

Appendix C Traffic Reanalysis Supporting Documentation

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/11/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Lane Configurations		↕	↗		↔		↖	↕	↗		↘	↕
Traffic Volume (vph)	60	10	350	10	10	10	235	690	10	5	25	1760
Future Volume (vph)	60	10	350	10	10	10	235	690	10	5	25	1760
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1385	1900	1900	1900	1385	1900
Total Lost time (s)		6.0	4.0		6.0		8.5	6.0	6.0		8.5	6.0
Lane Util. Factor		1.00	1.00		1.00		0.97	0.95	1.00		1.00	0.95
Frt		1.00	0.85		0.95		1.00	1.00	0.85		1.00	1.00
Flt Protected		0.96	1.00		0.98		0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)		1752	1553		1716		2454	3471	1553		1273	3471
Flt Permitted		0.73	1.00		0.90		0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)		1340	1553		1576		2454	3471	1553		1273	3471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	11	380	11	11	11	255	750	11	5	27	1913
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	3	0	0	0
Lane Group Flow (vph)	0	76	380	0	24	0	255	750	8	0	32	1913
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	4%	4%	4%	0%	4%	4%
Turn Type	Perm	NA	Free	Perm	NA		Prot	NA	Perm	Prot	Prot	NA
Protected Phases		4			8		5	2		1	1	6
Permitted Phases	4		Free	8					2			
Actuated Green, G (s)		22.6	160.0		22.6		20.2	111.4	111.4		8.0	99.2
Effective Green, g (s)		22.6	160.0		22.6		17.7	111.4	111.4		5.5	99.2
Actuated g/C Ratio		0.14	1.00		0.14		0.11	0.70	0.70		0.03	0.62
Clearance Time (s)		6.0			6.0		6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		189	1553		222		271	2416	1081		43	2152
v/s Ratio Prot							c0.10	0.22			0.03	c0.55
v/s Ratio Perm		c0.06	0.24		0.01				0.00			
v/c Ratio		0.40	0.24		0.11		0.94	0.31	0.01		0.74	0.89
Uniform Delay, d1		62.5	0.0		59.9		70.6	9.4	7.4		76.6	25.7
Progression Factor		1.00	1.00		1.00		0.84	1.18	1.00		1.11	0.87
Incremental Delay, d2		1.4	0.4		0.2		36.9	0.3	0.0		42.9	4.9
Delay (s)		64.0	0.4		60.1		96.0	11.4	7.4		128.1	27.3
Level of Service		E	A		E		F	B	A		F	C
Approach Delay (s)		11.0			60.1			32.6				28.3
Approach LOS		B			E			C				C

Intersection Summary		
HCM 2000 Control Delay	27.6	HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio	0.82	
Actuated Cycle Length (s)	160.0	Sum of lost time (s) 20.5
Intersection Capacity Utilization	83.5%	ICU Level of Service E
Analysis Period (min)	15	
c Critical Lane Group		

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/11/2019

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	65
Future Volume (vph)	65
Ideal Flow (vphpl)	1900
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1553
Flt Permitted	1.00
Satd. Flow (perm)	1553
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	71
RTOR Reduction (vph)	27
Lane Group Flow (vph)	44
Heavy Vehicles (%)	4%
Turn Type	Perm
Protected Phases	
Permitted Phases	6
Actuated Green, G (s)	99.2
Effective Green, g (s)	99.2
Actuated g/C Ratio	0.62
Clearance Time (s)	6.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	962
v/s Ratio Prot	
v/s Ratio Perm	0.03
v/c Ratio	0.05
Uniform Delay, d1	11.9
Progression Factor	0.92
Incremental Delay, d2	0.1
Delay (s)	11.0
Level of Service	B
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/11/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Lane Configurations		↕	↗		↔		↖	↕	↗		↘	↕
Traffic Volume (vph)	70	10	215	10	10	10	360	2135	10	5	25	945
Future Volume (vph)	70	10	215	10	10	10	360	2135	10	5	25	945
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1385	1900	1900	1900	1385	1900
Total Lost time (s)		6.0	4.0		6.0		8.5	6.0	6.0		8.5	6.0
Lane Util. Factor		1.00	1.00		1.00		0.97	0.95	1.00		1.00	0.95
Frt		1.00	0.85		0.95		1.00	1.00	0.85		1.00	1.00
Flt Protected		0.96	1.00		0.98		0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)		1750	1553		1716		2454	3471	1553		1273	3471
Flt Permitted		0.73	1.00		0.90		0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)		1333	1553		1572		2454	3471	1553		1273	3471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	11	234	11	11	11	391	2321	11	5	27	1027
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	3	0	0	0
Lane Group Flow (vph)	0	87	234	0	24	0	391	2321	8	0	32	1027
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	4%	4%	4%	0%	4%	4%
Turn Type	Perm	NA	Free	Perm	NA		Prot	NA	Perm	Prot	Prot	NA
Protected Phases		4			8		5	2		1	1	6
Permitted Phases	4		Free	8					2			
Actuated Green, G (s)		23.0	160.0		23.0		30.6	111.1	111.1		7.9	88.4
Effective Green, g (s)		23.0	160.0		23.0		28.1	111.1	111.1		5.4	88.4
Actuated g/C Ratio		0.14	1.00		0.14		0.18	0.69	0.69		0.03	0.55
Clearance Time (s)		6.0			6.0		6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		191	1553		225		430	2410	1078		42	1917
v/s Ratio Prot							c0.16	c0.67			0.03	0.30
v/s Ratio Perm		c0.07	0.15		0.02				0.00			
v/c Ratio		0.46	0.15		0.10		0.91	0.96	0.01		0.76	0.54
Uniform Delay, d1		62.8	0.0		59.6		64.7	22.6	7.5		76.7	22.8
Progression Factor		1.00	1.00		1.00		1.21	0.39	1.00		1.20	0.91
Incremental Delay, d2		1.7	0.2		0.2		3.0	1.6	0.0		52.9	1.0
Delay (s)		64.5	0.2		59.8		81.0	10.4	7.5		145.0	21.7
Level of Service		E	A		E		F	B	A		F	C
Approach Delay (s)		17.6			59.8			20.5				24.9
Approach LOS		B			E			C				C

