Final Report

New Jersey Traffic Signal Retiming

Blackwood Clementon Road (CR 534)

Black Horse Pike (NJ Route 168) to White Horse Pike (NJ Route 30)/
N Park Drive

Prepared for:
Delaware Valley Regional Planning Commission (DVRPC)

And

Camden County, NJ | Gloucester Township, NJ | Pine Hill Borough, NJ | Clementon Borough, NJ | Berlin Borough, NJ

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Subconsultants:

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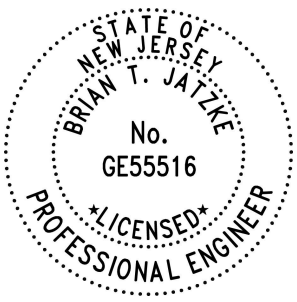

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EXECUTIVE SUMMARY

Iteris, Inc. was contracted by the Delaware Valley Regional Planning Commission (DVRPC) through the New Jersey Traffic Signal Retiming Program to provide engineering services for the full retiming of fifteen intersections in Camden County, New Jersey on Blackwood-Clementon Road (CR 534). These signals are all located within the municipalities of Gloucester Township, Pine Hill Borough, Clementon Borough, and Berlin Borough. Each signal is owned and maintained by the municipalities in Camden County. In addition to the County signals, two of the signals are owned and maintained by the New Jersey Department of Transportation (NJDOT). The subconsultants on this project were Imperial Traffic & Data Collection and Gannett Fleming.

Following the NJ Signal Retiming Regional Corridor Prioritization project completed in 2022, this signal system was identified to be the highest priority corridor in Camden County utilizing a scoring system developed to rank signal systems throughout the region. The goal of the retiming program is to optimize signal timings along critical corridors given current conditions and utilizing existing equipment, with a focus on optimizing signal operations at the study intersections while considering all users of the system.

Project Vision

- **Goal:** Optimize traffic operations and timings throughout the system utilizing existing equipment.
- **Goal**: Improve air quality through decreased motor vehicle emissions and fuel consumption.
- **Goal**: Improve reliability and predictability of travel along arterials.
- **Goal**: Improve the safety of motorists, pedestrians, and bicyclists.
- **Goal**: Identify equipment issues, report them to the maintaining agency and recommend improvements.

The majority of the traffic signals included in this project had not been retimed within the past 10-15 years according to the available documentation and insight provided by Camden County during the Regional Prioritization task. With the volume growth and development along CR 534 that has occurred over that time and the high presence of commercial properties and schools along the network, signal timing updates along this roadway were clearly appropriate.

There were several vehicle detection and operational issues through the system that were identified and reported to the municipalities and Camden County. Over the course of this project, several of these issues were addressed, greatly improving operation to those impacted intersections. Where issues had not yet been addressed, controller programming was updated as optimally as possible to limit the impact of non-functioning detection to the system. In general, issues were related to vehicle detection not functioning properly, resulting in certain movements utilizing all of their allotted time, regardless of actual vehicle demand. The issues and observations found in this project are included within this report and suggested recommendations are also provided.

This project was developed to evaluate signal timing and coordination needs given current conditions and existing equipment throughout the network and to reduce traffic signal delay and stops to help improve system performance and safety.

Project Accomplishments

As part of this project, the Iteris team developed and implemented seven unique time-of-day coordination patterns for most of the signals on this network. The nine intersections between Blenheim-Erial Road (CR 706) and Branch Avenue (CR 687) were included in a coordinated signal timing network for all identified time periods due to their proximity to each other and traffic characteristics in that section. For the other signals that did not merit coordination, signal timings were updated to efficiently service vehicle and pedestrian demand while utilizing all available features within each traffic controller. These signals all operate in free operation, meaning they do not hold a consistent cycle length, but rather service detector inputs based on the local intersection only. This decision was made generally due to the distance between the surrounding intersections but also because the traffic characteristics change widely through this network.

Four of the coordinated patterns were developed for weekday operation and three patterns were developed specifically to address weekend traffic characteristics. Based on the volume trends collected in this project, the following time periods were analyzed for timing pattern development:

Pattern Number	Time-of-Day	Abbreviation For Figures	Pattern Number	Time of Day	Abbreviation For Figures
1	Weekday AM Peak	AM	5	Weekend AM Peak	WA
2	Weekday Midday Peak	MD	6	Weekend Midday Peak	WM
3	Weekday PM Peak	PM	7	Weekend PM Peak	WP
4	Weekday PM Off-peak	PO			

Through the completion of this project, all clearance intervals for both vehicles and pedestrians were brought to standard utilizing the NJDOT methodology for vehicles and the Manual on Uniform Traffic Control (MUTCD). Pedestrian crosswalks were manually measured for these calculations and all pedestrian buttons were tested and any issues were documented and reported to the maintaining municipalities and Camden County. All controller safety features were programmed as appropriate through this network and were thoroughly reviewed and tested over the course of this project.

