0.05	0.00
Euro 3	0.08	0.00	0.24	0.00	2.15
Euro 4	0.58	0.13	0.41	0.93	3.42
Euro 5	3.92	1.06	0.83	3.66	92.62
Euro 6	60.47	33.74	4.95	88.77	0.00
Total	**65.07**	**34.93**	**6.59**	**93.43**	**100.00**

6.6.2 NO_2 emissions

PIARC tables give NO_X generation rates as a function of vehicle speed and road gradient. Since NO_2 is the dominant design pollutant, it is highly desirable to have tables of NO_2 evolution rather than its proxy NO_X which bundles together the NO and NO_2. The provision of tables giving NO_2 directly is under consideration by the relevant PIARC Working Group. In the absence of tables giving NO_2 emissions directly, the NO_2:NO_X ratio is a key parameter to supplement the PIARC method.

Table 6.14 provides NO_2:NO_X ratios used for estimating NO_2 emissions.

Table 6.14. Fleet NO_2:NO_X ratio.

Emission standard	PC		LDV		HGV
	Gasoline	Diesel	Gasoline	Diesel	Diesel
Pre Euro	0.07	0.15	0.07	0.15	0.11
Euro 1	0.06	0.13	0.06	0.13	0.11
Euro 2	0.05	0.13	0.05	0.13	n/a
Euro 3	0.04	0.51	0.04	0.51	0.14
Euro 4	0.03	0.42	0.03	0.42	0.10
Euro 5	0.03	0.33	0.03	0.33	0.17
Euro 6	0.03	0.30	0.03	0.30	0.08

Tables of NO_2 emissions are calculated as the NO_X weighted average for each vehicle category as follows, using the PC category for explanation purposes:

$q_{NO2=}$ NO_2 emission rate

$q_{NOx=}$ NO_X emission rate

$f_{NO2=}$ NO_2 NO_X ratio from Table 6.14

$f_{fleet=}$ Fraction of vehicles within the vehicle category, from Table 6.12 or Table 6.13.

$$
\begin{aligned}
q_{NO2(PC)} = {} & q_{NOx(PC\ Diesel,pre\ Euro)} \times f_{NO2(PC\ Diesel,pre-Euro)} \times f_{fleet(PC\ Diesel,pre-Euro)} \\
& + q_{NOx(PC\ Diesel,Euro\ 1)} \times f_{NO2(PC\ Diesel,Euro\ 1)} \times f_{fleet(PC\ Diesel,Euro\ 1)} \\
& + q_{NOx(PC\ Diesel,Euro\ 2)} \times f_{NO2(PC\ Diesel,Euro\ 2)} \times f_{fleet(PC\ Diesel,Euro\ 2)} \\
& + \cdots \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\
& + q_{NOx(PC\ Gas,Euro\ 5)} \times f_{NO2(PC\ Gas,Euro\ 5)} \times f_{fleet(PC\ Gas,Euro\ 5)} \\
& + q_{NOx(PC\ Gas,Euro\ 6)} \times f_{NO2(PC\ Gas,Euro\ 6)} \times f_{fleet(PC\ Gas,Euro\ 6)}
\end{aligned}
$$

6.6.3 Particulates and in-tunnel visibility

In-tunnel visibility is assessed including the contributions of both exhaust and non-exhaust emissions using a conversion factor of 0.0047 m^2/mg. Outlet emissions report each component (exhaust and non-exhaust) separately.

6.6.4 Heavy vehicle mass

Weigh-in-motion (WIM) stations are installed at strategic locations across the Roads and Maritime classified road network. For all vehicles, WIM stations measure and record the; date, time, lane (direction), vehicle speed, axle count, inter-axle spacing, individual and group axle weights and gross vehicle weights. The raw data are then automatically processed and cross-referenced to provide useful information relating the vehicle usage and traffic flow patterns at each monitored location. The information is analysed to generate seasonal and daily distribution of vehicle class (Austroads Classes 3-12), vehicle speed, flow and mass distributions.

HGV mass and vehicle counts throughout 2015 were reviewed for Botany WIM station located on Foreshore Road, in order to estimate an appropriate HGV mass for ventilation design of the M4-M5 link.

The annual average hourly distribution of HGV mass and vehicle flows, in each direction (inbound and outbound) for the Botany WIM station are shown in Figure 6.11 and Figure 6.12 below. It can be seen that the mass of HGVs in the outbound direction are generally greater than for the inbound direction throughout the day. It can also be seen that during off-peak periods, the average HGV mass in both directions increases, and the number of HGVs decreases. The mass of HGVs is lowest through the middle of each day when the flows of HGVs are the highest. This is an important point in that it indicates that high HGV masses do not coincide with periods of peak tunnel occupancy when the tunnel ventilation system would be operating a peak capacity. During off-peak hours when tunnel occupancy is low, and the risk of significant congestion is also low, the tunnel ventilation system will not be operating at peak flows, with capacity available to cater for increased emissions from the HGV portion of the fleet.

For the vehicle emissions estimate and ventilation design, a mass of 21 tonnes has been assumed for all HGV using the M4-M5 Link tunnel. This is based on the average HGV mass in the outbound direction during the 8am-9am morning peak hour period. The conservatism of this assumption for other links is accepted, in preference to the complexity of modelling different HGV masses in different links. The average HGV mass on which the PIARC tables are based is 23 tonnes. The pollution estimates include a mass correction factor of 0.925 in accordance with the PIARC approach.

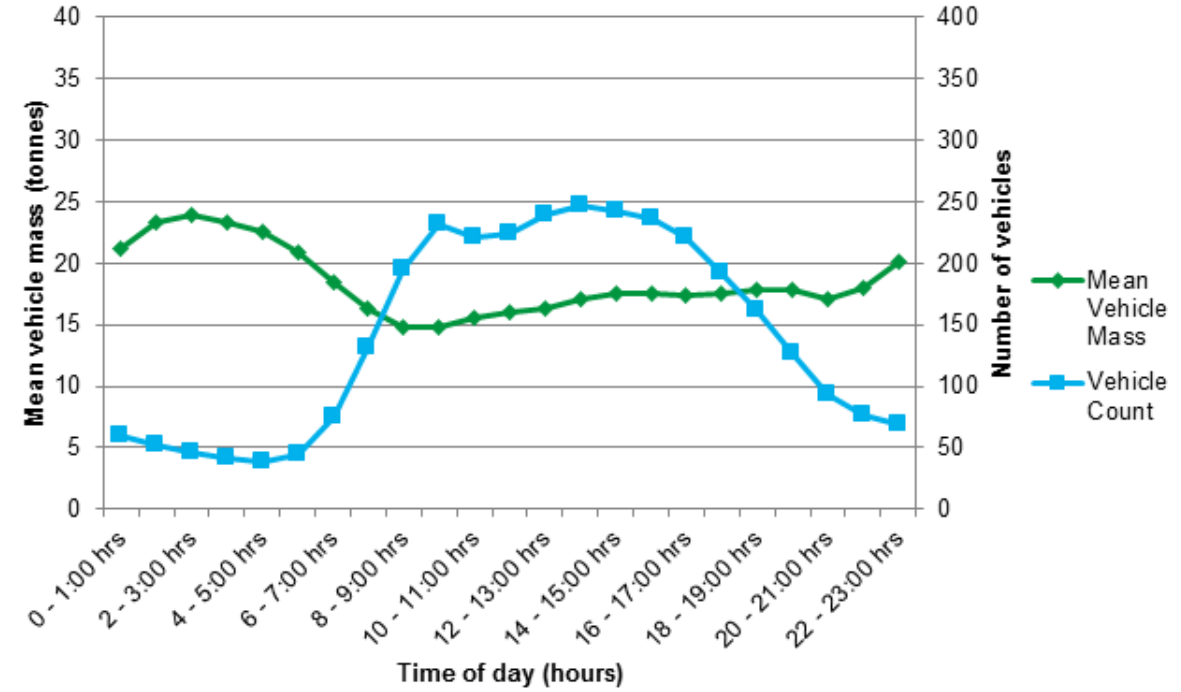


Figure 6.11. Inbound direction 2015 Annual Average Daily distribution of HGV mass and HGV vehicle count at Botany WIM station, across all traffic lanes (towards Port Botany).

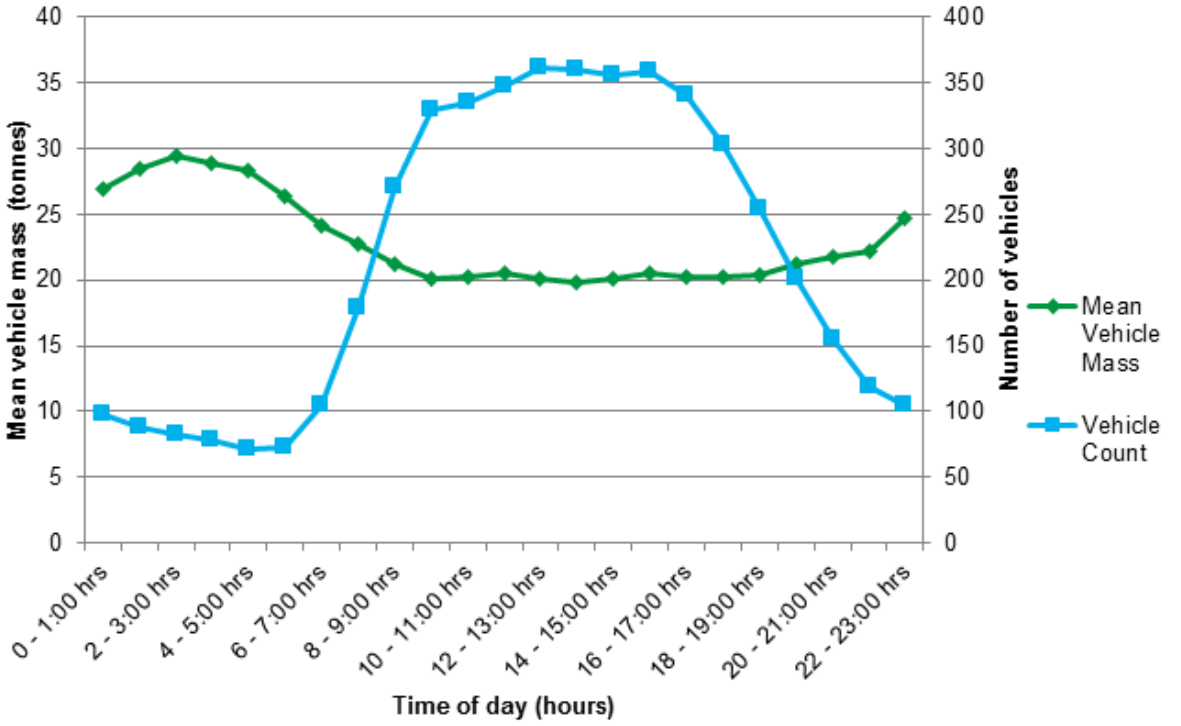


Figure 6.12 Outbound direction 2015 Annual Average Daily distribution of HGV mass and HGV vehicle count at Botany WIM station, for all traffic lanes (travelling away from Port Botany).

6.6.5 Other factors

No altitude factors are required as the tunnels are near sea level.

Cold start factors are excluded. The vast majority of vehicles will have travelled some distance to access the tunnel and so engines will be at their normal operating temperatures within the tunnel.

Age degradation factors are included for all petrol-fueled vehicles in accordance with Table 78 of PIARC 2012. Table 6.15 outlines the assumed year of implementation of each vehicle standard as adopted by Roads and Maritime for fleet estimation purposes. These values have also been adopted in estimating age degradation. PIARC does not provide any data for age degradation of Euro 5 and Euro 6 vehicles. For the purposes of this work, both are assumed to degrade in the same way as Euro 4.

Table 6.15. Assumed year of implementation for emission standards[5].

Emission standard	PC		LDV		HGV
	Petrol	Diesel	Petrol	Diesel	Diesel
Pre Euro					
Euro 1	1999	1999	1999	1999	1996
Euro 2	2004	2003	2004	2003	n/a
Euro 3	2006	n/a	2006	n/a	2003
Euro 4	2010	2008	2010	2008	2008
Euro 5	2014	2014	2014	2014	2011
Euro 6	2019	2019	2019	2019	n/a

6.6.6 Vehicle heat and air temperature

Vehicle heat generation is central to estimating in-tunnel and exhaust stream air temperatures. The vehicle parameters given in Table 6.16 are used to estimate vehicle heat emissions (engine exhaust and braking) on the basis of steady-state vehicle speed and roadway gradient. Dynamic effects of vehicle acceleration or deceleration are ignored due to the added complexity and uncertainty in estimating vehicle behavior. This is also consistent with the PIARC pollution assessment, which includes an allowance for such effects.

Table 6.16. Nominal vehicle parameters for heat generation.

Parameter	Unit	PC	LDV	HGV
Gross mass	tonne	1.5	3.0	21.0
Engine thermal efficiency	%	32	32	32
Idle heat release	kW	10	15	35
Coefficient of rolling resistance		0.01	0.01	0.01

[5] Roads and Maritime Services, NSW Fleet forecast for future road tunnel projects (TT-TN-16-12) Rev 3 dated 12th September 2016

Tunnel air temperatures are determined by the heat load from the vehicles, the advection of that heat by tunnel air, and the ability of the tunnel wall and surrounding ground to absorb heat. In the temperature-related simulations, it has been assumed that the ground temperatures 10 m from the wall, in summer and winter are 20°C and 16°C respectively. These values are taken from ground temperature measurements in the Sydney environs for other projects.

6.6.7 Vehicle emissions during fire

It is assumed that, during a fire scenario, vehicles stopped within the tunnel will be directed to shut off their engines and that, even with only partial compliance, pollution levels within the tunnel will not be a significant factor for the duration of the emergency.

6.6.8 Emission factors

Table 6.17. through Table 6.22. show the calculated vehicle category average pollutant emissions rate as a function of speed and gradient. These tables are used as input tables in simulations, with the resultant total vehicle emissions calculated based on the (variable) traffic flows in each vehicle category.

Table 6.17. PC emission rates for 2023.

PC - CO emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	1.9	1.9	1.9	1.9	1.9	1.9	1.9
10	14.3	12.1	12.7	14.6	16.2	17.4	18.5
20	7.6	13.3	12.8	16.3	18.6	21.9	25.9
30	6.2	9.1	13.3	17.8	21.9	28.0	35.3
40	6.2	8.6	15.0	19.1	26.2	35.5	50.6
50	6.1	6.6	14.1	20.9	30.9	45.6	70.1
60	6.1	6.6	15.2	23.8	37.3	62.5	103.3
70	6.1	6.7	16.7	27.9	48.5	83.5	180.2
80	6.1	6.9	18.3	33.9	65.3	136.9	307.9
90	6.1	10.6	22.5	42.6	88.3	234.7	509.0
100	6.2	11.5	27.6	59.7	151.7	393.9	821.0
110	6.4	16.1	35.5	82.6	265.0	647.2	1,300.1
120	6.6	19.8	51.0	151.0	455.0	1,042.7	2,018.5
130	14.5	28.9	76.0	282.3	766.6	1,653.9	3,079.8

PC - NOx emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	1.1	1.1	1.1	1.1	1.1	1.1	1.1
10	1.5	1.5	1.5	2.1	2.7	3.1	3.5
20	1.5	1.5	1.6	2.7	3.5	4.5	6.2
30	1.5	1.5	1.9	3.2	4.6	6.6	8.7
40	1.5	1.5	2.0	3.7	5.9	8.4	11.3
50	1.5	1.5	1.9	4.1	7.0	10.3	13.9
60	1.5	1.5	2.1	4.8	8.5	12.7	17.2
70	1.5	1.5	2.6	6.2	10.6	15.6	20.8
80	1.5	1.5	3.2	7.5	12.8	18.8	24.7
90	1.5	1.5	4.4	9.3	15.6	22.2	28.8
100	1.5	1.6	5.9	11.7	18.9	26.2	33.5
110	1.5	2.1	7.6	14.7	22.7	30.6	38.7
120	1.5	4.1	10.0	18.4	26.9	35.6	44.4
130	1.5	6.0	13.4	22.6	31.8	41.2	50.7

PC - NO2 emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.25	0.25	0.25	0.25	0.25	0.25	0.25
10	0.26	0.26	0.26	0.44	0.58	0.70	0.83
20	0.26	0.26	0.29	0.60	0.81	1.01	1.38
30	0.26	0.26	0.37	0.74	1.03	1.47	2.02
40	0.26	0.26	0.39	0.84	1.30	1.94	2.79
50	0.26	0.26	0.36	0.91	1.55	2.48	3.53
60	0.26	0.26	0.42	1.04	1.96	3.18	4.45
70	0.26	0.26	0.53	1.31	2.53	3.99	5.39
80	0.26	0.26	0.70	1.65	3.18	4.82	6.41
90	0.26	0.26	0.89	2.14	3.95	5.72	7.51
100	0.26	0.27	1.18	2.81	4.81	6.75	8.74
110	0.26	0.33	1.61	3.64	5.78	7.92	10.11
120	0.26	0.76	2.28	4.61	6.89	9.23	11.61
130	0.26	1.14	3.20	5.69	8.16	10.69	13.27

PC - Exhaust PM emission rate (m2/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.06	0.06	0.06	0.06	0.06	0.06	0.06
10	0.07	0.07	0.07	0.13	0.18	0.23	0.28
20	0.07	0.07	0.08	0.19	0.27	0.34	0.44
30	0.07	0.07	0.11	0.24	0.34	0.46	0.61
40	0.07	0.07	0.12	0.28	0.42	0.59	0.81
50	0.07	0.07	0.10	0.30	0.49	0.73	0.99
60	0.07	0.07	0.12	0.34	0.60	0.90	1.19
70	0.07	0.07	0.17	0.42	0.74	1.10	1.34
80	0.07	0.07	0.23	0.51	0.91	1.25	1.50
90	0.07	0.07	0.29	0.64	1.09	1.39	1.66
100	0.07	0.07	0.38	0.81	1.24	1.55	1.83
110	0.07	0.09	0.50	1.01	1.40	1.71	2.00
120	0.07	0.23	0.68	1.21	1.56	1.89	2.19
130	0.07	0.36	0.90	1.38	1.74	2.07	2.38

PC - Non-exhaust PM emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.28	0.28	0.28	0.28	0.28	0.28	0.28
20	0.56	0.56	0.56	0.56	0.56	0.56	0.56
30	0.84	0.84	0.84	0.84	0.84	0.84	0.84
40	1.12	1.12	1.12	1.12	1.12	1.12	1.12
50	1.40	1.40	1.40	1.40	1.40	1.40	1.40
60	1.68	1.68	1.68	1.68	1.68	1.68	1.68
70	1.96	1.96	1.96	1.96	1.96	1.96	1.96
80	2.24	2.24	2.24	2.24	2.24	2.24	2.24
90	2.52	2.52	2.52	2.52	2.52	2.52	2.52
100	2.80	2.80	2.80	2.80	2.80	2.80	2.80
110	3.08	3.08	3.08	3.08	3.08	3.08	3.08
120	3.36	3.36	3.36	3.36	3.36	3.36	3.36
130	3.64	3.64	3.64	3.64	3.64	3.64	3.64

Table 6.18. LDV emission rates for 2023.

LDV - CO emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
10	11.7	11.7	13.0	25.7	35.3	44.1	34.0
20	11.7	11.7	18.4	38.2	34.1	18.6	22.0
30	11.7	11.7	24.5	41.0	17.6	27.6	52.2
40	11.7	11.7	30.1	25.4	23.2	53.5	99.9
50	11.7	11.7	32.5	18.9	37.7	86.8	160.9
60	11.7	11.7	40.6	19.6	64.8	143.7	226.5
70	11.7	11.7	34.9	36.6	109.3	208.3	305.8
80	11.7	11.7	18.0	65.5	173.9	279.0	401.4
90	11.7	26.8	25.6	111.1	234.1	363.9	513.7
100	11.7	37.0	55.2	182.7	315.9	474.3	655.2
110	11.7	41.8	109.6	256.7	419.3	609.5	824.7
120	20.7	46.5	190.8	352.4	547.8	773.3	884.2
130	29.7	106.9	277.7	473.5	705.3	810.5	957.4

LDV - NOx emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	4.4	4.4	4.4	4.4	4.4	4.4	4.4
10	4.4	4.4	4.8	8.3	11.3	14.2	13.6
20	4.4	4.4	6.2	12.2	13.6	11.7	14.1
30	4.4	4.4	8.0	14.5	11.6	16.2	23.5
40	4.4	4.4	9.6	12.5	14.6	23.8	34.1
50	4.4	4.4	10.4	11.7	19.4	31.5	44.9
60	4.4	4.4	13.0	13.2	26.6	42.1	59.3
70	4.4	4.4	13.7	19.1	36.0	55.2	76.8
80	4.4	4.4	11.6	26.8	47.4	71.0	97.2
90	4.4	6.9	15.5	36.3	61.0	89.3	120.5
100	4.4	9.7	24.3	49.4	79.0	112.4	149.2
110	4.4	12.2	36.0	66.1	100.9	140.0	182.8
120	9.6	21.8	51.3	86.8	127.5	172.6	195.2
130	11.9	35.5	70.7	112.2	159.2	180.0	210.8

LDV - NO2 emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	1.32	1.32	1.32	1.32	1.32	1.32	1.32
10	1.30	1.30	1.38	2.05	2.49	2.87	2.98
20	1.30	1.30	1.68	2.62	2.98	3.03	3.76
30	1.30	1.30	1.99	2.98	3.03	4.27	6.00
40	1.30	1.30	2.25	2.99	3.87	6.08	8.44
50	1.30	1.30	2.36	3.02	5.05	7.84	10.81
60	1.30	1.30	2.72	3.53	6.73	10.19	14.68
70	1.30	1.30	2.98	4.97	8.84	13.56	19.55
80	1.30	1.30	3.03	6.77	11.41	17.91	25.33
90	1.30	2.01	4.09	8.92	15.15	23.07	32.03
100	1.30	2.75	6.18	11.96	20.16	29.69	40.39
110	1.30	3.28	8.86	16.54	26.40	37.70	50.29
120	2.26	5.61	12.47	22.37	34.06	47.30	53.83
130	3.02	8.74	17.83	29.64	43.32	49.47	58.23

LDV - Exhaust PM emission rate (m2/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	1.07	1.07	1.07	1.07	1.07	1.07	1.07
10	0.23	0.23	0.26	0.51	0.70	0.88	1.05
20	0.23	0.23	0.36	0.76	1.05	1.40	1.78
30	0.23	0.23	0.49	0.98	1.44	1.98	2.64
40	0.23	0.23	0.60	1.20	1.82	2.70	3.52
50	0.23	0.23	0.65	1.39	2.28	3.31	4.14
60	0.23	0.23	0.81	1.70	2.91	4.00	4.82
70	0.23	0.23	1.04	2.25	3.66	4.63	5.52
80	0.23	0.23	1.42	2.92	4.27	5.30	6.25
90	0.23	0.53	1.91	3.69	4.89	5.98	7.00
100	0.23	1.02	2.71	4.36	5.61	6.75	7.82
110	0.23	1.62	3.67	5.10	6.38	7.57	8.69
120	0.60	2.49	4.45	5.89	7.20	8.43	9.14
130	1.35	3.63	5.28	6.74	8.09	8.63	9.78

LDV - Non-exhaust PM emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.28	0.28	0.28	0.28	0.28	0.28	0.28
20	0.56	0.56	0.56	0.56	0.56	0.56	0.56
30	0.84	0.84	0.84	0.84	0.84	0.84	0.84
40	1.12	1.12	1.12	1.12	1.12	1.12	1.12
50	1.40	1.40	1.40	1.40	1.40	1.40	1.40
60	1.68	1.68	1.68	1.68	1.68	1.68	1.68
70	1.96	1.96	1.96	1.96	1.96	1.96	1.96
80	2.24	2.24	2.24	2.24	2.24	2.24	2.24
90	2.52	2.52	2.52	2.52	2.52	2.52	2.52
100	2.80	2.80	2.80	2.80	2.80	2.80	2.80
110	3.08	3.08	3.08	3.08	3.08	3.08	3.08
120	3.36	3.36	3.36	3.36	3.36	3.36	3.36
130	3.64	3.64	3.64	3.64	3.64	3.64	3.64

Table 6.19. HGV emissions rates for 2023.

HGV - CO emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	10.9	10.9	10.9	10.9	10.9	10.9	10.9
10	8.6	11.4	21.3	28.9	39.1	52.9	66.0
20	5.7	9.5	21.4	36.2	55.5	80.2	99.3
30	4.8	9.4	26.8	44.1	72.4	104.3	127.0
40	4.2	8.1	27.5	51.0	90.0	124.9	141.2
50	4.2	6.7	26.2	57.1	107.7	137.6	148.1
60	4.2	5.5	23.5	65.2	122.7	143.2	156.3
70	4.2	4.5	20.8	78.1	136.5	146.5	166.3
80	4.2	4.6	22.8	94.0	139.4	153.8	181.7
90	4.2	5.0	23.0	103.2	148.4	164.1	202.3
100	4.2	5.8	26.7	110.6	158.8	179.7	222.9
110	4.2	6.4	31.2	117.7	170.4	195.2	243.2
120	4.2	8.7	35.7	123.2	182.0	210.6	263.3
130	4.6	10.1	41.4	127.8	194.1	225.7	284.0

HGV - NOx emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	79.2	79.2	79.2	79.2	79.2	79.2	79.2
10	20.3	34.8	86.7	137.5	168.4	183.4	179.0
20	10.3	28.1	80.8	146.5	181.8	206.6	251.8
30	7.6	28.3	111.9	166.5	184.8	255.3	297.2
40	6.6	18.9	107.7	177.9	214.2	290.2	347.4
50	6.6	12.6	98.4	180.6	238.0	322.0	390.2
60	6.6	8.9	85.3	186.6	261.3	353.9	461.0
70	6.6	7.1	83.1	182.5	282.1	404.3	532.9
80	6.6	7.4	79.5	185.1	319.3	461.8	606.9
90	6.6	8.3	89.9	204.7	362.9	517.9	680.3
100	6.6	10.5	116.7	245.5	405.9	572.6	753.2
110	6.6	14.6	149.6	288.6	446.4	626.6	825.6
120	6.7	24.4	188.8	322.9	482.5	680.1	897.5
130	8.1	37.3	237.7	346.6	519.3	733.0	969.5

HGV - NO2 emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	11.90	11.90	11.90	11.90	11.90	11.90	11.90
10	2.93	5.15	12.99	20.57	25.07	27.16	25.93
20	1.46	4.14	12.09	21.67	26.79	29.98	36.67
30	1.05	4.17	16.54	24.47	26.52	36.93	42.15
40	0.91	2.71	15.70	26.05	30.76	41.16	48.39
50	0.91	1.76	14.24	26.36	33.81	44.91	53.30
60	0.91	1.22	12.40	27.12	36.50	48.59	62.90
70	0.91	0.97	12.02	26.05	38.79	55.19	72.67
80	0.91	1.01	11.38	25.81	43.68	63.01	82.74
90	0.91	1.13	12.66	28.19	49.61	70.65	92.74
100	0.91	1.42	16.42	33.74	55.47	78.10	102.67
110	0.91	1.97	21.00	39.67	61.03	85.47	112.53
120	0.92	3.28	26.46	44.43	65.93	92.75	122.32
130	1.10	4.98	33.33	47.66	70.96	99.96	132.13

HGV - Exhaust PM emission rate (m2/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	8.30	8.30	8.30	8.30	8.30	8.30	8.30
10	9.04	8.53	8.01	10.00	12.76	15.38	17.04
20	7.81	9.15	7.78	11.56	15.70	18.66	21.59
30	7.49	9.17	9.07	13.74	17.77	22.45	26.75
40	7.14	8.82	9.55	15.29	20.08	26.32	31.62
50	7.13	8.57	9.44	16.11	22.88	29.91	36.90
60	7.13	8.15	9.87	16.94	25.76	33.70	42.43
70	7.13	7.36	9.84	18.06	28.44	37.82	48.20
80	7.13	7.49	10.08	20.04	31.49	42.40	54.60
90	7.13	7.83	11.61	22.73	34.75	47.07	60.99
100	7.13	8.46	12.83	25.85	38.10	51.81	67.36
110	7.13	8.38	14.93	28.86	41.36	56.51	73.69
120	7.16	9.67	17.51	31.16	44.51	61.15	79.97
130	7.50	11.38	20.34	33.16	47.71	65.79	86.29

HGV - Non-exhaust PM emission rate (g/hr) - 2023

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.04	1.04	1.04	1.04	1.04	1.04	1.04
20	2.08	2.08	2.08	2.08	2.08	2.08	2.08
30	3.12	3.12	3.12	3.12	3.12	3.12	3.12
40	4.16	4.16	4.16	4.16	4.16	4.16	4.16
50	5.20	5.20	5.20	5.20	5.20	5.20	5.20
60	6.24	6.24	6.24	6.24	6.24	6.24	6.24
70	7.28	7.28	7.28	7.28	7.28	7.28	7.28
80	8.32	8.32	8.32	8.32	8.32	8.32	8.32
90	9.36	9.36	9.36	9.36	9.36	9.36	9.36
100	10.40	10.40	10.40	10.40	10.40	10.40	10.40
110	11.44	11.44	11.44	11.44	11.44	11.44	11.44
120	12.48	12.48	12.48	12.48	12.48	12.48	12.48
130	13.52	13.52	13.52	13.52	13.52	13.52	13.52

Table 6.20. PC emission rates for 2033.

PC - CO emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	1.9	1.9	1.9	1.9	1.9	1.9	1.9
10	14.5	11.8	12.6	14.8	16.3	17.6	18.8
20	7.4	13.5	12.8	16.4	18.6	20.9	24.5
30	6.1	9.0	13.2	17.8	20.8	25.8	31.1
40	6.1	8.4	14.9	18.8	24.2	30.9	42.9
50	6.0	6.2	13.6	19.9	27.5	38.3	59.4
60	6.0	6.2	14.6	22.0	31.8	53.0	90.6
70	5.9	6.2	16.1	25.4	40.9	71.5	165.6
80	5.9	6.4	17.8	29.8	55.9	125.2	288.2
90	5.9	10.2	21.8	36.6	76.9	218.6	483.1
100	6.0	11.0	25.4	52.0	140.1	371.0	786.3
110	6.0	15.2	31.2	72.5	248.7	614.7	1,249.7
120	6.1	18.2	44.2	139.3	430.6	997.1	1,946.4
130	14.8	26.3	66.6	262.5	728.5	1,587.1	2,977.9

PC - NOx emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	1.1	1.1	1.1	1.7	2.2	2.6	3.0
20	1.1	1.1	1.2	2.3	2.9	3.7	5.1
30	1.1	1.1	1.5	2.7	3.8	5.4	7.3
40	1.1	1.1	1.6	3.1	4.8	7.1	9.8
50	1.1	1.1	1.5	3.4	5.8	8.8	12.2
60	1.1	1.1	1.7	3.9	7.2	11.1	15.2
70	1.1	1.1	2.1	5.0	9.0	13.7	18.3
80	1.1	1.1	2.6	6.2	11.2	16.5	21.7
90	1.1	1.1	3.5	7.8	13.7	19.4	25.2
100	1.1	1.2	4.6	10.0	16.5	22.8	29.2
110	1.1	1.5	6.1	12.8	19.7	26.6	33.6
120	1.1	3.1	8.4	16.0	23.4	30.9	38.5
130	1.2	4.6	11.4	19.5	27.5	35.6	43.8

PC - NO2 emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.22	0.22	0.22	0.22	0.22	0.22	0.22
10	0.22	0.22	0.22	0.38	0.50	0.61	0.72
20	0.22	0.22	0.25	0.52	0.71	0.88	1.19
30	0.22	0.22	0.31	0.65	0.89	1.27	1.76
40	0.22	0.22	0.33	0.73	1.13	1.69	2.45
50	0.22	0.22	0.31	0.79	1.34	2.17	3.12
60	0.22	0.22	0.36	0.90	1.71	2.80	3.94
70	0.22	0.22	0.46	1.13	2.22	3.53	4.77
80	0.22	0.22	0.61	1.43	2.81	4.26	5.67
90	0.22	0.22	0.77	1.86	3.48	5.05	6.63
100	0.22	0.22	1.01	2.47	4.24	5.96	7.72
110	0.22	0.27	1.39	3.21	5.10	6.99	8.91
120	0.22	0.64	1.99	4.06	6.07	8.13	10.23
130	0.22	0.97	2.81	5.01	7.19	9.41	11.68

PC - Exhaust PM emission rate (m2/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.04	0.04	0.04	0.04	0.04	0.04	0.04
10	0.05	0.05	0.05	0.08	0.11	0.14	0.17
20	0.05	0.05	0.05	0.12	0.16	0.20	0.26
30	0.05	0.05	0.07	0.15	0.21	0.28	0.37
40	0.05	0.05	0.07	0.17	0.25	0.36	0.49
50	0.05	0.05	0.07	0.18	0.29	0.44	0.60
60	0.05	0.05	0.08	0.21	0.36	0.55	0.72
70	0.05	0.05	0.10	0.25	0.45	0.67	0.82
80	0.05	0.05	0.14	0.31	0.55	0.76	0.91
90	0.04	0.04	0.17	0.39	0.66	0.84	1.00
100	0.04	0.04	0.23	0.49	0.76	0.94	1.10
110	0.05	0.06	0.30	0.62	0.85	1.03	1.20
120	0.05	0.14	0.41	0.74	0.95	1.13	1.31
130	0.04	0.22	0.55	0.84	1.05	1.24	1.42

PC - Non-exhaust PM emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.28	0.28	0.28	0.28	0.28	0.28	0.28
20	0.56	0.56	0.56	0.56	0.56	0.56	0.56
30	0.84	0.84	0.84	0.84	0.84	0.84	0.84
40	1.12	1.12	1.12	1.12	1.12	1.12	1.12
50	1.40	1.40	1.40	1.40	1.40	1.40	1.40
60	1.68	1.68	1.68	1.68	1.68	1.68	1.68
70	1.96	1.96	1.96	1.96	1.96	1.96	1.96
80	2.24	2.24	2.24	2.24	2.24	2.24	2.24
90	2.52	2.52	2.52	2.52	2.52	2.52	2.52
100	2.80	2.80	2.80	2.80	2.80	2.80	2.80
110	3.08	3.08	3.08	3.08	3.08	3.08	3.08
120	3.36	3.36	3.36	3.36	3.36	3.36	3.36
130	3.64	3.64	3.64	3.64	3.64	3.64	3.64

Table 6.21 LDV emission rates for 2033

LDV - CO emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.9	0.9	0.9	0.9	0.9	0.9	0.9
10	4.6	4.6	5.0	8.7	11.4	13.8	11.0
20	4.6	4.6	6.6	12.2	11.0	6.6	7.4
30	4.6	4.6	8.4	13.0	6.3	8.9	15.2
40	4.6	4.6	9.9	8.6	7.7	15.5	27.3
50	4.6	4.6	10.6	6.7	11.5	24.0	42.7
60	4.6	4.6	12.9	6.7	18.4	38.4	59.0
70	4.6	4.6	11.3	11.2	29.7	54.5	78.8
80	4.6	4.6	6.4	18.6	45.9	72.1	102.6
90	4.6	9.0	8.3	30.1	61.0	93.3	130.6
100	4.6	11.9	16.0	48.1	81.3	120.8	165.8
110	4.6	13.0	29.8	66.6	107.1	154.4	207.9
120	7.6	14.1	50.1	90.4	139.1	195.1	222.8
130	9.4	29.1	71.8	120.6	178.2	204.4	241.2

LDV - NOx emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	2.8	2.8	2.8	2.8	2.8	2.8	2.8
10	2.7	2.7	2.8	4.3	5.2	6.0	6.2
20	2.7	2.7	3.5	5.5	6.2	6.2	7.8
30	2.7	2.7	4.1	6.3	6.3	8.8	12.4
40	2.7	2.7	4.7	6.2	8.0	12.6	17.5
50	2.7	2.7	4.9	6.2	10.4	16.2	22.4
60	2.7	2.7	5.7	7.3	13.9	21.2	30.4
70	2.7	2.7	6.2	10.3	18.3	28.1	40.4
80	2.7	2.7	6.3	14.0	23.7	37.1	52.3
90	2.7	4.2	8.4	18.5	31.4	47.7	66.1
100	2.7	5.7	12.8	24.8	41.7	61.3	83.2
110	2.7	6.8	18.4	34.3	54.5	77.7	103.5
120	4.7	11.6	25.9	46.2	70.2	97.4	110.8
130	6.2	18.1	36.9	61.2	89.2	101.8	119.8

LDV - NO2 emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.85	0.85	0.85	0.85	0.85	0.85	0.85
10	0.79	0.79	0.84	1.20	1.42	1.60	1.70
20	0.79	0.79	1.01	1.48	1.70	1.79	2.24
30	0.79	0.79	1.17	1.67	1.80	2.54	3.55
40	0.79	0.79	1.31	1.74	2.31	3.59	4.95
50	0.79	0.79	1.36	1.79	2.99	4.61	6.30
60	0.79	0.79	1.53	2.11	3.97	5.95	8.62
70	0.79	0.79	1.69	2.95	5.18	7.94	11.55
80	0.79	0.79	1.80	3.99	6.66	10.56	15.03
90	0.79	1.22	2.44	5.22	8.90	13.67	19.10
100	0.79	1.66	3.65	6.99	11.91	17.67	24.17
110	0.79	1.96	5.19	9.74	15.68	22.53	30.19
120	1.31	3.32	7.29	13.25	20.32	28.37	32.33
130	1.78	5.12	10.51	17.65	25.95	29.69	34.98

LDV - Exhaust PM emission rate (m2/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.45	0.45	0.45	0.45	0.45	0.45	0.45
10	0.15	0.15	0.17	0.33	0.44	0.55	0.65
20	0.15	0.15	0.24	0.48	0.65	0.87	1.10
30	0.15	0.15	0.31	0.61	0.89	1.23	1.66
40	0.15	0.15	0.38	0.74	1.13	1.68	2.23
50	0.15	0.15	0.41	0.86	1.42	2.10	2.62
60	0.15	0.15	0.51	1.05	1.83	2.53	3.02
70	0.15	0.15	0.65	1.41	2.33	2.91	3.43
80	0.15	0.15	0.88	1.84	2.69	3.30	3.86
90	0.15	0.34	1.19	2.34	3.06	3.70	4.29
100	0.15	0.63	1.70	2.75	3.48	4.14	4.76
110	0.15	1.00	2.33	3.18	3.93	4.61	5.25
120	0.38	1.56	2.80	3.65	4.40	5.10	5.51
130	0.83	2.31	3.29	4.14	4.91	5.22	5.90

LDV - Non-exhaust PM emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.28	0.28	0.28	0.28	0.28	0.28	0.28
20	0.56	0.56	0.56	0.56	0.56	0.56	0.56
30	0.84	0.84	0.84	0.84	0.84	0.84	0.84
40	1.12	1.12	1.12	1.12	1.12	1.12	1.12
50	1.40	1.40	1.40	1.40	1.40	1.40	1.40
60	1.68	1.68	1.68	1.68	1.68	1.68	1.68
70	1.96	1.96	1.96	1.96	1.96	1.96	1.96
80	2.24	2.24	2.24	2.24	2.24	2.24	2.24
90	2.52	2.52	2.52	2.52	2.52	2.52	2.52
100	2.80	2.80	2.80	2.80	2.80	2.80	2.80
110	3.08	3.08	3.08	3.08	3.08	3.08	3.08
120	3.36	3.36	3.36	3.36	3.36	3.36	3.36
130	3.64	3.64	3.64	3.64	3.64	3.64	3.64

Table 6.22. HGV emissions rates for 2033.

HGV - CO emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	7.4	7.4	7.4	7.4	7.4	7.4	7.4
10	5.5	8.1	17.3	24.7	35.1	49.3	62.7
20	3.3	6.3	17.6	32.3	52.0	77.3	96.7
30	2.6	6.2	22.6	40.3	69.2	101.6	124.3
40	2.2	5.0	23.2	47.2	87.2	122.2	137.3
50	2.2	3.8	21.9	53.5	105.2	134.3	141.6
60	2.2	3.0	19.2	61.8	120.0	138.1	147.0
70	2.2	2.4	16.7	75.2	134.0	139.2	154.3
80	2.2	2.4	18.4	91.5	135.3	144.3	167.2
90	2.2	2.6	17.9	100.0	143.3	152.4	185.9
100	2.2	2.9	20.8	106.2	152.8	166.7	204.7
110	2.2	3.2	24.4	112.4	163.7	181.0	223.3
120	2.2	4.0	27.9	117.3	174.6	195.1	241.7
130	2.3	4.8	32.2	121.3	186.1	209.0	260.6

HGV - NOx emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	74.5	74.5	74.5	74.5	74.5	74.5	74.5
10	16.1	30.8	80.5	127.7	154.1	163.7	148.1
20	7.4	24.4	74.7	131.6	159.8	171.2	209.9
30	4.9	24.4	100.3	146.6	148.4	208.1	226.6
40	4.2	14.7	92.5	154.3	171.0	221.3	248.8
50	4.2	8.6	82.6	154.4	182.4	231.4	259.9
60	4.2	5.6	72.2	156.6	188.8	240.1	306.0
70	4.2	4.5	69.2	143.4	192.6	268.8	353.0
80	4.2	4.6	63.9	133.5	213.7	306.5	401.8
90	4.2	5.2	68.8	140.3	242.3	343.6	450.2
100	4.2	6.3	88.8	167.1	270.7	379.7	498.2
110	4.2	8.7	113.1	196.6	298.1	415.4	546.0
120	4.2	14.2	141.8	220.7	321.7	450.7	593.4
130	4.8	21.4	178.9	236.5	346.1	485.6	640.9

HGV - NO2 emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	12.27	12.27	12.27	12.27	12.27	12.27	12.27
10	2.62	5.05	13.25	21.02	25.33	26.85	24.09
20	1.19	3.99	12.29	21.59	26.16	27.85	34.21
30	0.77	3.98	16.45	23.98	24.05	33.82	36.52
40	0.65	2.38	15.08	25.21	27.71	35.67	39.75
50	0.65	1.37	13.44	25.19	29.41	36.98	41.08
60	0.65	0.89	11.76	25.51	30.21	38.07	48.34
70	0.65	0.70	11.26	23.18	30.55	42.48	55.75
80	0.65	0.73	10.35	21.35	33.80	48.43	63.45
90	0.65	0.81	11.07	22.28	38.31	54.28	71.09
100	0.65	0.99	14.28	26.50	42.80	59.97	78.67
110	0.65	1.36	18.17	31.18	47.14	65.61	86.21
120	0.66	2.21	22.76	35.02	50.86	71.18	93.69
130	0.76	3.32	28.71	37.53	54.71	76.69	101.19

HGV - Exhaust PM emission rate (m2/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	4.73	4.73	4.73	4.73	4.73	4.73	4.73
10	6.87	6.01	4.10	5.38	7.69	9.74	10.79
20	6.34	6.92	4.05	6.71	9.97	11.70	13.37
30	6.19	6.90	4.50	8.52	11.18	13.82	16.13
40	5.99	6.73	4.88	9.66	12.47	15.88	18.66
50	5.98	6.61	4.85	10.18	14.02	17.74	21.36
60	5.98	6.40	5.58	10.66	15.56	19.68	24.26
70	5.98	6.09	6.12	11.22	16.95	21.79	27.32
80	5.98	6.14	5.85	12.35	18.48	24.23	30.89
90	5.98	6.26	6.87	13.79	20.15	26.78	34.45
100	5.99	6.45	7.41	15.40	21.93	29.42	38.01
110	5.98	6.17	8.66	17.05	23.76	32.03	41.54
120	5.99	6.28	10.34	18.35	25.48	34.63	45.05
130	6.11	7.37	12.05	19.55	27.27	37.24	48.57

HGV - Non-exhaust PM emission rate (g/hr) - 2033

Speed	Gradient						
(km/hr)	-6%	-4%	-2%	0%	2%	4%	6%
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.04	1.04	1.04	1.04	1.04	1.04	1.04
20	2.08	2.08	2.08	2.08	2.08	2.08	2.08
30	3.12	3.12	3.12	3.12	3.12	3.12	3.12
40	4.16	4.16	4.16	4.16	4.16	4.16	4.16
50	5.20	5.20	5.20	5.20	5.20	5.20	5.20
60	6.24	6.24	6.24	6.24	6.24	6.24	6.24
70	7.28	7.28	7.28	7.28	7.28	7.28	7.28
80	8.32	8.32	8.32	8.32	8.32	8.32	8.32
90	9.36	9.36	9.36	9.36	9.36	9.36	9.36
100	10.40	10.40	10.40	10.40	10.40	10.40	10.40
110	11.44	11.44	11.44	11.44	11.44	11.44	11.44
120	12.48	12.48	12.48	12.48	12.48	12.48	12.48
130	13.52	13.52	13.52	13.52	13.52	13.52	13.52

6.6.9 Validity of emissions estimates

A project to compare the emissions calculated using the methodology outlined in this report (i.e. the detailed PIARC approach) against measurements made in the M5 East Tunnel has been completed. The work[6] provides a first order comparison of the emissions estimate methodology adopted in this report, using the NSW Roads and Maritime fleet estimate methods, evaluated for the M5 East in March 2015, and for the basket of tunnel grades in the relevant part of M5 East.

For the controlling pollutant, NO_2, the conclusions are that the emissions estimated using the method in this report are consistent with in-tunnel measurements. In terms of the experiment conducted, this is saying that the method used in the concept design of M4-M5 Link, is as accurate as we can know it to be.

The comparison addresses third party concerns expressed during the earlier EIS processes, on the validity of the adopted pollution model.

6.7 Climate assumptions

In calculating the vehicle-induced airflow and associated pollution levels throughout a tunnel network, the influence of air temperature is largely insignificant for normal operations. This is because buoyancy forces are quite small compared to tunnel wall friction and the piston effect of vehicles, for most real operating conditions. There are also the forces from jet fans and tunnel extraction points. Most simulations and results assume constant ambient air conditions of 20°C and 50 % relative humidity.

The variability of normal operation system airflows across the year (due to differing ambient conditions) is expected to be within the accuracy band of the results for ventilation outlet airflows and pollutant emissions. With reference to the New M5 EIS, the difference in results between summer and winter simulations is seen to be minimal.

For temperature-related simulations, data from the Australian Bureau of Meteorology for the Canterbury Racecourse site has been used. The data were supplied by Pacific Environment[7] and consist of hourly records of dry-bulb temperature and relative humidity for 2015.

6.8 Background air quality

Table 6.23. below shows the assumed background air quality at all ventilation supply points and portals, assumed to apply at all times.

Table 6.23. Assumed background air quality.

Pollutant	Unit	Value
NO_2	ppm	0.03
CO	ppm	1.3
Visibility (extinction co-efficient)	m^{-1}	0.0001

The WestConnex ventilation system is designed to ensure net inflow of air at all traffic entry and exit portals and so no allowance for recirculation of pollutants between adjacent portals is necessary.

[6] Comparison of PIARC-based Pollution Estimates with Measurements in the M5 East Tunnel", Stacey Agnew, January 2017.

[7] Paul Boulter 2016, personnel communication, 26th September 2016.

Further, at this stage of design, no allowance has been made for the following effects as they are insignificant within the context of the design definition:

- Recirculation of pollutants from ventilation outlets to ventilation supply points and/or portals.
- Localised increases in background levels due to portal geometry and surface road traffic emissions.

For the purposes of ventilation design and results within this report, all simulations and results are completed with zero background pollutant levels. Consequently:

1) In-tunnel pollution criteria are assessed against revised criteria, being the limit value minus background (Table 6.23.).
2) All stack emissions include only vehicle-sourced emissions, without a background component.

6.9 Fire Scenarios

6.9.1 Design Fire parameters

Parameter	Value	Comments
Design Heat Release Rate (Hot)	50 MW	Used where buoyancy of the smoke resists the ventilation effort.
Design Heat Release Rate (Cold)	0 MW	Used where buoyancy of the smoke would assist the ventilation effort.
Fire power to air	0.7	The fraction of fire power (HRR) that goes to heating the tunnel air and smoke. Typical value without deluge operation. May be lower with deluge providing additional cooling of the smoke.

6.10 Vehicle drag and tunnel aerodynamics

The adopted tunnel aerodynamic parameters and criteria are:

Parameter	Value	Comments
Wall friction factors λ	0.035 0.030	Conservative for in-tunnel pollution levels and fire scenario. Conservative for tunnel flows and hence portal capture.
Adverse portal wind pressure	20 Pa	Applied only at portals where that would resist the ventilation effort.
Maximum in-tunnel air velocity	10 m/s	Applied only to cases where jet fans are used to assist tunnel airflows to meet in-tunnel air quality criteria.

Vehicle aerodynamic drag force on an isolated vehicle in open air is expressed by the equation: $F_d = \frac{1}{2}\rho C_d A_v (v-U)^2$, where;

- ρ is the density of air which is dependent on temperature [kg/m^3];
- C_d is the drag coefficient measured in open air. Typical drag coefficients for isolated vehicles in open air facing an oncoming air stream are given in Figure 6.13. The height of the bars in this graph indicate that drag coefficients are highly variable.

  When the airstream comes from the rear of the vehicle, as would occur with stopped traffic, the drag coefficient may be larger than when the airstream is coming from the front;
- A_v is the frontal area [m^2] of the vehicle;
- v is the vehicle speed [m/s], and;
- U is the tunnel air speed [m/s].

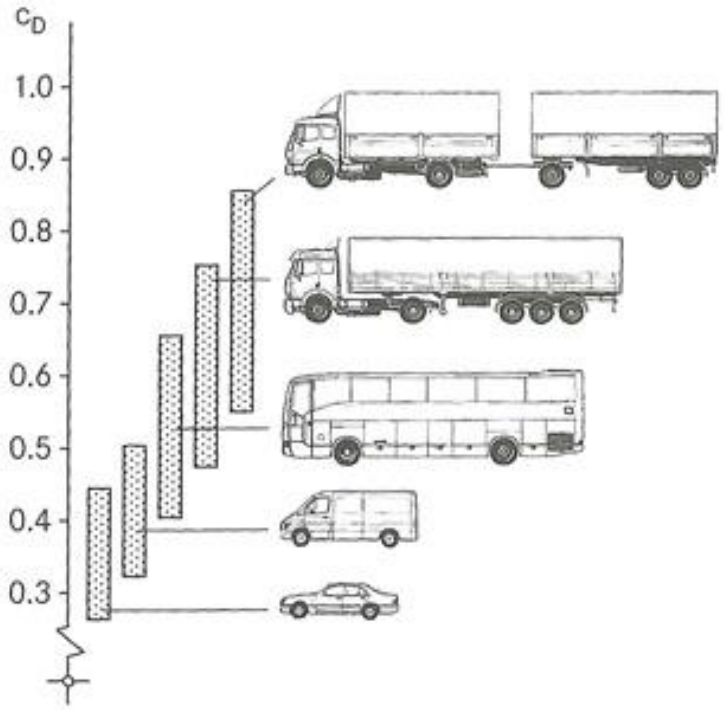


Figure 6.13. Typical drag coefficients for isolated vehicles in open air. (http://www.part20.eu/en/background/aerodynamics/)

The aerodynamic drag on vehicles varies considerably with vehicle spacing. The reduction of drag force by slipstreaming is demonstrated each year through the bunches and breakaways of the Tour de France. Of course, the same slipstreaming effect is seen with cars and trucks. One example dataset showing the effect is shown in Figure 6.14.

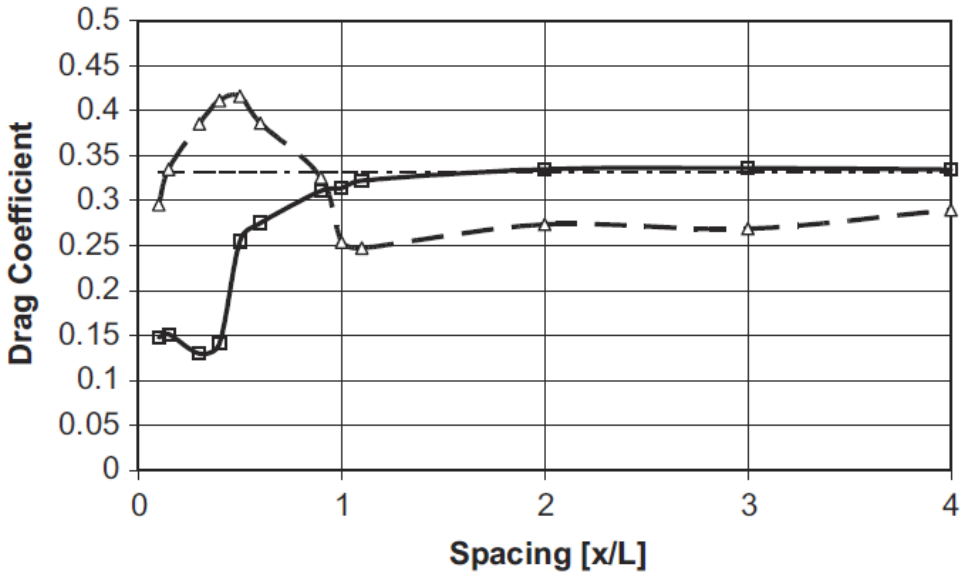


Figure 6.14. Effect of vehicle spacing (separation) on vehicle drag coefficients of the lead (square) and trailing (triangle) vehicle (Watkins & Gino 2007).

With the tunnel walls affecting both the airspeed around the vehicle and the nature of the vehicle wake, and with vehicles sometimes packed quite closely with no cross wind, the drag is different to (lower than) that in open air. Proximity of the tunnel walls and traffic in adjacent lanes has the effect of suppressing the wake being shed from a vehicle, thus reducing its effective drag coefficient.

For the purposes of concept design, typical single-vehicle drag coefficients, as shown in Table 6.24 have been used. Using the single vehicle drag coefficients is generally conservative from a design perspective because:

- at high traffic speeds, the higher drag coefficients will result in an over-estimate of the flow driven towards exit portals, and hence a conservative design for the portal emissions capture ventilation plant
- for 20 km/h traffic, the jet fans may be promoting flow faster than 20 km/h, meaning that the flow is coming from behind the vehicles. In that case, ignoring slipstreaming increases the calculated jet fan requirement.
- The effect at low speeds is in any case small, as the relative velocity between vehicles and the air is low, and drag is proportional to the square of relative velocity.

The drag coefficient values nominated by Roads and Maritime are:

Table 6.24. Vehicle aerodyamic factors.

Vehicle Type	Area (m^2)	Coefficient of Drag
PC	2.5	0.4
LDV	5.0	0.6
HGV	7.0	0.8

The local blockage effect of the vehicles has been included in all simulations.

6.11 In-tunnel air quality limits

The Secretary's Environmental Assessment Requirements (SEARS) require: *"a demonstration of how the project and ventilation design ensures that concentrations of air emissions meet NSW, national and international best practice for in-tunnel and ambient air quality, and taking into consideration the approved criteria for the M4 East project, New M5 project and the In-Tunnel Air Quality (Nitrogen Dioxide) Policy"*.

The pollution limit criteria as established for the recent M4 East and New M5 projects are given in Table 6.25. The three pollutants assessed in-tunnel are nitrogen dioxide (NO_2), carbon monoxide (CO) and particulate matter (PM) which is measured as an optical extinction coefficient. With the current pollution limits, for the assessment years of the WestConnex project, NO_2 will be the pollutant that determines the required airflow and drives the design of ventilation for in-tunnel pollution.

In February 2016, the NSW Government's Advisory Committee on Tunnel Air Quality (ACTAQ) issued a document titled "In-tunnel air quality (nitrogen dioxide) policy". That document further consolidated the approach taken earlier for NorthConnex, M4 East and New M5. The policy wording requires tunnels to be *"designed and operated so that the tunnel average nitrogen dioxide (NO_2) concentration is less than 0.5 ppm as a rolling 15 minute average"*.

The words "*tunnel average*" had been interpreted by Roads and Maritime as an average over all tunnel sections forming a project stage. As the policy document notes, the average over the tunnel is a proxy for motorist exposure, which is impractical to measure directly. Of course, in any trip, motorists don't traverse all underground sections in a project, but take just one route through particular sections. For simpler tunnel geometries like NorthConnex with limited ramps, that distinction is perhaps too fine to be of concern, however as WestConnex becomes more complex as the projects combine, the difference could become significant.

For the project and associated integrated analysis of WestConnex, "tunnel average" has been interpreted as a "route average", being the "length-weighted average pollutant concentration over a portal to portal route through the system". Tunnel average NO_2 has been assessed for every possible route through the system under all circumstances, however typically only the paths with the highest average are reported. The calculation of this is outlined in Section 7.3.

With the predicted maximum CO levels falling well below the "tunnel average" requirement, the complexity of evaluating "tunnel average" CO criteria has been simplified and assessed as an in-tunnel maximum criteria throughout this work.

The "averaging period" included in Table 6.25 is interpreted as a measure to allow short term perturbations above the nominated criteria in the operational tunnel. This would include such things as:

- a single vehicle with abnormally high dirty exhaust locally affecting visibility,
- a convoy of trucks passing through the tunnel, momentarily increasing the HGV fraction beyond the design values.

For this work, the simulations governing the system design (worst case operations) have been completed on the basis of steady-state operations, meaning that the averaging period for the purpose of this analysis is conservatively zero. That is, the ventilation system would maintain in-tunnel air quality indefinitely when continuously subjected to the most onerous design traffic conditions. During later stages of design, the dynamics of traffic may need to be reviewed to ensure the control system (and associated ventilation plant) provides a timely response to evolving traffic conditions with the tunnel.

Table 6.25. In-tunnel air quality criteria.

Pollutant	Concentration Limit	Unit	Averaging period
In-tunnel average along length of tunnel			
CO	87	ppm	Rolling 15-minute
CO	50	ppm	Rolling 30-minute
NO_2	0.5	ppm	Rolling 15-minute
In-tunnel single point maxima			
CO	200	ppm	Rolling 3-minute
Visibility	0.005	m^{-1}	Rolling 15-minute

6.12 Changes from previous work

Earlier M4 East and New M5 ventilation analyses were prepared for EIS purposes. Those earlier reports formed a starting point for this work on ventilation of the project as part of the combined WestConnex tunnel system. While details of the assumptions and methodology are given in sections above, we note here the material changes to the design and analysis approach made since the earlier projects. The changes arise primarily from seeking to continually improve the engineering, and also respond to substantive comments from RMS and third parties. Other minor improvements to the analysis or inputs are captured in the appropriate parts of this Section 6, which is intended to record all relevant detail.

6.12.1 Pollution model

For M4 East and New M5, the PIARC Australian tables were used. While that method has a sound basis, it was not developed specifically with the NSW regulatory practices in mind, and had not recently been compared to local outcomes.

A change has been made to refer to the PIARC detailed method rather than the Australian tables. The detailed method allows the NSW specific fleet characteristics (as estimated by Roads and Maritime) to be used, incorporating the current understanding of regulatory implementation of Euro standards and trends in fuel types. With fleet predictions available beyond 2020, the latest year forecast in the PIARC Australian tables, the emissions calculations incorporate the improved performance of the fleet for the different prediction years.

A project to validate the detailed PIARC approach (see Section 6.6.9), including NO_2 estimates, against measurements made in the M5 East Tunnel was completed after the M4 East and New M5 EIS analyses. This is now available to be referenced by the project. The PIARC method validation addresses third party concerns, expressed during the earlier EIS processes, on the validity of the adopted pollution model.

6.12.2 Fleet makeup

The PIARC method requires the fleet to be split into passenger cars (PC), light duty vehicles (LDV) and heavy goods vehicles (HGV). The traffic models, being also revenue focused, categorise vehicles by registration type rather than by emissions and aerodynamic behavior. Earlier work developed a transformation to turn the traffic model categories of vehicle into the categories used in the PIARC emissions method. A modified approach provided by Roads and Maritime is applied here.

The fleet age distribution has been changed. Up until now, the age distribution has been taken from automatic number plate recognition records along the M4 East corridor. Roads and Maritime have a distribution based on registration data and adjusted using Australian Bureau of Statistics data on the correlation of vehicle kilometres travelled (VKT) with vehicle age. The age distributions are conservative in being older, on average, than the registration database averages. The Roads and Maritime profile is adopted here, in the form of the Euro class distributions provided for the years analysed.

For most classes of vehicles, the age distribution is unchanged when extrapolating to future fleets. For diesel PCs and LDVs, acknowledgement is made of the uptake in diesel vehicles over the last decade, with the result that the diesel PC and LDV fleet age distribution will gradually shift to become older, on average, than it is now. Adoption of the PIARC detailed method also allows the fuel type mix for the fleet to be reflected accurately, addressing third party concerns expressed on the M4 East and New M5 reports.

6.12.3 Heavy vehicle mass

The pollution emitted by HGVs is correlated to their mass. The average mass of 15.5 t used in the New M5 EIS and in comparing against M5 East data has since been reconfirmed as appropriate, by Roads and Maritime analysis of weigh-in-motion station data. The same data for different stations have been re-analysed, also by Roads and Maritime, to give average HGV mass by time of day over a wider corridor. Those plots were used to conclude that an average HGV mass of 21 t is appropriate for much of the route, and slightly conservative for other links, where it might drop to 17 t or so. The complexity involved in having different fleet masses in each tunnel link has been rejected, accepting the slight conservatism inherent in adopting 21 t as the HGV mass everywhere.

The average HGV mass on which the PIARC tables are based is 23 t. The pollution estimation therefore also includes a mass correction factor, according to the PIARC approach.

6.12.4 Lane capacities

Work by Roads and Maritime has shown that the previous maximum traffic flow figure of 2200 PCU/lane/h at 80 km/h is too conservative, in that it has not been observed within Sydney motorway road tunnels. The upper limit at 80 km/h was seen to be 1900 PCU/lane/h, with flowrate peaking at 2060 PCU/lane/h at 70 km/h. These new figures are adopted here. The adopted maximum flow at 20 km/h is 1350 PCU/lane/h.

6.13 Sensitivity of input data and assumptions

Within the analysis, there are numerous inputs which are estimated. While many inputs to the ventilation analysis cannot be known with absolute certainty, from experience and measurements within existing tunnels, they are typically known with sufficient accuracy to give a basis of design.

The concept design adopts a basis of “reasonable worst case” throughout, with the most onerous combination of inputs used for the limiting design scenarios, in lieu of performing a range of sensitivity analyses for each input separately. An alternative basis of analysis may be adopted during detailed design phase of the project. Discussion on the possible range of inputs and the application within the concept design is made in the sections above where applicable.

7 METHODOLOGY

7.1 Simulation approach

7.1.1 Models

To reduce overall complexity of models, the overall system has been sub-divided into three distinct models which are aerodynamically separated from each other and do not involve underground traffic connections.

1) M4 to M5 direction
2) M5 to M4 direction
3) Western Harbour Tunnel and Beaches Link

While the future WHT&BL creates an aerodynamic and underground traffic connection between the three models, the assumption of complete exchange at the interface with WHT&BL allows the models to be separated. A fixed boundary condition, assuming the supply pressure is controlled to atmospheric pressure, is implemented at the WHT&BL interfaces with the project.

Scaling of traffic is completed independently by each model. For connections to WHT&BL (M4 to WHT&BL – 2 lanes, M5 to WHT&BL – 3 lanes), co-incident cases that give a total of 3 lanes of traffic heading to WHT&BL were considered for design of the overall Rozelle capacity.

The WHT&BL model is run independently and only for the expected traffic cases for the purpose of estimating emissions captured at the project interface plant at Rozelle. Only the southbound WHT&BL from North Sydney has been analysed, as the pollution from the northbound WHT&BL tube is not relevant to the project. WHT&BL has not been analysed for design purposes.

7.1.2 Expected traffic operations (24 h)

A comprehensive set of dynamic simulations using the expected traffic demand predicted by the WRTM have been completed. These simulations represent the expected behavior of the tunnel ventilation system under day-to-day conditions of expected traffic demand. These models adopt the expected traffic demand at all inlet portals and the expected exit fractions at all diverges. The traffic input parameters increase or decrease as a step change on the hour over 24 hours, with the resulting traffic conditions calculated by the IDA Tunnel traffic “congestion” model. All results for these simulations are a snapshot of conditions taken 54 minutes after the hour.

Generally, when the expected traffic is below capacity, the traffic, airflow and pollution levels throughout the tunnel will have reached a steady state condition at some time prior to the results snapshot. The results for these hours are effectively a steady-state solution obtained using a dynamic simulation, with the simulated traffic flows corresponding to the demand parameters.

If the traffic demand during some hours approaches or exceeds the lane capacity, the IDA Tunnel traffic model estimates the amount of congestion and queuing. As a result, the traffic conditions may be constantly evolving for some hours, not reaching the demand traffic flows and resulting in carryover of the demand flow to subsequent hours. Consequently, the airflow and pollution levels throughout the tunnel will have not reached a steady state condition that correlate directly with the demand traffic parameters. This same behaviour would be expected in the real tunnel.

All normal operations simulations are performed on the following basis:

- Constant ambient conditions, see Section 6.7
- Heat-neutral conditions (no vehicle heat, no heat flow through tunnel wall) effectively eliminating any buoyancy effects and air-temperature changes along the tunnel
- No external portal wind pressures

An important conclusion derived from these results is that the WestConnex tunnel are self-ventilating for the predicted traffic, generally without any requirement to operate the interface exchange plant at St Peters or Haberfield. Some jet fans are used however to maintain minimum air velocity goals around the system during times of low traffic conditions. Operational experience may show this to be unnecessary.

For the 2023 and 2033 Cumulative scenarios, the expected traffic results in predicted congestion in the M4 East travelling towards the M4 for some hours of the day. This congestion, combined with the impact of reverse flow in Concord Road off-ramp means that during these hours, partial air exchange at Haberfield is required to meet the in-tunnel air quality criteria.

7.1.3 Regulatory demand traffic operations (24 h)

The traffic data provided indicate that, under most scenarios, the expected traffic flows fall below the theoretical maximum lane capacity of 2060 PCU/lane/h of the tunnel network (i.e. Volume/Capacity ratio < 1). To cover the possibility of traffic being under-predicted, a limiting traffic case was sought relating to the maximum capacity of the tunnel. The daily traffic demand profile was uniformly scaled (see Section 6.5.4) such that the peak flow reached 2060 PCU/lane/h in the most congested link at a single hour. The scaled traffic demand profile is referred to in this report as “regulatory case” or just “regulatory” traffic demand. Table 7.1 below shows the scaling factors applied to the expected traffic profiles to scale up to regulatory demand traffic.

Scaling has been calculated and applied independently for the various parts of the network that are not connected underground. This means that a), the “M4 to M5” direction is scaled independently of the “M5 to M4” direction, and b) the M4 East and New M5 sections are scaled independently for the “Do minimum” scenario.

Table 7.1. Traffic scaling factors for the Regulatory case.

Scenario	M4 to M5 direction	M5 to M4 direction
2023 Do minimum	M4 East – 1.42 New M5 – 2.71	M4 East – 1.61 New M5 – 1.75
2033 Do minimum	M4 East – 1.26 New M5 – 2.06	M4 East – 1.52 New M5 – 1.32
2023 Do something	1.05	1.21
2033 Do something	1.13	1.07
2023 Cumulative	n/a	n/a
2033 Cumulative	n/a	n/a

The expected traffic for the 2023 Cumulative and 2033 Cumulative scenarios is equivalent to, or exceeds the regulatory demand and as such the regulatory demand traffic cases were already addressed by the expected traffic for these scenarios.

An additional set of simulations using the same basis as expected traffic operations but using regulatory traffic demand have been completed for the 2023 Do minimum, 2033 Do minimum, 2023 Do something and 2033 Do something scenarios.

As for the expected traffic case, the WestConnex tunnels are self-ventilating for the regulatory (scaled up expected) traffic, generally without any requirement to operate the interface exchange plant at St Peters or Haberfield. Again, as for the normal traffic, some jet fans are used to maintain minimum air velocity goals around the system during times of low traffic conditions.

7.1.4 Worst case operations

The tunnel ventilation system must be designed to cater for a wide range of varied traffic conditions, ranging from high traffic volumes at high speed (free flow) to low speed at high traffic density (congested). The demand traffic data, taken from the WRTM is aimed at predicting the typical traffic volumes and journeys through the WestConnex tunnels. However, it does not inform the potential variation from these flows and patterns, due to, for example, closures in the external road network or incidents within the tunnel itself.

In considering the most onerous traffic conditions for the ventilation system, the previous EISs completed on WestConnex (M4 East and New M5) adopted an approach whereby various restrictions or bottlenecks were introduced into the system. The resulting traffic conditions predicted by the IDA Tunnel congestion model were used to demonstrate the ventilation system capacity.

Due to the growth of the network and additional underground connections at Rozelle (linking M4 East and New M5 underground), the previous approach was not considered feasible. For the project an alternative methodology has been used to inform the required ventilation system capacity. This involved testing extremes of ramp splits, with either the ramp or mainline full at the expense of the other. With traffic in sections falling to zero, closure of tunnel sections has also been covered. Numerous different scenarios were explored for each mainline direction with different tunnel scenarios, seeking with each variation to push the capacity limits of one plant or another.

For the NSW fleet (as adopted for the project), the fleet average vehicle emissions are declining year on year. As a result, the worst case operations can be simplified by looking only at the most onerous cases of emissions (year 2023) for each potential overall network configuration. Worst case operations have been assessed on the basis of 2023 emissions for two tunnel arrangements:

Tunnel arrangement	Do something	Cumulative
M4 East	X	X
New M5	X	X
M4-M5 Link	X	X
Western Harbour Tunnel and Beaches Link		X
F6 Extension		X

The worst case operations also required consideration of the HGV fraction in the traffic. While HGVs generally make up a small proportion of the fleet, they are responsible for a large percentage of the dominant pollutant (NO_2) emissions within the tunnel. As such the selection of an appropriate HGV fraction becomes an important consideration for the tunnel ventilation design. For the M4-M5 Link, the normal traffic demand profiles have been used to inform the selection of the design HGV fraction as follows.

The project is effectively a 4-lane system; in both directions the mainline tunnels connecting Haberfield and St Peters to Rozelle, Links 8.1, 8.2, 12.1 and 12.2, have 4 lanes. These 4 links are the major contributors to total tunnel emissions, representing a major share of the total lane.km of roadway. We therefore consider the HGV fractions in these links as representative of the HGV occupancy in the project.

Figure 7.1 shows the relationship between "HGV fraction" and "V/C ratio" based on the normal traffic demand profiles for the 2023 Do something, 2033 Do something, 2023 Cumulative and 2033 Cumulative scenarios. With the exception of very low demand, it is evident that as the demand increases, the upper range of HGV fraction decreases.

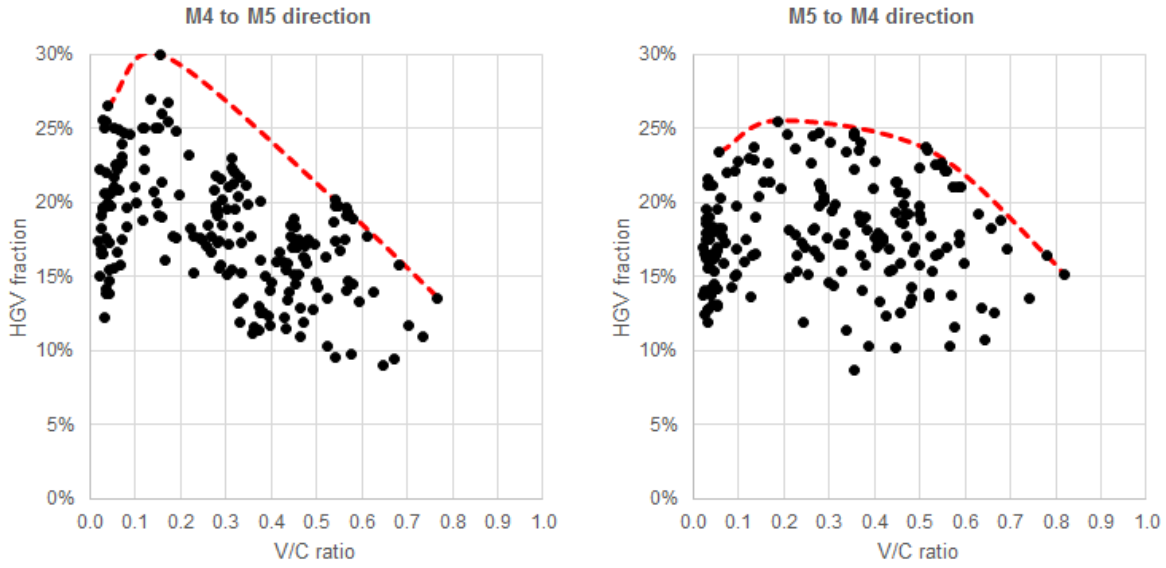


Figure 7.1. Scatter plot of HGV fraction against V/C ratio (for links 8.1/12.1 and 8.2/12.2).

The likelihood of significant congestion occurring is expected to be correlated with the traffic demand. When the traffic demand exceeds 3 lanes of capacity (V/C ratio > 0.75) an incident that results in the closure of a single lane in the M4-M5 Link would be expected to result in significant levels of congestion as the V/C ratio would then exceed 1. However, when the traffic demand is much less than 3 lanes, an incident closing 1 lane may not lead to significant levels of congestion throughout the M4-M5 Link.

The following selection criteria are adopted using the data shown in Table 7.2 and Table 7.3, with hours meeting the selection criteria highlighted orange, and the design basis (which is rounded up) highlighted red.

- Any HGV fraction where the V/C ratio exceeds 0.75, or
- The HGV fraction coinciding with the highest V/C ratio (i.e. the first hour that would reach capacity if scaled to regulatory demand flows).

It is noted that the HGV fraction is seen to increase somewhat between 2023 and 2033. If we were to look at the years separately, the higher vehicle emissions in 2023 would be offset partially by the lower HGV fraction. However, we conservatively adopt a fixed HGV fraction of 14% for the M4 to M5 direction and 17% for the M5 to M4 direction, for the worst case operations analyses.

For the project (and wider WestConnex), there are numerous traffic flow patterns that could occur due to a wide variety of factors. However, from a ventilation perspective, a limited number of scenarios will capture the most onerous requirements.

The maximum demand on various parts of the ventilation system and on integrated operation across WestConnex will occur under different traffic conditions, as outlined in Section 5.2. While the actual operation will depend highly on the traffic composition and distribution, generally:

- Free-flowing 60 to 80 km/h: The piston effect of vehicles will drive significant tunnel airflows maintaining low pollution levels throughout the tunnels. Under these conditions, ventilation plant for portal emissions capture will be operating at their peak. The interface ventilation plant will generally not be required, with each stage passing air downstream.
- Congested 20 to 40 km/h: The piston effect of vehicles will be small and vehicles may become a resistance to flow at 20 km/h, requiring peak jet fan numbers to drive adequate airflow to dilute pollutants. Under these conditions, the interface ventilation plant will be required to exhaust all air arriving along the tunnel and re-supply fresh air (complete exchange). Effectively, each stage will be operating with only its own plant capacity to meet the in-tunnel air criteria with fresh air boundary conditions. The portal emissions capture plant will be operating somewhat under capacity during these times, so total airflow will be much lower than that at 80 km/h. Maximum in-tunnel ventilation demand will occur when as many sections as possible have slow traffic at their peak capacity.

Table 7.2. Summary of HGV fractions in mainline links, M4 to M5 direction.

	2023 Do Something				2033 Do Something				2023 Cumulative				2033 Cumulative			
	Link [8.1]		Link [12.1]		Link [8.1]		Link [12.1]		Link [8.1]		Link [12.1]		Link [8.1]		Link [12.1]	
Hour	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %
0	0.05	21.7%	0.04	14.2%	0.06	22.5%	0.05	19.7%	0.06	22.2%	0.07	15.8%	0.07	24.0%	0.08	18.3%
1	0.03	16.5%	0.02	16.5%	0.04	26.5%	0.03	20.6%	0.04	22.0%	0.04	13.8%	0.04	19.8%	0.05	15.5%
2	0.02	15.0%	0.02	17.4%	0.03	25.5%	0.03	18.2%	0.03	19.6%	0.03	12.2%	0.04	19.8%	0.04	14.7%
3	0.03	19.0%	0.02	22.2%	0.03	25.0%	0.02	16.9%	0.03	19.5%	0.03	13.9%	0.04	19.9%	0.04	15.4%
4	0.04	20.6%	0.04	25.5%	0.05	25.0%	0.04	17.6%	0.05	20.6%	0.06	16.6%	0.06	22.5%	0.07	17.5%
5	0.12	25.0%	0.06	24.9%	0.12	23.5%	0.08	24.7%	0.12	22.2%	0.12	18.8%	0.15	25.0%	0.16	21.4%
6	0.33	11.9%	0.17	16.1%	0.36	11.6%	0.19	17.6%	0.39	15.0%	0.36	11.2%	0.47	17.1%	0.46	10.9%
7	0.54	**9.6%**	0.37	11.4%	0.58	**9.8%**	0.38	12.5%	0.70	**11.7%**	0.65	9.0%	0.77	**13.5%**	0.67	9.4%
8	0.49	12.8%	0.33	15.2%	0.52	13.5%	0.34	17.3%	0.58	14.5%	0.50	14.3%	0.68	15.8%	0.57	14.1%
9	0.45	14.5%	0.31	17.2%	0.48	15.9%	0.32	19.6%	0.52	16.3%	0.47	16.3%	0.61	17.7%	0.54	17.4%
10	0.43	15.5%	0.29	18.4%	0.46	17.5%	0.32	21.2%	0.49	17.2%	0.46	17.0%	0.58	18.8%	0.54	18.7%
11	0.42	16.0%	0.28	19.1%	0.45	18.4%	0.31	22.3%	0.48	17.5%	0.45	17.4%	0.57	19.3%	0.54	19.7%
12	0.42	16.6%	0.28	19.7%	0.45	18.9%	0.31	22.9%	0.47	17.3%	0.44	17.7%	0.57	19.7%	0.54	20.2%
13	0.41	16.0%	0.28	19.4%	0.44	18.5%	0.32	22.1%	0.45	15.2%	0.44	15.8%	0.57	19.1%	0.55	19.8%
14	0.40	14.0%	0.29	17.3%	0.45	16.9%	0.33	20.4%	0.43	13.5%	0.44	13.9%	0.55	16.7%	0.56	17.4%
15	0.40	12.3%	0.30	15.2%	0.46	15.1%	0.36	17.7%	0.43	12.2%	0.47	11.9%	0.57	14.7%	0.63	14.0%
16	0.40	11.7%	0.33	13.2%	0.46	12.9%	0.40	14.6%	0.43	11.5%	0.52	10.3%	0.59	13.3%	0.73	10.9%
17	0.34	13.5%	0.23	15.2%	0.38	16.1%	0.28	19.4%	0.37	13.0%	0.38	12.5%	0.47	16.2%	0.50	14.6%
18	0.29	15.7%	0.18	17.7%	0.33	18.4%	0.22	23.2%	0.31	15.4%	0.29	15.6%	0.38	20.1%	0.35	19.8%
19	0.27	16.7%	0.16	19.0%	0.30	19.5%	0.19	24.8%	0.28	17.3%	0.24	17.6%	0.35	21.1%	0.31	21.0%
20	0.26	17.1%	0.15	20.0%	0.29	20.2%	0.17	25.4%	0.27	17.7%	0.23	17.7%	0.33	21.7%	0.29	21.6%
21	0.25	17.5%	0.14	20.7%	0.28	20.8%	0.16	26.0%	0.26	18.4%	0.22	18.3%	0.32	22.0%	0.28	21.8%
22	0.13	27.0%	0.10	21.1%	0.16	30.0%	0.12	25.0%	0.15	25.0%	0.15	19.1%	0.17	26.8%	0.20	20.5%
23	0.06	20.8%	0.04	17.3%	0.07	22.6%	0.05	21.0%	0.07	23.1%	0.08	19.7%	0.09	24.6%	0.10	20.0%

Table 7.3. Summary of HGV fractions in mainline links, M5 to M4 direction.

	2023 Do Something				2033 Do Something				2023 Cumulative				2033 Cumulative			
	Link [8.2]		Link [12.2]		Link [8.2]		Link [12.2]		Link [8.2]		Link [12.2]		Link [8.2]		Link [12.2]	
Hour	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %	V/C	HGV %
0	0.04	14.2%	0.03	11.9%	0.05	16.4%	0.05	14.4%	0.05	14.2%	0.05	13.1%	0.06	18.2%	0.07	15.8%
1	0.03	16.5%	0.02	14.1%	0.04	19.0%	0.03	15.6%	0.04	17.5%	0.04	13.8%	0.04	21.1%	0.05	16.7%
2	0.02	17.0%	0.02	13.7%	0.03	19.5%	0.03	16.2%	0.03	17.9%	0.03	12.8%	0.03	21.6%	0.05	15.4%
3	0.02	16.5%	0.03	12.5%	0.03	18.9%	0.03	18.5%	0.03	17.5%	0.03	12.8%	0.03	21.1%	0.04	16.2%
4	0.04	15.7%	0.04	13.1%	0.05	18.0%	0.04	18.4%	0.04	16.5%	0.05	13.0%	0.05	19.6%	0.06	18.2%
5	0.10	15.2%	0.09	15.0%	0.12	17.5%	0.10	19.8%	0.11	15.9%	0.13	13.6%	0.14	19.0%	0.13	23.8%
6	0.36	8.7%	0.24	12.0%	0.45	10.2%	0.31	14.4%	0.39	10.3%	0.34	11.3%	0.46	12.6%	0.42	17.3%
7	0.48	13.5%	0.38	15.8%	0.60	15.9%	0.53	17.8%	0.57	13.8%	0.64	10.7%	0.69	16.8%	0.82	15.1%
8	0.44	15.5%	0.34	17.9%	0.56	17.0%	0.46	19.8%	0.53	15.4%	0.52	13.6%	0.63	19.2%	0.66	18.2%
9	0.40	17.0%	0.30	19.5%	0.50	19.2%	0.40	22.7%	0.49	16.9%	0.46	15.9%	0.58	21.0%	0.57	21.0%
10	0.38	18.1%	0.29	20.4%	0.47	20.6%	0.37	24.0%	0.47	17.7%	0.43	16.9%	0.56	22.2%	0.53	22.5%
11	0.37	18.7%	0.28	20.9%	0.45	21.3%	0.36	24.6%	0.46	18.7%	0.42	17.6%	0.54	22.6%	0.52	23.5%
12	0.37	19.1%	0.28	21.2%	0.45	21.4%	0.35	24.7%	0.45	19.3%	0.41	17.9%	0.55	22.7%	0.51	23.7%
13	0.37	18.8%	0.28	21.0%	0.45	20.7%	0.36	24.4%	0.47	19.2%	0.41	17.2%	0.56	22.1%	0.50	22.3%
14	0.40	17.6%	0.29	20.2%	0.47	19.2%	0.37	23.5%	0.50	18.8%	0.43	15.4%	0.59	21.1%	0.50	19.7%
15	0.48	14.3%	0.33	17.2%	0.53	16.4%	0.40	20.9%	0.59	17.3%	0.48	13.2%	0.68	18.8%	0.54	16.5%
16	0.58	**11.6%**	0.41	13.3%	0.67	**12.5%**	0.50	15.7%	0.74	**13.5%**	0.57	10.3%	0.78	16.4%	0.64	12.9%
17	0.42	12.3%	0.26	18.1%	0.48	16.6%	0.34	23.4%	0.52	13.9%	0.37	14.1%	0.59	17.8%	0.46	18.5%
18	0.30	14.6%	0.19	20.9%	0.37	16.4%	0.26	22.6%	0.33	15.4%	0.28	16.4%	0.38	19.0%	0.35	22.2%
19	0.25	15.1%	0.17	21.4%	0.32	17.2%	0.23	23.6%	0.27	16.8%	0.24	17.2%	0.31	19.9%	0.30	24.1%
20	0.23	15.3%	0.16	21.4%	0.29	17.6%	0.21	24.6%	0.25	16.9%	0.22	17.8%	0.29	20.1%	0.28	24.7%
21	0.21	14.9%	0.14	20.4%	0.27	18.3%	0.19	25.5%	0.23	16.4%	0.21	18.1%	0.28	19.7%	0.26	24.5%
22	0.09	16.9%	0.09	14.3%	0.12	23.0%	0.10	22.8%	0.13	16.4%	0.14	16.5%	0.13	22.8%	0.16	22.7%
23	0.05	17.0%	0.05	14.5%	0.06	20.3%	0.06	23.4%	0.06	17.7%	0.07	17.3%	0.07	22.0%	0.09	22.1%

A limited number of traffic patterns have been assessed, representing the potential worst case traffic distributions for the project and integrated operations. Table 7.4 to Table 7.7 describe the traffic patterns, being the "No. of lanes" of traffic in each section with all cases assessed at 20, 40, 60 and 80 km/h. For these tables, links at capacity have been highlighted in red and a grey highlight used to show the links which are out of the project scope. In all cases, continuity of traffic is maintained at all junctions and diverges. The vehicle flow is calculated according to the following:

$QS_{PC|LDV|HGV}$ = section traffic flow for each vehicle category

$PCU_{lane\ cap}$ = theoretical lane capacity at scenario design speed, see Table 6.11.

$No\ of\ lanes$ = lanes of traffic flows, see Table 7.4 to Table 7.7.

$PCU{:}HGV$ = HGV equivalence ratio, see Table 6.11.

HGV = Design HGV fraction.

$QS_{Total} = \frac{PCU_{lane\ cap} \times No\ of\ lanes}{HGV \times PCU{:}HGV + (1 - HGV)}$ = total vehicle flow in section.

$QS_{HGV} = QS_{Total} \times HGV$

$QS_{LDV} = QS_{Total} \times (1 - HGV) \times 0.16$

$QS_{PC} = QS_{Total} \times (1 - HGV) \times 0.84$

For the integrated operations and the project concept design, specific traffic patterns in the M4 East and New M5 provide the most onerous requirements during congested operations when the interface ventilation plant are operating.

In the M4 to M5 direction:

- M4 East boundary: The flow pattern with 3 lanes entering from M4 East and 1 lane entering from Wattle St will result in more emissions to be handled by the project. This is because vehicles entering downhill from Wattle St will emit fewer emissions than those travelling uphill (or level) entering from M4 East. As the interface plant will extract all polluted air, the traffic pattern in M4 East has no impact on the project. As a result, the traffic patterns reviewed for low speed operations have been limited to this arrangement (3 lanes from M4 East, 1 lane from Wattle St).
- New M5 boundary: The flow pattern with 3 lanes exiting to St Peters and 1 lane continuing to New M5 will result in more emissions to be handled in the project. Additional flows patterns with 2 lanes continuing to New M5 have also been considered as this will result in more emissions (and airflow demand) at the interface plant.

Similarly, but for the M5 to M4 direction:

- M4 East boundary: The flow pattern with 2 lanes exiting to Wattle St and 2 lanes continuing to M4 East results in more emissions to be handled by the project ventilation plant. This is because Wattle St is uphill compared to the relatively flat continuation on towards M4. Flow patterns with up to 3 lanes continuing on to M4 East have also been considered as being more onerous for the interface plant.
- New M5 boundary: The vehicle flow pattern with 2 lanes entering from New M5 will result in more onerous emissions in the project compared to up to 3 lanes entering from the downhill St Peters on-ramp.

Table 7.4. Traffic configurations for Cumulative worst case operations, M4 to M5 direction (values are "No of lanes" of traffic).

	Link	[1.1]	[2.1]	[3.1]	[4.1]	[5.1]	[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]	[19.2]	[20.1]	[21.1]	[22.1]
	No lanes	3	1	3	1	2	3	2	4	3	2	2	2	2	1	1	3	3	1	3	4	3	2	2	4	3	2
Design case	0	3	0	3	0	0	3	1	4	3	1	2	1	1	1	0	3	3	0	3	4	3	1	2	3	1	2
	1	2	1	3	0	0	3	1	4	3	1	2	1	1	1	0	3	3	0	3	4	3	1	2	3	1	2
	2	2	0	2	0	0	2	2	4	3	1	2	1	1	1	0	3	3	0	3	4	3	1	2	3	1	2
	3	3	0	3	0	0	3	1	4	3	2	1	1	1	1	0	3	3	0	3	4	3	1	2	3	1	2
	4	3	0	3	0	0	3	1	4	3	2	1	1	1	1	0	3	3	0	3	4	3	1	2	3	1	2
	5	3	0	3	0	0	3	1	4	2	2	0	2	1	1	0	2	2	0	2	4	3	1	2	3	1	2
	6	3	0	3	0	0	3	1	4	3	2	1	1	2	1	1	2	3	0	3	4	3	1	2	3	1	2
	7	3	0	3	0	0	3	1	4	3	2	1	1	2	1	1	1	2	1	3	4	3	1	2	3	1	2
	8	3	0	3	0	0	3	1	4	3	2	1	1	1	1	0	3	3	0	3	4	2	2	2	4	2	2
	9	3	0	3	0	0	3	0	3	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	1	0	1	0	0	1	2	3	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	1	0	1	0	0	1	2	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	3	0	3	0	0	3	0	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	2	2	1	3	4	3	1	0	1	0	1
	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	3	3	3	0	0	0	0	0
	15	0	0	0	0	0	0	2	2	0	0	0	2	0	0	0	0	0	1	1	3	3	0	0	0	0	0
	16	2	0	2	0	0	2	2	4	2	2	0	2	0	0	0	1	1	1	2	4	3	1	0	1	0	1
	17	2	0	2	0	0	2	2	4	2	2	0	2	0	0	0	1	1	1	2	4	2	2	2	4	2	2
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	0	2	0	2	0	2
	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	0	2	2	4	2	2
	20	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	21	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	0	1	1	1	0	0	0	0	0
	22	2	0	2	0	0	2	1	3	3	2	1	0	1	1	0	3	3	0	3	3	3	0	0	0	0	0

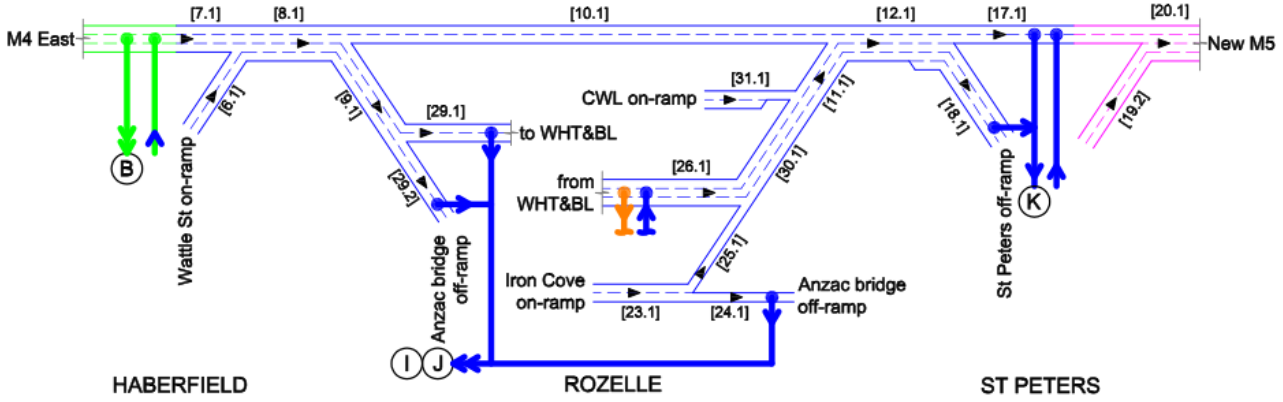


Table 7.5. Traffic configurations for Cumulative worst case operations, M5 to M4 direction (values are "No of lanes" of traffic).