Intersection Summary		
HCM 2000 Control Delay	21.8	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.92	C
Actuated Cycle Length (s)	160.0	Sum of lost time (s)
Intersection Capacity Utilization	90.3%	20.5
Analysis Period (min)	15	ICU Level of Service
		E
c Critical Lane Group		

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/11/2019

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	100
Future Volume (vph)	100
Ideal Flow (vphpl)	1900
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1553
Flt Permitted	1.00
Satd. Flow (perm)	1553
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	109
RTOR Reduction (vph)	46
Lane Group Flow (vph)	63
Heavy Vehicles (%)	4%
Turn Type	Perm
Protected Phases	
Permitted Phases	6
Actuated Green, G (s)	88.4
Effective Green, g (s)	88.4
Actuated g/C Ratio	0.55
Clearance Time (s)	6.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	858
v/s Ratio Prot	
v/s Ratio Perm	0.04
v/c Ratio	0.07
Uniform Delay, d1	16.7
Progression Factor	1.13
Incremental Delay, d2	0.2
Delay (s)	19.1
Level of Service	B
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/11/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Lane Configurations		↕	↗		↕		↗	↕	↗		↘	↕
Traffic Volume (vph)	74	10	480	10	10	10	325	970	10	5	20	2570
Future Volume (vph)	74	10	480	10	10	10	325	970	10	5	20	2570
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1385	1900	1900	1900	1385	1900
Total Lost time (s)		6.0	4.0		6.0		8.5	6.0	6.0		8.5	6.0
Lane Util. Factor		1.00	1.00		1.00		0.97	0.95	1.00		1.00	0.95
Frt		1.00	0.85		0.95		1.00	1.00	0.85		1.00	1.00
Flt Protected		0.96	1.00		0.98		0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)		1750	1553		1716		2454	3471	1553		1274	3471
Flt Permitted		0.73	1.00		0.90		0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)		1330	1553		1571		2454	3471	1553		1274	3471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	80	11	522	11	11	11	353	1054	11	5	22	2793
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	3	0	0	0
Lane Group Flow (vph)	0	91	522	0	24	0	353	1054	8	0	27	2793
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	4%	4%	4%	0%	4%	4%
Turn Type	Perm	NA	Free	Perm	NA		Prot	NA	Perm	Prot	Prot	NA
Protected Phases		4			8		5	2		1	1	6
Permitted Phases	4		Free	8					2			
Actuated Green, G (s)		23.2	160.0		23.2		25.8	112.8	112.8		6.0	93.0
Effective Green, g (s)		23.2	160.0		23.2		23.3	112.8	112.8		3.5	93.0
Actuated g/C Ratio		0.14	1.00		0.14		0.15	0.70	0.70		0.02	0.58
Clearance Time (s)		6.0			6.0		6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		192	1553		227		357	2447	1094		27	2017
v/s Ratio Prot							c0.14	0.30			0.02	c0.80
v/s Ratio Perm		c0.07	0.34		0.02				0.00			
v/c Ratio		0.47	0.34		0.10		0.99	0.43	0.01		1.00	1.38
Uniform Delay, d1		62.8	0.0		59.4		68.2	10.0	7.0		78.2	33.5
Progression Factor		1.00	1.00		1.00		0.82	1.06	1.00		1.09	0.92
Incremental Delay, d2		1.8	0.6		0.2		40.0	0.5	0.0		98.7	174.2
Delay (s)		64.6	0.6		59.6		96.2	11.1	7.0		184.2	205.0
Level of Service		E	A		E		F	B	A		F	F
Approach Delay (s)		10.1			59.6			32.2				199.1
Approach LOS		B			E			C				F

Intersection Summary		
HCM 2000 Control Delay	127.3	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	1.17	F
Actuated Cycle Length (s)	160.0	Sum of lost time (s)
Intersection Capacity Utilization	111.4%	20.5
Analysis Period (min)	15	ICU Level of Service
		H
c Critical Lane Group		

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/11/2019

Movement	SBR
Lane Configurations	7
Traffic Volume (vph)	80
Future Volume (vph)	80
Ideal Flow (vphpl)	1900
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1553
Flt Permitted	1.00
Satd. Flow (perm)	1553
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	87
RTOR Reduction (vph)	36
Lane Group Flow (vph)	51
Heavy Vehicles (%)	4%
Turn Type	Perm
Protected Phases	
Permitted Phases	6
Actuated Green, G (s)	93.0
Effective Green, g (s)	93.0
Actuated g/C Ratio	0.58
Clearance Time (s)	6.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	902
v/s Ratio Prot	
v/s Ratio Perm	0.03
v/c Ratio	0.06
Uniform Delay, d1	14.5
Progression Factor	1.04
Incremental Delay, d2	0.0
Delay (s)	15.2
Level of Service	B
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/18/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Lane Configurations		↕	↗		↕		↗	↕	↗		↘	↕
Traffic Volume (vph)	69	10	300	10	10	10	500	3030	10	5	25	1460
Future Volume (vph)	69	10	300	10	10	10	500	3030	10	5	25	1460
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1385	1900	1900	1900	1385	1900
Total Lost time (s)		6.0	4.0		6.0		8.5	6.0	6.0		8.5	6.0
Lane Util. Factor		1.00	1.00		1.00		0.97	0.95	1.00		1.00	0.95
Frt		1.00	0.85		0.95		1.00	1.00	0.85		1.00	1.00
Flt Protected		0.96	1.00		0.98		0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)		1751	1553		1716		2454	3471	1553		1273	3471
Flt Permitted		0.73	1.00		0.90		0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)		1333	1553		1572		2454	3471	1553		1273	3471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	75	11	326	11	11	11	543	3293	11	5	27	1587
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	3	0	0	0
Lane Group Flow (vph)	0	86	326	0	24	0	543	3293	8	0	32	1587
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	4%	4%	4%	0%	4%	4%
Turn Type	Perm	NA	Free	Perm	NA		Prot	NA	Perm	Prot	Prot	NA
Protected Phases		4			8		5	2		1	1	6
Permitted Phases	4		Free	8					2			
Actuated Green, G (s)		23.0	160.0		23.0		39.7	110.1	110.1		8.9	79.3
Effective Green, g (s)		23.0	160.0		23.0		37.2	110.1	110.1		6.4	79.3
Actuated g/C Ratio		0.14	1.00		0.14		0.23	0.69	0.69		0.04	0.50
Clearance Time (s)		6.0			6.0		6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		191	1553		225		570	2388	1068		50	1720
v/s Ratio Prot							c0.22	c0.95			0.03	0.46
v/s Ratio Perm		c0.06	0.21		0.01				0.00			
v/c Ratio		0.45	0.21		0.10		0.95	1.38	0.01		0.64	0.92
Uniform Delay, d1		62.7	0.0		59.6		60.5	25.0	7.8		75.7	37.5
Progression Factor		1.00	1.00		1.00		1.19	0.33	1.00		1.12	0.62
Incremental Delay, d2		1.7	0.3		0.2		4.4	170.8	0.0		16.8	6.8
Delay (s)		64.4	0.3		59.8		76.4	179.1	7.8		101.3	30.1
Level of Service		E	A		E		E	F	A		F	C
Approach Delay (s)		13.7			59.8			164.1				30.9
Approach LOS		B			E			F				C