The highest congestion area within this network is between Erial-Blenheim Road (CR 706) and Branch Avenue (CR 687) since that area contains the Route 42 interchange, Highland High School, and has a number of commercial properties. The congestion is largely based on high vehicular volumes, especially during the AM and PM peak periods and the density of the signals. The existing operation did not provide coordinated timings between the included signals and the clocks were not consistent during initial field reviews which led to inconsistent travel times, added delays, and frequent abrupt stops throughout the network. The implemented signal timings provide progression through this section with an emphasis on the heavier volume direction by time of day, which was generally traffic travelling to Route 42 during the AM period (westbound) and from the Route 42 interchange (eastbound) in the PM period, while the other time periods were much more balanced.

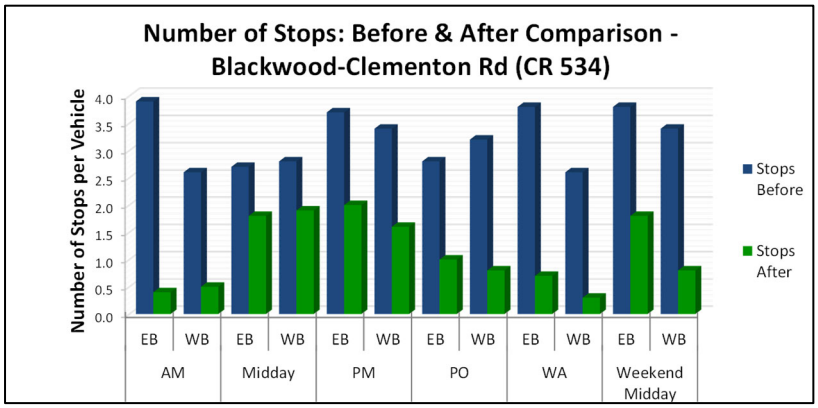
Through this project, Gloucester Township upgraded several of their traffic controllers, addressed most vehicle detection issues and also installed GPS units at all of their included intersections. Under existing conditions, only two of those traffic cabinets contained GPS units. These units keep controller clocks along the network on the same time source and update each clock periodically, eliminating the issue of controller time drift for those signals. The one coordinated signal on this network that does not have a GPS unit at the completion of this project is at Blackwood-Clementon Rd (CR 534) & Branch Avenue (CR 687), so that signal's clock will gradually drift unless set manually periodically or a GPS unit is installed.

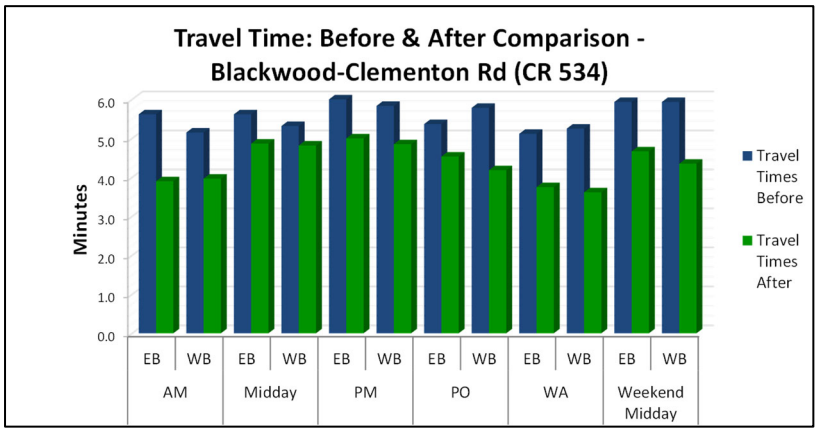
There were two high volume left-turn movements on the network where queues would impact the adjacent through lanes and also experience regular cycle failures. The first being the eastbound left-turn at Laurel Road/College Drive (CR 673) and the eastbound left-turn at Gibbsboro Road (CR 686)/Erial Road (CR 607). In both cases, timings were adjusted to handle these left-turn volumes much more efficiently where their queues do not impact the adjacent through nearly as often and vehicles are serviced much more efficiently and do not experience cycle failures.