	Link	[1.2]	[2.2]	[3.2]	[4.2]	[5.2]	[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]	[19.1]	[20.2]	[21.2]	[22.2]
	No lanes	3	1	3	1	1	3	2	4	3	2	2	2	2	1	1	3	3	2	3	4	3	2	2	4	3	2
Design case	0	3	0	3	0.5	0.5	2	2	4	3	1	2	1	2	1	1	2	3	0	3	4	2	2	2	4	2	2
	1	3	0	3	0.5	0.5	2	2	4	3	1	2	1	1	1	0	3	3	0	3	4	2	2	2	4	2	2
	2	3	0	3	0.5	0.5	2	2	4	3	1	2	1	1	1	0	2	2	1	3	4	2	2	2	4	2	2
	3	3	0	3	0.5	0.5	2	2	4	3	1	2	1	1	1	0	1	1	2	3	4	2	2	2	4	2	2
	4	3	0	3	0.5	0.5	2	2	4	3	1	2	1	2	1	1	0	1	2	3	4	2	2	2	4	2	2
	5	3	0	3	0.5	0.5	2	2	4	3	1	2	1	2	1	1	2	3	0	3	4	3	1	2	3	1	2
	6	3	0	3	0.5	0.5	2	2	4	2	1	1	2	2	1	1	1	2	0	2	4	2	2	2	4	2	2
	7	3	0	3	0	0	3	1	4	2	1	1	2	2	1	1	1	2	0	2	4	2	2	2	4	2	2
	8	3	0	3	0.5	0.5	2	2	4	2	0	2	2	2	1	1	1	2	0	2	4	2	2	2	4	2	2
	9	3	0	3	0.5	0.5	2	2	4	2	2	0	2	2	1	1	1	2	0	2	4	2	2	2	4	2	2
	10	3	0	3	0	0	3	1	4	3	1	2	1	2	1	1	2	3	0	3	4	2	2	2	4	2	2
	11	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	2	3	0	3	3	2	1	0	1	0	1
	12	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	3	0	3	3	2	1	0	1	0	1
	13	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	3	0	3	3	1	2	0	2	0	2
	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	3	2	1	0	1	0	1
	15	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	2	3	3	2	1	0	1	0	1
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	0	0
	17	3	0	3	0	0	3	0	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18	1	0	1	0	0	1	2	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19	3	0	3	0	0	3	1	4	3	2	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	20	2	0	2	0	0	2	2	4	3	2	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	21	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	0	1	1	1	0	0	0	0	0
	22	3	0	3	0.5	0.5	2	2	4	3	1	2	1	0	0	0	3	3	0	3	4	2	2	0	2	0	2

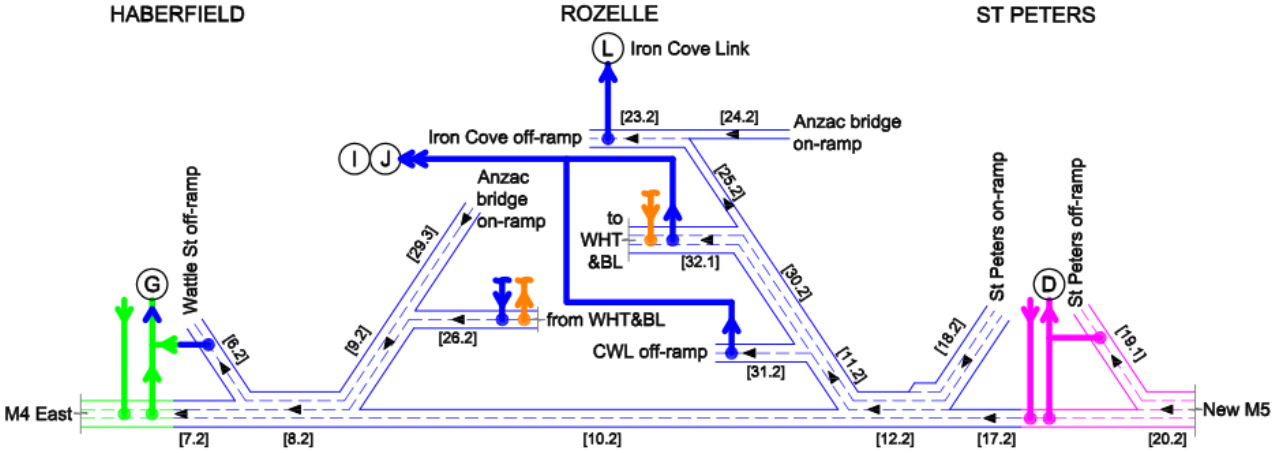


Table 7.6. Traffic configurations for Do something worst case operations, M4 to M5 direction (values are "No of lanes" of traffic).

	Link	[1.1]	[2.1]	[3.1]	[4.1]	[5.1]	[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]	[19.2]	[20.1]	[21.1]	[22.1]
	No lanes	3	1	3	1	2	3	2	4	3	2	2	2	2	1	1	3	3	1	3	4	3	2	2	4	3	2
Design case	0	3	0	3	0	0	3	1	4	2	0	2	2	2	1	1	0	1	1	2	4	3	1	1	2	0	2
	1	3	0	3	0	0	3	1	4	2	0	2	2	2	1	1	0	1	1	2	4	2	2	0	2	0	2
	2	2	0	2	0	0	2	2	4	2	0	2	2	2	1	1	0	1	1	2	4	3	1	1	2	0	2
	3	0	0	0	0	0	0	2	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	2	0	2	0	0	2	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	1	0	1	0	0	1	2	3	2	0	2	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	2	2	2	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	2	2	0	2	0	2	0	2
	8	0	0	0	0	0	0	1	1	0	0	0	1	1	0	1	0	1	1	2	3	3	0	0	0	0	0
	9	0	0	0	0	0	0	1	1	0	0	0	1	1	0	1	0	1	1	2	3	1	2	0	2	0	2

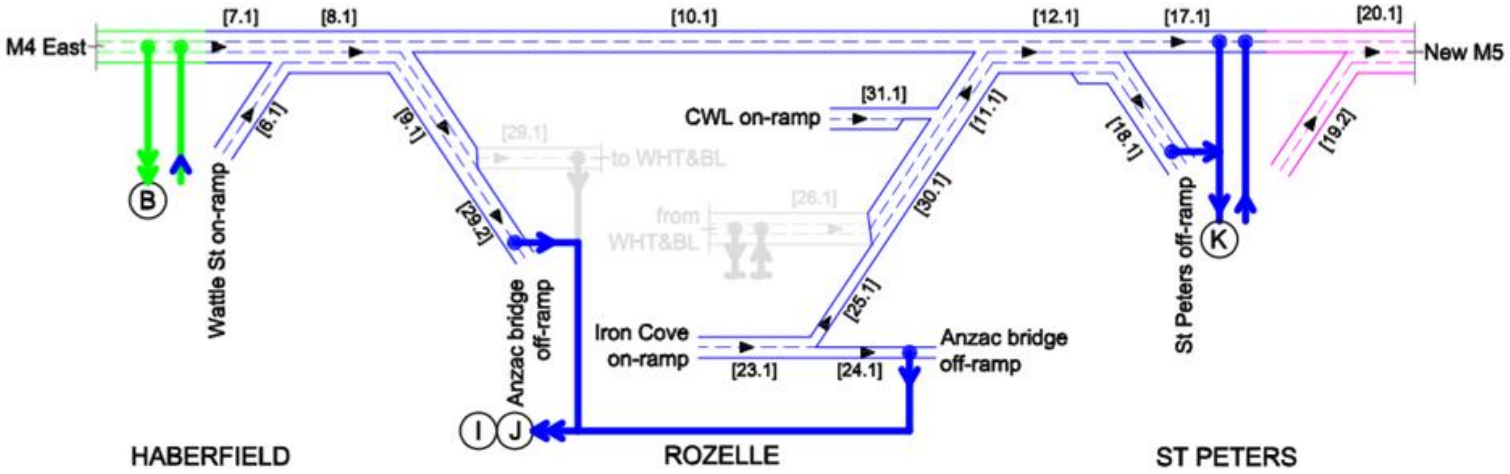
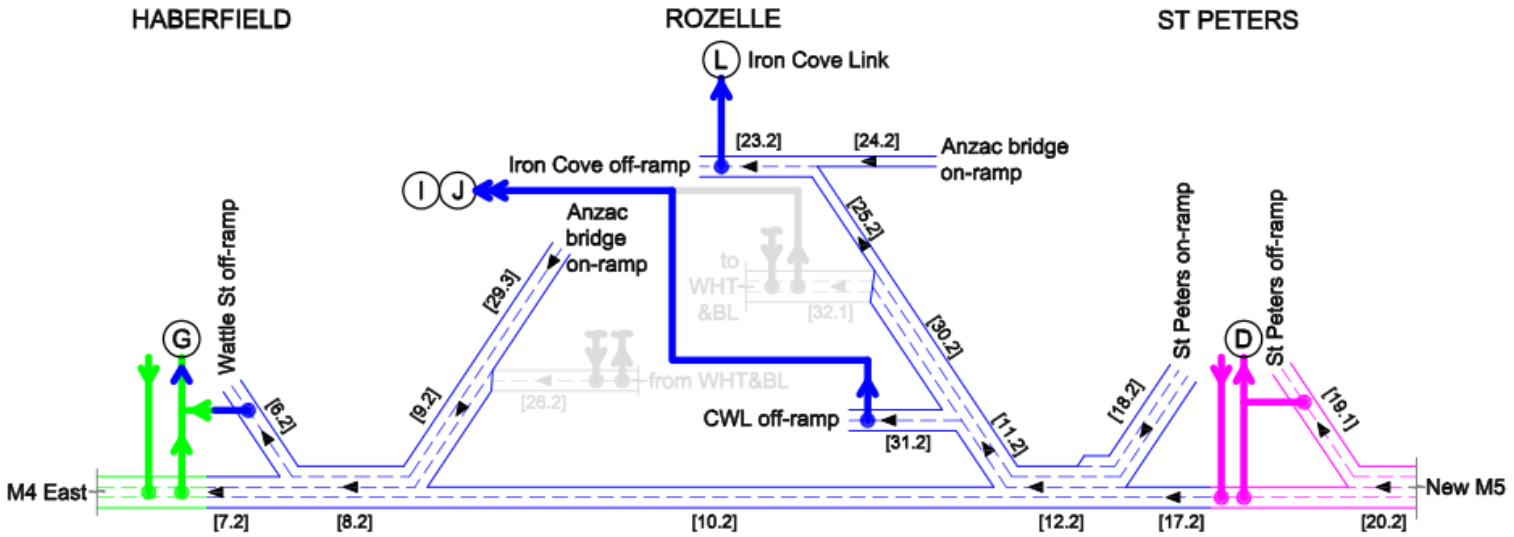


Table 7.7. Traffic configurations for Do something worst case operations, M5 to M4 direction (values are "No of lanes" of traffic).

	Link	[1.2]	[2.2]	[3.2]	[4.2]	[5.2]	[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]	[19.1]	[20.2]	[21.2]	[22.2]
	No lanes	3	1	3	1	1	3	2	4	3	2	2	2	2	1	1	3	3	2	3	4	3	2	2	4	3	2
Design case	0	2.5	0.5	3	1	1	1	2	3	2	0	2	1	2	1	1	0	1	2	3	4	2	2	0	2	0	2
	1	2.5	0.5	3	1	1	1	2	3	2	0	2	1	2	1	1	0	1	2	3	4	3	1	1	2	0	2
	2	1.5	0.5	2	0	0	2	1	3	2	0	2	1	2	1	1	0	1	2	3	4	2	2	0	2	0	2
	3	2.5	0.5	3	0	1	2	2	4	2	0	2	2	2	1	1	0	1	1	2	4	2	2	0	2	0	2
	4	2.5	0.5	3	0	0	3	1	4	2	0	2	2	2	1	1	0	1	1	2	4	2	2	0	2	0	2
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	2	3	3	3	0	0	0	0	0
	7	3	0	3	0	1	2	2	4	2	0	2	2	1	1	0	0	0	0	0	2	2	0	0	0	0	0
	8	3	0	3	0	0	3	1	4	2	0	2	2	0	0	0	0	0	0	0	2	2	0	0	0	0	0
	9	3	0	3	0	0	3	0	3	2	0	2	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	10	2.5	0.5	3	0	0	3	0	3	1	0	1	2	2	1	1	0	1	1	2	4	2	2	0	2	0	2
	11	0	0	0	0	0	0	2	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	0.5	0.5	1	0	0	1	2	3	2	0	2	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	0	1	1	1	0	0	0	0	0



7.1.5 Temperature estimates

The tunnel air temperatures are relevant to the dispersion of pollutants from ventilation outlets, velocity of the outlet streams for assessment relative to the Civil Aviation Safety Authority (CASA) criterion, and also to the tunnel occupants.

Remote from inlets, tunnel temperatures are not strongly influenced by the ambient conditions. Rather, the air temperature is determined by the balance between vehicle heat and the heat sink provided by the tunnel walls, which varies along the tunnel according to the traffic, airflow and seasonal variations in the ground temperature.

Exhaust outlet connections are generally the combination of two streams, being 1) the vehicle-driven airflow from the tunnel and, 2) the portal capture inflow. The vehicle-driven airflow is remote from inlet locations, hence its temperature is not subject to rapid variations in the ambient conditions. However, portal sections of the tunnel (between the exhaust connection and portals) are generally short, so the tunnel walls have little to no influence, with the temperature closely following the ambient condition. The portal capture stream(s) therefore have a moderating effect on the outlet stream temperature rise, diluting the vehicle driven airflow temperature rise down towards the ambient condition.

The buoyancy of the exhaust plume, a function of the difference between the outlet air temperature and ambient condition, could vary quite rapidly and widely as ambient conditions change. As the portal inflow remains roughly fixed around a target airflow, and the piston driven flows vary with the traffic, the potential variability in plume buoyancy is also linked to the traffic conditions. Generally:

1) High traffic volumes (high exhaust flows): Under these conditions, the vehicle-driven airflows are large, hence the outlet air temperature will be largely de-coupled from the ambient condition. The buoyancy of the plume therefore becomes strongly coupled to the ambient temperature, with rapid changes in ambient temperature resulting in rapid and wide variability in the buoyancy of the plume.

2) Low traffic volumes (low exhaust flows): Under these conditions, the vehicle driven airflows are generally lower, so the outlet air temperature will be more influenced by the portal inflow contribution, somewhat coupling the outlet temperature to the ambient condition. The buoyancy of the plume therefore becomes less subject to variability in the ambient conditions as changes in ambient conditions are also reflected in the outlet air temperature.

For the previous EIS's completed on WestConnex (M4 East and New M5), temperature simulations were carried out to understand the likely in-tunnel and exhaust air temperatures. Those assessment used results of a single 24 hour simulation, adopting a typical design day ambient temperature profile. To investigate the potential variability in plume buoyancy, this work uses the results from 31 days of simulation using measured ambient data records. At the core, this work adopts the same underlying basis of analysis, with parameters for the ground heat sink identical to those used for both the M4 East and New M5. However, significant changes to the tunnel geometry, particularly M4-M5 Link, traffic demand profiles, and statistical approach, mean that the results cannot be directly compared to previous analyses.

Simulations representing both summer and winter seasons were completed using IDA Tunnel for the 2033 Cumulative and 2023 Cumulative for the expected traffic profiles. These two scenarios were adopted as they represent the scenarios with the highest expected temperature differentials as they have the highest traffic volumes.

Ambient temperature records from the BOM Canterbury Racecourse station in 2015 were adopted, for consistency with plume dispersion works completed by others. Data for January (Figure 7.2) and July (Figure 7.3), having the highest and lowest average

temperature of the 12 months, have been used as representative of typical summer and winter conditions respectively.

Tunnel air predictions involved a multi-step simulation process, completed independently for both summer and winter inputs:

1) Long-term: Used to estimate the ground temperatures resulting from years of continuous operations.
2) Seasonal: Used to estimate the seasonal variation in ground temperatures.
3) Demand traffic operations: Continuous simulations for a month in duration, adopting the 24 hr traffic demand and operating regime used in the normal operations simulations for every day[8] with hourly varying ambient conditions. Unlike traffic data which consists of step inputs for each hour, ambient conditions are linearly interpolated between the raw data. An extra 2 weeks of simulation is done as additional warm-up period. The results for this warm-up time period are not included.

Results of this process consist of a snapshot of data every hour, corresponding to a particular hour of traffic condition, for 31 consecutive days. The primary variable at each hour of the day being the ambient temperature and its variation beforehand. A statistical analysis on each of the 31 sets of hourly results is presented for both the exhaust stream and the temperature differential (delta T). Differential temperatures are calculated as the difference between the exhaust stream and the concurrent ambient temperature at each results snapshot.

[8] Potential variability in traffic demand on weekends and public holidays have been ignored. The temperature analysis assumes that the demand traffic profile occurs every day of the year.

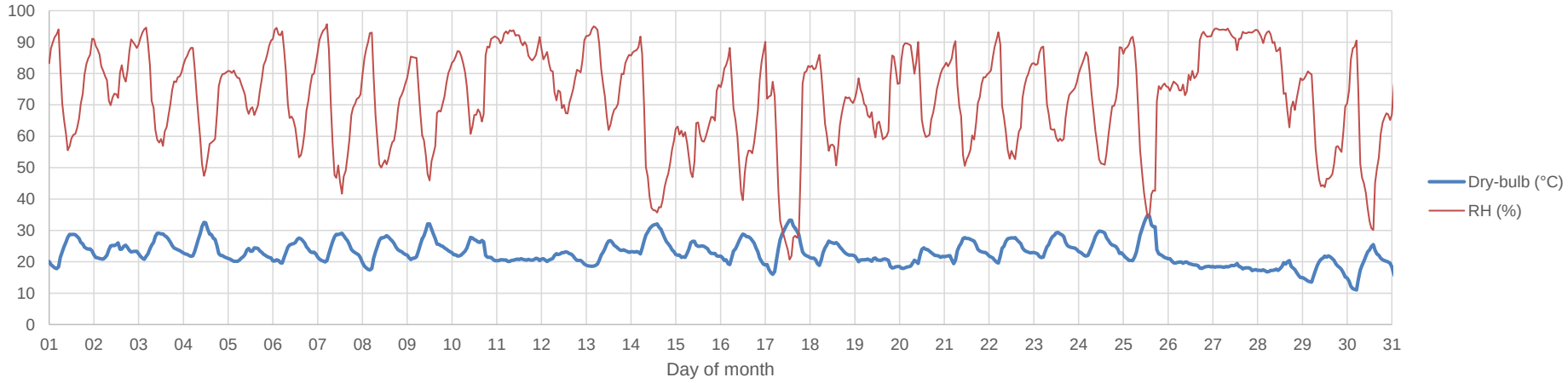


Figure 7.2. Ambient measurements used for summer, based on BOM Canterbury Racecourse station measurements from January 2015.

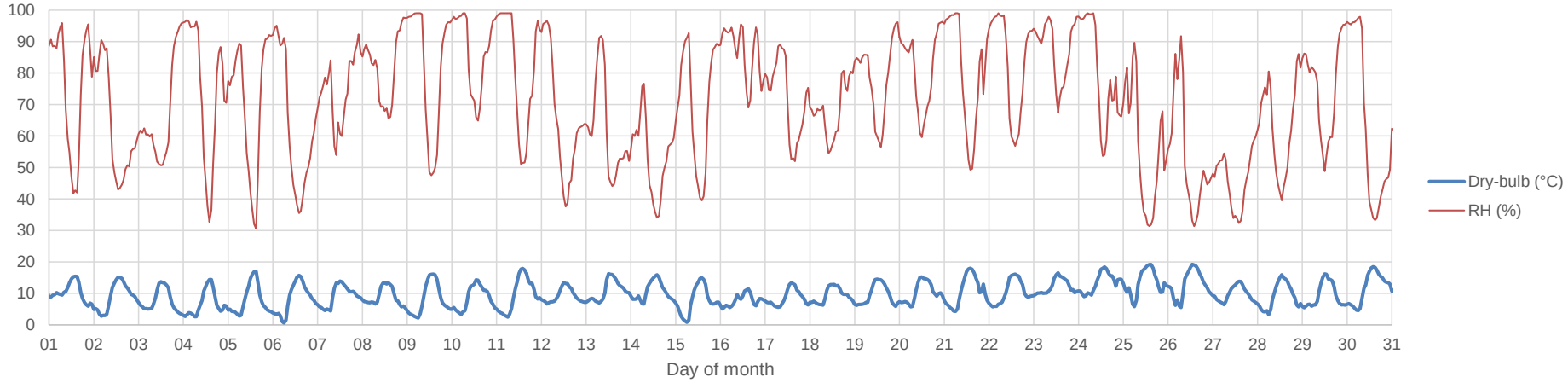


Figure 7.3. Ambient measurements used for winter, based on BOM Canterbury Racecourse station measurements from July 2015.

7.2 Simulation software

In-tunnel airflow, pollution levels and temperature, are simulated and analysed using software called IDA Tunnel, developed by EQUA AB in Sweden. IDA Tunnel was used for the previous M4 East and New M5 EIS and remains a design tool in use for the execution of those projects.

IDA Tunnel is comprehensive road and rail tunnel ventilation and smoke control simulation software. Specific to road tunnels, IDA Tunnel includes traffic flow simulation, so that there is realism in the traffic behaviour as roads reach capacity or as lane numbers change. A traffic model within the simulation applies traffic continuity, and realistic rules on traffic flow versus speed, to predict the traffic density and speed throughout the tunnel. This avoids the assumptions involved in 'hard-coding' the traffic movement in input files before the simulation starts. The airflows resulting from traffic movement, in combination with the vehicle emissions, determine the pollutant levels in the tunnel.

IDA Tunnel is a one-dimensional network analysis program, meaning that entire underground systems can be analysed as one, with all the traffic and air flows being resolved. Being one-dimensional, all quantities are cross section averages. Sub-models within the IDA Tunnel package deal with the traffic speed and flow, aerodynamics of vehicles, the effect of jet fans on air flow, the tunnel flow resistance and the network flow balance, the generation of pollutants and heat by vehicles, the stack effect within tunnels with non-zero gradient, the heat flow from the air to the walls and on to the ground, and the thermal inertia of the walls.

Development of IDA Tunnel began around 2000, with the ambition to encompass the best and most trusted mathematical models for environmental conditions in road and rail tunnels that are available in the literature and that can be simulated with acceptable efficiency and with a manageable amount of input data. Early versions became available around 2003. The software has been mature for some time. The package is actively supported by EQUA AB.

There are other software packages for simulation of road tunnel aero-thermodynamics. The Subway Environmental Simulation (SES) software was first written in the 1970s and was the leading tunnel ventilation program for several decades, being supported by the US Department of Transportation. With advances in computing and simulation generally, it became harder to maintain and for some years now DoT support has been unavailable, with the program still used privately by some firms who maintain their own versions of the code. Other firms have independently developed in-house software, generally to address specific behaviours such as air compressibility for high speed trains. To our knowledge, IDA Tunnel is the only openly available tunnel ventilation simulation package.

IDA Tunnel was developed from scratch using the Modelica simulation environment, an advantage over the Fortran 77 base of SES. Development was informed by SES and comparative assessments of the two programs have been done, including by London Underground.

Compared to the SES program, IDA Tunnel includes more sophisticated modelling of the wall and ground temperatures and heat flows. On the thermal response of tunnels, Stacey Agnew has used IDA Tunnel to calibrate models against measured wall and air temperatures of several cable and rail tunnels, three of which were in Sydney sandstone[9]. IDA Tunnel also includes thermal buoyancy (stack effect) in non-fire simulations, which SES did not do.

[9] Reference tunnels in Sydney; Epping Chatswood Rail Link, City West Cable Tunnel, City South Cable Tunnel, and in Auckland; Vector Cable Tunnel.

7.3 Route average NO_2 calculation

The in-tunnel criterion for NO_2 has been assessed as an average along any route through the tunnel network. Mathematically this means:

$$Route\ average\ NO_2 = \frac{\int_0^L NO_2\, dx}{L}$$

For the current analysis, the IDA Tunnel discretized finite grid has been used to approximate the true integral average as the "centre-weighted cell integral average":

$$Route\ average\ NO_2 = \frac{\sum(Cell\ NO_2 \times Cell\ length)}{\sum(Cell\ length)}$$

Typically the models adopt a grid size of 100 m. The actual grid size is calculated by IDA Tunnel depending on the overall length of sections and positions of different features within each section. The calculation is expanded below using a simple example concentration profile shown in Figure 7.4, depicting a straight tunnel 1500 m long with an on-ramp merge at 1000 m using a fixed grid size of 100 m.

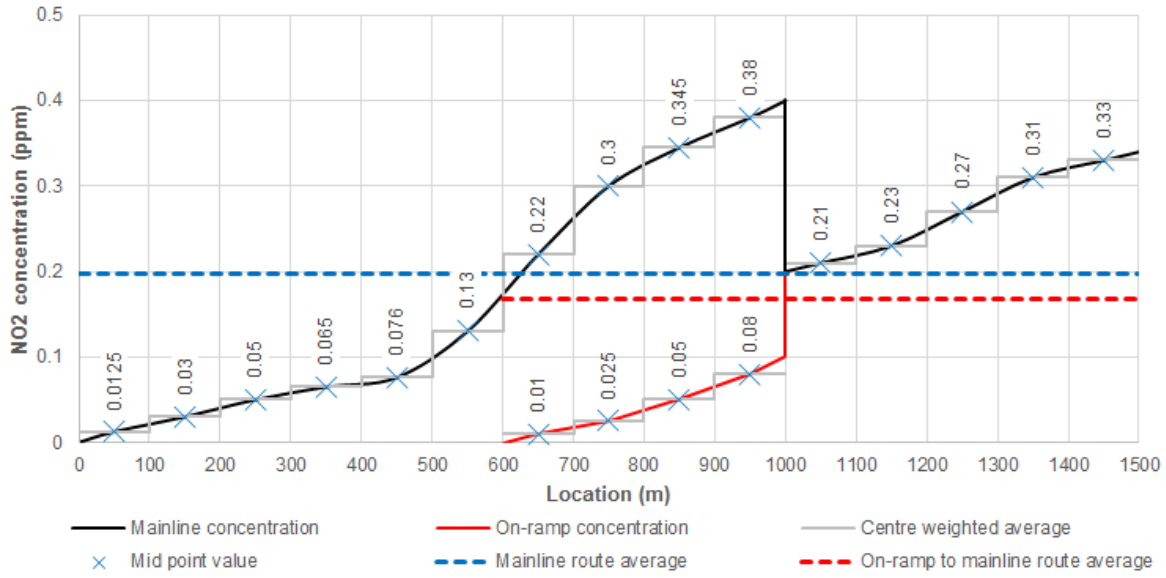


Figure 7.4. Example NO_2 concentration profile for route average calculation

For the mainline route (0 m to 1500 m):

$$Route\ average\ NO_2 = \frac{\begin{array}{c}0.0125 \times 100 + 0.03 \times 100 + 0.05 \times 100 + 0.065 \times 100 + \\ 0.076 \times 100 + 0.13 \times 100 + 0.22 \times 100 + 0.3 \times 100 + \\ 0.345 \times 100 + 0.38 \times 100 + 0.21 \times 100 + 0.23 \times 100 + \\ 0.27 \times 100 + 0.31 \times 100 + 0.33 \times 100\end{array}}{1500}$$

$$Route\ average\ NO_2 = \frac{295.85}{1500} = 0.197\ ppm$$

For the on-ramp route (600 m to 1500 m):

$$Route\ average\ NO_2 = \frac{\begin{array}{c}0.01 \times 100 + 0.025 \times 100 + 0.05 \times 100 + 0.08 \times 100 \\ +0.21 \times 100 + 0.23 \times 100 + 0.27 \times 100 + 0.31 \times 100 \\ +0.33 \times 100\end{array}}{900}$$

$$Route\ average\ NO_2 = \frac{151.5}{900} = 0.168\ ppm$$

For the concept design analysis, routes through the WestConnex system (as listed in Table 7.8 and Table 7.9) have been assessed using the calculation procedure outlined above. No allowance has been included in the concept design for potential difficulties in performing in-tunnel measurements.

For routes that will ultimately incorporate Western Harbour Tunnel, the route average NO_2 has been calculated as beginning or ending at the respective interface plant with M4-M5 Link. This requires Western Harbour Tunnel ventilation system to achieve the same route average NO_2 criteria for all paths starting or ending at the M4-M5 Link interface plant. As each portion of the entire trip meets the air quality criteria on its own, the average of the entire route from origin portal to destination portal will meet or exceed the air quality criteria. Similarly, routes including F6 Extension have been assessed on the basis of starting or ending at President Avenue and so F6 Extension ventilation system will be required to achieve the same criteria for upstream or downstream routes.

Table 7.8. List of routes assessed, M4 to M5 direction[10].

Route ID	Enter at		Exit at		Approx. length
1A	M4 East	M4 portal	M4 East	Wattle St	5.4 km
1B	M4 East	M4 portal	M4 East	Parramatta Rd	5.5 km
1C	M4 East	M4 portal	M4-M5 Link	Anzac Bridge	9.9 km
1D	M4 East	M4 portal	M4-M5 Link	St Peters	12.5 km
1E	M4 East	M4 portal	New M5	M5 portal	21.7 km
1F	M4 East	M4 portal	F6 Extension	President Ave.	19.6 km
1G	M4 East	Concord Rd	M4 East	Wattle St	4.4 km
1H	M4 East	Concord Rd	M4 East	Parramatta Rd	4.5 km
1J	M4 East	Concord Rd	M4-M5 Link	Anzac Bridge	8.9 km
1K	M4 East	Concord Rd	M4-M5 Link	St Peters	11.5 km
1L	M4 East	Concord Rd	New M5	M5 portal	20.7 km
1M	M4 East	Concord Rd	F6 Extension	President Ave.	18.5 km
1N	M4-M5 Link	Wattle St	M4-M5 Link	Anzac Bridge	4.6 km
1P	M4-M5 Link	Wattle St	M4-M5 Link	St Peters	7.2 km
1Q	M4-M5 Link	Wattle St	New M5	M5 portal	16.4 km
1R	M4-M5 Link	Wattle St	F6 Extension	President Ave.	14.3 km
1S	M4-M5 Link	WHT&BL interface	M4-M5 Link	St Peters	6.1 km
1T	M4-M5 Link	WHT&BL interface	New M5	M5 portal	15.3 km
1U	M4-M5 Link	WHT&BL interface	F6 Extension	President Ave.	13.1 km
1V	New M5	St Peters	New M5	M5 portal	9.1 km
1W	New M5	St Peters	F6 Extension	President Ave.	6.9 km
1X	M4-M5 Link	Iron Cove Link	M4-M5 Link	Anzac Bridge	1.2 km
1Y	M4-M5 Link	Iron Cove Link	M4-M5 Link	St Peters	6.4 km
1Z	M4-M5 Link	Iron Cove Link	New M5	M5 portal	15.7 km
1AA	M4-M5 Link	Iron Cove Link	F6 Extension	President Ave.	13.5 km
1AB	M4-M5 Link	City West Link	M4-M5 Link	St Peters	5.1 km
1AC	M4-M5 Link	City West Link	New M5	M5 portal	14.4 km
1AD	M4-M5 Link	City West Link	F6 Extension	President Ave.	12.2 km

[10] Alpha characters I and O are not used in the Route ID.

Table 7.9. List of routes assessed, M5 to M4 direction[11].

Route ID	Enter at		Exit at		Approx length
2A	New M5	M5 portal	New M5	St Peters	9.2 km
2B	New M5	M5 portal	M4-M5 Link	WHT&BL interface	14.8 km
2C	New M5	M5 portal	M4-M5 Link	Wattle St	16.4 km
2D	New M5	M5 portal	M4 East	Concord Rd	20.6 km
2E	New M5	M5 portal	M4 East	M4 portal	21.7 km
2F	F6 Extension	President Ave.	New M5	St Peters	7.1 km
2G	F6 Extension	President Ave.	M4-M5 Link	WHT&BL interface	12.8 km
2H	F6 Extension	President Ave.	M4-M5 Link	Wattle St	14.3 km
2J	F6 Extension	President Ave.	M4 East	Concord Rd	18.5 km
2K	F6 Extension	President Ave.	M4 East	M4 portal	19.7 km
2L	M4-M5 Link	St Peters	M4-M5 Link	WHT&BL interface	5.6 km
2M	M4-M5 Link	St Peters	M4-M5 Link	Wattle St	7.1 km
2N	M4-M5 Link	St Peters	M4 East	Concord Rd	11.3 km
2P	M4-M5 Link	St Peters	M4 East	M4 portal	12.5 km
2Q	M4-M5 Link	Anzac Bridge	M4-M5 Link	Wattle St	4.7 km
2R	M4-M5 Link	Anzac Bridge	M4 East	Concord Rd	8.9 km
2S	M4-M5 Link	Anzac Bridge	M4 East	M4 Portal	10 km
2T	M4 East	Parramatta Rd	M4 East	Concord Rd	4.4 km
2U	M4 East	Parramatta Rd	M4 East	M4 portal	5.5 km
2V	M4 East	Wattle St	M4 East	Concord Rd	4.4 km
2X	M4 East	Wattle St	M4 East	M4 portal	5.6 km
2Y	New M5	M5 portal	M4-M5 Link	Iron Cove Link	15.6 km
2Z	New M5	M5 portal	M4-M5 Link	City West Link	14.4 km
2AA	F6 Extension	President Ave.	M4-M5 Link	Iron Cove Link	13.6 km
2AB	F6 Extension	President Ave.	M4-M5 Link	City West Link	12.3 km
2AC	M4-M5 Link	St Peters	M4-M5 Link	Iron Cove Link	6.4 km
2AD	M4-M5 Link	St Peters	M4-M5 Link	City West Link	5.1 km
2AE	M4-M5 Link	Anzac Bridge	M4-M5 Link	Iron Cove Link	1.3 km
2AF	M4-M5 Link	WHT&BL interface	M4-M5 Link	Wattle St	4.7 km
2AG	M4-M5 Link	WHT&BL interface	M4 East	Concord Rd	8.9 km
2AH	M4-M5 Link	WHT&BL interface	M4 East	M4 portal	10 km

[11] Alpha characters I and O are not used in the Route ID.

8 ALTERNATIVE SCHEMES THAT ARE NOT PREFERRED

A number of options for design of the tunnel ventilation system were considered. A description of these systems is provided below and illustrated in Figure 8.1.

Longitudinal ventilation

The simplest form of ventilation for road tunnels is longitudinal ventilation in which fresh air is drawn in at the entry portal and passes out through the exit portal with the flow of traffic. For longer tunnels, the air flow is supplemented by jet fans that are used when traffic is moving too slowly to maintain adequate air flow. In NSW, ventilation plants are used draw air back from the exit portals against the flow of exiting traffic, to prevent portal emissions. This air is then exhausted through an elevated ventilation outlet to maximise dispersion. For longer tunnels, intermediate air exchange points can be used to reduce the pollution level in any one section of the tunnel. All road tunnels longer than one kilometre built in Australia in the last 20 years have been designed and operated with longitudinal ventilation systems. This includes the NorthConnex and the WestConnex M4 East and New M5 tunnel projects, which are approved and under construction.

Transverse ventilation

Another way to ensure adequate dilution of emissions is to provide fresh air inlets along the length of the tunnel along one side, with outlets on the opposite side. The outlets can also be on the ceiling. This system requires two ducts to be constructed along the length of the tunnel: one for the fresh air supply and one for the exhaust air. Transverse ventilation has been used in the past when vehicle emissions produced greater levels of pollutants than they do today in Australia. A transverse ventilation system is more expensive to construct because of the additional ducts that need to be excavated for each tunnel. It is also more energy intensive as more power is consumed to manage air flows. With transverse ventilation in a unidirectional tunnel, the entry region will normally be very well ventilated by the vehicle-driven flows, and so the ducts are wasteful.

Semi-transverse ventilation

As the name suggests, this is half a transverse system. Fresh air can be supplied through the portals and be continuously exhausted through a duct along the length of the tunnel. Alternatively, fresh air can be supplied through a duct and exhausted through the portals.

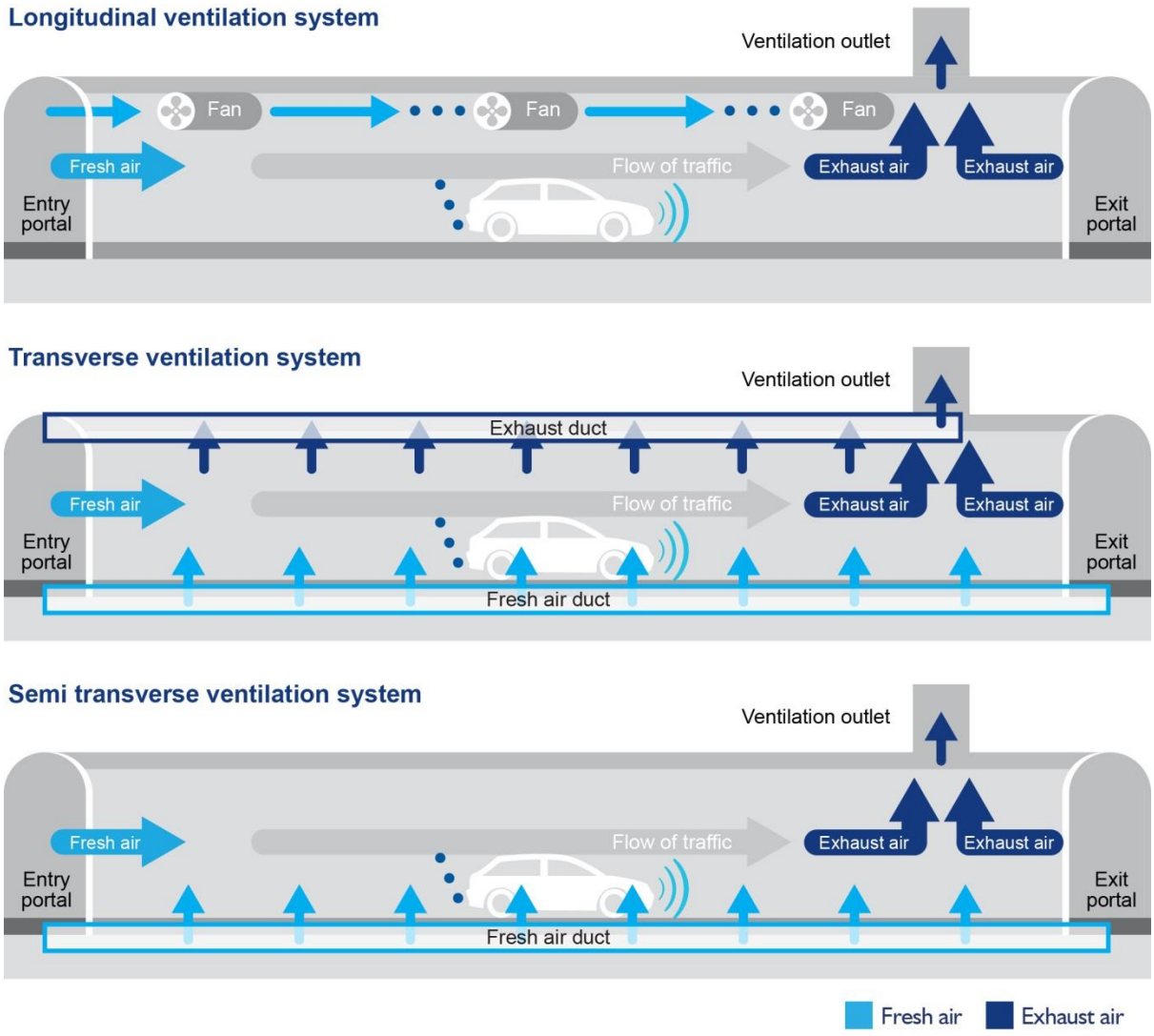


Figure 8.1. Ventilation system options

Although all the ventilation systems described above could be designed to ensure that in-tunnel air quality criteria would be met, a longitudinal system has been selected as the preferred option for the project, and the other tunnel projects forming part of the WestConnex program of works, as it:

- Is less costly to construct than transverse systems, requiring smaller tunnel excavations.
- Is less costly to operate than transverse system, for most operating conditions the vehicles within the tunnel provide the ventilation effort rather than using mechanical plant.
- Is able to ensure emissions are captured and dispersed via a ventilation outlet, so that there is minimal impact on ambient air quality.
- Is able to ensure effective smoke management for unidirectional tunnels.

9 ANALYSIS OUTPUTS – EXPECTED TRAFFIC OPERATIONS

Following sections detail the results for both expected traffic operations and regulatory demand traffic operations across all scenarios. All results exclude the background air quality as described in Section 6.8. In each set of results, the following data and graphs are provided:

1) Figure **"Ventilation Schematic"**: The ventilation schematic applicable to the scenario.
2) Table **"In-tunnel estimated air quality maximum"**: A summary of the maximum in-tunnel pollutant concentration levels within each project, including all on and off-ramps and mainline sections, at each hour of the day. The "NO2 avg" represents the highest route average NO_2 of all paths at the respective hour. The relevant in-tunnel air quality criteria for each pollutant is also included for quick reference.
3) Table **"In-tunnel NO_2 route average"**. The "route average NO_2" for key routes relevant to the scenario at each hour of the day.
4) Graphs **"In-tunnel NO_2"**: Displays the NO_2 concentration (ppm) along the described route at each hour of the day.
5) Graphs **"Maximum In-tunnel visibility"**: Displays the maximum in-tunnel visibility level (as extinction coefficient) within each project for every hour of the day.
6) Graphs **"In-tunnel visibility":** Displays the in-tunnel visibility (as extinction coefficient) along the described route for each hour of the day.
7) Table **"Outlet emissions summary"**: Shows the airflow and associated vehicle-sourced emissions of key pollutants (NO_X, CO, Non-exhaust $PM_{2.5}$, Exhaust PM and Total PM) from each outlet for each hour of the day. The outlet emissions do not include allowance for background ambient air quality; this will need to be considered as required for any analysis by others. For uniformity, these tables include all outlets for all scenarios; where a particular outlet is not relevant for the scenario, the value is shown as "-".

Results within this section are not controlling design cases for the project. For this reason, the results outline the overall integrated operation of WestConnex rather than project specific results. Project specific results are presented in the worst case operations as these scenarios are the most onerous for the project ventilation requirements.

For all **"In-Tunnel XXX"** graphs, individual series (lines) are shown for each hour of the day with major tunnel features (intersections, interface locations) added for reference. For the Cumulative and Do something scenarios, graphs are provided for the route from the M4 portal to M5 portal in both directions of travel as representative of the overall levels throughout the WestConnex tunnel system. For the Do minimum scenario, routes are provided for the route M4 portal to Wattle St, and for the route from St Peters to M5 portal, as representative of the M4 East and New M5 projects respectively.

For each outlet, the results assume that the flows from each tunnel exhaust are fully mixed through the ventilation plant before the outlet. For Outlets I and J, a notional operating philosophy has been incorporated to split the total demand of the ventilation plant (I + J) to maintain the exit velocity in each operating outlet within a narrow band as far as is practicable. The following philosophy has been applied based on outlet diameters of 14 m and 11 m for Outlet I and J respectively:

- When the total flow is less than 8 m/s in the smaller outlet, only the smaller outlet operates.
- When the total flow is greater than 8 m/s in the smaller outlet and less than 8 m/s in the larger outlet, only the larger outlet operates.
- When the total flow is greater than 8 m/s in the larger outlet, both outlets operate.

9.1 Do minimum

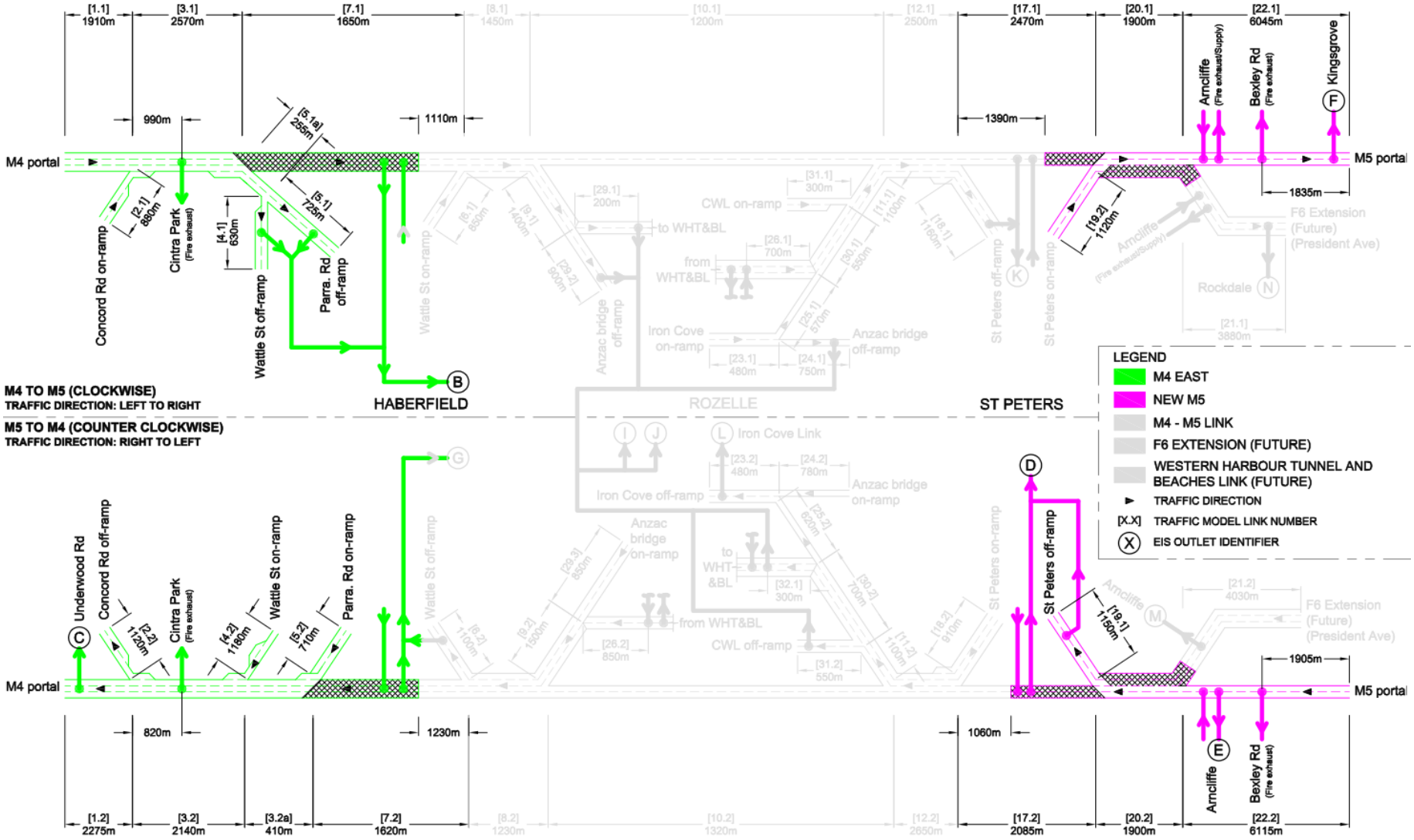


Figure 9.1. Ventilation schematic, 2023 and 2033 Do minimum.

9.1.1 2023 expected traffic operations

Table 9.1. In-Tunnel estimated air quality maximum [2023 Do minimum, expected traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.00	0.00	0.0000	0.09	1.50	0.0007	0.11	1.77	0.0006	0.04	0.00	0.00	0.0000	0.07	1.17	0.0004	0.05	0.87	0.0004	0.03
1	0.00	0.00	0.0000	0.05	0.72	0.0003	0.09	1.39	0.0005	0.03	0.00	0.00	0.0000	0.05	0.96	0.0003	0.04	0.66	0.0003	0.02
2	0.00	0.00	0.0000	0.05	0.66	0.0003	0.08	1.26	0.0004	0.03	0.00	0.00	0.0000	0.05	0.80	0.0003	0.04	0.61	0.0002	0.02
3	0.00	0.00	0.0000	0.05	0.68	0.0003	0.08	1.25	0.0004	0.03	0.00	0.00	0.0000	0.05	0.80	0.0003	0.04	0.61	0.0002	0.02
4	0.00	0.00	0.0000	0.05	0.83	0.0003	0.10	1.60	0.0005	0.04	0.00	0.00	0.0000	0.06	0.96	0.0003	0.04	0.72	0.0003	0.03
5	0.00	0.00	0.0000	0.08	1.15	0.0005	0.16	2.47	0.0008	0.06	0.00	0.00	0.0000	0.09	1.88	0.0005	0.06	0.98	0.0004	0.04
6	0.00	0.00	0.0000	0.14	2.60	0.0008	0.17	2.78	0.0009	0.07	0.00	0.00	0.0000	0.14	3.20	0.0008	0.10	1.60	0.0007	0.06
7	0.00	0.00	0.0000	0.31	5.21	0.0013	0.18	2.92	0.0009	0.09	0.00	0.00	0.0000	0.21	3.99	0.0012	0.19	3.13	0.0014	0.09
8	0.00	0.00	0.0000	0.28	4.90	0.0012	0.19	2.92	0.0009	0.08	0.00	0.00	0.0000	0.20	3.82	0.0011	0.13	2.09	0.0009	0.08
9	0.00	0.00	0.0000	0.26	4.69	0.0012	0.20	2.94	0.0010	0.08	0.00	0.00	0.0000	0.19	3.72	0.0010	0.12	1.87	0.0008	0.08
10	0.00	0.00	0.0000	0.26	4.62	0.0011	0.22	3.00	0.0010	0.09	0.00	0.00	0.0000	0.19	3.65	0.0010	0.12	1.86	0.0008	0.08
11	0.00	0.00	0.0000	0.25	4.58	0.0011	0.24	3.13	0.0011	0.10	0.00	0.00	0.0000	0.19	3.64	0.0010	0.12	1.85	0.0008	0.08
12	0.00	0.00	0.0000	0.24	4.55	0.0011	0.26	3.25	0.0012	0.10	0.00	0.00	0.0000	0.19	3.63	0.0010	0.12	1.84	0.0008	0.08
13	0.00	0.00	0.0000	0.22	4.55	0.0010	0.26	3.52	0.0013	0.10	0.00	0.00	0.0000	0.18	3.67	0.0010	0.11	1.81	0.0008	0.08
14	0.00	0.00	0.0000	0.20	4.64	0.0010	0.27	4.05	0.0013	0.11	0.00	0.00	0.0000	0.18	3.79	0.0010	0.11	1.76	0.0008	0.08
15	0.00	0.00	0.0000	0.20	4.96	0.0010	0.28	4.79	0.0014	0.11	0.00	0.00	0.0000	0.18	4.12	0.0010	0.11	1.69	0.0007	0.08
16	0.00	0.00	0.0000	0.23	5.78	0.0011	0.30	5.74	0.0016	0.12	0.00	0.00	0.0000	0.19	5.13	0.0011	0.11	1.64	0.0007	0.08
17	0.00	0.00	0.0000	0.18	4.37	0.0009	0.24	4.81	0.0013	0.09	0.00	0.00	0.0000	0.15	3.63	0.0009	0.09	1.35	0.0006	0.07
18	0.00	0.00	0.0000	0.14	3.10	0.0008	0.21	3.90	0.0011	0.08	0.00	0.00	0.0000	0.15	3.17	0.0008	0.08	1.19	0.0005	0.06
19	0.00	0.00	0.0000	0.13	2.75	0.0008	0.19	3.44	0.0010	0.07	0.00	0.00	0.0000	0.14	2.97	0.0008	0.08	1.13	0.0005	0.06
20	0.00	0.00	0.0000	0.12	2.61	0.0008	0.18	3.24	0.0009	0.07	0.00	0.00	0.0000	0.14	2.86	0.0008	0.07	1.09	0.0005	0.06
21	0.00	0.00	0.0000	0.12	2.32	0.0008	0.17	3.08	0.0009	0.07	0.00	0.00	0.0000	0.13	2.78	0.0008	0.07	1.00	0.0004	0.06
22	0.00	0.00	0.0000	0.10	1.55	0.0007	0.14	2.17	0.0007	0.05	0.00	0.00	0.0000	0.10	1.95	0.0006	0.05	0.86	0.0003	0.04
23	0.00	0.00	0.0000	0.10	1.53	0.0007	0.11	1.52	0.0005	0.04	0.00	0.00	0.0000	0.08	1.49	0.0005	0.05	0.84	0.0003	0.04

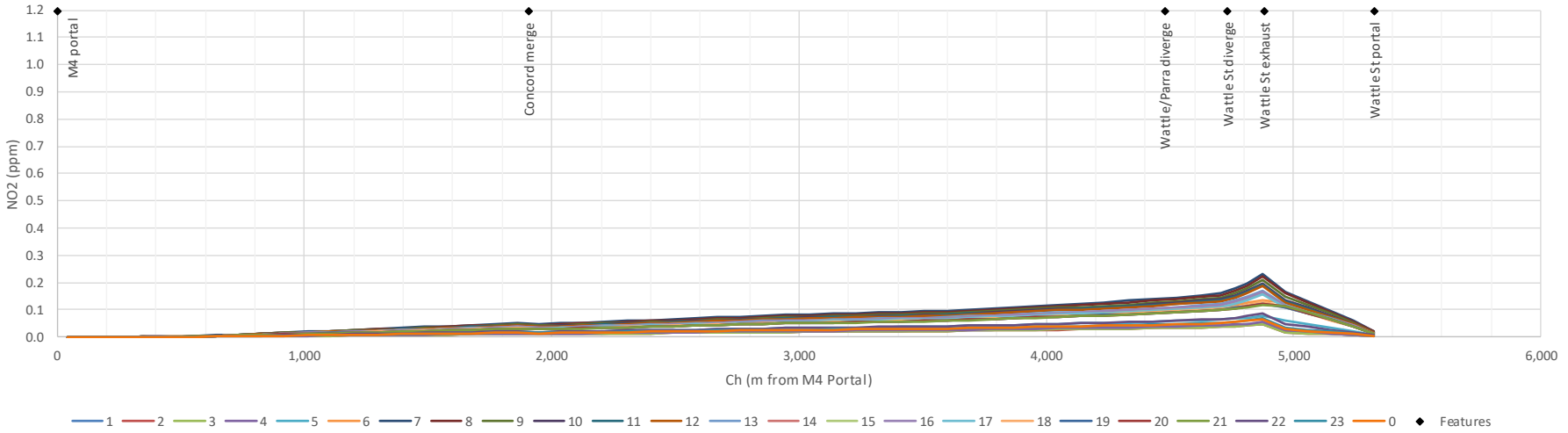


Figure 9.2 In-Tunnel NO_2 levels along route 1A from M4 Portal to Wattle Street [2023 Do minimum, expected traffic]

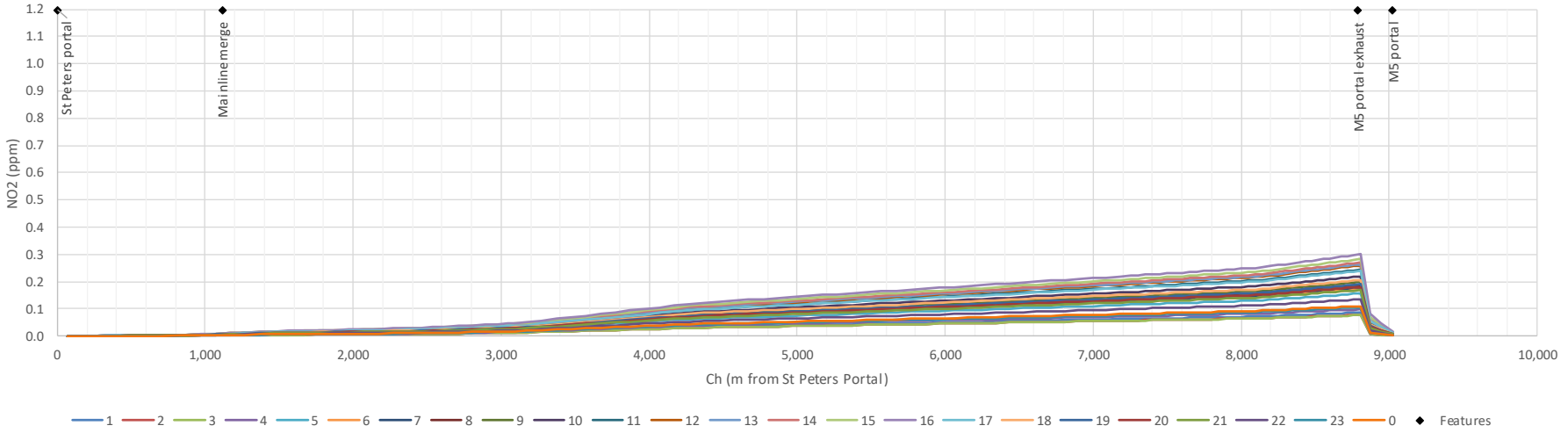


Figure 9.3 In-Tunnel NO_2 levels along route 1V from St Peters to M5 portal [2023 Do minimum, expected traffic]

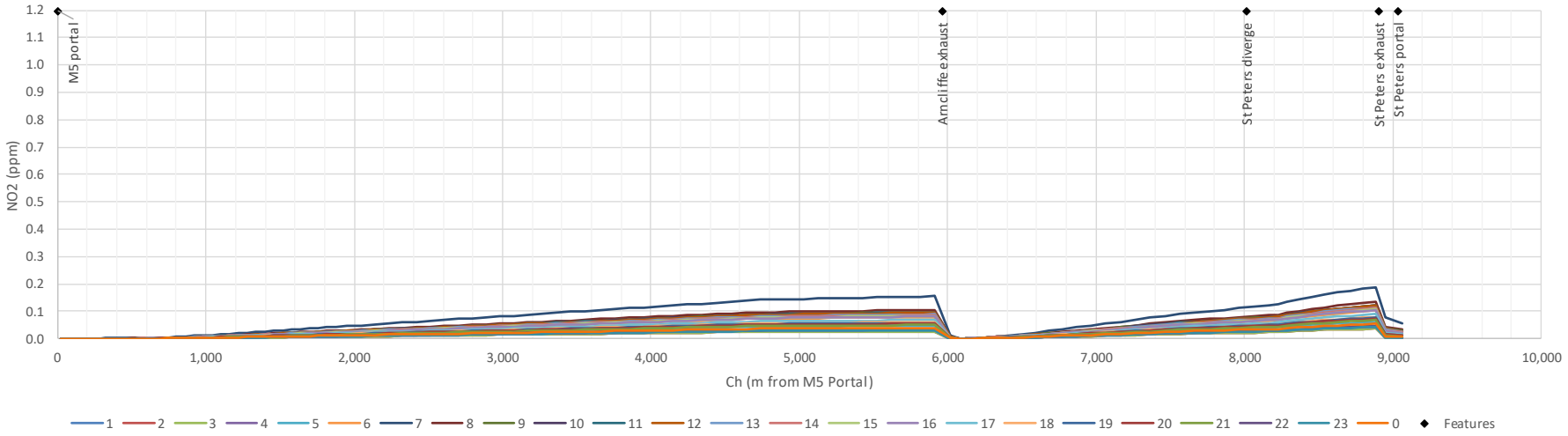


Figure 9.4. In-Tunnel NO_2 levels along route 2A from M5 portal to St Peters [2023 Do minimum, expected traffic]

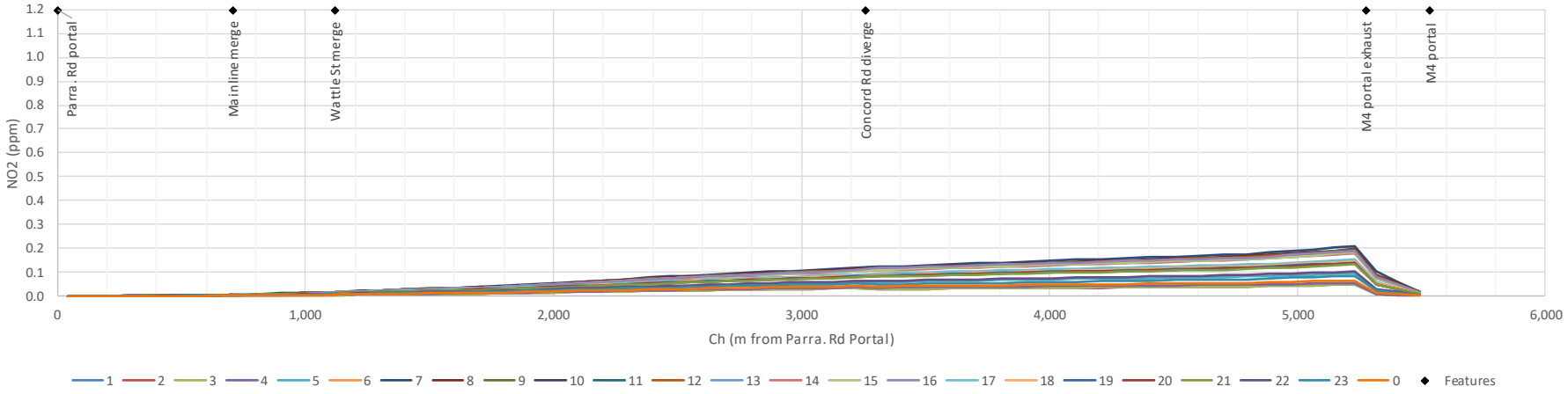


Figure 9.5. In-Tunnel NO_2 levels along route 2U from Parramatta Rd to M4 portal [2023 Do minimum, expected traffic]

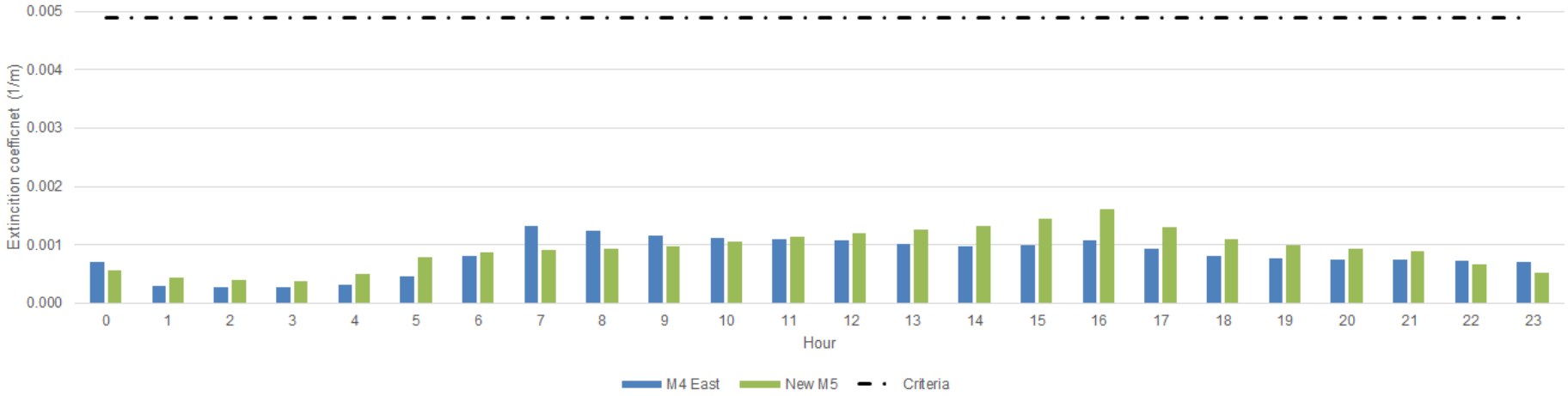


Figure 9.6. Maximum In-Tunnel visibility for M4 to M5 direction [2023 Do minimum, expected traffic]

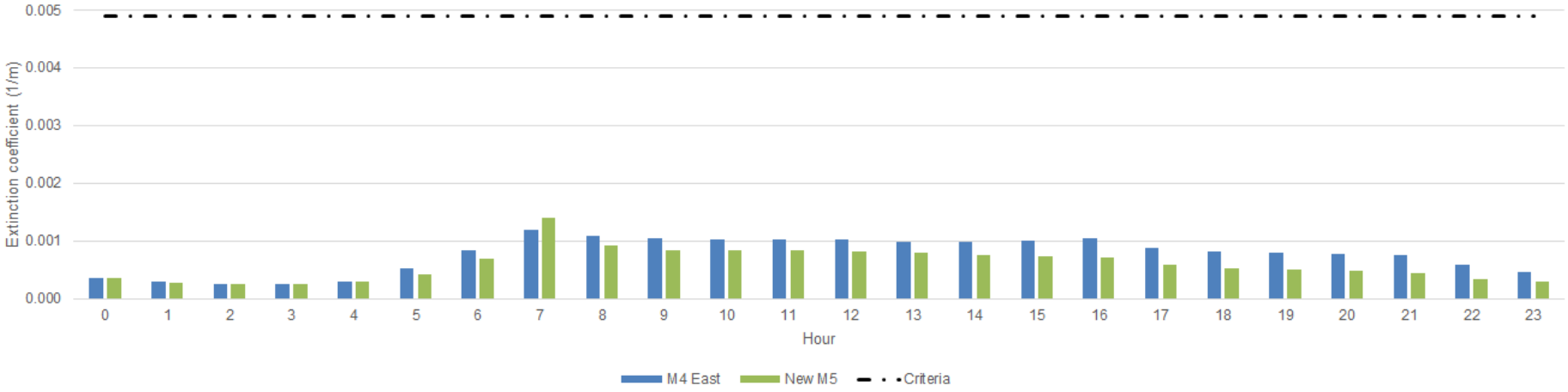


Figure 9.7. Maximum In-Tunnel visibility for M5 to M4 direction [2023 Do minimum, expected traffic]

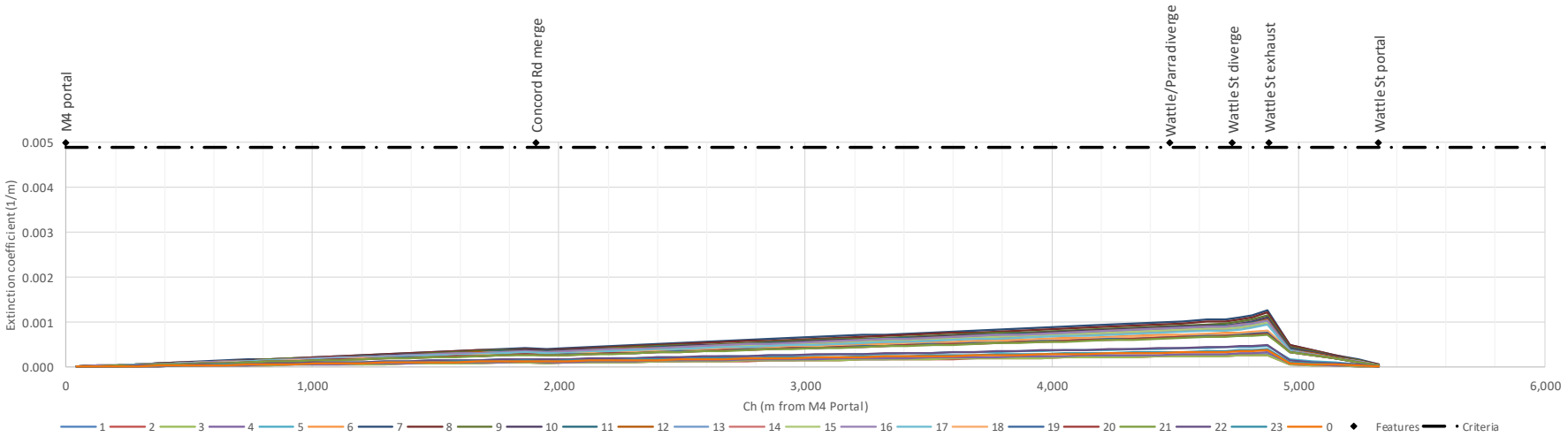


Figure 9.8. In-Tunnel visibility along route 1A from M4 portal to Wattle Street [2023 Do minimum, expected traffic]

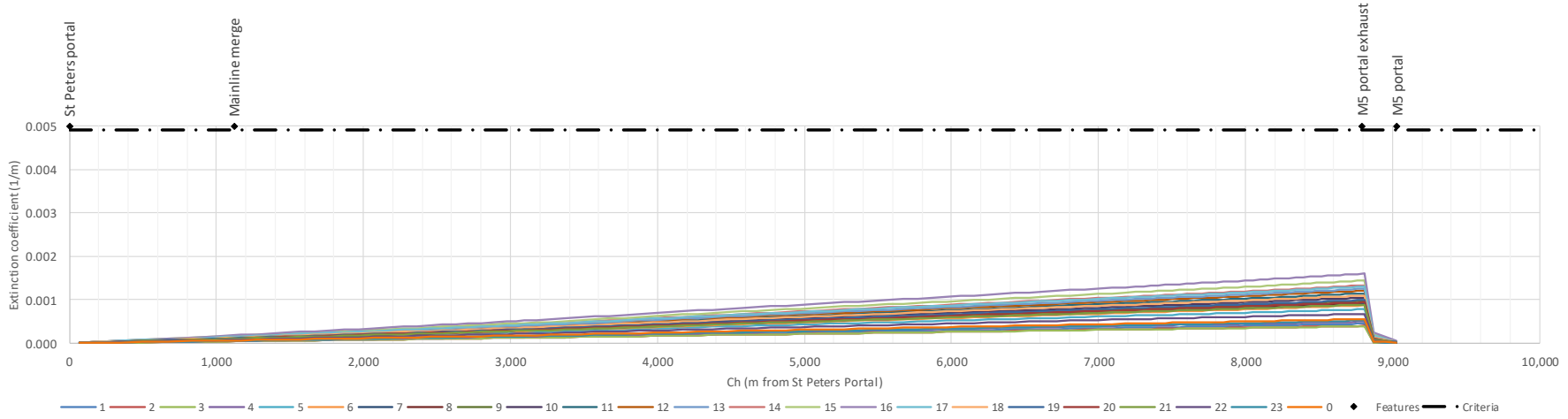


Figure 9.9. In-Tunnel visibility along route 1V from St Peters to M5 portal [2023 Do minimum, expected traffic]

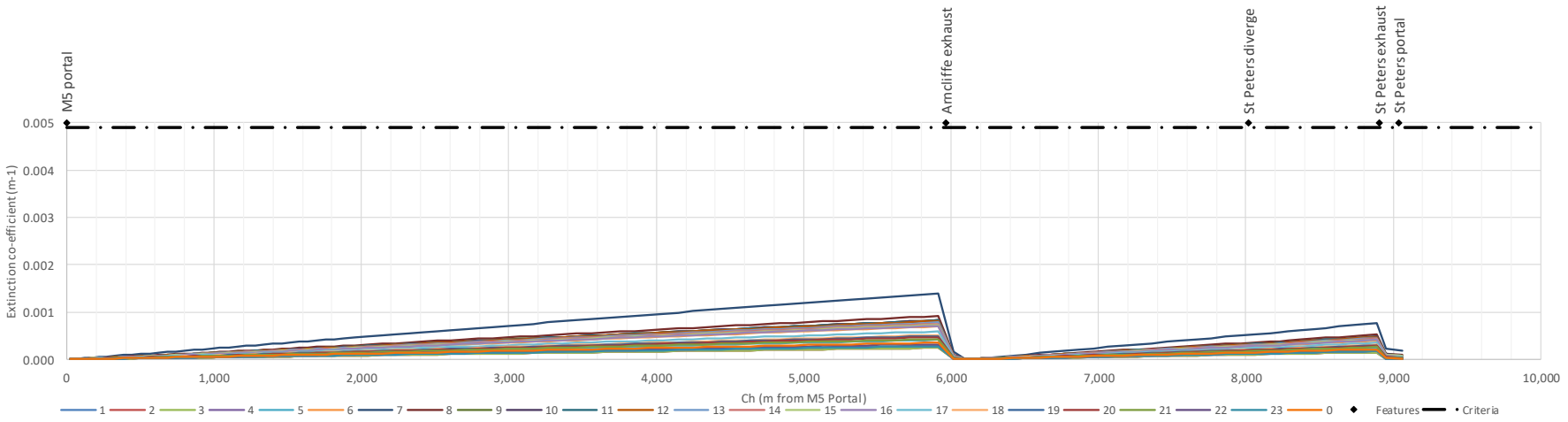


Figure 9.10. In-Tunnel visibility along route 2A from M5 portal to St Peters [2023 Do minimum, expected traffic]

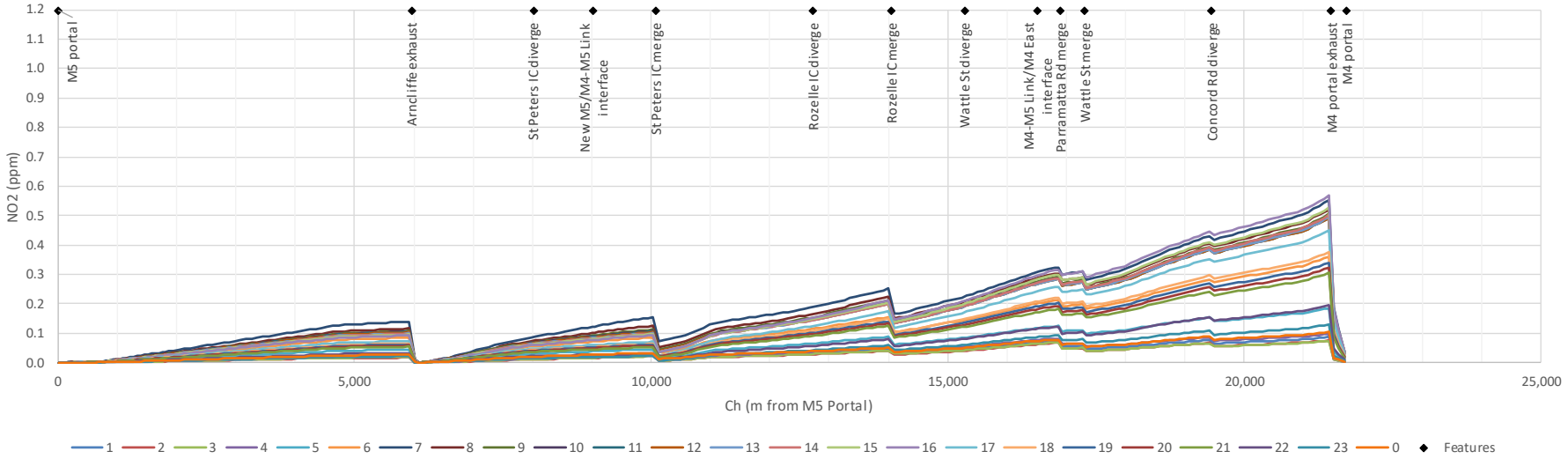


Figure 9.11. In-Tunnel visibility along route 2U from Parramatta Rd to M4 portal [2023 Do minimum, expected traffic]

Table 9.2. Outlet emissions summary [2023 Do minimum, expected traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	454	0.27	0.43	0.02	0.01	0.03	434	0.25	0.51	0.02	0.01	0.03	267	0.12	0.21	0.01	0.00	0.01
1	404	0.18	0.29	0.01	0.00	0.02	398	0.18	0.37	0.02	0.00	0.02	231	0.07	0.13	0.00	0.00	0.01
2	390	0.15	0.25	0.01	0.00	0.02	370	0.15	0.28	0.01	0.00	0.01	219	0.06	0.11	0.00	0.00	0.00
3	393	0.15	0.26	0.01	0.00	0.02	369	0.15	0.27	0.01	0.00	0.01	219	0.06	0.11	0.00	0.00	0.00
4	422	0.20	0.35	0.02	0.00	0.02	393	0.19	0.36	0.01	0.00	0.02	242	0.08	0.15	0.00	0.00	0.01
5	514	0.39	0.67	0.03	0.01	0.04	527	0.45	1.00	0.04	0.01	0.05	293	0.16	0.27	0.01	0.00	0.01
6	683	0.99	1.67	0.08	0.02	0.10	670	0.90	2.22	0.09	0.02	0.10	399	0.40	0.65	0.02	0.01	0.03
7	797	1.74	2.75	0.14	0.04	0.18	793	1.64	3.65	0.15	0.03	0.18	574	1.10	1.99	0.06	0.02	0.08
8	785	1.62	2.61	0.13	0.03	0.16	759	1.51	3.06	0.13	0.03	0.16	468	0.63	1.04	0.03	0.01	0.05
9	770	1.48	2.46	0.12	0.03	0.15	739	1.46	2.76	0.12	0.03	0.15	441	0.54	0.87	0.03	0.01	0.04
10	762	1.40	2.39	0.12	0.03	0.15	733	1.44	2.66	0.11	0.03	0.14	440	0.54	0.86	0.03	0.01	0.04
11	757	1.35	2.35	0.11	0.03	0.14	731	1.44	2.63	0.11	0.03	0.14	438	0.54	0.85	0.03	0.01	0.04
12	754	1.31	2.32	0.11	0.03	0.14	729	1.44	2.60	0.11	0.03	0.14	436	0.53	0.84	0.03	0.01	0.04
13	740	1.14	2.28	0.11	0.02	0.13	718	1.32	2.54	0.11	0.03	0.13	426	0.48	0.80	0.03	0.01	0.03
14	734	1.03	2.29	0.10	0.02	0.12	716	1.29	2.55	0.10	0.03	0.13	418	0.45	0.76	0.02	0.01	0.03
15	744	1.03	2.42	0.11	0.02	0.13	722	1.31	2.66	0.11	0.03	0.14	409	0.43	0.72	0.02	0.01	0.03
16	767	1.09	2.67	0.12	0.02	0.14	740	1.36	2.96	0.12	0.03	0.15	403	0.41	0.68	0.02	0.01	0.03
17	722	0.97	2.18	0.10	0.02	0.12	683	1.00	2.31	0.09	0.02	0.11	361	0.31	0.49	0.02	0.01	0.02
18	681	0.88	1.72	0.08	0.02	0.10	660	0.91	2.06	0.08	0.02	0.10	333	0.25	0.39	0.01	0.00	0.02
19	667	0.85	1.58	0.08	0.02	0.09	648	0.86	1.94	0.08	0.02	0.09	324	0.23	0.35	0.01	0.00	0.02
20	663	0.84	1.53	0.07	0.02	0.09	641	0.83	1.87	0.07	0.02	0.09	315	0.21	0.33	0.01	0.00	0.01
21	652	0.81	1.44	0.07	0.02	0.09	632	0.79	1.80	0.07	0.02	0.09	299	0.18	0.28	0.01	0.00	0.01
22	519	0.40	0.71	0.03	0.01	0.04	554	0.54	1.16	0.05	0.01	0.06	255	0.09	0.19	0.01	0.00	0.01
23	463	0.28	0.48	0.02	0.01	0.03	502	0.39	0.80	0.03	0.01	0.04	234	0.08	0.14	0.00	0.00	0.01

Table 9.2. Outlet emissions summary [2023 Do minimum, expected traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	237	0.09	0.14	0.01	0.00	0.02	272	0.26	0.45	0.02	0.01	0.02	-	-	-	-	-	-
1	196	0.05	0.09	0.01	0.00	0.01	236	0.17	0.29	0.01	0.00	0.02	-	-	-	-	-	-
2	184	0.04	0.07	0.01	0.00	0.01	223	0.14	0.24	0.01	0.00	0.01	-	-	-	-	-	-
3	184	0.04	0.07	0.01	0.00	0.01	223	0.14	0.24	0.01	0.00	0.01	-	-	-	-	-	-
4	207	0.06	0.10	0.01	0.00	0.01	257	0.21	0.37	0.01	0.00	0.02	-	-	-	-	-	-
5	259	0.12	0.18	0.02	0.00	0.02	335	0.49	0.82	0.03	0.01	0.04	-	-	-	-	-	-
6	363	0.30	0.44	0.04	0.01	0.05	356	0.58	1.00	0.04	0.01	0.05	-	-	-	-	-	-
7	524	0.83	1.33	0.13	0.02	0.15	366	0.62	1.09	0.04	0.01	0.06	-	-	-	-	-	-
8	429	0.47	0.70	0.07	0.01	0.08	371	0.68	1.11	0.05	0.01	0.06	-	-	-	-	-	-
9	404	0.40	0.58	0.06	0.01	0.07	378	0.74	1.14	0.05	0.02	0.06	-	-	-	-	-	-
10	403	0.40	0.58	0.06	0.01	0.07	392	0.87	1.22	0.05	0.02	0.07	-	-	-	-	-	-
11	401	0.40	0.57	0.05	0.01	0.06	410	1.04	1.34	0.06	0.02	0.08	-	-	-	-	-	-
12	400	0.40	0.57	0.05	0.01	0.06	421	1.14	1.44	0.07	0.02	0.09	-	-	-	-	-	-
13	390	0.36	0.54	0.05	0.01	0.06	432	1.18	1.61	0.07	0.02	0.10	-	-	-	-	-	-
14	383	0.34	0.51	0.05	0.01	0.06	451	1.24	1.95	0.08	0.03	0.11	-	-	-	-	-	-
15	375	0.32	0.48	0.05	0.01	0.05	477	1.34	2.47	0.10	0.03	0.13	-	-	-	-	-	-
16	369	0.31	0.46	0.04	0.01	0.05	510	1.47	3.21	0.12	0.03	0.15	-	-	-	-	-	-
17	328	0.23	0.33	0.03	0.01	0.04	457	1.02	2.37	0.09	0.02	0.11	-	-	-	-	-	-
18	302	0.18	0.26	0.03	0.00	0.03	412	0.79	1.69	0.06	0.02	0.08	-	-	-	-	-	-
19	293	0.17	0.24	0.02	0.00	0.03	389	0.69	1.39	0.05	0.01	0.07	-	-	-	-	-	-
20	284	0.16	0.22	0.02	0.00	0.03	376	0.63	1.26	0.05	0.01	0.06	-	-	-	-	-	-
21	268	0.13	0.19	0.02	0.00	0.02	364	0.56	1.15	0.04	0.01	0.06	-	-	-	-	-	-
22	226	0.07	0.13	0.01	0.00	0.01	308	0.38	0.65	0.03	0.01	0.03	-	-	-	-	-	-
23	205	0.06	0.09	0.01	0.00	0.01	256	0.24	0.35	0.02	0.00	0.02	-	-	-	-	-	-

Table 9.2. Outlet emissions summary [2023 Do minimum, expected traffic], continued

Outlet identifier:	H							I							J						
EIS name:	Rozelle North (WHT)							Rozelle Mid (M4-M5 Link/ICL)							Rozelle South (M4-M5 Link/ICL)						
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	
0	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
1	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
2	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
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23	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	

Table 9.2. Outlet emissions summary [2023 Do minimum, expected traffic], continued

Outlet identifier: EIS name:	K SPI (M4-M5 Link)						L Iron Cove Link (north)						M Arncliffe (F6 Extension)						N Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

9.1.2 2023 regulatory demand traffic operations

Table 9.3. In-Tunnel estimated air quality maximum [2023 Do minimum, regulatory traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.00	0.00	0.0000	0.12	1.87	0.0009	0.19	3.13	0.0010	0.08	0.00	0.00	0.0000	0.09	1.56	0.0005	0.08	1.24	0.0005	0.04
1	0.00	0.00	0.0000	0.06	0.91	0.0004	0.15	2.37	0.0007	0.06	0.00	0.00	0.0000	0.07	1.29	0.0004	0.06	0.89	0.0004	0.03
2	0.00	0.00	0.0000	0.06	0.84	0.0003	0.13	2.17	0.0007	0.05	0.00	0.00	0.0000	0.06	1.07	0.0003	0.05	0.82	0.0003	0.03
3	0.00	0.00	0.0000	0.06	0.85	0.0003	0.13	2.16	0.0007	0.05	0.00	0.00	0.0000	0.06	1.06	0.0003	0.05	0.82	0.0003	0.03
4	0.00	0.00	0.0000	0.07	1.05	0.0004	0.17	2.80	0.0009	0.07	0.00	0.00	0.0000	0.07	1.30	0.0004	0.06	0.97	0.0004	0.03
5	0.00	0.00	0.0000	0.09	1.48	0.0006	0.28	4.42	0.0014	0.11	0.00	0.00	0.0000	0.13	3.03	0.0007	0.08	1.32	0.0006	0.05
6	0.00	0.00	0.0000	0.20	3.69	0.0010	0.31	5.02	0.0016	0.12	0.00	0.00	0.0000	0.20	5.12	0.0011	0.14	2.20	0.0010	0.08
7	0.00	0.00	0.0000	0.44	6.30	0.0018	0.33	5.29	0.0016	0.13	0.00	0.00	0.0000	0.30	6.32	0.0017	0.36	4.36	0.0027	0.17
8	0.00	0.00	0.0000	0.40	6.42	0.0016	0.34	5.29	0.0017	0.14	0.00	0.00	0.0000	0.27	6.11	0.0015	0.19	2.87	0.0013	0.12
9	0.00	0.00	0.0000	0.37	6.30	0.0015	0.36	5.32	0.0018	0.14	0.00	0.00	0.0000	0.27	5.92	0.0014	0.17	2.58	0.0012	0.11
10	0.00	0.00	0.0000	0.36	6.19	0.0015	0.40	5.45	0.0019	0.16	0.00	0.00	0.0000	0.26	5.82	0.0014	0.17	2.57	0.0012	0.11
11	0.00	0.00	0.0000	0.35	6.14	0.0015	0.45	5.64	0.0021	0.18	0.00	0.00	0.0000	0.26	5.81	0.0014	0.17	2.55	0.0012	0.11
12	0.00	0.00	0.0000	0.35	6.08	0.0014	0.48	5.83	0.0023	0.19	0.00	0.00	0.0000	0.26	5.77	0.0014	0.17	2.54	0.0012	0.11
13	0.00	0.00	0.0000	0.30	6.06	0.0013	0.50	6.27	0.0024	0.20	0.00	0.00	0.0000	0.25	5.84	0.0014	0.16	2.49	0.0011	0.11
14	0.00	0.00	0.0000	0.28	6.15	0.0013	0.52	7.07	0.0026	0.21	0.00	0.00	0.0000	0.25	6.03	0.0013	0.15	2.42	0.0011	0.11
15	0.00	0.00	0.0000	0.29	6.61	0.0013	0.57	7.54	0.0030	0.23	0.00	0.00	0.0000	0.25	6.56	0.0014	0.15	2.33	0.0010	0.11
16	0.00	0.00	0.0000	0.31	6.66	0.0014	0.87	10.59	0.0042	0.37	0.00	0.00	0.0000	0.26	8.09	0.0015	0.15	2.26	0.0010	0.11
17	0.00	0.00	0.0000	0.26	5.80	0.0012	0.47	7.70	0.0026	0.18	0.00	0.00	0.0000	0.21	5.77	0.0012	0.12	1.85	0.0008	0.09
18	0.00	0.00	0.0000	0.20	4.37	0.0010	0.38	6.81	0.0021	0.15	0.00	0.00	0.0000	0.20	5.05	0.0011	0.11	1.62	0.0007	0.08
19	0.00	0.00	0.0000	0.18	3.90	0.0010	0.35	6.13	0.0018	0.14	0.00	0.00	0.0000	0.19	4.74	0.0011	0.10	1.54	0.0007	0.08
20	0.00	0.00	0.0000	0.17	3.70	0.0010	0.33	5.84	0.0017	0.13	0.00	0.00	0.0000	0.19	4.57	0.0010	0.10	1.47	0.0007	0.08
21	0.00	0.00	0.0000	0.16	3.29	0.0010	0.31	5.57	0.0016	0.12	0.00	0.00	0.0000	0.18	4.45	0.0010	0.09	1.35	0.0006	0.08
22	0.00	0.00	0.0000	0.12	1.98	0.0009	0.24	3.87	0.0012	0.10	0.00	0.00	0.0000	0.14	3.07	0.0008	0.08	1.28	0.0005	0.06
23	0.00	0.00	0.0000	0.12	1.93	0.0009	0.18	2.62	0.0009	0.07	0.00	0.00	0.0000	0.11	1.99	0.0006	0.08	1.26	0.0004	0.05

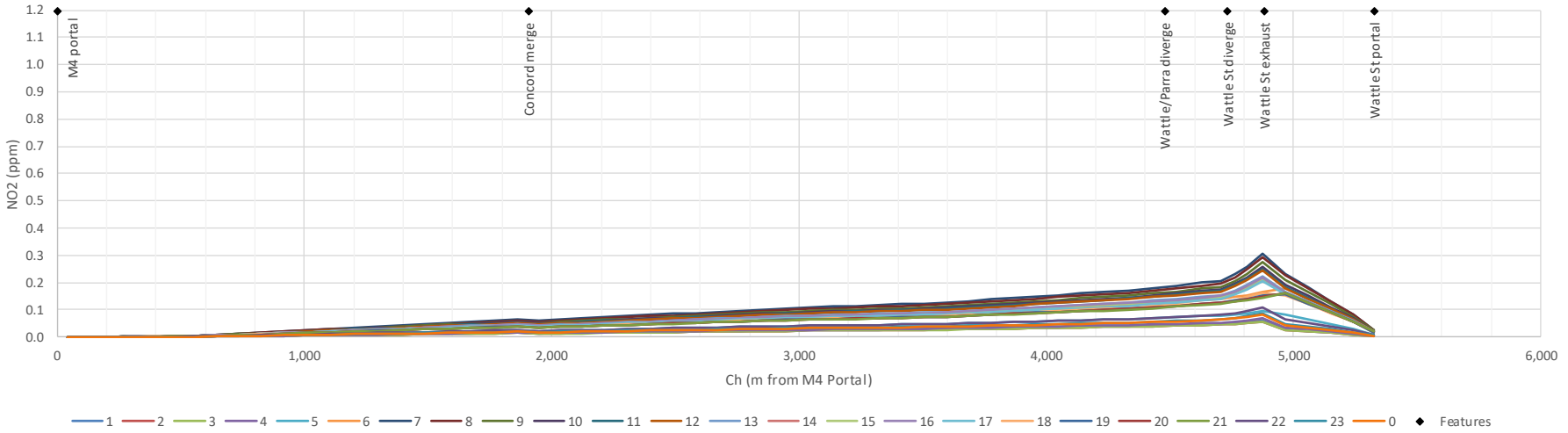

Figure 9.12 In-Tunnel NO_2 levels along route 1A from M4 portal to Wattle Street [2023 Do minimum, regulatory traffic]

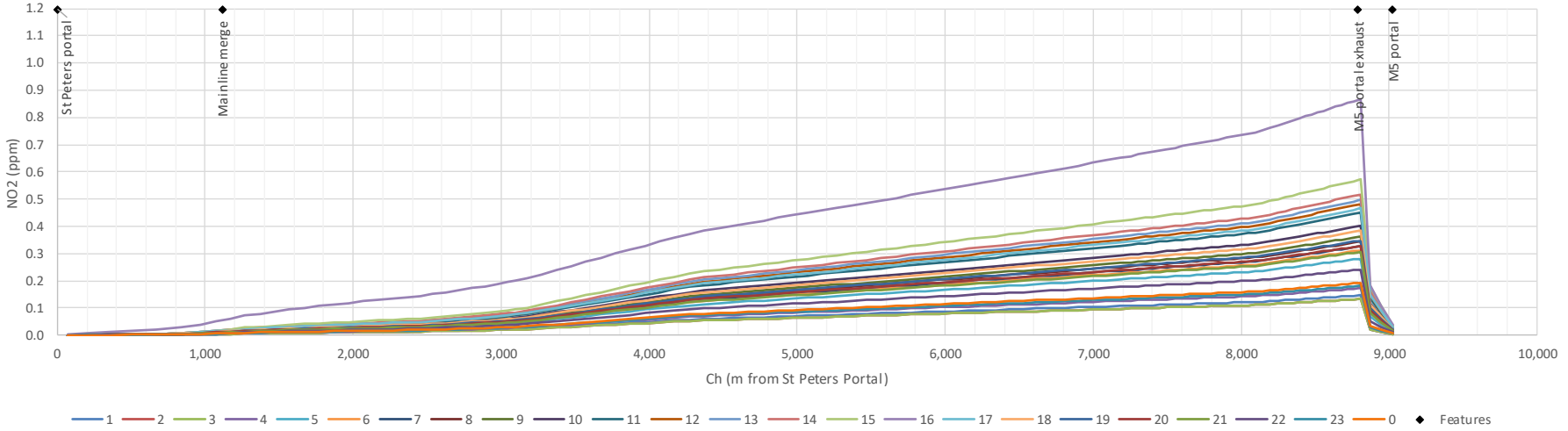

Figure 9.13 In-Tunnel NO_2 levels along route 1V from St Peters to M5 portal [2023 Do minimum, regulatory traffic]

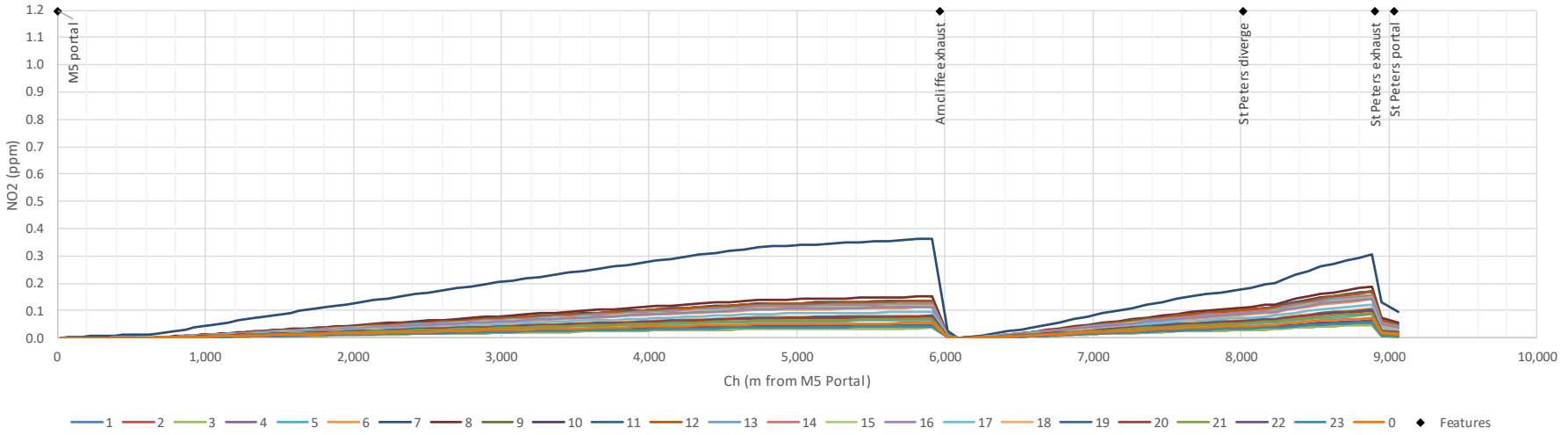

Figure 9.14. In-Tunnel NO_2 levels along route 2A from M5 portal to St Peters [2023 Do minimum, regulatory traffic]