Intersection Summary

HCM 2000 Control Delay	114.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	160.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	114.9%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
 19: SR 82 (S Glenn Ave) & Airport Road

11/18/2019

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	130
Future Volume (vph)	130
Ideal Flow (vphpl)	1900
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1553
Flt Permitted	1.00
Satd. Flow (perm)	1553
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	141
RTOR Reduction (vph)	51
Lane Group Flow (vph)	90
Heavy Vehicles (%)	4%
Turn Type	Perm
Protected Phases	
Permitted Phases	6
Actuated Green, G (s)	79.3
Effective Green, g (s)	79.3
Actuated g/C Ratio	0.50
Clearance Time (s)	6.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	769
v/s Ratio Prot	
v/s Ratio Perm	0.06
v/c Ratio	0.12
Uniform Delay, d1	21.6
Progression Factor	1.07
Incremental Delay, d2	0.2
Delay (s)	23.3
Level of Service	C
Approach Delay (s)	
Approach LOS	
Intersection Summary	

Queuing and Blocking Report
Baseline

11/11/2019

Intersection: 19: SR 82 (S Glenn Ave) & Airport Road

Movement	EB	EB	WB	NB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	LT	R	LTR	L	L	T	T	R	UL	T	T	R
Maximum Queue (ft)	173	199	71	151	175	216	220	24	68	632	678	50
Average Queue (ft)	53	7	20	97	121	84	99	1	23	356	382	16
95th Queue (ft)	117	65	54	153	174	166	180	8	52	613	643	38
Link Distance (ft)			191			1155	1155			608	608	608
Upstream Blk Time (%)										1	2	
Queuing Penalty (veh)										3	11	
Storage Bay Dist (ft)		160		350	350			530	380			
Storage Blk Time (%)	1									6		
Queuing Penalty (veh)	3									2		

Intersection: 19: SR 82 (S Glenn Ave) & Airport Road

Movement	B23
Directions Served	T
Maximum Queue (ft)	18
Average Queue (ft)	1
95th Queue (ft)	6
Link Distance (ft)	970
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Queuing and Blocking Report
Baseline

11/11/2019

Intersection: 19: SR 82 (S Glenn Ave) & Airport Road

Movement	EB	WB	NB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	LT	LTR	L	L	T	T	R	UL	T	T	R
Maximum Queue (ft)	177	51	238	260	483	554	24	88	306	304	71
Average Queue (ft)	89	17	145	169	212	228	1	25	154	165	21
95th Queue (ft)	166	51	215	229	426	467	8	65	293	305	56
Link Distance (ft)		191			1155	1155			609	609	609
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)			350	350			530	380			
Storage Blk Time (%)	2				2	0					
Queuing Penalty (veh)	4				8	0					

Queuing and Blocking Report
Baseline

11/11/2019

Intersection: 19: SR 82 (S Glenn Ave) & Airport Road

Movement	EB	EB	WB	NB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	LT	R	LTR	L	L	T	T	R	UL	T	T	R
Maximum Queue (ft)	185	200	71	221	239	376	384	30	580	728	728	52
Average Queue (ft)	76	7	24	132	148	141	161	3	52	689	686	16
95th Queue (ft)	142	66	65	200	220	288	316	16	287	710	704	43
Link Distance (ft)			191			1155	1155			608	608	608
Upstream Blk Time (%)										45	48	
Queuing Penalty (veh)										398	421	
Storage Bay Dist (ft)		160		350	350			530	380			
Storage Blk Time (%)	2						0			44		
Queuing Penalty (veh)	8						1			11		

Intersection: 19: SR 82 (S Glenn Ave) & Airport Road

Movement	B23	B23	B23
Directions Served	T	T	T
Maximum Queue (ft)	1019	1022	978
Average Queue (ft)	985	987	934
95th Queue (ft)	1006	1007	1055
Link Distance (ft)	970	970	970
Upstream Blk Time (%)	14	22	1
Queuing Penalty (veh)	128	195	9
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Queuing and Blocking Report
Baseline