Traffic Operations Analysis Summary

Field measured travel time runs were conducted along both Blackwood-Clementon Road (CR 534) through the entire network from Black Horse Pike (NJ Route 168) to White Horse Pike (NJ Route 30), but the comparison analysis for purposes of this report was completed between Blenheim-Erial Road (CR 706) and Branch Avenue (CR 687) since that is the section with coordinated signal timings. In the eastbound direction, weekday travel times decreased by up to 103 seconds (30.6%) and weekend travel times decreased by up to 82 seconds (26.7%). In the westbound direction, weekday travel times decreased by up to 96 seconds (27.7%) and weekend travel times decreased by up to 98 seconds (31.1%).

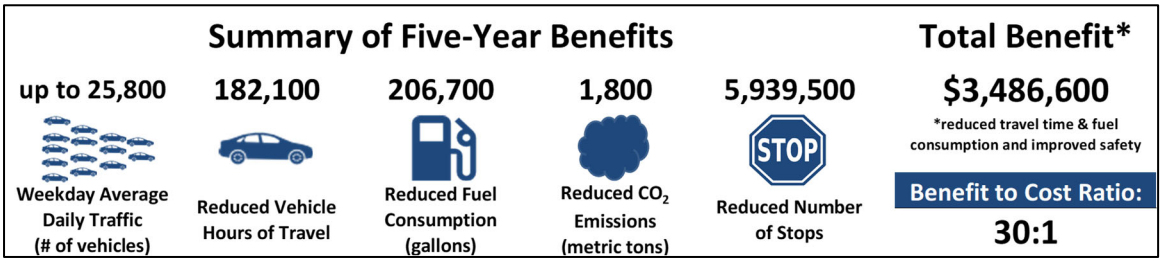
Tru-Traffic Before and After Analysis – Blackwood Clementon Road (CR 534)





Before and After Analysis – Blackwood-Clementon Rd (CR 534)

Though there are many benefits to signal retiming projects, two general benefit types were focused on to quantify the improvements from this project. The first is user benefits, which are enjoyed directly by travelers and are determined by a reduction in travel time and operating costs. Crash costs are also generally improved through signal retiming projects but require a comparison of crash data over at least three years, so could be considered and measured in the future. Travel time and number of stops comparisons were measured using Synchro and operating costs were estimated using a combination of vehicle occupancy, an average heavy vehicle percentage, and an average cost of fuel within the region according to the US Energy Information Administration (EIA) and the current Consumer Price Index. The second type of benefit used in this report is non-user benefits, which include environmental impacts, air quality, and reduced motorist frustration. All of these measures show significant improvements along Blackwood-Clementon Road (CR 534) from the completion of this project. The emissions estimate shown is calculated using an equation provided by the US Environmental Protection Agency (EPA). The various values and assumed benefit lifetime utilized for purposes of this report are intentionally conservative, so actual improvements are likely much higher than estimated in this report. The figure below summarizes the numerous benefits measured for this project.



Recommendations for Safety Improvements

Safety, operational and capacity related recommendations are provided and analyzed in the body of this report. The potential high impact recommendations are summarized below to highlight areas where there could be significant benefit in making certain improvements to this traffic network.

General Recommendations

- Consider reviewing and addressing the remaining vehicle and pedestrian detection issues within the network. The known issues are summarized in the Field Notes Summary provided in the Appendix and was last updated near the completion of this project in June 2023. A priority list of addressing known detection issues is provided in Section 8.2 of this report, which ranks the areas where functional detection would have the most impact. Addressing the detection problems would allow cycle time to be distributed more appropriately at some critical intersections throughout this network.
- Consider installing GPS units to each remaining cabinet to maintain consistent controller time throughout the network or developing a regular routine of setting controller clocks every six to eight weeks or as often as possible. The highest priority for GPS installation will be at Blackwood-Clementon Road (CR 534) & Branch Avenue (CR 687) since that signal runs coordinated signal timings.

  Though running in free operation, or non-coordinated timings, the signals at Gibbsboro Road (CR 686)/Erial Road (CR 607) and Franklin Avenue (CR 692) both run multiple timing plans by time of day, which are called via the controller scheduler in the programming. Therefore, it would still be beneficial to ensure those controller clocks are accurate to GPS time. The existing controller clocks where GPS units are not present were observed maintaining time well generally but over time, the clocks will drift and could result in incorrect timings running by time of day and coordinated timings losing their effectiveness.
- As this system continues to develop in the future, consider the impact to the signal timings for activities such as replacing controllers, upgrading equipment, new developments, or any roadway adjustments.