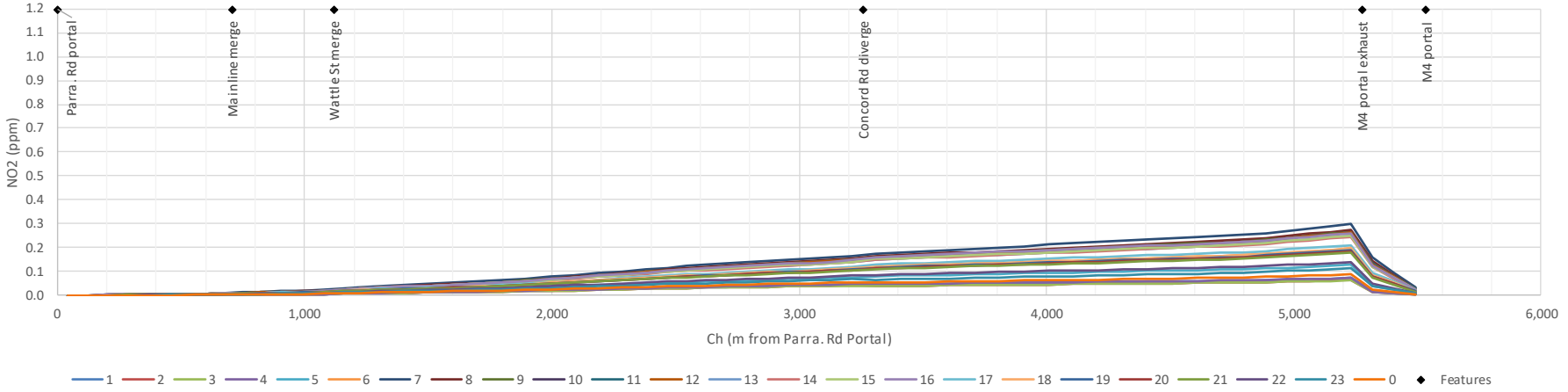

Figure 9.15. In-Tunnel NO_2 levels along route 2U from Parramatta Rd to M4 portal [2023 Do minimum, regulatory traffic]

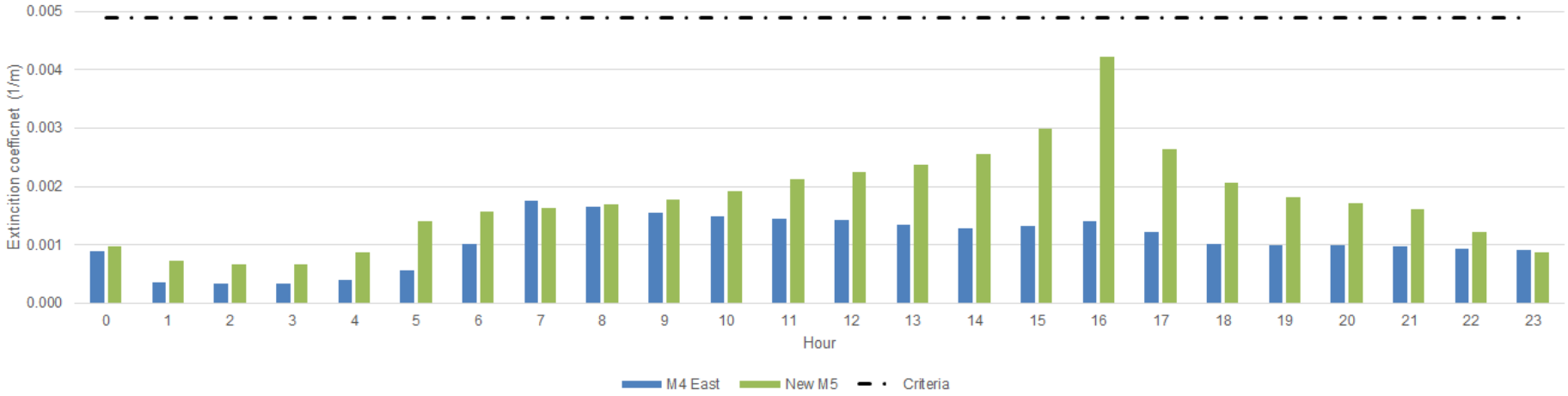

Figure 9.16. Maximum In-Tunnel visibility for M4 to M5 direction [2023 Do minimum, regulatory traffic]

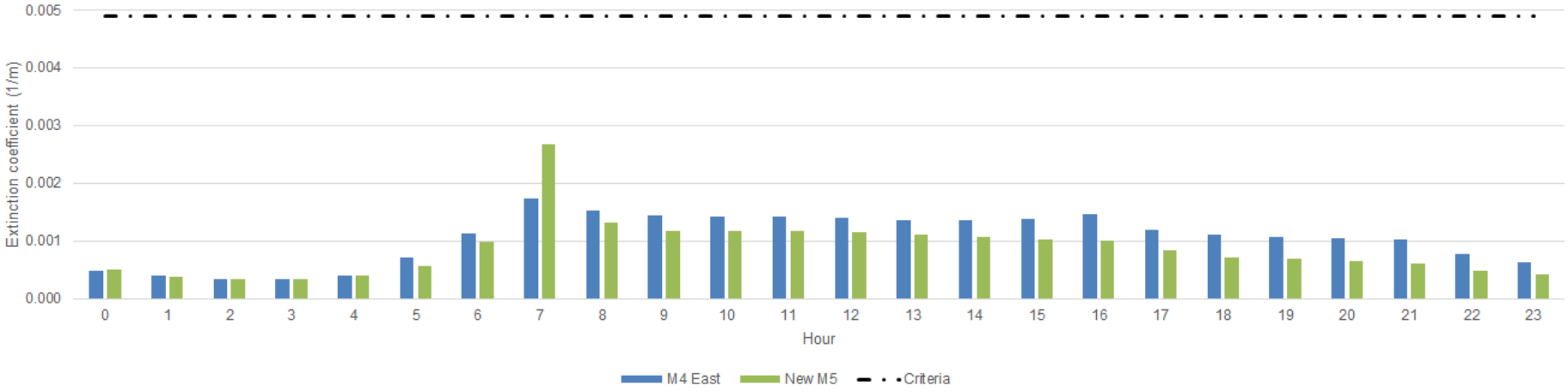

Figure 9.17. Maximum In-Tunnel visibility for M5 to M4 direction [2023 Do minimum, regulatory traffic]

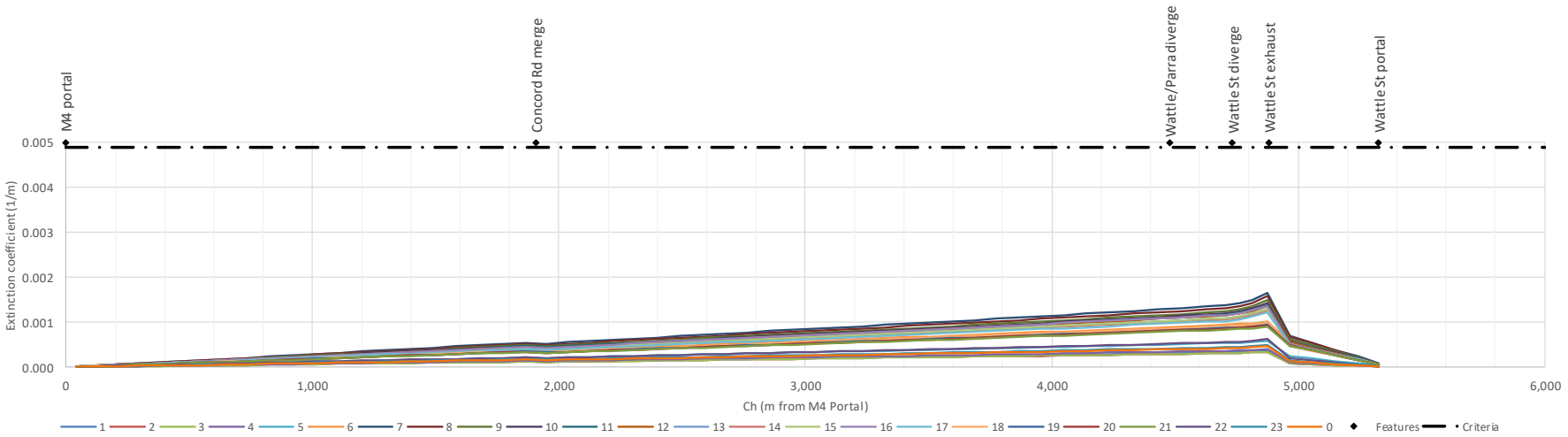

Figure 9.18. In-Tunnel visibility along route 1A from M4 portal to Wattle Street [2023 Do minimum, regulatory traffic]

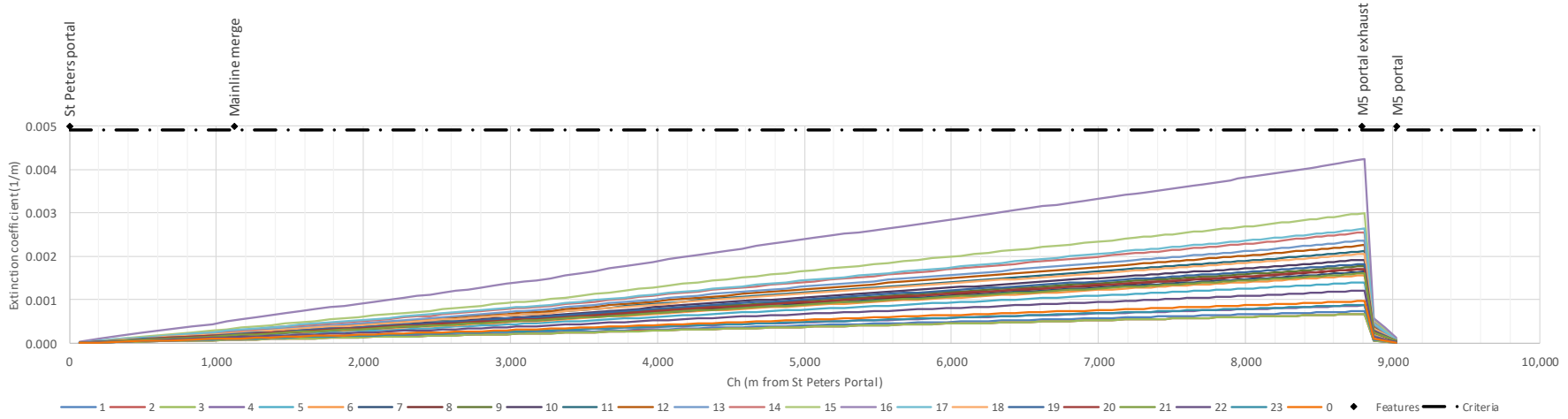

Figure 9.19. In-Tunnel visibility along route 1V from St Peters to M5 portal [2023 Do minimum, regulatory traffic]

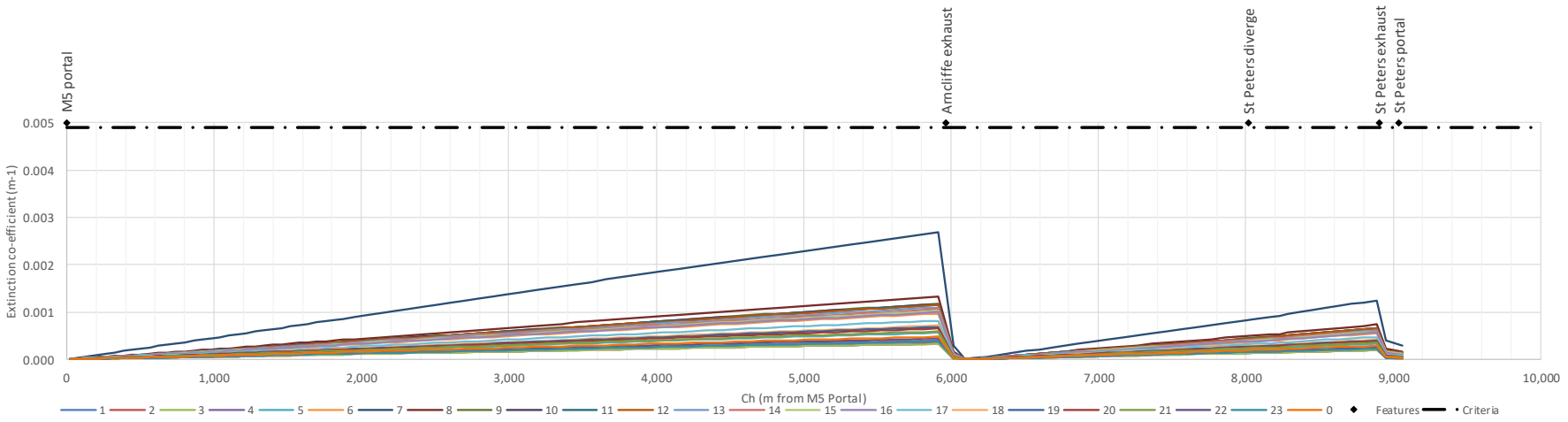

Figure 9.20. In-Tunnel visibility along route 2A from M5 portal to St Peters [2023 Do minimum, regulatory traffic]

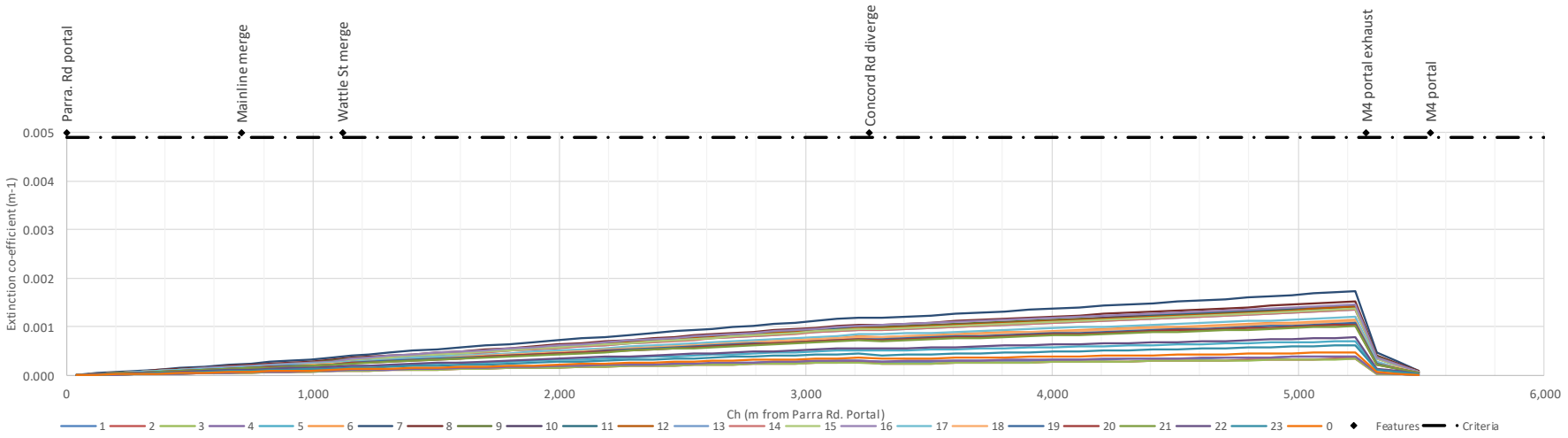

Figure 9.21. In-Tunnel visibility along route 2U from Parramatta Rd to M4 portal [2023 Do minimum, regulatory traffic]

Table 9.4. Outlet emissions summary [2023 Do minimum, regulatory traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	504	0.38	0.62	0.03	0.01	0.04	500	0.40	0.81	0.03	0.01	0.04	321	0.21	0.36	0.01	0.00	0.02
1	446	0.25	0.41	0.02	0.01	0.03	458	0.29	0.60	0.02	0.01	0.03	276	0.13	0.22	0.01	0.00	0.01
2	431	0.22	0.36	0.02	0.00	0.02	424	0.24	0.45	0.02	0.00	0.02	259	0.10	0.19	0.01	0.00	0.01
3	434	0.22	0.38	0.02	0.00	0.02	421	0.24	0.44	0.02	0.00	0.02	258	0.10	0.18	0.01	0.00	0.01
4	468	0.29	0.49	0.02	0.01	0.03	448	0.29	0.57	0.02	0.01	0.03	288	0.14	0.26	0.01	0.00	0.01
5	575	0.56	0.95	0.05	0.01	0.06	610	0.72	1.61	0.06	0.01	0.08	354	0.28	0.46	0.01	0.01	0.02
6	761	1.40	2.36	0.12	0.03	0.15	774	1.44	3.53	0.14	0.03	0.17	483	0.69	1.14	0.04	0.01	0.05
7	867	2.48	3.68	0.20	0.05	0.25	867	2.64	5.20	0.24	0.05	0.29	584	1.86	2.59	0.10	0.04	0.14
8	856	2.32	3.54	0.19	0.05	0.23	858	2.43	4.63	0.20	0.05	0.25	560	1.09	1.77	0.06	0.02	0.08
9	843	2.12	3.36	0.17	0.04	0.22	842	2.34	4.25	0.19	0.05	0.23	533	0.95	1.51	0.05	0.02	0.07
10	835	1.99	3.26	0.17	0.04	0.21	836	2.31	4.13	0.18	0.05	0.23	532	0.94	1.49	0.05	0.02	0.07
11	830	1.91	3.20	0.16	0.04	0.20	835	2.32	4.09	0.18	0.05	0.23	530	0.93	1.48	0.05	0.02	0.07
12	827	1.86	3.17	0.16	0.04	0.20	834	2.32	4.05	0.18	0.05	0.23	528	0.93	1.46	0.05	0.02	0.07
13	813	1.62	3.11	0.15	0.03	0.18	823	2.13	3.98	0.17	0.04	0.21	516	0.83	1.40	0.04	0.02	0.06
14	806	1.46	3.11	0.15	0.03	0.18	820	2.07	4.00	0.17	0.04	0.21	507	0.78	1.33	0.04	0.02	0.06
15	816	1.46	3.29	0.15	0.03	0.18	826	2.11	4.14	0.17	0.04	0.22	497	0.75	1.25	0.04	0.01	0.05
16	835	1.54	3.53	0.17	0.03	0.20	840	2.19	4.55	0.19	0.04	0.24	489	0.72	1.19	0.04	0.01	0.05
17	794	1.38	2.98	0.14	0.03	0.17	786	1.61	3.66	0.15	0.03	0.18	437	0.54	0.85	0.03	0.01	0.04
18	759	1.24	2.43	0.11	0.03	0.14	762	1.46	3.28	0.13	0.03	0.16	403	0.43	0.67	0.02	0.01	0.03
19	745	1.21	2.24	0.11	0.02	0.13	749	1.38	3.09	0.12	0.03	0.15	393	0.40	0.62	0.02	0.01	0.03
20	740	1.19	2.17	0.10	0.02	0.13	742	1.34	3.00	0.12	0.03	0.15	382	0.37	0.57	0.02	0.01	0.03
21	727	1.15	2.03	0.10	0.02	0.12	733	1.27	2.89	0.11	0.03	0.14	361	0.31	0.49	0.02	0.01	0.02
22	579	0.57	1.01	0.05	0.01	0.06	642	0.85	1.87	0.07	0.02	0.09	308	0.16	0.34	0.01	0.00	0.01
23	514	0.39	0.68	0.03	0.01	0.04	580	0.63	1.28	0.05	0.01	0.07	280	0.13	0.25	0.01	0.00	0.01

Table 9.4. Outlet emissions summary [2023 Do minimum, regulatory traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	291	0.16	0.24	0.02	0.00	0.03	379	0.70	1.22	0.05	0.01	0.06	-	-	-	-	-	-
1	241	0.10	0.15	0.01	0.00	0.02	325	0.44	0.76	0.03	0.01	0.04	-	-	-	-	-	-
2	224	0.08	0.12	0.01	0.00	0.01	307	0.37	0.65	0.03	0.01	0.03	-	-	-	-	-	-
3	224	0.08	0.12	0.01	0.00	0.01	307	0.37	0.64	0.03	0.01	0.03	-	-	-	-	-	-
4	254	0.11	0.17	0.02	0.00	0.02	357	0.58	1.02	0.04	0.01	0.05	-	-	-	-	-	-
5	319	0.21	0.31	0.03	0.00	0.03	467	1.33	2.22	0.09	0.03	0.12	-	-	-	-	-	-
6	443	0.51	0.77	0.07	0.01	0.08	496	1.57	2.71	0.11	0.03	0.14	-	-	-	-	-	-
7	468	1.81	2.27	0.21	0.04	0.25	509	1.69	2.95	0.12	0.03	0.16	-	-	-	-	-	-
8	513	0.82	1.19	0.12	0.02	0.14	517	1.84	3.00	0.13	0.04	0.16	-	-	-	-	-	-
9	491	0.71	1.02	0.10	0.02	0.11	525	2.00	3.07	0.13	0.04	0.17	-	-	-	-	-	-
10	489	0.70	1.01	0.10	0.02	0.11	544	2.36	3.28	0.15	0.05	0.20	-	-	-	-	-	-
11	488	0.70	1.00	0.10	0.02	0.11	567	2.82	3.54	0.17	0.06	0.23	-	-	-	-	-	-
12	486	0.69	0.99	0.09	0.02	0.11	579	3.09	3.75	0.18	0.07	0.25	-	-	-	-	-	-
13	476	0.62	0.94	0.09	0.01	0.10	588	3.21	4.11	0.20	0.07	0.26	-	-	-	-	-	-
14	467	0.59	0.89	0.08	0.01	0.10	605	3.36	4.78	0.22	0.07	0.29	-	-	-	-	-	-
15	458	0.56	0.84	0.08	0.01	0.09	601	3.62	5.04	0.27	0.07	0.34	-	-	-	-	-	-
16	450	0.54	0.80	0.08	0.01	0.09	491	4.21	5.51	0.30	0.08	0.38	-	-	-	-	-	-
17	402	0.40	0.57	0.06	0.01	0.06	597	2.80	5.16	0.25	0.06	0.31	-	-	-	-	-	-
18	370	0.32	0.45	0.04	0.01	0.05	563	2.13	4.25	0.17	0.04	0.22	-	-	-	-	-	-
19	359	0.30	0.42	0.04	0.01	0.05	538	1.85	3.65	0.15	0.04	0.18	-	-	-	-	-	-
20	349	0.28	0.39	0.04	0.01	0.04	524	1.70	3.37	0.13	0.03	0.17	-	-	-	-	-	-
21	329	0.23	0.33	0.03	0.01	0.04	507	1.52	3.09	0.12	0.03	0.15	-	-	-	-	-	-
22	278	0.12	0.22	0.02	0.00	0.02	430	1.03	1.76	0.07	0.02	0.09	-	-	-	-	-	-
23	250	0.10	0.16	0.02	0.00	0.02	355	0.63	0.94	0.04	0.01	0.05	-	-	-	-	-	-

Table 9.4. Outlet emissions summary [2023 Do minimum, regulatory traffic], continued

Outlet identifier:	H							I							J						
EIS name:	Rozelle North (WHT)							Rozelle Mid (M4-M5 Link/ICL)							Rozelle South (M4-M5 Link/ICL)						
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	
0	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
1	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
2	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
3	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
4	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
5	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
6	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
7	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
8	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
9	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
10	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
11	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
12	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
13	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
14	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
15	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
16	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
17	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
18	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
19	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
20	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
21	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
22	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
23	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	

Table 9.4. Outlet emissions summary [2023 Do minimum, regulatory traffic], continued

Outlet identifier:	K						L						M						N					
EIS name:	SPI (M4-M5 Link)						Iron Cove Link (north)						Arncliffe (F6 Extension)						Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

9.1.3 2033 expected traffic operations

Table 9.5. In-Tunnel estimated air quality maximum [2033 Do minimum, expected traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.00	0.00	0.0000	0.08	1.22	0.0007	0.08	1.18	0.0005	0.03	0.00	0.00	0.0000	0.05	1.00	0.0004	0.05	0.73	0.0004	0.02
1	0.00	0.00	0.0000	0.04	0.62	0.0003	0.08	0.94	0.0004	0.03	0.00	0.00	0.0000	0.05	0.78	0.0003	0.04	0.53	0.0003	0.02
2	0.00	0.00	0.0000	0.04	0.57	0.0003	0.07	0.89	0.0004	0.03	0.00	0.00	0.0000	0.04	0.73	0.0003	0.03	0.50	0.0003	0.02
3	0.00	0.00	0.0000	0.04	0.62	0.0003	0.07	0.89	0.0004	0.03	0.00	0.00	0.0000	0.04	0.76	0.0003	0.03	0.50	0.0003	0.02
4	0.00	0.00	0.0000	0.05	0.73	0.0003	0.08	1.09	0.0004	0.03	0.00	0.00	0.0000	0.05	0.95	0.0004	0.04	0.57	0.0003	0.02
5	0.00	0.00	0.0000	0.07	1.17	0.0005	0.12	1.85	0.0007	0.05	0.00	0.00	0.0000	0.08	1.55	0.0006	0.06	0.81	0.0004	0.04
6	0.00	0.00	0.0000	0.13	2.69	0.0008	0.15	2.38	0.0009	0.06	0.00	0.00	0.0000	0.12	2.18	0.0008	0.10	1.55	0.0008	0.05
7	0.00	0.00	0.0000	0.27	4.50	0.0013	0.16	2.59	0.0010	0.08	0.00	0.00	0.0000	0.17	3.03	0.0012	0.18	2.62	0.0017	0.08
8	0.00	0.00	0.0000	0.22	3.88	0.0012	0.17	2.60	0.0010	0.07	0.00	0.00	0.0000	0.16	2.87	0.0010	0.11	1.64	0.0009	0.07
9	0.00	0.00	0.0000	0.21	3.78	0.0011	0.19	2.67	0.0010	0.07	0.00	0.00	0.0000	0.16	2.81	0.0010	0.11	1.54	0.0009	0.07
10	0.00	0.00	0.0000	0.21	3.77	0.0011	0.21	2.71	0.0011	0.08	0.00	0.00	0.0000	0.16	2.74	0.0010	0.11	1.51	0.0009	0.07
11	0.00	0.00	0.0000	0.21	3.76	0.0011	0.22	2.76	0.0012	0.09	0.00	0.00	0.0000	0.16	2.67	0.0010	0.11	1.51	0.0009	0.07
12	0.00	0.00	0.0000	0.21	3.74	0.0011	0.24	2.83	0.0012	0.09	0.00	0.00	0.0000	0.16	2.60	0.0010	0.11	1.50	0.0009	0.07
13	0.00	0.00	0.0000	0.19	3.69	0.0010	0.25	3.12	0.0013	0.10	0.00	0.00	0.0000	0.15	2.67	0.0009	0.10	1.46	0.0008	0.06
14	0.00	0.00	0.0000	0.18	3.71	0.0010	0.25	3.66	0.0014	0.10	0.00	0.00	0.0000	0.15	2.75	0.0009	0.10	1.43	0.0008	0.06
15	0.00	0.00	0.0000	0.18	3.86	0.0010	0.27	4.28	0.0016	0.11	0.00	0.00	0.0000	0.15	3.02	0.0010	0.10	1.38	0.0008	0.06
16	0.00	0.00	0.0000	0.20	4.62	0.0011	0.29	4.98	0.0018	0.12	0.00	0.00	0.0000	0.15	3.92	0.0010	0.10	1.33	0.0008	0.07
17	0.00	0.00	0.0000	0.16	3.61	0.0010	0.23	4.07	0.0014	0.09	0.00	0.00	0.0000	0.13	2.77	0.0009	0.08	1.15	0.0006	0.06
18	0.00	0.00	0.0000	0.13	2.72	0.0008	0.19	3.30	0.0012	0.08	0.00	0.00	0.0000	0.12	2.56	0.0008	0.07	0.95	0.0005	0.05
19	0.00	0.00	0.0000	0.12	2.35	0.0008	0.17	2.96	0.0010	0.07	0.00	0.00	0.0000	0.12	2.51	0.0008	0.07	0.90	0.0005	0.05
20	0.00	0.00	0.0000	0.11	2.17	0.0008	0.16	2.72	0.0010	0.06	0.00	0.00	0.0000	0.12	2.39	0.0008	0.07	0.87	0.0005	0.05
21	0.00	0.00	0.0000	0.10	2.01	0.0008	0.15	2.48	0.0009	0.06	0.00	0.00	0.0000	0.11	2.29	0.0008	0.06	0.79	0.0004	0.05
22	0.00	0.00	0.0000	0.09	1.28	0.0007	0.12	1.87	0.0007	0.05	0.00	0.00	0.0000	0.08	1.50	0.0005	0.05	0.73	0.0003	0.03
23	0.00	0.00	0.0000	0.08	1.25	0.0007	0.09	1.30	0.0005	0.04	0.00	0.00	0.0000	0.06	1.09	0.0004	0.05	0.73	0.0003	0.02

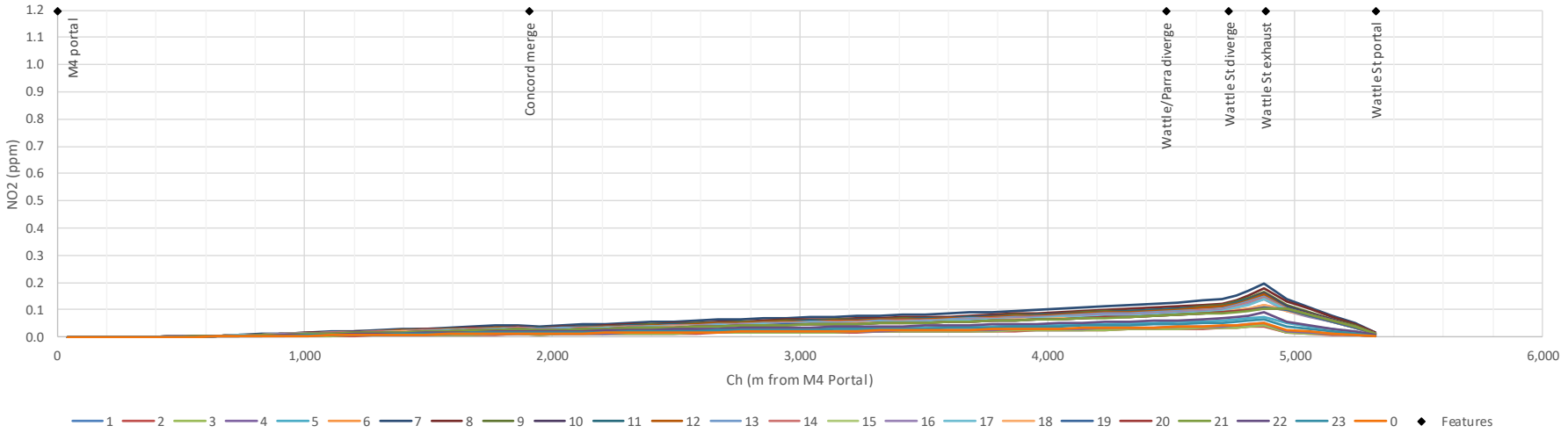

Figure 9.22. In-Tunnel NO_2 levels along route 1A from M4 portal to Wattle Street [2033 Do minimum, expected traffic]

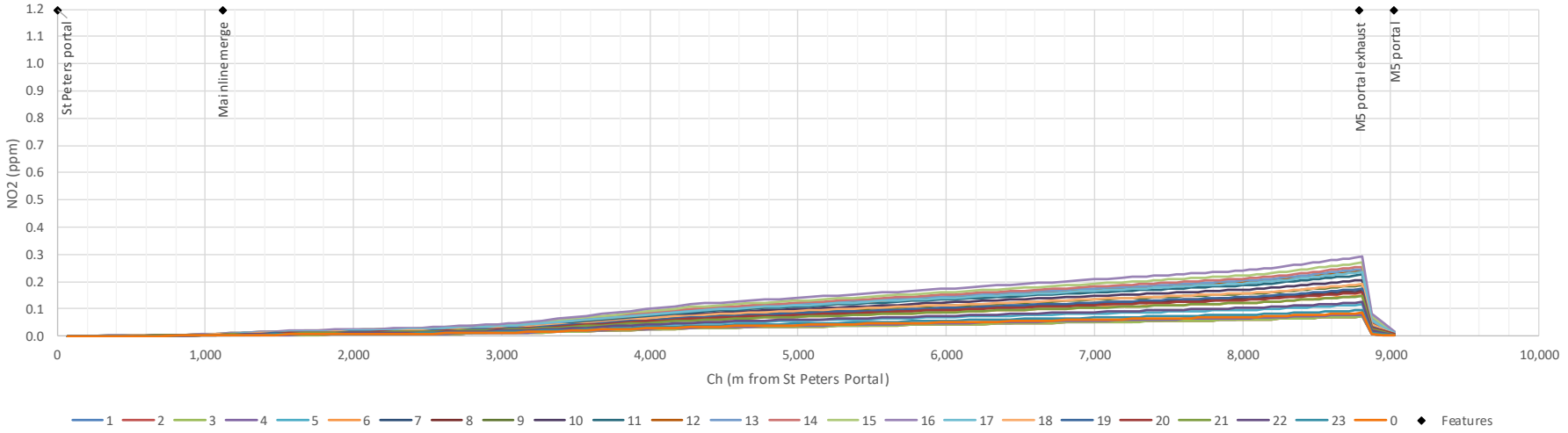

Figure 9.23 In-Tunnel NO_2 levels along route 1V from St Peters to M5 portal [2033 Do minimum, expected traffic]

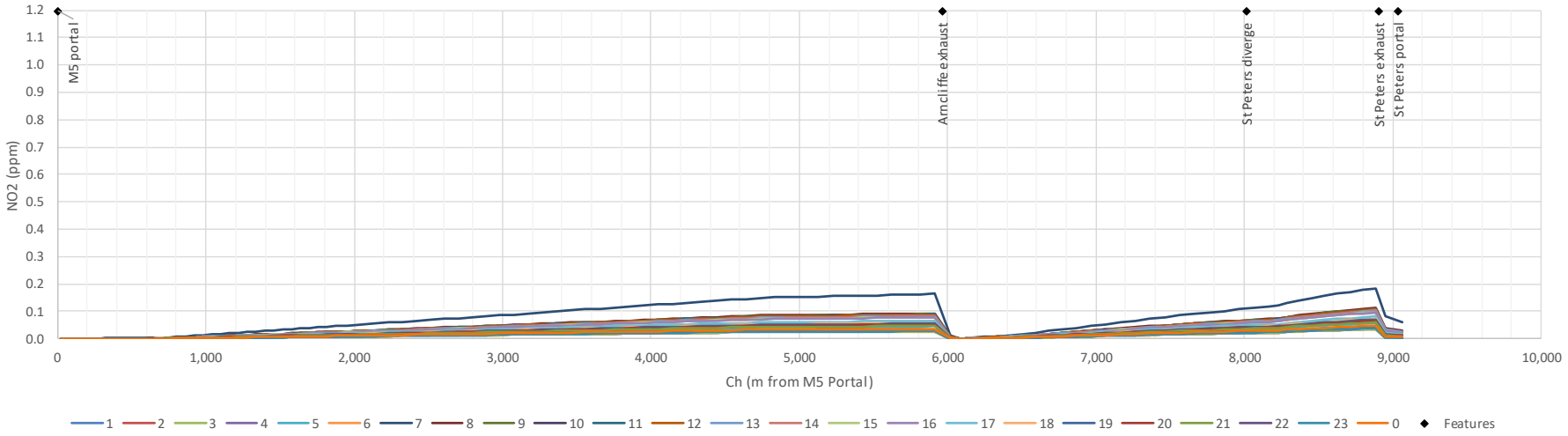

Figure 9.24 In-Tunnel NO_2 levels along route 2A from M5 portal to St Peters [2033 Do minimum, expected traffic]

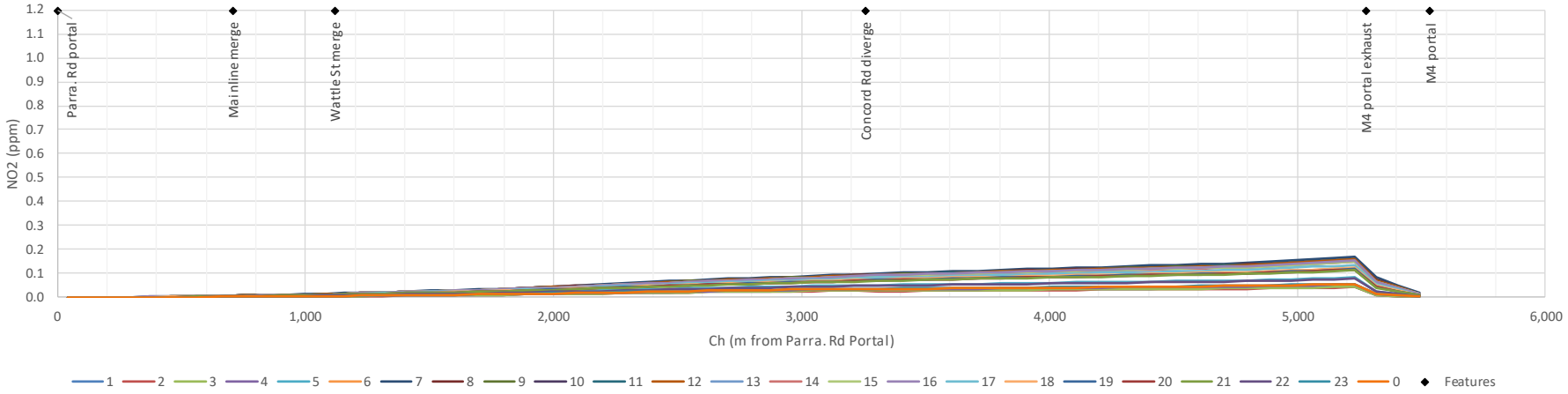

Figure 9.25. In-Tunnel NO_2 levels along route 2U from Parramatta Rd to M4 portal [2033 Do minimum, expected traffic]

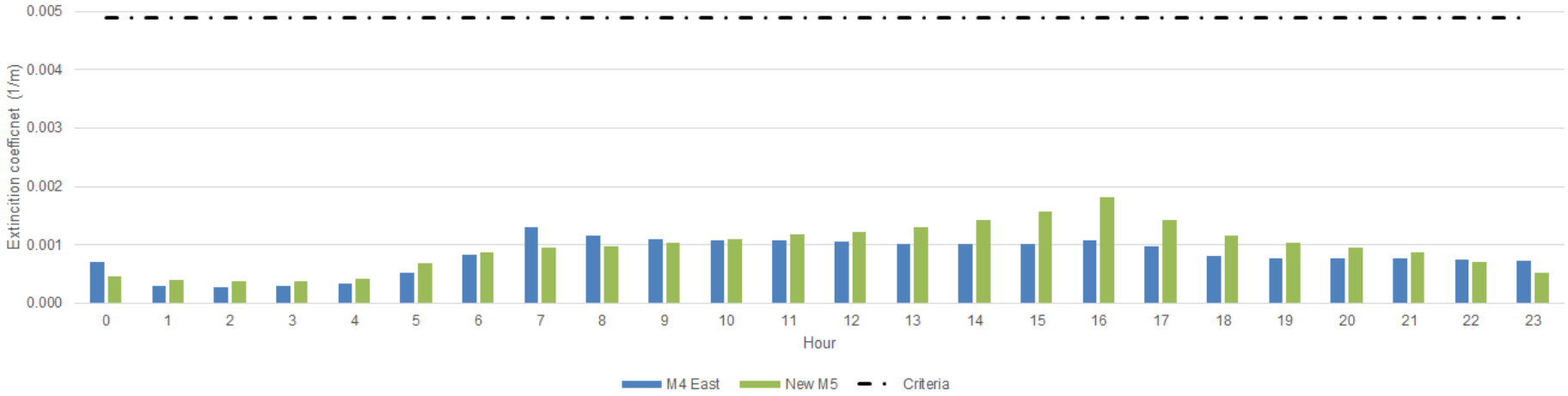

Figure 9.26. Maximum In-Tunnel visibility for M4 to M5 direction [2033 Do minimum, expected traffic]

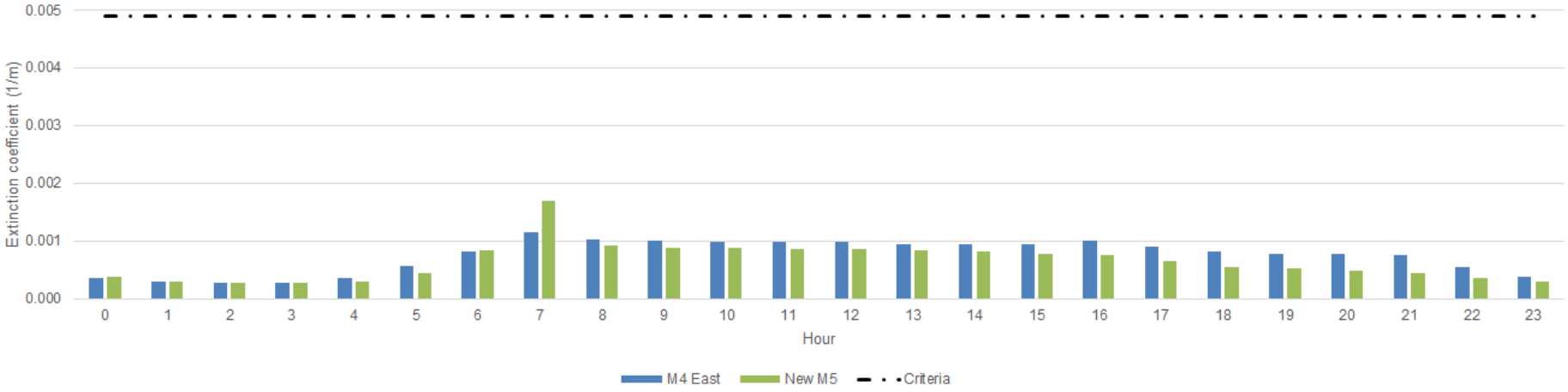

Figure 9.27. Maximum In-Tunnel visibility for M5 to M4 direction [2033 Do minimum, expected traffic]

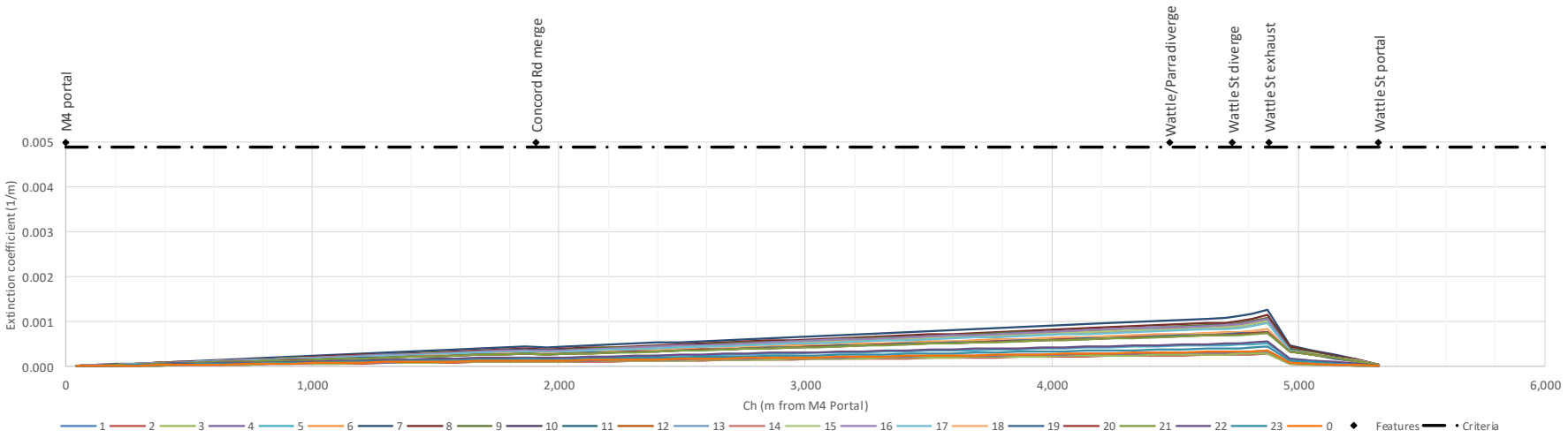

Figure 9.28. In-Tunnel visibility along route 1A from M4 portal to Wattle Street [2033 Do minimum, expected traffic]

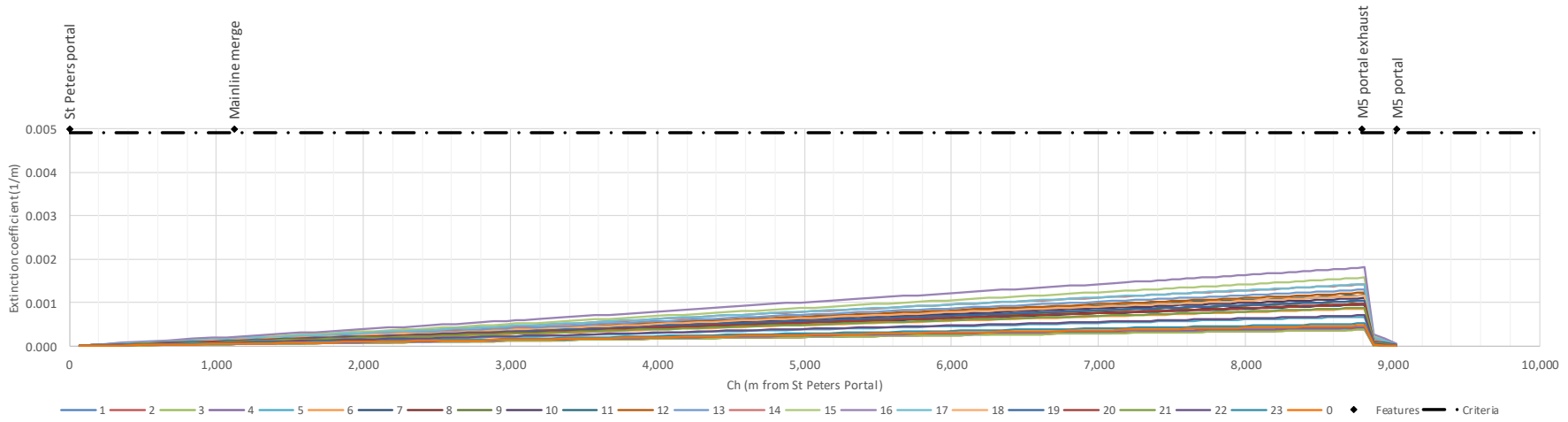

Figure 9.29. In-Tunnel visibility along route 1V from St Peters to M5 portal [2033 Do minimum, expected traffic]

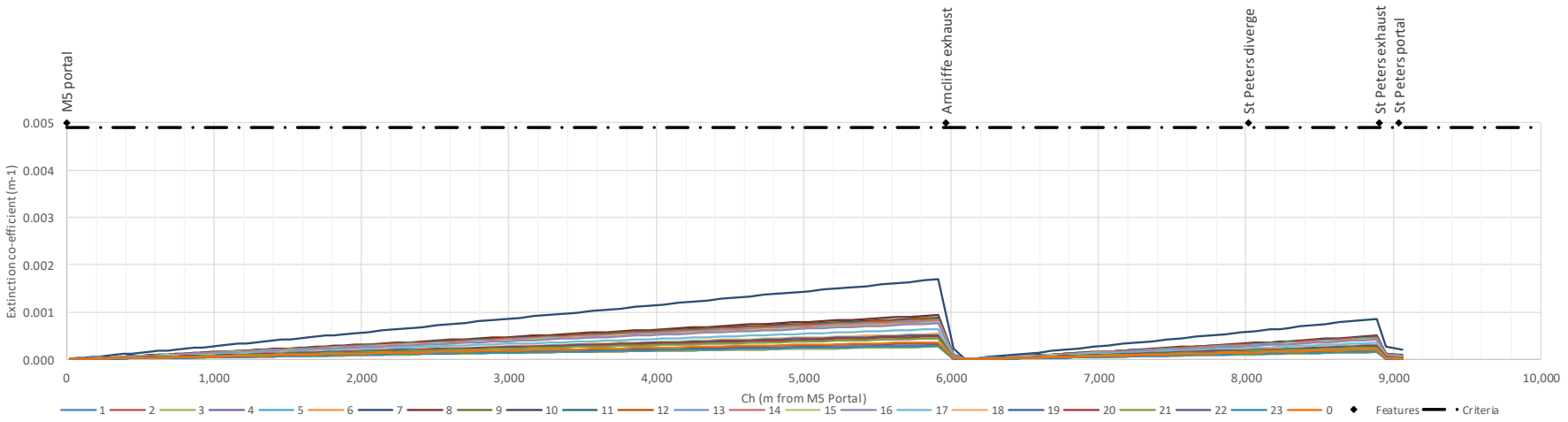

Figure 9.30. In-Tunnel visibility along route 2A from M5 portal to St Peters [2033 Do minimum, expected traffic]

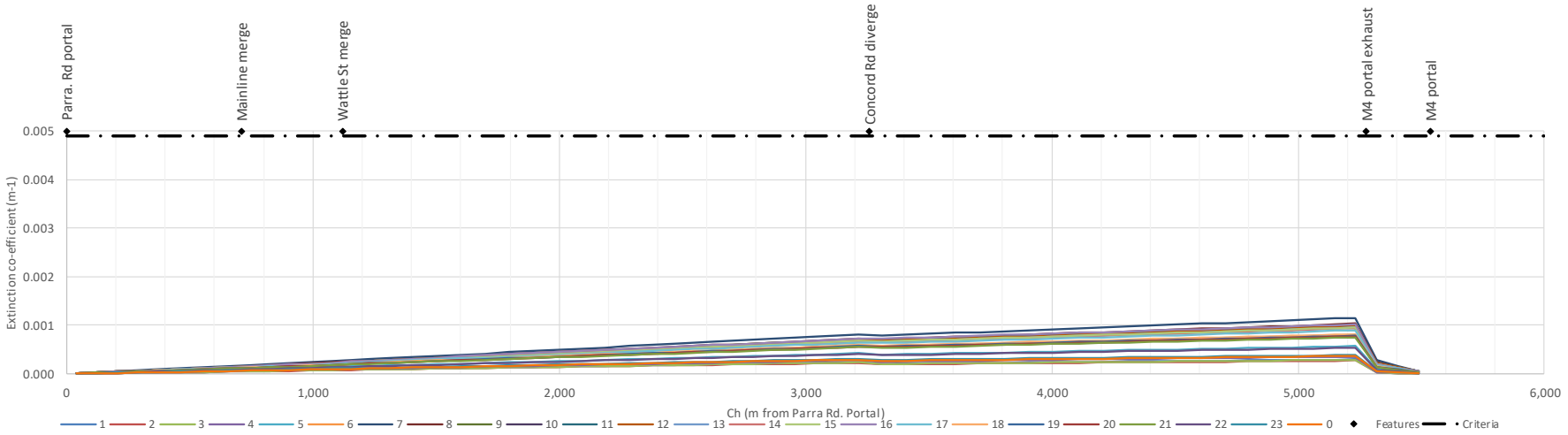

Figure 9.31. In-Tunnel visibility along route 2U from Parramatta Rd to M4 portal [2033 Do minimum, expected traffic]

Table 9.6. Outlet emissions summary [2033 Do minimum, expected traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	455	0.19	0.35	0.02	0.00	0.03	455	0.20	0.46	0.02	0.00	0.03	280	0.10	0.18	0.01	0.00	0.01
1	419	0.14	0.26	0.02	0.00	0.02	413	0.15	0.32	0.02	0.00	0.02	246	0.07	0.11	0.00	0.00	0.01
2	405	0.13	0.23	0.01	0.00	0.02	397	0.13	0.28	0.02	0.00	0.02	236	0.06	0.10	0.00	0.00	0.01
3	414	0.13	0.25	0.02	0.00	0.02	406	0.14	0.30	0.02	0.00	0.02	236	0.06	0.10	0.00	0.00	0.01
4	451	0.18	0.33	0.02	0.00	0.02	452	0.19	0.44	0.02	0.00	0.03	254	0.07	0.12	0.01	0.00	0.01
5	558	0.36	0.67	0.04	0.01	0.05	573	0.40	0.98	0.05	0.01	0.06	318	0.15	0.25	0.01	0.00	0.01
6	711	0.75	1.48	0.09	0.01	0.11	683	0.73	1.69	0.09	0.01	0.10	462	0.39	0.76	0.03	0.01	0.04
7	822	1.39	2.35	0.16	0.02	0.18	804	1.23	2.86	0.15	0.02	0.18	610	1.04	1.79	0.08	0.02	0.10
8	792	1.16	2.09	0.14	0.02	0.16	765	1.14	2.36	0.13	0.02	0.15	486	0.50	0.86	0.04	0.01	0.04
9	782	1.08	1.99	0.13	0.02	0.15	753	1.11	2.23	0.12	0.02	0.14	471	0.47	0.77	0.03	0.01	0.04
10	779	1.06	1.96	0.13	0.02	0.15	750	1.10	2.19	0.12	0.02	0.14	467	0.47	0.75	0.03	0.01	0.04
11	776	1.04	1.93	0.12	0.02	0.14	750	1.10	2.18	0.12	0.02	0.14	467	0.46	0.75	0.03	0.01	0.04
12	774	1.02	1.92	0.12	0.02	0.14	749	1.10	2.17	0.12	0.02	0.14	464	0.46	0.74	0.03	0.01	0.04
13	765	0.94	1.88	0.12	0.02	0.14	734	1.00	2.08	0.11	0.02	0.13	455	0.42	0.70	0.03	0.01	0.04
14	761	0.89	1.88	0.12	0.02	0.13	731	0.98	2.05	0.11	0.02	0.13	449	0.41	0.68	0.03	0.01	0.04
15	764	0.85	1.94	0.12	0.01	0.13	734	0.98	2.10	0.11	0.02	0.13	439	0.38	0.64	0.03	0.01	0.03
16	787	0.87	2.15	0.13	0.01	0.15	752	1.01	2.36	0.13	0.02	0.14	432	0.37	0.60	0.03	0.01	0.03
17	750	0.81	1.82	0.11	0.01	0.13	714	0.85	1.98	0.10	0.01	0.12	392	0.28	0.46	0.02	0.00	0.02
18	710	0.74	1.47	0.09	0.01	0.11	681	0.74	1.70	0.09	0.01	0.10	354	0.22	0.33	0.01	0.00	0.02
19	697	0.72	1.35	0.09	0.01	0.10	667	0.68	1.60	0.08	0.01	0.10	344	0.21	0.30	0.01	0.00	0.02
20	691	0.71	1.30	0.08	0.01	0.10	661	0.66	1.55	0.08	0.01	0.09	333	0.18	0.28	0.01	0.00	0.02
21	684	0.70	1.26	0.08	0.01	0.09	653	0.64	1.49	0.08	0.01	0.09	315	0.16	0.24	0.01	0.00	0.01
22	571	0.44	0.70	0.05	0.01	0.05	554	0.35	0.90	0.05	0.01	0.05	270	0.09	0.16	0.01	0.00	0.01
23	505	0.29	0.47	0.03	0.01	0.04	463	0.20	0.51	0.03	0.00	0.03	242	0.07	0.11	0.00	0.00	0.01

Table 9.6. Outlet emissions summary [2033 Do minimum, expected traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	251	0.08	0.13	0.02	0.00	0.02	256	0.17	0.27	0.02	0.00	0.02	-	-	-	-	-	-
1	211	0.05	0.08	0.01	0.00	0.01	235	0.14	0.19	0.01	0.00	0.01	-	-	-	-	-	-
2	201	0.05	0.07	0.01	0.00	0.01	228	0.12	0.17	0.01	0.00	0.01	-	-	-	-	-	-
3	201	0.05	0.07	0.01	0.00	0.01	228	0.12	0.17	0.01	0.00	0.01	-	-	-	-	-	-
4	220	0.06	0.09	0.01	0.00	0.01	250	0.15	0.24	0.01	0.00	0.02	-	-	-	-	-	-
5	284	0.12	0.18	0.02	0.00	0.02	325	0.31	0.59	0.03	0.01	0.04	-	-	-	-	-	-
6	423	0.31	0.54	0.06	0.01	0.07	375	0.47	0.92	0.05	0.01	0.06	-	-	-	-	-	-
7	550	0.87	1.35	0.17	0.02	0.19	396	0.57	1.07	0.06	0.01	0.07	-	-	-	-	-	-
8	446	0.39	0.61	0.07	0.01	0.08	401	0.60	1.09	0.06	0.01	0.07	-	-	-	-	-	-
9	432	0.37	0.55	0.07	0.01	0.08	414	0.70	1.16	0.06	0.01	0.08	-	-	-	-	-	-
10	429	0.37	0.54	0.07	0.01	0.07	427	0.81	1.22	0.07	0.01	0.08	-	-	-	-	-	-
11	429	0.36	0.54	0.07	0.01	0.07	440	0.93	1.29	0.08	0.02	0.09	-	-	-	-	-	-
12	426	0.36	0.53	0.06	0.01	0.07	450	1.02	1.35	0.08	0.02	0.10	-	-	-	-	-	-
13	418	0.33	0.50	0.06	0.01	0.07	466	1.08	1.56	0.09	0.02	0.11	-	-	-	-	-	-
14	412	0.32	0.49	0.06	0.01	0.07	491	1.16	1.95	0.11	0.02	0.13	-	-	-	-	-	-
15	403	0.30	0.46	0.06	0.01	0.06	521	1.28	2.46	0.13	0.02	0.15	-	-	-	-	-	-
16	396	0.29	0.43	0.05	0.01	0.06	553	1.45	3.06	0.16	0.03	0.19	-	-	-	-	-	-
17	358	0.22	0.33	0.04	0.00	0.04	496	1.03	2.21	0.11	0.02	0.13	-	-	-	-	-	-
18	323	0.17	0.24	0.03	0.00	0.03	443	0.73	1.56	0.08	0.01	0.09	-	-	-	-	-	-
19	313	0.16	0.22	0.03	0.00	0.03	418	0.62	1.31	0.07	0.01	0.08	-	-	-	-	-	-
20	302	0.14	0.20	0.02	0.00	0.03	399	0.55	1.13	0.06	0.01	0.07	-	-	-	-	-	-
21	285	0.12	0.17	0.02	0.00	0.02	379	0.47	0.97	0.05	0.01	0.06	-	-	-	-	-	-
22	240	0.07	0.11	0.01	0.00	0.01	331	0.35	0.61	0.03	0.01	0.04	-	-	-	-	-	-
23	213	0.05	0.08	0.01	0.00	0.01	275	0.21	0.33	0.02	0.00	0.02	-	-	-	-	-	-

Table 9.6. Outlet emissions summary [2033 Do minimum, expected traffic], continued

Outlet identifier:	H							I							J						
EIS name:	Rozelle North (WHT)							Rozelle Mid (M4-M5 Link/ICL)							Rozelle South (M4-M5 Link/ICL)						
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	
0	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
1	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
2	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
3	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
4	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
5	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
6	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
7	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
8	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
9	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
10	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
11	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
12	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
13	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
14	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
15	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
16	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
17	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
18	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
19	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
20	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
21	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
22	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
23	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	

Table 9.6. Outlet emissions summary [2033 Do minimum, expected traffic], continued

Outlet identifier:	K					
EIS name:	SPI (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	-	-	-	-	-	-
23	-	-	-	-	-	-

Outlet identifier:	L					
EIS name:	Iron Cove Link (north)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	-	-	-	-	-	-
23	-	-	-	-	-	-

Outlet identifier:	M					
EIS name:	Arncliffe (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	-	-	-	-	-	-
23	-	-	-	-	-	-

Outlet identifier:	N					
EIS name:	Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	-	-	-	-	-	-
23	-	-	-	-	-	-

9.1.4 2033 regulatory demand traffic operations

Table 9.7. In-Tunnel estimated air quality maximum [2033 Do minimum, regulatory traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.00	0.00	0.0000	0.10	1.42	0.0008	0.13	1.75	0.0007	0.05	0.00	0.00	0.0000	0.07	1.29	0.0005	0.06	0.87	0.0004	0.03
1	0.00	0.00	0.0000	0.05	0.73	0.0003	0.11	1.38	0.0006	0.04	0.00	0.00	0.0000	0.06	1.00	0.0004	0.04	0.62	0.0003	0.03
2	0.00	0.00	0.0000	0.05	0.66	0.0003	0.10	1.31	0.0006	0.04	0.00	0.00	0.0000	0.05	0.94	0.0004	0.04	0.58	0.0003	0.02
3	0.00	0.00	0.0000	0.05	0.72	0.0003	0.10	1.31	0.0006	0.04	0.00	0.00	0.0000	0.06	0.98	0.0004	0.04	0.58	0.0003	0.02
4	0.00	0.00	0.0000	0.06	0.85	0.0004	0.12	1.64	0.0007	0.05	0.00	0.00	0.0000	0.07	1.23	0.0005	0.04	0.66	0.0004	0.03
5	0.00	0.00	0.0000	0.08	1.48	0.0006	0.18	2.80	0.0010	0.07	0.00	0.00	0.0000	0.11	2.02	0.0007	0.07	0.95	0.0005	0.05
6	0.00	0.00	0.0000	0.16	3.35	0.0009	0.23	3.65	0.0013	0.09	0.00	0.00	0.0000	0.16	3.31	0.0011	0.11	1.82	0.0010	0.07
7	0.00	0.00	0.0000	0.34	4.64	0.0016	0.25	3.99	0.0015	0.10	0.00	0.00	0.0000	0.24	4.32	0.0016	0.33	3.67	0.0026	0.15
8	0.00	0.00	0.0000	0.27	4.69	0.0014	0.26	4.02	0.0015	0.10	0.00	0.00	0.0000	0.22	4.35	0.0014	0.13	1.93	0.0011	0.09
9	0.00	0.00	0.0000	0.27	4.56	0.0013	0.29	4.12	0.0016	0.12	0.00	0.00	0.0000	0.21	4.25	0.0013	0.13	1.81	0.0010	0.09
10	0.00	0.00	0.0000	0.27	4.55	0.0013	0.32	4.19	0.0017	0.13	0.00	0.00	0.0000	0.21	4.13	0.0013	0.13	1.78	0.0010	0.09
11	0.00	0.00	0.0000	0.27	4.54	0.0013	0.35	4.26	0.0018	0.14	0.00	0.00	0.0000	0.21	4.03	0.0013	0.13	1.78	0.0010	0.09
12	0.00	0.00	0.0000	0.26	4.52	0.0013	0.37	4.34	0.0019	0.15	0.00	0.00	0.0000	0.21	3.93	0.0013	0.13	1.76	0.0010	0.09
13	0.00	0.00	0.0000	0.24	4.44	0.0012	0.39	4.74	0.0021	0.16	0.00	0.00	0.0000	0.20	4.03	0.0013	0.12	1.72	0.0010	0.08
14	0.00	0.00	0.0000	0.22	4.46	0.0012	0.42	5.46	0.0023	0.17	0.00	0.00	0.0000	0.20	4.16	0.0013	0.12	1.68	0.0010	0.08
15	0.00	0.00	0.0000	0.22	4.64	0.0012	0.46	5.76	0.0027	0.18	0.00	0.00	0.0000	0.20	4.57	0.0013	0.11	1.62	0.0009	0.08
16	0.00	0.00	0.0000	0.25	4.72	0.0013	0.78	8.65	0.0039	0.33	0.00	0.00	0.0000	0.20	5.86	0.0014	0.11	1.56	0.0009	0.09
17	0.00	0.00	0.0000	0.20	4.32	0.0011	0.38	5.74	0.0023	0.15	0.00	0.00	0.0000	0.18	4.17	0.0012	0.10	1.34	0.0008	0.08
18	0.00	0.00	0.0000	0.16	3.37	0.0010	0.30	4.93	0.0018	0.12	0.00	0.00	0.0000	0.16	3.87	0.0011	0.08	1.11	0.0006	0.07
19	0.00	0.00	0.0000	0.15	2.95	0.0009	0.27	4.51	0.0016	0.11	0.00	0.00	0.0000	0.15	3.79	0.0010	0.08	1.05	0.0006	0.07
20	0.00	0.00	0.0000	0.14	2.74	0.0009	0.25	4.19	0.0015	0.10	0.00	0.00	0.0000	0.15	3.62	0.0010	0.08	1.01	0.0006	0.06
21	0.00	0.00	0.0000	0.13	2.53	0.0009	0.23	3.82	0.0014	0.09	0.00	0.00	0.0000	0.15	3.47	0.0010	0.07	0.92	0.0005	0.06
22	0.00	0.00	0.0000	0.10	1.61	0.0009	0.19	2.83	0.0011	0.07	0.00	0.00	0.0000	0.10	2.00	0.0007	0.06	0.89	0.0004	0.04
23	0.00	0.00	0.0000	0.10	1.46	0.0009	0.14	1.96	0.0008	0.06	0.00	0.00	0.0000	0.07	1.52	0.0005	0.06	0.89	0.0003	0.03

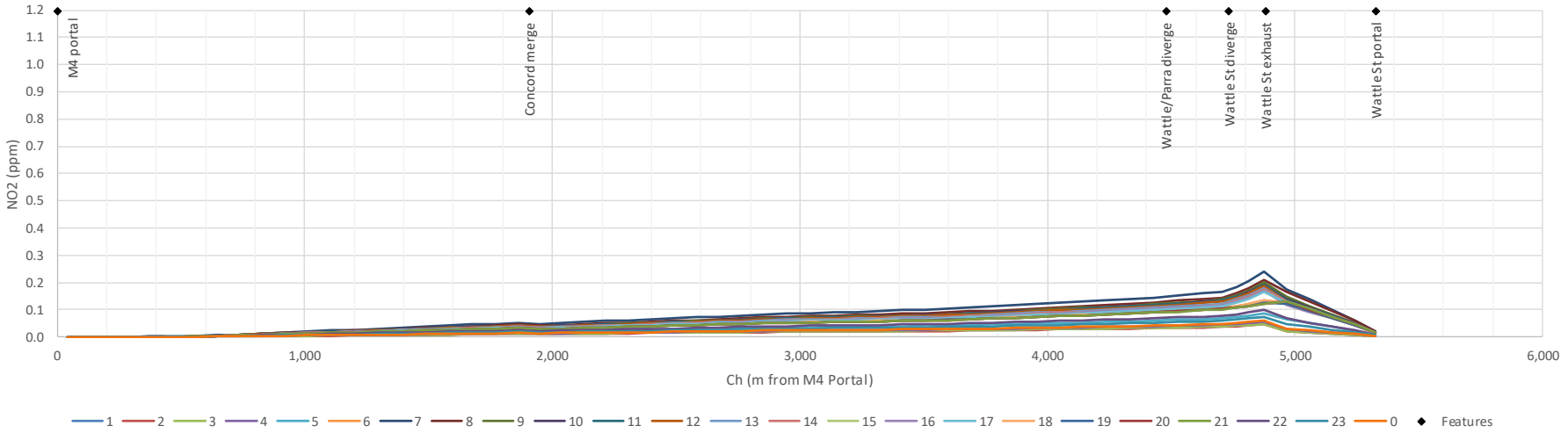

Figure 9.32 In-Tunnel NO_2 levels along route 1A from M4 portal to Wattle Street [2033 Do minimum, regulatory traffic]

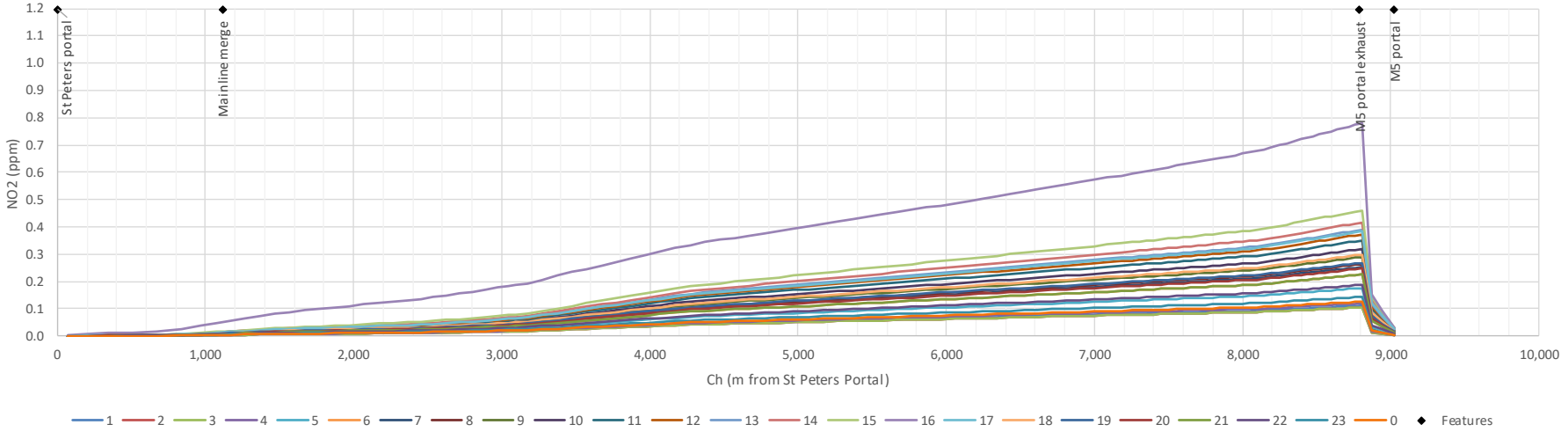

Figure 9.33 In-Tunnel NO_2 levels along route 1V from St Peters to M5 portal [2033 Do minimum, regulatory traffic]

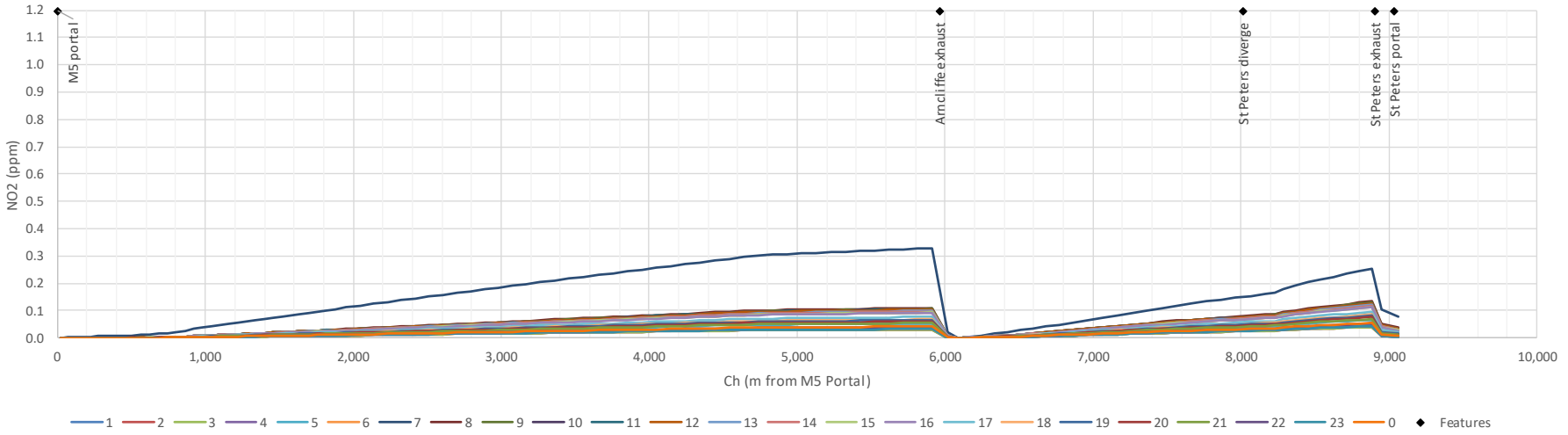

Figure 9.34. In-Tunnel NO_2 levels along route 2A from M5 portal to St Peters [2033 Do minimum, regulatory traffic]

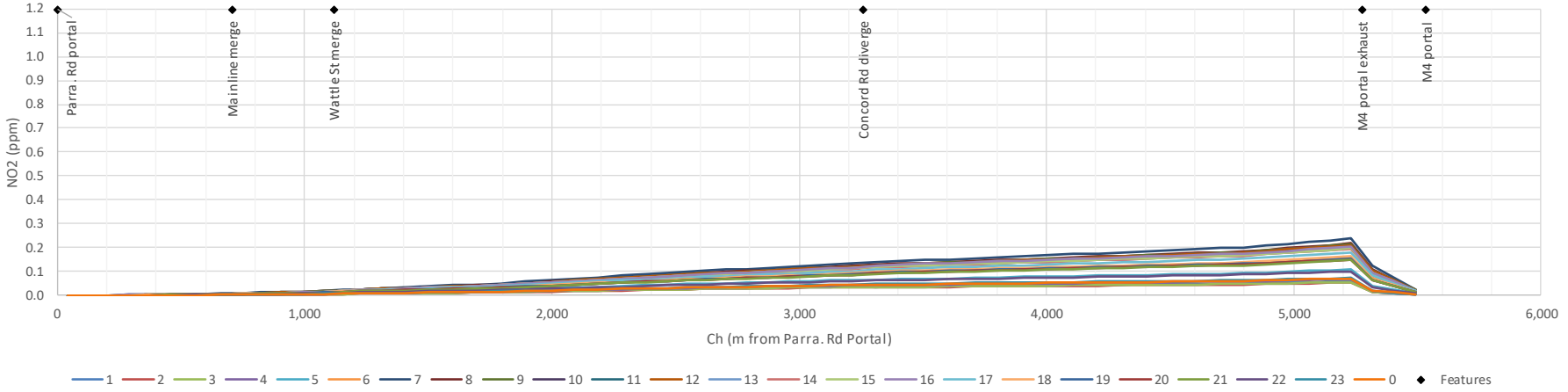

Figure 9.35. In-Tunnel NO_2 levels along route 2U from Parramatta Rd to M4 portal [2033 Do minimum, regulatory traffic]

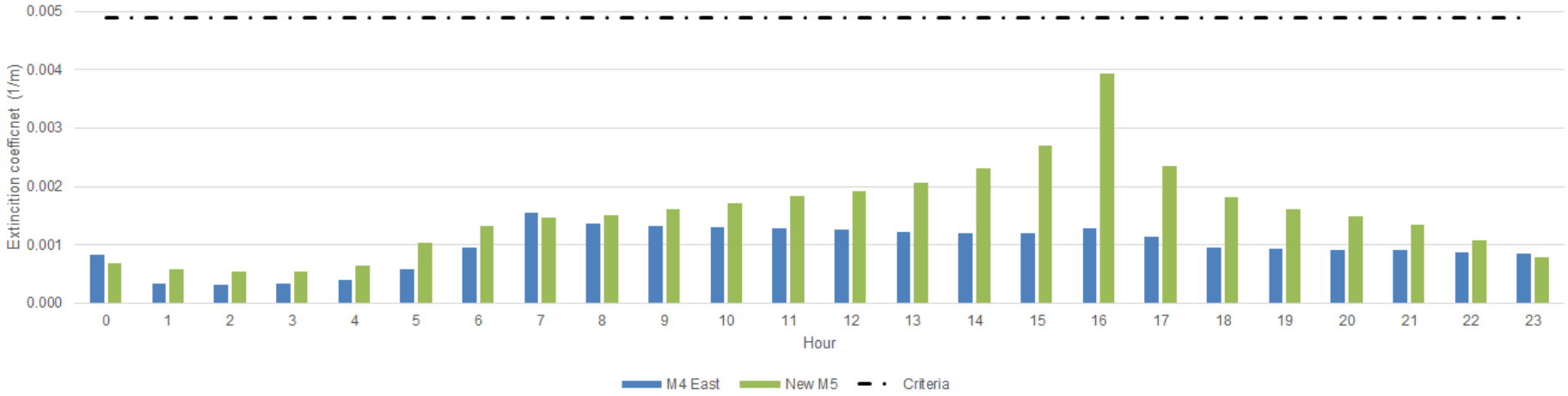

Figure 9.36. Maximum In-Tunnel visibility for M4 to M5 direction [2033 Do minimum, regulatory traffic]

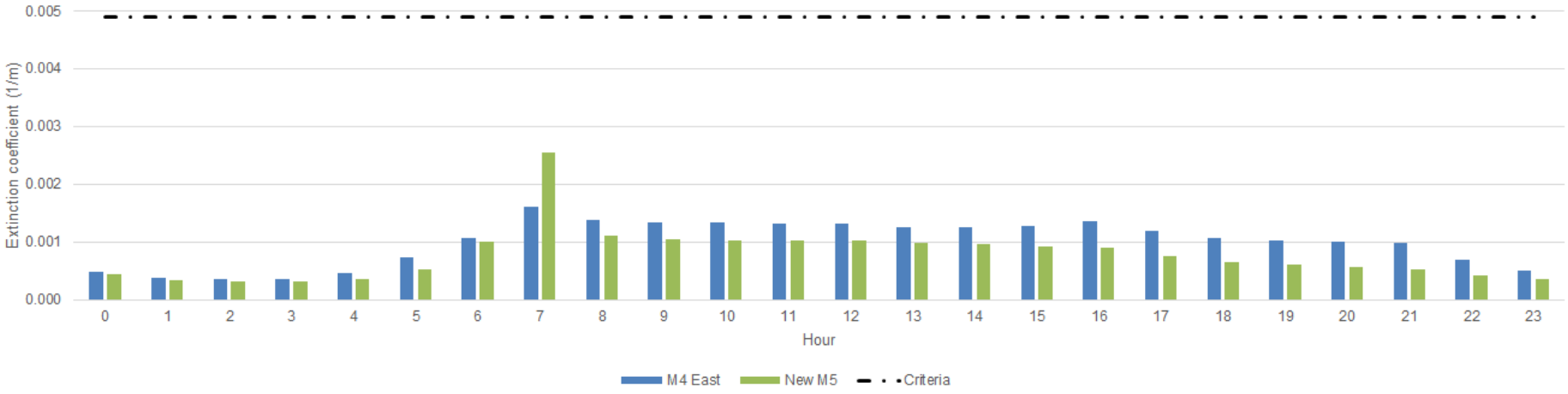

Figure 9.37. Maximum In-Tunnel visibility for M5 to M4 direction [2033 Do minimum, regulatory traffic]

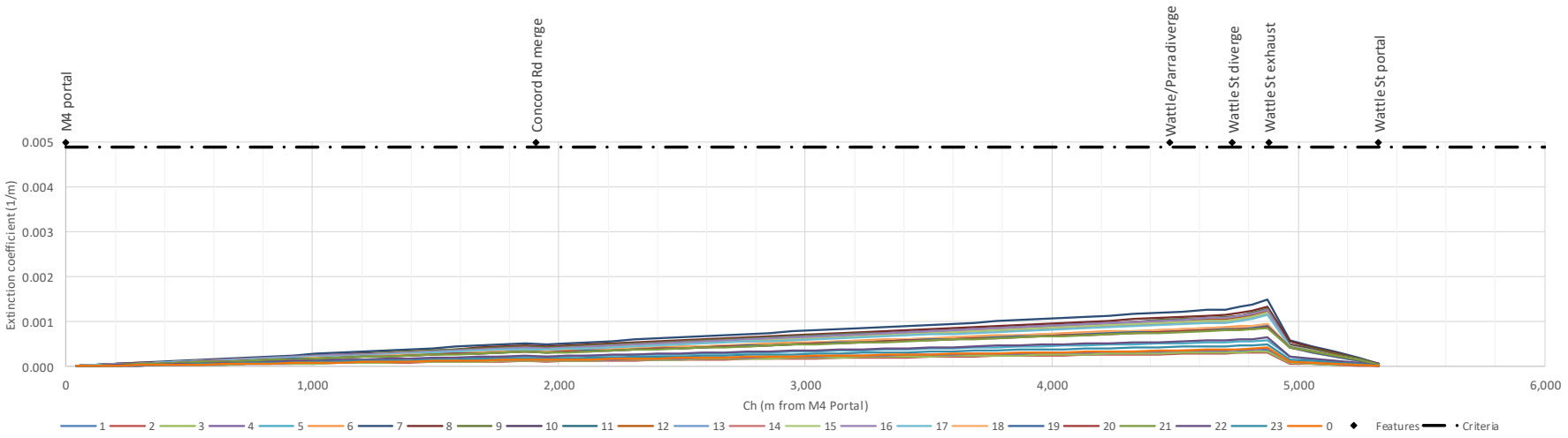

Figure 9.38. In-Tunnel visibility along route 1A from M4 portal to Wattle Street [2033 Do minimum, regulatory traffic]

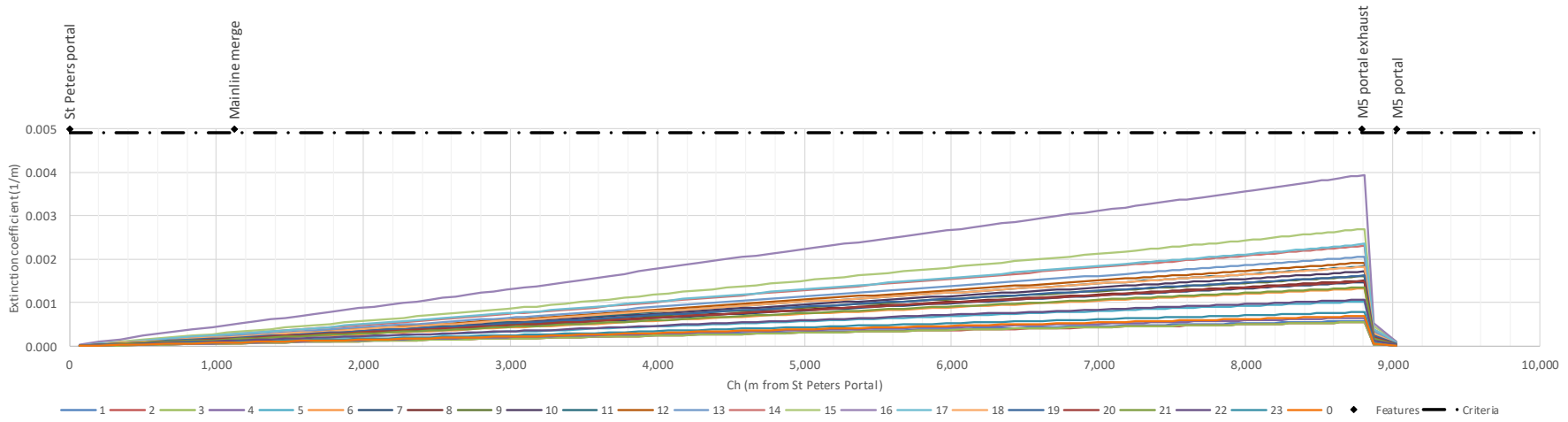

Figure 9.39. In-Tunnel visibility along route 1V from St Peters to M5 portal [2033 Do minimum, regulatory traffic]

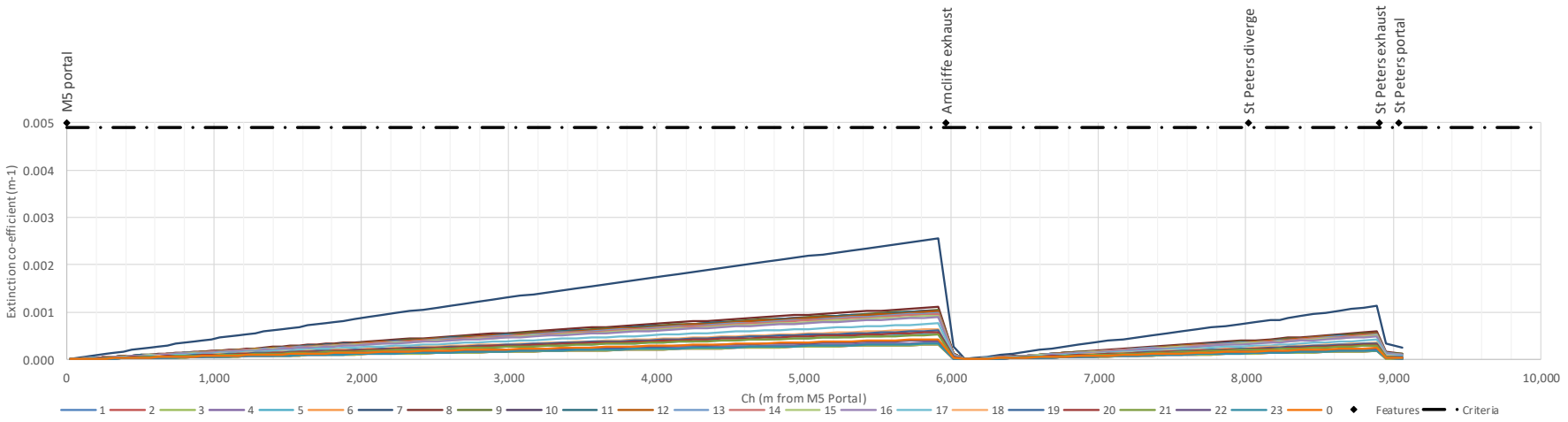

Figure 9.40. In-Tunnel visibility along route 2A from M5 portal to St Peters [2033 Do minimum, regulatory traffic]

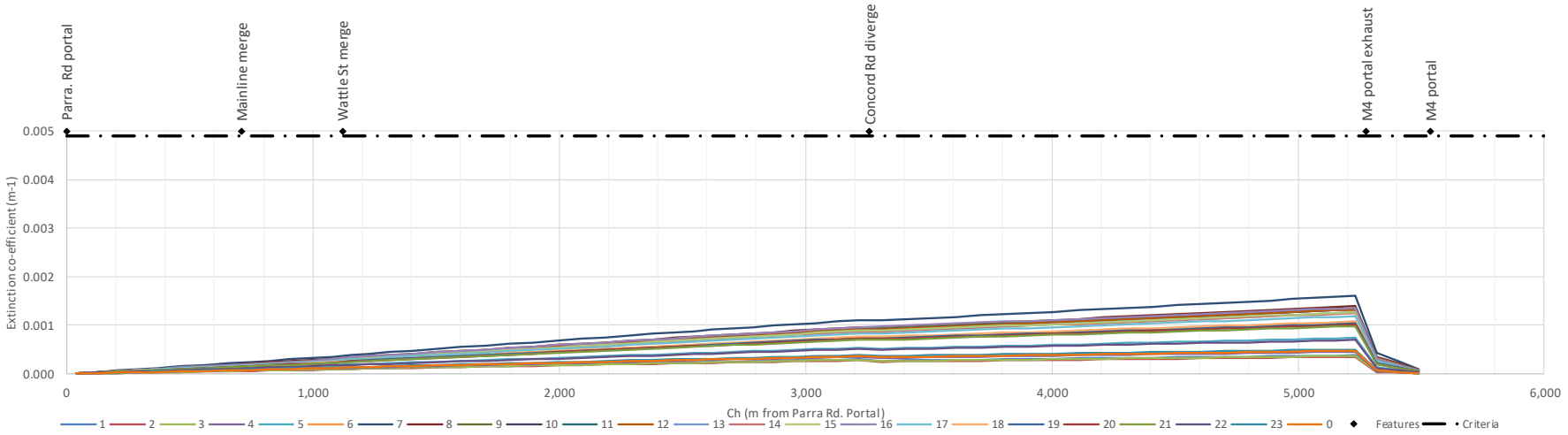

Figure 9.41. In-Tunnel visibility along route 2U from Parramatta Rd to M4 portal [2033 Do minimum, regulatory traffic]

Table 9.8. Outlet emissions summary [2033 Do minimum, regulatory traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	487	0.24	0.44	0.03	0.00	0.03	516	0.30	0.71	0.04	0.01	0.04	307	0.13	0.23	0.01	0.00	0.01
1	446	0.18	0.32	0.02	0.00	0.02	468	0.23	0.49	0.03	0.00	0.03	268	0.09	0.15	0.01	0.00	0.01
2	430	0.16	0.28	0.02	0.00	0.02	450	0.19	0.43	0.02	0.00	0.03	258	0.08	0.13	0.01	0.00	0.01
3	442	0.17	0.31	0.02	0.00	0.02	459	0.21	0.46	0.02	0.00	0.03	258	0.08	0.13	0.01	0.00	0.01
4	481	0.23	0.42	0.03	0.00	0.03	511	0.29	0.67	0.04	0.01	0.04	277	0.09	0.16	0.01	0.00	0.01
5	600	0.46	0.84	0.05	0.01	0.06	653	0.61	1.49	0.08	0.01	0.09	350	0.20	0.33	0.01	0.00	0.02
6	764	0.95	1.85	0.12	0.02	0.13	774	1.10	2.56	0.14	0.02	0.16	507	0.52	1.00	0.04	0.01	0.05
7	867	1.76	2.81	0.20	0.03	0.23	869	1.91	3.96	0.24	0.03	0.27	585	1.40	2.02	0.10	0.02	0.13
8	840	1.47	2.57	0.17	0.03	0.20	854	1.75	3.42	0.20	0.03	0.23	533	0.66	1.12	0.05	0.01	0.06
9	829	1.37	2.44	0.16	0.02	0.19	845	1.70	3.27	0.19	0.03	0.22	518	0.62	1.02	0.04	0.01	0.05
10	825	1.34	2.40	0.16	0.02	0.18	842	1.68	3.22	0.18	0.03	0.21	514	0.61	0.99	0.04	0.01	0.05
11	823	1.31	2.37	0.16	0.02	0.18	842	1.69	3.21	0.18	0.03	0.21	513	0.61	0.99	0.04	0.01	0.05
12	821	1.29	2.35	0.15	0.02	0.18	841	1.69	3.19	0.18	0.03	0.21	510	0.60	0.97	0.04	0.01	0.05
13	812	1.19	2.31	0.15	0.02	0.17	826	1.52	3.07	0.17	0.03	0.20	501	0.55	0.93	0.04	0.01	0.05
14	808	1.12	2.31	0.15	0.02	0.17	823	1.50	3.05	0.17	0.03	0.20	494	0.54	0.90	0.04	0.01	0.05
15	811	1.08	2.37	0.15	0.02	0.17	826	1.50	3.11	0.17	0.03	0.20	484	0.51	0.84	0.04	0.01	0.04
16	832	1.10	2.56	0.17	0.02	0.19	841	1.55	3.46	0.19	0.03	0.22	475	0.49	0.79	0.03	0.01	0.04
17	796	1.03	2.22	0.14	0.02	0.16	806	1.30	2.96	0.16	0.02	0.18	431	0.37	0.60	0.03	0.01	0.03
18	763	0.93	1.83	0.12	0.02	0.13	773	1.12	2.57	0.14	0.02	0.16	391	0.29	0.44	0.02	0.01	0.02
19	748	0.90	1.70	0.11	0.02	0.12	757	1.03	2.43	0.13	0.02	0.15	379	0.27	0.40	0.02	0.00	0.02
20	742	0.90	1.64	0.11	0.02	0.12	752	1.00	2.36	0.12	0.02	0.14	366	0.24	0.37	0.02	0.00	0.02
21	735	0.88	1.58	0.10	0.02	0.12	744	0.97	2.27	0.12	0.02	0.14	346	0.20	0.31	0.01	0.00	0.02
22	613	0.55	0.88	0.06	0.01	0.07	631	0.54	1.37	0.07	0.01	0.08	297	0.12	0.21	0.01	0.00	0.01
23	542	0.36	0.60	0.04	0.01	0.05	528	0.31	0.79	0.04	0.01	0.05	265	0.09	0.15	0.01	0.00	0.01

Table 9.8. Outlet emissions summary [2033 Do minimum, regulatory traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	277	0.10	0.17	0.02	0.00	0.02	325	0.35	0.56	0.03	0.01	0.04	-	-	-	-	-	-
1	233	0.07	0.11	0.01	0.00	0.01	295	0.28	0.39	0.02	0.01	0.03	-	-	-	-	-	-
2	223	0.06	0.09	0.01	0.00	0.01	285	0.25	0.35	0.02	0.00	0.03	-	-	-	-	-	-
3	223	0.06	0.09	0.01	0.00	0.01	285	0.25	0.35	0.02	0.00	0.03	-	-	-	-	-	-
4	243	0.07	0.12	0.01	0.00	0.02	316	0.32	0.51	0.03	0.01	0.03	-	-	-	-	-	-
5	316	0.15	0.23	0.03	0.00	0.03	413	0.64	1.22	0.06	0.01	0.08	-	-	-	-	-	-
6	466	0.41	0.71	0.08	0.01	0.09	477	0.97	1.89	0.10	0.02	0.12	-	-	-	-	-	-
7	469	1.52	1.91	0.21	0.03	0.24	503	1.17	2.20	0.12	0.02	0.14	-	-	-	-	-	-
8	491	0.52	0.81	0.10	0.01	0.11	509	1.24	2.24	0.12	0.02	0.14	-	-	-	-	-	-
9	476	0.49	0.73	0.09	0.01	0.10	525	1.43	2.38	0.13	0.03	0.16	-	-	-	-	-	-
10	473	0.48	0.71	0.09	0.01	0.10	541	1.66	2.50	0.14	0.03	0.17	-	-	-	-	-	-
11	472	0.48	0.71	0.09	0.01	0.10	556	1.91	2.62	0.16	0.04	0.19	-	-	-	-	-	-
12	470	0.47	0.70	0.09	0.01	0.10	568	2.10	2.73	0.17	0.04	0.21	-	-	-	-	-	-
13	461	0.44	0.67	0.08	0.01	0.09	582	2.23	3.07	0.19	0.04	0.23	-	-	-	-	-	-
14	455	0.42	0.64	0.08	0.01	0.09	604	2.43	3.68	0.22	0.04	0.26	-	-	-	-	-	-
15	445	0.40	0.60	0.07	0.01	0.08	612	2.69	3.92	0.27	0.05	0.31	-	-	-	-	-	-
16	437	0.39	0.57	0.07	0.01	0.08	498	3.58	4.57	0.31	0.06	0.36	-	-	-	-	-	-
17	396	0.29	0.43	0.05	0.01	0.06	605	2.15	3.90	0.23	0.04	0.27	-	-	-	-	-	-
18	357	0.23	0.32	0.04	0.00	0.04	555	1.50	3.04	0.16	0.03	0.19	-	-	-	-	-	-
19	346	0.21	0.29	0.04	0.00	0.04	530	1.28	2.65	0.14	0.02	0.16	-	-	-	-	-	-
20	334	0.19	0.27	0.03	0.00	0.04	507	1.12	2.33	0.12	0.02	0.14	-	-	-	-	-	-
21	315	0.16	0.23	0.03	0.00	0.03	482	0.97	2.00	0.10	0.02	0.12	-	-	-	-	-	-
22	268	0.10	0.15	0.02	0.00	0.02	421	0.71	1.26	0.07	0.01	0.08	-	-	-	-	-	-
23	236	0.07	0.11	0.01	0.00	0.01	350	0.44	0.69	0.04	0.01	0.05	-	-	-	-	-	-

