

Gosford Rd Emissions Reductions Calculations ¹

¹ based on ARB Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

Gosford Rd: White Ln to Target Entrance

Project Segment Length (mi)	1.31	mile
Operating Days per Year:	250	days
Average Annual Daily Traffic:	30,640	
Ave. Speed Before Coordination (mph)	25	mph
Ave. Speed After Coordination (mph)	45	mph
Annual Project Segment VMT ² :	10,034,600	miles/year

² Annual Project VMT = Operating Days per Year * Project Length * AADT

Emissions	ROG	CO	NOx	PM2.5 Ex
Before Speed Factor ³ (g/mi)	0.029	1.3483	0.2166	0.003
After Speed Factor ³ (g/mi)	0.0152	0.9708	0.1256	0.0018
Annual Emission Reduction ⁴ (lbs/yr)/mi	153	4172	1006	10
Annual Emission Reduction ⁵ (kg/day)/mi	0.19	5.20	1.25	0.01

³ Emissions factors are referenced from Table 3 of Methods to Find the Cost-Effectiveness of Funding Air Quality Projects, Emission Factor Tables, December 2022

⁴ Annual Emissions Reductions (lbs/yr) = [(0.50)*(VMT)*(Before Speed Factor - After Speed Factor)]/454 grams per lb.

⁵ Annual Emissions Reductions (kg/yr) = [Annual Emissions Reductions (lbs/yr)]*2.2 kg per lb.

Gosford Rd LOS Analysis (HCM 2016 Methodology)

Gosford Rd: White Ln to Target Entrance

Before Proposed Improvements

Base Free Flow Speed	f_{LW}	f_{TLC}	f_M	f_A
25	0	0.9	0	2.5
Free Flow Speed (FFS) = 21.6				
Note: FFS calculation is based on HCM 2016 Eq. 12-3. Adjustment factors f_{LW} , f_{TLC} , f_M , and f_A are referenced from HCM 2016 Exhibits 12-21, 12-22, 12-23, and 12-24, respectively. See HCM 2016 References on following page.				
Heavy Vehicle Factor	E_T	P_T		
	1.5	4		
f_{HV}	0.980			
Note: f_{HV} calculation is based on HCM 2016 Eq. 12-19. Factors P_T and E_T are referenced from Exhibits 12-25 in HCM 2016. See HCM 2016 References on following page.				
Service Flow Rate	V (veh/hr)	N (lanes)	PHF	
	1532	3	0.92	
v_p	566			
Note: Demand Volume, V , is based on 10% of half of the two-way AADT				
Density (D) = V(p)/FFS = 26				
Level Of Service (LOS) = C from HCM 2016 Exhibit 12-15				

Gosford Rd: White Ln to Target Entrance

After Proposed Improvements

Base Free Flow Speed	f_{LW}	f_{TLC}	f_M	f_A
45	0	0.9	0	2.5
Free Flow Speed (FFS) = 41.6				
Note: FFS calculation is based on HCM 2016 Eq. 12-3. Adjustment factors f_{LW} , f_{TLC} , f_M , and f_A are referenced from HCM 2016 Exhibits 12-21, 12-22, 12-23, and 12-24, respectively. See HCM 2016 References on following page.				
Heavy Vehicle Factor	E_T	P_T		
	1.5	4		
$f_{HV} = 0.980$				
Note: f_{HV} calculation is based on HCM 2016 Eq. 12-19. Factors P_T and E_T are referenced from Exhibits 12-25 in HCM 2016. See HCM 2016 References on following page.				
Service Flow Rate	V (veh/hr)	N (lanes)	PHF	
	1532	3	0.92	
$v_p = 566$				
Note: Demand Volume, V , is based on 10% of half of the two-way AADT				
Density (D) = V(p)/FFS = 14				
Level Of Service (LOS) = B from HCM 2016 Exhibit 12-15				

LOS	Density (pc/mi/ln)	Exhibit 12-15 LOS Criteria for Basic Freeway and Multilane Highway Segments
A	≤11	
B	>11–18	
C	>18–26	
D	>26–35	
E	>35–45	
F	Demand exceeds capacity OR density > 45	

Harris Rd Emissions Reductions Calculations ¹

¹ based on ARB Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

Harris Rd: Gosford to Mountain Vista Dr

Project Segment Length (mi)	1.50
Operating Days per Year:	250
Average Annual Daily Traffic:	21,687
Ave. Speed Before Coordination (mph)	20
Ave. Speed After Coordination (mph)	45
Annual Project Segment VMT ² :	8,132,625

² Annual Project VMT = Operating Days per Year * Project Length * AADT

Emissions	ROG	CO	NOx	PM2.5 Ex
Before Speed Factor ³ (g/mi)	0.0384	1.4894	0.2603	0.004
After Speed Factor ³ (g/mi)	0.0152	0.9708	0.1256	0.0018
Annual Emission Reduction ⁴ (lbs/yr)/mi	208	4645	1206	15
Annual Emission Reduction ⁵ (kg/day)/mi	0.26	5.78	1.50	0.02

³ Emissions factors are referenced from Table 3 of Methods to Find the Cost-Effectiveness of Funding Air Quality Projects, Emission Factor Tables, December 2022

⁴ Annual Emissions Reductions (lbs/yr) = [(0.50)*(VMT)*(Before Speed Factor - After Speed Factor)]/454 grams per lb.