Blackwood-Clementon Road (CR 534) & Blenheim-Erial Road (CR 706)

- Consider analyzing the installation of an eastbound right-turn overlap at Blackwood-Clementon Road (CR 534) & Blenheim-Erial Road (CR 706). This would entail adding a 5-section signal head in replacement of the existing 3-section signal head and would link an eastbound protected right-turn arrow with the heavy volume northbound movement. The eastbound approach is heavily influenced by vehicles existing Route 42, which would be random arrivals at this intersection, so the eastbound right-turn would be able to service with a protected arrow while the northbound movement is servicing. The northbound movement is given significant cycle time, so this overlap would improve operational efficiency and reduce delay. An additional change that would be necessary to support this recommendation would be adjusting the inside shared through/right movement to a through only since a protected movement should not be supported by a shared lane. The eastbound shared through/right lane is generally as a through only lane under existing conditions as very few vehicles were observed making the eastbound right turn movement from that lane.

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1.0 INTRODUCTION

1.1 Purpose

Iteris, Inc. was contracted by the Delaware Valley Regional Planning Commission (DVRPC) through the New Jersey Traffic Signal Retiming Program to provide engineering services for the full retiming of fifteen intersections in Camden County, New Jersey on Blackwood-Clementon Road (CR 534). These signals are all located within the municipalities of Gloucester Township, Pine Hill Borough, Clementon Borough, and Berlin Borough. Each signal is owned and maintained by the municipalities in Camden County. In addition to the County signals, two of the signals are owned and maintained by the New Jersey Department of Transportation (NJDOT). The goal of the project was to optimize signal timings given current conditions and utilizing existing equipment, with a focus on optimizing signal operations at the study intersections while considering all users of the system.

The tasks involved in this analysis were:

- Collected existing geometric, volume, and traffic signal timing data and existing timing directives.
- Conducted field visits to develop understanding of intersection and corridor issues.
- Conducted travel time runs to benchmark existing conditions.
- Updated and developed existing traffic operations models to benchmark existing capacity analysis.
- Updated basic timing parameters for both vehicle and pedestrian movements.
- Developed four unique timing patterns for weekday operation and three patterns for weekends.
- Modified day plan schedules and implemented new signal timing plans.
- Performed post-implementation observation and fine-tuning of timing and conducted travel time runs.
- Developed implemented operations models to compare and measure improvements.
- Updated timing directives to reflect new timings and placed final copy in each traffic cabinet.
- Documented all work performed and summarized findings in this technical report.
- Updated project website to include all deliverables and project material.

1.2 Traffic Signal Locations

The traffic signals included in this project are:

No.	Intersection
1	Black Horse Pike (NJ Route 168) & Church St (CR 534)
2	Blackwood-Clementon Rd (CR 534) & Blenheim-Erial Rd (CR 706)
3	Blackwood-Clementon Rd (CR 534) & Peters Ln
4	Blackwood-Clementon Rd (CR 534) & Chews Landing-Little Gloucester Rd (CR 759)
5	Blackwood-Clementon Rd (CR 534) & Emerson Dr
6	Blackwood-Clementon Rd (CR 534) & Cherrywood Dr
7	Blackwood-Clementon Rd (CR 534) & Millbridge Rd
8	Blackwood-Clementon Rd (CR 534) & Kelly Driver Rd
9	Blackwood-Clementon Rd (CR 534) & Laurel Rd/College Dr (CR 673)
10	Blackwood-Clementon Rd (CR 534) & Branch Ave (CR 687)
11	Blackwood-Clementon Rd (CR 534) & Gibbsboro Rd (CR 686)/Erial Rd (CR 607)
12	Berlin-Clementon Rd (CR 534) & White Horse Ave (CR 695)/Clementon Park Driveway
13	Berlin-Clementon Rd (CR 534) & New Freedom Rd (CR 691)
14	Clementon Rd (CR 534) & Franklin Ave (CR 692)
15	White Horse Pike (NJ Route 30) & Clementon Rd (CR 534)/North Park Dr
	Notes: #2 and #3 operate off same controller. #1 and #15 are NJDOT maintained signals.

Note that throughout this report, Blackwood-Clementon Rd (CR 534) is considered East-West in directionality and all crossing roadways are considered North-South. The models, timing sheets and timing directives developed for this project will also reflect this assumption consistently.