Table 9.8. Outlet emissions summary [2033 Do minimum, regulatory traffic], continued

Outlet identifier:	H							I							J						
EIS name:	Rozelle North (WHT)							Rozelle Mid (M4-M5 Link/ICL)							Rozelle South (M4-M5 Link/ICL)						
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)		Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	
0	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
1	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
2	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
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Table 9.8. Outlet emissions summary [2033 Do minimum, regulatory traffic], continued

Outlet identifier: EIS name:	K SPI (M4-M5 Link)						L Iron Cove Link (north)						M Arncliffe (F6 Extension)						N Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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9.2 Do something

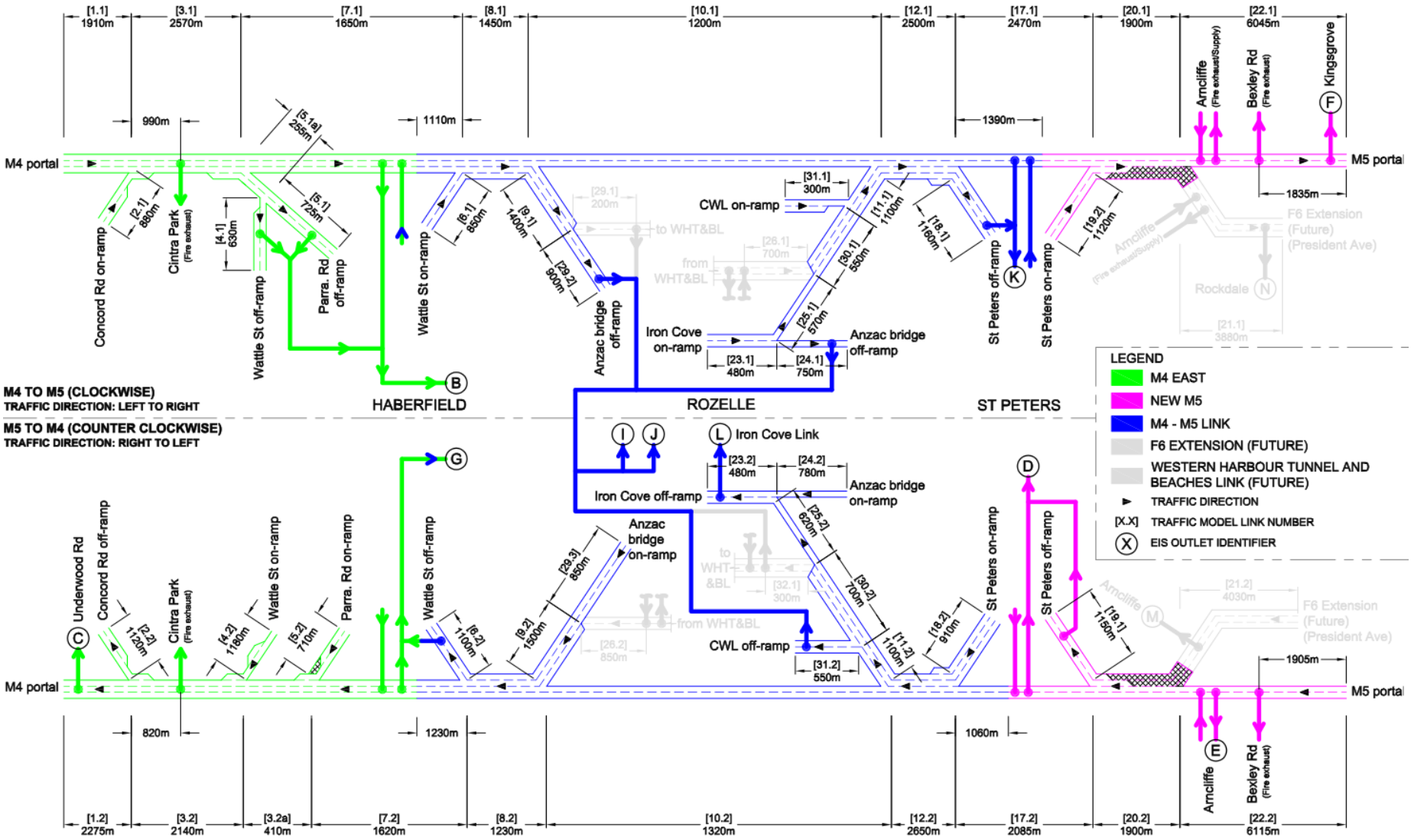


Figure 9.42. Ventilation schematic, 2023 and 2033 Do something

9.2.1 2023 expected traffic operations

Table 9.9. In-Tunnel estimated air quality maximum [2023 Do something, expected traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.11	1.42	0.0006	0.07	0.91	0.0004	0.16	2.68	0.0011	0.09	0.13	1.81	0.0007	0.10	1.47	0.0005	0.04	0.69	0.0003	0.06
1	0.08	1.04	0.0004	0.05	0.68	0.0003	0.11	1.97	0.0006	0.07	0.07	0.93	0.0004	0.09	1.19	0.0004	0.02	0.44	0.0002	0.06
2	0.07	0.91	0.0004	0.04	0.60	0.0003	0.12	1.88	0.0006	0.06	0.06	0.82	0.0003	0.08	1.02	0.0004	0.02	0.31	0.0002	0.05
3	0.08	0.95	0.0004	0.04	0.62	0.0003	0.10	1.59	0.0005	0.05	0.06	0.84	0.0003	0.07	1.01	0.0004	0.02	0.31	0.0002	0.05
4	0.12	1.32	0.0005	0.06	0.80	0.0004	0.10	1.65	0.0005	0.06	0.08	1.04	0.0004	0.10	1.39	0.0005	0.03	0.45	0.0002	0.06
5	0.19	2.13	0.0010	0.11	1.35	0.0007	0.14	2.16	0.0007	0.11	0.12	1.58	0.0007	0.18	2.68	0.0010	0.06	0.88	0.0004	0.12
6	0.27	4.28	0.0016	0.17	2.54	0.0010	0.21	3.35	0.0013	0.16	0.20	3.40	0.0012	0.36	6.47	0.0021	0.11	1.82	0.0008	0.22
7	0.37	5.82	0.0022	0.26	3.73	0.0016	0.33	6.03	0.0019	0.23	0.31	4.34	0.0017	0.55	8.01	0.0030	0.15	2.95	0.0013	0.34
8	0.39	5.46	0.0021	0.23	3.42	0.0014	0.36	6.00	0.0020	0.24	0.29	3.80	0.0016	0.52	7.23	0.0027	0.14	2.34	0.0010	0.32
9	0.39	5.17	0.0021	0.22	3.24	0.0014	0.36	5.67	0.0020	0.24	0.27	3.52	0.0015	0.51	6.75	0.0026	0.13	2.13	0.0010	0.31
10	0.38	4.98	0.0020	0.22	3.13	0.0013	0.36	5.48	0.0019	0.23	0.27	3.36	0.0015	0.50	6.44	0.0025	0.13	2.05	0.0009	0.30
11	0.38	4.90	0.0020	0.21	3.07	0.0013	0.37	5.37	0.0019	0.23	0.27	3.27	0.0014	0.49	6.29	0.0025	0.13	2.01	0.0009	0.30
12	0.39	4.87	0.0020	0.21	3.04	0.0013	0.37	5.30	0.0019	0.23	0.27	3.23	0.0014	0.49	6.22	0.0025	0.13	1.97	0.0009	0.30
13	0.38	4.87	0.0020	0.21	3.05	0.0013	0.38	5.67	0.0020	0.23	0.27	3.26	0.0014	0.49	6.27	0.0025	0.12	1.95	0.0009	0.30
14	0.36	4.88	0.0019	0.19	3.09	0.0012	0.39	6.40	0.0021	0.23	0.27	3.38	0.0015	0.50	6.51	0.0025	0.12	1.94	0.0009	0.31
15	0.35	4.99	0.0018	0.19	3.49	0.0012	0.41	7.55	0.0023	0.23	0.28	3.77	0.0016	0.53	7.32	0.0027	0.12	1.94	0.0008	0.32
16	0.34	5.12	0.0019	0.20	4.29	0.0013	0.44	8.68	0.0026	0.25	0.30	4.27	0.0017	0.57	8.26	0.0031	0.12	1.94	0.0008	0.35
17	0.31	4.35	0.0017	0.18	3.03	0.0011	0.33	6.82	0.0019	0.19	0.24	3.42	0.0014	0.45	6.76	0.0024	0.10	1.46	0.0006	0.28
18	0.29	3.78	0.0015	0.16	2.54	0.0010	0.28	5.52	0.0016	0.17	0.21	2.80	0.0012	0.38	5.40	0.0020	0.09	1.28	0.0006	0.23
19	0.28	3.59	0.0015	0.16	2.34	0.0010	0.26	4.84	0.0015	0.16	0.19	2.58	0.0011	0.34	4.87	0.0018	0.08	1.22	0.0005	0.21
20	0.27	3.49	0.0015	0.15	2.25	0.0009	0.24	4.49	0.0014	0.16	0.18	2.47	0.0010	0.32	4.61	0.0017	0.08	1.18	0.0005	0.20
21	0.27	3.38	0.0014	0.15	2.16	0.0009	0.23	4.18	0.0013	0.15	0.17	2.36	0.0010	0.31	4.43	0.0016	0.07	1.14	0.0005	0.19
22	0.23	2.57	0.0011	0.12	1.49	0.0007	0.21	3.60	0.0012	0.14	0.15	2.06	0.0008	0.20	2.97	0.0010	0.05	0.90	0.0003	0.12
23	0.13	1.64	0.0007	0.07	1.06	0.0005	0.17	2.64	0.0011	0.11	0.14	1.95	0.0008	0.13	1.78	0.0007	0.03	0.66	0.0002	0.08

Table 9.10. Summary of route average NO_2, M4 to M5 direction [2023 Do something, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		1A	1B	1C	1D	1E	1J	1K	1L	1N	1P	1Q	1V	1Y	1Z	1AB	1AC
Enter at		M4 portal	M4 portal	M4 portal	M4 portal	M4 portal	Concord Rd	Concord Rd	Concord Rd	Wattle St	Wattle St	Wattle St	St Peters	Iron Cove Link	Iron Cove Link	City West Link	City West Link
Exit at		Wattle St	Parramatta Rd	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	M5 portal	St Peters	M5 portal	St Peters	M5 portal
Distance		5.4 km	5.5 km	9.9 km	12.5 km	21.7 km	8.9 km	11.5 km	20.7 km	4.6 km	7.2 km	16.4 km	9.1 km	6.4 km	15.7 km	5.1 km	14.4 km
Design Case	0	0.02	0.02	0.05	0.06	0.08	0.06	0.06	0.08	0.07	0.06	0.09	0.09	0.05	0.08	0.06	0.09
	1	0.02	0.02	0.04	0.04	0.06	0.04	0.04	0.06	0.04	0.04	0.06	0.07	0.03	0.06	0.04	0.06
	2	0.01	0.01	0.03	0.03	0.05	0.03	0.03	0.05	0.04	0.04	0.06	0.06	0.03	0.05	0.03	0.06
	3	0.02	0.02	0.03	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.03	0.05	0.04	0.05
	4	0.02	0.02	0.05	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.06	0.06	0.06
	5	0.04	0.04	0.09	0.10	0.09	0.10	0.10	0.10	0.11	0.11	0.09	0.07	0.08	0.08	0.10	0.09
	6	0.06	0.06	0.13	0.13	0.14	0.14	0.14	0.14	0.16	0.15	0.15	0.12	0.11	0.13	0.13	0.14
	7	0.09	0.09	0.18	0.19	0.21	0.19	0.20	0.22	0.21	0.21	0.23	0.21	0.16	0.21	0.19	0.23
	8	0.08	0.09	0.17	0.19	0.22	0.19	0.20	0.23	0.21	0.22	0.24	0.22	0.16	0.21	0.20	0.23
	9	0.08	0.08	0.17	0.19	0.21	0.18	0.20	0.22	0.21	0.22	0.24	0.21	0.16	0.21	0.20	0.23
	10	0.08	0.08	0.17	0.19	0.21	0.18	0.20	0.22	0.20	0.21	0.23	0.21	0.16	0.21	0.20	0.23
	11	0.08	0.08	0.17	0.19	0.21	0.18	0.20	0.22	0.21	0.22	0.23	0.21	0.16	0.21	0.20	0.23
	12	0.08	0.08	0.17	0.19	0.21	0.18	0.20	0.22	0.21	0.22	0.23	0.21	0.16	0.21	0.20	0.23
	13	0.08	0.08	0.16	0.18	0.21	0.18	0.20	0.22	0.20	0.21	0.23	0.21	0.16	0.21	0.20	0.23
	14	0.07	0.07	0.15	0.17	0.20	0.16	0.18	0.21	0.18	0.20	0.23	0.21	0.15	0.21	0.18	0.22
	15	0.07	0.07	0.14	0.16	0.20	0.15	0.17	0.21	0.17	0.19	0.23	0.23	0.14	0.21	0.17	0.23
	16	0.07	0.07	0.14	0.16	0.21	0.15	0.17	0.22	0.17	0.18	0.24	0.25	0.14	0.22	0.17	0.24
	17	0.06	0.07	0.13	0.15	0.17	0.14	0.16	0.18	0.16	0.17	0.19	0.18	0.13	0.18	0.16	0.19
	18	0.06	0.06	0.12	0.14	0.16	0.14	0.15	0.16	0.15	0.16	0.17	0.16	0.12	0.16	0.15	0.17
	19	0.06	0.06	0.12	0.14	0.15	0.13	0.15	0.16	0.15	0.16	0.16	0.14	0.12	0.15	0.14	0.16
	20	0.06	0.06	0.12	0.13	0.15	0.13	0.14	0.15	0.15	0.15	0.16	0.14	0.11	0.14	0.14	0.15
	21	0.06	0.06	0.12	0.13	0.14	0.13	0.14	0.15	0.15	0.15	0.15	0.13	0.11	0.14	0.14	0.15
	22	0.05	0.05	0.10	0.11	0.13	0.11	0.12	0.13	0.12	0.13	0.14	0.12	0.10	0.12	0.12	0.14
	23	0.03	0.03	0.06	0.07	0.09	0.06	0.07	0.09	0.07	0.07	0.10	0.11	0.05	0.09	0.07	0.10

Table 9.11. Summary of route average NO_2, M5 to M4 direction [2023 Do something, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		2A	2C	2D	2E	2M	2N	2P	2Q	2R	2S	2T	2U	2V	2X	2Y	2AC
Enter at		M5 portal	M5 portal	M5 portal	M5 portal	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	Wattle St	M5 portal	St Peters
Exit at		St Peters	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 Portal	Concord Rd	M4 portal	Concord Rd	M4 portal	Iron Cove Link	Iron Cove Link
Distance		9.2 km	16.4 km	20.6 km	21.7 km	7.1 km	11.3 km	12.5 km	4.7 km	8.9 km	10 km	4.4 km	5.5 km	4.4 km	5.6 km	15.6 km	6.4 km
Hour	0	0.01	0.02	0.03	0.04	0.03	0.04	0.05	0.03	0.04	0.05	0.04	0.06	0.04	0.06	0.02	0.03
	1	0.01	0.02	0.03	0.03	0.03	0.04	0.04	0.02	0.03	0.04	0.04	0.06	0.03	0.05	0.02	0.03
	2	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.02	0.03	0.04	0.03	0.05	0.03	0.04	0.02	0.02
	3	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.02	0.03	0.04	0.03	0.05	0.03	0.04	0.02	0.02
	4	0.01	0.02	0.03	0.04	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.06	0.04	0.06	0.02	0.03
	5	0.02	0.04	0.05	0.06	0.06	0.07	0.09	0.04	0.07	0.09	0.08	0.12	0.07	0.11	0.04	0.05
	6	0.04	0.07	0.09	0.12	0.10	0.13	0.16	0.07	0.13	0.17	0.15	0.22	0.13	0.21	0.07	0.09
	7	0.07	0.12	0.15	0.18	0.16	0.21	0.26	0.10	0.19	0.26	0.23	0.34	0.20	0.31	0.11	0.14
	8	0.06	0.10	0.14	0.17	0.14	0.19	0.24	0.10	0.18	0.24	0.22	0.32	0.19	0.30	0.09	0.13
	9	0.05	0.09	0.13	0.16	0.13	0.18	0.23	0.09	0.17	0.23	0.21	0.31	0.18	0.29	0.09	0.12
	10	0.05	0.09	0.12	0.15	0.13	0.18	0.22	0.09	0.17	0.23	0.21	0.30	0.18	0.28	0.08	0.12
	11	0.05	0.09	0.12	0.15	0.13	0.18	0.22	0.09	0.17	0.23	0.20	0.30	0.18	0.28	0.08	0.12
	12	0.05	0.09	0.12	0.15	0.13	0.17	0.22	0.09	0.17	0.22	0.20	0.30	0.18	0.28	0.08	0.12
	13	0.05	0.09	0.12	0.15	0.13	0.17	0.22	0.09	0.17	0.23	0.20	0.30	0.18	0.28	0.08	0.12
	14	0.05	0.09	0.12	0.15	0.13	0.18	0.22	0.09	0.17	0.23	0.21	0.31	0.18	0.29	0.08	0.12
	15	0.05	0.09	0.13	0.16	0.13	0.18	0.23	0.09	0.18	0.24	0.22	0.32	0.19	0.30	0.08	0.12
	16	0.05	0.09	0.13	0.16	0.13	0.20	0.25	0.10	0.19	0.26	0.24	0.35	0.21	0.33	0.08	0.12
	17	0.04	0.07	0.11	0.13	0.11	0.16	0.20	0.08	0.15	0.21	0.19	0.28	0.17	0.26	0.07	0.10
	18	0.03	0.06	0.09	0.11	0.09	0.13	0.17	0.07	0.13	0.17	0.16	0.23	0.14	0.21	0.06	0.09
	19	0.03	0.06	0.08	0.10	0.09	0.12	0.15	0.06	0.12	0.16	0.14	0.21	0.12	0.19	0.05	0.08
	20	0.03	0.06	0.08	0.10	0.08	0.12	0.15	0.06	0.11	0.15	0.13	0.20	0.12	0.18	0.05	0.08
	21	0.03	0.05	0.07	0.09	0.08	0.11	0.14	0.06	0.10	0.14	0.13	0.19	0.11	0.17	0.05	0.07
	22	0.02	0.03	0.05	0.06	0.05	0.07	0.09	0.04	0.07	0.09	0.08	0.12	0.07	0.11	0.03	0.05
	23	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.03	0.05	0.06	0.05	0.08	0.04	0.07	0.02	0.03

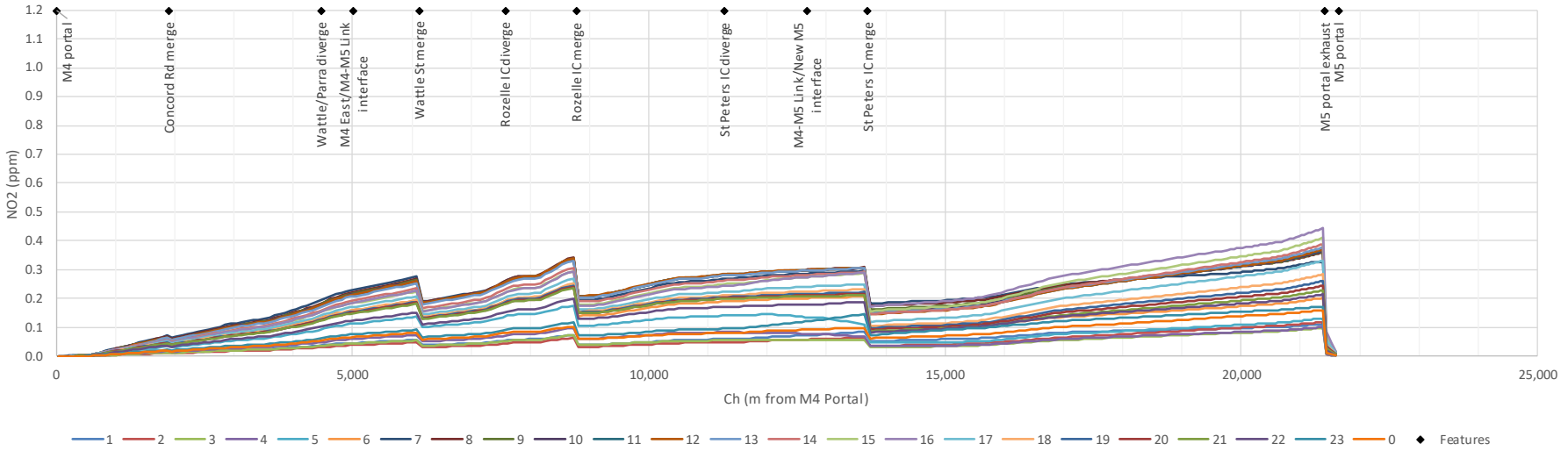


Figure 9.43 In-Tunnel NO_2 levels along route 1E from M4 portal to M5 portal [2023 Do something, expected traffic]

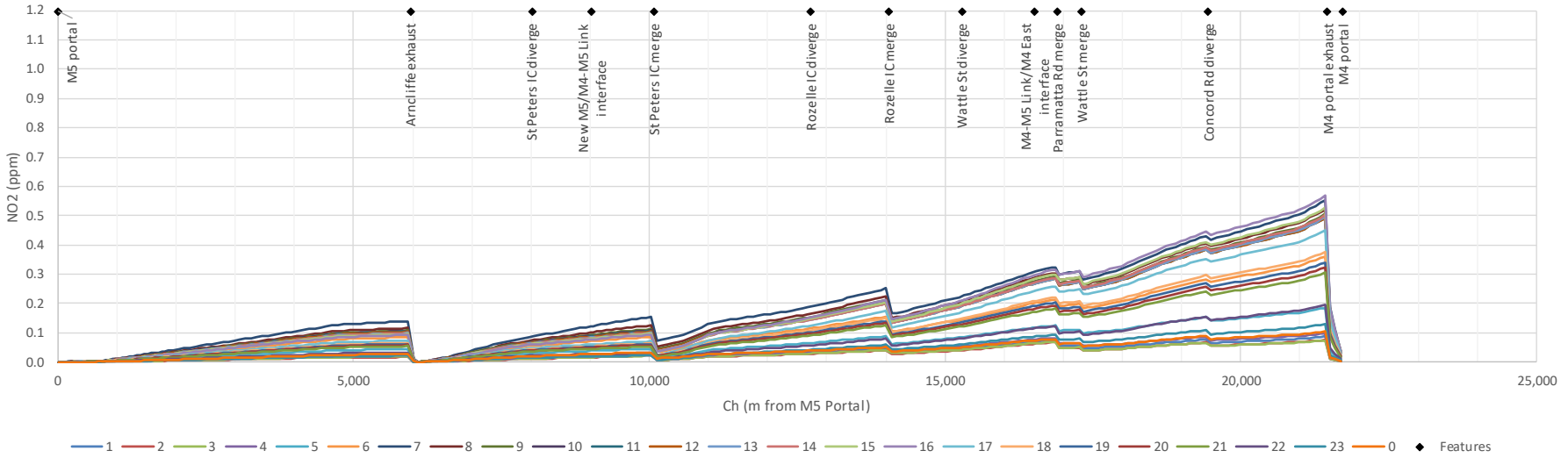


Figure 9.44. In-Tunnel NO_2 levels along route 2E from M5 portal to M4 portal [2023 Do something, expected traffic]

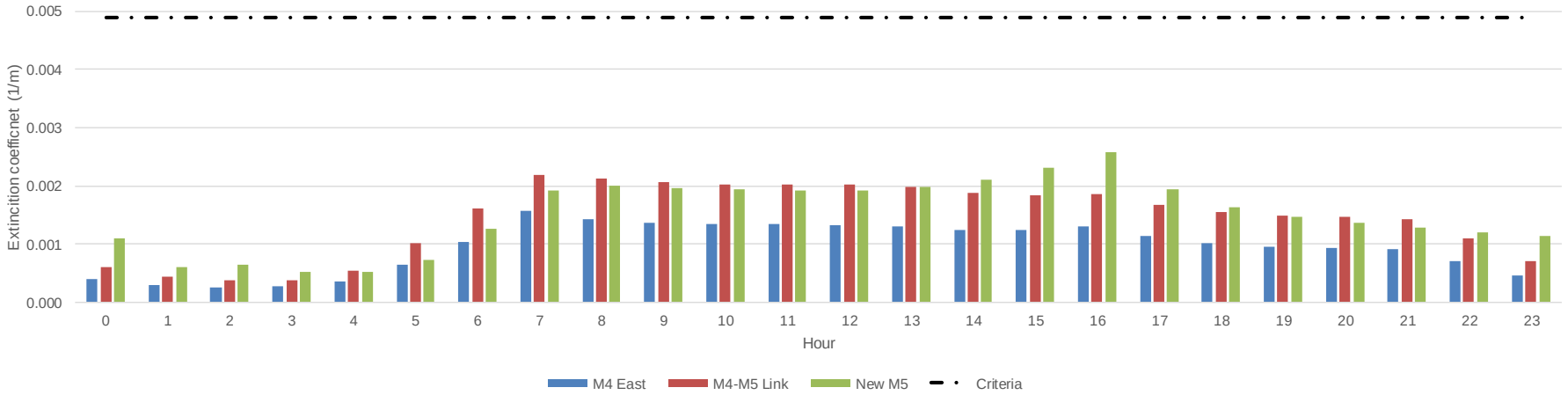


Figure 9.45. Maximum In-Tunnel visibility for M4 to M5 direction [2023 Do something, expected traffic]

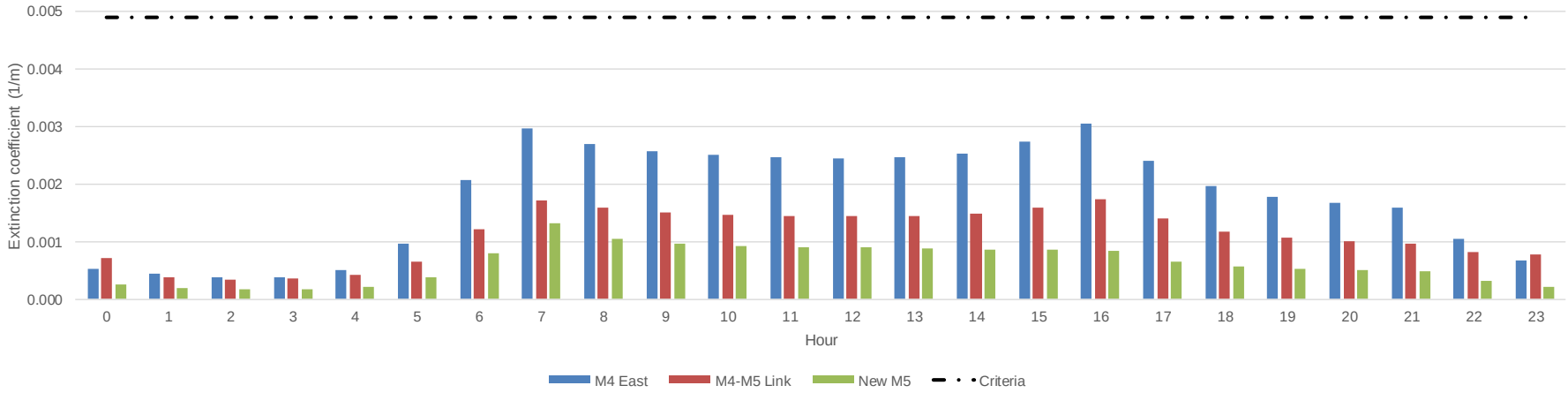


Figure 9.46. Maximum In-Tunnel visibility for M5 to M4 direction [2023 Do something, expected traffic]

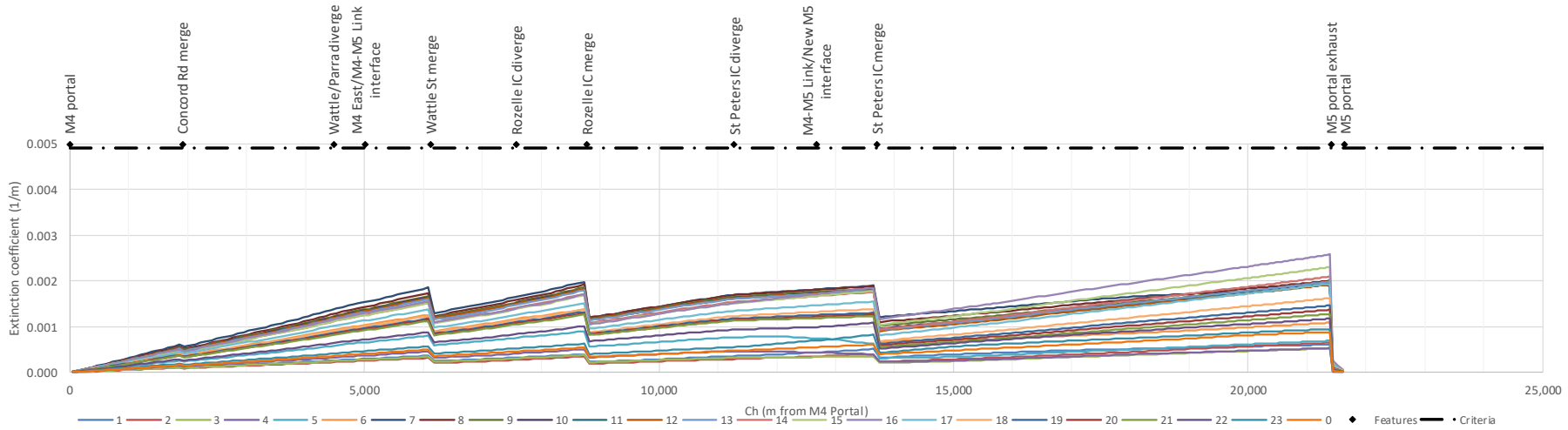


Figure 9.47. In-Tunnel visibility along route 1E from M4 portal to M5 portal [2023 Do something, expected traffic]

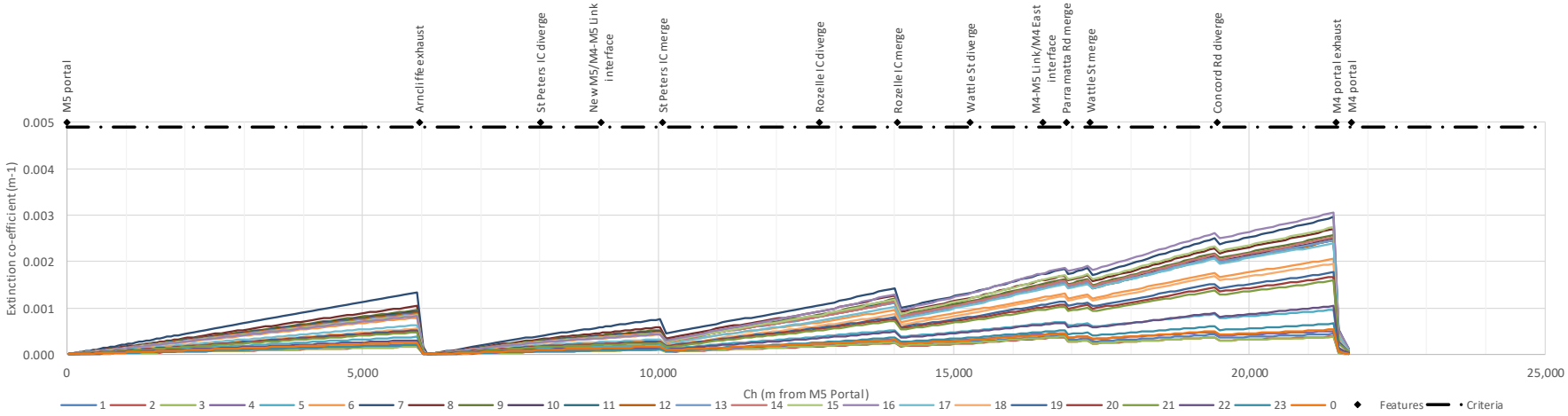


Figure 9.48. In-Tunnel visibility along route 2E from M5 portal to M4 portal [2023 Do something, expected traffic]

Table 9.12. Outlet emissions summary [2023 Do something, expected traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	276	0.12	0.21	0.01	0.00	0.01	464	0.46	0.67	0.03	0.01	0.04	157	0.03	0.07	0.00	0.00	0.00
1	276	0.08	0.15	0.01	0.00	0.01	432	0.35	0.49	0.02	0.01	0.03	156	0.02	0.04	0.00	0.00	0.00
2	276	0.07	0.13	0.01	0.00	0.01	410	0.28	0.40	0.02	0.01	0.03	155	0.01	0.03	0.00	0.00	0.00
3	276	0.07	0.14	0.01	0.00	0.01	410	0.28	0.39	0.02	0.01	0.02	155	0.01	0.03	0.00	0.00	0.00
4	276	0.11	0.18	0.01	0.00	0.01	458	0.42	0.62	0.03	0.01	0.04	156	0.02	0.04	0.00	0.00	0.00
5	276	0.22	0.32	0.02	0.00	0.02	591	1.07	1.65	0.08	0.02	0.10	186	0.08	0.12	0.00	0.00	0.01
6	321	0.43	0.75	0.04	0.01	0.04	841	2.93	6.07	0.27	0.06	0.33	276	0.25	0.46	0.01	0.00	0.02
7	358	0.83	1.35	0.07	0.02	0.08	921	5.29	8.28	0.41	0.11	0.52	325	0.42	0.93	0.03	0.01	0.03
8	358	0.71	1.26	0.06	0.01	0.07	917	5.06	7.39	0.36	0.11	0.47	308	0.36	0.69	0.02	0.01	0.03
9	352	0.67	1.18	0.05	0.01	0.07	902	4.89	6.78	0.34	0.10	0.44	304	0.35	0.62	0.02	0.01	0.03
10	348	0.64	1.13	0.05	0.01	0.07	893	4.79	6.40	0.32	0.10	0.42	307	0.36	0.60	0.02	0.01	0.03
11	344	0.63	1.10	0.05	0.01	0.06	888	4.74	6.20	0.31	0.10	0.41	306	0.35	0.59	0.02	0.01	0.02
12	340	0.61	1.08	0.05	0.01	0.06	887	4.75	6.13	0.31	0.10	0.41	305	0.35	0.57	0.02	0.01	0.02
13	340	0.58	1.08	0.05	0.01	0.06	888	4.77	6.18	0.31	0.10	0.41	299	0.33	0.55	0.02	0.01	0.02
14	346	0.53	1.12	0.05	0.01	0.06	894	4.84	6.45	0.33	0.10	0.43	293	0.32	0.54	0.02	0.01	0.02
15	367	0.56	1.30	0.06	0.01	0.07	914	5.08	7.44	0.37	0.11	0.47	285	0.29	0.52	0.02	0.01	0.02
16	396	0.63	1.59	0.07	0.01	0.08	915	5.37	8.40	0.42	0.11	0.53	274	0.27	0.49	0.01	0.01	0.02
17	361	0.50	1.15	0.05	0.01	0.06	875	4.04	6.56	0.31	0.08	0.40	244	0.20	0.31	0.01	0.00	0.01
18	328	0.40	0.81	0.04	0.01	0.04	813	3.19	4.85	0.23	0.07	0.30	227	0.16	0.24	0.01	0.00	0.01
19	315	0.37	0.69	0.03	0.01	0.04	781	2.77	4.18	0.20	0.06	0.26	220	0.14	0.22	0.01	0.00	0.01
20	309	0.35	0.64	0.03	0.01	0.04	763	2.56	3.85	0.18	0.05	0.24	214	0.13	0.20	0.01	0.00	0.01
21	304	0.34	0.60	0.03	0.01	0.03	748	2.35	3.62	0.17	0.05	0.22	213	0.12	0.19	0.01	0.00	0.01
22	276	0.24	0.35	0.02	0.01	0.02	637	1.25	2.04	0.09	0.03	0.12	177	0.05	0.11	0.00	0.00	0.00
23	276	0.14	0.25	0.01	0.00	0.01	509	0.65	0.92	0.04	0.01	0.06	148	0.02	0.06	0.00	0.00	0.00

Table 9.12. Outlet emissions summary [2023 Do something, expected traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	200	0.05	0.09	0.01	0.00	0.01	275	0.36	0.67	0.03	0.01	0.04	183	0.07	0.13	0.01	0.00	0.01
1	165	0.03	0.05	0.00	0.00	0.01	245	0.20	0.41	0.02	0.00	0.02	171	0.06	0.10	0.01	0.00	0.01
2	144	0.02	0.04	0.00	0.00	0.00	226	0.21	0.35	0.02	0.00	0.02	164	0.05	0.08	0.00	0.00	0.01
3	147	0.02	0.04	0.00	0.00	0.00	226	0.17	0.30	0.01	0.00	0.02	165	0.05	0.09	0.00	0.00	0.01
4	171	0.03	0.06	0.01	0.00	0.01	235	0.19	0.33	0.01	0.00	0.02	177	0.07	0.13	0.01	0.00	0.01
5	247	0.11	0.15	0.01	0.00	0.02	278	0.31	0.55	0.02	0.01	0.03	209	0.15	0.27	0.01	0.00	0.02
6	401	0.33	0.61	0.05	0.01	0.06	337	0.61	1.11	0.05	0.01	0.06	294	0.41	0.98	0.04	0.01	0.05
7	518	0.71	1.31	0.12	0.02	0.14	411	1.18	2.46	0.11	0.02	0.13	322	0.71	1.35	0.06	0.01	0.08
8	469	0.55	0.91	0.08	0.01	0.10	419	1.40	2.57	0.12	0.03	0.15	311	0.65	1.16	0.06	0.01	0.07
9	445	0.49	0.78	0.07	0.01	0.08	427	1.48	2.49	0.12	0.03	0.15	302	0.60	1.04	0.05	0.01	0.06
10	436	0.47	0.72	0.07	0.01	0.08	434	1.54	2.46	0.12	0.03	0.15	296	0.58	0.97	0.05	0.01	0.06
11	431	0.46	0.70	0.07	0.01	0.08	440	1.60	2.45	0.12	0.03	0.15	293	0.56	0.93	0.05	0.01	0.06
12	428	0.46	0.68	0.06	0.01	0.08	442	1.63	2.44	0.12	0.03	0.15	290	0.56	0.91	0.05	0.01	0.06
13	421	0.43	0.66	0.06	0.01	0.07	454	1.69	2.69	0.13	0.04	0.16	292	0.56	0.93	0.05	0.01	0.06
14	419	0.42	0.65	0.06	0.01	0.07	479	1.81	3.25	0.15	0.04	0.18	298	0.58	0.99	0.05	0.01	0.06
15	415	0.40	0.64	0.06	0.01	0.07	514	2.00	4.17	0.18	0.04	0.22	309	0.62	1.14	0.06	0.01	0.07
16	410	0.38	0.62	0.06	0.01	0.07	546	2.24	5.13	0.22	0.04	0.26	322	0.67	1.33	0.06	0.01	0.08
17	347	0.26	0.38	0.04	0.01	0.04	478	1.41	3.47	0.14	0.03	0.17	297	0.50	0.97	0.05	0.01	0.06
18	320	0.21	0.30	0.03	0.01	0.03	431	1.10	2.49	0.10	0.02	0.12	277	0.40	0.75	0.04	0.01	0.04
19	309	0.19	0.27	0.03	0.00	0.03	401	0.94	1.99	0.08	0.02	0.10	268	0.36	0.66	0.03	0.01	0.04
20	301	0.18	0.25	0.02	0.00	0.03	385	0.84	1.76	0.07	0.02	0.09	262	0.33	0.61	0.03	0.01	0.04
21	290	0.15	0.23	0.02	0.00	0.03	370	0.75	1.55	0.07	0.02	0.08	256	0.30	0.57	0.03	0.01	0.03
22	222	0.06	0.12	0.01	0.00	0.01	329	0.62	1.15	0.05	0.01	0.06	201	0.14	0.25	0.01	0.00	0.02
23	173	0.03	0.06	0.01	0.00	0.01	264	0.38	0.62	0.03	0.01	0.04	182	0.09	0.15	0.01	0.00	0.01

Table 9.12. Outlet emissions summary [2023 Do something, expected traffic], continued

Outlet identifier:	H						I						J					
EIS name:	Rozelle North (WHT)						Rozelle Mid (M4-M5 Link/ICL)						Rozelle South (M4-M5 Link/ICL)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	623	0.35	0.53	0.03	0.01	0.03
1	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	541	0.18	0.33	0.02	0.00	0.02
2	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	500	0.13	0.26	0.01	0.00	0.01
3	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	497	0.13	0.26	0.01	0.00	0.01
4	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	558	0.21	0.42	0.02	0.00	0.02
5	-	-	-	-	-	-	838	0.90	1.34	0.07	0.02	0.09	0	0.00	0.00	0.00	0.00	0.00
6	-	-	-	-	-	-	1,114	1.77	3.70	0.17	0.04	0.20	0	0.00	0.00	0.00	0.00	0.00
7	-	-	-	-	-	-	1,140	2.53	4.97	0.25	0.05	0.30	0	0.00	0.00	0.00	0.00	0.00
8	-	-	-	-	-	-	1,130	2.41	4.33	0.22	0.05	0.27	0	0.00	0.00	0.00	0.00	0.00
9	-	-	-	-	-	-	1,124	2.34	4.04	0.20	0.05	0.25	0	0.00	0.00	0.00	0.00	0.00
10	-	-	-	-	-	-	1,128	2.34	3.92	0.20	0.05	0.25	0	0.00	0.00	0.00	0.00	0.00
11	-	-	-	-	-	-	1,130	2.34	3.87	0.20	0.05	0.24	0	0.00	0.00	0.00	0.00	0.00
12	-	-	-	-	-	-	1,134	2.36	3.85	0.19	0.05	0.24	0	0.00	0.00	0.00	0.00	0.00
13	-	-	-	-	-	-	1,120	2.23	3.75	0.19	0.05	0.23	0	0.00	0.00	0.00	0.00	0.00
14	-	-	-	-	-	-	1,097	2.00	3.63	0.18	0.04	0.22	0	0.00	0.00	0.00	0.00	0.00
15	-	-	-	-	-	-	1,073	1.82	3.63	0.17	0.04	0.21	0	0.00	0.00	0.00	0.00	0.00
16	-	-	-	-	-	-	1,059	1.76	3.70	0.18	0.04	0.21	0	0.00	0.00	0.00	0.00	0.00
17	-	-	-	-	-	-	1,038	1.63	3.12	0.15	0.03	0.19	0	0.00	0.00	0.00	0.00	0.00
18	-	-	-	-	-	-	1,035	1.56	2.75	0.13	0.03	0.17	0	0.00	0.00	0.00	0.00	0.00
19	-	-	-	-	-	-	1,031	1.53	2.62	0.13	0.03	0.16	0	0.00	0.00	0.00	0.00	0.00
20	-	-	-	-	-	-	1,028	1.50	2.56	0.12	0.03	0.16	0	0.00	0.00	0.00	0.00	0.00
21	-	-	-	-	-	-	1,009	1.41	2.46	0.12	0.03	0.15	0	0.00	0.00	0.00	0.00	0.00
22	-	-	-	-	-	-	837	0.91	1.26	0.06	0.02	0.08	0	0.00	0.00	0.00	0.00	0.00
23	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	671	0.42	0.68	0.03	0.01	0.04

Table 9.12. Outlet emissions summary [2023 Do something, expected traffic], continued

Outlet identifier:	K						L						M						N					
EIS name:	SPI (M4-M5 Link)						Iron Cove Link (north)						Arncliffe (F6 Extension)						Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	266	0.23	0.30	0.02	0.00	0.02	295	0.11	0.26	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
1	247	0.16	0.20	0.01	0.00	0.01	258	0.08	0.18	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
2	248	0.13	0.17	0.01	0.00	0.01	242	0.06	0.14	0.00	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
3	269	0.17	0.21	0.01	0.00	0.01	242	0.06	0.15	0.00	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
4	319	0.33	0.36	0.02	0.01	0.03	267	0.07	0.23	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
5	395	0.71	0.74	0.04	0.02	0.06	345	0.14	0.53	0.01	0.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-
6	519	1.29	1.88	0.10	0.03	0.12	408	0.26	0.95	0.02	0.01	0.03	-	-	-	-	-	-	-	-	-	-	-	-
7	644	2.30	3.88	0.19	0.05	0.24	455	0.44	1.34	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
8	635	2.46	3.57	0.18	0.05	0.23	470	0.47	1.31	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
9	626	2.45	3.33	0.17	0.05	0.22	485	0.55	1.32	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
10	620	2.43	3.18	0.17	0.05	0.22	494	0.59	1.33	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
11	618	2.43	3.11	0.16	0.05	0.21	499	0.62	1.34	0.04	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
12	619	2.47	3.10	0.16	0.05	0.22	502	0.65	1.34	0.04	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
13	613	2.40	3.07	0.16	0.05	0.21	502	0.65	1.35	0.04	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
14	598	2.16	2.99	0.15	0.05	0.20	503	0.65	1.39	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
15	577	1.95	2.93	0.15	0.04	0.19	504	0.63	1.51	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
16	557	1.81	2.88	0.14	0.04	0.18	507	0.63	1.69	0.06	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
17	543	1.62	2.37	0.12	0.03	0.15	499	0.57	1.39	0.04	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
18	521	1.47	1.96	0.10	0.03	0.13	486	0.52	1.20	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
19	508	1.39	1.77	0.09	0.03	0.12	476	0.48	1.10	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
20	503	1.36	1.68	0.09	0.03	0.12	466	0.44	1.03	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
21	501	1.34	1.63	0.09	0.03	0.12	457	0.40	0.97	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
22	441	0.99	1.09	0.06	0.02	0.08	405	0.27	0.68	0.02	0.01	0.02	-	-	-	-	-	-	-	-	-	-	-	-
23	318	0.37	0.45	0.03	0.01	0.03	313	0.14	0.32	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-

9.2.2 2023 regulatory demand traffic operations

Table 9.13. In-Tunnel estimated air quality maximum [2023 Do something, regulatory traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.12	1.45	0.0006	0.07	0.94	0.0004	0.16	2.75	0.0011	0.09	0.14	1.98	0.0008	0.12	1.68	0.0006	0.04	0.81	0.0003	0.07
1	0.09	1.09	0.0005	0.05	0.70	0.0003	0.11	2.02	0.0006	0.07	0.07	1.02	0.0004	0.10	1.39	0.0005	0.03	0.51	0.0002	0.06
2	0.07	0.93	0.0004	0.04	0.62	0.0003	0.12	1.94	0.0007	0.06	0.07	0.89	0.0004	0.09	1.18	0.0004	0.02	0.37	0.0002	0.05
3	0.08	0.99	0.0004	0.04	0.64	0.0003	0.10	1.67	0.0006	0.05	0.07	0.92	0.0004	0.09	1.18	0.0004	0.02	0.35	0.0002	0.05
4	0.12	1.38	0.0006	0.06	0.83	0.0004	0.11	1.70	0.0006	0.07	0.08	1.14	0.0005	0.12	1.62	0.0006	0.03	0.52	0.0002	0.07
5	0.20	2.20	0.0010	0.12	1.41	0.0007	0.15	2.24	0.0008	0.12	0.13	1.77	0.0007	0.21	3.06	0.0011	0.07	0.97	0.0004	0.13
6	0.27	4.41	0.0017	0.17	2.63	0.0011	0.21	3.47	0.0013	0.16	0.23	3.82	0.0014	0.41	7.27	0.0024	0.12	2.03	0.0009	0.25
7	0.38	5.98	0.0023	0.28	3.93	0.0017	0.35	6.35	0.0020	0.24	0.36	4.97	0.0020	0.73	9.49	0.0037	0.17	3.29	0.0015	0.45
8	0.40	5.60	0.0022	0.24	3.54	0.0015	0.37	6.18	0.0021	0.25	0.33	4.29	0.0018	0.62	8.18	0.0032	0.15	2.61	0.0012	0.38
9	0.40	5.31	0.0021	0.23	3.35	0.0014	0.37	5.83	0.0020	0.24	0.31	3.95	0.0017	0.59	7.60	0.0030	0.15	2.38	0.0011	0.36
10	0.40	5.13	0.0021	0.23	3.24	0.0014	0.38	5.64	0.0020	0.24	0.31	3.77	0.0017	0.57	7.27	0.0029	0.14	2.29	0.0010	0.35
11	0.40	5.05	0.0021	0.22	3.18	0.0014	0.38	5.54	0.0020	0.24	0.30	3.68	0.0016	0.57	7.10	0.0028	0.14	2.24	0.0010	0.34
12	0.40	5.02	0.0021	0.22	3.15	0.0014	0.38	5.46	0.0020	0.24	0.30	3.63	0.0016	0.57	7.02	0.0028	0.14	2.20	0.0010	0.34
13	0.40	5.02	0.0020	0.22	3.16	0.0014	0.39	5.85	0.0020	0.24	0.30	3.67	0.0016	0.57	7.08	0.0028	0.14	2.17	0.0010	0.35
14	0.37	5.03	0.0020	0.20	3.19	0.0013	0.40	6.59	0.0021	0.23	0.31	3.80	0.0017	0.58	7.33	0.0029	0.14	2.16	0.0010	0.35
15	0.36	5.14	0.0019	0.20	3.68	0.0013	0.42	7.78	0.0024	0.24	0.32	4.26	0.0018	0.63	8.28	0.0033	0.13	2.16	0.0010	0.38
16	0.35	5.26	0.0019	0.20	4.52	0.0014	0.46	8.89	0.0027	0.26	0.35	4.79	0.0021	0.72	9.52	0.0037	0.13	2.15	0.0009	0.44
17	0.32	4.48	0.0017	0.18	3.14	0.0012	0.34	6.92	0.0020	0.20	0.27	3.84	0.0016	0.52	7.62	0.0028	0.11	1.62	0.0007	0.32
18	0.30	3.90	0.0016	0.17	2.63	0.0010	0.29	5.69	0.0017	0.18	0.23	3.16	0.0013	0.43	6.13	0.0022	0.10	1.41	0.0006	0.26
19	0.29	3.70	0.0015	0.16	2.42	0.0010	0.27	4.95	0.0015	0.17	0.21	2.91	0.0012	0.39	5.53	0.0020	0.09	1.35	0.0006	0.24
20	0.28	3.61	0.0015	0.16	2.33	0.0010	0.25	4.63	0.0014	0.16	0.20	2.78	0.0011	0.37	5.24	0.0019	0.09	1.30	0.0006	0.22
21	0.28	3.49	0.0015	0.15	2.23	0.0009	0.24	4.31	0.0013	0.16	0.19	2.65	0.0011	0.35	5.03	0.0018	0.08	1.25	0.0005	0.21
22	0.24	2.65	0.0011	0.13	1.55	0.0007	0.22	3.69	0.0012	0.14	0.16	2.27	0.0009	0.22	3.35	0.0012	0.05	0.99	0.0003	0.13
23	0.13	1.67	0.0007	0.08	1.10	0.0005	0.18	2.71	0.0012	0.11	0.15	2.13	0.0009	0.15	2.02	0.0008	0.04	0.73	0.0002	0.09

Table 9.14. Summary of route average NO_2, M4 to M5 direction [2023 Do something, regulatory traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		1A	1B	1C	1D	1E	1J	1K	1L	1N	1P	1Q	1V	1Y	1Z	1AB	1AC
Enter at		M4 portal	M4 portal	M4 portal	M4 portal	M4 portal	Concord Rd	Concord Rd	Concord Rd	Wattle St	Wattle St	Wattle St	St Peters	Iron Cove Link	Iron Cove Link	City West Link	City West Link
Exit at		Wattle St	Parramatta Rd	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	M5 portal	St Peters	M5 portal	St Peters	M5 portal
Distance		5.4 km	5.5 km	9.9 km	12.5 km	21.7 km	8.9 km	11.5 km	20.7 km	4.6 km	7.2 km	16.4 km	9.1 km	6.4 km	15.7 km	5.1 km	14.4 km
Design Case	0	0.02	0.02	0.05	0.06	0.08	0.06	0.06	0.08	0.07	0.06	0.09	0.09	0.05	0.08	0.06	0.09
	1	0.02	0.02	0.04	0.04	0.06	0.04	0.04	0.06	0.04	0.05	0.07	0.07	0.03	0.06	0.04	0.07
	2	0.01	0.01	0.03	0.03	0.05	0.03	0.04	0.05	0.04	0.04	0.06	0.06	0.03	0.05	0.03	0.06
	3	0.02	0.02	0.03	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.03	0.05	0.04	0.05
	4	0.02	0.02	0.05	0.06	0.06	0.05	0.06	0.06	0.06	0.07	0.06	0.06	0.05	0.06	0.06	0.06
	5	0.04	0.04	0.09	0.10	0.10	0.10	0.11	0.10	0.12	0.11	0.10	0.07	0.08	0.09	0.10	0.09
	6	0.06	0.06	0.13	0.14	0.14	0.14	0.15	0.15	0.16	0.15	0.15	0.13	0.11	0.14	0.14	0.15
	7	0.10	0.10	0.19	0.20	0.22	0.20	0.21	0.23	0.22	0.22	0.24	0.22	0.16	0.22	0.20	0.24
	8	0.09	0.09	0.18	0.20	0.22	0.19	0.21	0.23	0.22	0.22	0.25	0.22	0.17	0.22	0.20	0.24
	9	0.08	0.09	0.17	0.20	0.22	0.19	0.21	0.23	0.21	0.22	0.24	0.22	0.17	0.22	0.20	0.24
	10	0.08	0.09	0.17	0.19	0.22	0.19	0.21	0.23	0.21	0.22	0.24	0.22	0.16	0.22	0.20	0.23
	11	0.08	0.09	0.17	0.19	0.22	0.19	0.21	0.23	0.21	0.22	0.24	0.22	0.16	0.22	0.20	0.23
	12	0.08	0.09	0.17	0.20	0.22	0.19	0.21	0.23	0.21	0.22	0.24	0.22	0.17	0.22	0.20	0.23
	13	0.08	0.08	0.17	0.19	0.22	0.18	0.20	0.23	0.21	0.22	0.24	0.22	0.16	0.22	0.20	0.24
	14	0.07	0.08	0.15	0.18	0.21	0.17	0.19	0.22	0.19	0.20	0.23	0.22	0.15	0.21	0.19	0.23
	15	0.07	0.07	0.15	0.17	0.21	0.16	0.18	0.22	0.18	0.19	0.24	0.24	0.15	0.22	0.18	0.24
	16	0.07	0.08	0.15	0.17	0.22	0.16	0.18	0.23	0.18	0.19	0.25	0.26	0.14	0.23	0.18	0.25
	17	0.07	0.07	0.14	0.15	0.18	0.15	0.16	0.19	0.17	0.18	0.20	0.19	0.13	0.18	0.16	0.20
	18	0.06	0.06	0.13	0.14	0.16	0.14	0.15	0.17	0.16	0.17	0.18	0.16	0.12	0.16	0.15	0.18
	19	0.06	0.06	0.13	0.14	0.15	0.14	0.15	0.16	0.16	0.16	0.17	0.15	0.12	0.15	0.15	0.16
	20	0.06	0.06	0.12	0.14	0.15	0.13	0.15	0.16	0.15	0.16	0.16	0.14	0.12	0.15	0.14	0.16
	21	0.06	0.06	0.12	0.14	0.14	0.13	0.15	0.15	0.15	0.16	0.16	0.13	0.12	0.14	0.14	0.15
	22	0.05	0.05	0.10	0.12	0.13	0.11	0.12	0.13	0.13	0.14	0.14	0.13	0.10	0.13	0.12	0.14
	23	0.03	0.03	0.06	0.07	0.09	0.07	0.07	0.10	0.08	0.08	0.11	0.11	0.06	0.10	0.07	0.11

Table 9.15. Summary of route average NO_2, M5 to M4 direction [2023 Do something, regulatory traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		2A	2C	2D	2E	2M	2N	2P	2Q	2R	2S	2T	2U	2V	2X	2Y	2AC
Enter at		M5 portal	M5 portal	M5 portal	M5 portal	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	Wattle St	M5 portal	St Peters
Exit at		St Peters	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 Portal	Concord Rd	M4 portal	Concord Rd	M4 portal	Iron Cove Link	Iron Cove Link
Distance		9.2 km	16.4 km	20.6 km	21.7 km	7.1 km	11.3 km	12.5 km	4.7 km	8.9 km	10 km	4.4 km	5.5 km	4.4 km	5.6 km	15.6 km	6.4 km
Hour	0	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.03	0.05	0.06	0.05	0.07	0.04	0.07	0.03	0.04
	1	0.01	0.02	0.03	0.04	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.06	0.04	0.06	0.02	0.03
	2	0.01	0.02	0.03	0.03	0.03	0.04	0.04	0.02	0.03	0.04	0.04	0.05	0.03	0.05	0.02	0.03
	3	0.01	0.02	0.03	0.03	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.05	0.03	0.05	0.02	0.03
	4	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.03	0.05	0.06	0.05	0.07	0.04	0.07	0.02	0.03
	5	0.02	0.04	0.06	0.07	0.06	0.08	0.10	0.04	0.08	0.10	0.09	0.13	0.08	0.12	0.04	0.06
	6	0.05	0.08	0.11	0.13	0.11	0.15	0.19	0.08	0.14	0.19	0.17	0.25	0.15	0.23	0.07	0.10
	7	0.08	0.13	0.18	0.23	0.18	0.25	0.32	0.12	0.24	0.33	0.30	0.45	0.27	0.42	0.12	0.16
	8	0.06	0.11	0.16	0.19	0.16	0.22	0.28	0.11	0.21	0.28	0.26	0.38	0.23	0.35	0.10	0.14
	9	0.06	0.11	0.15	0.18	0.15	0.21	0.26	0.11	0.20	0.27	0.24	0.36	0.21	0.33	0.10	0.14
	10	0.06	0.10	0.14	0.18	0.15	0.20	0.25	0.10	0.19	0.26	0.24	0.35	0.21	0.32	0.10	0.13
	11	0.06	0.10	0.14	0.17	0.14	0.20	0.25	0.10	0.19	0.26	0.24	0.34	0.21	0.32	0.09	0.13
	12	0.06	0.10	0.14	0.17	0.14	0.20	0.25	0.10	0.19	0.26	0.23	0.34	0.21	0.32	0.09	0.13
	13	0.06	0.10	0.14	0.17	0.14	0.20	0.25	0.10	0.19	0.26	0.24	0.35	0.21	0.32	0.09	0.13
	14	0.06	0.10	0.14	0.17	0.14	0.20	0.25	0.10	0.20	0.26	0.24	0.35	0.21	0.33	0.09	0.13
	15	0.05	0.10	0.15	0.18	0.15	0.21	0.27	0.11	0.21	0.28	0.26	0.38	0.23	0.36	0.09	0.13
	16	0.05	0.10	0.16	0.20	0.15	0.24	0.30	0.11	0.24	0.32	0.30	0.44	0.27	0.41	0.09	0.14
	17	0.04	0.08	0.12	0.15	0.12	0.18	0.23	0.09	0.18	0.24	0.22	0.32	0.19	0.30	0.07	0.11
	18	0.04	0.07	0.10	0.13	0.11	0.15	0.19	0.08	0.15	0.20	0.18	0.26	0.16	0.24	0.07	0.10
	19	0.03	0.07	0.09	0.12	0.10	0.14	0.17	0.07	0.13	0.18	0.16	0.24	0.14	0.22	0.06	0.09
	20	0.03	0.06	0.09	0.11	0.09	0.13	0.16	0.07	0.13	0.17	0.15	0.22	0.13	0.21	0.06	0.09
	21	0.03	0.06	0.08	0.10	0.09	0.12	0.15	0.06	0.12	0.16	0.14	0.21	0.12	0.20	0.05	0.08
	22	0.02	0.04	0.05	0.06	0.06	0.08	0.10	0.04	0.07	0.10	0.08	0.13	0.07	0.12	0.03	0.05
	23	0.01	0.03	0.04	0.05	0.04	0.05	0.07	0.03	0.05	0.07	0.06	0.09	0.05	0.08	0.02	0.04

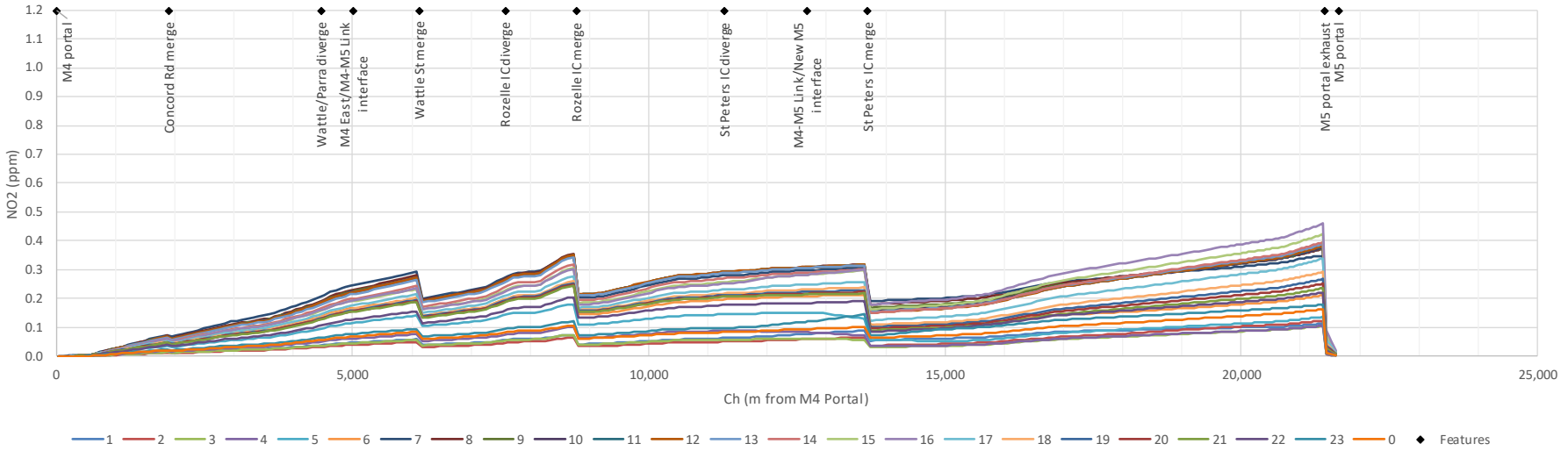


Figure 9.49 In-Tunnel NO_2 levels along route 1E from M4 portal to M5 portal [2023 Do something, regulatory traffic]

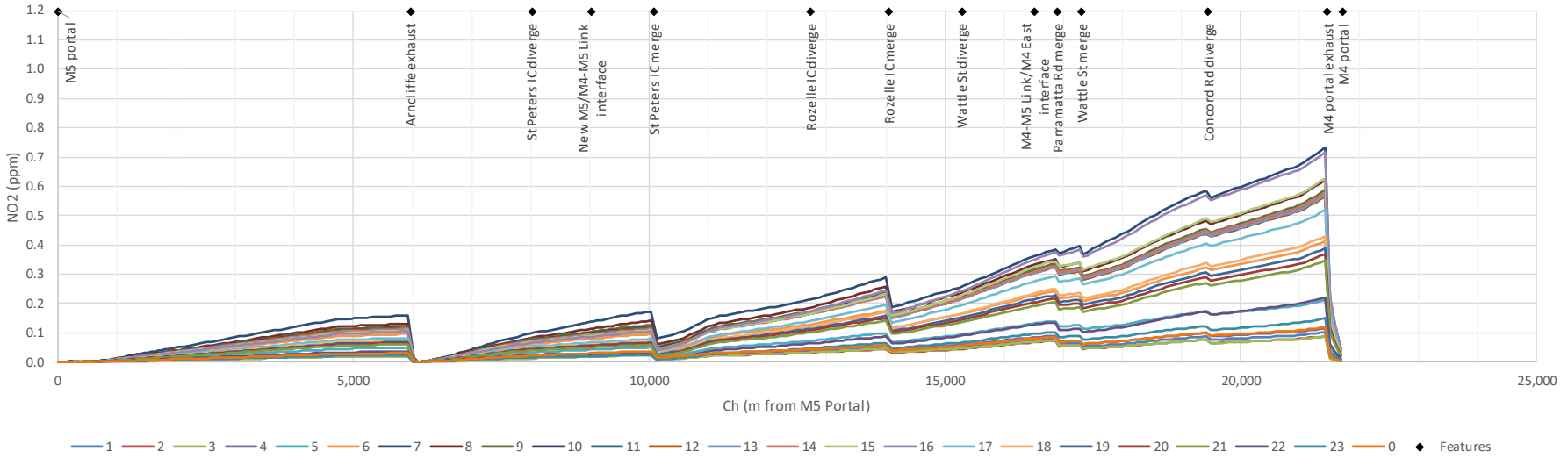


Figure 9.50. In-Tunnel NO_2 levels along route 2E from M5 portal to M4 portal [2023 Do something, regulatory traffic]

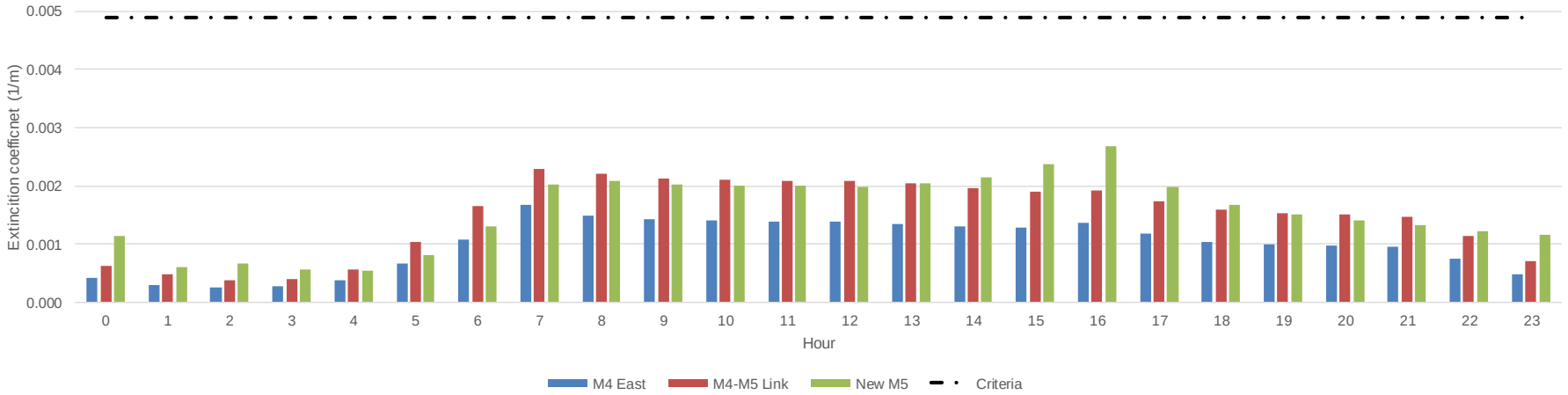


Figure 9.51. Maximum In-Tunnel visibility for M4 to M5 direction [2023 Do something, regulatory traffic]

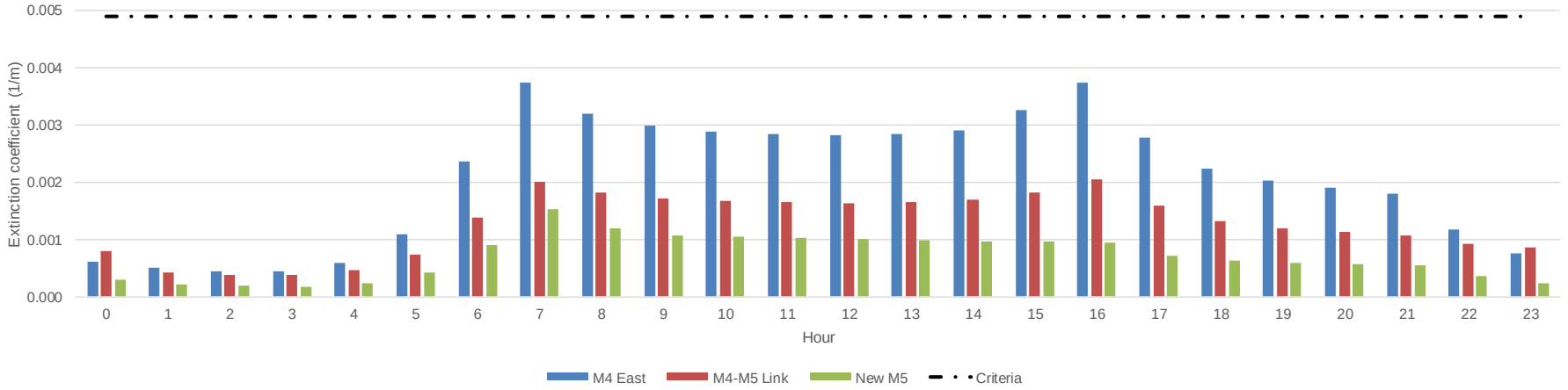


Figure 9.52. Maximum In-Tunnel visibility for M5 to M4 direction [2023 Do something, regulatory traffic]

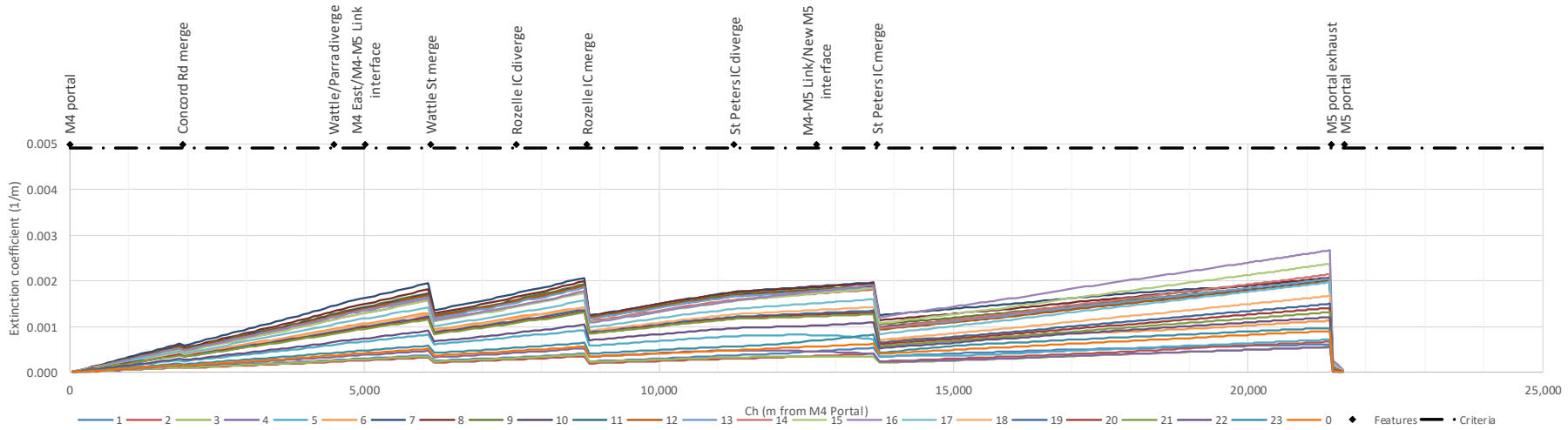


Figure 9.53. In-Tunnel visibility along route 1E from M4 portal to M5 portal [2023 Do something, regulatory traffic]

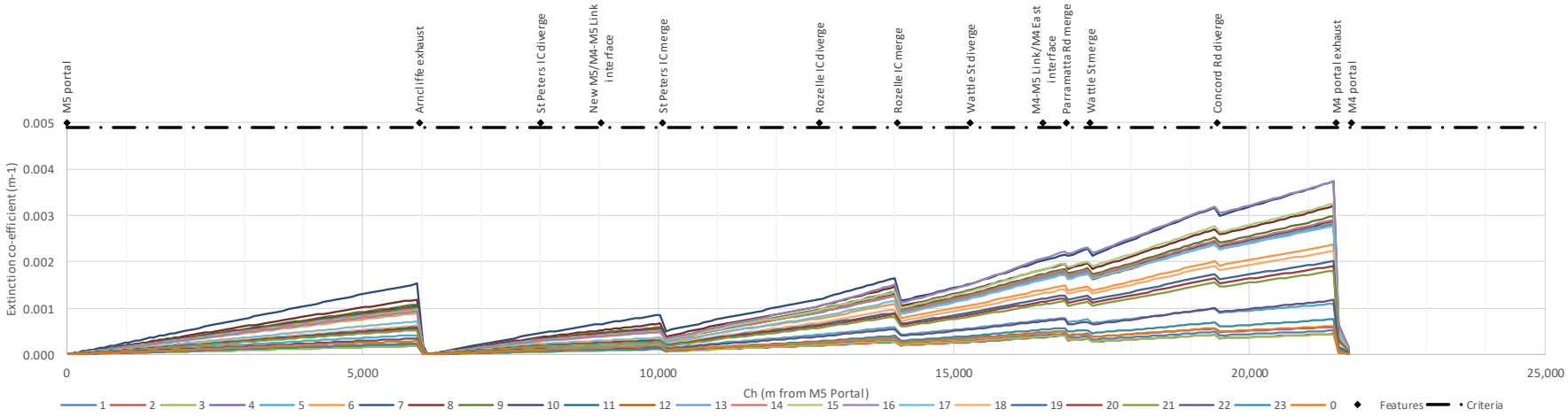


Figure 9.54. In-Tunnel visibility along mainline for M5 to M4 direction [2023 Do something, regulatory traffic]

Table 9.16. Outlet emissions summary [2023 Do something, regulatory traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	276	0.12	0.22	0.01	0.00	0.01	489	0.55	0.82	0.04	0.01	0.05	156	0.03	0.08	0.00	0.00	0.00
1	276	0.08	0.16	0.01	0.00	0.01	456	0.43	0.62	0.03	0.01	0.04	156	0.02	0.05	0.00	0.00	0.00
2	276	0.07	0.14	0.01	0.00	0.01	433	0.35	0.49	0.02	0.01	0.03	156	0.02	0.03	0.00	0.00	0.00
3	276	0.08	0.15	0.01	0.00	0.01	432	0.35	0.49	0.02	0.01	0.03	155	0.02	0.03	0.00	0.00	0.00
4	276	0.11	0.19	0.01	0.00	0.01	483	0.53	0.77	0.04	0.01	0.05	156	0.03	0.05	0.00	0.00	0.00
5	276	0.23	0.33	0.02	0.00	0.02	625	1.30	2.01	0.09	0.03	0.12	195	0.09	0.14	0.00	0.00	0.01
6	324	0.45	0.79	0.04	0.01	0.05	881	3.54	7.16	0.32	0.07	0.39	294	0.31	0.56	0.02	0.01	0.02
7	350	0.87	1.39	0.07	0.02	0.08	871	6.65	9.06	0.48	0.13	0.61	345	0.52	1.13	0.03	0.01	0.04
8	357	0.74	1.31	0.06	0.02	0.08	931	6.19	8.51	0.44	0.13	0.57	328	0.44	0.84	0.02	0.01	0.03
9	356	0.71	1.24	0.06	0.01	0.07	937	5.95	7.94	0.41	0.12	0.53	325	0.43	0.75	0.02	0.01	0.03
10	351	0.68	1.19	0.06	0.01	0.07	935	5.83	7.58	0.39	0.12	0.51	327	0.43	0.73	0.02	0.01	0.03
11	347	0.66	1.15	0.05	0.01	0.07	931	5.76	7.35	0.38	0.12	0.50	326	0.43	0.71	0.02	0.01	0.03
12	343	0.64	1.13	0.05	0.01	0.07	929	5.77	7.27	0.38	0.12	0.50	324	0.43	0.70	0.02	0.01	0.03
13	343	0.61	1.13	0.05	0.01	0.06	931	5.79	7.33	0.38	0.12	0.50	319	0.40	0.67	0.02	0.01	0.03
14	349	0.56	1.18	0.05	0.01	0.06	934	5.88	7.62	0.39	0.12	0.52	312	0.38	0.65	0.02	0.01	0.03
15	369	0.59	1.36	0.06	0.01	0.07	930	6.21	8.58	0.45	0.13	0.57	303	0.36	0.63	0.02	0.01	0.03
16	394	0.65	1.66	0.07	0.01	0.08	895	6.67	9.40	0.50	0.13	0.63	294	0.33	0.60	0.02	0.01	0.02
17	363	0.53	1.20	0.05	0.01	0.06	911	4.89	7.72	0.38	0.10	0.48	260	0.24	0.38	0.01	0.00	0.02
18	331	0.43	0.85	0.04	0.01	0.05	857	3.86	5.83	0.28	0.08	0.36	242	0.20	0.29	0.01	0.00	0.01
19	318	0.39	0.73	0.03	0.01	0.04	825	3.35	5.04	0.24	0.07	0.31	233	0.17	0.27	0.01	0.00	0.01
20	312	0.37	0.68	0.03	0.01	0.04	808	3.11	4.68	0.22	0.06	0.29	227	0.16	0.25	0.01	0.00	0.01
21	307	0.36	0.63	0.03	0.01	0.04	793	2.85	4.40	0.21	0.06	0.27	225	0.15	0.23	0.01	0.00	0.01
22	277	0.25	0.37	0.02	0.01	0.02	677	1.51	2.47	0.11	0.03	0.14	186	0.06	0.13	0.00	0.00	0.00
23	276	0.14	0.26	0.01	0.00	0.01	538	0.79	1.12	0.05	0.02	0.07	153	0.03	0.07	0.00	0.00	0.00

Table 9.16. Outlet emissions summary [2023 Do something, regulatory traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	214	0.06	0.11	0.01	0.00	0.01	279	0.37	0.70	0.03	0.01	0.04	188	0.08	0.15	0.01	0.00	0.01
1	176	0.03	0.06	0.01	0.00	0.01	249	0.22	0.44	0.02	0.00	0.02	177	0.07	0.12	0.01	0.00	0.01
2	156	0.03	0.04	0.00	0.00	0.00	228	0.22	0.37	0.02	0.00	0.02	170	0.06	0.10	0.00	0.00	0.01
3	155	0.03	0.04	0.00	0.00	0.00	226	0.18	0.32	0.01	0.00	0.02	170	0.06	0.10	0.01	0.00	0.01
4	181	0.04	0.07	0.01	0.00	0.01	239	0.20	0.35	0.02	0.00	0.02	182	0.08	0.15	0.01	0.00	0.01
5	266	0.13	0.18	0.02	0.00	0.02	282	0.33	0.59	0.03	0.01	0.03	216	0.18	0.32	0.02	0.00	0.02
6	430	0.40	0.74	0.07	0.01	0.08	344	0.65	1.18	0.05	0.01	0.07	313	0.50	1.19	0.05	0.01	0.06
7	547	0.87	1.56	0.15	0.02	0.17	418	1.29	2.69	0.12	0.03	0.15	370	0.96	1.76	0.09	0.02	0.11
8	497	0.67	1.09	0.10	0.02	0.12	426	1.48	2.71	0.13	0.03	0.16	333	0.81	1.42	0.07	0.02	0.09
9	476	0.60	0.94	0.09	0.01	0.10	435	1.57	2.63	0.12	0.03	0.16	323	0.75	1.27	0.06	0.02	0.08
10	467	0.58	0.88	0.08	0.01	0.10	441	1.62	2.59	0.12	0.03	0.16	317	0.71	1.19	0.06	0.02	0.07
11	462	0.56	0.85	0.08	0.01	0.09	447	1.69	2.58	0.12	0.04	0.16	312	0.69	1.14	0.06	0.01	0.07
12	458	0.56	0.82	0.08	0.01	0.09	450	1.72	2.56	0.12	0.04	0.16	310	0.69	1.11	0.06	0.01	0.07
13	452	0.53	0.80	0.08	0.01	0.09	462	1.78	2.84	0.13	0.04	0.17	312	0.69	1.13	0.06	0.01	0.07
14	449	0.51	0.79	0.07	0.01	0.09	488	1.88	3.42	0.15	0.04	0.19	318	0.71	1.20	0.06	0.02	0.07
15	445	0.49	0.77	0.07	0.01	0.08	523	2.10	4.38	0.19	0.04	0.23	331	0.76	1.39	0.07	0.02	0.08
16	440	0.46	0.76	0.07	0.01	0.08	553	2.36	5.34	0.23	0.05	0.27	370	0.90	1.73	0.09	0.02	0.11
17	373	0.32	0.46	0.04	0.01	0.05	487	1.49	3.63	0.15	0.03	0.18	314	0.61	1.18	0.06	0.01	0.07
18	344	0.26	0.36	0.03	0.01	0.04	438	1.16	2.62	0.11	0.02	0.13	293	0.49	0.90	0.04	0.01	0.05
19	331	0.23	0.33	0.03	0.01	0.04	408	0.99	2.09	0.09	0.02	0.11	282	0.43	0.80	0.04	0.01	0.05
20	323	0.21	0.31	0.03	0.00	0.03	392	0.88	1.85	0.08	0.02	0.10	276	0.40	0.74	0.03	0.01	0.04
21	311	0.19	0.28	0.03	0.00	0.03	377	0.79	1.64	0.07	0.02	0.09	271	0.36	0.69	0.03	0.01	0.04
22	238	0.08	0.15	0.01	0.00	0.01	335	0.65	1.20	0.05	0.01	0.07	212	0.17	0.30	0.01	0.00	0.02
23	184	0.04	0.07	0.01	0.00	0.01	268	0.40	0.65	0.03	0.01	0.04	187	0.10	0.17	0.01	0.00	0.01

Table 9.16. Outlet emissions summary [2023 Do something, regulatory traffic], continued

Outlet identifier:	H						I						J					
EIS name:	Rozelle North (WHT)						Rozelle Mid (M4-M5 Link/ICL)						Rozelle South (M4-M5 Link/ICL)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	637	0.37	0.57	0.03	0.01	0.04
1	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	546	0.19	0.36	0.02	0.00	0.02
2	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	508	0.14	0.28	0.01	0.00	0.02
3	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	503	0.14	0.28	0.01	0.00	0.02
4	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	570	0.24	0.46	0.02	0.00	0.03
5	-	-	-	-	-	-	860	0.97	1.45	0.07	0.02	0.09	0	0.00	0.00	0.00	0.00	0.00
6	-	-	-	-	-	-	1,141	1.91	3.97	0.18	0.04	0.22	0	0.00	0.00	0.00	0.00	0.00
7	-	-	-	-	-	-	1,160	2.78	5.36	0.27	0.06	0.32	0	0.00	0.00	0.00	0.00	0.00
8	-	-	-	-	-	-	1,147	2.63	4.65	0.24	0.05	0.29	0	0.00	0.00	0.00	0.00	0.00
9	-	-	-	-	-	-	1,137	2.54	4.30	0.22	0.05	0.27	0	0.00	0.00	0.00	0.00	0.00
10	-	-	-	-	-	-	1,137	2.52	4.16	0.21	0.05	0.27	0	0.00	0.00	0.00	0.00	0.00
11	-	-	-	-	-	-	1,137	2.52	4.10	0.21	0.05	0.26	0	0.00	0.00	0.00	0.00	0.00
12	-	-	-	-	-	-	1,141	2.55	4.06	0.21	0.05	0.26	0	0.00	0.00	0.00	0.00	0.00
13	-	-	-	-	-	-	1,128	2.41	3.97	0.20	0.05	0.25	0	0.00	0.00	0.00	0.00	0.00
14	-	-	-	-	-	-	1,106	2.17	3.87	0.19	0.05	0.24	0	0.00	0.00	0.00	0.00	0.00
15	-	-	-	-	-	-	1,085	1.98	3.89	0.19	0.04	0.23	0	0.00	0.00	0.00	0.00	0.00
16	-	-	-	-	-	-	1,071	1.93	3.95	0.19	0.04	0.23	0	0.00	0.00	0.00	0.00	0.00
17	-	-	-	-	-	-	1,046	1.76	3.30	0.16	0.04	0.20	0	0.00	0.00	0.00	0.00	0.00
18	-	-	-	-	-	-	1,041	1.68	2.87	0.14	0.04	0.18	0	0.00	0.00	0.00	0.00	0.00
19	-	-	-	-	-	-	1,044	1.65	2.73	0.14	0.03	0.17	0	0.00	0.00	0.00	0.00	0.00
20	-	-	-	-	-	-	1,043	1.61	2.67	0.13	0.03	0.17	0	0.00	0.00	0.00	0.00	0.00
21	-	-	-	-	-	-	1,028	1.52	2.57	0.13	0.03	0.16	0	0.00	0.00	0.00	0.00	0.00
22	-	-	-	-	-	-	857	0.97	1.35	0.07	0.02	0.09	0	0.00	0.00	0.00	0.00	0.00
23	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	685	0.44	0.73	0.04	0.01	0.04

Table 9.16. Outlet emissions summary [2023 Do something, regulatory traffic], continued

Outlet identifier: EIS name:	K SPI (M4-M5 Link)						L Iron Cove Link (north)						M Arncliffe (F6 Extension)						N Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	270	0.24	0.32	0.02	0.01	0.02	315	0.13	0.31	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
1	249	0.17	0.21	0.01	0.00	0.02	271	0.09	0.21	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
2	251	0.14	0.18	0.01	0.00	0.01	251	0.07	0.17	0.00	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
3	274	0.18	0.22	0.01	0.00	0.02	257	0.07	0.18	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
4	327	0.36	0.39	0.02	0.01	0.03	283	0.09	0.27	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
5	402	0.75	0.78	0.05	0.02	0.06	370	0.18	0.65	0.02	0.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-
6	528	1.37	1.98	0.10	0.03	0.13	435	0.32	1.12	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
7	653	2.43	4.05	0.20	0.05	0.25	475	0.55	1.51	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
8	644	2.59	3.73	0.19	0.05	0.24	486	0.59	1.44	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
9	637	2.59	3.49	0.18	0.05	0.24	501	0.68	1.43	0.05	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
10	630	2.56	3.33	0.17	0.05	0.23	509	0.74	1.44	0.05	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
11	628	2.56	3.26	0.17	0.05	0.23	514	0.78	1.46	0.05	0.02	0.07	-	-	-	-	-	-	-	-	-	-	-	-
12	630	2.59	3.26	0.17	0.05	0.23	516	0.80	1.47	0.06	0.02	0.07	-	-	-	-	-	-	-	-	-	-	-	-
13	624	2.53	3.22	0.17	0.05	0.22	518	0.80	1.48	0.06	0.02	0.07	-	-	-	-	-	-	-	-	-	-	-	-
14	608	2.27	3.14	0.16	0.05	0.21	519	0.80	1.52	0.06	0.02	0.07	-	-	-	-	-	-	-	-	-	-	-	-
15	587	2.06	3.08	0.15	0.04	0.20	520	0.78	1.65	0.06	0.02	0.08	-	-	-	-	-	-	-	-	-	-	-	-
16	567	1.91	3.02	0.15	0.04	0.19	525	0.78	1.85	0.07	0.02	0.09	-	-	-	-	-	-	-	-	-	-	-	-
17	553	1.70	2.50	0.13	0.04	0.16	517	0.70	1.52	0.05	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
18	531	1.55	2.06	0.11	0.03	0.14	508	0.63	1.33	0.04	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
19	517	1.46	1.87	0.10	0.03	0.13	500	0.58	1.26	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
20	511	1.43	1.77	0.09	0.03	0.12	492	0.53	1.19	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
21	510	1.41	1.72	0.09	0.03	0.12	484	0.48	1.13	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
22	449	1.05	1.15	0.06	0.02	0.09	432	0.33	0.80	0.02	0.01	0.03	-	-	-	-	-	-	-	-	-	-	-	-
23	323	0.38	0.47	0.03	0.01	0.03	335	0.17	0.39	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-

9.2.3 2033 expected traffic operations

Table 9.17. In-Tunnel estimated air quality maximum [2033 Do something, expected traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.11	1.23	0.0006	0.06	0.78	0.0004	0.16	2.29	0.0013	0.08	0.12	1.54	0.0007	0.09	1.23	0.0005	0.03	0.51	0.0002	0.06
1	0.09	1.03	0.0005	0.05	0.60	0.0003	0.10	1.77	0.0007	0.07	0.06	0.75	0.0004	0.08	1.02	0.0005	0.02	0.32	0.0002	0.05
2	0.08	0.88	0.0004	0.04	0.51	0.0003	0.11	1.67	0.0007	0.06	0.06	0.67	0.0003	0.07	0.87	0.0004	0.01	0.21	0.0001	0.04
3	0.07	0.84	0.0004	0.04	0.53	0.0003	0.09	1.45	0.0006	0.05	0.06	0.68	0.0003	0.07	0.86	0.0004	0.01	0.21	0.0001	0.04
4	0.10	1.10	0.0006	0.06	0.69	0.0004	0.09	1.53	0.0006	0.06	0.06	0.80	0.0004	0.09	1.15	0.0005	0.02	0.30	0.0002	0.06
5	0.16	1.80	0.0009	0.09	1.19	0.0006	0.13	1.99	0.0008	0.09	0.10	1.24	0.0006	0.17	2.21	0.0010	0.04	0.65	0.0003	0.10
6	0.23	3.58	0.0016	0.15	2.24	0.0011	0.19	3.13	0.0013	0.13	0.19	2.83	0.0013	0.34	5.39	0.0022	0.09	1.50	0.0009	0.21
7	0.32	4.71	0.0022	0.26	3.40	0.0017	0.31	5.32	0.0021	0.21	0.30	3.89	0.0019	0.57	6.96	0.0033	0.17	2.60	0.0018	0.35
8	0.34	4.43	0.0022	0.23	3.08	0.0015	0.33	5.23	0.0021	0.22	0.28	3.50	0.0017	0.51	6.41	0.0030	0.13	2.07	0.0013	0.32
9	0.34	4.24	0.0021	0.21	2.85	0.0014	0.33	5.00	0.0021	0.22	0.26	3.10	0.0016	0.48	5.81	0.0027	0.12	1.79	0.0011	0.29
10	0.35	4.20	0.0021	0.21	2.76	0.0014	0.34	4.85	0.0020	0.22	0.25	2.91	0.0015	0.46	5.52	0.0026	0.12	1.66	0.0010	0.28
11	0.36	4.19	0.0021	0.21	2.72	0.0014	0.34	4.74	0.0020	0.22	0.25	2.81	0.0015	0.46	5.37	0.0025	0.11	1.59	0.0009	0.28
12	0.36	4.18	0.0021	0.20	2.70	0.0014	0.34	4.76	0.0020	0.22	0.25	2.80	0.0015	0.45	5.34	0.0025	0.11	1.57	0.0009	0.28
13	0.36	4.18	0.0020	0.20	2.69	0.0014	0.35	5.12	0.0021	0.22	0.25	2.82	0.0015	0.45	5.36	0.0025	0.11	1.56	0.0009	0.28
14	0.35	4.20	0.0020	0.19	2.70	0.0013	0.36	5.74	0.0023	0.22	0.24	2.88	0.0015	0.45	5.49	0.0025	0.11	1.56	0.0009	0.28
15	0.34	4.31	0.0020	0.18	2.85	0.0014	0.40	6.67	0.0026	0.23	0.25	3.08	0.0016	0.46	5.86	0.0027	0.11	1.57	0.0009	0.28
16	0.32	4.42	0.0020	0.19	3.46	0.0015	0.43	7.70	0.0030	0.25	0.26	3.52	0.0018	0.51	6.84	0.0031	0.10	1.56	0.0009	0.32
17	0.30	3.78	0.0017	0.16	2.56	0.0012	0.33	5.98	0.0022	0.20	0.23	2.79	0.0014	0.42	5.47	0.0025	0.08	1.21	0.0007	0.26
18	0.29	3.36	0.0016	0.15	2.23	0.0011	0.27	4.71	0.0018	0.17	0.19	2.35	0.0012	0.35	4.64	0.0020	0.07	1.05	0.0006	0.21
19	0.28	3.14	0.0016	0.15	2.06	0.0010	0.23	4.02	0.0015	0.16	0.18	2.17	0.0011	0.32	4.24	0.0019	0.07	0.99	0.0005	0.20
20	0.27	3.03	0.0015	0.15	1.99	0.0010	0.22	3.70	0.0014	0.15	0.17	2.08	0.0011	0.31	4.03	0.0018	0.07	0.95	0.0005	0.19
21	0.26	2.93	0.0015	0.14	1.89	0.0010	0.21	3.45	0.0014	0.15	0.16	1.98	0.0010	0.29	3.79	0.0017	0.07	0.91	0.0005	0.18
22	0.22	2.31	0.0012	0.12	1.36	0.0008	0.19	2.84	0.0013	0.13	0.14	1.74	0.0009	0.20	2.55	0.0011	0.05	0.64	0.0003	0.12
23	0.13	1.48	0.0007	0.07	0.87	0.0005	0.16	2.24	0.0013	0.09	0.13	1.63	0.0008	0.12	1.48	0.0007	0.03	0.48	0.0002	0.08