11/18/2019

Intersection: 19: SR 82 (S Glenn Ave) & Airport Road

Movement	EB	WB	NB	NB	NB	NB	NB	B17	B17	SB	SB	SB
Directions Served	LT	LTR	L	L	T	T	R	T	T	UL	T	T
Maximum Queue (ft)	153	91	290	649	1262	1263	830	2649	2644	69	557	619
Average Queue (ft)	67	27	175	362	931	936	29	526	556	26	330	364
95th Queue (ft)	138	72	254	729	1509	1484	275	1797	1881	62	490	535
Link Distance (ft)		191			1155	1155		3291	3291		609	609
Upstream Blk Time (%)					10	11						0
Queuing Penalty (veh)					175	190						1
Storage Bay Dist (ft)			350	350			530			380		
Storage Blk Time (%)	0				21	19						5
Queuing Penalty (veh)	0				103	2						2

Intersection: 19: SR 82 (S Glenn Ave) & Airport Road

Movement	SB
Directions Served	R
Maximum Queue (ft)	97
Average Queue (ft)	34
95th Queue (ft)	80
Link Distance (ft)	609
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

MEMO

TO: Catherine Ventling, Mark Bunnell—CDOT Region 3 **DATE:** September 9, 2020

CC: Terri Parch, Project File

FROM: Jim Clarke, Mike Heugh, Joseph Davis

SUBJECT: Review of SH 82 Traffic Volumes used in FONSI Transportation Analysis **Project No.:** 072564.401

Purpose

This memo provides supporting data relative to the traffic volumes used in the traffic analysis documented in the project draft Finding of No Significant Impact (FONSI). Concerns were raised about whether the traffic counts used in the analysis were affected by construction of the Grand Avenue Bridge project. To confirm that the traffic volumes used in the analysis are representative of normal traffic conditions and were not unduly affected by this project, the study team collected traffic data for recent years to compare against the 2017 volumes used in the FONSI analysis. The Grand Avenue bridge construction began January 2016 ended in late 2018, with substantial work elements completed by summer 2018. A three-month full bridge closure and detour occurred from August to November 2017.

Background

The traffic analysis for the 2013 South Bridge Environmental Assessment (EA) used 2008 traffic volumes. Prior to completion of the EA, the study team prepared a sensitivity analysis documenting that the 2008 volumes were appropriate for use in the EA (see Appendix B of EA).

In updating the traffic analysis for the FONSI, the study team coordinated with Region 3 traffic who checked SH 82 traffic count data and, in email correspondence from July 27th, 2017, approved of the traffic data to be used in the FONSI. This included approval of the 2% annual growth rate used for future forecasts.

State Highway (SH) 82 Daily Volumes

In order to determine if the SH 82 Average Daily Traffic (ADT) volumes collected in 2017 to support the FONSI traffic analysis were representative of normal traffic conditions, the study team analyzed historical ADT volumes along SH 82.

South Bridge SH 82 Traffic Volumes used in FONSI Transportation Analysis

The FONSI references 3 ADT locations along SH 82: Blake Avenue, 23rd Street, and south of Holy Cross Energy. (Holy Cross Energy is located within the South Bridge project area.) Two of these locations have historical ADT provided by CDOT's Online Transportation Information System (OTIS). The Holy Cross Energy volumes were collected by the project team in June/July 2017. The SH 82 & Blake Avenue count location is an Automatic Traffic Recorder (ATR) which has volume data dating back to 1991, with incomplete data for 2001, 2002, and 2004. The SH 82 and 23rd St count location has short duration counts taken during summer months in 2002, 2005, 2008, 2011, 2015, and 2018. The Blake Avenue and 23rd Street stations are identified as ATR Station ID 000214 and Station ID 103503, respectively.

The charts below show historical data collected from OTIS compared to data presented in the 2013 EA and draft 2020 FONSI.

Chart 1 shows collected Annual Average Daily Traffic (AADT) at Station ID 000214 (Blake Ave) from 2000 to 2019, as well as the AADT projected to 2040 using OTIS's "Future Traffic" estimation. These volumes are shown in green. As shown, the 2017 AADT is very similar to 2008 AADT, but is slightly lower than the 2016 AADT. Based on OTIS monthly ADT, this is due to lower volumes during the full-bridge closure duration from August to November 2017. However, the FONSI traffic volumes were collected prior to the full bridge closure, when ADT by month was comparable to historical SH 82 traffic volumes at this ATR before and after the 2 ½ year bridge construction. Attachment A shows monthly ADT from 1991 to 2019 at ATR Station ID 000214.

Chart 1 also shows traffic volumes from the EA (blue) and FONSI (gold). As shown, the 2035 volumes from the EA are 2,000 vehicles a day higher than the 2040 projections used in the FONSI. Because of the conservative 2% annual growth rate used in the EA and FONSI, future volumes used in the NEPA analysis are well above the projected 2040 AADT volume of 30,336 shown in OTIS.

South Bridge
SH 82 Traffic Volumes used in FONSI Transportation Analysis

Chart 1 - AADT from Station ID 000214 (SH 82 & Blake Ave)