⁵ Annual Emissions Reductions (kg/yr) = [Annual Emissions Reductions (lbs/yr)]*2.2 kg per lb.

Harris Rd LOS Analysis (HCM 2016 Methodology)

Harris Rd: Gosford to Mountain Vista Dr

Before Proposed Improvements

Base Free Flow Speed	f_{LW}	f_{TLC}	f_M	f_A
20	0	0.9	0	2.5

Free Flow Speed (FFS) = 16.6

Note: FFS calculation is based on HCM 2016 Eq. 12-3. Adjustment factors f_{LW} , f_{TLC} , f_M , and f_A are referenced from HCM 2016 Exhibits 12-21, 12-22, 12-23, and 12-24, respectively. See HCM 2016 References on following page.

Heavy Vehicle Factor

E_T	P_T
1.5	4

$f_{HV} = 0.980$

Note: f_{HV} calculation is based on HCM 2016 Eq. 12-19. Factors P_T and E_T are referenced from Exhibits 12-25 in HCM 2016. See HCM 2016 References on following page.

Service Flow Rate

V (veh/hr)	N (lanes)	PHF
1084	3	0.92

$v_p = 401$

Note: Demand Volume, V , is based on 10% of half of the two-way AADT

Density (D) = $V(p)/FFS = 24$

Level Of Service (LOS) = C from HCM 2016 Exhibit 12-15

Harris Rd: Gosford to Mountain Vista Dr

After Proposed Improvements

Base Free Flow Speed	f_{LW}	f_{TLC}	f_M	f_A
45	0	0.9	0	2.5

Free Flow Speed (FFS) = 41.6

Note: FFS calculation is based on HCM 2016 Eq. 12-3. Adjustment factors f_{LW} , f_{TLC} , f_M , and f_A are referenced from HCM 2016 Exhibits 12-21, 12-22, 12-23, and 12-24, respectively. See HCM 2016 References on following page.

Heavy Vehicle Factor

E_T	P_T
1.5	4

$f_{HV} = 0.980$

Note: f_{HV} calculation is based on HCM 2016 Eq. 12-19. Factors P_T and E_T are referenced from Exhibits 12-25 in HCM 2016. See HCM 2016 References on following page.

Service Flow Rate

V (veh/hr)	N (lanes)	PHF
1084	3	0.92

$v_p = 401$

Note: Demand Volume, V , is based on 10% of half of the two-way AADT

Density (D) = $V(p)/FFS = 10$

Level Of Service (LOS) = B from HCM 2016 Exhibit 12-15

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11–18
C	> 18–26
D	> 26–35
E	> 35–45
F	Demand exceeds capacity OR density > 45

Exhibit 12-15

LOS Criteria for Basic Freeway and Multilane Highway Segments

Old River Rd Emissions Reductions Calculations ¹

¹ based on ARB Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

Old River Rd: Harris Rd to McCutchen Rd

Project Segment Length (mi)	1.50	mile
Operating Days per Year:	250	days
Average Annual Daily Traffic:	10,903	
Ave. Speed Before Coordination (mph)	24	mph
Ave. Speed After Coordination (mph)	50	mph
Annual Project Segment VMT ² :	4,088,625	miles/year

² Annual Project VMT = Operating Days per Year * Project Length * AADT

Emissions	ROG	CO	NOx	PM2.5 Ex
Before Speed Factor ³ (g/mi)	0.0307	1.3754	0.2247	0.003
After Speed Factor ³ (g/mi)	0.0145	0.9106	0.1218	0.0019
Annual Emission Reduction ⁴ (lbs/yr)/mi	73	2093	463	5
Annual Emission Reduction ⁵ (kg/day)/mi	0.09	2.61	0.58	0.01

³ Emissions factors are referenced from Table 3 of Methods to Find the Cost-Effectiveness of Funding Air Quality Projects, Emission Factor Tables, December 2022

⁴ Annual Emissions Reductions (lbs/yr) = [(0.50)*(VMT)*(Before Speed Factor - After Speed Factor)]/454 grams per lb.

⁵ Annual Emissions Reductions (kg/yr) = [Annual Emissions Reductions (lbs/yr)]*2.2 kg per lb.