The lane configurations along this network vary and are summarized as follows:

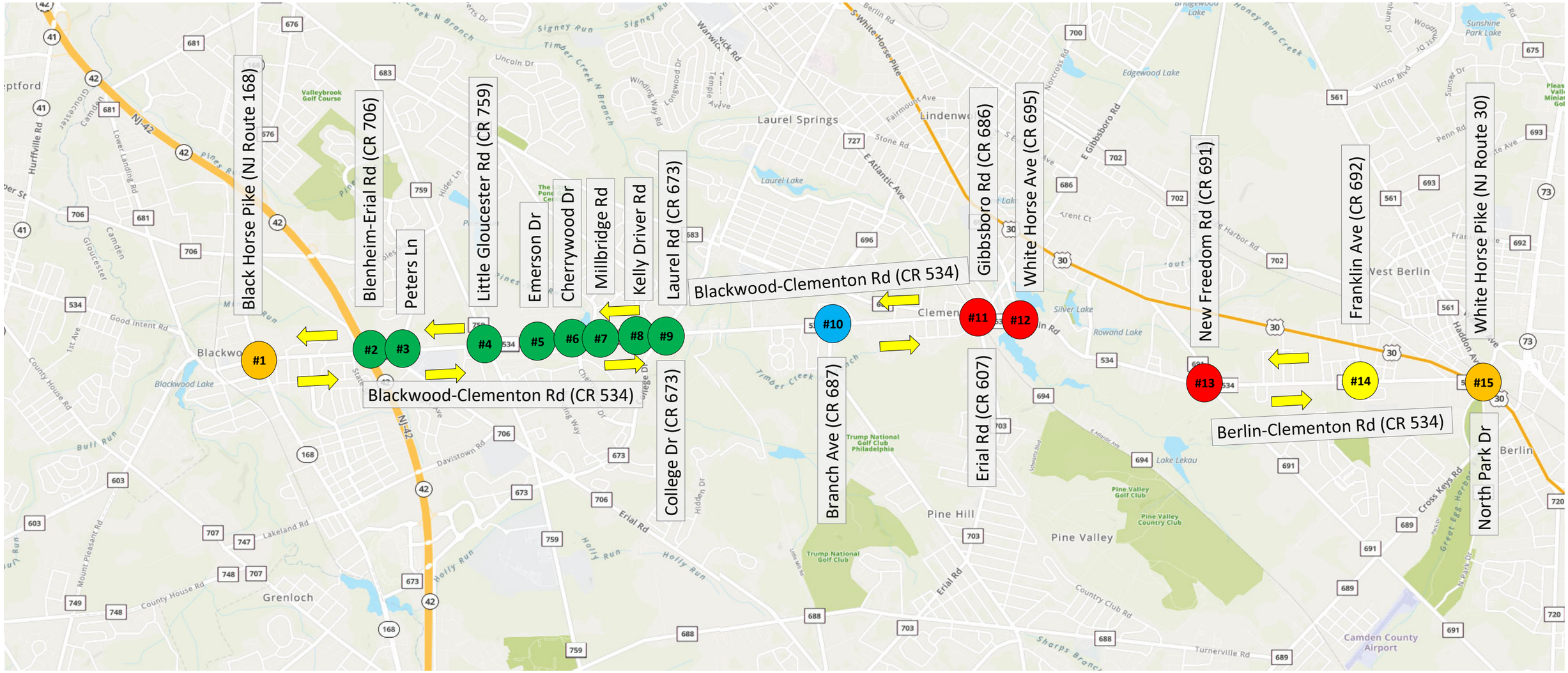
- CR 534 is a combination of two-lane & four-lane roadway and spans approximately 7.1. Within the defined network, CR 534 is considered Church Street between Black Horse Pike (NJ Route 168) and Route 42, Blackwood-Clementon Road between Route 42 and Gibbsboro Road (CR 686)/Erial Road (CR 703), Berlin-Clementon Road between White Horse Ave (CR 695)/Clementon Park Driveway and New Freedom Drive (CR 691) and finally Clementon Road between New Freedom Drive (CR 691) and White Horse Pike (NJ Route 30).

  Between Blackhorse Pike (NJ Route 168) and Route 42, CR 534 is a two-lane undivided roadway with a 35-mph posted speed limit. It then transitions to primarily a four-lane roadway divided with a two-way left turn lane median between Blenheim-Erial Road (CR 706) and Emerson Drive with a 45-mph posted speed limits. There is a 30-mph school zone around Highland High School posted to be active when children are present.