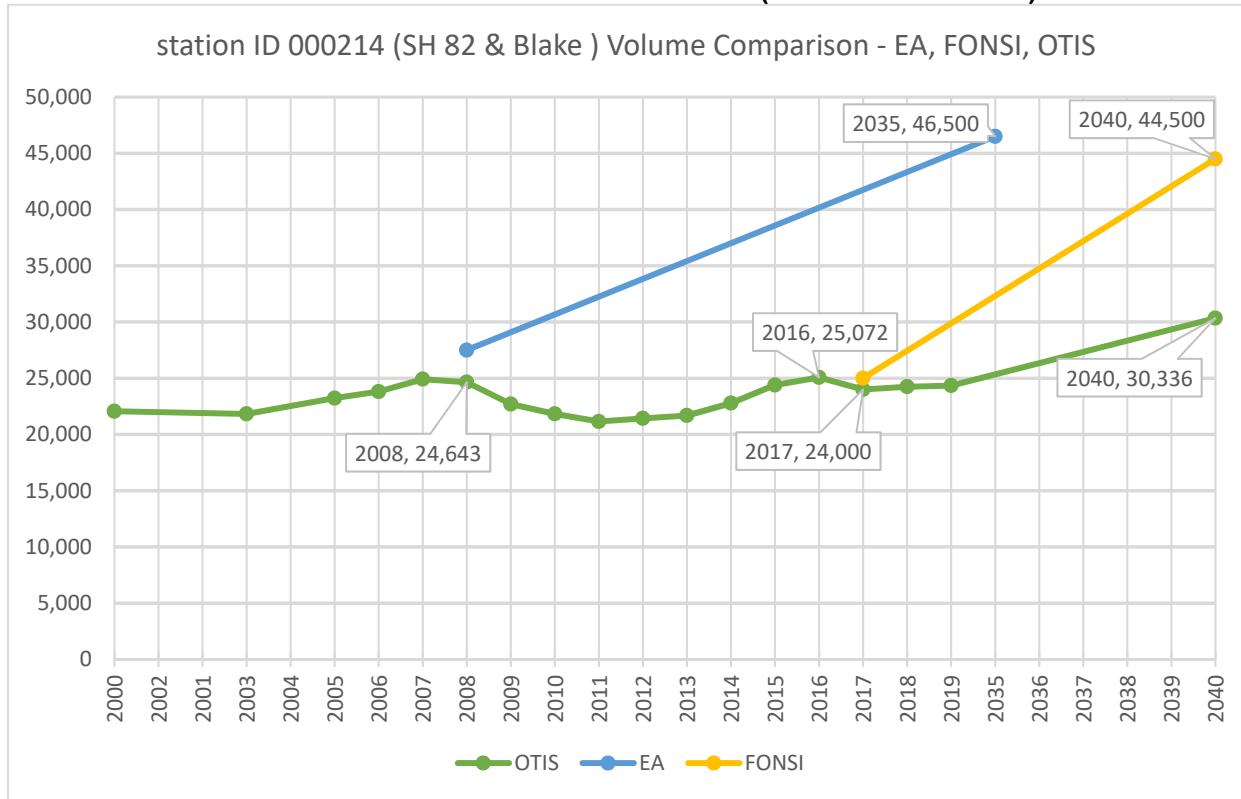
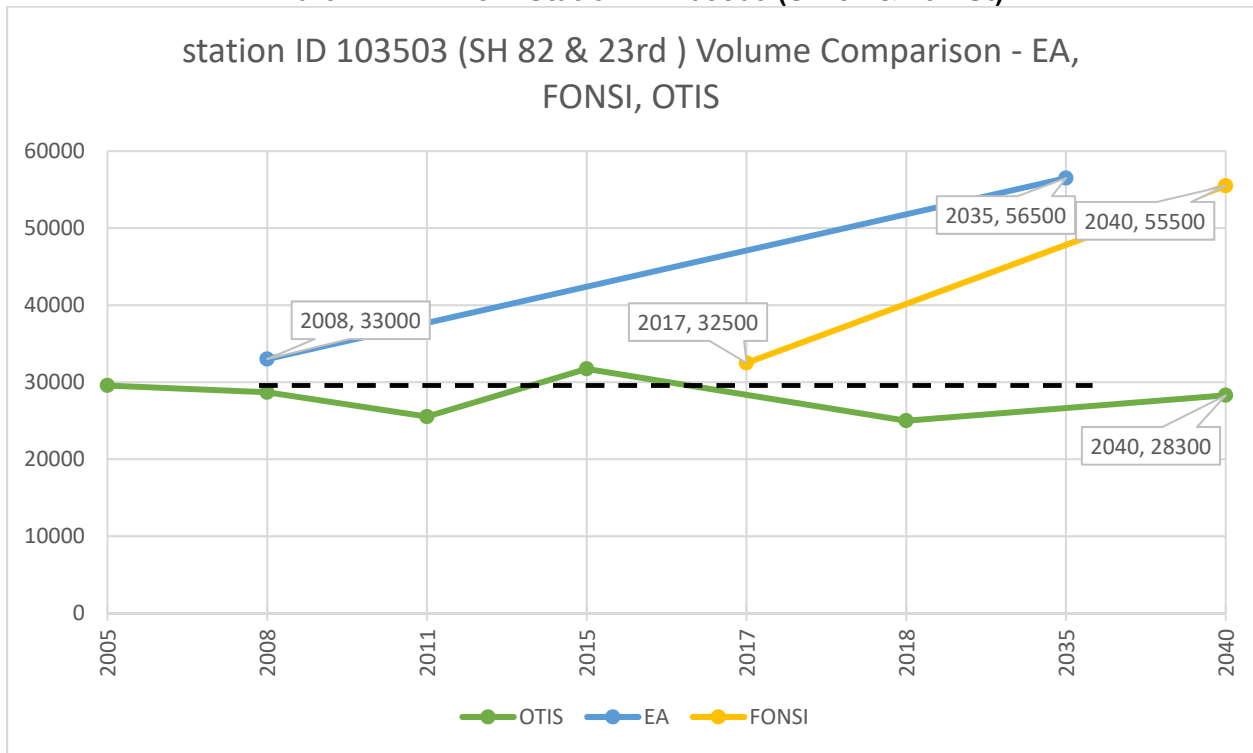


Chart 2 shows similar information for the data available at Station ID 103503 (23rd St). As mentioned, this data is from short duration counts taken in June or July (depending on the year) and are not adjusted for seasonal factors. The dotted line shows 2008 ADT compared to 2017 ADT. (Note: because no data was collected in 2017, this point is a straight-line interpolation between 2015 and 2018 data). 2008 ADT is very similar to 2017 interpolated ADT. Volumes from the EA (blue line) and FONSI (gold line) are also plotted on Chart 2. As shown, the 2035 volumes from the EA are 1,500 vehicles a day higher than the 2040 projections used in the FONSI, but both well above CDOT’s projected 2040 AADT volume of 28,300, showing a conservative estimate in both environmental documents.