Table 9.18. Summary of route average NO_2, M4 to M5 direction [2033 Do something, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		1A	1B	1C	1D	1E	1J	1K	1L	1N	1P	1Q	1V	1Y	1Z	1AB	1AC
Enter at		M4 portal	M4 portal	M4 portal	M4 portal	M4 portal	Concord Rd	Concord Rd	Concord Rd	Wattle St	Wattle St	Wattle St	St Peters	Iron Cove Link	Iron Cove Link	City West Link	City West Link
Exit at		Wattle St	Parramatta Rd	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	M5 portal	St Peters	M5 portal	St Peters	M5 portal
Distance		5.4 km	5.5 km	9.9 km	12.5 km	21.7 km	8.9 km	11.5 km	20.7 km	4.6 km	7.2 km	16.4 km	9.1 km	6.4 km	15.7 km	5.1 km	14.4 km
Design Case	0	0.02	0.02	0.05	0.05	0.07	0.05	0.05	0.07	0.06	0.06	0.08	0.08	0.04	0.07	0.05	0.08
	1	0.02	0.02	0.04	0.04	0.06	0.04	0.05	0.06	0.05	0.05	0.07	0.07	0.04	0.06	0.05	0.07
	2	0.02	0.02	0.03	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.06	0.06	0.03	0.05	0.04	0.06
	3	0.02	0.02	0.03	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.03	0.05	0.04	0.05
	4	0.02	0.02	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.05	0.04	0.05	0.05	0.05
	5	0.03	0.03	0.07	0.08	0.08	0.08	0.09	0.08	0.09	0.09	0.09	0.07	0.07	0.08	0.08	0.08
	6	0.05	0.05	0.11	0.12	0.13	0.12	0.12	0.13	0.13	0.13	0.13	0.12	0.10	0.12	0.12	0.13
	7	0.09	0.09	0.16	0.17	0.20	0.18	0.18	0.20	0.19	0.18	0.21	0.20	0.13	0.19	0.16	0.20
	8	0.08	0.09	0.16	0.18	0.20	0.18	0.19	0.21	0.19	0.19	0.22	0.20	0.14	0.20	0.17	0.21
	9	0.08	0.08	0.16	0.17	0.20	0.17	0.18	0.21	0.19	0.19	0.22	0.20	0.14	0.20	0.18	0.21
	10	0.08	0.08	0.16	0.18	0.20	0.17	0.19	0.21	0.19	0.20	0.22	0.20	0.15	0.20	0.18	0.21
	11	0.08	0.08	0.16	0.18	0.20	0.17	0.19	0.21	0.19	0.20	0.22	0.20	0.15	0.20	0.18	0.21
	12	0.08	0.08	0.16	0.18	0.20	0.17	0.19	0.21	0.19	0.20	0.22	0.20	0.15	0.20	0.19	0.22
	13	0.07	0.08	0.15	0.17	0.20	0.17	0.19	0.21	0.19	0.20	0.22	0.20	0.15	0.20	0.18	0.22
	14	0.07	0.07	0.15	0.17	0.20	0.16	0.18	0.20	0.18	0.19	0.22	0.21	0.14	0.20	0.18	0.22
	15	0.07	0.07	0.14	0.16	0.20	0.15	0.17	0.21	0.17	0.18	0.23	0.23	0.14	0.21	0.17	0.23
	16	0.07	0.07	0.14	0.16	0.21	0.15	0.17	0.22	0.16	0.18	0.24	0.25	0.13	0.22	0.16	0.24
	17	0.06	0.06	0.12	0.14	0.17	0.13	0.15	0.18	0.15	0.16	0.20	0.19	0.12	0.18	0.15	0.19
	18	0.06	0.06	0.12	0.14	0.15	0.13	0.15	0.16	0.14	0.16	0.17	0.15	0.12	0.15	0.15	0.17
	19	0.06	0.05	0.12	0.13	0.14	0.13	0.14	0.15	0.14	0.15	0.16	0.13	0.11	0.14	0.14	0.15
	20	0.05	0.05	0.12	0.13	0.14	0.13	0.14	0.14	0.14	0.15	0.15	0.13	0.11	0.13	0.14	0.15
	21	0.05	0.05	0.11	0.13	0.13	0.12	0.14	0.14	0.14	0.15	0.14	0.12	0.11	0.13	0.13	0.14
	22	0.04	0.04	0.10	0.11	0.12	0.10	0.12	0.12	0.12	0.13	0.13	0.11	0.09	0.12	0.11	0.13
	23	0.03	0.03	0.05	0.06	0.08	0.06	0.06	0.08	0.07	0.07	0.09	0.09	0.05	0.08	0.06	0.09

Table 9.19. Summary of route average NO_2, M5 to M4 direction [2033 Do something, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		2A	2C	2D	2E	2M	2N	2P	2Q	2R	2S	2T	2U	2V	2X	2Y	2AC
Enter at		M5 portal	M5 portal	M5 portal	M5 portal	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	Wattle St	M5 portal	St Peters
Exit at		St Peters	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 Portal	Concord Rd	M4 portal	Concord Rd	M4 portal	Iron Cove Link	Iron Cove Link
Distance		9.2 km	16.4 km	20.6 km	21.7 km	7.1 km	11.3 km	12.5 km	4.7 km	8.9 km	10 km	4.4 km	5.5 km	4.4 km	5.6 km	15.6 km	6.4 km
Hour	0	0.01	0.02	0.03	0.03	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.06	0.03	0.05	0.02	0.03
	1	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.02	0.03	0.04	0.03	0.05	0.03	0.05	0.02	0.02
	2	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.02	0.03	0.04	0.03	0.04	0.02	0.04	0.01	0.02
	3	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.02	0.03	0.04	0.03	0.04	0.02	0.04	0.01	0.02
	4	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.02	0.03	0.05	0.04	0.06	0.03	0.05	0.01	0.02
	5	0.01	0.03	0.04	0.05	0.04	0.06	0.08	0.03	0.06	0.08	0.07	0.10	0.06	0.10	0.03	0.04
	6	0.04	0.06	0.09	0.11	0.09	0.12	0.15	0.06	0.12	0.16	0.14	0.21	0.12	0.19	0.06	0.08
	7	0.08	0.12	0.16	0.19	0.16	0.21	0.27	0.10	0.19	0.26	0.23	0.35	0.20	0.33	0.12	0.15
	8	0.06	0.10	0.14	0.17	0.15	0.19	0.24	0.10	0.18	0.24	0.21	0.32	0.19	0.30	0.10	0.13
	9	0.05	0.09	0.12	0.15	0.13	0.17	0.22	0.09	0.16	0.22	0.20	0.29	0.17	0.27	0.09	0.12
	10	0.05	0.09	0.12	0.15	0.12	0.17	0.21	0.08	0.16	0.21	0.19	0.28	0.17	0.26	0.08	0.11
	11	0.05	0.08	0.11	0.14	0.12	0.16	0.21	0.08	0.16	0.21	0.19	0.28	0.16	0.26	0.08	0.11
	12	0.05	0.08	0.11	0.14	0.12	0.16	0.20	0.08	0.15	0.21	0.19	0.28	0.16	0.26	0.08	0.11
	13	0.05	0.08	0.11	0.14	0.12	0.16	0.20	0.08	0.15	0.21	0.19	0.28	0.16	0.26	0.08	0.11
	14	0.05	0.08	0.11	0.14	0.12	0.16	0.20	0.08	0.15	0.21	0.19	0.28	0.16	0.26	0.08	0.11
	15	0.04	0.08	0.11	0.14	0.12	0.16	0.21	0.08	0.16	0.21	0.19	0.28	0.17	0.26	0.07	0.11
	16	0.04	0.08	0.12	0.15	0.12	0.18	0.23	0.09	0.17	0.23	0.22	0.32	0.19	0.30	0.07	0.11
	17	0.03	0.07	0.10	0.12	0.11	0.15	0.19	0.08	0.15	0.20	0.18	0.26	0.16	0.24	0.06	0.09
	18	0.03	0.06	0.08	0.10	0.09	0.12	0.16	0.06	0.12	0.16	0.15	0.21	0.13	0.20	0.05	0.08
	19	0.03	0.05	0.08	0.10	0.08	0.11	0.14	0.06	0.11	0.15	0.13	0.20	0.12	0.18	0.05	0.08
	20	0.03	0.05	0.07	0.09	0.08	0.11	0.14	0.06	0.11	0.14	0.13	0.19	0.11	0.17	0.05	0.07
	21	0.02	0.05	0.07	0.09	0.08	0.10	0.13	0.05	0.10	0.13	0.12	0.18	0.10	0.17	0.04	0.07
	22	0.02	0.03	0.05	0.06	0.05	0.07	0.09	0.04	0.07	0.09	0.08	0.12	0.07	0.11	0.03	0.05
	23	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.03	0.05	0.06	0.05	0.08	0.04	0.07	0.02	0.03

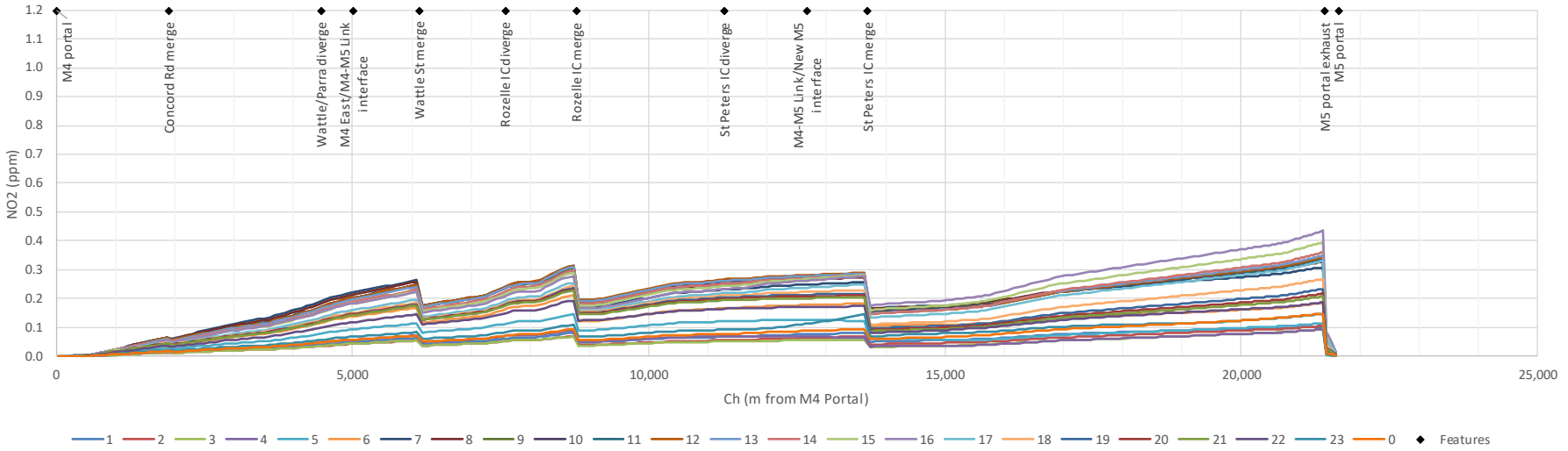


Figure 9.55 In-Tunnel NO_2 levels along route 1E from M4 portal to M5 portal [2033 Do something, expected traffic]

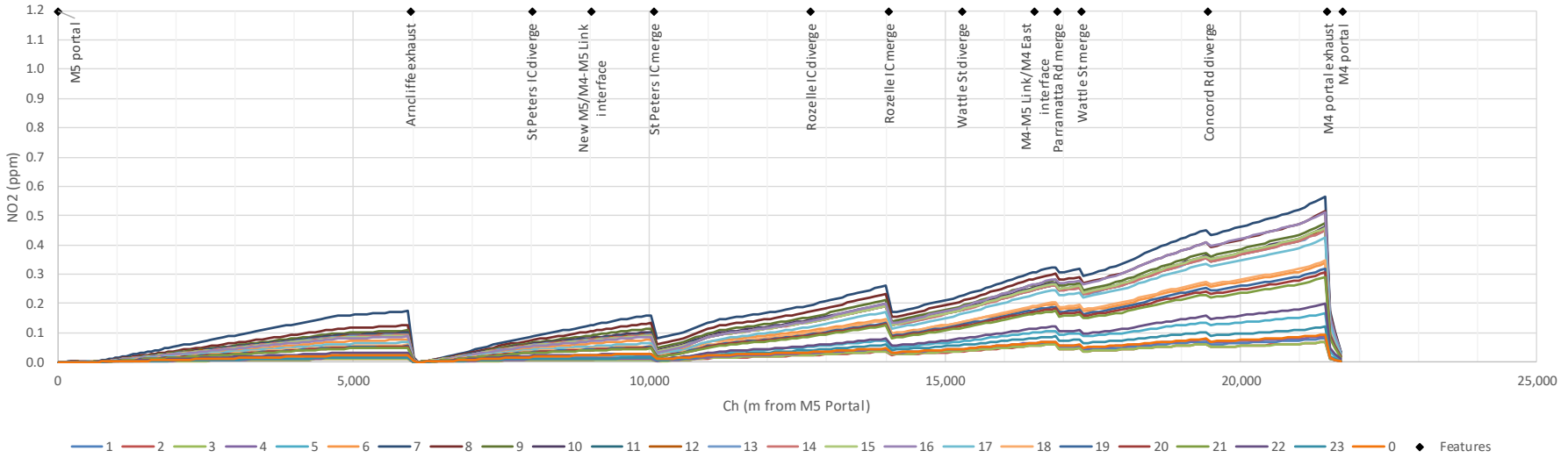


Figure 9.56. In-Tunnel NO_2 levels along route 2E from M5 portal to M4 portal [2033 Do something, expected traffic]

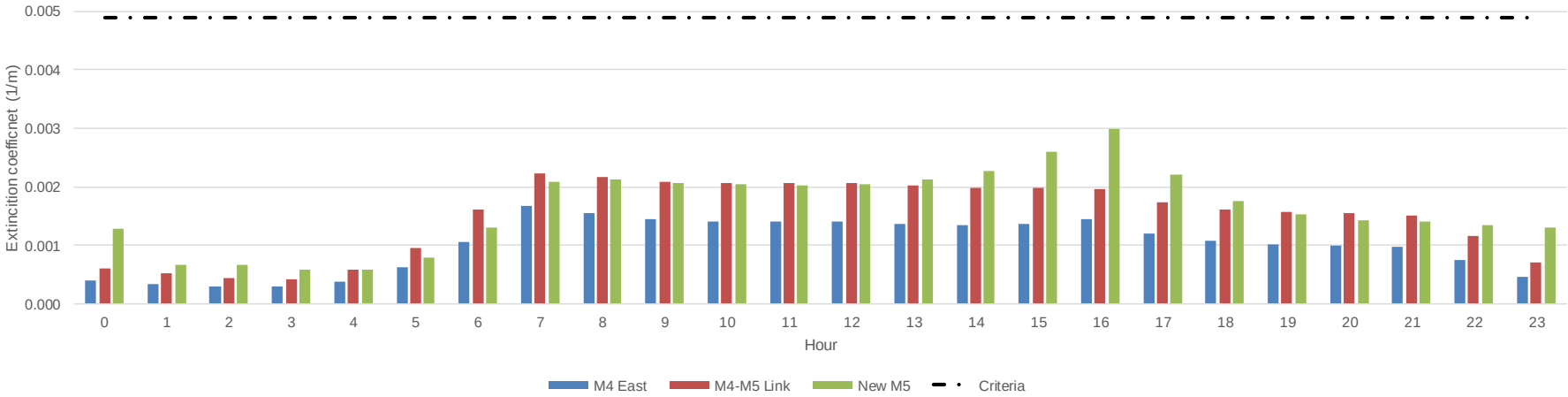


Figure 9.57. Maximum In-Tunnel visibility for M4 to M5 direction [2033 Do something, expected traffic]

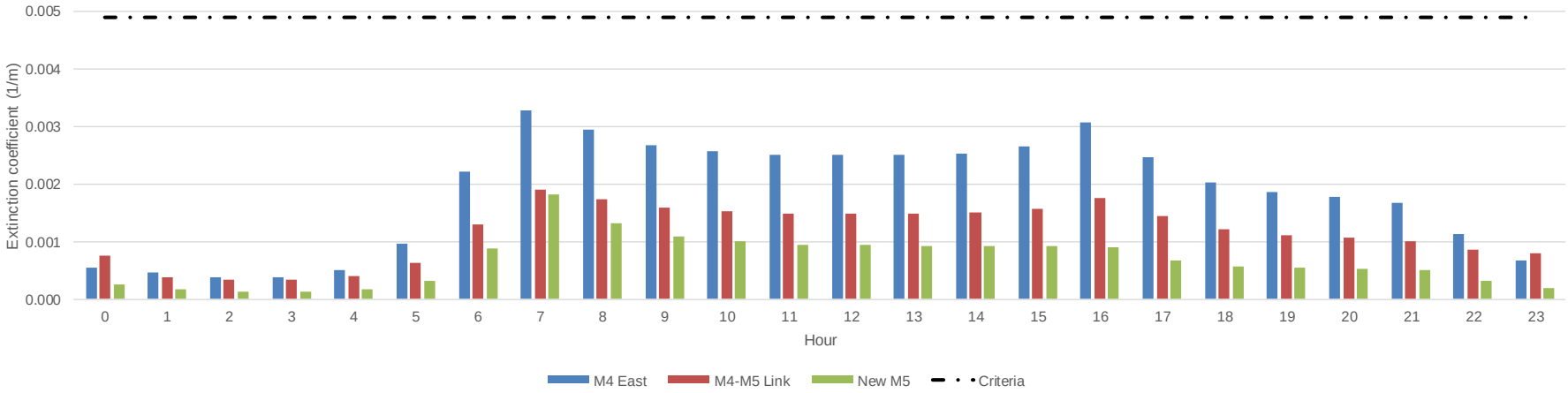


Figure 9.58. Maximum In-Tunnel visibility for M5 to M4 direction [2033 Do something, expected traffic]

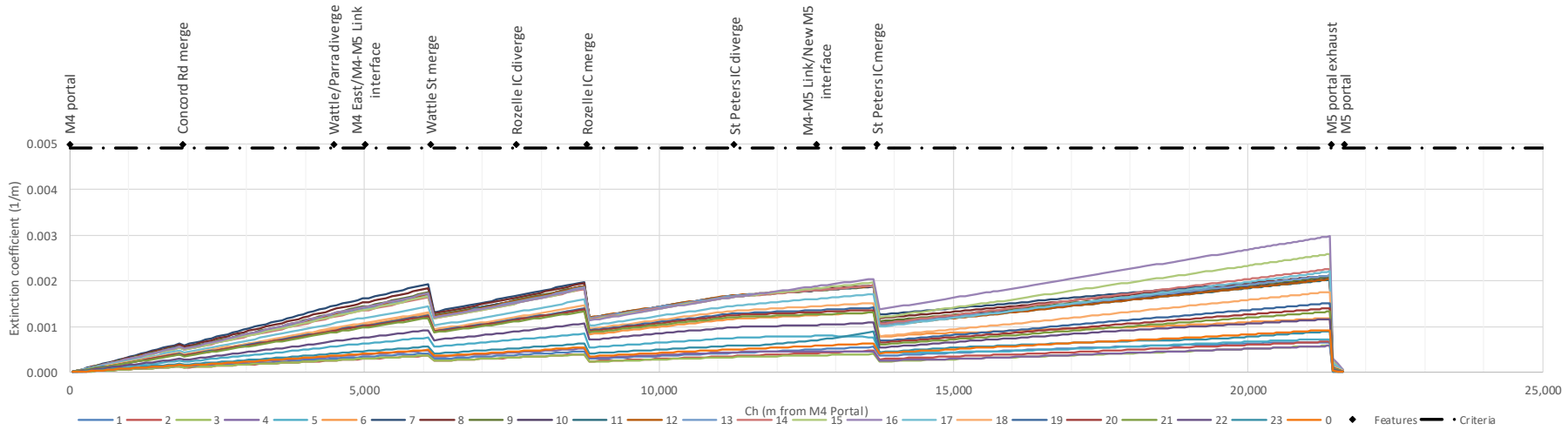


Figure 9.59. In-Tunnel visibility along route 1E from M4 portal to M5 portal [2033 Do something, expected traffic]

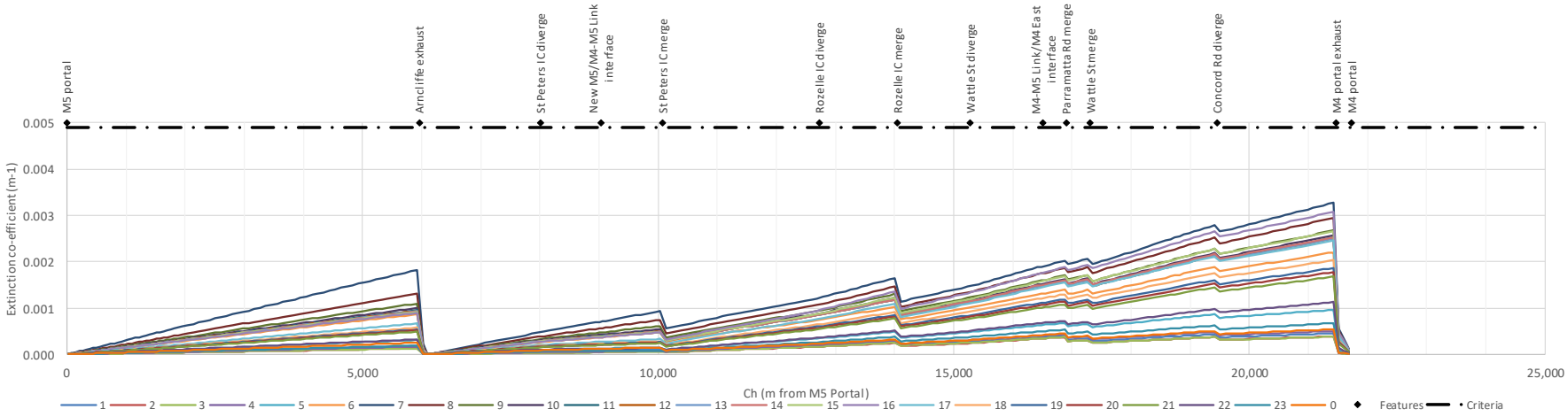


Figure 9.60. In-Tunnel visibility along route 2E from M5 portal to M4 portal [2033 Do something, expected traffic]

Table 9.20. Outlet emissions summary [2033 Do something, expected traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	276	0.09	0.18	0.01	0.00	0.01	480	0.38	0.58	0.04	0.01	0.04	157	0.02	0.05	0.00	0.00	0.00
1	276	0.08	0.13	0.01	0.00	0.01	450	0.31	0.44	0.03	0.01	0.03	156	0.01	0.03	0.00	0.00	0.00
2	276	0.06	0.11	0.01	0.00	0.01	423	0.24	0.35	0.02	0.00	0.03	156	0.01	0.02	0.00	0.00	0.00
3	276	0.07	0.12	0.01	0.00	0.01	425	0.24	0.35	0.02	0.00	0.03	155	0.01	0.02	0.00	0.00	0.00
4	276	0.09	0.16	0.01	0.00	0.01	475	0.36	0.54	0.03	0.01	0.04	156	0.01	0.03	0.00	0.00	0.00
5	282	0.17	0.29	0.02	0.00	0.02	616	0.92	1.42	0.09	0.02	0.11	178	0.04	0.08	0.00	0.00	0.00
6	336	0.36	0.70	0.04	0.01	0.05	878	2.66	5.29	0.32	0.05	0.36	285	0.21	0.39	0.02	0.00	0.02
7	358	0.72	1.23	0.07	0.01	0.09	921	4.97	7.06	0.49	0.08	0.57	335	0.39	0.86	0.03	0.01	0.04
8	354	0.63	1.12	0.07	0.01	0.08	939	4.66	6.72	0.44	0.08	0.53	310	0.32	0.61	0.03	0.01	0.03
9	361	0.59	1.06	0.06	0.01	0.08	939	4.35	6.08	0.40	0.08	0.48	310	0.30	0.53	0.02	0.01	0.03
10	358	0.57	1.02	0.06	0.01	0.07	929	4.21	5.71	0.38	0.08	0.45	310	0.29	0.49	0.02	0.00	0.03
11	353	0.55	0.99	0.06	0.01	0.07	922	4.13	5.51	0.36	0.07	0.44	309	0.29	0.47	0.02	0.00	0.02
12	350	0.54	0.97	0.06	0.01	0.07	921	4.11	5.48	0.36	0.07	0.44	307	0.28	0.46	0.02	0.00	0.02
13	345	0.50	0.95	0.06	0.01	0.07	919	4.06	5.49	0.36	0.07	0.44	304	0.28	0.45	0.02	0.00	0.02
14	347	0.47	0.97	0.06	0.01	0.07	921	4.05	5.63	0.37	0.07	0.44	302	0.27	0.45	0.02	0.00	0.02
15	358	0.48	1.07	0.06	0.01	0.07	930	4.11	6.07	0.39	0.07	0.47	298	0.26	0.44	0.02	0.00	0.02
16	372	0.52	1.28	0.07	0.01	0.08	919	4.43	6.99	0.46	0.08	0.53	287	0.24	0.42	0.02	0.00	0.02
17	358	0.42	0.94	0.05	0.01	0.06	905	3.67	5.50	0.35	0.07	0.42	254	0.16	0.27	0.01	0.00	0.01
18	331	0.35	0.71	0.04	0.01	0.05	852	2.79	4.39	0.27	0.05	0.32	236	0.13	0.21	0.01	0.00	0.01
19	317	0.31	0.60	0.04	0.01	0.04	825	2.50	3.87	0.24	0.04	0.29	228	0.12	0.19	0.01	0.00	0.01
20	312	0.31	0.57	0.03	0.01	0.04	811	2.35	3.61	0.23	0.04	0.27	223	0.11	0.18	0.01	0.00	0.01
21	308	0.29	0.53	0.03	0.01	0.04	792	2.18	3.30	0.21	0.04	0.25	220	0.10	0.16	0.01	0.00	0.01
22	278	0.20	0.32	0.02	0.00	0.02	673	1.24	1.84	0.12	0.02	0.14	194	0.06	0.09	0.00	0.00	0.00
23	276	0.11	0.20	0.01	0.00	0.01	527	0.56	0.79	0.05	0.01	0.06	151	0.02	0.04	0.00	0.00	0.00

Table 9.20. Outlet emissions summary [2033 Do something, expected traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	200	0.04	0.07	0.01	0.00	0.01	292	0.33	0.62	0.04	0.01	0.04	185	0.06	0.11	0.01	0.00	0.01
1	158	0.02	0.04	0.00	0.00	0.00	259	0.19	0.41	0.02	0.00	0.03	176	0.05	0.09	0.01	0.00	0.01
2	129	0.01	0.02	0.00	0.00	0.00	239	0.18	0.34	0.02	0.00	0.02	166	0.04	0.07	0.00	0.00	0.01
3	130	0.01	0.02	0.00	0.00	0.00	228	0.15	0.28	0.02	0.00	0.02	165	0.04	0.07	0.00	0.00	0.01
4	154	0.02	0.03	0.00	0.00	0.00	251	0.17	0.34	0.02	0.00	0.02	181	0.06	0.10	0.01	0.00	0.01
5	227	0.05	0.10	0.01	0.00	0.01	297	0.26	0.56	0.03	0.00	0.03	214	0.12	0.22	0.01	0.00	0.02
6	434	0.30	0.59	0.07	0.01	0.07	366	0.55	1.15	0.06	0.01	0.07	305	0.36	0.85	0.05	0.01	0.06
7	528	0.87	1.43	0.18	0.02	0.19	438	1.09	2.38	0.14	0.02	0.16	336	0.68	1.25	0.08	0.01	0.09
8	526	0.62	1.04	0.13	0.01	0.14	448	1.26	2.44	0.15	0.02	0.17	321	0.60	1.09	0.07	0.01	0.08
9	493	0.50	0.81	0.10	0.01	0.11	456	1.33	2.38	0.15	0.02	0.17	313	0.55	0.95	0.06	0.01	0.07
10	470	0.45	0.70	0.08	0.01	0.09	459	1.36	2.33	0.14	0.02	0.17	308	0.51	0.87	0.06	0.01	0.07
11	457	0.42	0.64	0.08	0.01	0.09	462	1.40	2.30	0.14	0.03	0.17	302	0.49	0.82	0.05	0.01	0.06
12	454	0.41	0.62	0.08	0.01	0.08	468	1.44	2.34	0.15	0.03	0.17	301	0.49	0.81	0.05	0.01	0.06
13	452	0.40	0.62	0.08	0.01	0.08	487	1.53	2.64	0.16	0.03	0.19	302	0.49	0.82	0.05	0.01	0.06
14	451	0.39	0.62	0.07	0.01	0.08	518	1.66	3.20	0.19	0.03	0.22	307	0.49	0.86	0.06	0.01	0.06
15	449	0.38	0.62	0.07	0.01	0.08	558	1.94	4.05	0.23	0.03	0.27	317	0.52	0.96	0.06	0.01	0.07
16	443	0.36	0.60	0.07	0.01	0.08	591	2.22	4.98	0.29	0.04	0.33	331	0.56	1.12	0.07	0.01	0.08
17	372	0.23	0.36	0.04	0.00	0.05	522	1.48	3.38	0.19	0.03	0.21	304	0.45	0.82	0.05	0.01	0.06
18	339	0.18	0.28	0.03	0.00	0.04	456	1.03	2.26	0.13	0.02	0.14	283	0.34	0.64	0.04	0.01	0.05
19	325	0.16	0.25	0.03	0.00	0.03	418	0.81	1.74	0.10	0.01	0.11	272	0.31	0.56	0.04	0.01	0.04
20	317	0.15	0.23	0.03	0.00	0.03	400	0.72	1.52	0.09	0.01	0.10	268	0.29	0.53	0.03	0.01	0.04
21	308	0.14	0.21	0.03	0.00	0.03	383	0.66	1.34	0.08	0.01	0.09	263	0.27	0.49	0.03	0.00	0.04
22	235	0.07	0.10	0.01	0.00	0.01	323	0.48	0.88	0.05	0.01	0.06	204	0.13	0.21	0.01	0.00	0.02
23	170	0.02	0.04	0.01	0.00	0.01	254	0.28	0.44	0.03	0.01	0.03	184	0.08	0.12	0.01	0.00	0.01

Table 9.20. Outlet emissions summary [2033 Do something, expected traffic], continued

Outlet identifier:	H						I						J					
EIS name:	Rozelle North (WHT)						Rozelle Mid (M4-M5 Link/ICL)						Rozelle South (M4-M5 Link/ICL)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	633	0.26	0.46	0.03	0.00	0.03
1	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	556	0.19	0.30	0.02	0.00	0.02
2	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	530	0.15	0.24	0.02	0.00	0.02
3	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	551	0.17	0.26	0.02	0.00	0.02
4	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	631	0.29	0.44	0.03	0.01	0.03
5	-	-	-	-	-	-	833	0.62	1.07	0.07	0.01	0.08	0	0.00	0.00	0.00	0.00	0.00
6	-	-	-	-	-	-	1,120	1.39	3.14	0.19	0.02	0.21	0	0.00	0.00	0.00	0.00	0.00
7	-	-	-	-	-	-	1,224	2.35	4.69	0.30	0.04	0.34	0	0.00	0.00	0.00	0.00	0.00
8	-	-	-	-	-	-	1,202	2.22	4.06	0.27	0.04	0.30	0	0.00	0.00	0.00	0.00	0.00
9	-	-	-	-	-	-	1,179	2.08	3.63	0.24	0.04	0.28	0	0.00	0.00	0.00	0.00	0.00
10	-	-	-	-	-	-	1,168	2.03	3.45	0.23	0.04	0.26	0	0.00	0.00	0.00	0.00	0.00
11	-	-	-	-	-	-	1,163	2.02	3.38	0.22	0.04	0.26	0	0.00	0.00	0.00	0.00	0.00
12	-	-	-	-	-	-	1,158	2.00	3.33	0.22	0.04	0.26	0	0.00	0.00	0.00	0.00	0.00
13	-	-	-	-	-	-	1,149	1.93	3.28	0.21	0.03	0.25	0	0.00	0.00	0.00	0.00	0.00
14	-	-	-	-	-	-	1,133	1.80	3.24	0.21	0.03	0.24	0	0.00	0.00	0.00	0.00	0.00
15	-	-	-	-	-	-	1,112	1.68	3.29	0.21	0.03	0.24	0	0.00	0.00	0.00	0.00	0.00
16	-	-	-	-	-	-	1,095	1.55	3.32	0.21	0.03	0.23	0	0.00	0.00	0.00	0.00	0.00
17	-	-	-	-	-	-	1,066	1.38	2.73	0.17	0.02	0.19	0	0.00	0.00	0.00	0.00	0.00
18	-	-	-	-	-	-	1,060	1.31	2.47	0.15	0.02	0.18	0	0.00	0.00	0.00	0.00	0.00
19	-	-	-	-	-	-	1,057	1.29	2.35	0.15	0.02	0.17	0	0.00	0.00	0.00	0.00	0.00
20	-	-	-	-	-	-	1,055	1.30	2.31	0.15	0.02	0.17	0	0.00	0.00	0.00	0.00	0.00
21	-	-	-	-	-	-	1,040	1.26	2.21	0.14	0.02	0.16	0	0.00	0.00	0.00	0.00	0.00
22	-	-	-	-	-	-	862	0.82	1.19	0.08	0.02	0.09	0	0.00	0.00	0.00	0.00	0.00
23	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	657	0.32	0.55	0.03	0.01	0.04

Table 9.20. Outlet emissions summary [2033 Do something, expected traffic], continued

Outlet identifier:	K						L						M						N					
EIS name:	SPI (M4-M5 Link)						Iron Cove Link (north)						Arncliffe (F6 Extension)						Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	305	0.25	0.32	0.02	0.00	0.03	303	0.09	0.21	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
1	283	0.20	0.24	0.02	0.00	0.02	267	0.07	0.15	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
2	274	0.15	0.20	0.01	0.00	0.02	252	0.05	0.12	0.00	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
3	270	0.14	0.18	0.01	0.00	0.01	251	0.05	0.12	0.00	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
4	306	0.21	0.28	0.02	0.00	0.02	274	0.06	0.19	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
5	409	0.57	0.69	0.05	0.01	0.06	353	0.12	0.43	0.01	0.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-
6	542	1.09	1.68	0.11	0.02	0.13	415	0.23	0.79	0.03	0.00	0.03	-	-	-	-	-	-	-	-	-	-	-	-
7	646	1.81	3.09	0.20	0.03	0.23	449	0.38	1.10	0.05	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
8	631	1.93	2.84	0.19	0.03	0.23	468	0.40	1.11	0.05	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
9	631	1.99	2.76	0.19	0.04	0.22	489	0.45	1.08	0.05	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
10	638	2.08	2.77	0.19	0.04	0.23	496	0.47	1.07	0.05	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
11	644	2.15	2.79	0.19	0.04	0.23	501	0.49	1.07	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
12	645	2.18	2.79	0.19	0.04	0.23	503	0.50	1.08	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
13	639	2.13	2.76	0.19	0.04	0.23	505	0.51	1.09	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
14	629	2.01	2.72	0.19	0.04	0.22	507	0.51	1.12	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
15	608	1.85	2.68	0.18	0.03	0.21	501	0.48	1.19	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
16	588	1.68	2.65	0.17	0.03	0.20	507	0.49	1.33	0.06	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
17	574	1.56	2.20	0.15	0.03	0.18	493	0.43	1.09	0.05	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
18	570	1.50	1.94	0.13	0.03	0.16	489	0.39	0.99	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
19	564	1.44	1.79	0.12	0.03	0.15	483	0.37	0.92	0.04	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
20	554	1.37	1.69	0.12	0.03	0.14	476	0.35	0.87	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
21	543	1.30	1.58	0.11	0.02	0.13	465	0.32	0.81	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
22	493	0.98	1.12	0.08	0.02	0.10	409	0.22	0.54	0.02	0.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-
23	379	0.39	0.52	0.04	0.01	0.04	333	0.12	0.29	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-

9.2.4 2033 regulatory demand traffic operations

Table 9.21. In-Tunnel estimated air quality maximum [2033 Do something, regulatory traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.11	1.32	0.0006	0.06	0.85	0.0004	0.18	2.46	0.0014	0.09	0.12	1.62	0.0008	0.10	1.29	0.0006	0.03	0.54	0.0003	0.06
1	0.10	1.11	0.0006	0.05	0.65	0.0004	0.11	1.93	0.0007	0.07	0.06	0.77	0.0004	0.08	1.08	0.0005	0.02	0.34	0.0002	0.05
2	0.08	0.96	0.0005	0.05	0.56	0.0003	0.11	1.77	0.0007	0.06	0.06	0.69	0.0003	0.07	0.92	0.0004	0.01	0.23	0.0001	0.05
3	0.08	0.92	0.0005	0.05	0.57	0.0003	0.10	1.56	0.0006	0.05	0.06	0.70	0.0004	0.07	0.90	0.0004	0.01	0.22	0.0001	0.05
4	0.11	1.18	0.0006	0.06	0.76	0.0004	0.10	1.65	0.0006	0.06	0.07	0.82	0.0004	0.09	1.21	0.0005	0.02	0.32	0.0002	0.06
5	0.18	1.93	0.0010	0.10	1.29	0.0007	0.14	2.19	0.0009	0.10	0.10	1.28	0.0007	0.17	2.30	0.0010	0.04	0.68	0.0003	0.11
6	0.25	3.86	0.0018	0.16	2.45	0.0012	0.21	3.54	0.0014	0.15	0.20	2.95	0.0014	0.36	5.62	0.0023	0.10	1.56	0.0009	0.22
7	0.39	5.28	0.0026	0.37	4.38	0.0021	0.34	5.76	0.0023	0.25	0.33	4.10	0.0020	0.66	7.66	0.0036	0.20	2.72	0.0020	0.41
8	0.37	4.81	0.0024	0.28	3.52	0.0018	0.37	5.69	0.0023	0.24	0.30	3.67	0.0018	0.56	6.75	0.0032	0.14	2.16	0.0014	0.35
9	0.38	4.55	0.0023	0.25	3.25	0.0017	0.36	5.38	0.0022	0.24	0.28	3.25	0.0017	0.51	6.08	0.0028	0.13	1.87	0.0011	0.31
10	0.39	4.50	0.0023	0.24	3.12	0.0016	0.37	5.21	0.0022	0.24	0.27	3.05	0.0016	0.49	5.78	0.0027	0.12	1.73	0.0010	0.30
11	0.39	4.48	0.0023	0.24	3.04	0.0016	0.37	5.10	0.0022	0.24	0.26	2.94	0.0016	0.48	5.62	0.0026	0.12	1.65	0.0010	0.29
12	0.40	4.47	0.0023	0.24	3.01	0.0016	0.37	5.12	0.0022	0.24	0.26	2.93	0.0015	0.48	5.60	0.0026	0.12	1.64	0.0010	0.29
13	0.39	4.47	0.0022	0.23	2.99	0.0015	0.38	5.50	0.0023	0.24	0.26	2.94	0.0015	0.48	5.61	0.0026	0.12	1.63	0.0010	0.29
14	0.38	4.49	0.0022	0.22	3.02	0.0015	0.39	6.15	0.0025	0.24	0.26	3.02	0.0016	0.48	5.75	0.0027	0.11	1.63	0.0010	0.29
15	0.37	4.62	0.0022	0.22	3.23	0.0016	0.43	7.13	0.0028	0.25	0.26	3.23	0.0017	0.49	6.15	0.0028	0.11	1.63	0.0010	0.30
16	0.35	4.74	0.0022	0.23	3.79	0.0017	0.48	8.13	0.0033	0.27	0.28	3.67	0.0019	0.55	7.20	0.0033	0.11	1.62	0.0009	0.34
17	0.32	4.05	0.0019	0.18	2.78	0.0013	0.36	6.35	0.0024	0.21	0.24	2.92	0.0015	0.45	5.73	0.0026	0.09	1.26	0.0007	0.28
18	0.31	3.61	0.0018	0.17	2.44	0.0012	0.29	5.00	0.0019	0.18	0.20	2.46	0.0013	0.36	4.86	0.0021	0.08	1.09	0.0006	0.22
19	0.30	3.38	0.0017	0.16	2.25	0.0011	0.25	4.31	0.0016	0.17	0.18	2.26	0.0012	0.34	4.44	0.0020	0.07	1.03	0.0006	0.21
20	0.29	3.28	0.0017	0.16	2.17	0.0011	0.23	3.98	0.0016	0.16	0.18	2.17	0.0011	0.32	4.23	0.0019	0.07	0.99	0.0005	0.20
21	0.28	3.16	0.0016	0.15	2.06	0.0011	0.22	3.69	0.0015	0.16	0.17	2.07	0.0011	0.31	3.97	0.0018	0.07	0.94	0.0005	0.19
22	0.24	2.49	0.0012	0.13	1.47	0.0008	0.20	3.04	0.0015	0.14	0.14	1.80	0.0009	0.21	2.66	0.0012	0.05	0.67	0.0003	0.13
23	0.13	1.59	0.0007	0.07	0.95	0.0005	0.18	2.45	0.0014	0.09	0.13	1.69	0.0008	0.13	1.55	0.0007	0.03	0.50	0.0002	0.08

Table 9.22. Summary of route average NO_2, M4 to M5 direction [2033 Do something, regulatory traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		1A	1B	1C	1D	1E	1J	1K	1L	1N	1P	1Q	1V	1Y	1Z	1AB	1AC
Enter at		M4 portal	M4 portal	M4 portal	M4 portal	M4 portal	Concord Rd	Concord Rd	Concord Rd	Wattle St	Wattle St	Wattle St	St Peters	Iron Cove Link	Iron Cove Link	City West Link	City West Link
Exit at		Wattle St	Parramatta Rd	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	M5 portal	St Peters	M5 portal	St Peters	M5 portal
Distance		5.4 km	5.5 km	9.9 km	12.5 km	21.7 km	8.9 km	11.5 km	20.7 km	4.6 km	7.2 km	16.4 km	9.1 km	6.4 km	15.7 km	5.1 km	14.4 km
Design Case	0	0.02	0.02	0.05	0.06	0.07	0.05	0.06	0.08	0.06	0.06	0.09	0.09	0.05	0.08	0.06	0.08
	1	0.02	0.02	0.04	0.05	0.06	0.05	0.05	0.06	0.05	0.06	0.07	0.07	0.04	0.06	0.05	0.07
	2	0.02	0.02	0.04	0.04	0.05	0.04	0.04	0.06	0.04	0.05	0.06	0.06	0.03	0.06	0.04	0.06
	3	0.02	0.02	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.04	0.05	0.05	0.03	0.05	0.04	0.05
	4	0.02	0.02	0.05	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.05	0.04	0.05	0.05	0.06
	5	0.04	0.04	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.08	0.07	0.09	0.09	0.09
	6	0.06	0.06	0.12	0.13	0.14	0.13	0.14	0.15	0.14	0.14	0.15	0.13	0.10	0.14	0.13	0.15
	7	0.14	0.14	0.23	0.23	0.24	0.25	0.24	0.25	0.25	0.22	0.24	0.22	0.16	0.22	0.19	0.23
	8	0.10	0.10	0.19	0.20	0.23	0.21	0.22	0.24	0.22	0.22	0.24	0.23	0.16	0.22	0.19	0.24
	9	0.09	0.10	0.18	0.20	0.22	0.20	0.21	0.23	0.22	0.22	0.24	0.22	0.16	0.22	0.20	0.23
	10	0.09	0.09	0.18	0.20	0.22	0.20	0.21	0.23	0.22	0.22	0.24	0.22	0.16	0.22	0.20	0.23
	11	0.09	0.09	0.18	0.20	0.22	0.20	0.21	0.23	0.22	0.22	0.24	0.22	0.16	0.22	0.20	0.23
	12	0.09	0.09	0.18	0.20	0.22	0.19	0.21	0.23	0.22	0.22	0.24	0.22	0.16	0.22	0.20	0.24
	13	0.09	0.09	0.17	0.19	0.22	0.19	0.21	0.23	0.21	0.22	0.24	0.22	0.16	0.22	0.20	0.24
	14	0.08	0.08	0.17	0.19	0.22	0.18	0.20	0.23	0.20	0.21	0.24	0.22	0.16	0.22	0.19	0.24
	15	0.08	0.08	0.16	0.18	0.23	0.18	0.20	0.24	0.20	0.21	0.25	0.25	0.15	0.23	0.19	0.25
	16	0.08	0.09	0.16	0.18	0.23	0.17	0.19	0.24	0.19	0.20	0.26	0.27	0.14	0.24	0.18	0.26
	17	0.07	0.07	0.14	0.15	0.19	0.15	0.17	0.20	0.16	0.18	0.21	0.20	0.13	0.19	0.16	0.21
	18	0.06	0.06	0.13	0.15	0.17	0.14	0.16	0.17	0.16	0.17	0.18	0.16	0.13	0.17	0.16	0.18
	19	0.06	0.06	0.13	0.14	0.15	0.14	0.15	0.16	0.15	0.17	0.17	0.14	0.12	0.15	0.15	0.16
	20	0.06	0.06	0.13	0.14	0.15	0.14	0.15	0.16	0.15	0.16	0.16	0.13	0.12	0.14	0.15	0.16
	21	0.06	0.06	0.12	0.14	0.14	0.13	0.15	0.15	0.15	0.16	0.16	0.13	0.12	0.14	0.15	0.15
	22	0.05	0.05	0.10	0.12	0.13	0.11	0.12	0.13	0.13	0.14	0.14	0.12	0.10	0.12	0.12	0.13
	23	0.03	0.03	0.06	0.07	0.08	0.06	0.07	0.09	0.07	0.08	0.09	0.09	0.06	0.09	0.07	0.09

Table 9.23. Summary of route average NO_2, M5 to M4 direction [2033 Do something, regulatory traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		2A	2C	2D	2E	2M	2N	2P	2Q	2R	2S	2T	2U	2V	2X	2Y	2AC
Enter at		M5 portal	M5 portal	M5 portal	M5 portal	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	Wattle St	M5 portal	St Peters
Exit at		St Peters	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 Portal	Concord Rd	M4 portal	Concord Rd	M4 portal	Iron Cove Link	Iron Cove Link
Distance		9.2 km	16.4 km	20.6 km	21.7 km	7.1 km	11.3 km	12.5 km	4.7 km	8.9 km	10 km	4.4 km	5.5 km	4.4 km	5.6 km	15.6 km	6.4 km
Hour	0	0.01	0.02	0.03	0.03	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.06	0.04	0.06	0.02	0.03
	1	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.02	0.03	0.04	0.04	0.05	0.03	0.05	0.02	0.02
	2	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.02	0.03	0.04	0.03	0.05	0.03	0.04	0.01	0.02
	3	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.02	0.03	0.04	0.03	0.05	0.03	0.04	0.01	0.02
	4	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.06	0.03	0.05	0.02	0.02
	5	0.01	0.03	0.04	0.05	0.05	0.06	0.08	0.03	0.06	0.08	0.07	0.11	0.06	0.10	0.03	0.04
	6	0.04	0.07	0.09	0.11	0.10	0.13	0.16	0.07	0.12	0.16	0.15	0.22	0.13	0.20	0.06	0.09
	7	0.09	0.13	0.17	0.22	0.17	0.23	0.30	0.11	0.22	0.30	0.27	0.41	0.24	0.38	0.13	0.16
	8	0.06	0.11	0.15	0.18	0.15	0.20	0.26	0.10	0.19	0.26	0.23	0.35	0.20	0.32	0.10	0.14
	9	0.06	0.10	0.13	0.16	0.14	0.18	0.23	0.09	0.17	0.23	0.21	0.31	0.18	0.29	0.09	0.12
	10	0.05	0.09	0.12	0.15	0.13	0.18	0.22	0.09	0.17	0.22	0.20	0.30	0.18	0.28	0.08	0.12
	11	0.05	0.09	0.12	0.15	0.13	0.17	0.22	0.09	0.16	0.22	0.20	0.29	0.17	0.27	0.08	0.11
	12	0.05	0.09	0.12	0.15	0.12	0.17	0.22	0.09	0.16	0.22	0.20	0.29	0.17	0.27	0.08	0.11
	13	0.05	0.09	0.12	0.15	0.12	0.17	0.21	0.09	0.16	0.22	0.20	0.29	0.17	0.27	0.08	0.11
	14	0.05	0.08	0.12	0.15	0.12	0.17	0.21	0.09	0.16	0.22	0.20	0.29	0.17	0.27	0.08	0.11
	15	0.05	0.08	0.12	0.15	0.12	0.17	0.22	0.09	0.17	0.23	0.21	0.30	0.18	0.28	0.08	0.11
	16	0.04	0.09	0.13	0.16	0.13	0.19	0.24	0.09	0.19	0.25	0.24	0.34	0.21	0.32	0.08	0.12
	17	0.03	0.07	0.10	0.13	0.11	0.16	0.20	0.08	0.15	0.21	0.19	0.28	0.17	0.26	0.06	0.10
	18	0.03	0.06	0.09	0.11	0.09	0.13	0.16	0.07	0.13	0.17	0.15	0.22	0.13	0.21	0.05	0.08
	19	0.03	0.06	0.08	0.10	0.09	0.12	0.15	0.06	0.12	0.15	0.14	0.21	0.12	0.19	0.05	0.08
	20	0.03	0.05	0.08	0.10	0.08	0.11	0.14	0.06	0.11	0.15	0.13	0.20	0.12	0.18	0.05	0.08
	21	0.03	0.05	0.07	0.09	0.08	0.11	0.14	0.06	0.10	0.14	0.13	0.19	0.11	0.17	0.05	0.07
	22	0.02	0.03	0.05	0.06	0.05	0.07	0.09	0.04	0.07	0.09	0.08	0.13	0.07	0.12	0.03	0.05
	23	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.03	0.05	0.06	0.05	0.08	0.04	0.07	0.02	0.03

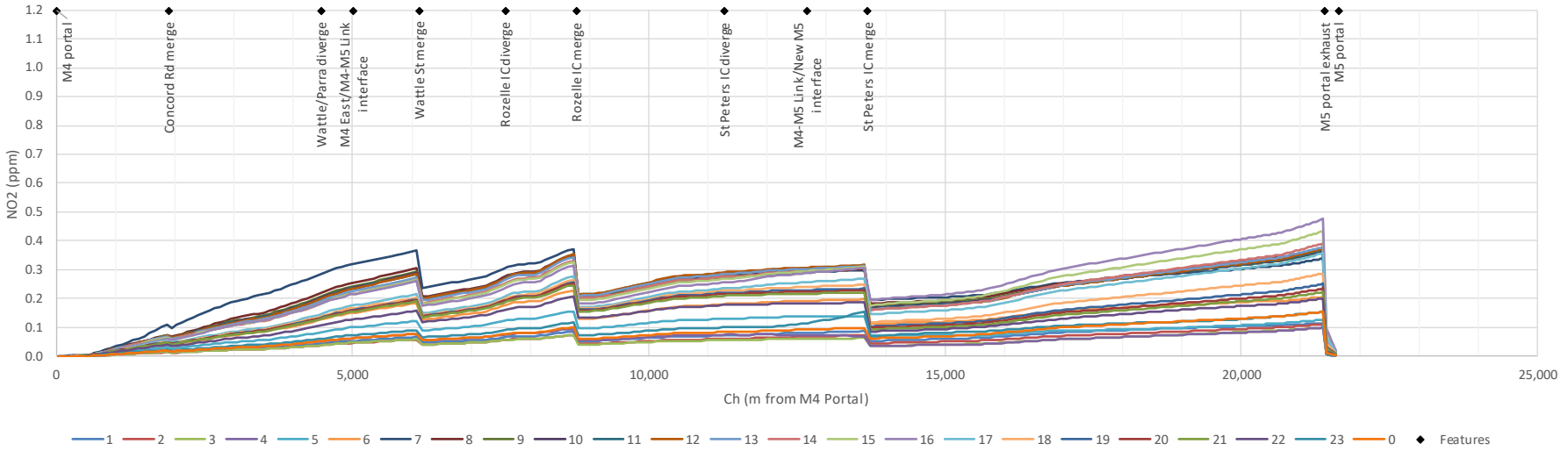


Figure 9.61 In-Tunnel NO_2 levels along route 1E from M4 portal to M5 portal [2033 Do something, regulatory traffic]

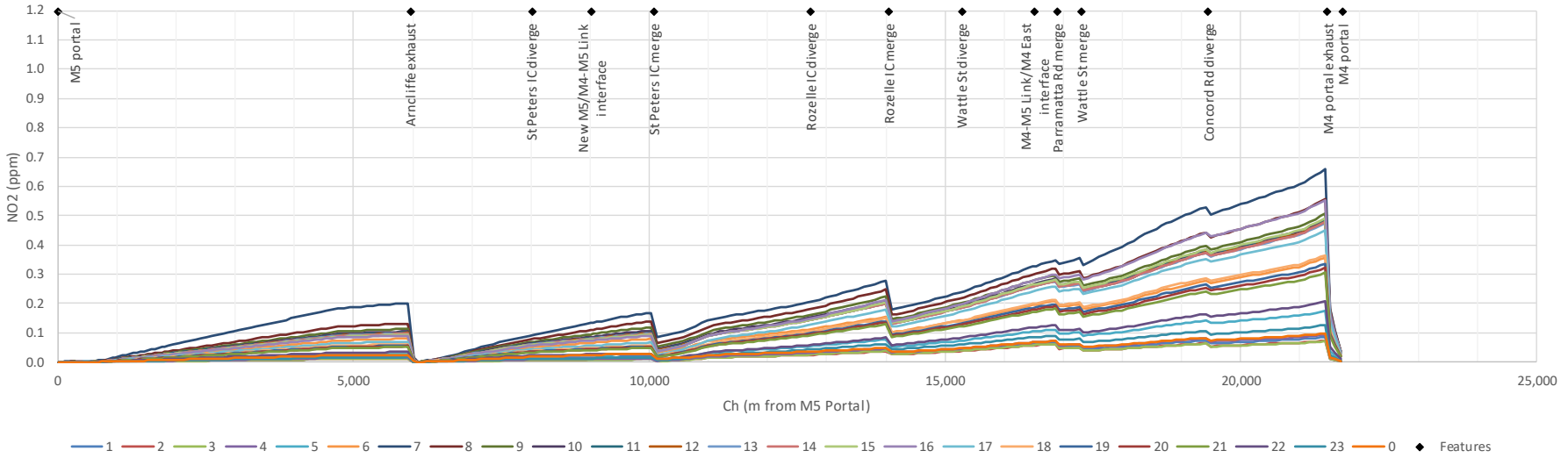


Figure 9.62. In-Tunnel NO_2 levels along route 2E from M5 portal to M4 portal [2033 Do something, regulatory traffic]

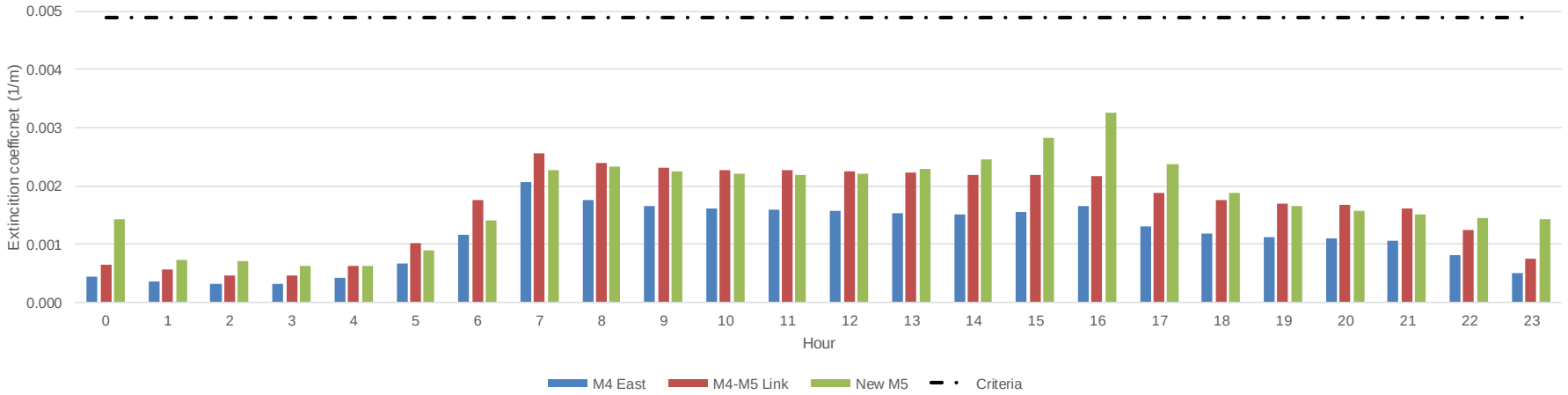


Figure 9.63. Maximum In-Tunnel visibility for M4 to M5 direction [2033 Do something, regulatory traffic]

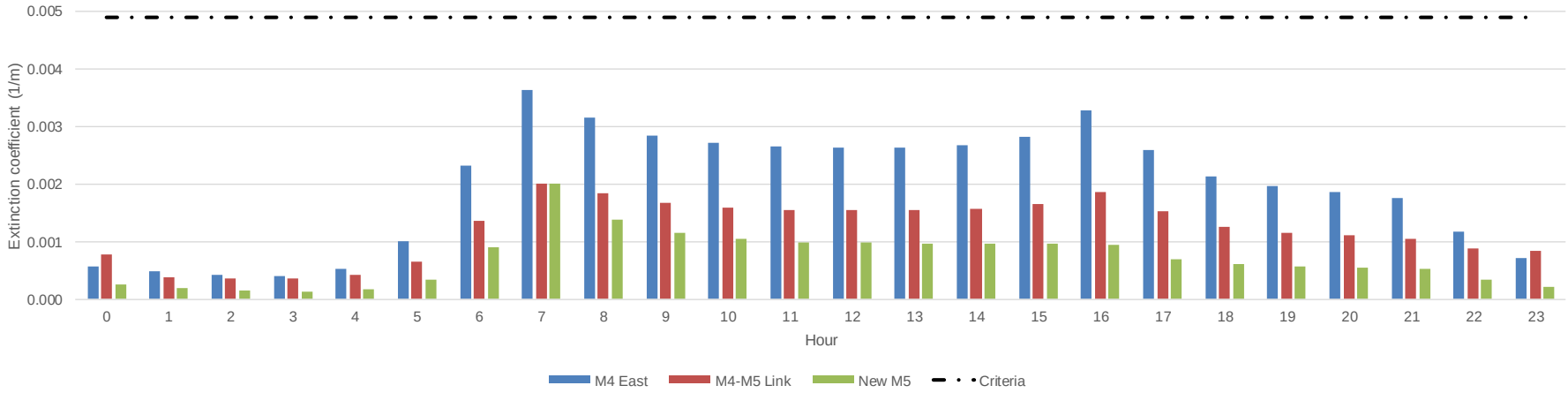


Figure 9.64. Maximum In-Tunnel visibility for M5 to M4 direction [2033 Do something, regulatory traffic]

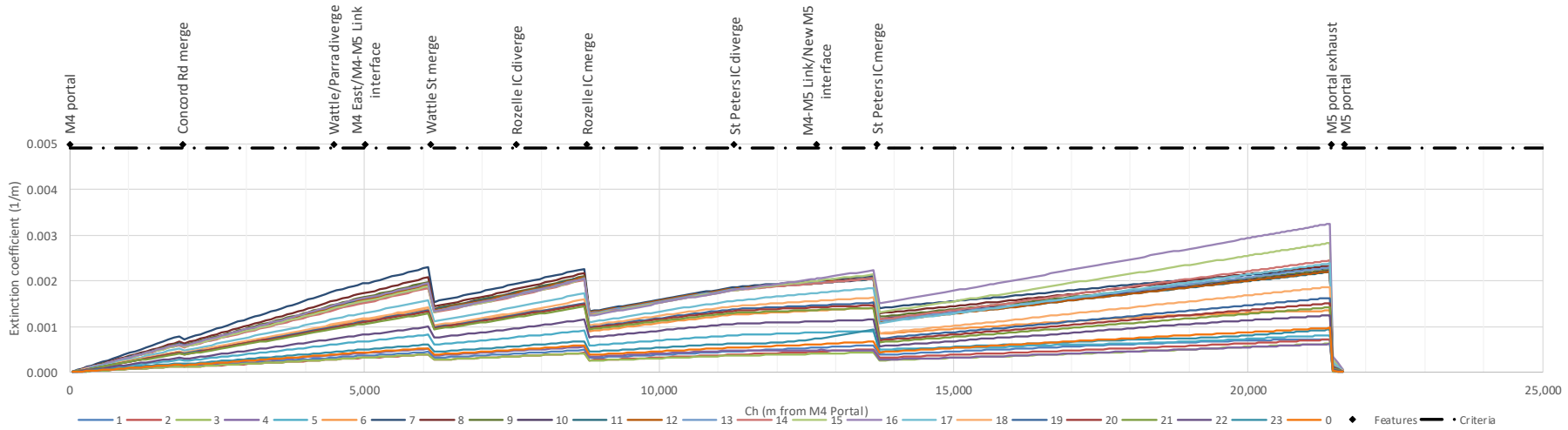


Figure 9.65. In-Tunnel visibility along route 1E from M4 portal to M5 portal [2033 Do something, regulatory traffic]

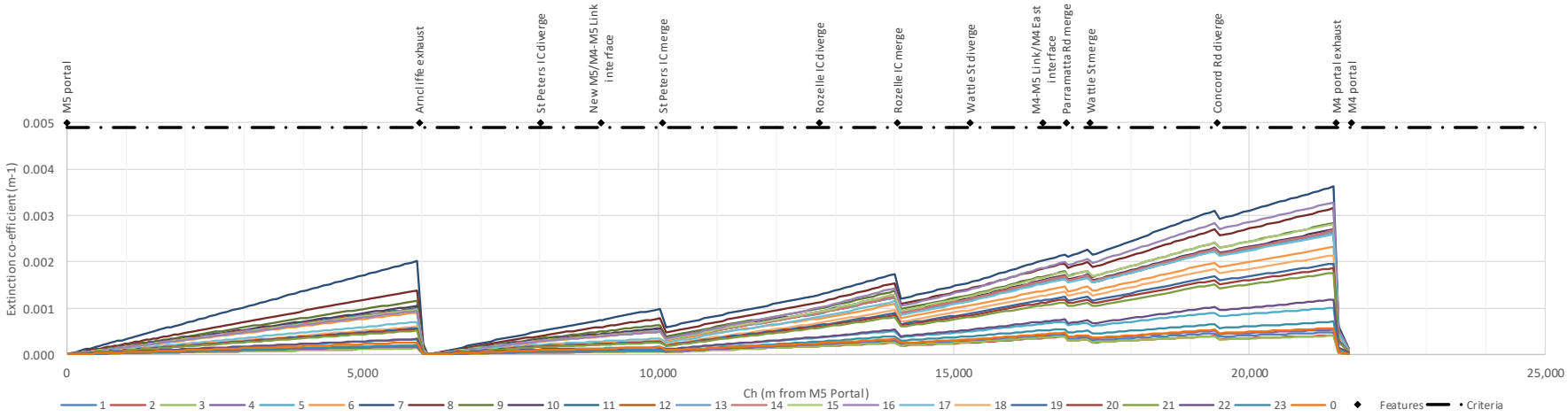


Figure 9.66. In-Tunnel visibility along route 2E from M5 portal to M4 portal [2033 Do something, regulatory traffic]

Table 9.24. Outlet emissions summary [2033 Do something, regulatory traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	276	0.10	0.20	0.01	0.00	0.01	489	0.41	0.63	0.04	0.01	0.05	156	0.03	0.05	0.00	0.00	0.00
1	276	0.08	0.15	0.01	0.00	0.01	458	0.33	0.48	0.03	0.01	0.04	156	0.02	0.03	0.00	0.00	0.00
2	276	0.07	0.13	0.01	0.00	0.01	433	0.27	0.38	0.02	0.00	0.03	156	0.01	0.02	0.00	0.00	0.00
3	276	0.07	0.13	0.01	0.00	0.01	431	0.26	0.37	0.02	0.00	0.03	155	0.01	0.02	0.00	0.00	0.00
4	276	0.10	0.17	0.01	0.00	0.01	484	0.38	0.58	0.04	0.01	0.04	156	0.01	0.03	0.00	0.00	0.00
5	288	0.19	0.32	0.02	0.00	0.02	629	0.99	1.52	0.10	0.02	0.11	182	0.04	0.09	0.00	0.00	0.00
6	342	0.40	0.78	0.05	0.01	0.05	894	2.86	5.62	0.34	0.05	0.39	291	0.22	0.42	0.02	0.00	0.02
7	306	0.82	1.29	0.07	0.01	0.08	886	5.55	7.40	0.51	0.09	0.61	341	0.42	0.92	0.04	0.01	0.04
8	338	0.71	1.21	0.07	0.01	0.08	940	5.07	7.09	0.48	0.09	0.56	318	0.35	0.66	0.03	0.01	0.03
9	342	0.66	1.15	0.07	0.01	0.08	947	4.68	6.43	0.43	0.08	0.51	317	0.33	0.57	0.02	0.01	0.03
10	343	0.64	1.11	0.07	0.01	0.08	944	4.53	6.08	0.40	0.08	0.48	317	0.31	0.53	0.02	0.01	0.03
11	342	0.62	1.08	0.07	0.01	0.08	938	4.44	5.88	0.39	0.08	0.47	316	0.31	0.51	0.02	0.01	0.03
12	341	0.60	1.06	0.06	0.01	0.07	937	4.42	5.84	0.39	0.08	0.47	314	0.30	0.50	0.02	0.01	0.03
13	338	0.55	1.04	0.06	0.01	0.07	934	4.37	5.84	0.39	0.08	0.47	312	0.30	0.49	0.02	0.01	0.03
14	338	0.52	1.06	0.06	0.01	0.07	937	4.36	6.00	0.40	0.08	0.47	309	0.29	0.48	0.02	0.00	0.02
15	341	0.53	1.15	0.07	0.01	0.07	937	4.43	6.41	0.42	0.08	0.50	305	0.28	0.48	0.02	0.00	0.02
16	358	0.59	1.40	0.08	0.01	0.09	922	4.80	7.37	0.49	0.08	0.57	294	0.25	0.45	0.02	0.00	0.02
17	364	0.48	1.05	0.06	0.01	0.07	920	3.96	5.86	0.38	0.07	0.45	261	0.17	0.29	0.01	0.00	0.01
18	336	0.39	0.79	0.05	0.01	0.05	868	3.00	4.68	0.29	0.05	0.35	242	0.14	0.23	0.01	0.00	0.01
19	321	0.35	0.67	0.04	0.01	0.05	842	2.68	4.15	0.26	0.05	0.31	233	0.12	0.20	0.01	0.00	0.01
20	316	0.34	0.64	0.04	0.01	0.04	827	2.53	3.87	0.24	0.05	0.29	228	0.12	0.19	0.01	0.00	0.01
21	313	0.33	0.60	0.04	0.01	0.04	809	2.35	3.54	0.22	0.04	0.27	225	0.11	0.18	0.01	0.00	0.01
22	285	0.23	0.37	0.02	0.00	0.03	688	1.33	1.98	0.12	0.02	0.15	198	0.06	0.10	0.00	0.00	0.01
23	276	0.12	0.22	0.01	0.00	0.02	537	0.61	0.85	0.05	0.01	0.07	155	0.02	0.05	0.00	0.00	0.00

Table 9.24. Outlet emissions summary [2033 Do something, regulatory traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	205	0.04	0.07	0.01	0.00	0.01	304	0.36	0.71	0.04	0.01	0.05	187	0.06	0.12	0.01	0.00	0.01
1	163	0.02	0.04	0.00	0.00	0.01	269	0.22	0.47	0.03	0.00	0.03	178	0.05	0.09	0.01	0.00	0.01
2	132	0.01	0.02	0.00	0.00	0.00	246	0.20	0.38	0.02	0.00	0.03	171	0.04	0.07	0.01	0.00	0.01
3	134	0.01	0.02	0.00	0.00	0.00	236	0.17	0.31	0.02	0.00	0.02	166	0.04	0.07	0.01	0.00	0.01
4	156	0.02	0.04	0.00	0.00	0.00	259	0.19	0.38	0.02	0.00	0.02	183	0.06	0.11	0.01	0.00	0.01
5	234	0.06	0.11	0.01	0.00	0.01	308	0.30	0.64	0.03	0.01	0.04	217	0.13	0.23	0.02	0.00	0.02
6	445	0.32	0.64	0.07	0.01	0.08	381	0.64	1.36	0.08	0.01	0.09	312	0.39	0.91	0.05	0.01	0.06
7	516	1.00	1.56	0.19	0.02	0.21	456	1.27	2.72	0.16	0.02	0.18	357	0.78	1.39	0.09	0.01	0.10
8	537	0.67	1.11	0.14	0.01	0.15	467	1.51	2.80	0.17	0.03	0.20	331	0.66	1.18	0.08	0.01	0.09
9	503	0.54	0.86	0.10	0.01	0.12	475	1.52	2.69	0.17	0.03	0.19	321	0.59	1.02	0.07	0.01	0.08
10	482	0.48	0.75	0.09	0.01	0.10	478	1.57	2.63	0.16	0.03	0.19	315	0.56	0.94	0.06	0.01	0.07
11	468	0.45	0.68	0.08	0.01	0.09	482	1.60	2.59	0.16	0.03	0.19	310	0.53	0.88	0.06	0.01	0.07
12	465	0.44	0.67	0.08	0.01	0.09	488	1.65	2.65	0.17	0.03	0.20	309	0.53	0.87	0.06	0.01	0.07
13	463	0.43	0.66	0.08	0.01	0.09	507	1.74	2.98	0.18	0.03	0.21	310	0.53	0.88	0.06	0.01	0.07
14	462	0.42	0.66	0.08	0.01	0.09	539	1.89	3.59	0.21	0.03	0.24	314	0.53	0.93	0.06	0.01	0.07
15	460	0.41	0.66	0.08	0.01	0.09	577	2.21	4.49	0.27	0.04	0.30	325	0.56	1.03	0.07	0.01	0.08
16	454	0.39	0.64	0.08	0.01	0.08	611	2.53	5.46	0.33	0.04	0.37	343	0.62	1.22	0.08	0.01	0.09
17	381	0.25	0.38	0.05	0.01	0.05	542	1.67	3.74	0.21	0.03	0.24	310	0.48	0.88	0.06	0.01	0.07
18	348	0.20	0.30	0.04	0.00	0.04	475	1.16	2.53	0.14	0.02	0.16	288	0.37	0.69	0.04	0.01	0.05
19	334	0.17	0.27	0.03	0.00	0.04	436	0.92	1.97	0.11	0.02	0.13	278	0.33	0.60	0.04	0.01	0.04
20	326	0.16	0.25	0.03	0.00	0.03	417	0.82	1.72	0.10	0.01	0.11	273	0.31	0.57	0.04	0.01	0.04
21	316	0.15	0.23	0.03	0.00	0.03	400	0.75	1.52	0.09	0.01	0.10	268	0.29	0.53	0.03	0.01	0.04
22	241	0.07	0.11	0.01	0.00	0.01	337	0.55	1.00	0.06	0.01	0.07	208	0.14	0.22	0.01	0.00	0.02
23	176	0.02	0.05	0.01	0.00	0.01	263	0.31	0.48	0.03	0.01	0.04	186	0.08	0.13	0.01	0.00	0.01

Table 9.24. Outlet emissions summary [2033 Do something, regulatory traffic], continued

Outlet identifier:	H						I						J					
EIS name:	Rozelle North (WHT)						Rozelle Mid (M4-M5 Link/ICL)						Rozelle South (M4-M5 Link/ICL)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	656	0.29	0.52	0.03	0.01	0.04
1	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	575	0.21	0.34	0.02	0.00	0.03
2	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	535	0.16	0.26	0.02	0.00	0.02
3	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	568	0.19	0.29	0.02	0.00	0.02
4	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	653	0.32	0.49	0.03	0.01	0.04
5	-	-	-	-	-	-	865	0.70	1.20	0.07	0.01	0.09	0	0.00	0.00	0.00	0.00	0.00
6	-	-	-	-	-	-	1,157	1.56	3.47	0.21	0.03	0.24	0	0.00	0.00	0.00	0.00	0.00
7	-	-	-	-	-	-	1,211	2.82	4.93	0.34	0.05	0.38	0	0.00	0.00	0.00	0.00	0.00
8	-	-	-	-	-	-	1,211	2.56	4.44	0.30	0.04	0.34	0	0.00	0.00	0.00	0.00	0.00
9	-	-	-	-	-	-	1,186	2.41	3.97	0.27	0.04	0.31	0	0.00	0.00	0.00	0.00	0.00
10	-	-	-	-	-	-	1,172	2.34	3.73	0.26	0.04	0.30	0	0.00	0.00	0.00	0.00	0.00
11	-	-	-	-	-	-	1,165	2.31	3.63	0.25	0.04	0.29	0	0.00	0.00	0.00	0.00	0.00
12	-	-	-	-	-	-	1,161	2.29	3.57	0.25	0.04	0.29	0	0.00	0.00	0.00	0.00	0.00
13	-	-	-	-	-	-	1,151	2.20	3.51	0.24	0.04	0.28	0	0.00	0.00	0.00	0.00	0.00
14	-	-	-	-	-	-	1,135	2.06	3.46	0.24	0.04	0.27	0	0.00	0.00	0.00	0.00	0.00
15	-	-	-	-	-	-	1,117	1.94	3.51	0.23	0.03	0.27	0	0.00	0.00	0.00	0.00	0.00
16	-	-	-	-	-	-	1,097	1.78	3.54	0.23	0.03	0.26	0	0.00	0.00	0.00	0.00	0.00
17	-	-	-	-	-	-	1,071	1.55	2.90	0.19	0.03	0.22	0	0.00	0.00	0.00	0.00	0.00
18	-	-	-	-	-	-	1,067	1.47	2.63	0.17	0.03	0.20	0	0.00	0.00	0.00	0.00	0.00
19	-	-	-	-	-	-	1,068	1.45	2.50	0.17	0.03	0.19	0	0.00	0.00	0.00	0.00	0.00
20	-	-	-	-	-	-	1,071	1.47	2.45	0.16	0.03	0.19	0	0.00	0.00	0.00	0.00	0.00
21	-	-	-	-	-	-	1,066	1.42	2.36	0.16	0.03	0.18	0	0.00	0.00	0.00	0.00	0.00
22	-	-	-	-	-	-	895	0.93	1.33	0.09	0.02	0.11	0	0.00	0.00	0.00	0.00	0.00
23	-	-	-	-	-	-	0	0.00	0.00	0.00	0.00	0.00	683	0.36	0.63	0.04	0.01	0.05

Table 9.24. Outlet emissions summary [2033 Do something, regulatory traffic], continued

Outlet identifier:	K						L						M						N					
EIS name:	SPI (M4-M5 Link)						Iron Cove Link (north)						Arncliffe (F6 Extension)						Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	316	0.28	0.36	0.03	0.01	0.03	311	0.10	0.23	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
1	294	0.23	0.27	0.02	0.00	0.02	274	0.07	0.16	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
2	278	0.17	0.22	0.02	0.00	0.02	253	0.06	0.12	0.00	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
3	276	0.15	0.21	0.01	0.00	0.02	256	0.05	0.13	0.00	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
4	319	0.24	0.33	0.02	0.00	0.03	282	0.07	0.20	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
5	425	0.65	0.78	0.06	0.01	0.07	362	0.13	0.46	0.01	0.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-
6	563	1.24	1.90	0.13	0.02	0.15	426	0.24	0.84	0.03	0.00	0.03	-	-	-	-	-	-	-	-	-	-	-	-
7	668	2.17	3.52	0.23	0.04	0.27	459	0.41	1.17	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
8	654	2.23	3.18	0.22	0.04	0.26	477	0.43	1.17	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
9	654	2.29	3.08	0.21	0.04	0.25	496	0.49	1.11	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
10	662	2.39	3.09	0.22	0.04	0.26	502	0.51	1.09	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
11	668	2.46	3.11	0.22	0.04	0.26	506	0.53	1.09	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
12	669	2.49	3.11	0.22	0.05	0.26	509	0.54	1.10	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
13	663	2.42	3.08	0.22	0.04	0.26	511	0.55	1.11	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
14	652	2.29	3.04	0.21	0.04	0.25	513	0.55	1.14	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
15	631	2.13	3.01	0.20	0.04	0.24	507	0.52	1.22	0.06	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
16	608	1.92	2.95	0.20	0.03	0.23	513	0.53	1.36	0.06	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
17	597	1.76	2.47	0.17	0.03	0.20	501	0.46	1.12	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
18	594	1.70	2.19	0.15	0.03	0.18	497	0.42	1.03	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
19	587	1.62	2.02	0.14	0.03	0.17	492	0.40	0.97	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
20	576	1.55	1.90	0.13	0.03	0.16	486	0.38	0.92	0.04	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
21	564	1.47	1.78	0.13	0.03	0.15	476	0.35	0.85	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
22	513	1.11	1.27	0.09	0.02	0.11	419	0.24	0.57	0.02	0.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-
23	398	0.45	0.59	0.04	0.01	0.05	341	0.13	0.31	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-

9.3 Cumulative

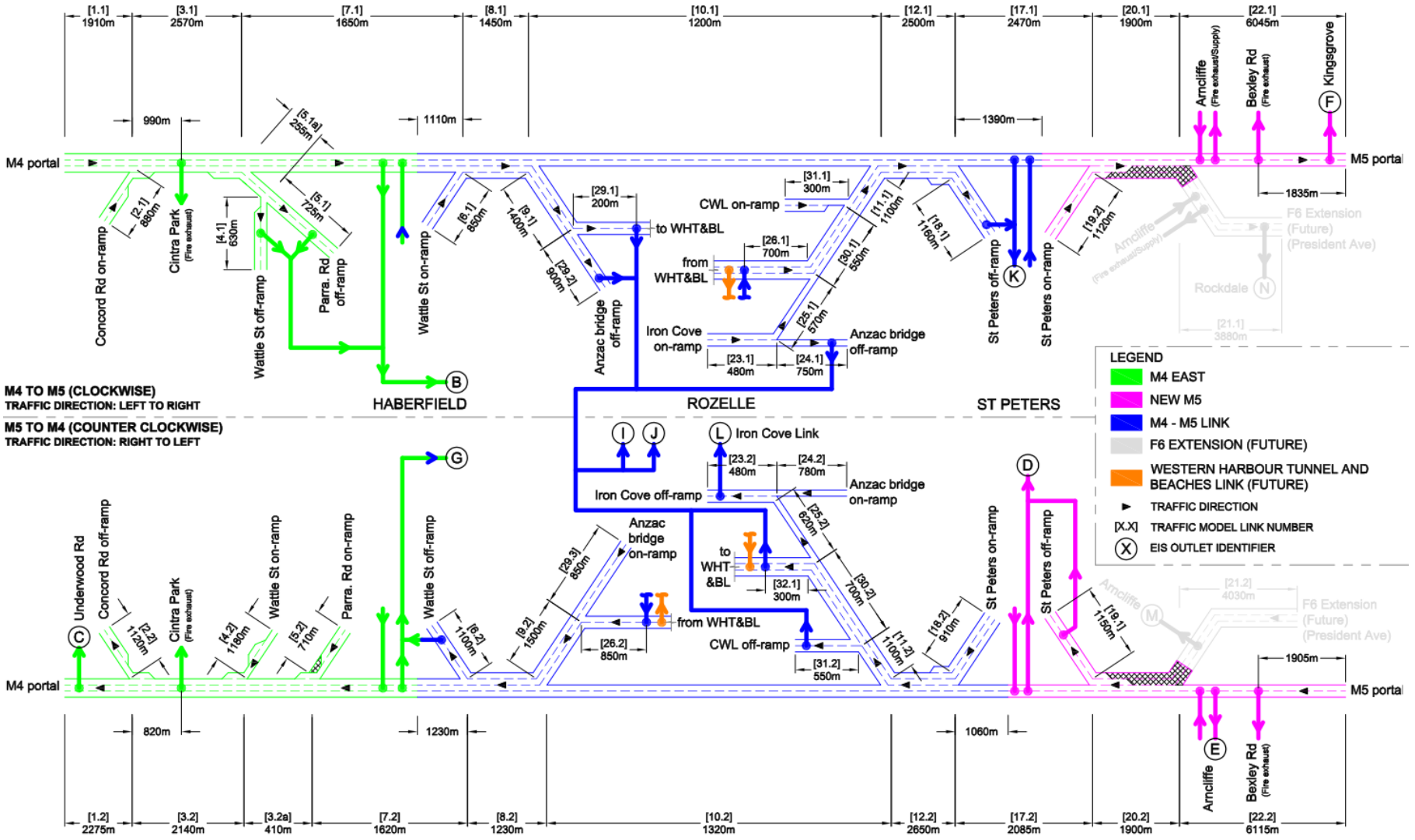


Figure 9.67. Ventilation schematic, 2023 Cumulative.

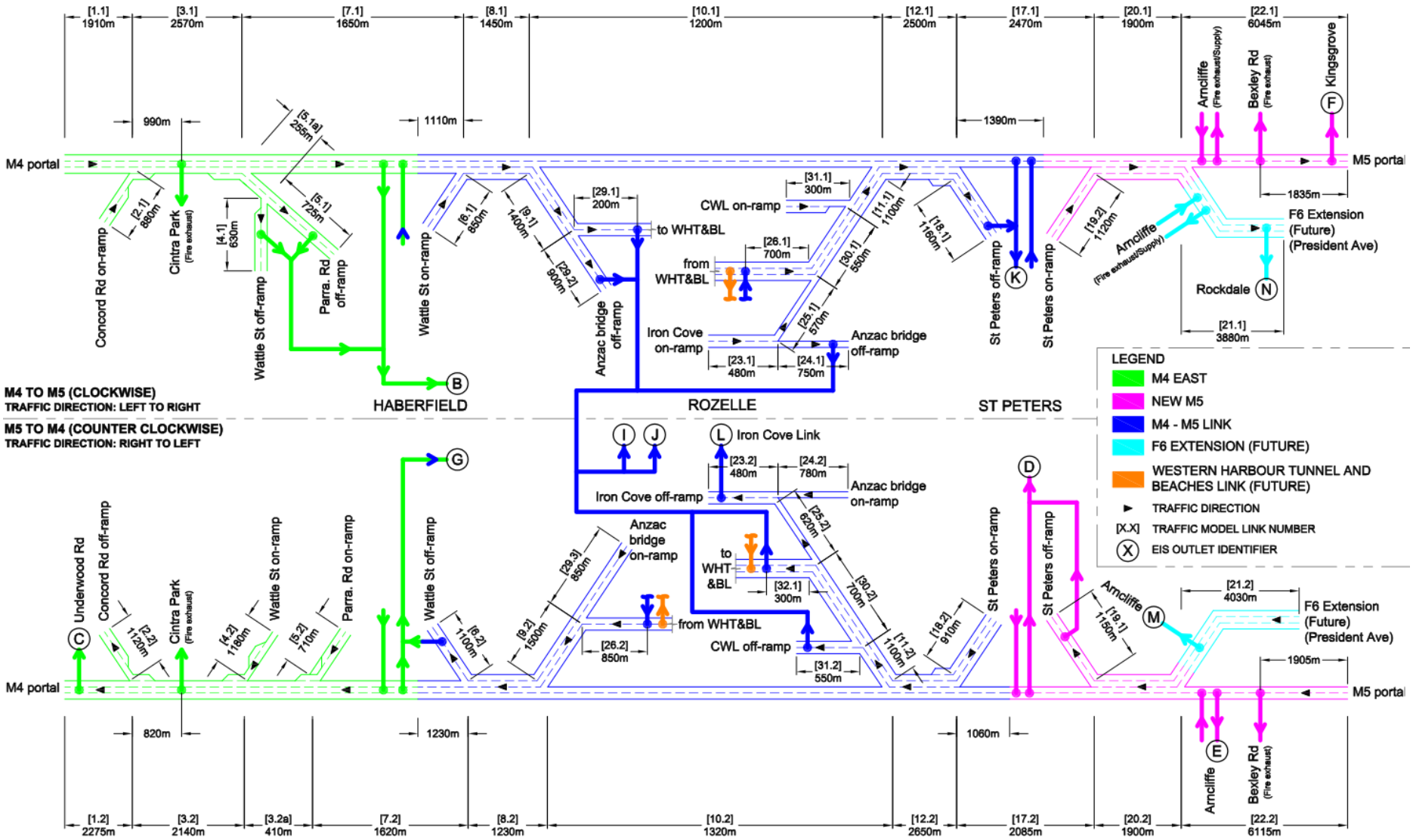


Figure 9.68. Ventilation schematic, 2033 Cumulative.