Eye St LOS Analysis (HCM 2016 Methodology)

Old River Rd: Harris Rd to McCutchen Rd

Before Proposed Improvements

Base Free Flow Speed	f_{LW}	f_{TLC}	f_M	f_A
24	0	0.9	0	2.5

Free Flow Speed (FFS) = 20.6

Note: FFS calculation is based on HCM 2016 Eq. 12-3. Adjustment factors f_{LW} , f_{TLC} , f_M , and f_A are referenced from HCM 2016 Exhibits 12-21, 12-22, 12-23, and 12-24, respectively. See HCM 2016 References on following page.

Heavy Vehicle Factor	E_T	P_T
	1.5	4

$f_{HV} = 0.980$

Note: f_{HV} calculation is based on HCM 2016 Eq. 12-19. Factors P_T and E_T are referenced from Exhibits 12-25 in HCM 2016. See HCM 2016 References on following page.

Service Flow Rate	V (veh/hr)	N (lanes)	PHF
	545	3	0.92

$v_p = 201$

Note: Demand Volume, V , is based on 10% of half of the two-way AADT

Density (D) = $V(p)/FFS = 10$

Level Of Service (LOS) = A from HCM 2016 Exhibit 12-15

Old River Rd: Harris Rd to McCutchen Rd

After Proposed Improvements

Base Free Flow Speed	f_{LW}	f_{TLC}	f_M	f_A
50	0	0.9	0	2.5

Free Flow Speed (FFS) = 46.6

Note: FFS calculation is based on HCM 2016 Eq. 12-3. Adjustment factors f_{LW} , f_{TLC} , f_M , and f_A are referenced from HCM 2016 Exhibits 12-21, 12-22, 12-23, and 12-24, respectively. See HCM 2016 References on following page.

Heavy Vehicle Factor	E_T	P_T
	1.5	4

$f_{HV} = 0.980$

Note: f_{HV} calculation is based on HCM 2016 Eq. 12-19. Factors P_T and E_T are referenced from Exhibits 12-25 in HCM 2016. See HCM 2016 References on following page.

Service Flow Rate	V (veh/hr)	N (lanes)	PHF
	545	3	0.92

$v_p = 201$

Note: Demand Volume, V , is based on 10% of half of the two-way AADT

Density (D) = $V(p)/FFS = 4$

Level Of Service (LOS) = A from HCM 2016 Exhibit 12-15

LOS	Density (pc/mi/ln)
A	≤11
B	>11–18
C	>18–26
D	>26–35
E	>35–45
F	Demand exceeds capacity OR density > 45

Exhibit 12-15
LOS Criteria for Basic Freeway
and Multilane Highway
Segments

Project Total Emissions Reduction & Cost-Benefit Analysis ¹

¹ based on ARB Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

Southwest Expansion

Gosford Rd, White Ln to Target Entrance; Harris Rd, Gosford Rd to Mountain Vista Dr; Old River, Harris Rd to McCutchen Rd	
Total Project Length (mi)	4.31
Operating Days per Year	250
Total Average Annual Daily Traffic	63,230
Total Project VMT	22,255,850
Effective Life of Project (n), years	5
Discount Rate (i)	3%
Capital Recovery Factor (A/P, 3%, 5) ²	0.22
CMAQ Funding Dollars	\$2,282,038
CoFund Dollars	\$295,662
CMAQ + CoFund Funding Dollars	\$2,577,700

Local Match

11.47%

² CRF = $(((1+i)^n)^i) / (((1+i)^n) - 1)$

AADT Totals

Segment	AADT	VMT ³
Gosford Rd: White Ln to Target	30,640	10,034,600
Harris Rd: Gosford Rd to Mtn Vista	21,687	8,132,625
Old River Rd: Harris Rd to McCutchen Rd	10,903	4,088,625
	63,230	22,255,850

³ Annual Project VMT = Operating Days per Year * Project Length * AADT

Emission Reductions Totals

Kg/day

Segment	ROG	CO	NOx	PM2.5 Ex
Gosford Rd: White Ln to Target	0.19	5.20	1.25	0.01
Harris Rd: Gosford Rd to Mtn Vista	0.26	5.78	1.50	0.02
Old River Rd: Harris Rd to McCutchen Rd	0.09	2.61	0.58	0.01
	0.54	1.94	3.33	0.04

lbs/yr

Segment	ROG	CO	NOx	PM2.5 Ex
Gosford Rd: White Ln to Target	153	4172	1006	10
Harris Rd: Gosford Rd to Mtn Vista	208	4645	1206	15
Old River Rd: Harris Rd to McCutchen Rd	73	2093	463	5
	433	1559	2675	30

dollars per lb. dollars per ton

CMAQ Cost-Effectiveness⁴ \$106.09 \$212,178

Total Cost-Effectiveness⁵ \$119.83 \$239,668

⁴ Cost-Effectiveness of CMAQ Funding Dollars = (CRF * CMAQ Funding Dollars) / (ROG + CO + NOx + PM10)

⁵ Cost-Effectiveness of Total Funding Dollars = (CRF * Total Funding Dollars) / (ROG + CO + NOx + PM10)