South Bridge
SH 82 Traffic Volumes used in FONSI Transportation Analysis

Chart 2 - ADT from Station ID 103503 (SH 82 & 23rd St)



SH 82 Turning Movements

In addition to the SH 82 mainline volumes, FHWA raised concerns about the Grand Avenue Bridge construction affecting the peak hour turning movement counts (TMCs) used in the FONSI traffic analysis. FHWA’s primary concern was the peak hour TMCs at SH82 & 27th Street may not be representative of normal traffic due to vehicles turning from SH 82 to avoid the Grand Avenue Bridge construction.

Jacobs collected the TMCs used in the FONSI traffic analysis in July 2017. To determine whether the TMCs used in the FONSI traffic analysis were reasonable and not unduly affected by bridge construction, Jacobs compared the peak hour TMCs at SH82 & 27th Street to peak hour TMCs found in two traffic impact studies prepared in support of development projects near SH 82 and 27th Street. These documents are:

- Transportation Impact Study for Glenwood Multifamily Development (Formerly Bell Rippy Apartments) (McDowell Engineering, Revised April 2019)
- 27th Street Corridor Analysis & Traffic Impact Analysis (prepared by SGM, 2016)

The figures below show the raw and extrapolated data from these studies to complete the comparison.

**South Bridge
SH 82 Traffic Volumes used in FONSI Transportation Analysis**

2016 - 27th Street Corridor Analysis TMCs

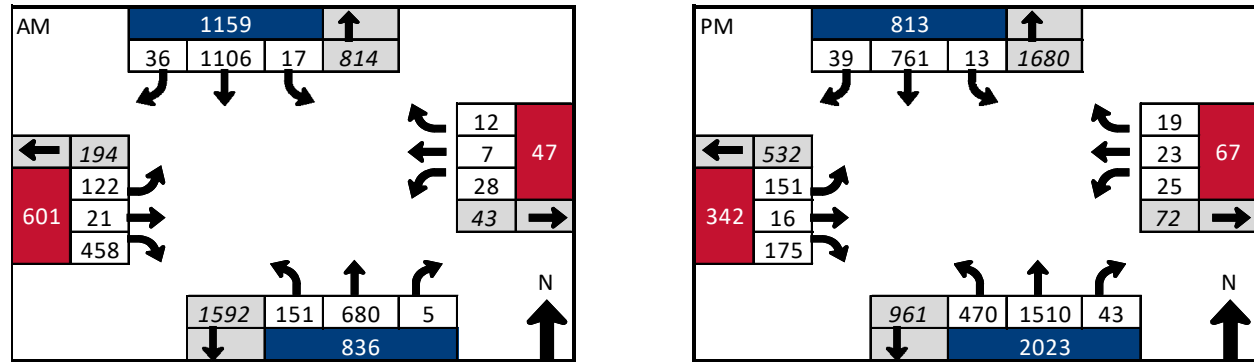


Figure 1: 2016 27th Street Corridor Analysis Turning Movement Counts – SH82 & 27th Street.

2017 - FONSI TMCs

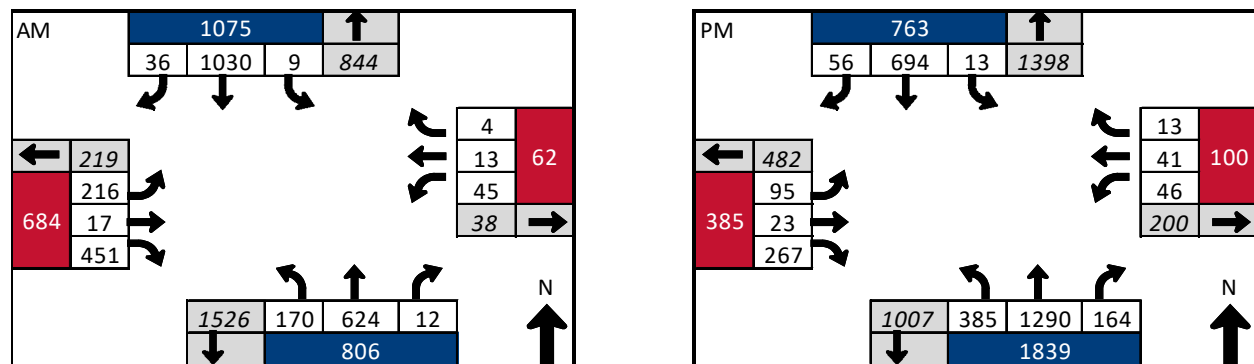


Figure 2: 2017 FONSI Turning Movement Counts – SH82 & 27th Street.

2019 - Transportation Impact Study TMCs

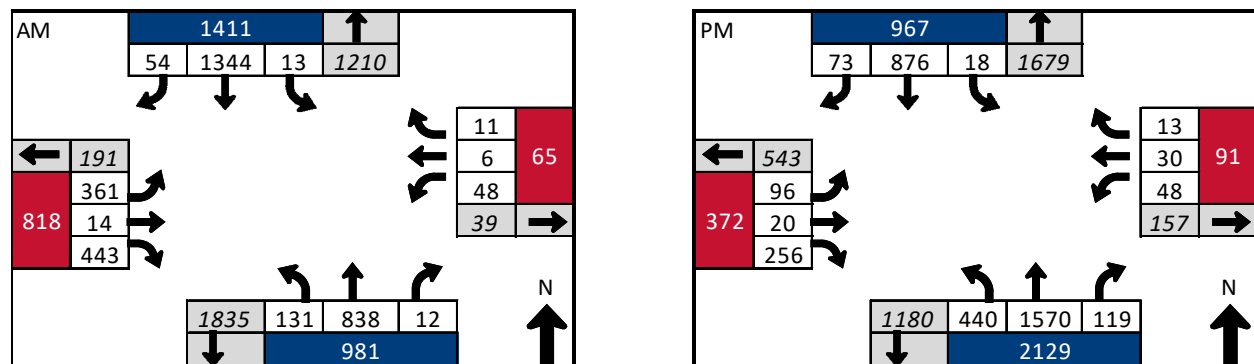


Figure 3: 2019 Transportation Impact Study Turning Movement Counts – SH82 & 27th Street.