9.3.1 2023 expected traffic operations

Table 9.25. In-Tunnel estimated air quality maximum [2023 Cumulative, expected traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.14	1.76	0.0007	0.07	0.95	0.0004	0.20	3.00	0.0014	0.11	0.08	1.17	0.0005	0.12	1.77	0.0006	0.04	0.69	0.0003	0.08
1	0.10	1.34	0.0005	0.06	0.69	0.0003	0.14	2.37	0.0008	0.08	0.07	1.05	0.0004	0.10	1.38	0.0005	0.02	0.44	0.0002	0.06
2	0.08	1.16	0.0004	0.05	0.61	0.0003	0.13	2.06	0.0007	0.07	0.07	0.91	0.0004	0.09	1.18	0.0004	0.02	0.30	0.0002	0.06
3	0.09	1.20	0.0004	0.05	0.62	0.0003	0.12	1.85	0.0006	0.06	0.07	0.87	0.0004	0.08	1.17	0.0004	0.01	0.29	0.0001	0.05
4	0.13	1.63	0.0006	0.06	0.81	0.0004	0.12	2.13	0.0007	0.07	0.08	1.13	0.0004	0.11	1.54	0.0006	0.02	0.41	0.0002	0.07
5	0.21	2.55	0.0010	0.11	1.39	0.0007	0.17	2.98	0.0009	0.12	0.12	2.28	0.0007	0.20	2.95	0.0011	0.05	0.96	0.0003	0.13
6	0.34	5.17	0.0018	0.19	2.70	0.0012	0.26	4.54	0.0016	0.20	0.21	4.03	0.0013	0.40	6.71	0.0022	0.11	1.73	0.0007	0.24
7	0.49	7.23	0.0028	0.35	4.47	0.0020	0.41	7.29	0.0024	0.30	0.36	8.03	0.0019	0.63	8.68	0.0034	0.16	3.16	0.0014	0.39
8	0.46	6.30	0.0025	0.27	3.63	0.0017	0.44	6.76	0.0024	0.28	0.31	5.78	0.0018	0.60	7.96	0.0031	0.14	2.44	0.0011	0.36
9	0.46	6.02	0.0023	0.25	3.35	0.0016	0.44	6.26	0.0023	0.28	0.30	4.96	0.0017	0.57	7.45	0.0029	0.14	2.19	0.0010	0.35
10	0.46	5.91	0.0023	0.25	3.27	0.0015	0.44	6.04	0.0023	0.28	0.30	4.69	0.0016	0.57	7.24	0.0029	0.13	2.09	0.0009	0.34
11	0.46	5.84	0.0023	0.25	3.22	0.0015	0.44	5.91	0.0023	0.28	0.30	4.56	0.0016	0.56	7.06	0.0028	0.13	2.05	0.0009	0.34
12	0.46	5.80	0.0023	0.24	3.18	0.0015	0.44	5.87	0.0023	0.28	0.29	4.48	0.0016	0.56	6.93	0.0028	0.13	2.01	0.0009	0.34
13	0.43	5.75	0.0021	0.22	3.16	0.0014	0.44	6.20	0.0023	0.26	0.30	4.52	0.0016	0.57	7.06	0.0029	0.13	1.99	0.0009	0.35
14	0.40	5.77	0.0021	0.20	3.23	0.0013	0.45	7.11	0.0024	0.26	0.31	4.82	0.0017	0.59	7.32	0.0030	0.13	1.98	0.0009	0.36
15	0.39	5.94	0.0020	0.20	3.42	0.0013	0.48	8.38	0.0027	0.27	0.33	5.37	0.0018	0.65	8.02	0.0033	0.12	1.97	0.0009	0.40
16	0.39	6.20	0.0021	0.21	4.18	0.0014	0.52	9.61	0.0030	0.29	0.36	6.64	0.0021	0.76	9.15	0.0038	0.12	1.97	0.0008	0.46
17	0.35	5.34	0.0018	0.19	3.13	0.0012	0.36	7.11	0.0021	0.22	0.28	4.63	0.0016	0.53	7.48	0.0028	0.10	1.61	0.0007	0.33
18	0.33	4.52	0.0017	0.17	2.65	0.0011	0.32	5.81	0.0018	0.19	0.22	3.85	0.0012	0.41	5.71	0.0021	0.09	1.44	0.0006	0.25
19	0.32	4.09	0.0016	0.16	2.41	0.0010	0.29	5.16	0.0016	0.18	0.20	3.45	0.0011	0.37	5.09	0.0019	0.09	1.35	0.0006	0.23
20	0.31	3.96	0.0015	0.16	2.32	0.0010	0.28	4.81	0.0015	0.18	0.19	3.22	0.0011	0.35	4.85	0.0018	0.08	1.27	0.0005	0.21
21	0.31	3.87	0.0015	0.16	2.24	0.0010	0.27	4.60	0.0015	0.17	0.19	3.08	0.0010	0.33	4.71	0.0017	0.08	1.19	0.0005	0.20
22	0.25	3.03	0.0012	0.13	1.61	0.0008	0.24	3.97	0.0014	0.15	0.14	2.09	0.0008	0.24	3.49	0.0012	0.05	1.05	0.0003	0.14
23	0.17	2.08	0.0008	0.08	1.04	0.0005	0.20	2.88	0.0014	0.12	0.10	1.38	0.0005	0.15	2.05	0.0008	0.03	0.57	0.0002	0.09

Table 9.26. Summary of route average NO_2, M4 to M5 direction [2023 Cumulative, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		1A	1C	1D	1E	1F	1K	1L	1N	1P	1Q	1S	1T	1V	1Y	1AB	1AC
Enter at		M4 portal	M4 portal	M4 portal	M4 portal	M4 portal	Concord Rd	Concord Rd	Wattle St	Wattle St	Wattle St	WHT&BL interface	WHT&BL interface	St Peters	Iron Cove Link	City West Link	City West Link
Exit at		Wattle St	Anzac Bridge	St Peters	M5 portal	President Ave.	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	St Peters	M5 portal	M5 portal	St Peters	St Peters	M5 portal
Distance		5.4 km	9.9 km	12.5 km	21.7 km	19.6 km	11.5 km	20.7 km	4.6 km	7.2 km	16.4 km	6.1 km	15.3 km	9.1 km	6.4 km	5.1 km	14.4 km
Design Case	0	0.03	0.06	0.06	0.09	0.06	0.07	0.09	0.07	0.07	0.10	0.06	0.09	0.11	0.06	0.07	0.10
	1	0.02	0.04	0.05	0.07	0.04	0.05	0.07	0.05	0.05	0.08	0.04	0.07	0.08	0.04	0.05	0.08
	2	0.02	0.04	0.04	0.05	0.03	0.04	0.06	0.04	0.04	0.06	0.03	0.06	0.07	0.03	0.04	0.06
	3	0.02	0.04	0.04	0.05	0.03	0.04	0.05	0.04	0.05	0.06	0.04	0.06	0.06	0.03	0.04	0.06
	4	0.02	0.05	0.06	0.07	0.05	0.06	0.07	0.06	0.07	0.07	0.05	0.07	0.07	0.05	0.06	0.07
	5	0.04	0.09	0.10	0.11	0.08	0.11	0.11	0.11	0.11	0.12	0.09	0.11	0.10	0.09	0.11	0.11
	6	0.07	0.15	0.17	0.18	0.14	0.18	0.19	0.19	0.19	0.20	0.15	0.18	0.18	0.14	0.17	0.20
	7	0.12	0.24	0.25	0.29	0.21	0.27	0.30	0.29	0.27	0.30	0.21	0.28	0.29	0.20	0.25	0.30
	8	0.10	0.21	0.23	0.26	0.19	0.24	0.27	0.25	0.25	0.28	0.20	0.26	0.27	0.19	0.23	0.28
	9	0.09	0.20	0.22	0.25	0.19	0.24	0.26	0.24	0.25	0.28	0.20	0.26	0.26	0.19	0.23	0.28
	10	0.09	0.19	0.22	0.25	0.18	0.23	0.26	0.24	0.25	0.28	0.20	0.26	0.26	0.19	0.23	0.28
	11	0.09	0.19	0.22	0.25	0.18	0.23	0.26	0.24	0.25	0.28	0.20	0.26	0.26	0.19	0.23	0.27
	12	0.09	0.19	0.21	0.25	0.18	0.23	0.26	0.23	0.25	0.28	0.20	0.26	0.26	0.19	0.23	0.27
	13	0.08	0.17	0.20	0.24	0.17	0.21	0.24	0.21	0.23	0.26	0.18	0.25	0.25	0.17	0.21	0.26
	14	0.08	0.16	0.18	0.23	0.16	0.20	0.24	0.20	0.21	0.26	0.17	0.24	0.25	0.16	0.20	0.26
	15	0.07	0.15	0.18	0.23	0.16	0.19	0.24	0.19	0.20	0.26	0.16	0.25	0.27	0.16	0.19	0.26
	16	0.07	0.15	0.18	0.24	0.16	0.19	0.25	0.19	0.20	0.28	0.16	0.26	0.29	0.16	0.19	0.28
	17	0.07	0.14	0.16	0.19	0.14	0.17	0.20	0.18	0.19	0.22	0.15	0.20	0.21	0.14	0.17	0.21
	18	0.06	0.13	0.15	0.17	0.13	0.16	0.18	0.17	0.18	0.19	0.14	0.18	0.18	0.13	0.16	0.19
	19	0.06	0.13	0.15	0.17	0.13	0.16	0.17	0.16	0.17	0.18	0.13	0.17	0.17	0.13	0.16	0.18
	20	0.06	0.13	0.14	0.16	0.12	0.15	0.17	0.16	0.17	0.18	0.13	0.16	0.16	0.13	0.15	0.17
	21	0.06	0.13	0.14	0.16	0.12	0.15	0.17	0.16	0.17	0.17	0.13	0.16	0.15	0.12	0.15	0.17
	22	0.05	0.10	0.12	0.14	0.10	0.13	0.14	0.13	0.14	0.15	0.11	0.14	0.14	0.10	0.13	0.15
	23	0.03	0.06	0.08	0.10	0.07	0.08	0.11	0.08	0.09	0.12	0.07	0.11	0.12	0.07	0.09	0.12

Table 9.27. Summary of route average NO_2, M5 to M4 direction [2023 Cumulative, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		2A	2D	2E	2K	2L	2M	2N	2P	2Q	2S	2T	2U	2X	2AC	2AF	2AH
Enter at		M5 portal	M5 portal	M5 portal	President Ave.	St Peters	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	St Peters	WHT&BL interface	WHT&BL interface
Exit at		St Peters	Concord Rd	M4 portal	M4 portal	WHT&BL interface	Wattle St	Concord Rd	M4 portal	Wattle St	M4 Portal	Concord Rd	M4 portal	M4 portal	Iron Cove Link	Wattle St	M4 portal
Distance		9.2 km	20.6 km	21.7 km	19.7 km	5.6 km	7.1 km	11.3 km	12.5 km	4.7 km	10 km	4.4 km	5.5 km	5.6 km	6.4 km	4.7 km	10 km
Hour	0	0.01	0.03	0.04	0.04	0.03	0.04	0.05	0.06	0.03	0.06	0.05	0.08	0.07	0.04	0.03	0.06
	1	0.01	0.03	0.03	0.04	0.03	0.03	0.04	0.05	0.02	0.05	0.04	0.06	0.06	0.03	0.02	0.05
	2	0.01	0.02	0.03	0.03	0.02	0.03	0.04	0.04	0.02	0.04	0.04	0.06	0.05	0.03	0.02	0.04
	3	0.01	0.02	0.03	0.03	0.02	0.03	0.04	0.04	0.02	0.04	0.04	0.05	0.05	0.03	0.02	0.04
	4	0.01	0.03	0.04	0.04	0.03	0.03	0.04	0.05	0.02	0.06	0.05	0.07	0.06	0.03	0.02	0.06
	5	0.02	0.05	0.06	0.06	0.05	0.06	0.08	0.10	0.04	0.10	0.09	0.13	0.12	0.05	0.04	0.10
	6	0.04	0.10	0.12	0.12	0.09	0.10	0.14	0.18	0.07	0.18	0.16	0.24	0.23	0.10	0.07	0.18
	7	0.07	0.16	0.20	0.20	0.15	0.17	0.23	0.29	0.11	0.29	0.26	0.39	0.36	0.16	0.11	0.29
	8	0.06	0.15	0.18	0.18	0.14	0.15	0.21	0.27	0.10	0.27	0.25	0.36	0.34	0.14	0.10	0.27
	9	0.05	0.14	0.17	0.17	0.13	0.15	0.20	0.25	0.10	0.26	0.24	0.35	0.32	0.14	0.10	0.26
	10	0.05	0.14	0.17	0.17	0.12	0.14	0.20	0.25	0.10	0.26	0.23	0.34	0.32	0.13	0.10	0.26
	11	0.05	0.14	0.17	0.17	0.12	0.14	0.20	0.25	0.10	0.25	0.23	0.34	0.32	0.13	0.10	0.26
	12	0.05	0.13	0.17	0.17	0.12	0.14	0.20	0.25	0.10	0.25	0.23	0.34	0.32	0.13	0.10	0.25
	13	0.05	0.13	0.17	0.17	0.12	0.14	0.20	0.25	0.10	0.26	0.24	0.35	0.33	0.13	0.10	0.26
	14	0.05	0.14	0.17	0.17	0.12	0.14	0.20	0.26	0.10	0.27	0.25	0.36	0.34	0.13	0.10	0.27
	15	0.05	0.14	0.18	0.19	0.12	0.14	0.22	0.28	0.10	0.29	0.27	0.40	0.37	0.13	0.11	0.29
	16	0.05	0.15	0.20	0.21	0.12	0.15	0.24	0.31	0.11	0.33	0.31	0.46	0.43	0.13	0.12	0.33
	17	0.04	0.12	0.15	0.15	0.10	0.12	0.18	0.23	0.09	0.24	0.22	0.33	0.30	0.11	0.09	0.24
	18	0.03	0.10	0.12	0.12	0.09	0.10	0.14	0.18	0.07	0.19	0.17	0.25	0.23	0.10	0.07	0.19
	19	0.03	0.09	0.11	0.11	0.08	0.10	0.13	0.17	0.07	0.17	0.15	0.23	0.21	0.09	0.07	0.17
	20	0.03	0.08	0.10	0.11	0.08	0.09	0.13	0.16	0.06	0.16	0.14	0.21	0.20	0.09	0.06	0.16
	21	0.03	0.08	0.10	0.10	0.08	0.09	0.12	0.15	0.06	0.15	0.14	0.20	0.19	0.08	0.06	0.15
	22	0.02	0.05	0.07	0.07	0.06	0.06	0.08	0.11	0.04	0.11	0.09	0.14	0.13	0.06	0.05	0.11
	23	0.01	0.04	0.05	0.05	0.04	0.04	0.06	0.07	0.03	0.07	0.06	0.09	0.09	0.04	0.03	0.07

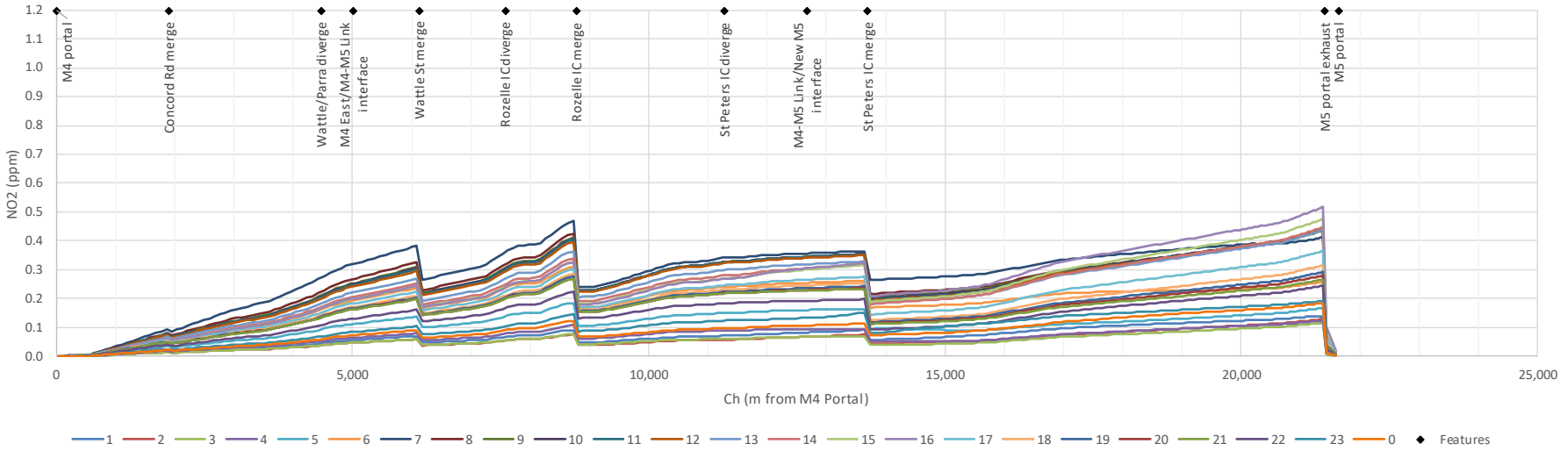


Figure 9.69 In-Tunnel NO_2 levels along route 1E from M4 portal to M5 portal [2023 Cumulative, expected traffic]

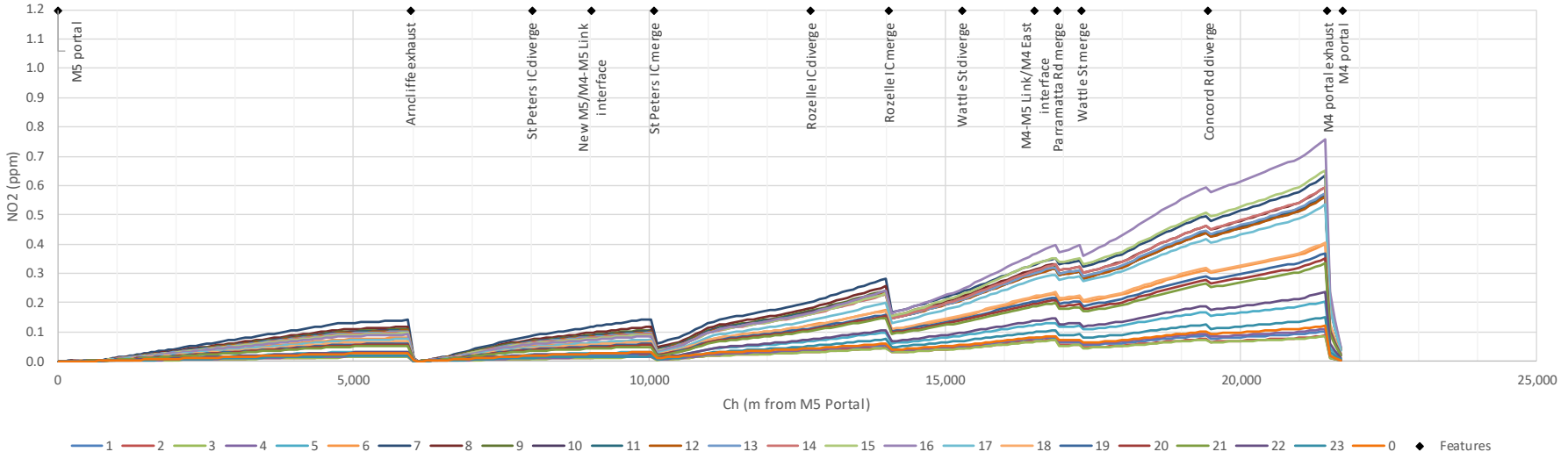


Figure 9.70. In-Tunnel NO_2 levels along route 2E from M5 portal to M4 portal [2023 Cumulative, expected traffic]

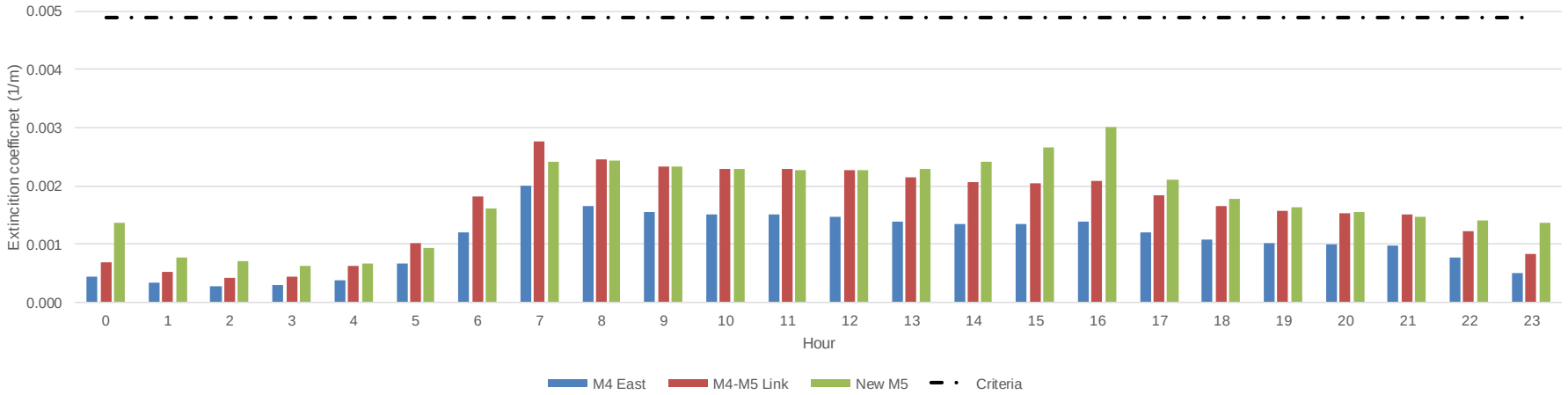


Figure 9.71. Maximum In-Tunnel visibility for M4 to M5 direction [2023 Cumulative, expected traffic]

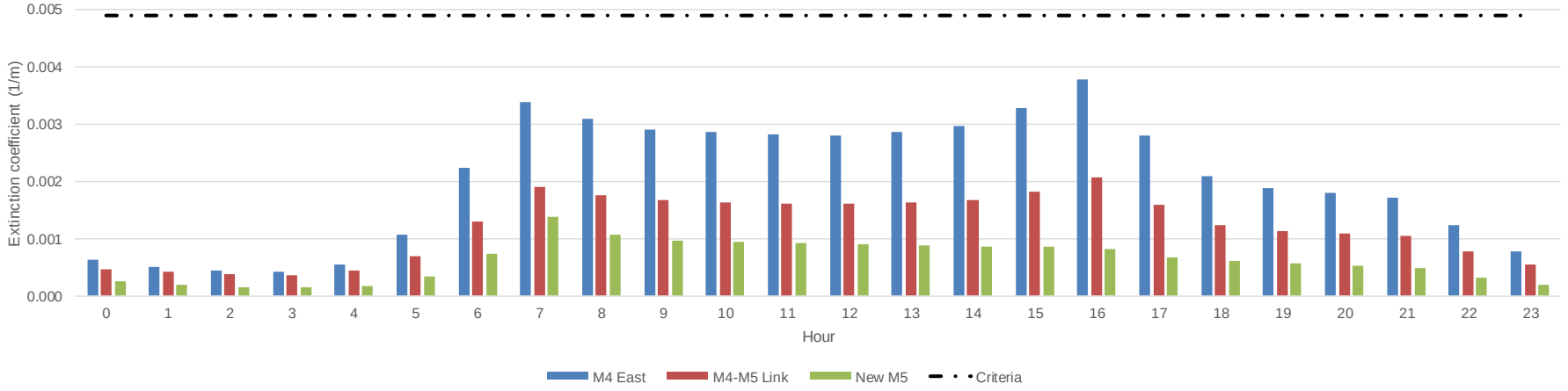


Figure 9.72. Maximum In-Tunnel visibility for M5 to M4 direction [2023 Cumulative, expected traffic]

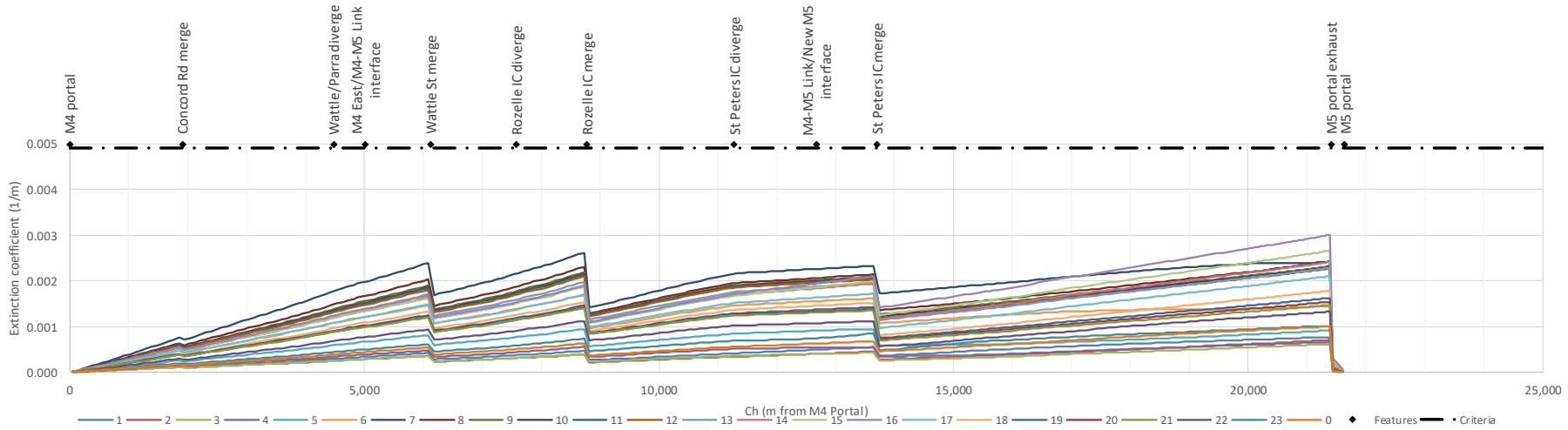


Figure 9.73. In-Tunnel visibility along route 1E from M4 portal to M5 portal [2023 Cumulative, expected traffic]

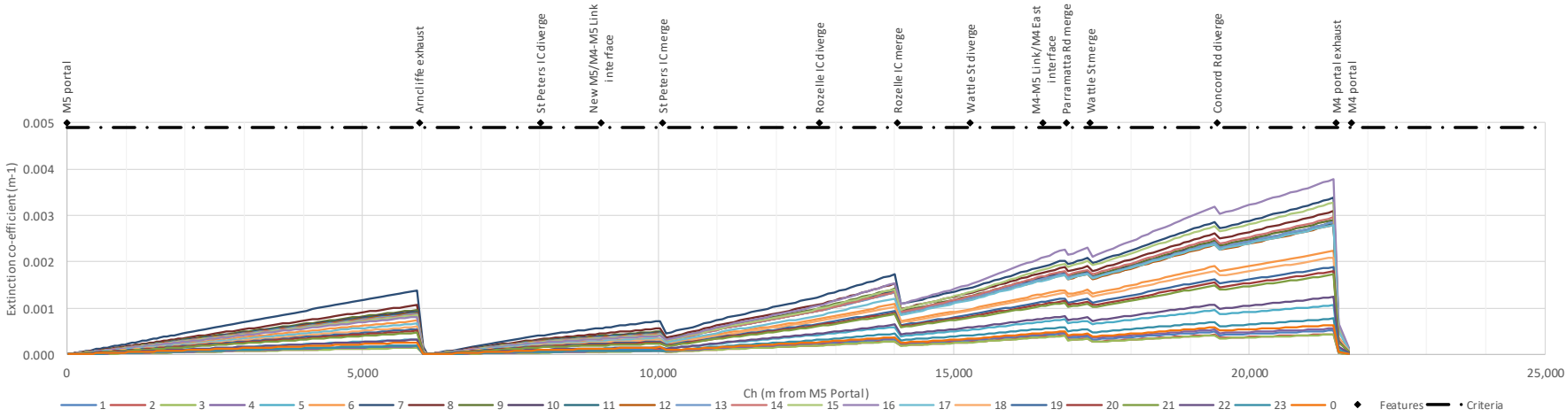


Figure 9.74. In-Tunnel visibility along route 2E from M5 portal to M4 portal [2023 Cumulative, expected traffic]

Table 9.28. Outlet emissions summary [2023 Cumulative, expected traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	276	0.13	0.22	0.01	0.00	0.01	491	0.56	0.86	0.04	0.01	0.05	157	0.03	0.07	0.00	0.00	0.00
1	276	0.09	0.15	0.01	0.00	0.01	453	0.43	0.60	0.03	0.01	0.04	156	0.02	0.04	0.00	0.00	0.00
2	276	0.08	0.13	0.01	0.00	0.01	427	0.34	0.48	0.02	0.01	0.03	155	0.01	0.03	0.00	0.00	0.00
3	276	0.08	0.14	0.01	0.00	0.01	427	0.33	0.47	0.02	0.01	0.03	155	0.01	0.03	0.00	0.00	0.00
4	276	0.11	0.18	0.01	0.00	0.01	477	0.49	0.72	0.03	0.01	0.04	155	0.02	0.04	0.00	0.00	0.00
5	276	0.21	0.32	0.02	0.00	0.02	621	1.27	1.93	0.09	0.03	0.12	161	0.05	0.10	0.00	0.00	0.00
6	297	0.43	0.71	0.03	0.01	0.04	865	3.42	6.48	0.29	0.07	0.36	273	0.25	0.43	0.01	0.00	0.02
7	275	0.70	1.09	0.05	0.01	0.07	920	6.10	8.88	0.47	0.12	0.59	345	0.48	1.09	0.03	0.01	0.04
8	313	0.67	1.10	0.05	0.01	0.07	931	5.89	8.27	0.42	0.12	0.55	314	0.40	0.74	0.02	0.01	0.03
9	331	0.67	1.11	0.05	0.01	0.07	933	5.74	7.74	0.40	0.12	0.52	304	0.37	0.64	0.02	0.01	0.03
10	331	0.66	1.08	0.05	0.01	0.07	928	5.71	7.48	0.38	0.12	0.50	300	0.36	0.60	0.02	0.01	0.03
11	329	0.65	1.07	0.05	0.01	0.07	925	5.70	7.26	0.38	0.12	0.50	298	0.36	0.58	0.02	0.01	0.02
12	329	0.63	1.06	0.05	0.01	0.06	922	5.69	7.11	0.37	0.12	0.49	297	0.35	0.57	0.02	0.01	0.02
13	330	0.57	1.05	0.05	0.01	0.06	927	5.85	7.27	0.38	0.12	0.50	293	0.34	0.55	0.02	0.01	0.02
14	337	0.54	1.12	0.05	0.01	0.06	936	6.10	7.62	0.40	0.13	0.53	286	0.32	0.53	0.02	0.01	0.02
15	356	0.56	1.29	0.06	0.01	0.07	945	6.72	8.44	0.45	0.14	0.59	281	0.30	0.52	0.02	0.01	0.02
16	376	0.61	1.53	0.06	0.01	0.08	887	7.13	8.95	0.49	0.14	0.63	270	0.27	0.49	0.01	0.01	0.02
17	348	0.50	1.12	0.05	0.01	0.06	921	5.19	7.69	0.38	0.11	0.49	233	0.19	0.32	0.01	0.00	0.01
18	319	0.41	0.81	0.04	0.01	0.04	834	3.55	5.26	0.25	0.07	0.33	220	0.16	0.26	0.01	0.00	0.01
19	308	0.38	0.69	0.03	0.01	0.04	799	3.11	4.47	0.22	0.07	0.28	212	0.14	0.23	0.01	0.00	0.01
20	301	0.36	0.63	0.03	0.01	0.04	784	2.89	4.17	0.20	0.06	0.26	207	0.13	0.21	0.01	0.00	0.01
21	297	0.35	0.60	0.03	0.01	0.04	772	2.68	3.98	0.19	0.06	0.25	197	0.11	0.18	0.01	0.00	0.01
22	276	0.25	0.38	0.02	0.01	0.02	678	1.62	2.57	0.12	0.03	0.15	156	0.04	0.10	0.00	0.00	0.00
23	276	0.15	0.23	0.01	0.00	0.01	539	0.80	1.14	0.06	0.02	0.07	156	0.02	0.05	0.00	0.00	0.00

Table 9.28. Outlet emissions summary [2023 Cumulative, expected traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	200	0.05	0.09	0.01	0.00	0.01	289	0.45	0.80	0.04	0.01	0.05	186	0.08	0.14	0.01	0.00	0.01
1	163	0.03	0.05	0.00	0.00	0.01	257	0.29	0.54	0.02	0.01	0.03	175	0.07	0.11	0.01	0.00	0.01
2	139	0.02	0.03	0.00	0.00	0.00	234	0.24	0.41	0.02	0.00	0.02	169	0.06	0.09	0.00	0.00	0.01
3	135	0.01	0.03	0.00	0.00	0.00	234	0.21	0.37	0.02	0.00	0.02	171	0.06	0.09	0.00	0.00	0.01
4	156	0.02	0.05	0.00	0.00	0.00	264	0.27	0.51	0.02	0.01	0.03	182	0.08	0.14	0.01	0.00	0.01
5	225	0.07	0.13	0.01	0.00	0.01	312	0.44	0.89	0.04	0.01	0.05	216	0.16	0.30	0.01	0.00	0.02
6	380	0.30	0.51	0.05	0.01	0.05	377	0.87	1.71	0.07	0.02	0.09	296	0.43	0.95	0.04	0.01	0.05
7	526	0.72	1.39	0.13	0.02	0.14	428	1.58	3.17	0.15	0.03	0.18	336	0.78	1.48	0.07	0.02	0.09
8	475	0.56	0.95	0.09	0.01	0.10	441	1.85	3.07	0.15	0.04	0.19	327	0.73	1.30	0.06	0.02	0.08
9	447	0.50	0.78	0.07	0.01	0.09	451	1.94	2.92	0.15	0.04	0.19	321	0.70	1.20	0.06	0.01	0.07
10	437	0.48	0.72	0.07	0.01	0.08	457	2.02	2.87	0.15	0.04	0.19	319	0.69	1.15	0.06	0.01	0.07
11	433	0.47	0.70	0.07	0.01	0.08	459	2.05	2.82	0.14	0.04	0.19	318	0.68	1.12	0.06	0.01	0.07
12	428	0.46	0.67	0.06	0.01	0.08	460	2.07	2.82	0.14	0.04	0.19	315	0.67	1.09	0.06	0.01	0.07
13	424	0.45	0.66	0.06	0.01	0.07	473	2.09	3.07	0.15	0.04	0.20	319	0.69	1.12	0.06	0.01	0.07
14	419	0.42	0.65	0.06	0.01	0.07	503	2.22	3.80	0.18	0.05	0.22	324	0.71	1.17	0.06	0.02	0.08
15	415	0.41	0.63	0.06	0.01	0.07	543	2.49	4.92	0.22	0.05	0.27	337	0.78	1.31	0.07	0.02	0.08
16	407	0.38	0.61	0.06	0.01	0.06	572	2.79	5.98	0.26	0.06	0.32	446	1.27	2.06	0.12	0.03	0.14
17	361	0.27	0.43	0.04	0.01	0.05	488	1.63	3.70	0.15	0.03	0.19	321	0.61	1.13	0.06	0.01	0.07
18	336	0.23	0.35	0.03	0.01	0.04	439	1.27	2.67	0.11	0.03	0.14	287	0.44	0.81	0.04	0.01	0.05
19	318	0.19	0.30	0.03	0.00	0.03	412	1.11	2.19	0.10	0.02	0.12	273	0.39	0.69	0.03	0.01	0.04
20	304	0.17	0.27	0.03	0.00	0.03	399	1.02	1.96	0.09	0.02	0.11	265	0.36	0.63	0.03	0.01	0.04
21	289	0.15	0.23	0.02	0.00	0.03	388	0.94	1.81	0.08	0.02	0.10	259	0.33	0.59	0.03	0.01	0.04
22	227	0.06	0.13	0.01	0.00	0.01	353	0.78	1.38	0.06	0.02	0.08	205	0.17	0.29	0.02	0.00	0.02
23	169	0.03	0.06	0.00	0.00	0.01	264	0.42	0.61	0.03	0.01	0.04	183	0.10	0.17	0.01	0.00	0.01

Table 9.28. Outlet emissions summary [2023 Cumulative, expected traffic], continued

Outlet identifier:	H						I						J					
EIS name:	Rozelle North (WHT)						Rozelle Mid (M4-M5 Link/ICL)						Rozelle South (M4-M5 Link/ICL)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	365	0.12	0.28	0.02	0.00	0.02	788	0.40	0.66	0.03	0.01	0.04	0	0.00	0.00	0.00	0.00	0.00
1	310	0.07	0.17	0.01	0.00	0.01	0	0.00	0.00	0.00	0.00	0.00	695	0.27	0.43	0.02	0.01	0.03
2	275	0.05	0.11	0.01	0.00	0.01	0	0.00	0.00	0.00	0.00	0.00	650	0.20	0.34	0.02	0.00	0.02
3	283	0.06	0.12	0.01	0.00	0.01	0	0.00	0.00	0.00	0.00	0.00	638	0.18	0.32	0.02	0.00	0.02
4	343	0.10	0.24	0.01	0.00	0.02	0	0.00	0.00	0.00	0.00	0.00	732	0.29	0.54	0.03	0.01	0.03
5	455	0.22	0.62	0.04	0.00	0.04	1,006	0.89	1.52	0.07	0.02	0.09	0	0.00	0.00	0.00	0.00	0.00
6	630	0.61	1.70	0.10	0.01	0.11	840	1.48	2.69	0.13	0.03	0.16	519	0.91	1.66	0.08	0.02	0.10
7	753	1.33	2.98	0.20	0.03	0.23	944	2.83	4.97	0.27	0.06	0.32	583	1.75	3.07	0.16	0.04	0.20
8	721	1.21	2.46	0.16	0.03	0.19	865	2.31	3.87	0.21	0.05	0.25	534	1.43	2.39	0.13	0.03	0.16
9	699	1.14	2.14	0.14	0.03	0.17	874	2.05	3.34	0.18	0.04	0.22	539	1.26	2.06	0.11	0.03	0.14
10	680	1.09	1.90	0.13	0.02	0.15	859	1.96	3.14	0.17	0.04	0.21	530	1.21	1.94	0.10	0.03	0.13
11	663	1.05	1.71	0.12	0.02	0.14	854	1.91	3.05	0.16	0.04	0.20	527	1.18	1.88	0.10	0.03	0.12
12	658	1.04	1.65	0.12	0.02	0.14	847	1.83	2.98	0.15	0.04	0.19	523	1.13	1.84	0.10	0.02	0.12
13	679	1.17	1.82	0.13	0.03	0.15	841	1.67	2.90	0.15	0.04	0.18	519	1.03	1.79	0.09	0.02	0.11
14	722	1.42	2.24	0.16	0.03	0.19	838	1.56	2.89	0.15	0.03	0.18	517	0.96	1.78	0.09	0.02	0.11
15	773	1.83	2.98	0.21	0.04	0.25	839	1.50	2.96	0.15	0.03	0.18	518	0.93	1.82	0.09	0.02	0.11
16	740	2.41	3.95	0.31	0.05	0.36	841	1.48	3.08	0.16	0.03	0.19	519	0.92	1.90	0.10	0.02	0.11
17	713	1.12	2.39	0.16	0.02	0.18	786	1.25	2.41	0.12	0.03	0.15	485	0.77	1.49	0.08	0.02	0.09
18	581	0.51	1.31	0.08	0.01	0.09	1,229	1.84	3.31	0.17	0.04	0.21	0	0.00	0.00	0.00	0.00	0.00
19	514	0.36	0.87	0.05	0.01	0.06	1,211	1.75	3.01	0.15	0.04	0.19	0	0.00	0.00	0.00	0.00	0.00
20	475	0.29	0.67	0.04	0.01	0.05	1,200	1.70	2.88	0.15	0.04	0.18	0	0.00	0.00	0.00	0.00	0.00
21	454	0.25	0.57	0.04	0.01	0.04	1,190	1.65	2.79	0.14	0.04	0.18	0	0.00	0.00	0.00	0.00	0.00
22	410	0.17	0.43	0.03	0.00	0.03	1,000	1.02	1.53	0.08	0.02	0.10	0	0.00	0.00	0.00	0.00	0.00
23	355	0.10	0.27	0.02	0.00	0.02	787	0.41	0.73	0.04	0.01	0.04	0	0.00	0.00	0.00	0.00	0.00

Table 9.28. Outlet emissions summary [2023 Cumulative, expected traffic], continued

Outlet identifier:	K						L						M						N					
EIS name:	SPI (M4-M5 Link)						Iron Cove Link (north)						Arncliffe (F6 Extension)						Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	359	0.45	0.57	0.03	0.01	0.04	300	0.13	0.29	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
1	307	0.26	0.35	0.02	0.01	0.02	274	0.10	0.22	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
2	287	0.19	0.28	0.01	0.00	0.02	262	0.09	0.18	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
3	302	0.22	0.31	0.02	0.00	0.02	264	0.08	0.19	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
4	368	0.42	0.55	0.03	0.01	0.04	286	0.10	0.28	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-
5	470	0.97	1.17	0.06	0.02	0.08	359	0.16	0.63	0.01	0.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-
6	668	2.23	3.60	0.17	0.05	0.22	416	0.27	1.03	0.03	0.01	0.03	-	-	-	-	-	-	-	-	-	-	-	-
7	737	3.51	5.63	0.29	0.07	0.36	430	0.35	1.27	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
8	740	3.52	4.93	0.25	0.07	0.33	457	0.47	1.36	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
9	736	3.55	4.67	0.24	0.07	0.32	479	0.59	1.37	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
10	735	3.55	4.58	0.24	0.07	0.31	487	0.64	1.38	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
11	734	3.55	4.53	0.24	0.07	0.31	490	0.66	1.38	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
12	733	3.52	4.48	0.23	0.07	0.31	492	0.67	1.38	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
13	717	3.14	4.34	0.22	0.07	0.29	493	0.67	1.39	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
14	696	2.80	4.21	0.21	0.06	0.27	492	0.66	1.42	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
15	678	2.56	4.21	0.20	0.05	0.26	484	0.59	1.48	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
16	666	2.47	4.30	0.21	0.05	0.26	485	0.58	1.59	0.06	0.01	0.07	-	-	-	-	-	-	-	-	-	-	-	-
17	673	2.33	3.75	0.18	0.05	0.23	486	0.54	1.41	0.05	0.01	0.06	-	-	-	-	-	-	-	-	-	-	-	-
18	638	2.10	2.98	0.15	0.04	0.19	482	0.52	1.26	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
19	612	1.96	2.57	0.13	0.04	0.17	479	0.49	1.20	0.04	0.01	0.05	-	-	-	-	-	-	-	-	-	-	-	-
20	603	1.88	2.45	0.13	0.04	0.17	477	0.48	1.17	0.04	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
21	601	1.87	2.38	0.12	0.04	0.16	474	0.46	1.15	0.03	0.01	0.04	-	-	-	-	-	-	-	-	-	-	-	-
22	533	1.37	1.62	0.09	0.03	0.12	439	0.35	0.90	0.02	0.01	0.03	-	-	-	-	-	-	-	-	-	-	-	-
23	436	0.73	0.87	0.05	0.02	0.06	308	0.16	0.32	0.01	0.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-

9.3.2 2033 expected traffic operations

Table 9.29. In-Tunnel estimated air quality maximum [2033 Cumulative, expected traffic]

	M4 to M5 direction										M5 to M4 direction									
	M4-M5 Link			M4 East			New M5			NO2 avg	M4-M5 Link			M4 East			New M5			NO2 avg
	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)		NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	NO2 (ppm)	CO (ppm)	Vis (1/m)	
Criteria	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47	n/a	48.7	0.0049	n/a	48.7	0.0049	n/a	48.7	0.0049	0.47
Hour																				
0	0.13	1.55	0.0007	0.07	0.81	0.0004	0.14	2.16	0.0009	0.08	0.08	1.17	0.0005	0.11	1.47	0.0007	0.05	0.90	0.0002	0.07
1	0.09	1.16	0.0005	0.05	0.60	0.0003	0.12	1.77	0.0007	0.06	0.07	1.02	0.0005	0.10	1.23	0.0006	0.04	0.75	0.0002	0.06
2	0.08	1.04	0.0005	0.04	0.56	0.0003	0.10	1.54	0.0006	0.05	0.07	0.93	0.0004	0.09	1.05	0.0005	0.03	0.52	0.0002	0.06
3	0.08	1.04	0.0005	0.04	0.58	0.0003	0.10	1.48	0.0006	0.05	0.07	0.84	0.0004	0.09	1.04	0.0005	0.03	0.52	0.0002	0.05
4	0.12	1.39	0.0006	0.06	0.73	0.0004	0.11	1.80	0.0007	0.07	0.08	1.00	0.0005	0.11	1.36	0.0006	0.04	0.68	0.0002	0.07
5	0.21	2.31	0.0011	0.11	1.28	0.0007	0.16	2.87	0.0011	0.12	0.12	1.64	0.0008	0.20	2.54	0.0011	0.06	1.13	0.0003	0.13
6	0.31	4.55	0.0020	0.19	2.44	0.0013	0.27	4.67	0.0018	0.19	0.21	3.71	0.0014	0.39	5.75	0.0024	0.11	2.22	0.0006	0.24
7	0.47	5.64	0.0028	0.43	4.41	0.0022	0.34	5.65	0.0023	0.32	0.39	7.48	0.0024	0.74	7.87	0.0038	0.20	3.59	0.0011	0.47
8	0.41	5.27	0.0026	0.29	3.47	0.0018	0.36	5.50	0.0022	0.26	0.33	6.14	0.0020	0.66	7.31	0.0036	0.16	3.01	0.0009	0.40
9	0.43	5.15	0.0025	0.27	3.17	0.0017	0.37	5.24	0.0022	0.25	0.31	5.03	0.0019	0.61	6.77	0.0033	0.15	2.68	0.0009	0.37
10	0.44	5.11	0.0024	0.25	3.02	0.0017	0.38	5.08	0.0022	0.25	0.31	4.62	0.0018	0.58	6.49	0.0031	0.14	2.52	0.0009	0.36
11	0.45	5.12	0.0024	0.25	2.97	0.0016	0.40	5.04	0.0023	0.25	0.30	4.42	0.0018	0.58	6.38	0.0031	0.14	2.44	0.0009	0.35
12	0.45	5.12	0.0024	0.25	2.95	0.0016	0.41	5.03	0.0023	0.26	0.30	4.33	0.0018	0.58	6.38	0.0031	0.14	2.37	0.0009	0.36
13	0.45	5.17	0.0024	0.25	2.97	0.0016	0.41	5.20	0.0023	0.26	0.30	4.30	0.0018	0.58	6.39	0.0031	0.14	2.33	0.0009	0.36
14	0.43	5.18	0.0023	0.23	2.98	0.0016	0.41	5.82	0.0024	0.25	0.30	4.39	0.0018	0.59	6.52	0.0032	0.13	2.28	0.0009	0.36
15	0.42	5.41	0.0024	0.23	3.23	0.0016	0.42	6.69	0.0027	0.25	0.32	5.06	0.0019	0.64	7.10	0.0034	0.13	2.25	0.0009	0.40
16	0.41	5.76	0.0025	0.25	3.67	0.0017	0.46	8.03	0.0034	0.27	0.36	5.55	0.0021	0.74	7.64	0.0036	0.13	2.23	0.0008	0.46
17	0.36	4.78	0.0021	0.19	2.75	0.0014	0.36	6.06	0.0024	0.21	0.27	4.18	0.0017	0.53	6.43	0.0030	0.11	2.07	0.0007	0.33
18	0.33	3.95	0.0018	0.17	2.33	0.0012	0.30	4.87	0.0019	0.18	0.22	3.64	0.0013	0.39	4.99	0.0022	0.10	1.91	0.0006	0.24
19	0.32	3.69	0.0017	0.16	2.15	0.0011	0.27	4.34	0.0017	0.17	0.20	3.38	0.0012	0.35	4.46	0.0020	0.09	1.80	0.0005	0.22
20	0.31	3.56	0.0016	0.16	2.07	0.0011	0.26	4.07	0.0016	0.17	0.19	2.99	0.0012	0.34	4.29	0.0019	0.09	1.72	0.0005	0.21
21	0.30	3.48	0.0016	0.16	2.01	0.0011	0.25	3.92	0.0015	0.16	0.18	2.83	0.0011	0.33	4.17	0.0019	0.08	1.65	0.0005	0.20
22	0.24	2.74	0.0013	0.12	1.40	0.0008	0.23	3.44	0.0014	0.14	0.13	1.99	0.0008	0.22	2.91	0.0013	0.05	1.19	0.0003	0.14
23	0.16	1.83	0.0009	0.08	0.94	0.0005	0.17	2.66	0.0011	0.10	0.10	1.27	0.0006	0.15	1.78	0.0008	0.04	0.90	0.0002	0.09

Table 9.30. Summary of route average NO_2, M4 to M5 direction [2033 Cumulative, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		1A	1B	1C	1D	1E	1J	1K	1L	1N	1P	1Q	1V	1Y	1Z	1AB	1AC
Enter at		M4 portal	M4 portal	M4 portal	M4 portal	M4 portal	Concord Rd	Concord Rd	Concord Rd	Wattle St	Wattle St	Wattle St	St Peters	Iron Cove Link	Iron Cove Link	City West Link	City West Link
Exit at		Wattle St	Parramatta Rd	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	Anzac Bridge	St Peters	M5 portal	M5 portal	St Peters	M5 portal	St Peters	M5 portal
Distance		5.4 km	5.5 km	9.9 km	12.5 km	21.7 km	8.9 km	11.5 km	20.7 km	4.6 km	7.2 km	16.4 km	9.1 km	6.4 km	15.7 km	5.1 km	14.4 km
Design Case	0	0.02	0.02	0.05	0.06	0.07	0.06	0.06	0.08	0.06	0.07	0.08	0.08	0.05	0.07	0.06	0.08
	1	0.02	0.02	0.04	0.04	0.05	0.04	0.04	0.06	0.04	0.05	0.06	0.06	0.04	0.06	0.04	0.06
	2	0.02	0.02	0.03	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.03	0.05	0.04	0.05
	3	0.02	0.02	0.03	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.03	0.05	0.04	0.05
	4	0.02	0.02	0.05	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.07	0.06	0.05	0.06	0.06	0.07
	5	0.04	0.04	0.09	0.10	0.11	0.09	0.10	0.11	0.11	0.11	0.12	0.10	0.08	0.11	0.10	0.12
	6	0.07	0.07	0.15	0.16	0.17	0.16	0.17	0.18	0.19	0.17	0.18	0.16	0.13	0.17	0.16	0.18
	7	0.18	0.18	0.29	0.28	0.27	0.32	0.30	0.27	0.31	0.25	0.25	0.21	0.17	0.22	0.21	0.23
	8	0.11	0.11	0.22	0.22	0.23	0.24	0.24	0.24	0.26	0.23	0.24	0.21	0.17	0.21	0.21	0.23
	9	0.10	0.10	0.20	0.22	0.23	0.22	0.23	0.24	0.24	0.24	0.25	0.21	0.17	0.22	0.21	0.24
	10	0.10	0.10	0.20	0.21	0.23	0.21	0.23	0.24	0.24	0.24	0.25	0.22	0.18	0.22	0.22	0.24
	11	0.10	0.10	0.19	0.21	0.23	0.21	0.23	0.24	0.23	0.24	0.25	0.22	0.18	0.23	0.22	0.25
	12	0.09	0.10	0.19	0.22	0.24	0.21	0.23	0.25	0.23	0.24	0.26	0.23	0.18	0.23	0.22	0.25
	13	0.09	0.09	0.19	0.21	0.24	0.21	0.23	0.25	0.23	0.24	0.26	0.23	0.18	0.23	0.22	0.25
	14	0.09	0.09	0.17	0.20	0.22	0.19	0.21	0.23	0.21	0.22	0.25	0.22	0.17	0.22	0.21	0.24
	15	0.09	0.09	0.17	0.19	0.23	0.19	0.21	0.23	0.21	0.22	0.25	0.23	0.16	0.23	0.20	0.24
	16	0.09	0.09	0.18	0.20	0.24	0.20	0.21	0.25	0.21	0.22	0.27	0.26	0.16	0.24	0.20	0.27
	17	0.07	0.07	0.15	0.17	0.19	0.16	0.18	0.20	0.18	0.19	0.21	0.20	0.14	0.19	0.17	0.21
	18	0.06	0.06	0.13	0.15	0.17	0.15	0.16	0.18	0.17	0.17	0.18	0.16	0.13	0.17	0.16	0.18
	19	0.06	0.06	0.13	0.15	0.16	0.14	0.16	0.17	0.16	0.17	0.17	0.15	0.13	0.16	0.15	0.17
	20	0.06	0.06	0.13	0.14	0.16	0.14	0.15	0.16	0.16	0.17	0.17	0.14	0.12	0.15	0.15	0.16
	21	0.06	0.06	0.13	0.14	0.15	0.14	0.15	0.16	0.16	0.16	0.16	0.14	0.12	0.15	0.15	0.16
	22	0.05	0.05	0.10	0.11	0.12	0.10	0.12	0.13	0.12	0.13	0.14	0.12	0.10	0.12	0.12	0.13
	23	0.03	0.03	0.06	0.07	0.09	0.07	0.08	0.09	0.08	0.08	0.10	0.09	0.06	0.09	0.08	0.10

Table 9.31. Summary of route average NO_2, M5 to M4 direction [2033 Cumulative, expected traffic] (values are ppm, criteria is 0.47 ppm)

Route ID		2A	2C	2D	2E	2M	2N	2P	2Q	2R	2S	2T	2U	2V	2X	2Y	2AC
Enter at		M5 portal	M5 portal	M5 portal	M5 portal	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	Wattle St	M5 portal	St Peters
Exit at		St Peters	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 portal	Wattle St	Concord Rd	M4 Portal	Concord Rd	M4 portal	Concord Rd	M4 portal	Iron Cove Link	Iron Cove Link
Distance		9.2 km	16.4 km	20.6 km	21.7 km	7.1 km	11.3 km	12.5 km	4.7 km	8.9 km	10 km	4.4 km	5.5 km	4.4 km	5.6 km	15.6 km	6.4 km
Hour	0	0.01	0.03	0.03	0.04	0.04	0.05	0.06	0.03	0.05	0.06	0.05	0.07	0.04	0.07	0.02	0.04
	1	0.01	0.02	0.03	0.04	0.04	0.04	0.05	0.02	0.04	0.05	0.04	0.06	0.04	0.06	0.02	0.03
	2	0.01	0.02	0.03	0.03	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.06	0.03	0.05	0.02	0.03
	3	0.01	0.02	0.03	0.03	0.03	0.04	0.05	0.02	0.04	0.05	0.04	0.05	0.03	0.05	0.02	0.03
	4	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.03	0.04	0.06	0.05	0.07	0.04	0.06	0.02	0.04
	5	0.02	0.04	0.05	0.06	0.06	0.08	0.10	0.04	0.07	0.10	0.09	0.13	0.07	0.12	0.03	0.05
	6	0.04	0.07	0.10	0.12	0.11	0.15	0.18	0.07	0.13	0.18	0.16	0.24	0.14	0.22	0.07	0.10
	7	0.06	0.13	0.18	0.23	0.20	0.26	0.34	0.12	0.24	0.34	0.31	0.47	0.26	0.43	0.12	0.19
	8	0.05	0.11	0.16	0.20	0.17	0.23	0.29	0.11	0.21	0.30	0.27	0.40	0.23	0.38	0.10	0.16
	9	0.05	0.10	0.15	0.18	0.16	0.21	0.27	0.10	0.20	0.28	0.25	0.37	0.22	0.35	0.10	0.15
	10	0.05	0.10	0.14	0.18	0.15	0.21	0.26	0.10	0.20	0.27	0.24	0.36	0.21	0.34	0.09	0.14
	11	0.05	0.10	0.14	0.18	0.15	0.21	0.26	0.10	0.19	0.26	0.24	0.35	0.21	0.33	0.09	0.14
	12	0.05	0.10	0.14	0.18	0.15	0.21	0.26	0.10	0.19	0.26	0.24	0.36	0.21	0.33	0.09	0.14
	13	0.05	0.10	0.14	0.17	0.15	0.20	0.26	0.10	0.19	0.26	0.24	0.36	0.21	0.33	0.09	0.14
	14	0.05	0.09	0.14	0.17	0.14	0.20	0.26	0.10	0.19	0.27	0.24	0.36	0.21	0.34	0.09	0.13
	15	0.05	0.09	0.14	0.18	0.14	0.21	0.28	0.10	0.21	0.29	0.27	0.40	0.23	0.37	0.09	0.13
	16	0.05	0.10	0.16	0.20	0.15	0.24	0.31	0.11	0.24	0.33	0.31	0.46	0.27	0.43	0.09	0.13
	17	0.04	0.08	0.12	0.15	0.12	0.18	0.23	0.09	0.18	0.24	0.22	0.33	0.20	0.31	0.07	0.11
	18	0.03	0.07	0.10	0.12	0.11	0.14	0.18	0.07	0.14	0.18	0.16	0.24	0.14	0.23	0.06	0.10
	19	0.03	0.06	0.09	0.11	0.10	0.13	0.16	0.07	0.12	0.16	0.15	0.22	0.13	0.20	0.06	0.09
	20	0.03	0.06	0.08	0.10	0.09	0.12	0.16	0.06	0.12	0.16	0.14	0.21	0.12	0.19	0.06	0.09
	21	0.03	0.06	0.08	0.10	0.09	0.12	0.15	0.06	0.11	0.15	0.13	0.20	0.12	0.19	0.05	0.08
	22	0.01	0.04	0.05	0.07	0.06	0.08	0.10	0.04	0.08	0.10	0.09	0.14	0.08	0.13	0.03	0.06
	23	0.01	0.03	0.04	0.05	0.04	0.06	0.07	0.03	0.05	0.07	0.06	0.09	0.05	0.08	0.02	0.04

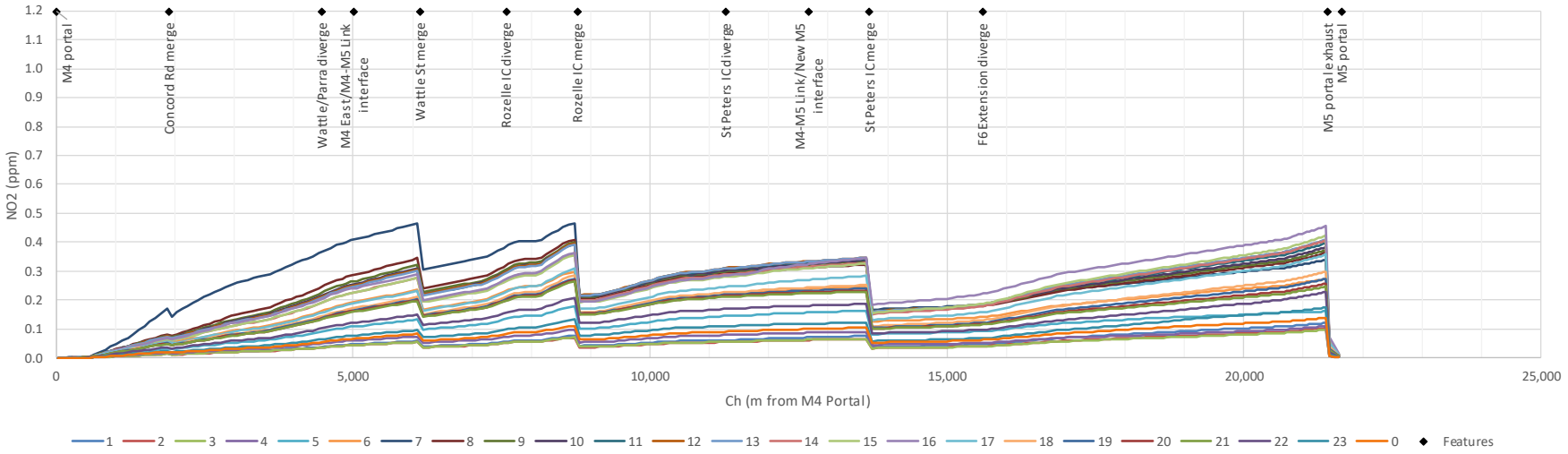


Figure 9.75 In-Tunnel NO_2 levels along route 1E from M4 portal to M5 portal [2033 Cumulative, expected traffic]

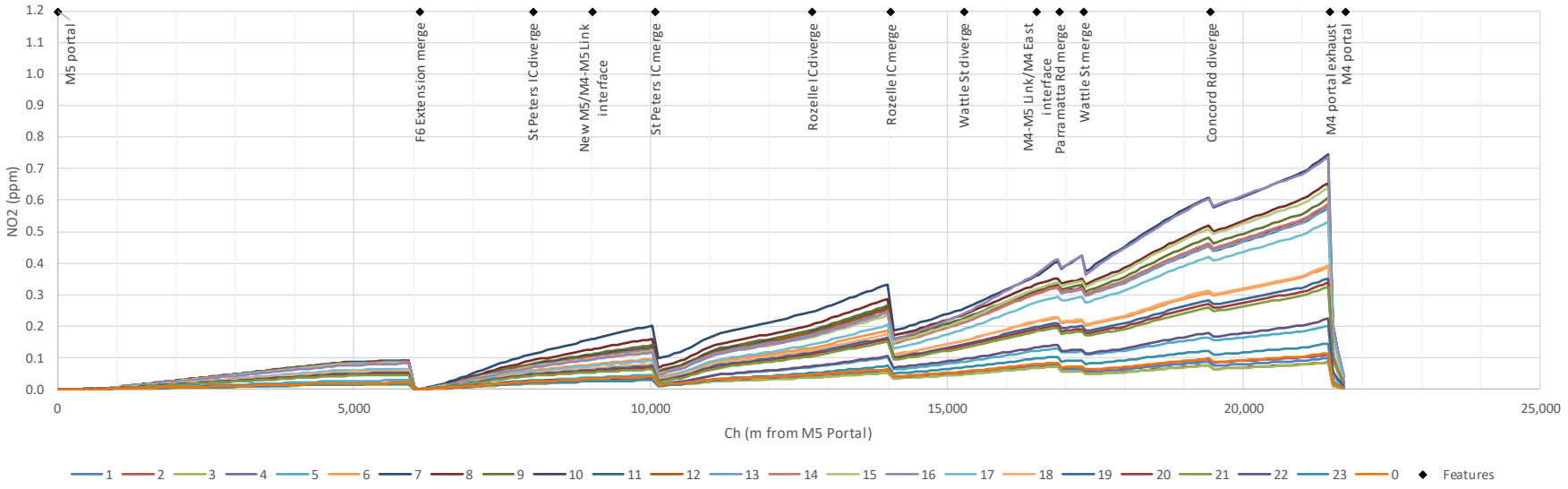


Figure 9.76. In-Tunnel NO_2 levels along route 2E from M5 portal to M4 portal [2033 Cumulative, expected traffic]

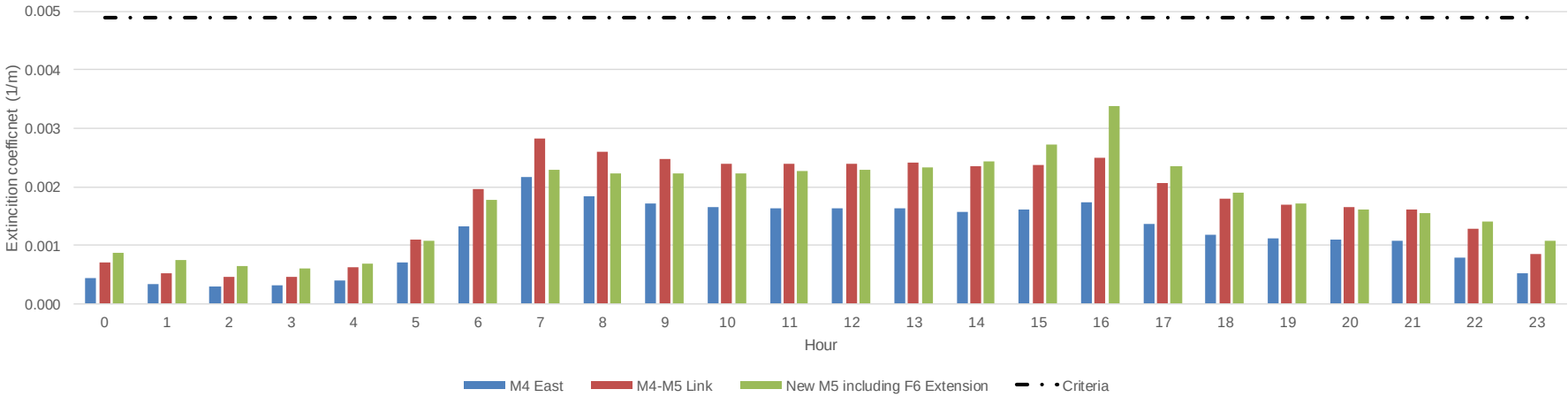


Figure 9.77. Maximum In-Tunnel visibility for M4 to M5 direction [2033 Cumulative, expected traffic]

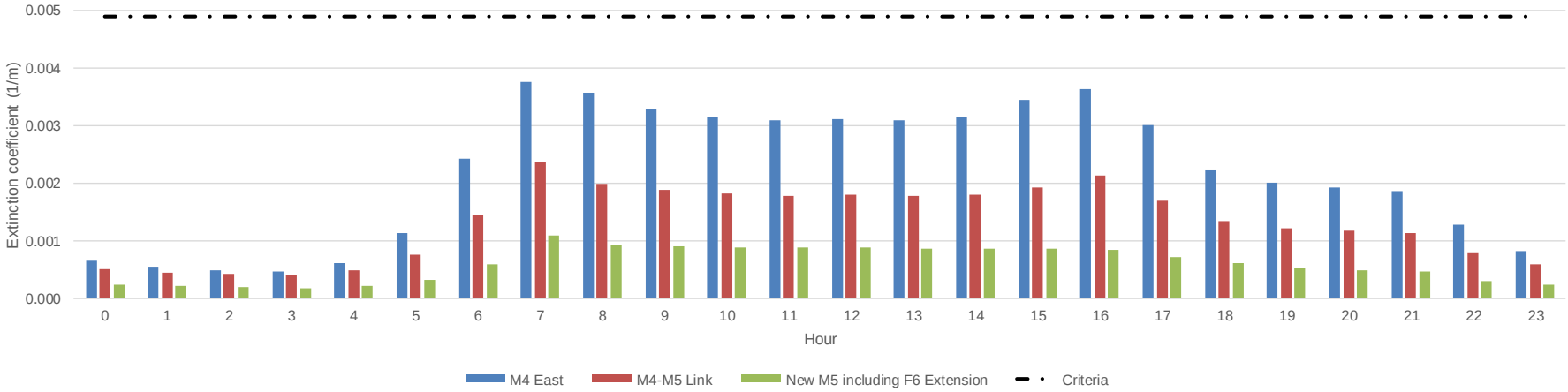


Figure 9.78. Maximum In-Tunnel visibility for M5 to M4 direction [2033 Cumulative, expected traffic]

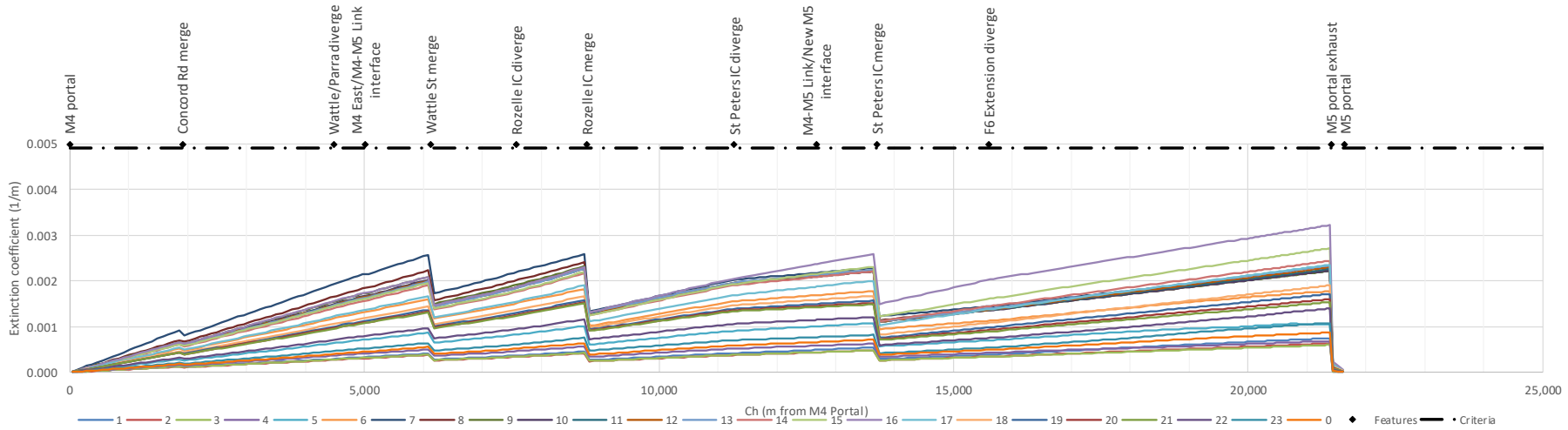


Figure 9.79. In-Tunnel visibility along route 1E from M4 portal to M5 portal [2033 Cumulative, expected traffic]

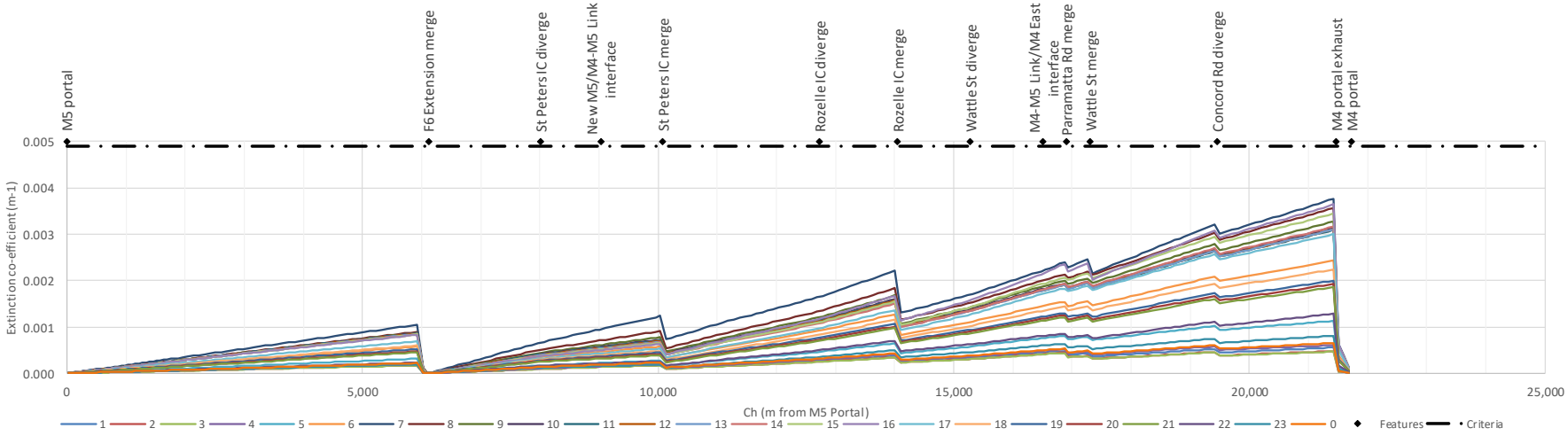


Figure 9.80. In-Tunnel visibility along route 2E from M5 portal to M4 portal [2033 Cumulative, expected traffic]

Table 9.32. Outlet emissions summary [2033 Cumulative, expected traffic]

Outlet identifier:	B						C						D					
EIS name:	Parramatta Road (M4 East)						Underwood Road (M4 East)						SPI (New M5)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	276	0.10	0.18	0.01	0.00	0.01	512	0.51	0.75	0.05	0.01	0.06	174	0.04	0.11	0.00	0.00	0.00
1	276	0.07	0.13	0.01	0.00	0.01	478	0.41	0.58	0.04	0.01	0.04	148	0.03	0.06	0.00	0.00	0.00
2	276	0.07	0.12	0.01	0.00	0.01	451	0.33	0.45	0.03	0.01	0.04	155	0.02	0.05	0.00	0.00	0.00
3	276	0.07	0.13	0.01	0.00	0.01	451	0.33	0.45	0.03	0.01	0.03	155	0.02	0.05	0.00	0.00	0.00
4	276	0.10	0.17	0.01	0.00	0.01	504	0.48	0.68	0.04	0.01	0.05	156	0.03	0.06	0.00	0.00	0.00
5	276	0.19	0.29	0.02	0.00	0.02	653	1.20	1.75	0.11	0.02	0.13	208	0.07	0.19	0.01	0.00	0.01
6	307	0.41	0.67	0.04	0.01	0.05	901	3.22	5.78	0.36	0.06	0.41	348	0.30	0.78	0.03	0.00	0.03
7	261	0.68	0.93	0.05	0.01	0.06	858	6.16	7.35	0.51	0.10	0.61	413	0.64	1.57	0.07	0.01	0.08
8	285	0.56	0.90	0.06	0.01	0.06	944	6.05	7.62	0.54	0.10	0.64	393	0.51	1.23	0.05	0.01	0.06
9	298	0.54	0.89	0.05	0.01	0.06	957	5.72	7.22	0.50	0.10	0.60	380	0.45	1.05	0.04	0.01	0.05
10	307	0.54	0.89	0.06	0.01	0.06	961	5.57	6.94	0.48	0.10	0.57	370	0.43	0.95	0.04	0.01	0.04
11	312	0.54	0.90	0.06	0.01	0.07	962	5.50	6.82	0.47	0.10	0.57	362	0.41	0.90	0.04	0.01	0.04
12	313	0.54	0.90	0.06	0.01	0.07	962	5.54	6.83	0.47	0.10	0.57	353	0.39	0.84	0.03	0.01	0.04
13	311	0.52	0.90	0.06	0.01	0.06	962	5.52	6.84	0.47	0.10	0.57	350	0.38	0.82	0.03	0.01	0.04
14	316	0.48	0.93	0.06	0.01	0.06	961	5.59	6.97	0.48	0.10	0.58	346	0.37	0.79	0.03	0.01	0.04
15	312	0.47	1.01	0.06	0.01	0.07	954	5.99	7.52	0.52	0.10	0.62	341	0.36	0.76	0.03	0.01	0.04
16	312	0.51	1.18	0.06	0.01	0.07	885	6.35	7.42	0.51	0.10	0.61	336	0.35	0.74	0.03	0.01	0.03
17	337	0.43	0.93	0.05	0.01	0.06	944	4.89	6.74	0.45	0.09	0.54	322	0.26	0.65	0.02	0.00	0.03
18	310	0.35	0.67	0.04	0.01	0.05	877	3.32	4.84	0.31	0.06	0.37	312	0.23	0.58	0.02	0.00	0.03
19	301	0.32	0.58	0.04	0.01	0.04	841	2.84	4.14	0.26	0.05	0.32	305	0.21	0.53	0.02	0.00	0.02
20	300	0.31	0.55	0.03	0.01	0.04	831	2.69	3.93	0.25	0.05	0.30	300	0.19	0.49	0.02	0.00	0.02
21	299	0.31	0.53	0.03	0.01	0.04	821	2.55	3.78	0.24	0.05	0.29	297	0.18	0.47	0.02	0.00	0.02
22	276	0.21	0.32	0.02	0.00	0.02	705	1.47	2.23	0.14	0.03	0.17	207	0.06	0.19	0.01	0.00	0.01
23	276	0.12	0.21	0.01	0.00	0.02	562	0.74	1.03	0.07	0.01	0.08	178	0.04	0.11	0.00	0.00	0.00

Table 9.32. Outlet emissions summary [2033 Cumulative, expected traffic], continued

Outlet identifier:	E						F						G					
EIS name:	Arncliffe (New M5)						Kingsgrove (New M5)						Parramatta Road (M4-M5 Link)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	198	0.03	0.06	0.01	0.00	0.01	243	0.24	0.45	0.03	0.00	0.03	186	0.07	0.14	0.01	0.00	0.01
1	181	0.03	0.05	0.01	0.00	0.01	220	0.18	0.32	0.02	0.00	0.02	177	0.06	0.11	0.01	0.00	0.01
2	167	0.02	0.04	0.00	0.00	0.00	211	0.15	0.26	0.02	0.00	0.02	170	0.05	0.09	0.01	0.00	0.01
3	163	0.02	0.03	0.00	0.00	0.00	210	0.14	0.25	0.01	0.00	0.02	172	0.05	0.09	0.01	0.00	0.01
4	182	0.03	0.05	0.01	0.00	0.01	243	0.19	0.38	0.02	0.00	0.02	190	0.08	0.13	0.01	0.00	0.01
5	243	0.06	0.11	0.01	0.00	0.01	307	0.37	0.83	0.04	0.01	0.05	227	0.16	0.29	0.02	0.00	0.02
6	362	0.21	0.29	0.04	0.00	0.04	388	0.86	1.82	0.10	0.01	0.12	312	0.43	0.91	0.06	0.01	0.06
7	502	0.42	0.82	0.10	0.01	0.10	426	1.21	2.48	0.15	0.02	0.17	480	1.29	2.06	0.15	0.02	0.17
8	462	0.39	0.61	0.07	0.01	0.08	424	1.36	2.42	0.15	0.02	0.17	348	0.75	1.27	0.08	0.01	0.10
9	453	0.39	0.58	0.07	0.01	0.08	421	1.37	2.27	0.14	0.02	0.16	338	0.70	1.15	0.08	0.01	0.09
10	449	0.39	0.56	0.07	0.01	0.08	418	1.42	2.18	0.14	0.03	0.16	333	0.67	1.08	0.07	0.01	0.08
11	448	0.39	0.56	0.07	0.01	0.08	422	1.51	2.18	0.14	0.03	0.17	329	0.66	1.05	0.07	0.01	0.08
12	445	0.39	0.55	0.07	0.01	0.08	425	1.57	2.20	0.14	0.03	0.17	330	0.66	1.04	0.07	0.01	0.08
13	442	0.37	0.54	0.07	0.01	0.07	425	1.57	2.25	0.15	0.03	0.18	333	0.65	1.05	0.07	0.01	0.08
14	440	0.36	0.54	0.07	0.01	0.07	432	1.56	2.53	0.16	0.03	0.19	340	0.67	1.09	0.07	0.01	0.08
15	438	0.35	0.54	0.07	0.01	0.07	457	1.68	3.21	0.19	0.03	0.22	354	0.72	1.20	0.08	0.01	0.09
16	436	0.34	0.54	0.06	0.01	0.07	499	1.93	4.26	0.26	0.03	0.29	503	1.35	2.01	0.15	0.02	0.17
17	396	0.24	0.41	0.05	0.00	0.05	431	1.30	2.72	0.16	0.02	0.18	331	0.57	1.00	0.07	0.01	0.08
18	363	0.20	0.32	0.04	0.00	0.04	393	0.98	1.96	0.11	0.02	0.13	292	0.40	0.72	0.05	0.01	0.05
19	336	0.17	0.25	0.03	0.00	0.03	374	0.85	1.64	0.10	0.02	0.11	277	0.35	0.62	0.04	0.01	0.05
20	318	0.15	0.21	0.03	0.00	0.03	363	0.77	1.48	0.09	0.01	0.10	272	0.32	0.58	0.04	0.01	0.04
21	308	0.13	0.19	0.02	0.00	0.03	359	0.73	1.40	0.08	0.01	0.09	267	0.31	0.55	0.04	0.01	0.04
22	211	0.04	0.07	0.01	0.00	0.01	324	0.60	1.08	0.06	0.01	0.08	201	0.15	0.25	0.02	0.00	0.02
23	187	0.03	0.05	0.01	0.00	0.01	272	0.36	0.66	0.04	0.01	0.05	185	0.09	0.16	0.01	0.00	0.01

Table 9.32. Outlet emissions summary [2033 Cumulative, expected traffic], continued

Outlet identifier:	H						I						J					
EIS name:	Rozelle North (WHT)						Rozelle Mid (M4-M5 Link/ICL)						Rozelle South (M4-M5 Link/ICL)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	402	0.12	0.29	0.02	0.00	0.03	802	0.33	0.60	0.04	0.01	0.04	0	0.00	0.00	0.00	0.00	0.00
1	352	0.09	0.19	0.02	0.00	0.02	0	0.00	0.00	0.00	0.00	0.00	704	0.21	0.40	0.02	0.00	0.03
2	329	0.06	0.15	0.01	0.00	0.01	0	0.00	0.00	0.00	0.00	0.00	686	0.19	0.36	0.02	0.00	0.03
3	338	0.07	0.17	0.01	0.00	0.02	0	0.00	0.00	0.00	0.00	0.00	682	0.19	0.34	0.02	0.00	0.03
4	391	0.11	0.27	0.02	0.00	0.02	768	0.30	0.51	0.03	0.01	0.04	0	0.00	0.00	0.00	0.00	0.00
5	511	0.24	0.65	0.05	0.00	0.06	997	0.76	1.28	0.08	0.01	0.10	0	0.00	0.00	0.00	0.00	0.00
6	700	0.60	1.80	0.15	0.01	0.16	899	1.46	2.64	0.17	0.03	0.20	555	0.90	1.63	0.11	0.02	0.12
7	767	1.45	2.77	0.27	0.03	0.29	1,050	3.02	4.84	0.34	0.05	0.39	648	1.86	2.99	0.21	0.03	0.24
8	773	1.24	2.35	0.21	0.02	0.24	980	2.35	3.84	0.27	0.04	0.31	605	1.45	2.37	0.17	0.03	0.19
9	746	1.12	2.01	0.18	0.02	0.21	930	2.02	3.28	0.23	0.04	0.26	574	1.25	2.02	0.14	0.02	0.16
10	731	1.06	1.83	0.17	0.02	0.19	908	1.87	3.02	0.21	0.03	0.24	560	1.15	1.86	0.13	0.02	0.15
11	724	1.03	1.74	0.16	0.02	0.18	894	1.79	2.91	0.20	0.03	0.23	552	1.10	1.79	0.12	0.02	0.14
12	723	1.04	1.72	0.16	0.02	0.18	891	1.77	2.87	0.19	0.03	0.23	550	1.10	1.77	0.12	0.02	0.14
13	731	1.10	1.77	0.16	0.02	0.19	886	1.71	2.82	0.19	0.03	0.22	547	1.05	1.74	0.12	0.02	0.14
14	756	1.28	2.03	0.19	0.03	0.22	880	1.55	2.73	0.18	0.03	0.21	543	0.96	1.69	0.11	0.02	0.13
15	802	1.54	2.64	0.25	0.03	0.28	887	1.55	2.83	0.19	0.03	0.22	548	0.95	1.75	0.12	0.02	0.13
16	696	2.14	3.49	0.32	0.04	0.36	910	1.62	3.06	0.21	0.03	0.24	562	1.00	1.89	0.13	0.02	0.15
17	742	1.02	2.03	0.18	0.02	0.20	865	1.29	2.41	0.16	0.02	0.18	534	0.80	1.49	0.10	0.01	0.11
18	595	0.42	1.01	0.08	0.01	0.09	816	1.11	1.99	0.13	0.02	0.15	504	0.68	1.23	0.08	0.01	0.09
19	539	0.31	0.74	0.06	0.01	0.07	789	1.02	1.80	0.12	0.02	0.14	487	0.63	1.11	0.07	0.01	0.08
20	516	0.28	0.63	0.05	0.01	0.06	772	0.97	1.69	0.11	0.02	0.13	477	0.60	1.04	0.07	0.01	0.08
21	504	0.26	0.58	0.05	0.00	0.05	762	0.94	1.63	0.11	0.02	0.12	470	0.58	1.00	0.07	0.01	0.08
22	460	0.18	0.45	0.04	0.00	0.04	991	0.78	1.32	0.09	0.01	0.10	0	0.00	0.00	0.00	0.00	0.00
23	406	0.12	0.31	0.03	0.00	0.03	820	0.38	0.70	0.04	0.01	0.05	0	0.00	0.00	0.00	0.00	0.00

Table 9.32. Outlet emissions summary [2033 Cumulative, expected traffic], continued

Outlet identifier: EIS name:	K SPI (M4-M5 Link)						L Iron Cove Link (north)						M Arncliffe (F6 Extension)						N Rockdale (F6 Extension)					
Hour start	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)	Exhaust flow (m^3/s)	NO_X (g/s)	CO (g/s)	Non-exhaust PM2.5 (g/s)	Exhaust PM (g/s)	Total PM (g/s)
0	352	0.38	0.49	0.03	0.01	0.04	307	0.10	0.25	0.01	0.00	0.01	322	0.03	0.07	0.01	0.00	0.01	330	0.26	0.66	0.03	0.00	0.04
1	293	0.20	0.29	0.02	0.00	0.02	278	0.08	0.18	0.01	0.00	0.01	269	0.02	0.04	0.00	0.00	0.00	299	0.18	0.48	0.02	0.00	0.03
2	270	0.16	0.23	0.01	0.00	0.02	261	0.07	0.15	0.01	0.00	0.01	255	0.02	0.03	0.00	0.00	0.00	289	0.14	0.41	0.02	0.00	0.02
3	273	0.16	0.23	0.02	0.00	0.02	263	0.07	0.16	0.01	0.00	0.01	254	0.02	0.03	0.00	0.00	0.00	290	0.13	0.41	0.02	0.00	0.02
4	332	0.30	0.41	0.03	0.01	0.03	290	0.08	0.24	0.01	0.00	0.01	277	0.02	0.04	0.00	0.00	0.00	314	0.17	0.52	0.02	0.00	0.03
5	455	0.84	1.02	0.07	0.02	0.09	359	0.13	0.50	0.02	0.00	0.02	371	0.03	0.10	0.01	0.00	0.01	352	0.32	0.84	0.04	0.01	0.05
6	645	1.79	3.04	0.19	0.03	0.22	413	0.23	0.84	0.03	0.00	0.03	631	0.15	0.51	0.05	0.00	0.05	385	0.54	1.41	0.08	0.01	0.09
7	673	2.48	3.97	0.26	0.04	0.31	411	0.24	0.91	0.03	0.00	0.03	848	0.50	1.26	0.13	0.01	0.14	427	0.77	1.99	0.11	0.01	0.13
8	669	2.52	3.68	0.24	0.04	0.29	450	0.39	1.11	0.04	0.01	0.05	761	0.32	0.83	0.08	0.01	0.09	456	0.95	2.25	0.12	0.02	0.14
9	670	2.68	3.60	0.24	0.05	0.29	477	0.49	1.13	0.05	0.01	0.06	694	0.22	0.61	0.06	0.00	0.06	479	1.01	2.41	0.13	0.02	0.15
10	670	2.75	3.57	0.24	0.05	0.29	484	0.51	1.12	0.05	0.01	0.06	657	0.19	0.50	0.05	0.00	0.05	503	1.10	2.66	0.14	0.02	0.16
11	672	2.82	3.59	0.24	0.05	0.30	487	0.52	1.12	0.05	0.01	0.06	641	0.17	0.46	0.05	0.00	0.05	518	1.16	2.84	0.15	0.02	0.17
12	671	2.85	3.58	0.25	0.05	0.30	489	0.53	1.13	0.05	0.01	0.06	627	0.16	0.43	0.04	0.00	0.05	533	1.24	3.01	0.16	0.02	0.18
13	664	2.81	3.58	0.24	0.05	0.29	488	0.52	1.12	0.05	0.01	0.06	616	0.16	0.40	0.04	0.00	0.04	566	1.36	3.47	0.18	0.02	0.20
14	638	2.50	3.43	0.23	0.04	0.27	488	0.52	1.12	0.05	0.01	0.06	607	0.15	0.38	0.04	0.00	0.04	635	1.61	4.43	0.22	0.03	0.25
15	613	2.29	3.42	0.22	0.04	0.26	477	0.46	1.14	0.05	0.01	0.06	598	0.15	0.36	0.04	0.00	0.04	685	1.90	5.36	0.28	0.03	0.32
16	600	2.17	3.54	0.23	0.04	0.27	476	0.46	1.19	0.06	0.01	0.06	590	0.15	0.34	0.03	0.00	0.04	634	2.22	5.00	0.35	0.04	0.39
17	592	1.92	2.90	0.19	0.03	0.22	470	0.40	1.06	0.05	0.01	0.05	559	0.10	0.31	0.03	0.00	0.03	652	1.50	4.70	0.23	0.03	0.26
18	578	1.76	2.33	0.15	0.03	0.19	475	0.39	1.00	0.04	0.01	0.05	540	0.09	0.30	0.03	0.00	0.03	571	1.04	3.32	0.15	0.02	0.17
19	573	1.67	2.15	0.14	0.03	0.17	475	0.38	0.97	0.04	0.01	0.05	531	0.08	0.30	0.03	0.00	0.03	516	0.84	2.52	0.12	0.01	0.13
20	575	1.64	2.08	0.14	0.03	0.17	476	0.37	0.96	0.04	0.01	0.04	516	0.08	0.28	0.03	0.00	0.03	466	0.69	1.95	0.09	0.01	0.11
21	578	1.62	2.05	0.14	0.03	0.17	471	0.35	0.92	0.04	0.01	0.04	502	0.07	0.26	0.02	0.00	0.03	422	0.57	1.53	0.08	0.01	0.09
22	505	1.11	1.38	0.09	0.02	0.11	418	0.24	0.64	0.02	0.00	0.03	398	0.04	0.14	0.01	0.00	0.01	395	0.47	1.25	0.06	0.01	0.07
23	403	0.55	0.69	0.05	0.01	0.06	328	0.13	0.31	0.01	0.00	0.01	315	0.02	0.07	0.01	0.00	0.01	314	0.28	0.67	0.04	0.01	0.04

10 ANALYSIS OUTPUTS – WORST CASE OPERATIONS

Results within this section summarise the analysis outlined in Section 7.1.4. All results exclude the background air quality as described in Section 6.8.

For the Worst Case operations, the ventilation plant in each simulation was adjusted such that the system meets, or marginally exceeds, the in-tunnel air quality criteria. Within each simulation this represents the minimum required capacity of the ventilation plant.

Table 10.1 outlines a summary of analysis for each scenario and traffic speed with the values shown being the maximum value for each plant across all associated traffic cases. In this way, the determining traffic conditions (highlighted red) for each plant or offtake and their general relationship with traffic speed is better understood.

For the purpose of comparison, a summary of ventilation plant operation for expected traffic operation (expected traffic and regulatory demand traffic) is also included. The values shown are the maximum across all 24 hours within each scenario. As the Do minimum scenarios do not involve the project, they have not been analysed, with the design in that arrangement being the responsibility of the M4 East and New M5 projects. Generally speaking, the project ventilation plant is expected to be operating in the range 50 per cent to 75 per cent of its required capacity to meet worst case traffic conditions for expected traffic.

At this stage, the concept design has not considered the likelihood of any specific traffic scenario occurring. The plant capacity has conservatively been taken as maximum value of the required capacity from all simulations, with a nominal design margin.

To further understand the operating regime and air quality within the tunnel, graphs showing the pollution concentration profile along key routes are shown in the following sections. Within each section, results for a specific traffic case is shown for each analysis speed. For each section, the traffic case that represents the most onerous requirement for jet fans (the 20 km/h case) is used for all graphs. In viewing the graphs, it is important to understand that in each simulation, the ventilation plant is operated only to the capacity required to achieve the in-tunnel air quality criteria.

Table 10.1. Summary of minimum required capacity for M4-M5 Link ventilation plant (values are m^3/s)

Maximum demand
>90% maximum demand

	M4 to M5 direction										M5 to M4 direction								Both directions	
	Haberfield mainline	Rozelle offramp at Anzac Bridge	Rozelle offramp to WHT&BL	ICL at Anzac Bridge	**Rozelle (M4 to M5) total**	WHT&BL to M5	St Peters offramp	St Peters mainline	**St Peters (M4 to M5) total**	St Peters mainline	CWL offramp	M5 to WHT&BL	**Rozelle (M5 to M4) total**	WHT&BL to M4	Iron Cove Link	Haberfield Mainline	Wattle St offramp	**Haberfield (M5 to M4) total**	**M4-M5 Link: Rozelle total**	**M4-M5 Link: Rozelle total**
	Supply	Exh	Exh	Exh	**Exh**	Sup	Exh	Exh	**Outlet K Exh**	Sup	Exh	Exh	**Exh**	Sup	Outlet L Exh	Exh	Exh	**Outlet G Exh**	**Outlet I + J Exh**	**Sup**
Worst Case operations:																				
Cumulative (2033) - 20 km/hr	365	487	210	340	982	576	723	362	1,021	357	195	476	609	329	492	523	484	970	1,545	895
Cumulative (2033) - 40 km/hr	430	425	361	286	835	446	673	417	997	415	405	504	637	342	590	484	453	866	1,402	664
Cumulative (2033) - 60 km/hr	0	556	486	373	1,143	560	786	369	886	316	527	635	767	431	604	389	488	732	1,905	795
Cumulative (2033) - 80 km/hr	0	644	564	429	1,324	678	853	0	853	0	525	771	903	502	673	403	536	719	2,206	935
Cumulative (2033) - 80 km/hr (f=0.030)	0	674	582	448	1,379	709	891	0	891	0	542	810	942	519	700	188	556	562	2,298	974
Do Something - 20 km/hr	378	563	0	183	745	0	710	364	906	239	282	0	282	0	583	524	448	905	1,028	0
Do Something - 40 km/hr	449	517	0	235	713	0	645	406	902	309	423	0	423	0	555	517	445	893	1,136	0
Do Something - 60 km/hr	134	614	0	314	878	0	821	401	934	291	554	0	554	0	638	497	583	779	1,433	0
Do Something - 80 km/hr	0	718	0	361	1,015	0	930	282	930	204	582	0	582	0	722	291	623	623	1,597	0
Do Something - 80 km/hr (f=0.030)	0	749	0	374	1,056	0	971	318	971	220	603	0	603	0	753	226	644	644	1,659	0
Worst Case operations (max)	**449**	**749**	**582**	**448**	**1,379**	**709**	**971**	**417**	**1,021**	**415**	**603**	**810**	**942**	**519**	**753**	**524**	**644**	**970**	**2,298**	**974**
Demand traffic scenarios																				
2033 Cumulative - Normal	0	495	225	400	1,076	369	673	0	673	0	180	494	623	306	489	142	362	503	1,699	674
2033 Cumulative - Regulatory	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2023 Cumulative - Normal	0	488	202	401	972	296	740	0	740	0	187	427	557	304	493	97	349	446	1,530	600
2023 Cumulative - Regulatory	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2033 Do Something - Normal	0	568	0	389	907	0	646	0	646	0	318	0	318	0	507	0	336	336	1,224	0
2033 Do Something - Regulatory	0	566	0	388	915	0	669	0	669	0	325	0	325	0	513	0	357	357	1,241	0
2023 Do Something - Normal	0	538	0	389	883	0	644	0	644	0	274	0	274	0	507	0	322	322	1,157	0
2023 Do Something - Regulatory	0	545	0	390	894	0	653	0	653	0	292	0	292	0	525	0	370	370	1,186	0
Demand traffic scenarios (max)	**0**	**568**	**225**	**401**	**1,076**	**369**	**740**	**0**	**740**	**0**	**325**	**494**	**623**	**306**	**525**	**142**	**370**	**503**	**1,699**	**674**
(as % of overall maximum)									**73%**						**70%**			**52%**	**74%**	**69%**
Maximum	**449**	**749**	**582**	**448**	**1,379**	**709**	**971**	**417**	**1,021**	**415**	**603**	**810**	**942**	**519**	**753**	**524**	**644**	**970**	**2,298**	**974**

10.1 Do something arrangement

10.1.1 M4 to M5 direction

For scenarios of extreme congestion such as the 20 and 40 km/h speed cases, the interface plant at both Haberfield and St Peters are required to operate at full exchange and it is the 20 km/h case that drives the jet fan requirements. Table 10.2 shows the calculated NO_2 route averages (key routes only) for the 20 km/h design cases, representing the most onerous air quality driven ventilation requirements.

Under these circumstances the route from City West Link to St Peters (Route 1AB, red bounding box Table 10.2) controls the ventilation requirements for the project, even though it is one of the shortest routes. For illustrative purposes, Figure 10.1 displays the NO_2 levels along this route for a controlling design case. The short CWL ramp length means that the low pollution levels in the ramp form a low weighting in the route average. The pollution carry-over from sections upstream of Rozelle also have a similar impact on the NO_2 average for this route in the Do something arrangement.

The route from Wattle St to St Peters (Route 1P, orange bounding box Table 10.2) is the next controlling route under conditions of complete interface exchange. With the ventilation requirements along the mainline sections driven by that route, the routes ending within Rozelle are generally well below the required air quality limit.

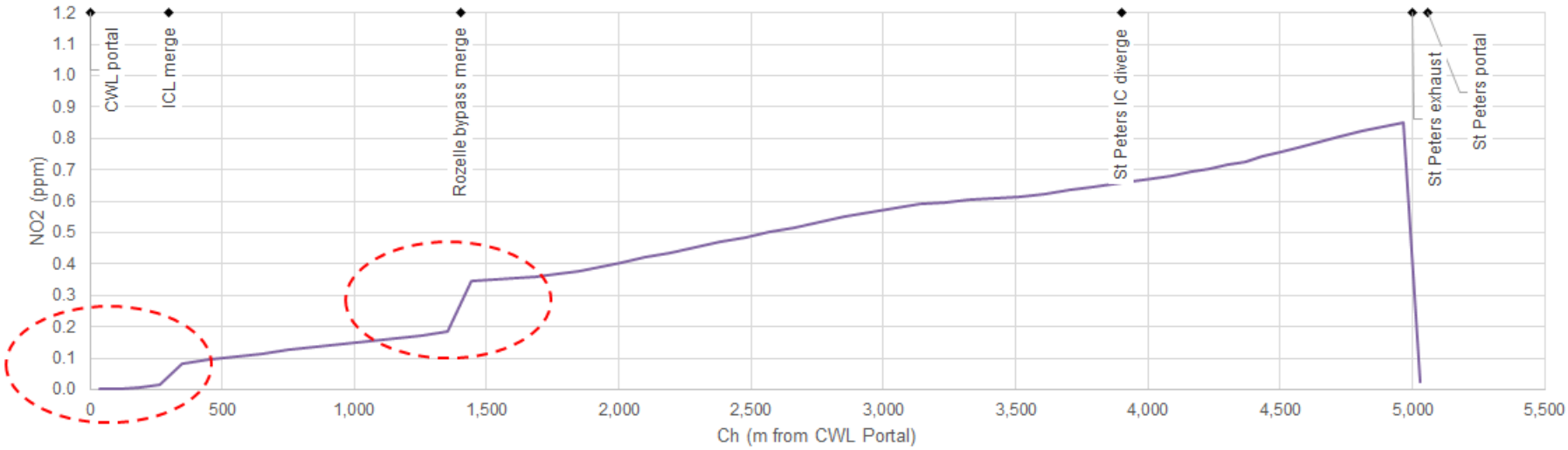


Figure 10.1. In-tunnel NO_2 levels along route 1AB from City West Link to St Peters (Do something, worst case operations, design case 1, 20 km/h].

Table 10.2. Summary of NO_2 route averages, M4 to M5 direction, Do something arrangement at 20 km/h (values are ppm).

Route ID		1E	1M	1N	1P	1Q	1R	1S	1T	1U	1Y	1Z	1AA	1AB	1AC	1AD
Enter at		M4 portal	Concord Rd	Wattle St	Wattle St	Wattle St	Wattle St	WHT&BL interface	WHT&BL interface	WHT&BL interface	Iron Cove Link	Iron Cove Link	Iron Cove Link	City West Link	City West Link	City West Link
Exit at		M5 portal	President Ave.	Anzac Bridge	St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.
Distance		21.7 km	18.5 km	4.6 km	7.2 km	16.4 km	14.3 km	6.1 km	15.3 km	13.1 km	6.4 km	15.7 km	13.5 km	5.1 km	14.4 km	12.2 km
Design Case	0	0.45	0.32	0.34	0.45	0.45	0.27	0.39	0.43	0.23	0.38	0.42	0.23	0.45	0.46	0.24
	1	**0.46**	**0.32**	**0.34**	**0.44**	**0.46**	**0.28**	**0.38**	**0.44**	**0.24**	**0.37**	**0.44**	**0.24**	**0.44**	**0.47**	**0.25**
	2	0.42	0.29	0.32	0.43	0.45	0.27	0.38	0.43	0.23	0.37	0.42	0.23	0.45	0.45	0.25
	3	0.03	0.04	0.18	0.09	0.04	0.05	0.04	0.02	0.03	0.03	0.02	0.03	0.04	0.02	0.03
	4	0.12	0.14	0.22	0.12	0.05	0.07	0.05	0.02	0.03	0.05	0.02	0.03	0.06	0.02	0.04
	5	0.13	0.15	0.25	0.25	0.11	0.14	0.18	0.07	0.09	0.17	0.07	0.09	0.21	0.08	0.10
	6	0.07	0.09	0.00	0.22	0.10	0.12	0.31	0.12	0.15	0.30	0.12	0.15	0.36	0.13	0.16
	7	0.27	0.12	0.00	0.19	0.36	0.16	0.27	0.41	0.20	0.26	0.40	0.20	0.31	0.43	0.21
	8	0.10	0.12	0.09	0.30	0.13	0.16	0.33	0.13	0.16	0.31	0.13	0.16	0.38	0.14	0.17
	9	0.30	0.16	0.09	0.29	0.40	0.21	0.31	0.42	0.21	0.30	0.41	0.21	0.36	0.44	0.23

For scenarios involving free-flowing traffic conditions, it is the routes that commence in the most downstream portions of the network that drive the interface exchange requirements. This occurs because the pollution carry-over from upstream sections results in an a step increase in pollution levels after the merge with the mainline, similar to that discussed above for the City West Link to St Peters route.