To develop an accurate comparison, the peak hour TMCs from the FONSI document and the 2016 Traffic Impact Analysis were adjusted to 2019 peak hour turning movement counts using a conservative 2% annual growth factor. The following figures show the adjusted peak hour TMCs:

**South Bridge
SH 82 Traffic Volumes used in FONSI Transportation Analysis**

Adjusted 2019 - 27th Street Corridor Analysis TMCs

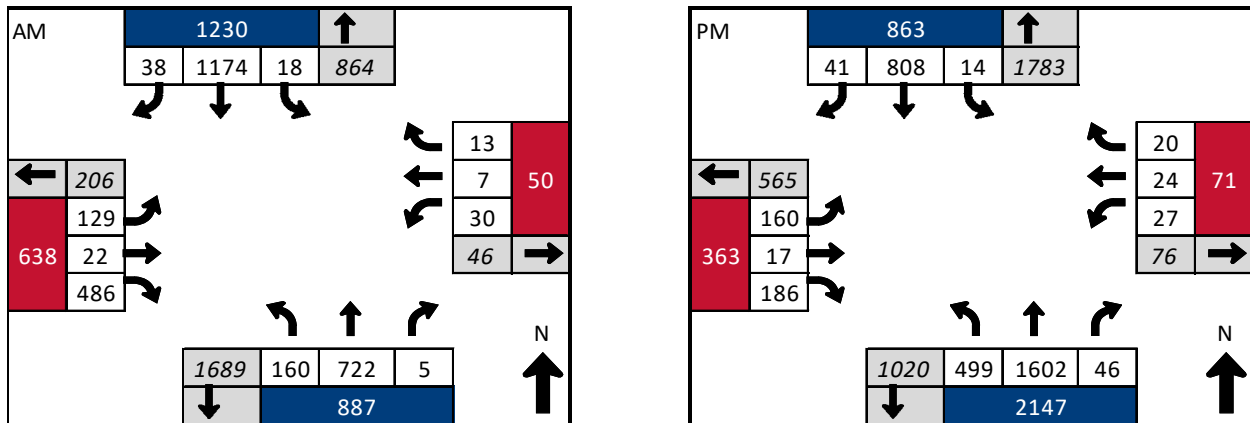


Figure 4: Adjusted 27th Street Corridor Analysis Turning Movement Counts – SH82 & 27th Street.

Adjusted 2019 - FONSI TMCs

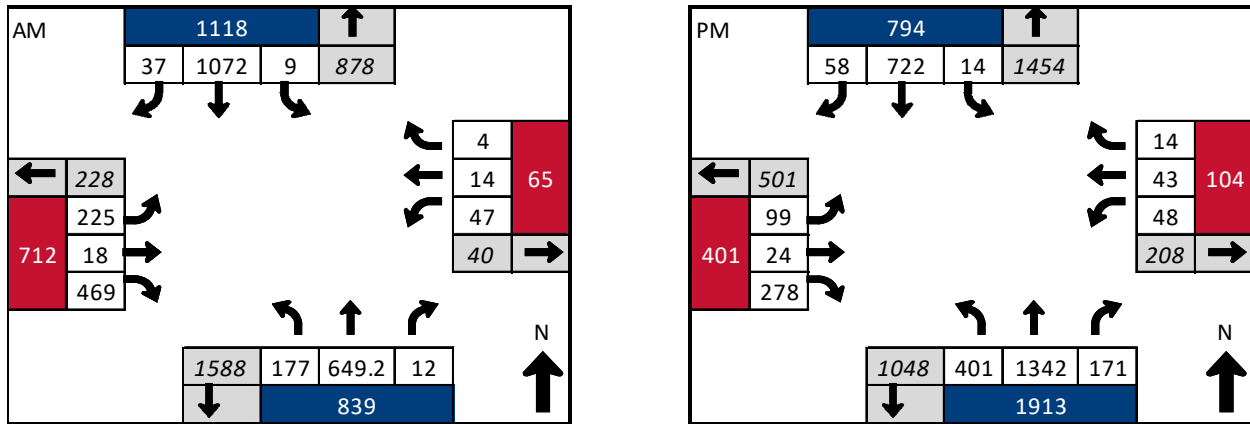


Figure 5: Adjusted FONSI Turning Movement Counts – SH82 & 27th Street.

Due to FHWA’s concern that the peak hour TMCs used in the FONSI documents’ traffic analysis might not represent normal traffic distribution, Jacobs analyzed the percent distribution of the north, south, east and west approaches of the SH 82 & 27th Street intersection for the peak hour TMCs. The following table summarizes the vehicle distribution per each movement at the intersection for the above studies.

South Bridge
SH 82 Traffic Volumes used in FONSI Transportation Analysis

Table 1 – SH 82 & 27th Street Turning Movements by Percentage of Total Approach Volumes

SH 82 & 27th Street	AM PEAK HOUR			PM PEAK HOUR		
	2016 Corridor Study	2017 FONSI	2019 Multifamily	2016 Corridor Study	2017 FONSI	2019 Multifamily
NBLT	0.18	0.21	0.13	0.23	0.21	0.21
NBTH	0.81	0.77	0.85	0.75	0.70	0.74
NBRT	0.01	0.01	0.01	0.02	0.09	0.06
WBLT	0.60	0.73	0.74	0.37	0.46	0.53
WBTH	0.15	0.21	0.09	0.34	0.41	0.33
WBRT	0.26	0.06	0.17	0.28	0.13	0.14
SBLT	0.01	0.01	0.01	0.02	0.02	0.02
SBTH	0.95	0.96	0.95	0.94	0.91	0.91
SBRT	0.03	0.03	0.04	0.05	0.07	0.08
EBLT	0.38	0.32	0.44	0.44	0.25	0.26
EBTH	0.03	0.02	0.02	0.05	0.06	0.05
EBRT	0.59	0.66	0.54	0.51	0.69	0.69

For the AM peak hour, Table 1 shows that the northbound percent vehicle distributions are similar between the studies. For example:

- In the FONSI TMCs, 21% of the vehicles completed a northbound left movement and 77% of vehicles completed a northbound through movement.
- In the 2019 Glenwood Multifamily Traffic Analysis, 13% of the vehicles completed a northbound left movement and 85% of vehicles completed a northbound through movement.
- In the 2019 Glenwood Multifamily Traffic Analysis, 18% of the vehicles completed a northbound left movement and 81% of vehicles completed a northbound through movement.

Although these values are not exact between studies, the differences are reasonable given the natural fluctuations in traffic volume data. Also, for the FONSI, the 2017 TMCs were used to develop future turning movement volumes in support of the design and noise analysis. Because a conservative 2% annual growth rate was applied to estimate 2040 turning movements, these volumes were conservative and would have accounted for any minor differences in turn movement distribution.

For the PM peak hour, the northbound percent vehicle distributions are near exact between studies. Specifically:

- FONSI TMCs show 21% of the vehicles completed a northbound left movement and 70% of vehicles completed a northbound through movement
- In the 2019 Glenwood Multifamily Traffic Analysis, 21% of the vehicles completed a northbound left movement and 74% of vehicles completed a northbound through movement
- In the 2016 Corridor Study Traffic Analysis, 23% of the vehicles completed a northbound left movement and 75% of vehicles completed a northbound through movement in the 2016 Corridor Study.

South Bridge
SH 82 Traffic Volumes used in FONSI Transportation Analysis

Conclusions

This analysis shows that the SH 82 mainline and turning movement data used in the FONSI are representative of normal traffic conditions were not unduly influenced by the Grand Avenue Bridge construction.

**South Bridge
SH 82 Traffic Volumes used in FONSI Transportation Analysis**

Attachment A: ATR Station ID 000214 Monthly ADT: 1991 to 2019

ATR 000214	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	OTIS
1991	12373	13,146	13,369	13,493	14,121	14,842	15,762	16,104	15,337	14,549	12,979	13,291	14,114
1992	12894	13,533	13,822	14,372	14,101	15,743	16,987	16,684	16,170	15,158	13,561	13,941	14,747
1993	12808	13,807	14,594	14,787	15,606	17,180	18,002	18,632	17,947	16,255	14,918	15,148	15,807
1994	14415	15,144	16,350	16,291	16,480	18,263	19,179	19,490	18,640	17,381	15,854	16,158	16,970
1995	15478	16,157	17,065	16,747	17,155	19,329	19,741	20,133	18,982	18,151	16,730	16,602	17,689
1996	14877	16,403	17,139	17,623	17,852	18,869	19,817	19,933	18,605	18,320	16,122	15,860	17,618
1997	15386	16,515	17,677	17,446	17,871	19,404	20,643	19,942	19,535	18,822	16,256	15,632	17,927
1998	16217	16,607	17,722	18,423	18,489	20,127	21,486	20,892	20,247	20,686	18,700	18,857	19,038
1999	17820	19,049	20,071	20,246	20,259	22,756	23,208	22,999	22,652	21,438	19,915	19,502	20,826
2000	18546	20,063	20,881	21,592	22,350	24,926	24,236	24,569	23,737	22,778	20,828	20,217	22,060
2001									23,173	22,975	20,658	20,845	
2002	20369	20,980	22,123	22,774	23,131	24,161	24,315	25,555	24,094				
2003	20521	20,586	20,471	20,691	21,234	23,811	24,859	23,899	23,188	22,506	19,602	20,525	21,824
2004		21,064	21,764	22,242	21,886	24,336	24,937	24,743	24,373	22,921	21,363	21,829	
2005	21024	21,907	22,544	22,652	22,997	24,963	25,564	25,465	24,352	23,362	22,362	21,578	23,231
2006	21346	22,174	22,476	23,410	23,967	25,736	25,747	25,967	25,854	24,205	22,466	22,424	23,814
2007	20956	23,067	24,472	24,836	25,605	26,598	26,724	27,227	26,754	25,724	24,328	22,715	24,917
2008	23,112	23,324	24,444	24,929	25,006	26,191	26,580	26,231	25,768	25,323	22,664	22,140	24,643
2009	21,638	22,319	22,144	22,424	22,912	24,701	25,134	24,300	24,150	22,561	19,785	20,400	22,706
2010	20,137	20,140	20,998	20,777	21,017	23,097	24,447	24,073	24,005	21,863	21,239	20,097	21,824
2011	19,557	19,445	20,557	20,174	20,612	22,241	23,089	23,255	23,149	21,614	19,952	20,194	21,153
2012	19,531	19,709	20,760	20,884	21,349	22,956	23,301	23,793	22,904	22,152	20,404	19,386	21,427
2013	20,065	20,137	20,483	20,986	21,928	22,998	23,938	23,718	22,993	22,538	20,564	19,880	21,686
2014	20,312	20,646	21,761	22,204	22,727	24,366	25,318	24,725	24,859	23,947	20,843	21,677	22,782
2015	22,134	22,151	23,508	23,842	24,174	26,460	27,049	26,201	26,455	25,224	22,799	22,782	24,398
2016	22,629	22,949	23,948	24,786	25,563	27,086	27,406	27,089	27,051	25,737	23,475	23,145	25,072
2017	22,576	23,590	24,797	25,270	25,389	27,223	27,128	23,295	21,072	21,144	22,774	23,736	24,000
2018	23,365	23,237	24,444	24,974	25,824	26,106	25,420	25,235	24,793	23,781	22,025	21,717	24,243
2019	22,045	22,387	22,885	23,892	24,283	25,402	25,858	25,648	25,266	26,224	24,326	23,900	24,343

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