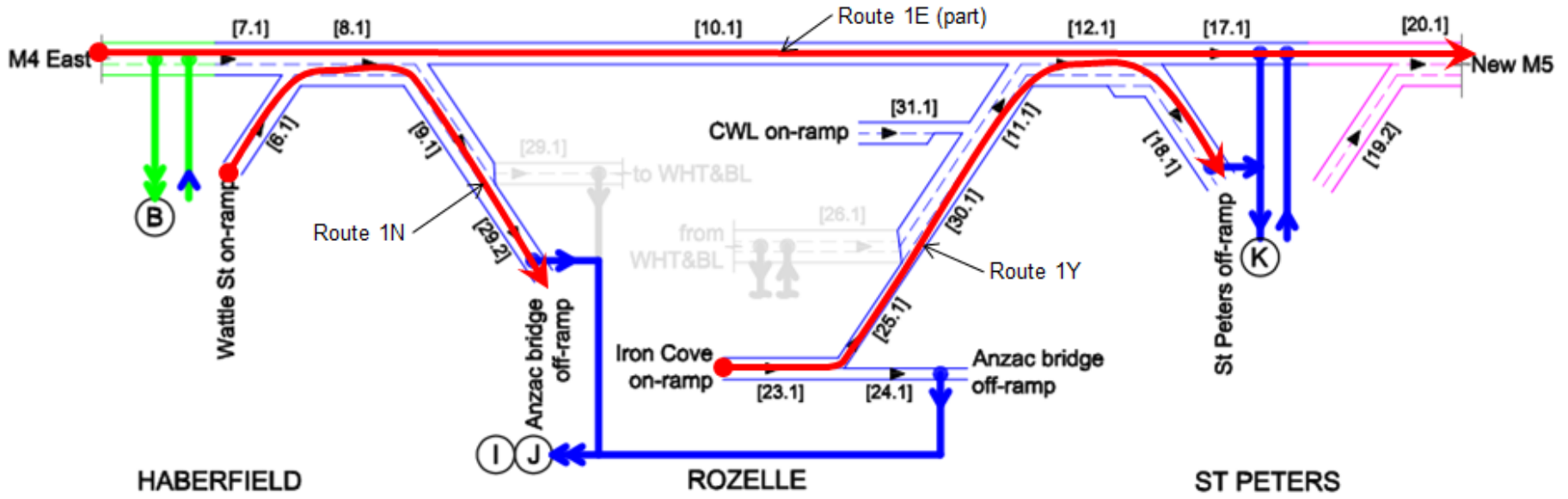
Table 10.3 shows selected NO_2 route averages for the 80 km/hr scenario for discussion. Route 1V from St Peters to M5 portal (red bounding box) becomes the dominant route which determines the amount of exchange required at St Peters interface plant. Route 1AC from City West Link to M5 Portal (orange bounding box) becomes the controlling route for exchange required at Haberfield, though routes 1Q and 1T from Wattle St and WHT&BL to the M5 portal have similar requirements.

In the free flowing cases, the traffic patterns with maximum flow continuing along the mainline, resulting in maximum pollution carry-over between projects are the ones that drive the interface requirements. While specific design case traffic patterns approach the air quality criteria for free-flow traffic, the expected traffic patterns have significant flows to the interchanges which drive a much higher natural exchange effect. With additional diversity in the expected traffic flows, it is predicted that no interface exchange will be required at Haberfield and St Peters for the expected traffic conditions.

Table 10.3. Summary of NO_2 route averages, M4 to M5 direction, Do something arrangement at 80 km/h (values are ppm).

Route ID		1D	1E	1M	1P	1Q	1R	1T	1U	1V	1W	1Y	1Z	1AB	1AC	1AD
Enter at		M4 portal	M4 portal	Concord Rd	Wattle St	Wattle St	Wattle St	WHT&BL interface	WHT&BL interface	St Peters	St Peters	Iron Cove Link	Iron Cove Link	City West Link	City West Link	City West Link
Exit at		St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.	M5 portal	President Ave.	M5 portal	President Ave.	St Peters	M5 portal	St Peters	M5 portal	President Ave.
Distance		12.5 km	21.7 km	18.5 km	7.2 km	16.4 km	14.3 km	15.3 km	13.1 km	9.1 km	6.9 km	6.4 km	15.7 km	5.1 km	14.4 km	12.2 km
Design Case	0	0.26	0.36	0.23	0.33	0.42	0.25	0.40	0.21	0.44	0.09	0.24	0.39	0.30	0.42	0.22
	1	0.26	0.36	0.23	0.32	0.42	0.25	0.40	0.21	0.46	0.11	0.24	0.40	0.29	0.43	0.22
	2	0.22	0.34	0.21	0.28	0.40	0.23	0.39	0.21	0.45	0.11	0.22	0.39	0.27	0.42	0.22
	3	0.03	0.03	0.03	0.05	0.05	0.04	0.04	0.03	0.04	0.03	0.02	0.03	0.02	0.04	0.03
	4	0.14	0.10	0.11	0.15	0.09	0.10	0.05	0.05	0.03	0.03	0.05	0.04	0.07	0.05	0.06
	5	0.14	0.14	0.13	0.18	0.16	0.14	0.14	0.12	0.11	0.05	0.13	0.14	0.17	0.15	0.13
	6	0.05	0.07	0.06	0.08	0.09	0.08	0.11	0.09	0.08	0.05	0.11	0.10	0.13	0.11	0.10
	7	0.04	0.23	0.09	0.07	0.30	0.12	0.33	0.14	0.45	0.12	0.10	0.33	0.12	0.35	0.15
	8	0.08	0.11	0.10	0.14	0.15	0.13	0.15	0.13	0.12	0.07	0.15	0.15	0.18	0.16	0.14
	9	0.08	0.24	0.11	0.13	0.31	0.15	0.33	0.15	0.42	0.11	0.14	0.32	0.17	0.35	0.16

Design case 1 (see Table 7.6) is generally the most onerous on jet fan requirements across the project with very similar requirements to that of case 0. The figures below show more detailed results for case 1 to illustrate the in-tunnel conditions. For easy reference, Figure 10.2 shows the schematic for that case including the traffic pattern and routes for which graphs are shown below.



Case	[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]
Vehicle flows (lanes of traffic) - all speed cases																	
1	3	1	4	2	0	2	2	2	1	1	0	1	1	2	4	2	2

Figure 10.2. Ventilation schematic M4 to M5 direction [Do something, worst case operations, design case 1].

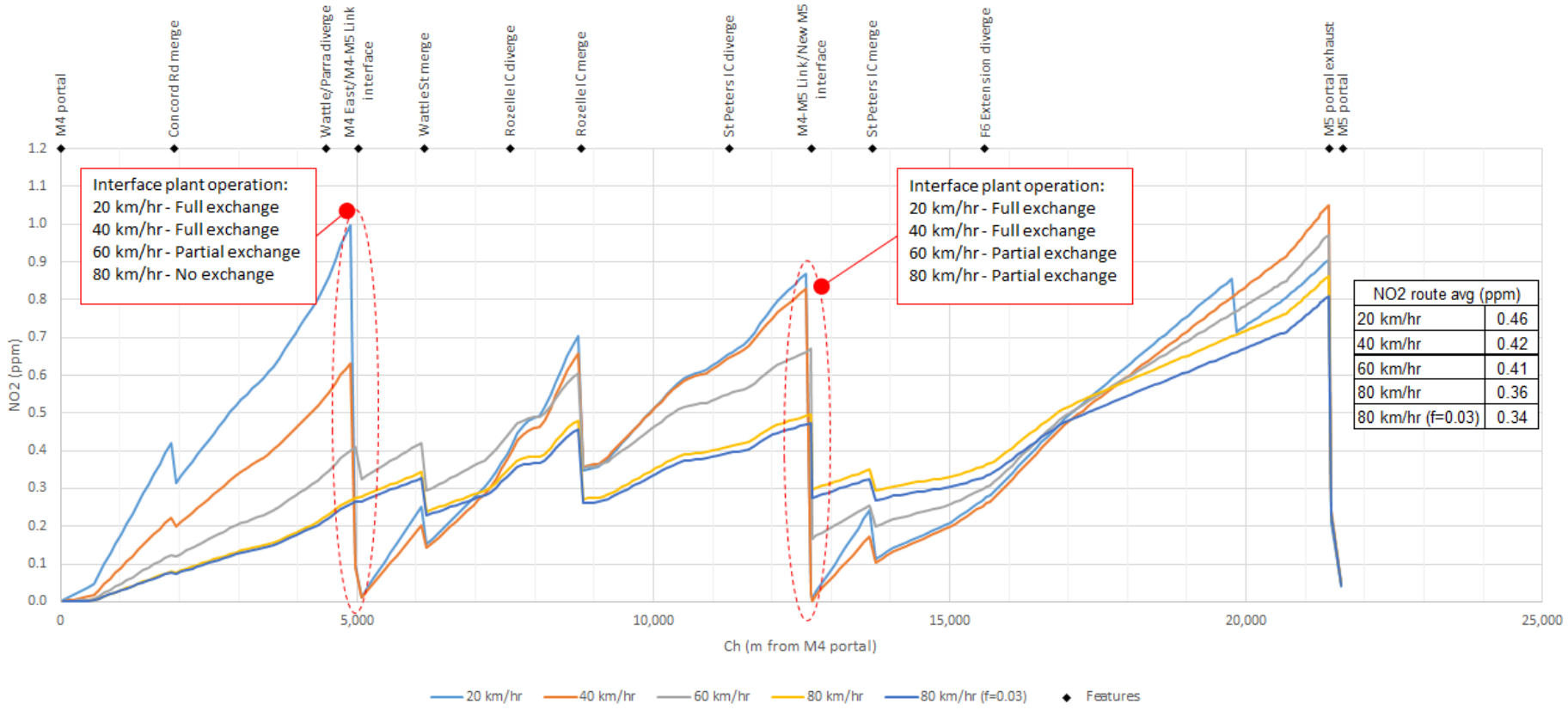


Figure 10.3. In-tunnel NO_2 levels along route 1E from M4 portal to M5 portal [Do something, worst case operations, design case 1].

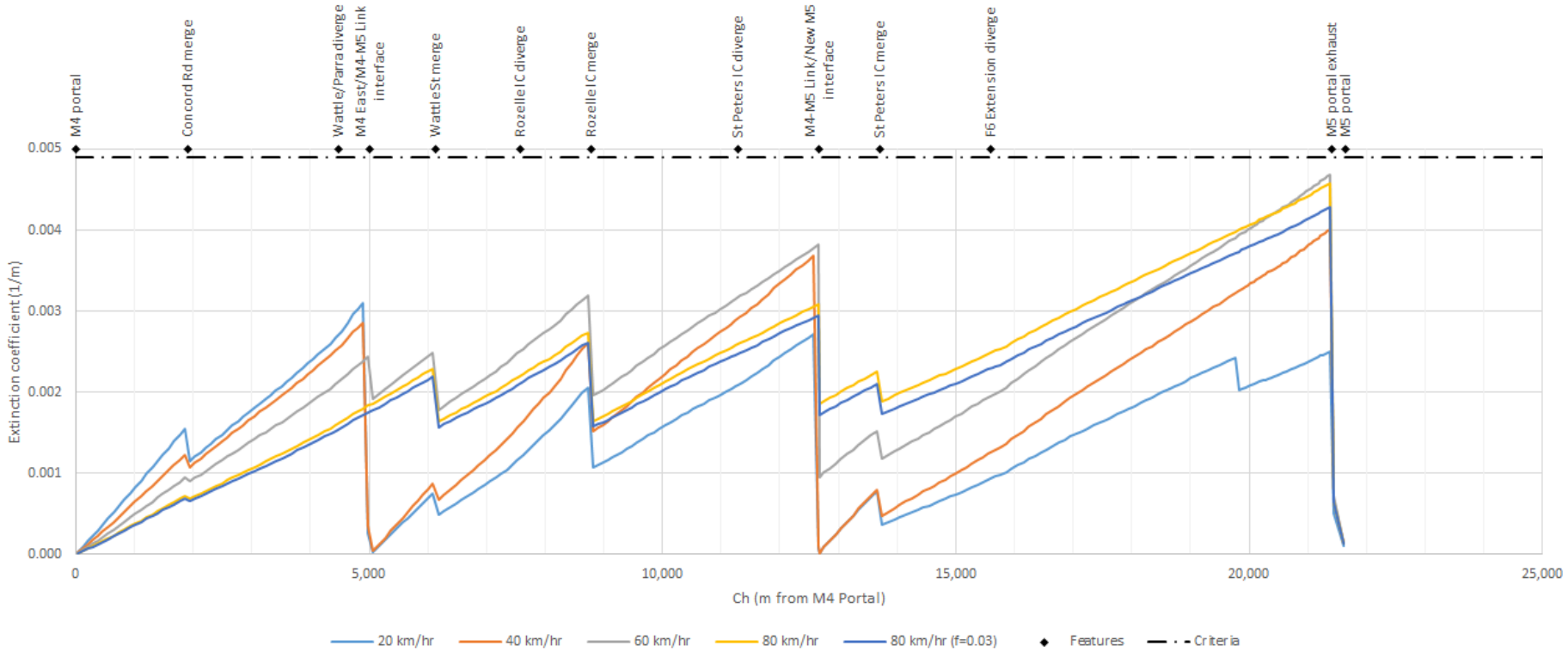


Figure 10.4. In-tunnel visibility along route 1E from M4 portal to M5 portal [Do something, worst case operations, design case 1].

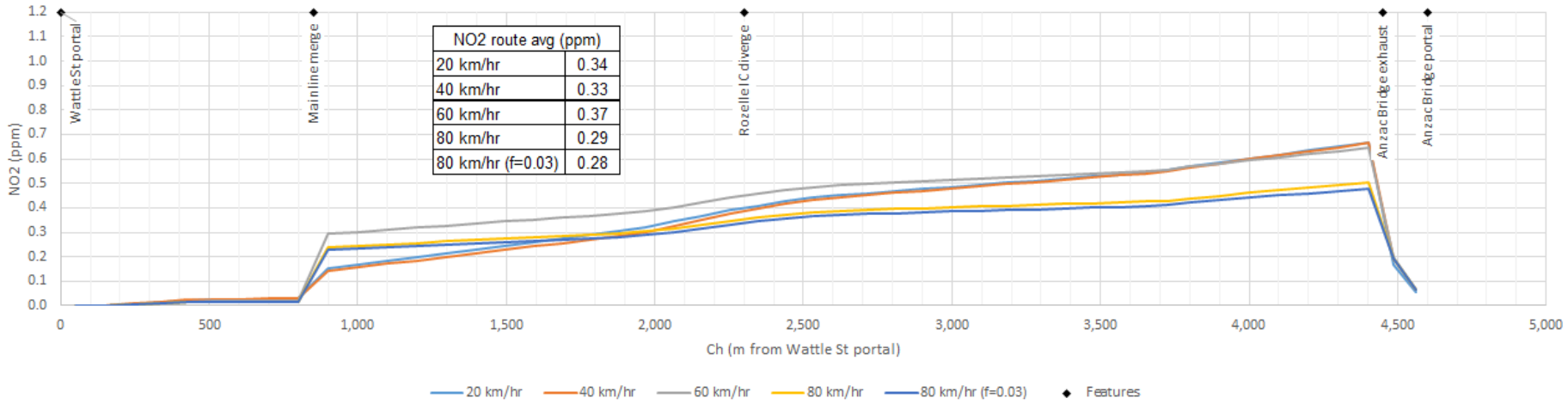


Figure 10.5. In-tunnel NO_2 levels along route 1N from Wattle St portal to Anzac Bridge portal [Do something, worst case operations, design case 1].

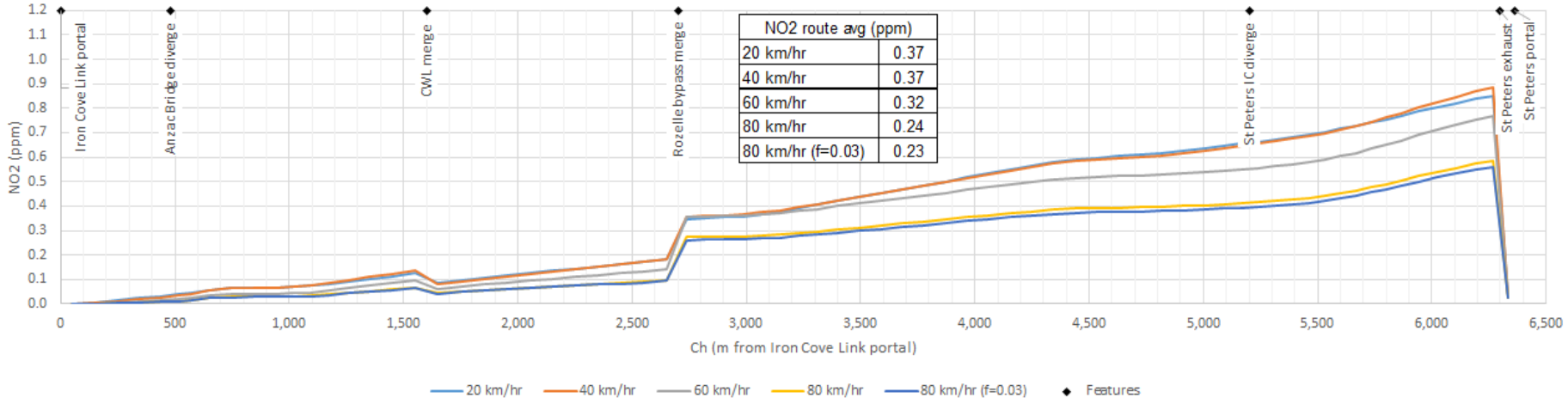


Figure 10.6. In-tunnel NO_2 levels along route 1Y Iron Cove Link portal to St Peters portal [Do something, worst case operations, design case 1].

Table 10.4 and Table 10.5 show the air velocity within the tunnel sections (at the smallest cross-section) for the design analyses where jet fans are used to increase tunnel airflows to achieve air quality criteria. The air velocities are well below the 10 m/s criteria.

Table 10.4. Summary of section air velocity, M4 to M5 direction [Do something, worst case operations, 20 km/h] (values are m/s).

Link No.		[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]
Design Case	0	3.6	5.2	5.9	5.0	0.0	6.8	2.9	5.3	1.1	4.7	0.0	3.1	4.2	5.9	6.6	6.7	1.9
	1	3.6	5.3	5.9	4.9	0.0	6.8	3.0	5.3	1.0	4.8	0.0	3.2	4.3	6.0	6.8	4.9	4.3
	2	3.6	5.2	5.9	4.9	0.0	6.8	2.9	5.3	1.1	4.7	0.0	3.1	4.2	5.9	6.6	6.7	1.9
	3	3.0	4.8	5.1	5.4	0.0	7.5	1.2	3.7	2.0	2.0	0.0	1.3	1.0	2.0	2.4	1.4	1.9
	4	3.1	4.6	5.2	5.5	0.0	7.5	1.2	3.7	2.0	2.0	0.0	1.3	1.0	2.0	2.4	1.4	1.9
	5	3.4	5.2	5.7	5.0	0.0	6.9	2.5	4.1	1.2	3.4	0.0	2.2	1.0	2.9	4.0	4.1	1.0
	6	1.6	2.4	2.6	1.6	0.0	2.2	2.0	4.5	1.0	3.9	0.0	2.6	1.0	3.3	4.0	4.1	1.0
	7	1.6	2.5	2.7	1.5	0.0	2.1	2.3	4.5	1.0	4.0	0.0	2.6	1.2	3.4	4.2	2.7	3.1
	8	2.0	3.3	3.5	2.5	0.0	3.4	2.3	4.9	1.0	4.4	0.0	2.9	3.0	4.9	5.4	5.7	1.3
	9	2.0	3.3	3.5	2.4	0.0	3.3	2.4	4.9	1.0	4.4	0.0	2.9	3.1	4.9	5.5	3.8	3.7

Table 10.5. Summary of section air velocity, M4 to M5 direction [Do something, worst case operations, 40 km/h] (values are m/s).

Link No.		[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]
Design Case	0	4.4	4.6	6.2	4.5	0.0	6.1	3.9	5.9	2.9	3.5	0.0	2.3	4.1	5.0	6.6	6.0	2.7
	1	4.3	4.4	6.0	4.6	0.0	6.3	3.5	6.0	2.8	3.8	0.0	2.5	4.6	5.5	6.8	4.4	4.8
	2	4.0	5.2	6.2	4.5	0.0	6.2	3.9	5.9	2.9	3.5	0.0	2.3	4.1	5.0	6.6	6.0	2.7
	3	2.1	5.1	4.6	4.9	0.0	6.8	1.1	2.4	1.0	1.6	0.0	1.1	3.0	3.1	3.2	2.0	2.3
	4	3.8	2.8	4.6	5.0	0.0	6.8	1.0	1.8	1.0	1.0	0.0	0.7	2.0	2.0	2.3	1.3	1.8
	5	3.3	5.1	5.5	4.7	0.0	6.5	2.6	1.8	1.0	1.0	0.0	0.7	2.1	2.0	3.3	3.3	1.0
	6	1.8	2.7	3.0	2.8	0.0	3.9	1.0	4.6	1.0	4.0	0.0	2.7	3.9	5.2	4.9	5.2	1.0
	7	1.8	2.7	3.0	2.8	0.0	3.9	1.1	4.6	1.0	4.1	0.0	2.7	4.0	5.3	5.0	2.5	4.4
	8	1.9	4.3	4.0	3.0	0.0	4.1	2.4	4.3	1.0	3.7	0.0	2.4	2.8	4.3	5.0	5.3	1.2
	9	2.1	4.4	4.2	2.7	0.0	3.8	3.1	4.5	1.0	3.9	0.0	2.6	3.5	4.9	5.9	4.1	4.0

10.1.2 M5 to M4 direction

For scenarios with high levels of congestion such as the 20 and 40 km/h speed cases, the interface plant at both Haberfield and St Peters are required to operate at full exchange and it is the 20 km/h case that drives the jet fan requirements. Table 10.11 shows the calculated NO_2 route averages (key routes only) for the 20 km/h design cases, representing the most onerous air quality driven ventilation requirements.

Under these circumstances the routes from St Peters to Iron Cove Link and St Peters to M4 Portal (Route 2AC and 2P, red bounding box) determine the ventilation requirements. For full exchange at Haberfield, the project can only influence the portion of route 2P up to the Haberfield interface plant. Contrary to the M4 to M5 direction, it is the longer routes as might generally be expected, that control the ventilation requirements for the M5 to M4 direction. The route from St Peters to Wattle St (route 2M, orange bounding box) is the next controlling route under conditions of complete interface exchange. With the ventilation requirements along the mainline sections driven by those routes, the routes beginning within Rozelle are generally well below the required air quality limit.

Table 10.6. Summary of NO_2 route averages, M5 to M4 direction, Do something arrangement at 20 km/h (values are ppm).

Route ID		2E	2K	2L	2M	2P	2Q	2R	2S	2Y	2Z	2AA	2AB	2AC	2AD	2AE	2AF	2AG	2AH
Enter at		M5 portal	President Ave.	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Anzac Bridge	M5 portal	M5 portal	President Ave.	President Ave.	St Peters	St Peters	Anzac Bridge	WHT&BL interface	WHT&BL interface	WHT&BL interface
Exit at		M4 portal	M4 portal	WHT&BL interface	Wattle St	M4 portal	Wattle St	Concord Rd	M4 Portal	Iron Cove Link	City West Link	Iron Cove Link	City West Link	Iron Cove Link	City West Link	Iron Cove Link	Wattle St	Concord Rd	M4 portal
Distance		21.7 km	19.7 km	5.6 km	7.1 km	12.5 km	4.7 km	8.9 km	10 km	15.6 km	14.4 km	13.6 km	12.3 km	6.4 km	5.1 km	1.3 km	4.7 km	8.9 km	10 km
Design Case	0	0.43	0.35	0.40	0.43	0.45	0.31	0.29	0.40	0.43	0.40	0.31	0.26	0.47	0.40	0.28	0.31	0.29	0.40
	1	0.42	0.33	0.38	0.41	0.44	0.30	0.29	0.40	0.41	0.38	0.28	0.24	0.43	0.37	0.27	0.30	0.29	0.40
	2	0.40	0.31	0.42	0.42	0.40	0.30	0.27	0.33	0.43	0.40	0.31	0.26	0.47	0.40	0.28	0.29	0.27	0.33
	3	0.44	0.36	0.40	0.46	0.47	0.34	0.31	0.41	0.42	0.39	0.29	0.25	0.44	0.37	0.26	0.33	0.31	0.41
	4	0.45	0.37	0.41	0.45	0.47	0.31	0.31	0.41	0.43	0.41	0.31	0.27	0.45	0.38	0.26	0.31	0.31	0.41
	5	0.07	0.07	0.32	0.20	0.12	0.08	0.05	0.04	0.13	0.11	0.15	0.13	0.32	0.31	0.12	0.08	0.05	0.04
	6	0.08	0.09	0.37	0.25	0.15	0.12	0.07	0.06	0.17	0.12	0.19	0.15	0.41	0.35	0.26	0.12	0.07	0.06
	7	0.25	0.28	0.31	0.41	0.44	0.34	0.31	0.41	0.11	0.09	0.13	0.11	0.28	0.26	0.16	0.34	0.31	0.41
	8	0.25	0.28	0.29	0.39	0.44	0.32	0.32	0.42	0.11	0.09	0.12	0.10	0.26	0.24	0.06	0.32	0.31	0.42
	9	0.20	0.22	0.17	0.23	0.35	0.22	0.27	0.38	0.05	0.04	0.06	0.05	0.13	0.12	0.03	0.21	0.26	0.37
	10	0.44	0.36	0.44	0.42	0.47	0.26	0.29	0.40	0.43	0.40	0.31	0.26	0.47	0.39	0.23	0.26	0.29	0.40
	11	0.03	0.03	0.04	0.11	0.05	0.17	0.08	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.08	0.07
	12	0.13	0.14	0.17	0.27	0.23	0.26	0.19	0.21	0.06	0.05	0.07	0.06	0.15	0.14	0.04	0.26	0.18	0.21
	13	0.04	0.04	0.24	0.12	0.07	0.04	0.02	0.02	0.12	0.06	0.14	0.08	0.30	0.18	0.27	0.04	0.02	0.02

For scenarios involving free-flowing traffic conditions, it is the routes that commence in the most downstream portions of the network that drive the interface exchange requirements. This occurs because the pollution carry-over from upstream sections results in an a step increase in pollution levels after the merges with the mainline, similar to that discussed above for the City West Link to St Peters route.

Table 10.7 shows key NO_2 route averages for the 80 km/h scenario for discussion. Similar trends occur at 60 km/h. However, increased levels of interface exchange (as a proportion of tunnel airflow) are required due to the reduction in vehicle drawn airflows. Routes 2U and 2X from Parramatta Rd and Wattle St (in M4 East) to the M4 portal (red bounding boxes) determine the amount of exchange required at the Haberfield interface plant. For this arrangement, some interface exchange is required at Haberfield for the worst design cases analysed. This is mostly due the ventilation approach for Concord Rd off-ramp which uses jet fans to create reverse flow towards the mainline, increasing the in-tunnel pressure at the diverge, ultimately resulting in retarding effect on the vehicle drawn airflows in M4 East. This particularly affects the amount or air drawn in the M4 East on-ramps to dilute the carry-over from M5-M5 Link.

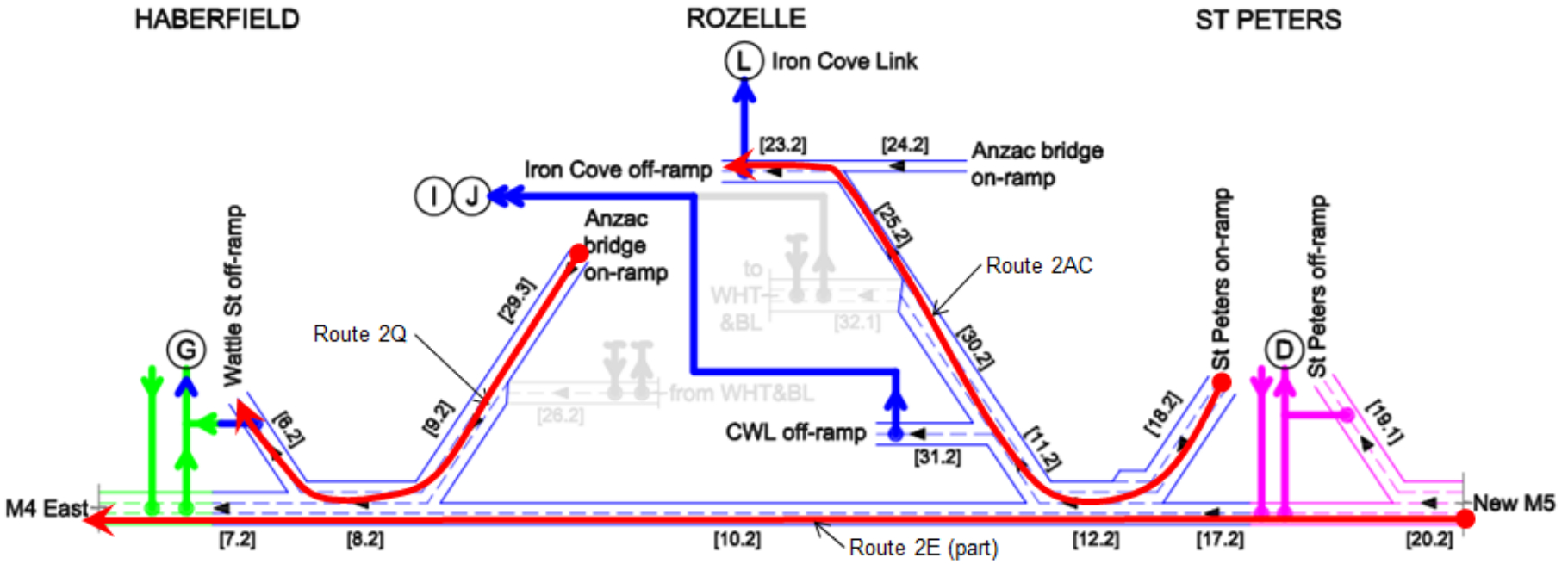
With Parramatta Rd (and Wattle St) merge located only a short distance downstream of the interface plant, in most cases it will be feasible to use only the interface exhaust to remove some of the polluted air carry-over from M4-M5 Link. The fresh-air supply then naturally occurs through Parramatta Rd on-ramp rather than using the mechanical plant at the interface. The end result being a higher dilution effect after the Parramatta Rd merge.

For expected traffic conditions, the increased diversity in the traffic patterns compared to the design cases mean that no exchange is predicted to be required at Haberfield. At 60 to 80 km/h, no interface exchange is required at St Peters for the design cases, due to the assumed ventilation operation at Arncliffe. If lower levels of exchange are used at Arncliffe then the St Peters interface demand will be driven by a number of routes within the project, both commencing at St Peters and also within Rozelle. These routes are shown in orange bounding boxes in Table 10.7.

Table 10.7. Summary of NO_2 route averages, M5 to M4 direction, Do something arrangement at 80 km/h (values are ppm).

Route ID		2A	2E	2L	2M	2P	2Q	2S	2T	2U	2V	2X	2AC	2AD	2AE	2AF	2AG	2AH
Enter at		M5 portal	M5 portal	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	Wattle St	St Peters	St Peters	Anzac Bridge	WHT&BL interface	WHT&BL interface	WHT&BL interface
Exit at		St Peters	M4 portal	WHT&BL interface	Wattle St	M4 portal	Wattle St	M4 Portal	Concord Rd	M4 portal	Concord Rd	M4 portal	Iron Cove Link	City West Link	Iron Cove Link	Wattle St	Concord Rd	M4 portal
Distance		9.2 km	21.7 km	5.6 km	7.1 km	12.5 km	4.7 km	10 km	4.4 km	5.5 km	4.4 km	5.6 km	6.4 km	5.1 km	1.3 km	4.7 km	8.9 km	10 km
Design Case	0	0.12	0.26	0.31	0.30	0.34	0.17	0.29	0.25	0.34	0.22	0.32	0.34	0.31	0.14	0.17	0.23	0.29
	1	0.12	0.24	0.26	0.26	0.31	0.16	0.27	0.24	0.33	0.21	0.31	0.29	0.25	0.13	0.16	0.22	0.27
	2	0.12	0.28	0.32	0.30	0.37	0.17	0.33	0.31	0.41	0.27	0.37	0.34	0.31	0.14	0.17	0.27	0.33
	3	0.12	0.30	0.31	0.32	0.40	0.20	0.36	0.32	0.45	0.28	0.41	0.34	0.30	0.14	0.20	0.29	0.36
	4	0.12	0.30	0.32	0.32	0.40	0.19	0.36	0.32	0.45	0.28	0.42	0.33	0.30	0.14	0.19	0.29	0.36
	5	0.00	0.03	0.13	0.08	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.13	0.12	0.05	0.03	0.02	0.02
	6	0.00	0.04	0.17	0.10	0.07	0.03	0.03	0.01	0.02	0.01	0.01	0.18	0.15	0.11	0.03	0.03	0.03
	7	0.00	0.16	0.11	0.16	0.27	0.15	0.29	0.22	0.37	0.19	0.34	0.10	0.10	0.05	0.14	0.20	0.29
	8	0.00	0.17	0.11	0.16	0.30	0.14	0.32	0.26	0.43	0.22	0.39	0.10	0.10	0.03	0.14	0.23	0.32
	9	0.00	0.15	0.08	0.11	0.26	0.10	0.29	0.23	0.39	0.20	0.36	0.07	0.06	0.02	0.10	0.20	0.29
	10	0.12	0.29	0.31	0.31	0.40	0.17	0.36	0.32	0.44	0.28	0.41	0.34	0.30	0.14	0.17	0.28	0.36
	11	0.00	0.04	0.01	0.06	0.07	0.10	0.09	0.05	0.06	0.04	0.05	0.00	0.00	0.00	0.10	0.08	0.09
	12	0.00	0.11	0.07	0.12	0.19	0.12	0.21	0.21	0.26	0.19	0.24	0.07	0.06	0.02	0.12	0.18	0.21
	13	0.00	0.02	0.09	0.05	0.03	0.02	0.01	0.01	0.01	0.00	0.01	0.10	0.07	0.09	0.02	0.01	0.01

Design case 3 and 4 (see Table 7.7) are generally the most onerous on jet fan requirements in the M5 to M4 direction. Figures below show more detailed results for case 3 to illustrate the in-tunnel conditions. For easy reference, Figure 10.7 shows the schematic for that case including the traffic flows and routes used for results also highlighted.



Case	[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]
Vehicle flows (lanes of traffic) - all speeds																	
3	2	2	4	2	0	2	2	2	1	1	0	1	1	2	4	2	2

Figure 10.7. Ventilation schematic M5 to M4 direction [Do something, worst case operations, design case 3].

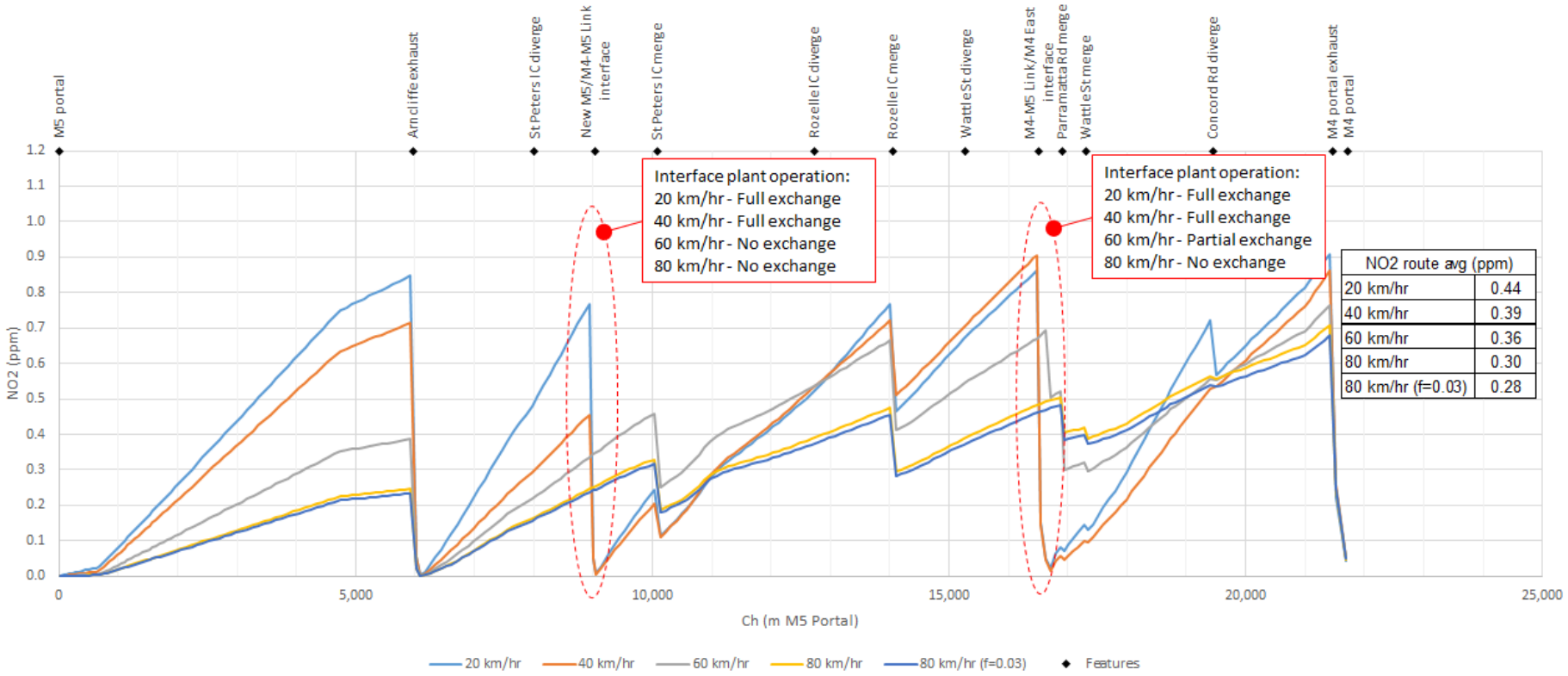


Figure 10.8. In-tunnel NO_2 levels along route 2E from M5 portal to M4 portal [Do something, worst case operations, design case 3].

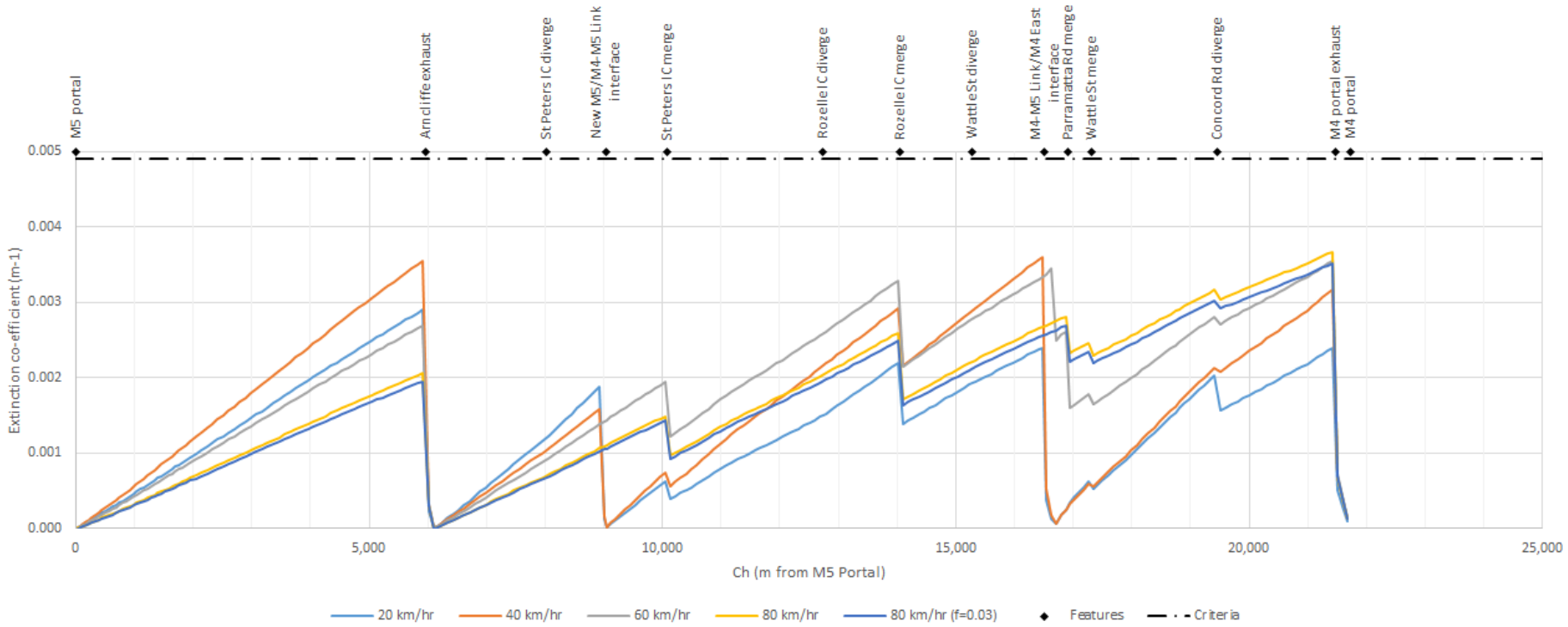


Figure 10.9. In-tunnel visibility along route 2E from M5 portal to M4 portal [Do something, worst case operations, design case 3].

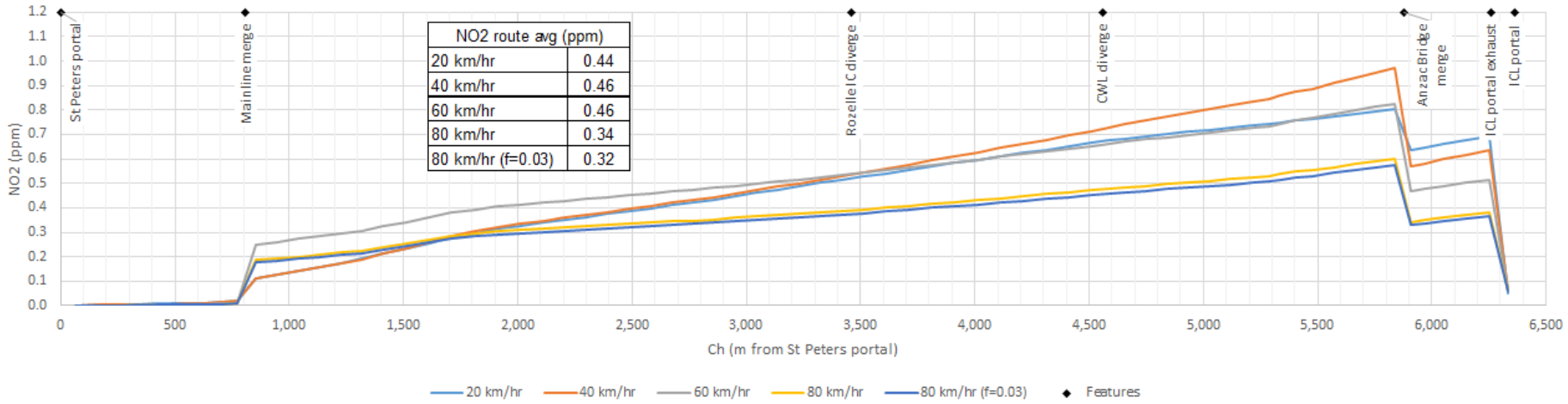


Figure 10.10. In-tunnel NO_2 levels along route 2AC from St Peters portal to Iron Cove Link portal [Do something, worst case operations, design case 3].

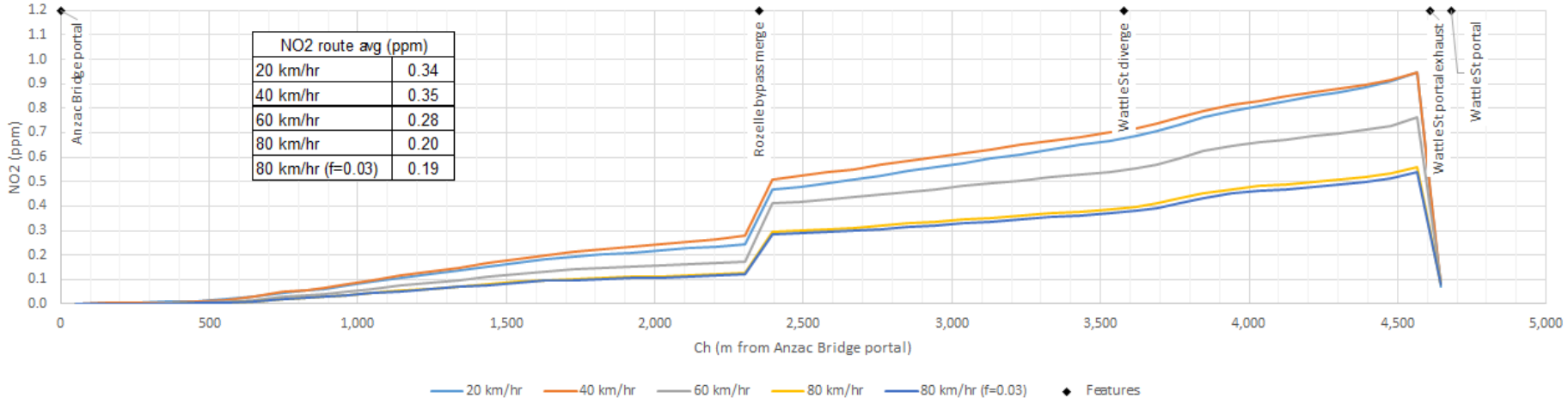


Figure 10.11. In-tunnel NO_2 levels along route 2Q from Anzac Bridge portal to Wattle St portal [Do something, worst case operations, design case 3].

Table 10.12 and Table 10.13 show the air velocity within the tunnel sections (at the smallest cross-section) for the design analyses where jet fans are used to increase tunnel airflows to achieve air quality criteria. The air velocities are well below the 10 m/s criteria.

Table 10.8. Summary of section air velocity, M5 to M4 direction [Do something, worst case operations, 20 km/h] (values are m/s).

Link No.		[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]
Design Case	0	3.4	5.7	6.1	4.5	0.0	6.2	3.7	7.7	2.5	6.0	0.0	4.0	2.4	5.7	7.0	5.7	3.7
	1	3.4	5.7	6.1	4.5	0.0	6.2	3.7	7.7	2.5	6.0	0.0	4.0	2.4	5.7	7.0	5.7	3.7
	2	3.6	5.5	6.1	4.5	0.0	6.3	3.7	7.7	2.5	6.0	0.0	4.0	2.3	5.7	7.0	5.7	3.7
	3	4.9	4.8	6.7	5.1	0.0	7.0	3.9	7.8	2.4	6.1	0.0	4.0	2.1	5.6	7.1	5.7	3.8
	4	5.2	4.8	6.9	5.5	0.0	7.6	3.8	7.7	2.4	6.1	0.0	4.0	2.0	5.5	6.9	6.5	2.7
	5	2.0	1.5	2.5	1.8	0.0	2.5	1.6	6.9	2.7	4.8	0.0	3.2	1.0	3.9	4.2	3.9	1.6
	6	2.7	2.1	3.4	1.7	0.0	2.3	3.0	7.5	2.7	5.5	0.0	3.7	1.0	4.4	5.5	4.4	3.1
	7	4.9	4.0	6.2	4.6	0.0	6.3	3.9	2.7	1.9	1.0	0.0	0.7	1.1	1.4	3.8	3.7	1.3
	8	5.0	3.7	6.2	4.6	0.0	6.4	3.7	1.8	1.0	1.0	0.0	0.7	1.7	1.9	4.0	3.8	1.4
	9	5.1	3.5	6.1	4.6	0.0	6.4	3.6	1.8	1.0	1.0	0.0	0.7	1.7	1.9	3.9	3.7	1.4
	10	4.8	4.6	6.5	4.7	0.0	6.5	4.1	6.7	3.4	3.9	0.0	2.6	3.3	5.0	6.7	5.5	3.6
	11	4.4	4.1	5.9	4.7	0.0	6.6	3.1	1.8	1.0	1.0	0.0	0.7	1.0	1.4	3.2	2.5	1.7
	12	4.6	3.9	5.9	4.7	0.0	6.5	3.2	1.8	1.0	1.0	0.0	0.7	1.3	1.6	3.4	2.9	1.8
	13	4.5	3.7	5.8	4.8	0.0	6.6	2.9	3.3	1.8	1.8	0.0	1.2	1.0	1.9	3.5	2.9	1.8

Table 10.9. Summary of section air velocity, M5 to M4 direction [Do something, worst case operations, 40 km/h] (values are m/s).

Link No.		[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]
Design Case	0	3.4	4.5	5.3	4.0	0.0	5.6	3.2	7.4	4.0	4.1	0.0	2.7	4.4	5.9	6.8	4.9	4.4
	1	3.6	4.6	5.5	3.9	0.0	5.4	3.6	6.1	3.3	3.3	0.0	2.2	4.3	5.3	6.6	5.3	3.7
	2	4.7	2.9	5.4	4.1	0.0	5.6	3.3	7.3	4.0	4.0	0.0	2.7	4.4	5.9	6.9	5.0	4.4
	3	4.4	5.6	6.8	4.3	0.0	5.9	5.0	6.1	3.3	3.3	0.0	2.2	2.9	4.3	6.8	4.9	4.3
	4	5.1	4.5	6.7	4.2	0.0	5.9	4.9	6.1	3.3	3.4	0.0	2.2	2.9	4.3	6.8	4.9	4.3
	5	0.6	2.5	1.9	1.6	0.0	2.2	1.0	1.8	1.0	1.0	0.0	0.7	5.4	4.6	4.3	4.3	1.3
	6	0.6	2.5	1.9	1.6	0.0	2.2	1.0	6.1	3.3	3.4	0.0	2.2	4.4	5.4	5.0	4.9	1.6
	7	4.7	4.3	6.2	3.8	0.0	5.3	4.7	4.4	3.8	1.0	0.0	0.7	1.0	1.4	4.3	4.3	1.2
	8	5.1	3.8	6.3	4.0	0.0	5.5	4.7	1.8	1.0	1.0	0.0	0.7	1.5	1.7	4.5	4.4	1.5
	9	4.9	3.5	5.9	4.2	0.0	5.8	3.9	1.8	1.0	1.0	0.0	0.7	1.2	1.6	3.8	3.7	1.4
	10	4.7	3.2	5.6	3.7	0.0	5.1	4.0	6.2	3.2	3.6	0.0	2.4	3.6	5.0	6.7	4.8	4.3
	11	0.6	5.7	3.8	3.9	0.0	5.4	1.0	1.8	1.0	1.0	0.0	0.7	1.0	1.4	1.8	1.5	0.9
	12	3.5	4.6	5.4	3.9	0.0	5.4	3.4	1.8	1.0	1.0	0.0	0.7	1.5	1.7	3.7	3.6	1.2
	13	0.6	2.5	1.9	1.6	0.0	2.2	1.0	6.5	3.0	4.0	0.0	2.7	2.7	4.7	4.4	4.0	1.9

10.2 Cumulative arrangement

10.2.1 M4 to M5 direction

For scenarios of extreme congestion such as the 20 and 40 km/h speed cases, the interface plant at both Haberfield and St Peters are required to operate at full exchange and it is the 20 km/h case that drives the jet fan requirements. Table 10.10 shows the calculated NO_2 route averages (key routes only) for the 20 km/h design cases, representing the most onerous air quality driven ventilation requirements.

Under these circumstances the route from City West Link to St Peters (Route 1AB, red bounding box Table 10.10) again controls the ventilation requirements. This is due to the short length of the on-ramp before the merge with connections from Iron Cove Link and WHT&BL which results in a sudden increase in pollution levels. With additional pollution generation upstream of that first merge, due to the added connection from WHT&BL in this arrangement, the effect is more pronounced than for the Do something arrangement, making the criteria more onerous. For illustrative purposes, Figure 10.12 displays the NO_2 levels along this route for a controlling design case. The short ramp length means that the low pollution levels in the ramp form a low weighting in the route average, being less than 6% of the overall route length. All other on-ramps within WestConnex are generally longer than 1 km, so this effect is not seen elsewhere. For the current criteria, lengthening the City West Link on-ramp would actually make the ventilation task less onerous.

The route from Wattle St to St Peters (Route 1P, orange bounding box Table 10.10) is the next controlling route under conditions of complete interface exchange. With the ventilation requirements along the mainline sections driven by that route, the routes ending within Rozelle are generally well below the required air quality.

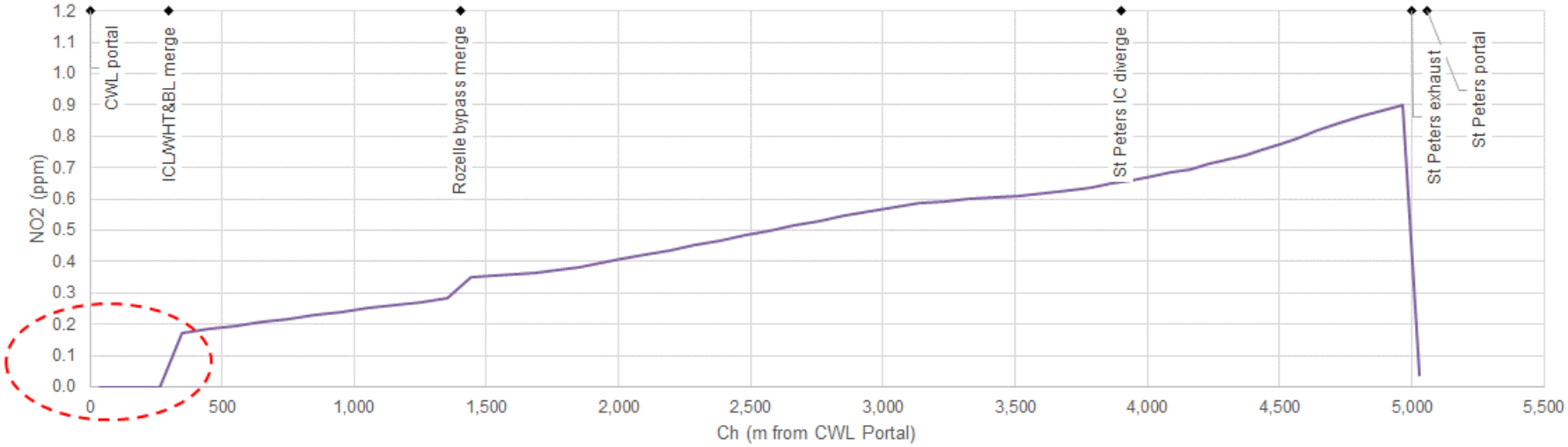


Figure 10.12. In-tunnel NO_2 levels along route 1AB from City West Link to St Peters (Cumulative, worst case operations, design case 4, 20 km/h].

Table 10.10. Summary of NO_2 route averages, M4 to M5 direction, Cumulative arrangement at 20 km/h (values are ppm).

Route ID		1E	1M	1N	1P	1Q	1R	1S	1T	1U	1Y	1Z	1AA	1AB	1AC	1AD
Enter at		M4 portal	Concord Rd	Wattle St	Wattle St	Wattle St	Wattle St	WHT&BL interface	WHT&BL interface	WHT&BL interface	Iron Cove Link	Iron Cove Link	Iron Cove Link	City West Link	City West Link	City West Link
Exit at		M5 portal	President Ave.	Anzac Bridge	St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.
Distance		21.7 km	18.5 km	4.6 km	7.2 km	16.4 km	14.3 km	6.1 km	15.3 km	13.1 km	6.4 km	15.7 km	13.5 km	5.1 km	14.4 km	12.2 km
Design Case	0	0.43	0.37	0.38	0.44	0.44	0.36	0.41	0.43	0.34	0.39	0.42	0.33	0.47	0.45	0.36
	1	0.41	0.36	0.38	0.44	0.44	0.36	0.41	0.43	0.34	0.39	0.42	0.33	0.47	0.45	0.36
	2	0.39	0.34	0.36	0.43	0.44	0.36	0.41	0.43	0.34	0.38	0.42	0.33	0.46	0.45	0.36
	3	0.42	0.37	0.35	0.43	0.44	0.36	0.41	0.43	0.34	0.39	0.42	0.33	0.47	0.45	0.36
	4	**0.44**	**0.39**	**0.36**	**0.46**	**0.45**	**0.38**	**0.41**	**0.43**	**0.34**	**0.39**	**0.42**	**0.33**	**0.47**	**0.45**	**0.36**
	5	0.43	0.38	0.33	0.45	0.45	0.37	0.39	0.43	0.34	0.36	0.42	0.33	0.44	0.45	0.36
	6	0.44	0.39	0.37	0.47	0.46	0.38	0.41	0.44	0.35	0.39	0.43	0.34	0.46	0.46	0.37
	7	0.44	0.39	0.40	0.46	0.46	0.38	0.40	0.43	0.34	0.40	0.43	0.34	0.47	0.46	0.37
	8	0.44	0.45	0.36	0.46	0.46	0.45	0.41	0.44	0.43	0.39	0.43	0.42	0.47	0.46	0.45
	9	0.18	0.19	0.44	0.22	0.12	0.11	0.09	0.06	0.04	0.08	0.05	0.04	0.10	0.06	0.05
	10	0.12	0.13	0.39	0.18	0.08	0.10	0.07	0.03	0.04	0.07	0.03	0.03	0.09	0.03	0.04
	11	0.12	0.13	0.38	0.18	0.08	0.09	0.07	0.03	0.04	0.07	0.03	0.03	0.08	0.03	0.04
	12	0.17	0.19	0.43	0.22	0.10	0.11	0.09	0.04	0.04	0.08	0.04	0.04	0.10	0.04	0.05
	13	0.27	0.19	0.08	0.35	0.35	0.25	0.41	0.38	0.27	0.38	0.36	0.26	0.46	0.39	0.28
	14	0.09	0.11	0.00	0.27	0.12	0.14	0.40	0.16	0.19	0.37	0.15	0.18	0.45	0.16	0.19
	15	0.14	0.17	0.27	0.43	0.19	0.22	0.33	0.13	0.15	0.31	0.13	0.15	0.39	0.14	0.17
	16	0.37	0.30	0.34	0.47	0.40	0.31	0.40	0.37	0.26	0.37	0.36	0.25	0.46	0.39	0.27
	17	0.41	0.41	0.34	0.46	0.46	0.45	0.39	0.43	0.42	0.36	0.42	0.41	0.45	0.46	0.45
	18	0.26	0.14	0.00	0.16	0.35	0.18	0.23	0.39	0.22	0.22	0.38	0.21	0.26	0.41	0.23
	19	0.26	0.25	0.00	0.19	0.35	0.32	0.27	0.39	0.37	0.25	0.38	0.36	0.31	0.41	0.39
	20	0.02	0.00	0.00	0.00	0.02	0.00	0.01	0.03	0.01	0.01	0.03	0.01	0.01	0.03	0.00
	21	0.07	0.08	0.00	0.22	0.10	0.11	0.33	0.13	0.15	0.32	0.13	0.15	0.37	0.13	0.15
	22	0.21	0.23	0.31	0.35	0.16	0.18	0.36	0.15	0.17	0.34	0.14	0.16	0.41	0.15	0.17

For scenarios involving free-flowing traffic conditions, it is the routes that commence in the most downstream portions of the network that drive the interface exchange requirements. This occurs because the pollution carry-over from upstream sections results in an a step increase in pollution levels after the merge with the mainline, similar to that discussed above for the City West Link to St Peters route.

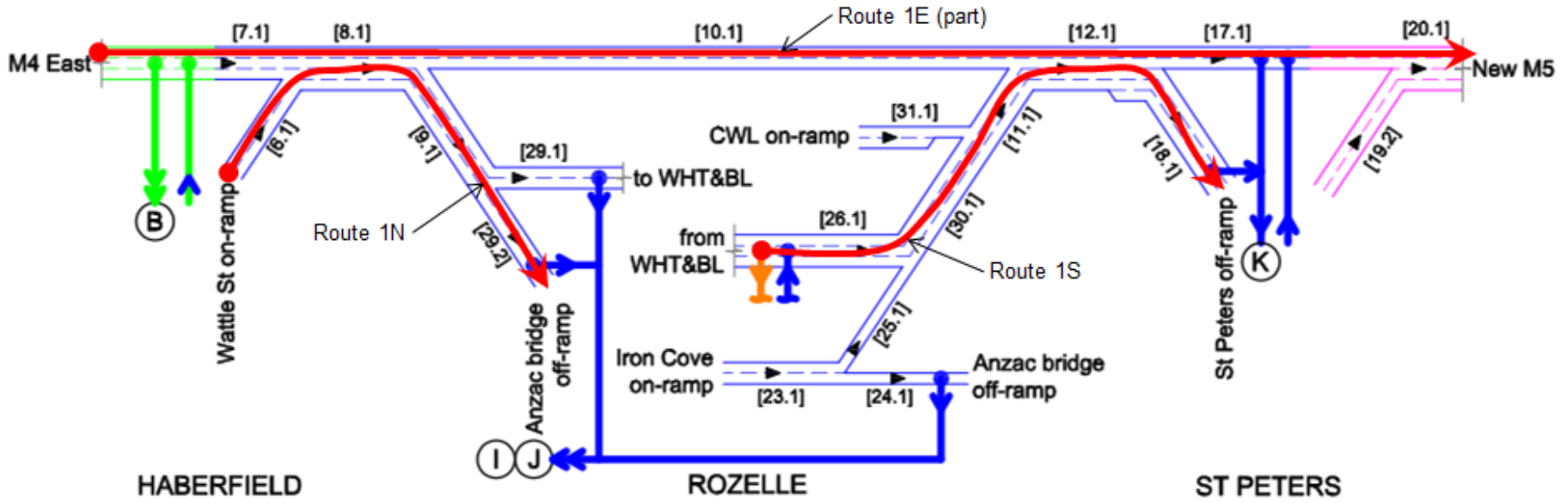
Table 10.11 shows selected NO_2 route averages for the 80 km/h scenario for discussion. Route 1V from St Peters to M5 portal (red bounding box) becomes the dominant route which determines the amount of exchange required at St Peters interface plant. Route 1AC from City West Link to M5 Portal (orange bounding box) becomes the controlling route for exchange required at Haberfield. In the free-flowing cases, the traffic patterns with maximum flow continuing along the mainline (e.g. case 8 and 17), resulting in maximum pollution carry-over between

projects are the ones that drive the interface requirements. While specific design case traffic patterns approach the air quality criteria for free-flow traffic, the expected traffic patterns have significant flows to the interchanges which drive a much higher natural exchange effect. With additional diversity in the expected traffic flows, it is predicted that no interface exchange will be required at Haberfield and St Peters for the expected traffic conditions.

Table 10.11. Summary of NO_2 route averages, M4 to M5 direction, Cumulative arrangement at 80 km/h (values are ppm).

Route ID		1D	1E	1M	1P	1Q	1R	1T	1U	1V	1W	1Y	1Z	1AB	1AC	1AD
Enter at		M4 portal	M4 portal	Concord Rd	Wattle St	Wattle St	Wattle St	WHT&BL interface	WHT&BL interface	St Peters	St Peters	Iron Cove Link	Iron Cove Link	City West Link	City West Link	City West Link
Exit at		St Peters	M5 portal	President Ave.	St Peters	M5 portal	President Ave.	M5 portal	President Ave.	M5 portal	President Ave.	St Peters	M5 portal	St Peters	M5 portal	President Ave.
Distance		12.5 km	21.7 km	18.5 km	7.2 km	16.4 km	14.3 km	15.3 km	13.1 km	9.1 km	6.9 km	6.4 km	15.7 km	5.1 km	14.4 km	12.2 km
Design Case	0	0.26	0.35	0.30	0.32	0.40	0.33	0.39	0.31	0.42	0.27	0.25	0.38	0.30	0.41	0.33
	1	0.24	0.34	0.29	0.31	0.40	0.33	0.39	0.31	0.42	0.27	0.25	0.38	0.30	0.41	0.32
	2	0.21	0.32	0.27	0.28	0.38	0.31	0.38	0.29	0.41	0.27	0.23	0.37	0.28	0.40	0.31
	3	0.25	0.35	0.30	0.32	0.40	0.33	0.39	0.31	0.42	0.27	0.25	0.38	0.30	0.41	0.32
	4	0.25	0.35	0.30	0.32	0.40	0.33	0.39	0.31	0.42	0.27	0.25	0.38	0.30	0.41	0.32
	5	0.26	0.36	0.31	0.33	0.42	0.35	0.40	0.32	0.43	0.29	0.26	0.39	0.31	0.43	0.34
	6	0.25	0.34	0.30	0.31	0.40	0.33	0.39	0.30	0.42	0.27	0.24	0.38	0.29	0.41	0.32
	7	0.25	0.34	0.29	0.30	0.39	0.32	0.37	0.29	0.41	0.26	0.23	0.36	0.27	0.39	0.31
	8	**0.25**	**0.37**	**0.33**	**0.31**	**0.44**	**0.37**	**0.42**	**0.35**	**0.47**	**0.34**	**0.24**	**0.41**	**0.30**	**0.45**	**0.37**
	9	0.18	0.15	0.15	0.19	0.14	0.14	0.09	0.08	0.09	0.07	0.07	0.09	0.08	0.10	0.08
	10	0.09	0.08	0.08	0.10	0.07	0.07	0.05	0.04	0.05	0.04	0.04	0.05	0.04	0.05	0.05
	11	0.09	0.07	0.07	0.10	0.07	0.07	0.04	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04
	12	0.18	0.13	0.14	0.19	0.12	0.13	0.06	0.07	0.05	0.05	0.06	0.06	0.08	0.07	0.08
	13	0.09	0.23	0.18	0.16	0.30	0.23	0.33	0.25	0.37	0.25	0.18	0.32	0.22	0.34	0.27
	14	0.07	0.13	0.13	0.12	0.18	0.17	0.20	0.20	0.20	0.19	0.15	0.20	0.19	0.21	0.21
	15	0.10	0.17	0.16	0.17	0.22	0.21	0.22	0.21	0.26	0.26	0.15	0.21	0.19	0.23	0.23
	16	0.21	0.33	0.28	0.28	0.39	0.33	0.38	0.31	0.43	0.30	0.22	0.37	0.27	0.41	0.33
	17	**0.21**	**0.34**	**0.30**	**0.28**	**0.41**	**0.34**	**0.41**	**0.33**	**0.46**	**0.33**	**0.22**	**0.40**	**0.27**	**0.43**	**0.35**
	18	0.04	0.22	0.14	0.07	0.29	0.18	0.31	0.20	0.41	0.23	0.10	0.31	0.12	0.33	0.21
	19	0.04	0.20	0.15	0.07	0.27	0.19	0.29	0.21	0.38	0.26	0.10	0.29	0.12	0.31	0.23
	20	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.00	0.03	0.01	0.00	0.02	0.00	0.02	0.00
	21	0.03	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.05	0.06	0.08	0.07	0.09	0.08	0.09
	22	0.19	0.23	0.24	0.24	0.26	0.27	0.25	0.26	0.24	0.26	0.20	0.24	0.24	0.26	0.27

Design case 4 (see Table 7.4) with maximum traffic exiting through the uphill to St Peters off-ramp is generally the most onerous on jet fan requirements across the project. The figures below show more detailed results for that specific case, to illustrate the in-tunnel conditions. For easy reference, Figure 10.13 shows the schematic for that case including the traffic pattern and routes for which graphs are shown below.



Case	[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]
Vehicle flows (lanes of traffic) - all speed cases																	
4	3	1	4	3	2	1	1	1	1	0	3	3	0	3	4	3	1

Figure 10.13. Ventilation schematic M4 to M5 direction [Cumulative, worst case operations, design case 4].

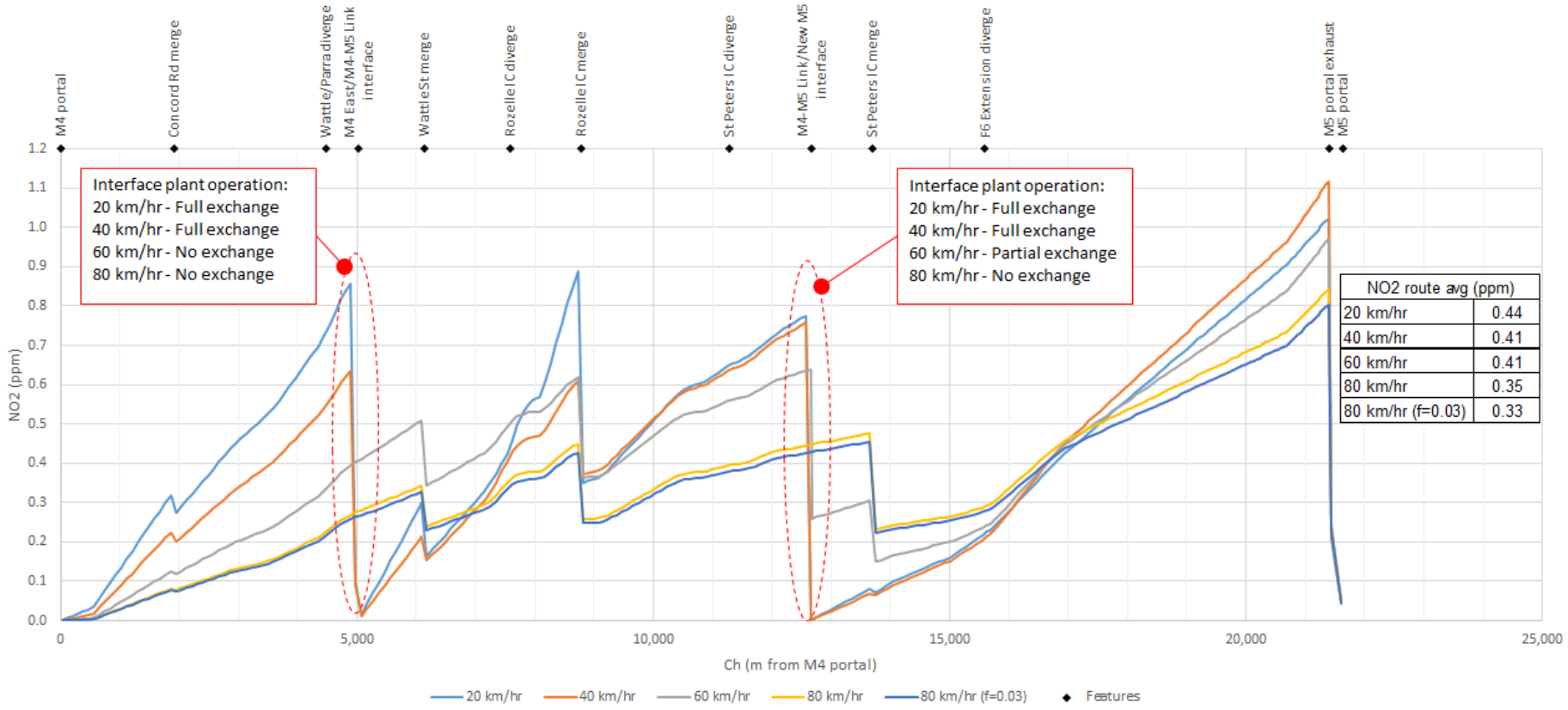


Figure 10.14. In-tunnel NO_2 levels along route 1E from M4 portal to M5 portal [Cumulative, worst case operations, design case 4].

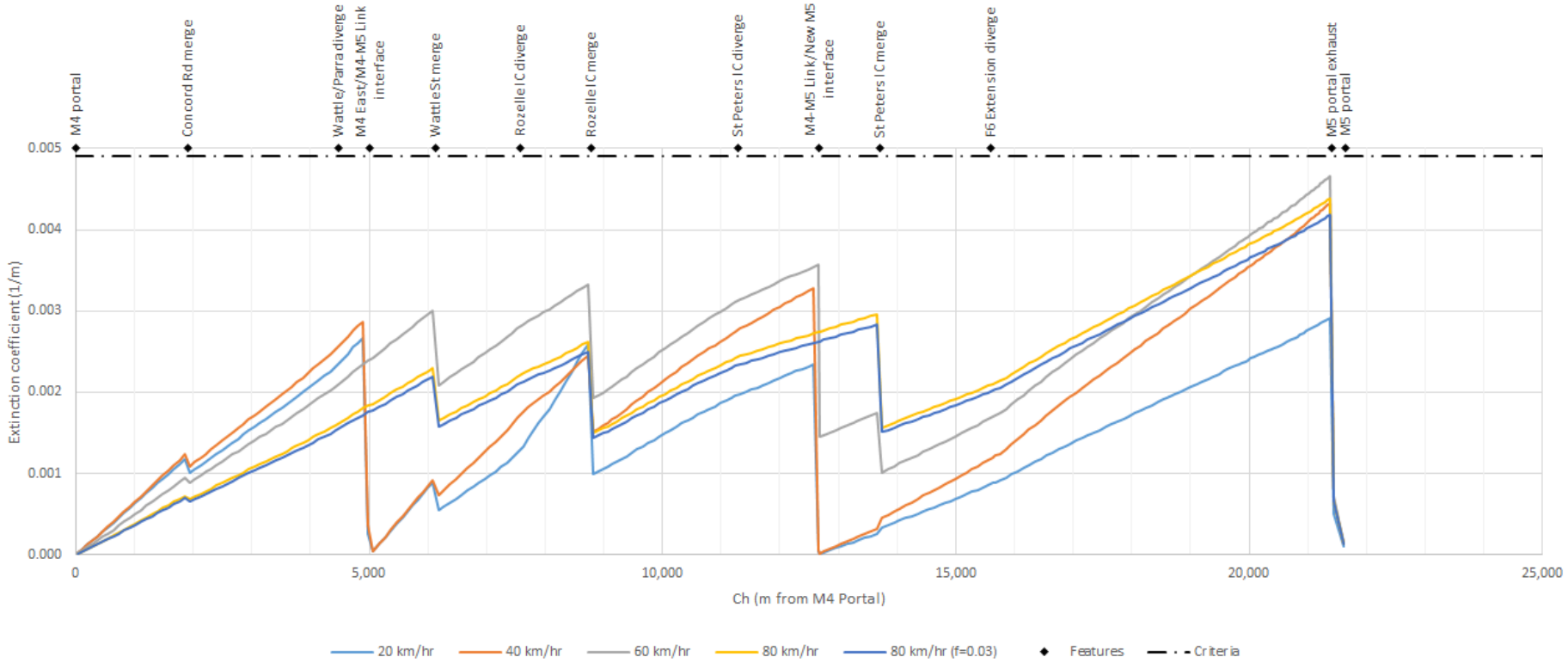


Figure 10.15. In-tunnel visibility along route 1E from M4 portal to M5 portal [Cumulative, worst case operations, design case 4].

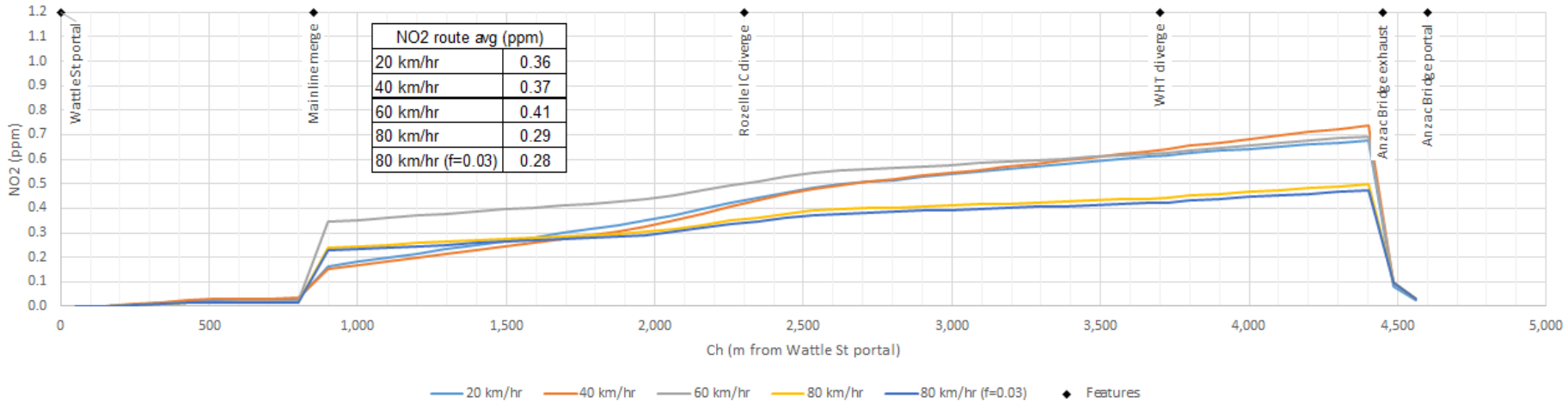


Figure 10.16. In-tunnel NO_2 levels along route 1N from Wattle St portal to Anzac Bridge [Cumulative, worst case operations, design case 4].

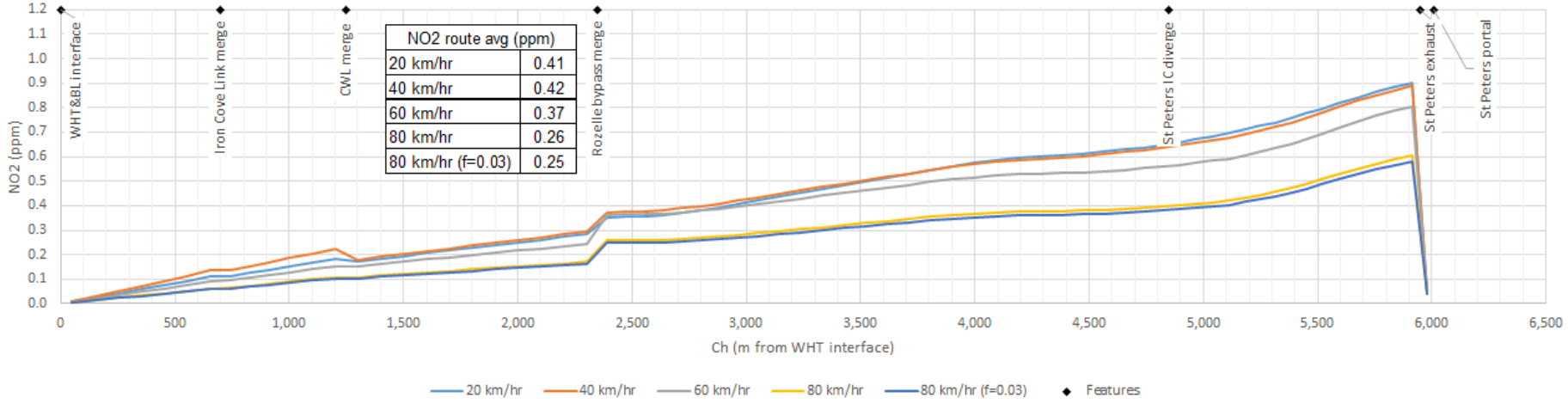


Figure 10.17. In-tunnel NO_2 levels along route 1S from WHT&BL interface to St Peters portal [Cumulative, worst case operations, design case 4]

Table 10.12 and Table 10.13 show the air velocity within the tunnel sections (at the smallest cross-section) for the design analyses where jet fans are used to increase tunnel airflows to achieve air quality criteria. The air velocities are well below the 10 m/s criterion.

Table 10.12. Summary of section air velocity, M4 to M5 direction [Cumulative, worst case operations, 20 km/h] (values are m/s).

Link No.		[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]
Design Case	0	3.4	4.9	5.5	4.9	1.0	5.8	2.4	5.2	4.6	1.1	6.0	6.8	1.4	7.7	7.7	6.1	4.2
	1	3.4	4.9	5.5	4.9	1.0	5.8	2.4	5.2	4.6	1.1	6.0	6.8	1.4	7.7	7.7	6.1	4.2
	2	3.3	4.9	5.5	4.9	1.0	5.8	2.4	5.2	4.6	1.1	6.0	6.8	1.4	7.7	7.7	6.1	4.2
	3	3.4	5.7	6.0	5.3	1.1	6.2	2.6	5.2	4.6	1.1	6.0	6.7	1.2	7.5	7.8	6.2	4.2
	4	3.1	5.2	5.5	6.0	1.9	6.4	1.0	5.3	4.6	1.2	6.0	6.8	1.8	8.0	7.0	5.7	3.7
	5	3.5	5.0	5.7	5.4	1.4	6.0	2.0	5.2	4.7	1.0	5.9	6.5	1.0	7.2	7.1	6.8	2.4
	6	3.3	4.8	5.4	5.9	1.8	6.3	1.0	5.4	4.4	1.5	5.9	6.9	1.3	7.7	6.8	6.7	2.1
	7	3.1	4.5	5.1	4.9	1.0	5.8	1.7	5.2	4.7	1.0	5.5	6.1	1.0	6.8	6.5	6.0	2.6
	8	3.1	5.2	5.5	6.0	1.9	6.4	1.0	3.7	3.0	1.0	6.1	6.7	1.6	7.8	6.9	5.1	4.1
	9	2.8	2.8	3.9	4.0	1.4	4.2	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.2	1.9
	10	2.5	3.3	3.9	4.0	1.4	4.2	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.2	1.9
	11	2.5	3.3	3.9	4.1	2.0	3.6	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.2	1.9
	12	2.8	2.9	3.9	4.1	2.0	3.6	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.2	1.9
	13	2.4	3.3	3.8	3.3	1.1	3.4	1.8	1.8	1.0	1.0	4.4	5.0	2.0	6.4	6.3	5.4	3.0
	14	1.1	1.8	1.9	1.5	1.2	0.9	1.0	1.8	1.0	1.0	3.4	4.0	2.3	5.5	5.1	5.6	0.9
	15	1.0	2.7	2.3	1.5	1.2	0.9	1.7	1.8	1.0	1.0	3.0	3.6	1.7	4.8	4.9	5.6	0.7
	16	3.1	4.7	5.2	4.7	2.7	3.8	2.1	1.8	1.0	1.0	4.3	5.0	1.8	6.2	6.3	4.6	3.9
	17	3.1	4.7	5.2	4.7	2.7	3.8	2.1	1.8	1.0	1.0	4.3	5.0	1.9	6.2	6.3	4.5	4.0
	18	1.1	1.8	1.9	1.5	1.2	0.9	1.0	1.8	1.0	1.0	3.4	4.1	2.1	5.5	5.0	3.0	3.9
	19	1.1	1.8	1.9	1.5	1.2	0.9	1.0	1.8	1.0	1.0	2.8	3.5	1.7	4.6	4.3	2.3	3.7
	20	1.1	1.8	1.9	1.5	1.2	0.9	1.0	2.7	1.9	1.0	0.5	1.1	1.3	2.0	2.3	1.2	2.0
	21	1.1	1.8	1.9	1.5	1.2	0.9	1.0	3.0	1.9	1.3	0.5	1.3	1.0	2.0	2.3	1.8	1.2
	22	3.1	4.6	5.1	5.1	1.0	6.0	1.6	5.2	4.6	1.1	6.0	6.7	1.0	7.4	6.9	6.8	2.2

Table 10.13. Summary of section air velocity, M4 to M5 direction [Cumulative, worst case operations, 40 km/h] (values are m/s).

Link No.		[7.1]	[6.1]	[8.1]	[9.1]	[29.1]	[29.2]	[10.1]	[23.1]	[24.1]	[25.1]	[26.1]	[30.1]	[31.1]	[11.1]	[12.1]	[18.1]	[17.1]
Design Case	0	4.1	3.9	5.5	4.9	1.3	5.4	2.5	4.4	3.8	1.0	4.6	5.3	2.9	7.2	7.4	6.3	3.6
	1	4.1	3.9	5.5	4.9	1.3	5.4	2.5	4.4	3.8	1.0	4.6	5.3	2.9	7.2	7.4	6.3	3.6
	2	3.6	4.7	5.6	4.9	1.3	5.4	2.5	4.4	3.8	1.0	4.6	5.3	2.9	7.2	7.4	6.3	3.6
	3	4.1	4.0	5.6	4.9	3.0	3.7	2.5	4.4	3.8	1.0	4.6	5.3	2.9	7.2	7.4	6.2	3.6
	4	4.1	4.0	5.6	4.9	3.1	3.7	2.5	4.4	3.8	1.0	4.6	5.3	2.9	7.2	7.4	6.2	3.6
	5	4.1	4.0	5.6	4.2	4.1	1.6	3.3	4.4	3.8	1.0	4.1	4.8	2.9	6.7	7.6	6.3	3.7
	6	4.1	4.0	5.6	5.0	3.1	3.8	2.4	5.3	3.5	2.3	3.9	5.4	2.8	7.2	7.3	5.8	4.0
	7	4.1	4.0	5.5	5.0	3.1	3.8	2.3	5.4	3.5	2.4	3.1	4.7	3.8	7.2	7.3	6.1	3.5
	8	4.1	4.0	5.6	4.9	3.1	3.7	2.5	4.4	3.8	1.0	4.7	5.3	3.0	7.3	7.4	5.2	4.9
	9	4.2	2.5	4.8	5.1	1.6	5.4	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.0	2.2
	10	2.8	4.6	4.8	5.2	1.8	5.4	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.0	2.2
	11	2.8	4.6	4.9	5.3	3.4	3.9	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.0	2.2
	12	4.2	2.5	4.8	5.2	3.3	3.8	1.0	1.8	1.0	1.0	0.5	1.1	1.3	2.0	2.3	1.0	2.2
	13	1.1	3.9	3.1	1.5	0.7	1.4	2.9	1.8	1.0	1.0	3.6	4.3	2.2	5.7	6.5	5.2	3.4
	14	1.1	1.8	1.9	1.5	0.7	1.4	1.0	1.8	1.0	1.0	3.6	4.2	2.0	5.6	5.1	4.8	1.8
	15	1.6	4.8	4.1	1.5	0.7	1.4	4.3	1.8	1.0	1.0	0.4	1.1	3.0	3.1	5.3	4.9	2.1
	16	3.7	4.8	5.7	4.2	3.4	2.4	3.4	1.8	1.0	1.0	3.1	3.7	3.3	5.9	7.0	5.5	3.8
	17	3.5	4.5	5.4	4.4	5.0	1.1	2.8	1.8	1.0	1.0	3.1	3.7	3.4	6.0	6.6	4.5	4.5
	18	1.3	2.1	2.2	1.5	0.7	1.4	1.5	1.8	1.0	1.0	2.8	3.5	2.7	5.3	5.2	2.4	5.0
	19	1.3	2.1	2.2	1.5	0.7	1.4	1.5	1.8	1.0	1.0	2.8	3.5	2.7	5.3	5.2	2.4	4.9
	20	1.1	1.8	1.9	1.5	0.7	1.4	1.0	4.4	3.8	1.0	0.5	1.1	1.3	2.0	2.3	1.0	2.2
	21	1.1	1.8	1.9	1.5	0.7	1.4	1.0	5.5	3.4	2.6	1.4	3.1	1.1	3.8	3.7	3.0	2.0
	22	3.6	3.9	5.1	5.1	3.2	3.8	1.5	4.4	3.8	1.0	4.5	5.2	1.9	6.4	6.2	5.2	3.0

10.2.2 M5 to M4 direction

For scenarios with high levels of congestion such as the 20 and 40 km/h speed cases, the interface plant at both Haberfield and St Peters are required to operate at full exchange and it is the 20 km/h case that drives the jet fan requirements. Table 10.14 shows the calculated NO_2 route averages (key routes only) for the 20 km/hr design cases, representing the most onerous air quality driven ventilation requirements.

Under these circumstances the routes from St Peters to Iron Cove Link and St Peters to M4 Portal (Route 2AC and 2P, red bounding box Table 10.14) determine the ventilation requirements. For full exchange at Haberfield, the project can only influence the portion of route 2P up to the Haberfield interface plant. Contrary to the M4 to M5 direction, it is the longer routes, as expected, that control the ventilation requirements for the M5 to M4 direction. The route from St Peters to Wattle St (route 2M, orange bounding box Table 10.14) is the next controlling route under conditions of complete interface exchange. With the ventilation requirements along the mainline sections driven by those routes, the routes beginning within Rozelle are generally well below the required air quality limit.

Table 10.14. Summary of NO_2 route averages, M5 to M4 direction, Cumulative arrangement at 20 km/h (values are ppm).

Route ID		2E	2K	2L	2M	2P	2Q	2R	2S	2Y	2Z	2AA	2AB	2AC	2AD	2AE	2AF	2AG	2AH
Enter at		M5 portal	President Ave.	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Anzac Bridge	M5 portal	M5 portal	President Ave.	President Ave.	St Peters	St Peters	Anzac Bridge	WHT&BL interface	WHT&BL interface	WHT&BL interface
Exit at		M4 portal	M4 portal	WHT&BL interface	Wattle St	M4 portal	Wattle St	Concord Rd	M4 Portal	Iron Cove Link	City West Link	Iron Cove Link	City West Link	Iron Cove Link	City West Link	Iron Cove Link	Wattle St	Concord Rd	M4 portal
Distance		21.7 km	19.7 km	5.6 km	7.1 km	12.5 km	4.7 km	8.9 km	10 km	15.6 km	14.4 km	13.6 km	12.3 km	6.4 km	5.1 km	1.3 km	4.7 km	8.9 km	10 km
Design Case	0	0.46	0.42	0.42	0.44	0.46	0.31	0.29	0.41	0.46	0.43	0.39	0.35	0.47	0.38	0.16	0.31	0.29	0.41
	1	0.46	0.42	0.44	0.45	0.47	0.32	0.29	0.41	0.46	0.43	0.39	0.36	0.46	0.39	0.14	0.32	0.30	0.41
	2	0.46	0.42	0.43	0.45	0.47	0.32	0.29	0.41	0.45	0.44	0.39	0.36	0.46	0.41	0.14	0.32	0.30	0.41
	3	0.46	0.42	0.42	0.45	0.47	0.32	0.29	0.41	0.45	0.44	0.39	0.37	0.45	0.41	0.14	0.32	0.30	0.41
	4	0.46	0.42	0.42	0.45	0.47	0.32	0.29	0.41	0.46	0.44	0.40	0.37	0.47	0.41	0.19	0.32	0.30	0.41
	5	0.44	0.37	0.41	0.43	0.46	0.31	0.29	0.41	0.43	0.39	0.33	0.28	0.45	0.37	0.16	0.31	0.29	0.41
	6	0.46	0.42	0.41	0.44	0.46	0.29	0.28	0.40	0.45	0.42	0.39	0.35	0.45	0.38	0.18	0.29	0.28	0.40
	7	0.46	0.42	0.41	0.44	0.47	0.28	0.28	0.40	0.45	0.42	0.39	0.35	0.45	0.38	0.18	0.28	0.29	0.40
	8	0.46	0.42	0.41	0.44	0.46	0.30	0.28	0.40	0.45	0.42	0.39	0.35	0.45	0.38	0.18	0.29	0.28	0.40
	9	0.46	0.42	0.41	0.45	0.47	0.29	0.28	0.40	0.45	0.42	0.39	0.35	0.45	0.38	0.18	0.30	0.28	0.40
	10	**0.46**	**0.41**	**0.42**	**0.42**	**0.46**	**0.29**	**0.29**	**0.41**	**0.46**	**0.43**	**0.39**	**0.35**	**0.46**	**0.38**	**0.16**	**0.29**	**0.29**	**0.41**
	11	0.20	0.13	0.39	0.25	0.15	0.07	0.04	0.04	0.34	0.31	0.26	0.21	0.44	0.35	0.16	0.07	0.04	0.04
	12	0.20	0.13	0.39	0.25	0.15	0.07	0.04	0.04	0.34	0.31	0.25	0.21	0.42	0.35	0.11	0.07	0.04	0.04
	13	0.29	0.15	0.42	0.27	0.16	0.07	0.04	0.04	0.46	0.44	0.28	0.24	0.44	0.38	0.11	0.07	0.04	0.04
	14	0.20	0.13	0.38	0.25	0.15	0.07	0.04	0.04	0.33	0.32	0.24	0.22	0.40	0.39	0.06	0.07	0.04	0.04
	15	0.20	0.13	0.38	0.25	0.15	0.07	0.04	0.04	0.33	0.32	0.24	0.22	0.40	0.39	0.11	0.07	0.04	0.04
	16	0.05	0.05	0.23	0.15	0.09	0.04	0.02	0.02	0.09	0.08	0.11	0.10	0.23	0.24	0.04	0.04	0.02	0.02
	17	0.18	0.20	0.00	0.14	0.32	0.22	0.27	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.28	0.40
	18	0.12	0.13	0.00	0.16	0.20	0.26	0.20	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.21	0.26
	19	0.24	0.27	0.17	0.33	0.42	0.31	0.31	0.44	0.07	0.06	0.08	0.07	0.17	0.16	0.04	0.33	0.32	0.44
	20	0.21	0.23	0.17	0.34	0.36	0.33	0.28	0.36	0.07	0.06	0.08	0.07	0.17	0.16	0.04	0.34	0.29	0.37
	21	0.04	0.05	0.25	0.13	0.08	0.03	0.02	0.02	0.13	0.08	0.15	0.09	0.32	0.21	0.27	0.03	0.02	0.02
	22	0.43	0.34	0.44	0.45	0.47	0.32	0.30	0.41	0.42	0.39	0.28	0.24	0.46	0.39	0.09	0.32	0.30	0.41

For scenarios involving free-flowing traffic conditions, it is the routes that commence in the most downstream portions of the network that drive the interface exchange requirements. This occurs because the pollution carry-over from upstream sections results in an a step increase in pollution levels after the merges with the mainline, similar to that discussed above for the City West Link to St Peters route.

Table 10.15 shows key NO_2 route averages for the 80 km/h scenario for discussion. Similar trends occur at 60 km/h. However, increased levels of interface exchange (as a proportion of tunnel airflow) are required due to the reduction in vehicle drawn airflows. Routes 2U and 2X from Parramatta Rd and Wattle St (in M4 East) to the M4 portal (red bounding boxes) determine the amount of exchange required at the Haberfield interface plant. In this direction, some interface exchange is required at Haberfield for the worst design cases analysed. This is mostly due the ventilation approach for Concord Rd off-ramp. The use of jet fans to create reverse flow towards the mainline increases the in-tunnel pressure at the diverge, resulting in retarding effect on the vehicle drawn airflows in M4 East, particularly affecting the amount of air drawn in the M4 East on-ramps to dilute the carry-over from M5-M5 Link.

With Parramatta Rd (and Wattle St) merge located only a short distance downstream of the interface plant, in most cases it will be feasible to use only the interface exhaust to remove some of the polluted air carry-over from M4-M5 Link. The fresh-air supply then naturally occurs through Parramatta Rd on-ramp.

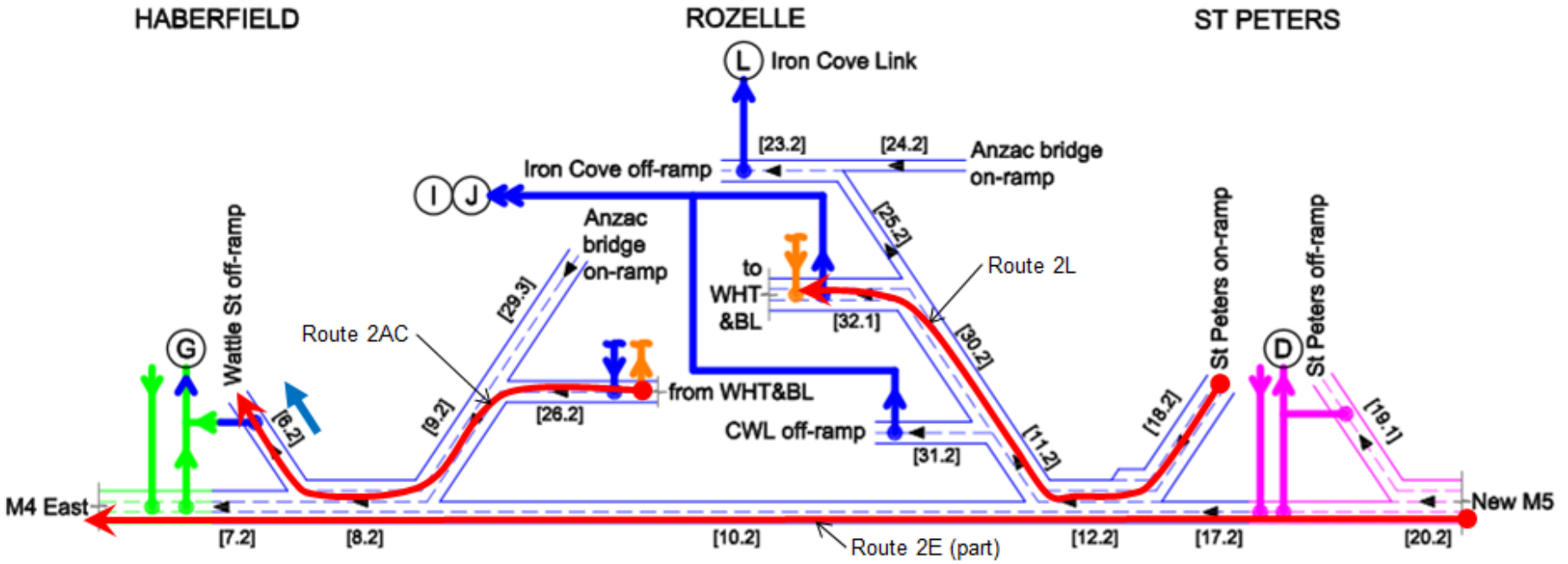
For expected traffic conditions, high vehicle flows continue along the mainline from M4-M5 Link to M4 East, reducing the natural exchange occurring through the interchange. The higher in-tunnel pressure at Concord Rd diverge further limits the in-flow of fresh air from Parramatta Rd and Wattle St on-ramps; the high piston effect in the mainline dominates the flow balance. The end result being that some interface exchange (or exhaust only) at Haberfield is predicted to be required during times of heaviest expected traffic.

At 80 km/h, no interface exchange is required at St Peters for the design cases, however, some is required at 60 km/h. The St Peters interface demand is driven by a number of routes within the project, commencing both at St Peters and within Rozelle. These routes are shown in orange bounding boxes in Table 10.15.

Table 10.15. Summary of NO_2 route averages, M5 to M4 direction, Cumulative arrangement at 80 km/hr (values are ppm).

Route ID		2A	2E	2L	2M	2P	2Q	2S	2T	2U	2V	2X	2AC	2AD	2AE	2AF	2AG	2AH
Enter at		M5 portal	M5 portal	St Peters	St Peters	St Peters	Anzac Bridge	Anzac Bridge	Parramatta Rd	Parramatta Rd	Wattle St	Wattle St	St Peters	St Peters	Anzac Bridge	WHT&BL interface	WHT&BL interface	WHT&BL interface
Exit at		St Peters	M4 portal	WHT&BL interface	Wattle St	M4 portal	Wattle St	M4 Portal	Concord Rd	M4 portal	Concord Rd	M4 portal	Iron Cove Link	City West Link	Iron Cove Link	Wattle St	Concord Rd	M4 portal
Distance		9.2 km	21.7 km	5.6 km	7.1 km	12.5 km	4.7 km	10 km	4.4 km	5.5 km	4.4 km	5.6 km	6.4 km	5.1 km	1.3 km	4.7 km	8.9 km	10 km
Design Case	0	0.14	0.30	0.34	0.32	0.38	0.18	0.33	0.26	0.42	0.22	0.39	0.36	0.32	0.12	0.18	0.24	0.33
	1	0.14	0.30	0.34	0.32	0.38	0.18	0.33	0.26	0.42	0.22	0.38	0.35	0.32	0.07	0.18	0.24	0.33
	2	0.14	0.30	0.34	0.32	0.39	0.18	0.34	0.26	0.42	0.22	0.39	0.35	0.34	0.07	0.18	0.25	0.34
	3	0.14	0.30	0.34	0.32	0.39	0.18	0.33	0.26	0.42	0.22	0.39	0.34	0.33	0.07	0.18	0.25	0.34
	4	0.14	0.30	0.34	0.33	0.39	0.18	0.34	0.26	0.42	0.22	0.39	0.36	0.33	0.14	0.18	0.25	0.34
	5	0.13	0.27	0.27	0.27	0.35	0.17	0.32	0.25	0.40	0.21	0.37	0.30	0.25	0.11	0.17	0.23	0.32
	6	0.14	0.31	0.33	0.33	0.40	0.19	0.35	0.27	0.44	0.23	0.41	0.35	0.32	0.12	0.20	0.26	0.36
	7	0.14	0.29	0.33	0.33	0.38	0.19	0.32	0.23	0.38	0.20	0.35	0.35	0.32	0.12	0.19	0.24	0.32
	8	0.14	0.31	0.33	0.34	0.41	0.20	0.36	0.28	0.44	0.23	0.41	0.35	0.32	0.12	0.20	0.26	0.36
	9	0.14	0.31	0.33	0.34	0.41	0.20	0.36	0.28	0.45	0.24	0.41	0.35	0.32	0.12	0.20	0.27	0.36
	10	0.14	0.28	0.34	0.32	0.36	0.17	0.31	0.22	0.37	0.19	0.34	0.36	0.32	0.12	0.18	0.23	0.31
	11	0.07	0.11	0.23	0.17	0.12	0.06	0.06	0.04	0.04	0.03	0.04	0.25	0.21	0.10	0.06	0.06	0.06
	12	0.07	0.11	0.23	0.17	0.12	0.06	0.06	0.03	0.04	0.03	0.03	0.24	0.21	0.06	0.06	0.05	0.06
	13	0.12	0.16	0.32	0.24	0.17	0.08	0.08	0.04	0.05	0.03	0.05	0.32	0.30	0.07	0.08	0.07	0.08
	14	0.07	0.11	0.23	0.17	0.12	0.06	0.06	0.04	0.04	0.03	0.04	0.24	0.22	0.07	0.06	0.06	0.06
	15	0.07	0.11	0.23	0.17	0.12	0.06	0.06	0.04	0.04	0.03	0.04	0.24	0.22	0.06	0.06	0.06	0.06
	16	0.00	0.03	0.12	0.08	0.06	0.03	0.03	0.02	0.02	0.01	0.02	0.12	0.11	0.04	0.03	0.03	0.03
	17	0.00	0.13	0.00	0.06	0.23	0.10	0.29	0.24	0.40	0.21	0.37	0.00	0.00	0.00	0.10	0.20	0.29
	18	0.00	0.09	0.00	0.07	0.16	0.11	0.20	0.16	0.25	0.14	0.23	0.00	0.00	0.00	0.12	0.15	0.20
	19	0.00	0.16	0.06	0.13	0.28	0.12	0.31	0.26	0.42	0.22	0.39	0.07	0.06	0.02	0.13	0.22	0.31
	20	0.00	0.14	0.06	0.13	0.25	0.13	0.27	0.22	0.36	0.19	0.33	0.07	0.06	0.02	0.14	0.20	0.28
	21	0.00	0.02	0.08	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.10	0.07	0.08	0.02	0.01	0.01
	22	0.12	0.28	0.32	0.30	0.37	0.17	0.33	0.25	0.41	0.22	0.38	0.33	0.29	0.09	0.17	0.24	0.33

Design case 10 (see Table 7.5) is generally the most onerous on jet fan requirements in the M5 to M4 direction. Figures below show more detailed results for that specific case to illustrate the in-tunnel conditions. For easy reference, Figure 10.18 shows the schematic for that case, including the traffic flows, and with routes used for results also highlighted.



Case	[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]
Vehicle flows (lanes of traffic) - all speeds																	
10	3	1	4	3	1	2	1	2	1	1	2	3	0	3	4	2	2

Figure 10.18. Ventilation schematic M5 to M4 direction [Cumulative, worst case operations, design case 10].

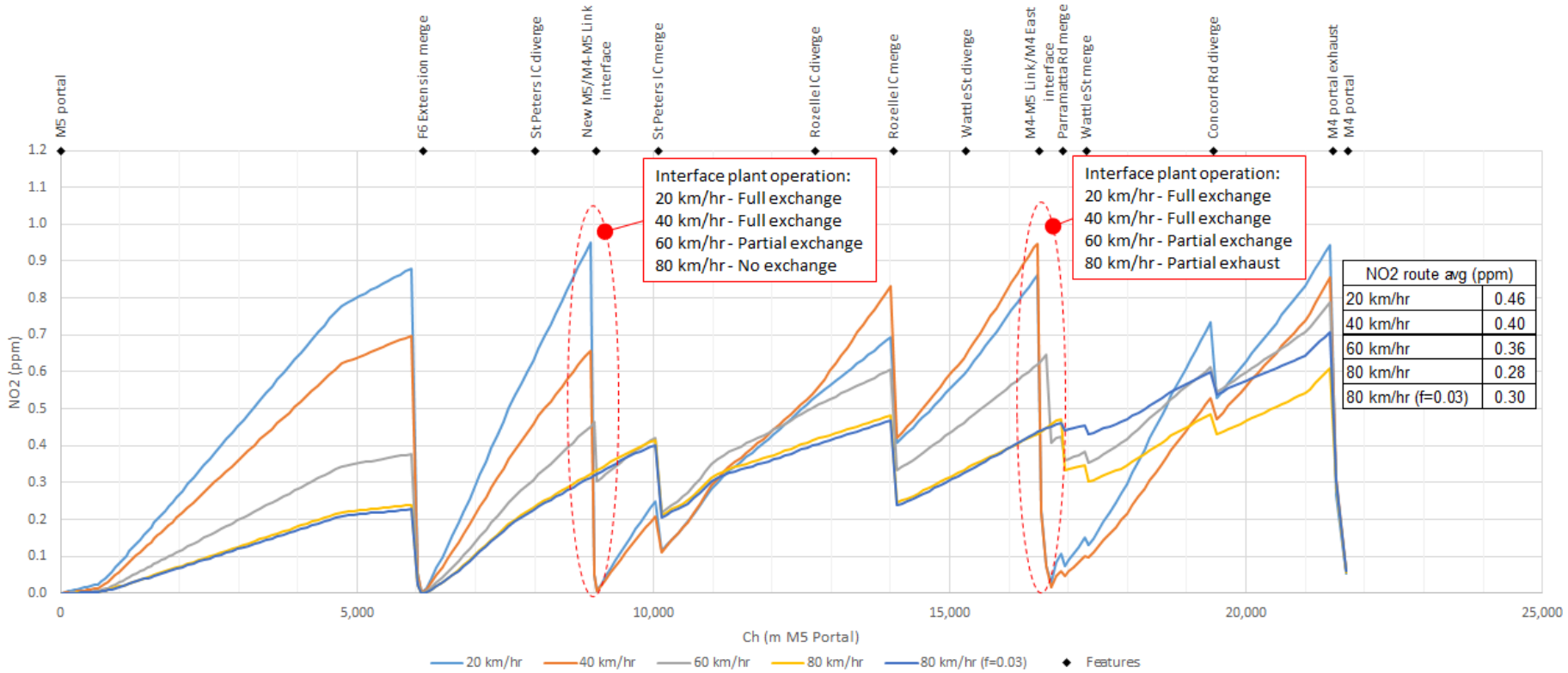


Figure 10.19. In-tunnel NO_2 levels along route 2E from M5 portal to M4 portal [Cumulative, worst case operations, design case 10]

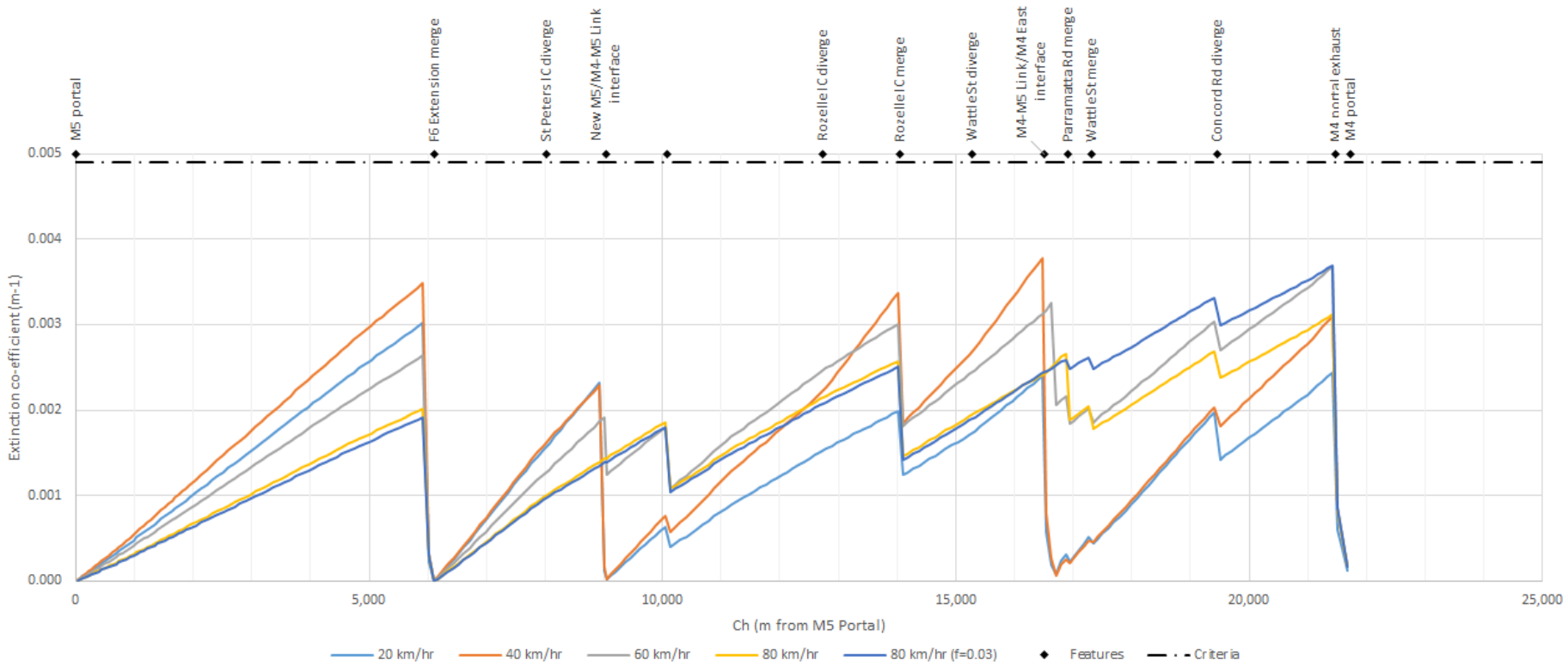


Figure 10.20. In-tunnel visibility along route 2E from M5 portal to M4 portal [Cumulative, worst case operations, design case 10].

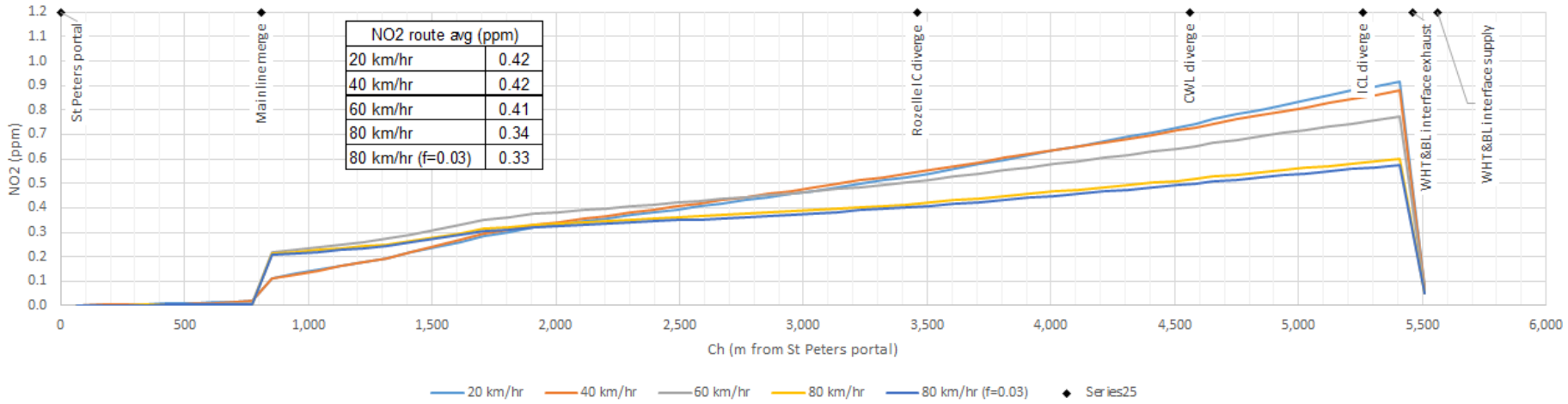


Figure 10.21. In-tunnel NO_2 levels along route 2L from St Peters portal to WHT&BL interface [Cumulative, worst case operations, design case 10].

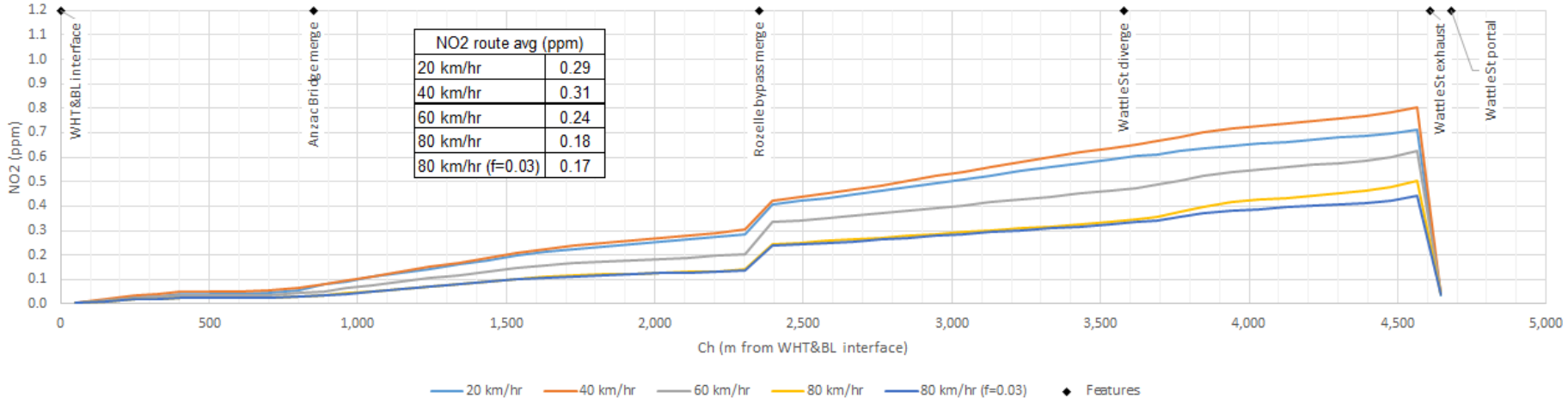


Figure 10.22. In-tunnel NO_2 levels along route 2AF from WHT&BL int-erface to Wattle St portal [Cumulative, worst case operations, design case 10].

Table 10.16 and Table 10.17 show the air velocity within the tunnel sections (at the smallest cross-section) for the design analyses where jet fans are used to increase tunnel airflows to achieve air quality criteria. The air velocities are well below the 10 m/s criterion.

Table 10.16. Summary of section air velocity, M5 to M4 direction [Cumulative, worst case operations, 20 km/h] (values are m/s).

Link No.		[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]
Design Case	0	4.3	6.0	6.9	6.4	4.3	4.6	2.6	6.4	5.0	2.1	4.3	5.6	1.0	6.4	6.8	5.6	3.6
	1	4.4	6.1	7.0	6.3	4.3	4.5	2.9	5.6	4.3	1.9	4.1	5.3	1.0	6.0	6.7	5.5	3.6
	2	4.4	6.1	7.0	6.3	4.3	4.5	2.9	5.7	4.3	2.0	3.8	5.2	1.2	6.0	6.7	5.5	3.6
	3	4.3	6.0	7.0	6.4	4.3	4.5	2.8	5.8	4.2	2.2	3.4	4.8	1.8	6.1	6.7	5.5	3.6
	4	4.3	6.0	7.0	6.4	4.3	4.5	2.8	5.1	3.6	2.0	3.4	4.7	1.9	6.1	6.7	5.5	3.6
	5	4.3	6.0	6.9	6.4	4.4	4.6	2.6	6.4	5.0	2.0	4.0	5.3	1.0	6.1	6.6	5.4	3.4
	6	4.8	6.3	7.5	6.6	4.6	4.6	3.3	6.0	4.1	2.5	3.4	5.0	1.0	5.8	6.8	5.5	3.6
	7	5.2	5.6	7.4	6.6	4.5	4.6	3.2	6.0	4.1	2.5	3.4	5.1	1.0	5.8	6.8	5.5	3.6
	8	5.1	5.8	7.4	6.6	4.5	4.6	3.2	6.0	4.1	2.5	3.4	5.1	1.0	5.8	6.8	5.5	3.6
	9	5.1	5.8	7.4	6.6	4.6	4.5	3.2	6.0	4.1	2.5	3.4	5.1	1.0	5.8	6.8	5.5	3.6
	10	5.2	5.6	7.4	6.8	4.6	4.7	3.0	6.4	5.0	2.0	4.1	5.5	1.0	6.2	6.9	5.6	3.7
	11	1.6	1.0	1.9	1.7	1.1	1.2	0.8	6.4	5.0	2.0	4.0	5.3	1.0	6.0	5.4	4.2	3.1
	12	1.6	1.1	1.9	1.7	1.1	1.2	0.8	6.0	5.2	1.4	4.4	5.3	1.0	6.0	5.4	4.2	3.1
	13	1.6	1.0	1.8	1.7	1.1	1.2	0.8	6.0	5.2	1.4	4.7	5.6	1.0	6.3	5.6	4.3	3.3
	14	1.6	1.1	1.9	1.6	1.1	1.2	0.8	6.0	5.1	1.6	4.2	5.2	1.0	6.0	5.4	4.2	3.1
	15	1.6	1.1	1.9	1.6	1.1	1.2	0.8	6.1	5.1	1.7	4.2	5.2	1.0	6.0	5.4	4.2	3.1
	16	1.6	1.1	1.9	1.6	1.1	1.2	0.8	6.1	5.0	1.7	4.0	5.2	1.1	5.9	5.3	4.2	2.9
	17	3.3	4.9	5.4	5.4	3.7	3.8	1.7	1.7	1.0	0.9	0.6	1.2	1.0	2.0	2.7	2.2	1.4
	18	2.7	5.4	5.3	5.4	3.7	3.7	1.5	1.7	1.0	0.9	0.7	1.3	1.0	2.0	2.6	2.1	1.4
	19	3.4	5.1	5.6	5.3	3.6	3.7	2.1	1.7	1.0	0.9	0.6	1.2	1.0	2.0	3.0	2.6	1.4
	20	3.1	5.3	5.6	5.2	3.6	3.6	2.1	1.7	1.0	0.9	0.6	1.3	1.0	2.0	3.0	2.6	1.4
	21	2.6	5.5	5.2	5.1	3.5	3.7	1.7	3.2	1.9	1.7	0.2	1.3	1.0	2.1	2.8	2.4	1.3
	22	4.4	6.0	7.0	6.3	4.3	4.5	2.9	5.4	4.2	1.7	4.1	5.3	1.0	6.0	6.7	5.5	3.6

Table 10.17. Summary of section air velocity, M5 to M4 direction [Cumulative, worst case operations, 40 km/h] (values are m/s).

Link No.		[7.2]	[6.2]	[8.2]	[9.2]	[26.2]	[29.3]	[10.2]	[23.2]	[24.2]	[25.2]	[32.1]	[30.2]	[31.2]	[11.2]	[12.2]	[18.2]	[17.2]
Design Case	0	4.0	4.9	6.0	6.1	3.6	4.8	1.7	7.5	4.6	3.6	3.8	6.1	1.0	6.9	6.6	4.8	4.2
	1	4.1	4.9	6.1	6.0	3.6	4.7	2.0	6.0	4.6	2.0	4.5	5.8	1.0	6.5	6.5	4.7	4.2
	2	4.1	4.9	6.1	5.9	3.5	4.7	2.1	6.0	4.6	2.0	4.3	5.6	1.0	6.3	6.5	4.6	4.2
	3	4.1	5.0	6.2	5.9	3.5	4.7	2.1	6.0	4.6	2.1	3.6	4.9	1.9	6.3	6.4	4.6	4.1
	4	4.1	4.9	6.1	6.0	3.5	4.7	2.1	7.9	4.4	4.3	2.7	5.5	1.2	6.4	6.5	4.6	4.2
	5	3.8	4.7	5.8	5.8	3.4	4.6	1.8	6.9	4.4	3.2	3.7	5.8	1.0	6.6	6.4	5.1	3.5
	6	3.8	5.7	6.4	5.4	3.6	3.9	3.1	7.1	4.2	3.5	2.7	5.0	1.0	5.7	6.6	4.8	4.2
	7	4.7	4.7	6.5	5.5	3.7	3.9	3.1	7.1	4.2	3.5	2.6	5.0	1.0	5.7	6.6	4.8	4.3
	8	3.8	5.7	6.3	5.3	2.3	5.1	3.1	7.1	4.2	3.5	2.7	5.0	1.0	5.7	6.6	4.8	4.3
	9	4.0	5.8	6.5	5.5	4.8	2.7	3.2	7.1	4.2	3.5	2.6	4.9	1.0	5.7	6.7	4.8	4.3
	10	4.3	4.3	5.9	6.0	3.6	4.8	1.7	7.5	4.6	3.6	3.8	6.2	1.0	6.9	6.6	4.8	4.2
	11	1.6	1.1	1.9	1.6	1.1	1.2	0.9	5.5	3.7	2.3	3.4	4.9	1.0	5.7	5.2	4.0	2.9
	12	1.6	1.1	1.9	1.6	1.1	1.2	0.9	4.4	3.8	1.0	4.3	5.0	1.0	5.7	5.2	4.0	3.0
	13	1.5	1.0	1.7	1.7	1.1	1.2	0.6	6.3	5.1	1.8	5.0	6.2	1.0	6.9	6.0	4.0	4.2
	14	1.6	1.1	1.9	1.6	1.1	1.2	0.9	1.8	1.0	1.0	2.2	2.9	3.8	5.6	5.1	4.0	2.9
	15	1.6	1.1	1.9	1.6	1.1	1.2	0.9	4.4	3.8	1.0	2.2	2.9	3.8	5.6	5.1	4.0	2.9
	16	1.6	1.1	2.0	1.6	1.1	1.2	1.0	1.8	1.0	1.0	0.3	0.9	5.1	4.6	4.3	4.4	1.3
	17	4.7	3.2	5.6	5.8	4.4	3.7	1.5	1.8	1.0	1.0	0.6	1.3	1.0	2.0	2.6	2.1	1.4
	18	3.3	4.3	5.1	5.6	4.3	3.6	0.9	1.8	1.0	1.0	0.6	1.3	1.0	2.0	2.2	1.8	1.2
	19	4.8	4.8	6.6	5.4	4.1	3.3	3.4	1.8	1.0	1.0	0.7	1.3	1.0	2.0	3.9	3.7	1.4
	20	4.7	4.2	6.2	5.2	4.0	3.1	3.1	1.8	1.0	1.0	0.7	1.3	1.0	2.1	3.8	3.6	1.3
	21	1.6	1.1	1.9	1.6	1.1	1.2	0.9	6.0	3.4	3.1	1.0	3.0	1.0	3.8	3.6	3.6	1.2
	22	3.7	5.6	6.2	6.1	3.6	4.8	2.1	4.7	3.2	2.0	4.4	5.7	1.0	6.5	6.6	4.7	4.2

11 ANALYSIS OUTPUTS – TEMPERATURE ESTIMATES

The following sections show the results for the temperature estimates as outlined in Section 7.1.5. Within each season, simulation results are binned according to the hour of the day. Effectively each bin represents the same traffic conditions across the system with the only variable being the ambient temperature and its recent history. Results from a statistical analysis in each bin, for each outlet, are presented to show the outlet conditions and the potential range of variability:

- Temperature: The minimum, average and maximum of the 31 results at each hour of the day.
- Delta T to Ambient: The k^{th} percentile of the 31 results at each hour of the day.

While buoyancy effects introduce some variability in the system airflow compared to the fixed ambient results shown in Section 9, this variability is insignificant in relation to the variability due to ambient conditions. Consequently, the temperature results in this section can be read in conjunction with the corresponding results for outlet airflow and pollutant emissions in Section 9. That is:

- 2023 Cumulative demand traffic: Section 9.3.1 aligns with Section 11.1
- 2033 Cumulative demand traffic: Section 9.3.2 aligns with Section 11.2

For outlets I and J, the same operating philosophy outlined in Section 9 is used.

11.1 2023 Cumulative demand traffic operations

Table 11.1. Outlet temperature summary [2023 Cumulative, expected traffic].

Outlet identifier:	B								B							
EIS name:	Parramatta Road (M4 East)								Parramatta Road (M4 East)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	24	26	2	2	4	6	7	12	13	16	4	4	6	8	9
1	20	24	26	2	2	4	7	8	11	13	15	4	4	6	8	9
2	20	24	25	2	2	4	7	9	11	13	15	4	4	7	9	9
3	20	24	25	2	2	5	7	9	11	13	15	4	4	7	9	10
4	20	24	25	2	2	5	7	9	11	13	15	3	4	7	10	10
5	21	25	26	1	2	4	6	7	11	13	15	4	5	8	10	11
6	23	26	28	1	2	4	7	7	13	15	16	5	6	9	11	12
7	25	28	30	1	2	4	9	9	15	17	19	5	7	9	10	11
8	25	28	30	0	0	3	8	8	15	17	19	3	4	7	8	9
9	25	28	30	-2	-1	2	8	8	15	17	19	2	3	5	8	8
10	25	28	30	-3	-2	2	8	8	16	17	19	1	2	3	6	8
11	25	28	31	-3	-3	1	8	8	16	17	19	1	1	2	5	7
12	25	28	31	-4	-3	1	7	8	16	17	20	0	0	2	4	5
13	25	28	31	-4	-3	1	7	8	16	17	19	0	0	2	4	5
14	25	28	30	-2	-2	2	7	8	16	17	20	0	0	3	4	5
15	25	28	30	-1	-1	3	8	9	16	18	20	1	1	4	5	6
16	26	28	31	0	0	3	8	10	16	18	20	2	3	5	8	8
17	25	28	29	0	2	4	7	9	15	17	19	2	3	6	9	9
18	24	27	28	2	2	4	7	8	14	16	18	2	3	6	9	9
19	24	27	28	2	3	4	7	8	14	16	18	3	4	7	9	10
20	23	26	28	3	3	4	7	8	14	15	18	3	4	7	9	10
21	23	26	28	3	3	5	7	8	14	15	18	3	4	7	9	10
22	22	25	27	2	3	4	7	8	13	14	17	3	3	7	9	10
23	21	25	26	2	2	4	6	7	12	14	16	3	4	6	8	9
Outlet identifier:	**C**								**C**							
EIS name:	**Underwood Road (M4 East)**								**Underwood Road (M4 East)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	28	30	31	8	8	10	14	14	20	21	23	11	11	14	17	18
1	28	30	31	8	8	10	13	15	20	21	22	11	11	14	16	17
2	27	29	30	7	8	9	14	15	19	20	22	10	11	14	16	17
3	27	29	30	7	7	10	13	15	19	20	21	11	11	14	17	17
4	27	30	31	7	8	10	14	16	19	20	22	10	11	14	18	18
5	29	31	32	7	8	10	14	15	20	22	23	12	13	16	19	20
6	31	33	34	7	8	10	15	15	23	24	25	13	15	18	21	22
7	33	35	36	7	8	11	16	17	25	26	27	13	15	18	20	21
8	33	35	36	6	7	10	16	17	25	26	27	12	13	16	18	20
9	33	35	36	4	5	9	15	17	25	26	27	10	11	14	17	18
10	33	35	36	3	4	9	16	17	26	26	27	10	10	13	16	17
11	33	35	37	3	3	9	16	17	26	26	28	9	9	12	14	17
12	34	35	37	2	3	9	16	16	26	27	28	8	9	11	13	15
13	34	35	37	2	4	9	16	16	26	27	28	9	9	12	14	15
14	34	36	37	4	5	10	16	17	26	27	28	9	9	12	14	15
15	35	36	38	6	6	10	17	18	27	28	29	10	11	14	16	16
16	35	37	38	7	8	12	18	19	28	28	29	13	13	16	19	19
17	34	36	37	7	9	12	17	18	26	27	28	12	13	16	20	20
18	33	34	35	8	9	12	16	16	25	26	27	11	12	15	19	20
19	32	34	35	9	10	11	16	16	24	25	26	12	13	16	19	20
20	32	34	35	9	10	12	16	16	24	25	26	12	12	16	19	20
21	32	33	34	9	10	12	16	17	24	25	26	12	12	16	19	20
22	31	32	33	9	9	11	15	16	23	24	25	11	12	16	18	20
23	29	31	32	8	9	10	14	15	21	22	24	10	11	15	17	18

Table 11.1. Outlet temperature summary [2023 Cumulative, expected traffic], continued.

Outlet identifier:	D								D							
EIS name:	SPI (New M5)								SPI (New M5)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	19	23	24	1	1	2	4	5	10	11	14	2	2	4	6	7
1	18	22	24	1	1	3	5	6	9	11	14	2	2	4	6	6
2	18	22	24	0	1	2	5	6	9	11	13	2	2	4	7	7
3	18	22	24	0	1	3	5	6	9	10	13	2	2	5	7	7
4	18	22	24	0	1	3	5	7	8	11	13	2	2	5	7	8
5	19	23	25	0	1	2	4	5	9	11	13	2	3	5	8	9
6	22	25	26	0	0	3	6	6	11	13	15	4	5	7	9	10
7	23	26	28	-1	0	3	7	7	13	15	17	3	5	7	8	9
8	23	26	28	-2	-1	1	6	6	13	15	17	1	2	5	6	7
9	23	26	29	-3	-2	1	6	6	13	15	17	1	1	3	6	6
10	23	26	29	-4	-3	0	6	6	14	15	18	0	0	2	4	5
11	24	27	29	-4	-4	0	6	6	14	16	18	-1	-1	1	3	5
12	24	27	30	-5	-4	0	5	7	14	16	18	-2	-1	0	3	4
13	24	27	30	-5	-4	0	5	7	14	16	18	-2	-2	1	2	3
14	24	26	29	-3	-3	0	5	6	14	16	18	-2	-2	1	3	3
15	23	26	29	-3	-2	1	6	6	14	16	18	-1	-1	2	3	4
16	23	26	29	-2	-2	1	5	7	14	15	17	0	1	3	5	5
17	23	25	27	-1	0	2	5	6	12	14	17	0	1	3	6	6
18	22	25	27	0	1	2	5	6	12	14	16	0	1	4	6	7
19	22	25	26	1	1	2	5	5	11	13	16	1	2	4	7	7
20	21	24	26	1	1	2	5	5	11	13	16	1	2	4	7	8
21	21	24	26	1	1	3	5	6	11	13	16	1	2	5	6	8
22	20	23	25	0	1	2	4	5	10	12	15	1	2	4	6	7
23	19	23	25	1	1	2	4	5	10	11	14	1	2	4	6	7
Outlet identifier:	**E**								**E**							
EIS name:	**Arncliffe (New M5)**								**Arncliffe (New M5)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	20	23	24	0	0	2	6	7	12	13	14	2	3	6	8	9
1	20	22	23	0	0	2	6	7	11	12	14	3	3	6	8	8
2	19	22	23	0	0	2	6	7	11	12	14	2	3	5	8	8
3	19	22	23	0	0	3	6	7	10	12	14	3	3	5	8	8
4	19	22	23	0	0	3	6	8	10	12	14	2	3	6	9	9
5	20	23	24	-2	-1	2	6	7	12	13	14	3	4	7	11	11
6	21	23	24	-3	-2	1	5	6	13	14	15	3	5	8	11	12
7	22	24	25	-4	-3	0	5	6	14	14	15	2	4	6	9	10
8	22	24	25	-5	-5	-2	5	6	14	14	15	0	1	4	7	8
9	22	24	25	-7	-6	-3	5	6	14	14	15	-1	-1	2	6	7
10	22	24	25	-8	-7	-3	5	6	14	14	16	-2	-2	1	4	6
11	22	24	25	-9	-8	-3	5	5	14	15	16	-3	-3	0	3	5
12	22	24	25	-10	-8	-3	5	5	14	15	16	-4	-3	-1	1	3
13	22	24	25	-9	-8	-3	4	5	14	15	16	-4	-4	-1	1	3
14	22	24	25	-8	-7	-2	4	5	14	15	16	-4	-4	0	2	3
15	22	24	25	-7	-6	-2	4	6	14	14	16	-3	-3	1	3	3
16	22	24	25	-6	-6	-1	4	6	14	14	15	-2	-1	2	5	5
17	22	24	25	-5	-3	0	5	6	13	14	15	-1	0	3	7	7
18	21	23	24	-3	-2	0	5	6	13	14	15	-1	1	4	8	8
19	21	23	24	-2	-1	1	5	5	13	14	15	0	2	4	8	9
20	21	23	24	-1	-1	1	5	6	13	14	15	1	1	5	8	9
21	21	23	24	-1	-1	1	5	6	13	14	15	1	1	5	8	10
22	21	23	24	-1	0	1	5	7	12	13	15	0	1	6	8	9
23	20	23	24	0	0	2	5	6	11	13	15	1	2	5	8	9

Table 11.1. Outlet temperature summary [2023 Cumulative, expected traffic], continued

Outlet identifier:	F								F							
EIS name:	Kingsgrove (New M5)								Kingsgrove (New M5)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	24	26	27	3	3	5	9	10	16	17	19	6	7	10	13	14
1	23	25	26	3	3	5	9	11	16	17	18	7	7	10	13	13
2	23	25	26	3	3	5	9	11	15	16	18	6	7	10	12	13
3	23	25	26	3	3	5	9	11	15	16	18	7	7	10	13	13
4	23	25	26	3	4	6	10	12	15	16	18	6	7	10	14	14
5	24	26	27	2	3	5	9	10	16	17	18	7	8	11	15	15
6	25	27	28	1	2	4	8	9	17	18	19	7	9	12	15	16
7	26	27	28	0	1	3	8	9	18	19	20	6	8	11	13	14
8	26	28	29	-1	-1	2	8	9	18	19	20	5	6	9	11	13
9	26	28	29	-3	-2	2	8	9	19	20	21	4	4	7	11	12
10	27	28	29	-4	-3	2	8	10	19	20	21	3	4	6	10	11
11	27	28	30	-4	-4	2	8	9	19	20	21	3	3	5	8	10
12	27	28	30	-5	-4	1	8	9	19	20	21	2	2	5	7	9
13	27	28	30	-5	-4	2	8	9	20	20	21	2	2	5	7	9
14	27	28	30	-3	-2	3	9	9	20	21	22	2	3	6	8	9
15	27	29	30	-2	-1	3	9	10	20	21	22	3	4	7	9	10
16	28	29	30	-1	0	4	10	11	21	21	22	5	6	9	12	12
17	27	28	29	0	2	4	9	10	19	20	21	5	6	9	13	13
18	26	28	28	2	2	5	9	9	19	19	21	5	6	9	13	14
19	26	27	28	2	3	5	9	9	18	19	20	6	7	10	13	14
20	26	27	28	3	3	5	9	10	18	19	20	6	6	10	13	14
21	26	27	28	3	3	5	9	10	18	19	20	6	6	10	13	14
22	25	27	27	3	3	5	9	10	17	18	20	5	6	11	13	14
23	24	26	27	3	3	5	8	9	16	17	19	5	6	10	12	13
Outlet identifier:	**G**								**G**							
EIS name:	**Parramatta Road (M4-M5 Link)**								**Parramatta Road (M4-M5 Link)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	24	26	2	2	4	7	7	12	14	16	4	4	7	9	10
1	21	24	25	2	2	4	7	8	12	14	16	4	5	7	9	9
2	20	24	25	2	2	4	7	9	12	13	16	4	4	7	9	9
3	20	24	25	2	2	4	7	9	12	13	15	4	5	7	10	10
4	20	24	25	2	2	4	7	9	12	13	15	4	5	8	10	11
5	22	25	26	1	2	4	7	8	12	14	16	5	6	8	11	12
6	23	26	27	0	1	4	7	8	14	15	17	5	7	9	12	13
7	24	27	28	-1	0	3	7	8	15	16	18	4	6	8	10	11
8	24	27	28	-2	-1	2	7	8	16	17	18	3	4	7	9	10
9	25	27	29	-3	-2	1	7	8	16	17	19	2	2	5	8	8
10	25	27	29	-4	-3	1	7	8	16	17	19	1	2	3	6	8
11	25	27	29	-4	-4	1	7	7	16	17	19	0	1	2	5	7
12	25	27	30	-5	-4	0	7	7	16	17	19	0	0	2	4	6
13	25	27	30	-5	-4	0	7	8	16	18	19	0	0	2	4	5
14	25	27	29	-3	-3	1	7	8	16	18	19	0	0	3	5	5
15	25	27	29	-3	-2	1	7	8	16	18	19	0	1	4	5	6
16	25	28	30	-1	-1	3	8	10	17	18	19	2	3	6	8	8
17	25	27	28	-1	1	3	7	8	16	17	19	2	3	6	9	9
18	24	26	28	1	2	3	7	8	15	16	18	3	4	6	10	10
19	24	26	27	1	2	4	7	8	15	16	18	3	5	7	10	10
20	24	26	27	2	2	4	7	8	15	16	18	3	4	7	10	11
21	23	26	27	2	3	4	7	8	14	16	18	3	4	7	10	11
22	22	25	26	2	2	4	7	8	13	15	17	3	4	7	9	10
23	22	25	26	2	2	4	7	7	13	14	17	3	4	7	9	10

Table 11.1. Outlet temperature summary [2023 Cumulative, expected traffic], continued.

Outlet identifier:	H								H							
EIS name:	Rozelle North (WHT)								Rozelle North (WHT)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	24	26	2	2	4	7	8	12	14	16	4	4	7	9	10
1	20	24	25	2	2	4	6	8	11	13	16	4	4	7	8	9
2	19	23	25	2	2	4	6	8	11	13	15	4	4	6	8	8
3	19	23	25	2	2	4	7	8	11	13	15	4	4	6	8	9
4	20	24	25	2	2	4	7	9	11	13	15	4	5	7	10	10
5	22	25	26	1	2	5	7	8	13	14	16	5	6	9	12	12
6	24	26	27	1	1	4	7	8	14	16	17	5	7	10	13	13
7	25	27	29	0	1	3	8	9	16	17	19	5	7	9	11	12
8	25	27	29	-1	-1	2	8	9	16	17	19	3	4	7	9	10
9	25	27	29	-3	-2	1	8	8	16	17	19	2	3	5	8	9
10	25	27	29	-4	-3	1	8	8	16	17	19	1	2	4	7	8
11	25	27	29	-4	-4	1	8	8	16	18	19	0	1	3	5	7
12	25	27	30	-5	-4	0	7	8	17	18	19	0	0	2	4	6
13	25	27	30	-5	-4	0	7	8	17	18	19	0	0	3	4	6
14	25	28	29	-3	-3	2	8	8	17	18	20	0	0	3	5	6
15	26	28	30	-2	-2	2	8	9	17	18	20	1	2	4	6	7
16	27	29	31	0	0	4	10	11	18	19	21	4	5	7	10	10
17	25	27	29	-1	1	4	8	10	16	18	19	3	4	6	10	10
18	24	27	28	1	2	4	7	8	15	17	18	3	4	6	10	10
19	24	26	27	1	2	3	7	8	15	16	18	3	5	7	10	10
20	23	26	27	2	2	4	7	8	14	16	18	3	4	7	10	10
21	23	25	27	2	2	4	7	8	14	15	18	3	4	7	9	11
22	22	25	26	2	2	4	7	8	13	15	17	3	4	7	9	10
23	22	25	26	2	2	4	7	7	12	14	17	3	4	7	9	10
Outlet identifier:	**I**								**I**							
EIS name:	**Rozelle Mid (M4-M5 Link/ICL)**								**Rozelle Mid (M4-M5 Link/ICL)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	24	26	2	2	4	6	7	12	13	16	4	4	6	8	9
1	20	24	26	2	2	4	6	7	11	13	16	4	4	6	8	8
2	19	24	25	2	2	4	6	8	11	13	15	4	4	6	8	8
3	19	23	25	2	2	4	6	8	10	12	15	4	4	6	8	9
4	19	23	25	2	2	4	7	8	10	12	15	4	4	7	9	9
5	21	25	26	2	2	4	7	7	11	14	16	5	5	8	10	11
6	23	26	28	1	2	4	7	7	13	15	17	6	7	9	12	13
7	25	28	29	1	2	4	9	9	16	17	19	5	7	9	11	12
8	25	28	30	0	0	3	8	8	16	17	19	4	5	7	9	10
9	25	28	30	-2	-1	2	7	7	16	17	19	2	3	5	8	8
10	25	28	30	-3	-2	1	7	8	16	17	19	2	2	3	6	7
11	25	28	30	-3	-3	1	7	7	16	17	19	1	1	3	5	7
12	25	28	31	-4	-3	1	6	7	16	18	20	0	0	2	4	5
13	25	28	31	-4	-3	1	6	7	16	18	20	0	0	3	4	5
14	25	27	30	-3	-2	1	7	7	16	18	20	0	0	3	4	5
15	25	27	30	-2	-1	2	7	7	16	17	19	1	1	4	5	6
16	25	27	30	-1	-1	3	7	8	16	17	19	2	3	5	7	7
17	24	27	29	0	1	3	6	8	15	17	19	2	3	5	8	9
18	24	27	28	2	2	4	7	7	14	16	18	3	4	6	9	9
19	24	26	28	2	3	4	7	7	14	16	18	3	5	7	9	10
20	24	26	28	3	3	4	7	7	14	16	18	4	4	7	9	10
21	23	26	28	3	3	5	7	8	14	15	18	4	4	7	9	10
22	22	25	27	2	3	4	6	7	13	14	17	3	4	7	8	9
23	21	24	26	2	2	3	6	6	11	13	16	3	4	6	8	8

Table 11.1. Outlet temperature summary [2023 Cumulative, expected traffic], continued.

Outlet identifier:	J								J							
EIS name:	Rozelle South (M4-M5 Link/ICL)								Rozelle South (M4-M5 Link/ICL)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	24	26	2	2	4	6	7	12	13	16	4	4	6	8	9
1	20	24	26	2	2	4	6	7	11	13	16	4	4	6	8	8
2	19	24	25	2	2	4	6	8	11	13	15	4	4	6	8	8
3	19	23	25	2	2	4	6	8	10	12	15	4	4	6	8	9
4	19	23	25	2	2	4	7	8	10	12	15	4	4	7	9	9
5	21	25	26	2	2	4	7	7	11	14	16	5	5	8	10	11
6	23	26	28	1	2	4	7	7	13	15	17	6	7	9	12	13
7	25	28	29	1	2	4	9	9	16	17	19	5	7	9	11	12
8	25	28	30	0	0	3	8	8	16	17	19	4	5	7	9	10
9	25	28	30	-2	-1	2	7	7	16	17	19	2	3	5	8	8
10	25	28	30	-3	-2	1	7	8	16	17	19	2	2	3	6	7
11	25	28	30	-3	-3	1	7	7	16	17	19	1	1	3	5	7
12	25	28	31	-4	-3	1	6	7	16	18	20	0	0	2	4	5
13	25	28	31	-4	-3	1	6	7	16	18	20	0	0	3	4	5
14	25	27	30	-3	-2	1	7	7	16	18	20	0	0	3	4	5
15	25	27	30	-2	-1	2	7	7	16	17	19	1	1	4	5	6
16	25	27	30	-1	-1	3	7	8	16	17	19	2	3	5	7	7
17	24	27	29	0	1	3	6	8	15	17	19	2	3	5	8	9
18	24	27	28	2	2	4	7	7	14	16	18	3	4	6	9	9
19	24	26	28	2	3	4	7	7	14	16	18	3	5	7	9	10
20	24	26	28	3	3	4	7	7	14	16	18	4	4	7	9	10
21	23	26	28	3	3	5	7	8	14	15	18	4	4	7	9	10
22	22	25	27	2	3	4	6	7	13	14	17	3	4	7	8	9
23	21	24	26	2	2	3	6	6	11	13	16	3	4	6	8	8
Outlet identifier:	**K**								**K**							
EIS name:	**SPI (M4-M5 Link)**								**SPI (M4-M5 Link)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	26	28	29	6	6	8	11	12	17	19	20	8	9	12	14	15
1	25	27	29	5	5	7	11	12	16	18	19	8	8	11	13	14
2	24	27	28	5	5	7	10	12	16	17	19	7	8	11	13	13
3	24	27	28	5	5	7	11	13	16	17	19	8	8	11	14	14
4	25	28	29	5	6	8	12	14	16	18	19	8	9	12	15	16
5	26	29	30	5	6	8	12	12	18	19	20	9	10	13	17	17
6	29	31	32	5	6	8	12	13	20	21	22	11	12	15	18	19
7	31	33	34	5	6	9	14	15	22	23	25	11	13	15	17	18
8	31	33	34	4	5	8	13	14	22	23	25	9	10	13	15	17
9	31	33	34	3	4	7	13	14	23	23	25	8	9	11	15	15
10	31	33	35	2	2	7	14	14	23	24	25	7	8	10	13	15
11	31	33	35	1	2	7	14	14	23	24	25	7	7	9	12	14
12	31	33	35	0	2	7	13	14	23	24	25	6	6	9	11	13
13	31	33	35	0	1	6	13	14	23	24	25	6	6	9	11	12
14	31	33	35	2	3	7	13	14	23	24	25	5	6	9	11	12
15	31	33	34	3	3	7	13	14	23	24	25	6	7	10	11	12
16	31	33	35	3	4	8	13	15	23	23	25	8	9	11	14	14
17	30	32	33	4	6	8	13	14	22	23	24	8	9	12	15	16
18	30	32	33	6	7	9	13	14	21	22	24	8	9	12	16	16
19	29	31	33	6	7	9	13	13	21	22	23	9	10	13	16	17
20	29	31	32	7	7	9	13	13	21	22	23	9	9	13	16	17
21	29	31	32	7	8	9	13	14	20	22	23	9	9	13	16	17
22	28	30	31	7	7	9	12	14	20	21	23	8	9	13	15	17
23	27	29	30	6	7	8	12	12	18	19	21	8	9	12	14	16

Table 11.1. Outlet temperature summary [2023 Cumulative, expected traffic], continued.

Outlet identifier:	L								L							
EIS name:	Iron Cove Link (north)								Iron Cove Link (north)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	20	24	26	2	2	4	6	6	11	13	16	4	4	6	8	8
1	19	24	26	2	2	4	6	7	10	12	15	4	4	6	7	8
2	19	23	25	2	2	4	6	7	10	12	15	4	4	6	8	8
3	19	23	25	2	2	4	6	8	10	12	15	3	4	6	8	9
4	19	23	25	2	2	4	6	8	10	12	14	3	4	6	9	9
5	20	24	26	1	2	4	6	6	10	12	15	4	4	7	9	10
6	21	25	27	0	1	3	5	5	11	13	15	4	5	7	9	10
7	22	25	27	-1	0	2	5	6	12	13	16	3	4	5	7	7
8	22	26	28	-2	-1	1	5	6	12	14	17	1	2	4	6	6
9	23	26	29	-2	-2	1	5	6	13	15	18	1	1	3	5	6
10	23	27	29	-3	-3	1	6	6	14	16	18	0	1	2	5	6
11	23	27	30	-4	-3	0	6	7	14	16	18	0	0	1	4	5
12	24	27	31	-4	-3	0	5	7	15	16	19	-1	-1	1	3	4
13	24	27	31	-4	-3	0	6	7	15	17	19	-1	-1	1	3	4
14	24	27	30	-3	-2	1	6	7	15	17	19	-1	-1	2	3	4
15	24	27	30	-2	-1	2	6	7	15	16	19	0	0	2	4	4
16	24	27	30	-1	-1	2	6	7	14	16	18	1	2	4	6	6
17	24	27	29	0	1	3	6	7	14	16	18	2	3	5	7	8
18	23	26	29	2	2	3	6	7	14	16	18	2	3	6	8	9
19	23	26	28	3	3	4	6	7	13	15	18	3	4	6	9	9
20	23	26	28	3	3	4	6	6	13	15	18	3	4	7	9	9
21	23	26	28	3	3	5	6	7	13	15	18	3	4	7	8	10
22	22	25	27	3	3	4	6	7	13	14	17	3	4	7	8	9
23	21	25	26	2	2	4	6	6	11	13	16	3	4	6	8	8
Outlet identifier:	**M**								**M**							
EIS name:	**Arncliffe (F6 Extension)**								**Arncliffe (F6 Extension)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 11.1. Outlet temperature summary [2023 Cumulative, expected traffic], continued.

Outlet identifier:	N								N							
EIS name:	Rockdale (F6 Extension)								Rockdale (F6 Extension)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

11.2 2033 Cumulative demand traffic operations

Table 11.2. Outlet temperature summary [2033 Cumulative, expected traffic].

Outlet identifier:	B								B							
EIS name:	Parramatta Road (M4 East)								Parramatta Road (M4 East)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	22	25	27	3	3	5	7	8	12	14	17	4	5	7	9	10
1	21	25	26	2	3	5	7	9	12	14	16	5	5	7	9	9
2	21	25	26	2	3	5	8	9	12	14	16	4	5	7	10	10
3	21	24	26	2	3	5	8	9	12	13	16	5	5	8	10	11
4	21	25	26	3	3	5	8	10	12	14	15	4	5	8	10	11
5	22	25	27	2	3	5	7	8	12	14	16	5	6	8	11	12
6	24	27	29	2	3	5	8	8	14	16	17	6	7	10	12	13
7	26	29	31	2	4	6	10	10	16	17	20	6	8	10	11	12
8	26	29	31	1	2	4	9	9	16	18	20	4	5	8	9	10
9	26	29	31	0	0	3	9	9	16	18	20	3	4	6	8	9
10	26	29	31	-2	-1	3	9	9	17	18	20	2	3	4	7	8
11	26	29	32	-2	-2	3	9	9	17	18	20	2	2	3	6	8
12	26	29	32	-3	-2	2	8	10	17	19	21	1	1	3	5	7
13	26	29	32	-3	-2	2	8	10	17	19	21	1	1	4	5	6
14	26	29	32	-1	-1	3	8	9	17	19	21	1	1	4	6	6
15	26	29	32	0	0	4	9	10	17	19	21	2	2	5	6	7
16	27	30	32	1	1	5	9	11	17	19	21	3	4	6	9	9
17	26	28	30	1	3	5	8	10	16	18	20	3	4	7	10	10
18	25	28	29	2	3	5	8	9	15	17	19	3	4	7	10	10
19	25	27	29	3	4	5	8	9	15	16	19	4	5	8	10	11
20	24	27	29	3	4	5	8	8	15	16	19	4	4	8	10	11
21	24	27	29	4	4	6	8	9	14	16	19	4	5	8	10	11
22	23	26	28	3	4	5	8	8	14	15	18	3	4	7	9	11
23	22	25	27	3	3	5	7	8	13	14	17	4	4	7	9	10
Outlet identifier:	**C**								**C**							
EIS name:	**Underwood Road (M4 East)**								**Underwood Road (M4 East)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	30	33	33	10	10	12	16	17	22	23	25	13	13	17	19	20
1	30	32	33	10	10	12	16	17	22	23	24	13	13	16	19	19
2	29	31	32	9	10	11	16	18	21	22	24	12	13	16	18	19
3	29	31	32	9	9	12	15	18	21	22	23	13	13	16	19	19
4	29	32	32	9	10	12	16	18	21	22	24	12	13	16	20	20
5	31	33	34	9	10	12	16	17	23	24	25	14	15	18	21	22
6	33	35	36	10	10	13	17	18	25	26	27	16	17	20	24	24
7	36	38	39	11	12	14	19	20	28	29	30	17	18	21	23	24
8	36	38	39	9	10	13	19	20	29	29	30	15	16	19	21	23
9	36	38	39	7	9	12	19	20	29	29	31	14	14	17	21	21
10	37	38	39	6	7	12	19	20	29	29	31	13	13	16	19	20
11	37	38	40	6	7	12	19	20	29	30	31	12	13	15	18	20
12	37	38	40	5	7	12	19	19	29	30	31	12	12	14	17	19
13	37	39	40	5	7	12	19	20	29	30	31	12	12	15	17	18
14	37	39	40	8	8	13	19	20	29	30	31	12	12	15	17	18
15	38	39	40	9	9	13	20	21	30	31	32	13	14	17	19	19
16	38	40	41	10	11	15	20	22	30	31	32	15	16	19	22	22
17	37	39	40	10	12	15	20	21	29	30	31	15	16	19	23	23
18	36	37	38	11	12	14	19	19	28	28	30	14	15	18	22	23
19	35	37	38	11	13	14	18	18	27	28	29	14	16	18	22	23
20	35	36	37	12	12	14	18	19	27	28	29	15	15	19	22	23
21	34	36	37	12	12	15	18	20	27	27	29	14	15	19	22	23
22	33	35	36	11	12	14	17	19	25	26	27	13	14	18	21	22
23	31	33	34	10	11	12	16	17	23	24	26	13	14	17	19	21

Table 11.2. Outlet temperature summary [2033 Cumulative, expected traffic], continued.

Outlet identifier:	D								D							
EIS name:	SPI (New M5)								SPI (New M5)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	24	26	2	2	4	6	7	11	13	16	4	4	6	8	9
1	20	24	26	2	2	4	6	7	10	12	15	4	4	6	7	8
2	19	23	25	2	2	4	6	7	10	12	15	3	3	5	8	8
3	19	23	25	2	2	4	6	8	10	12	14	3	3	6	8	9
4	19	23	25	2	2	4	6	8	10	12	14	3	4	6	8	9
5	21	25	26	2	2	4	6	7	11	13	15	4	5	7	10	11
6	24	27	29	2	3	5	8	8	13	15	17	6	7	9	12	13
7	26	30	31	2	4	6	10	11	16	18	20	6	8	10	12	12
8	26	29	31	1	2	4	9	9	16	17	20	4	5	7	9	10
9	26	29	31	0	0	3	8	9	16	17	20	3	3	5	8	8
10	26	29	31	-2	-1	3	8	9	16	18	20	2	2	4	7	8
11	26	29	32	-2	-2	2	8	9	16	18	20	1	1	3	5	7
12	26	29	32	-3	-2	2	7	9	16	18	20	0	1	3	5	6
13	26	29	32	-3	-2	2	8	9	16	18	20	0	0	3	5	5
14	26	29	32	-1	-1	3	8	9	16	18	20	0	0	3	5	5
15	25	29	31	0	0	3	8	9	16	18	20	1	1	4	5	6
16	25	28	31	0	1	4	8	9	16	17	20	2	3	5	7	7
17	25	28	30	1	2	4	7	9	15	17	19	2	4	5	8	9
18	24	27	29	2	3	4	7	8	14	16	19	3	4	6	9	9
19	24	27	29	3	4	5	7	8	14	16	18	3	5	7	9	10
20	24	27	29	3	3	5	7	8	14	15	18	3	4	7	9	10
21	23	27	28	3	4	5	7	8	13	15	18	3	4	7	9	10
22	22	25	27	2	3	4	6	7	12	14	17	2	3	6	8	9
23	21	25	26	2	3	4	6	6	11	13	16	3	4	6	8	8
Outlet identifier:	**E**								**E**							
EIS name:	**Arncliffe (New M5)**								**Arncliffe (New M5)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	20	23	24	0	0	2	6	6	12	13	14	2	3	6	8	9
1	20	22	23	0	0	2	6	7	11	13	14	3	3	6	8	9
2	19	22	23	0	0	3	6	8	11	12	14	2	3	6	8	9
3	19	22	23	0	0	3	6	8	11	12	14	3	3	6	9	9
4	19	22	23	0	0	3	7	8	11	12	14	2	3	6	10	10
5	20	23	24	-2	-1	2	6	6	12	13	14	3	4	7	11	11
6	21	23	24	-3	-2	0	5	5	13	13	14	3	4	7	11	11
7	22	24	25	-4	-3	-1	5	6	13	14	15	1	3	6	9	9
8	22	23	25	-5	-5	-2	5	6	13	14	15	-1	1	4	6	8
9	22	24	25	-7	-6	-3	4	5	13	14	15	-2	-1	2	5	6
10	22	24	25	-8	-8	-3	5	6	14	14	15	-3	-2	1	4	5
11	22	24	25	-9	-8	-3	5	5	14	14	15	-3	-3	-1	2	5
12	22	24	25	-10	-8	-3	4	5	14	14	15	-4	-4	-1	1	3
13	22	24	25	-10	-9	-3	4	5	14	14	15	-4	-4	-1	1	3
14	22	24	25	-8	-7	-2	4	5	14	14	15	-4	-4	0	2	2
15	22	24	25	-7	-6	-2	4	6	14	14	15	-4	-3	0	2	3
16	22	24	25	-6	-6	-1	4	6	14	14	15	-2	-1	2	5	5
17	21	23	25	-5	-3	0	5	6	13	14	15	-1	0	3	7	7
18	21	23	24	-3	-2	0	5	6	13	14	15	-1	1	4	8	8
19	21	23	24	-2	-1	1	5	5	13	14	15	0	2	4	8	9
20	21	23	24	-1	-1	1	5	6	13	14	15	1	1	5	8	9
21	21	23	24	-1	-1	1	5	6	13	13	15	0	1	5	8	9
22	21	23	24	-1	0	1	5	6	12	13	15	0	1	5	8	9
23	20	23	24	0	0	2	5	6	12	13	15	1	2	5	8	9

Table 11.2. Outlet temperature summary [2033 Cumulative, expected traffic], continued.

Outlet identifier:	F								F							
EIS name:	Kingsgrove (New M5)								Kingsgrove (New M5)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	24	26	27	4	4	6	9	10	17	17	19	7	7	11	13	14
1	24	26	27	4	4	6	9	11	16	17	18	7	8	10	13	13
2	23	26	27	4	4	6	10	12	16	17	18	7	7	10	13	13
3	23	26	27	4	4	6	10	12	15	17	18	7	8	10	13	14
4	24	26	27	4	4	6	10	12	16	17	19	7	8	11	14	15
5	25	27	28	3	4	6	10	11	17	18	19	8	9	12	16	16
6	26	28	29	3	3	5	10	10	18	19	20	9	10	13	17	17
7	27	29	30	1	2	5	10	11	19	20	21	8	9	12	14	15
8	27	29	30	1	1	4	9	11	20	21	22	6	7	11	13	14
9	28	29	30	-1	0	3	9	11	20	21	22	5	6	9	12	13
10	28	29	31	-3	-2	3	10	11	20	21	22	5	5	8	11	12
11	28	30	31	-3	-2	3	10	11	20	22	22	4	4	7	9	11
12	28	30	31	-4	-2	3	10	10	21	22	23	3	4	6	8	10
13	28	30	31	-3	-2	3	10	10	21	22	23	4	4	7	9	10
14	28	30	31	-1	-1	4	10	11	21	22	23	3	4	7	9	10
15	29	30	31	0	0	4	10	12	21	22	23	4	5	8	10	11
16	29	30	32	0	1	5	11	12	22	22	23	6	7	10	13	13
17	28	29	30	1	3	6	11	11	21	21	22	7	7	10	14	14
18	28	29	30	3	4	6	10	11	20	21	22	6	8	10	14	15
19	27	29	30	4	5	6	10	10	19	20	21	7	9	11	14	15
20	27	28	29	4	4	6	10	11	19	20	21	7	7	11	14	15
21	27	28	29	4	5	7	10	11	19	20	21	7	7	11	14	15
22	26	28	29	4	5	6	10	11	18	19	21	6	7	11	14	15
23	25	27	28	4	4	6	10	11	17	18	20	6	8	11	13	14
Outlet identifier:	**G**								**G**							
EIS name:	**Parramatta Road (M4-M5 Link)**								**Parramatta Road (M4-M5 Link)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	22	25	27	3	3	5	8	8	13	15	17	5	5	8	10	11
1	21	25	26	3	3	5	8	9	13	15	17	5	6	8	10	10
2	21	25	26	3	3	5	8	9	13	14	17	5	5	8	10	10
3	21	24	26	3	3	5	8	10	13	14	16	5	6	8	11	11
4	21	25	26	3	3	5	8	10	13	14	16	5	6	9	11	12
5	23	26	27	2	3	5	8	9	13	15	17	6	7	10	12	13
6	25	27	28	2	2	5	8	9	15	17	18	7	8	11	13	14
7	26	29	30	1	3	5	10	10	17	18	20	6	8	11	13	13
8	25	28	29	-1	0	3	8	9	17	18	19	4	5	8	10	11
9	26	28	30	-2	-1	2	8	9	17	18	20	3	3	6	9	10
10	26	28	30	-3	-2	2	8	9	17	18	20	2	3	5	8	9
11	26	28	30	-3	-3	2	8	8	17	18	20	1	2	4	6	8
12	26	28	31	-4	-3	1	8	9	18	19	20	1	1	3	5	7
13	26	28	31	-4	-3	1	8	9	18	19	20	1	1	4	5	7
14	26	28	30	-2	-2	2	8	9	18	19	20	1	1	4	6	6
15	26	28	30	-2	-1	2	8	9	18	19	20	1	2	5	6	7
16	27	29	31	0	1	4	10	11	18	19	21	4	5	7	9	10
17	26	28	29	0	2	4	8	10	17	18	20	3	4	7	10	11
18	25	27	29	2	3	4	8	9	16	17	19	4	5	7	11	11
19	25	27	28	2	3	5	8	9	16	17	19	4	6	8	11	11
20	25	27	28	3	3	5	8	9	16	17	19	4	5	8	11	12
21	24	27	28	3	4	5	8	9	15	17	19	4	5	8	11	12
22	23	26	27	3	3	5	8	9	14	16	18	4	5	8	10	11
23	22	25	27	3	3	4	7	8	14	15	18	4	5	8	10	11

Table 11.2. Outlet temperature summary [2033 Cumulative, expected traffic], continued.

Outlet identifier:	H								H							
EIS name:	Rozelle North (WHT)								Rozelle North (WHT)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	22	26	27	3	3	5	8	9	14	15	17	5	5	8	10	11
1	21	25	26	3	3	5	8	9	13	14	17	5	6	8	10	10
2	21	25	26	3	3	5	8	9	12	14	17	5	5	8	10	10
3	21	25	26	3	3	5	8	9	12	14	16	5	6	8	10	10
4	21	25	26	3	3	5	9	10	13	15	16	5	6	9	11	12
5	23	26	27	2	3	6	8	9	14	16	17	6	7	10	13	13
6	25	27	29	2	3	5	9	9	16	17	18	7	8	11	14	15
7	26	29	30	1	3	5	10	10	17	19	20	6	8	11	13	14
8	26	29	30	0	1	4	9	10	18	19	20	4	6	8	11	12
9	26	29	30	-2	-1	3	9	10	18	19	20	3	4	7	10	10
10	26	29	30	-3	-2	2	9	10	18	19	20	2	3	5	8	9
11	26	29	31	-3	-3	2	9	9	18	19	20	2	2	4	7	9
12	26	29	31	-4	-3	2	9	9	18	19	21	1	1	4	6	7
13	26	29	31	-4	-3	2	9	10	18	19	21	1	1	4	6	7
14	27	29	31	-2	-1	3	9	10	18	19	21	1	2	4	6	7
15	27	29	31	-1	0	4	10	11	19	20	21	2	3	6	7	8
16	28	30	32	1	2	6	11	12	19	20	22	5	6	8	11	11
17	26	29	30	1	3	5	9	11	18	19	20	4	5	8	11	11
18	25	28	29	2	3	5	8	9	16	18	19	4	5	7	11	11
19	25	27	29	2	3	5	8	9	16	17	19	4	6	8	11	11
20	24	27	28	3	3	5	8	9	15	17	19	4	5	8	11	12
21	24	27	28	3	3	5	8	9	15	16	19	4	5	8	10	12
22	23	26	28	3	4	5	8	9	14	16	18	4	5	8	10	12
23	23	26	27	3	3	5	8	9	14	15	18	4	5	8	10	11
Outlet identifier:	**I**								**I**							
EIS name:	**Rozelle Mid (M4-M5 Link/ICL)**								**Rozelle Mid (M4-M5 Link/ICL)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	25	27	3	3	5	7	7	12	14	17	5	5	7	9	10
1	20	24	26	3	3	5	7	8	12	14	16	5	5	7	9	9
2	20	24	26	3	3	5	7	9	12	13	16	5	5	7	9	9
3	20	24	26	3	3	5	7	9	11	13	16	5	5	7	9	10
4	20	24	26	3	3	5	7	9	11	13	16	5	5	8	10	10
5	22	25	27	2	3	5	7	8	12	14	16	5	6	9	11	12
6	25	27	29	2	3	5	8	9	15	16	18	7	8	10	13	14
7	26	29	30	2	3	5	10	10	17	18	20	7	8	10	12	13
8	26	29	30	1	1	4	9	9	17	18	20	5	6	8	10	11
9	26	29	31	-1	0	3	8	9	17	18	20	4	4	6	9	9
10	26	29	31	-2	-1	2	8	9	17	18	20	3	3	5	7	9
11	26	29	31	-2	-2	2	8	9	17	19	21	2	2	4	6	8
12	26	29	32	-3	-2	2	8	9	17	19	21	1	1	3	5	7
13	26	29	32	-3	-2	2	8	9	17	19	21	1	1	4	5	6
14	26	29	31	-2	-1	2	8	8	17	19	21	1	1	4	6	6
15	26	28	31	-1	0	3	8	9	17	19	21	2	2	5	6	7
16	26	28	31	0	0	4	8	9	17	18	20	3	4	6	8	8
17	25	28	30	1	2	4	8	9	16	18	20	3	4	7	10	10
18	25	28	29	3	3	5	8	8	15	17	19	4	5	7	10	10
19	25	27	29	3	4	5	8	8	15	17	19	4	6	8	10	11
20	24	27	29	4	4	5	8	8	15	17	19	5	5	8	10	11
21	24	27	29	4	4	6	8	9	15	16	19	5	5	8	10	11
22	23	26	28	3	4	5	7	8	13	15	18	4	4	7	9	10
23	22	25	27	3	3	4	6	7	12	14	17	4	5	7	9	9

Table 11.2. Outlet temperature summary [2033 Cumulative, expected traffic], continued.

Outlet identifier:	J								J							
EIS name:	Rozelle South (M4-M5 Link/ICL)								Rozelle South (M4-M5 Link/ICL)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	25	27	3	3	5	7	7	12	14	17	5	5	7	9	10
1	20	24	26	3	3	5	7	8	12	14	16	5	5	7	9	9
2	20	24	26	3	3	5	7	9	12	13	16	5	5	7	9	9
3	20	24	26	3	3	5	7	9	11	13	16	5	5	7	9	10
4	20	24	26	3	3	5	7	9	11	13	16	5	5	8	10	10
5	22	25	27	2	3	5	7	8	12	14	16	5	6	9	11	12
6	25	27	29	2	3	5	8	9	15	16	18	7	8	10	13	14
7	26	29	30	2	3	5	10	10	17	18	20	7	8	10	12	13
8	26	29	30	1	1	4	9	9	17	18	20	5	6	8	10	11
9	26	29	31	-1	0	3	8	9	17	18	20	4	4	6	9	9
10	26	29	31	-2	-1	2	8	9	17	18	20	3	3	5	7	9
11	26	29	31	-2	-2	2	8	9	17	19	21	2	2	4	6	8
12	26	29	32	-3	-2	2	8	9	17	19	21	1	1	3	5	7
13	26	29	32	-3	-2	2	8	9	17	19	21	1	1	4	5	6
14	26	29	31	-2	-1	2	8	8	17	19	21	1	1	4	6	6
15	26	28	31	-1	0	3	8	9	17	19	21	2	2	5	6	7
16	26	28	31	0	0	4	8	9	17	18	20	3	4	6	8	8
17	25	28	30	1	2	4	8	9	16	18	20	3	4	7	10	10
18	25	28	29	3	3	5	8	8	15	17	19	4	5	7	10	10
19	25	27	29	3	4	5	8	8	15	17	19	4	6	8	10	11
20	24	27	29	4	4	5	8	8	15	17	19	5	5	8	10	11
21	24	27	29	4	4	6	8	9	15	16	19	5	5	8	10	11
22	23	26	28	3	4	5	7	8	13	15	18	4	4	7	9	10
23	22	25	27	3	3	4	6	7	12	14	17	4	5	7	9	9
Outlet identifier:	**K**								**K**							
EIS name:	**SPI (M4-M5 Link)**								**SPI (M4-M5 Link)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	27	30	31	8	8	9	13	13	19	20	22	10	10	13	15	17
1	26	29	30	7	7	9	12	13	18	19	21	10	10	12	15	15
2	25	28	30	6	7	9	12	14	17	18	21	9	9	12	14	15
3	25	28	29	6	7	9	12	14	17	18	20	9	10	12	15	15
4	26	29	30	7	7	9	13	15	18	19	21	9	10	13	16	17
5	28	31	32	7	8	10	13	14	19	21	22	11	12	15	18	19
6	31	33	34	7	8	11	14	15	22	23	24	13	14	17	20	21
7	32	34	36	7	8	10	16	16	24	25	26	12	14	17	19	20
8	32	35	36	6	7	10	15	16	24	25	27	11	12	15	17	18
9	33	35	37	5	6	9	15	16	25	26	27	10	11	13	17	17
10	33	35	37	4	5	9	16	17	25	26	27	10	10	12	15	17
11	34	36	38	4	4	9	16	16	25	26	28	9	10	11	14	16
12	34	36	38	3	4	9	16	17	26	27	28	9	9	11	13	15
13	34	36	38	3	4	9	16	17	26	27	28	9	9	12	13	15
14	34	36	38	5	6	10	16	17	26	27	28	8	9	12	14	14
15	34	36	38	6	6	10	16	17	25	26	28	9	10	13	14	15
16	34	36	38	6	7	11	16	17	25	26	28	11	11	14	16	17
17	33	35	36	7	9	11	16	17	24	25	27	11	12	14	18	18
18	32	34	35	8	9	11	15	16	24	25	26	11	12	15	18	19
19	32	34	35	9	10	11	15	16	23	24	26	11	13	15	18	19
20	32	34	35	9	10	12	15	16	23	24	26	11	12	15	18	19
21	31	33	34	10	10	12	15	16	23	24	26	11	12	16	18	20
22	30	32	33	9	9	11	14	16	22	23	25	10	11	15	17	19
23	28	31	32	8	8	10	13	14	20	21	23	10	11	14	16	17

Table 11.2. Outlet temperature summary [2033 Cumulative, expected traffic], continued.

Outlet identifier:	L								L							
EIS name:	Iron Cove Link (north)								Iron Cove Link (north)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	21	25	26	2	3	4	6	7	11	13	16	4	4	6	8	9
1	20	24	26	2	2	4	6	7	11	13	16	4	4	6	8	8
2	19	24	26	2	2	4	6	8	11	12	15	4	4	6	8	9
3	19	24	25	2	2	4	7	8	10	12	15	4	4	6	8	9
4	19	24	26	2	2	4	7	8	10	12	15	4	4	7	9	10
5	21	24	26	1	2	4	6	7	11	13	15	4	5	7	10	11
6	21	25	27	0	1	3	5	6	11	13	15	4	5	7	10	11
7	22	25	27	-1	0	2	5	6	12	13	16	3	4	6	7	7
8	23	26	28	-1	-1	1	6	6	13	14	17	2	2	4	6	7
9	23	27	29	-2	-2	1	6	6	13	15	18	1	2	3	6	6
10	24	27	30	-3	-3	1	6	7	14	16	18	1	1	2	5	6
11	24	27	30	-3	-3	1	6	7	15	16	19	0	0	2	4	5
12	24	27	31	-4	-3	1	6	7	15	17	19	-1	-1	1	3	4
13	24	28	31	-4	-3	1	6	7	15	17	19	-1	-1	2	3	4
14	24	28	31	-2	-1	2	6	7	15	17	20	-1	0	2	4	4
15	24	27	30	-2	-1	2	6	7	15	17	19	0	1	3	4	5
16	24	27	31	-1	0	3	6	8	15	16	19	1	2	4	6	6
17	24	27	29	0	2	3	6	7	14	16	18	2	3	5	8	8
18	24	27	29	2	3	4	6	7	14	16	18	2	4	6	9	9
19	24	27	29	3	3	4	7	7	14	16	18	3	5	7	9	9
20	23	26	28	3	3	5	7	7	13	15	18	4	4	7	9	10
21	23	26	28	3	4	5	7	7	13	15	18	4	4	7	9	10
22	22	26	28	3	3	5	7	7	13	15	18	3	4	7	8	10
23	21	25	27	3	3	4	6	7	12	14	17	4	4	6	8	9
Outlet identifier:	**M**								**M**							
EIS name:	**Arncliffe (F6 Extension)**								**Arncliffe (F6 Extension)**							
Season	**Summer (Jan 2015)**								**Winter (Jul 2015)**							
Hour start	**Temperature (C)**			**Delta T to Ambient (C)**					**Temperature (C)**			**Delta T to Ambient (C)**				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	19	23	24	0	0	2	5	5	10	12	14	1	2	5	7	8
1	19	22	24	0	0	3	5	6	10	11	14	2	2	5	7	7
2	18	22	24	-1	0	2	6	7	10	11	13	2	2	5	7	8
3	18	22	24	0	0	3	6	7	10	11	13	2	2	5	8	8
4	18	22	24	0	0	3	6	7	9	11	13	1	2	5	8	9
5	19	23	24	-1	-1	2	5	5	10	11	13	2	3	6	9	10
6	20	23	25	-3	-2	1	4	5	11	12	14	2	3	6	9	10
7	21	24	26	-4	-2	0	5	6	12	13	15	1	3	5	7	8
8	21	24	26	-5	-4	-1	5	5	11	13	15	-1	0	3	5	6
9	20	24	26	-6	-6	-2	4	5	11	13	15	-2	-2	0	4	4
10	20	24	26	-7	-7	-3	4	5	11	13	15	-3	-3	-1	2	4
11	20	24	26	-8	-8	-3	4	5	11	13	15	-4	-4	-2	1	3
12	21	24	26	-9	-8	-4	3	5	12	13	15	-5	-5	-3	0	1
13	21	24	26	-9	-8	-3	4	5	12	13	15	-5	-5	-2	0	1
14	21	24	26	-7	-7	-3	4	5	12	13	15	-5	-5	-2	0	1
15	20	24	26	-6	-6	-2	4	5	12	13	15	-4	-4	-1	1	1
16	20	24	26	-6	-5	-2	4	6	11	13	15	-3	-2	0	3	3
17	20	23	25	-5	-3	-1	4	6	11	13	14	-3	-1	1	5	5
18	20	23	25	-2	-2	0	4	5	11	12	14	-2	-1	2	6	6
19	20	23	25	-2	-1	1	4	5	11	12	14	-1	1	4	6	7
20	20	23	25	-1	-1	1	4	5	11	12	14	-1	0	4	7	7
21	20	23	25	-1	0	2	4	5	11	12	14	-1	1	4	6	8
22	20	23	25	-1	0	2	4	5	10	12	14	0	1	4	6	8
23	19	23	24	0	0	2	4	5	10	12	14	1	1	4	7	8

Table 11.2. Outlet temperature summary [2033 Cumulative, expected traffic], continued.

Outlet identifier:	N								N							
EIS name:	Rockdale (F6 Extension)								Rockdale (F6 Extension)							
Season	Summer (Jan 2015)								Winter (Jul 2015)							
Hour start	Temperature (C)			Delta T to Ambient (C)					Temperature (C)			Delta T to Ambient (C)				
	Min	Avg	Max	Min	5th	50th	95th	Max	Min	Avg	Max	Min	5th	50th	95th	Max
0	24	26	27	4	4	6	9	10	15	17	18	6	7	10	12	13
1	23	26	27	4	4	6	9	10	15	16	18	7	7	10	12	12
2	22	25	27	3	4	6	9	11	15	16	18	6	7	9	12	12
3	22	25	27	3	4	6	9	11	14	16	17	7	7	9	12	12
4	23	26	27	3	4	6	10	12	14	16	18	6	7	10	13	13
5	24	26	27	2	3	6	9	10	15	16	18	7	8	11	14	14
6	25	27	28	1	2	4	8	9	16	17	18	7	8	11	14	14
7	25	27	29	0	1	3	8	9	17	18	19	6	7	10	12	13
8	26	28	29	-1	0	3	8	9	18	18	20	4	5	9	11	12
9	26	28	30	-2	-1	2	8	9	18	19	21	4	4	7	10	11
10	27	28	30	-3	-2	2	9	10	18	19	21	3	4	6	9	10
11	27	29	30	-3	-3	2	9	9	19	20	21	3	3	5	8	10
12	27	29	31	-4	-3	2	9	9	19	20	21	2	2	5	7	8
13	27	29	31	-4	-3	2	9	10	20	20	22	2	2	5	7	8
14	28	30	31	-1	-1	4	10	11	20	21	22	3	3	6	8	9
15	29	30	32	0	1	5	11	12	21	22	23	4	5	8	10	11
16	30	32	34	3	3	7	13	14	23	23	24	8	8	11	14	14
17	28	30	31	2	4	6	11	12	20	21	22	6	7	10	14	14
18	27	29	30	3	4	6	10	11	19	20	21	6	7	10	14	14
19	27	28	30	3	4	6	10	10	18	19	21	6	8	10	14	14
20	26	28	29	4	4	6	10	10	18	19	20	6	7	10	13	14
21	26	27	28	4	4	6	9	10	17	18	20	6	6	10	12	14
22	25	27	28	3	4	6	9	10	17	18	20	5	6	10	12	14
23	24	26	27	3	4	5	9	9	15	17	19	5	6	9	11	12

12 VENTILATION CONTROL STRATEGY

For the project air quality criteria and design parameters, it is the "NO_2 route average" criterion that dominates the ventilation requirements during normal operations. As such, the NO_2 criteria will be the primary focus of ventilation control requirements. The potential complexity of the route average criterion is that it is impractical to measure accurately within the tunnel, as:

- Current (industrial) measurement technology cannot reliably measure very low NO_2 concentrations in the range that the majority of the tunnel would experience.
- There is no linear measurement technology, so point measurements within the tunnel would need to be interpolated in calculating the length-weighted average. With the concentration profile a function of many factors, there is an associated uncertainty in the intermediate concentration levels.

Nevertheless, in-tunnel measurements at key locations, combined with estimates of the intermediate profile based on design analysis, would enable the in-tunnel route average NO_2 to be estimated in real-time as a basis for ventilation control. With tunnel airflows able to be measured with good reliability, techniques such as calculating mixed conditions, say downstream of the interface plant, could also be used in lieu of direct measurement.

For free-flowing (expected) traffic conditions, the ventilation system is not constrained by the air quality criteria, with the ventilation plant operating well below the installed capacity. Under these conditions, some margin for measurement inaccuracies would be tolerable, with a consequence perhaps of higher power consumption.

For the slowest design traffic conditions (20 km/h), the ventilation system is constrained by the installed capacity of jet fans and ventilation plant. For these conditions, deducting a margin from the criteria to account for the potential range of uncertainty would lead to significant additional ventilation plant requirements.

Within the context of an operational system, the ventilation control task to meet the air quality criteria can be conceptually segmented. The portal emissions capture plants would be effectively autonomous in operation as they do not affect in-tunnel concentration levels. Their control would be based on the requirement to achieve a net portal inflow using measurements of in-tunnel and ventilation plant airflows.

As discussed in Section 10, only a few key routes within the numerous potential routes are important for different operating conditions of the interface plant. Recognition of that allows the monitoring to be simplified, with monitoring appropriately focused.

Control of the interface plants would be driven largely by the downstream project requirements, as the pollution carry-over has the greatest influence on the routes commencing downstream of each interface. As the pollution levels within the tunnel increase (due to slowing traffic conditions), the proportion of (upstream) interface exchange would be increased, resulting in a relative decrease in the downstream pollutant concentration levels. With the concentration immediately prior to the interface exhaust being a primary influence on downstream routes, it is likely that that single point measurement could be used as the basis of controlling the interface plant. Additional feedback from the downstream routes would enable higher levels of energy efficiency.

Once the upstream interface plant is effecting complete exchange and delivering fresh air to the downstream project, the downstream project would be required to use jet fans to increase airflows should traffic conditions continue to deteriorate. Jet fans would be used to increase airflows to the most heavily polluted sections of the tunnel.

APPENDIX A – INCORPORATION OF SEARS AND COMMENTS

This appendix describes how the SEARs and comments on the SEARS are, or will be, addressed. It is not exhaustive in that generic comments that are discussed within the body of this report, such as “describe the ventilation system” are not discussed further.

Table A.1. SEARS – air quality

Desired Performance Outcome	SEARs	Where addressed in the EIS
The project is designed, constructed and operated in a manner that minimises air quality impacts (including nuisance dust and odour) to minimise risks to human health and the environment to the greatest extent practicable.	1. The Proponent must undertake an air quality assessment (AQIA) for construction and operation of the project in accordance with the current guidelines;	To be addressed in the AQ Report.
	2. The Proponent must ensure the AQIA also includes the following: (a) demonstrated ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment Regulation 2010;*	To be addressed in the AQ Report.
	(b) the identification of all potential sources of air pollution and an assessment of potential emissions of PM_{10}, $PM_{2.5}$, CO and NO_2 and other nitrogen oxides and volatile organic compounds (eg BTEX);	Within the scope of ventilation, the sources of pollution are the vehicles. This report assesses in-tunnel and emitted concentrations for pollutants with defined in-tunnel air quality criteria, being CO, NO_2 and particulates (see Section 6.11). NO_X emissions from outlets are also calculated for ambient air quality assessment by others. Other pollutants may be inferred approximately by their typical proportions in vehicle exhaust, if known. That is not done within the scope of this report.
	(c) consider the impacts from the dispersal of these air pollutants on the ambient air quality along the proposal route, proposed ventilation outlets and portal, surface roads, ramps and interchanges and the alternative surface road network;	To be addressed in the AQ Report.

Desired Performance Outcome	SEARs	Where addressed in the EIS
	(d) assessment of worst case scenarios for in-tunnel and ambient air quality, including a range of potential ventilation scenarios and range of traffic scenarios, including the worst case design maximum traffic flow scenario (variable speed) and worst case breakdown scenario, and discussions of the likely occurrence of each;	This report assesses a range of worst case traffic scenarios ranging from highest occupancy traffic flows at the posted speed limit at 80 km/h, to highest occupancy traffic flows at the minimum design speed of 20 km/h. The likelihood of these scenarios is not considered, with the concept design ventilation system capable of handling all traffic scenarios with average speeds above 20 km/h. The likely occurrence frequency for various traffic conditions may be considered during future design stages, which may lead to optimisation of plant capacities.
	(e) details of the proposed tunnel design and mitigation measures to address –in-tunnel air quality and the air quality in the vicinity of portals and any mechanical ventilation systems (ie ventilation outlets and air inlets) including details of proposed air quality monitoring (including frequency and criteria);	In-tunnel air quality is proposed to be continuously monitored by permanently installed sensors placed at strategic locations within the tunnel. The type, number and location of sensors will be determined during detailed design. The ventilation systems are described Section 3 and Section 5.
	(f) a demonstration of how the project and ventilation design ensures that concentrations of air emissions meet NSW, national and international best practice for in-tunnel and ambient air quality, and taking into consideration the approved criteria for the M4 East project and the In-Tunnel Air Quality (Nitrogen Dioxide) Policy;	This report presents predicted in-tunnel air quality for a range of tunnel configuration and years of operation when subjected to the demand traffic predicted by WRTM. The results presented in Section 9 demonstrate that the ventilation system will meet the nominated in-tunnel air quality criteria. Further analysis of worst case traffic scenarios is presented in Section 10, to similarly show that the ventilation system can ensure compliance with criteria. This report provides estimated emissions from outlets to enable assessment of external air quality by others.

Desired Performance Outcome	SEARs	Where addressed in the EIS
	(g) consideration of any advice from the Advisory Committee on Tunnel Air Quality on the project, particularly in relation to assessment methodology;	To be addressed in the AQ Report.
	(h) details of any emergency ventilation systems, such as air intake/exhaust outlets, including protocols for the operation of these systems in emergency situations, potential emissions of air pollutants and their dispersal, and safety procedures;	Refer Section 5.3.2 of this report. The specific protocols and operation will be determined during later stages of design.
	(i) details of in-tunnel air quality control measures considered, including air filtration, and justification of the proposed measures;	Details of alternative ventilation schemes to meet in-tunnel air quality criteria are discussed in Section 8.
	(j) details of the proposed mitigation measures to prevent the generation and emission of dust (particulate matter and TSP) and air pollutants (including odours) during the construction of the proposal, particularly in relation to ancillary facilities (such as concrete batching plants), the use of mobile plant, stockpiles and the processing and movement of spoil; and	To be addressed in the AQ Report.
	(k) a cumulative assessment of the in-tunnel, local and regional air quality due to the operation of and potential continuous travel through the M4 East and New M5 Motorways and surface roads.	See item (f) above.