  Between Emerson Drive and Kelly Driver Road, there is an added westbound lane making CR 534 a five-lane, three westbound and two eastbound, roadway with a two-way left turn lane divider and a 45-mph posted speed limit. The roadway between Kelly Driver Road and Laurel Road/College Drive (CR 673) continues at a 45-mph posted speed limit and is a four-lane roadway with a two-way left turn lane divider. The roadway then transitions shortly to the east to a two-lane undivided roadway until Franklin Ave (CR 692) with speeds ranging from 35-45 mph eastbound and 30-45 mph westbound. There is a short segment just east and west of New Freedom Drive (CR 691), where the roadway is a four-lane undivided roadway.

  The land use varies widely as well, including residential, schools, recreational and commercial throughout. There are several large traffic generators, including Highland High School, Berlin Farmer's Market, and a number of commercial properties throughout.

Figure 1 on pages 3 illustrate the locations of the signals included in this report.



NJDOT Signal:

Pine Hill Borough Signal:

Berlin Borough Signal:

Gloucester Twp Signal:

Clementon Borough Signal:

7-Day, 24-Hour Count Location:

Figure 1
Traffic Signal Locations
Blackwood-Clementon Rd (CR 534)

2.0 DATA COLLECTION

2.1 7-Day, 24-Hour Volumes

24-hour segment counts were conducted by Imperial Traffic & Data Collection (ITDC) during January of 2023 while public schools were in session. Counts were collected at five locations on CR 534, three locations within the coordinated section, one location between Branch Avenue (CR 687) and Gibbsboro Road (CR 686)/Erial Road (CR 607) and one location on the east end between New Freedom Road (CR 691) and Franklin Avenue (CR 692). These counts were collected to illustrate the various traffic patterns that occur during a typical day on the various roadways at the count locations. The count locations were selected to get a picture of the different trends throughout the network since traffic characteristics change so widely from end to end.

The Average Daily Traffic (ADT) volume on Blackwood-Clementon Road (CR 534) from the locations counted was as high as 25,800 on weekdays and 18,300 on weekends. The highest counts were collected at the location between Peters Lane and Chews Landing-Little Gloucester Road (CR 759).

Figure 2 through Figure 8 on pages 6 – 12 illustrate the average weekday, Saturday and daily hourly volume data for the counts collected for this project.

2.2 Turning Movement Counts

Turning movement counts (TMCs) were collected by ITDC at all 15 locations throughout the project limits.

TMCs for all signals in the network were collected from 7:00 am – 9:00 am, 12:00 pm – 2:00 pm, 2:45 pm – 5:45 pm, and 6:15 pm – 7:15 pm on weekdays. On Saturdays, the intersections were counted from 9:00 am – 10:00 am, 11:00 am – 5:00 pm, and 6:00 pm – 7:00 pm.

These volumes were then increased by a growth factor of five percent to account for fluctuations in daily traffic volumes and to factor in some future volume growth. TMC diagrams illustrating hourly volumes for each developed timing pattern can be found on Figure 16 through Figure 47 on pages 37 – 68. Raw TMC data can be found on the project website.

2.3 Traffic Signal Timing and Phasing Data

Existing data files were uploaded via Aries Zone Manager, an Econolite direct connect software, directly from each local controller. There was one Peek ATC-1000 controller, which was uploaded via USB and read using ATC-Link, which is the local software for that type of controller.

2.4 Field Notes

Field notes were collected by Iteris, Inc. staff in March of 2023 at each intersection on various signal and traffic characteristics to assist in model development and signal optimization. The field notes contain information on various intersections, signal, and traffic characteristics. Diagrams within the field notes contain lane geometry at the stop bar, measured lane storage lengths, number of signal heads, and cabinet locations. Posted speed limits, left turn types (protected only, protected/permissive, or permissive only), turn restrictions, and the presence of roadway lighting and signal back plates were noted.

For each approach, vehicle and pedestrian clearance distances and median widths were measured. Vehicle detection was reviewed, and pedestrian push buttons (if present) were tested for proper operation. Other unusual or unique characteristics were also recorded. The summary of findings from the Field Notes can be found in Field Notes folder on the project website. The Appendix of this report contains the status of those observations at the end of the project, some of which

had changed since the field reviews. The final table will be accurate as of June 28, 2023, when detection was last reviewed for this project.

Photographs were taken within every traffic cabinet and approach photos were also collected for all intersections. The photographs are a record of the current geometrics and other intersection, signal, and roadside characteristics. Field notes and intersection photographs can be found within the project website.

2.5 Travel Time Runs

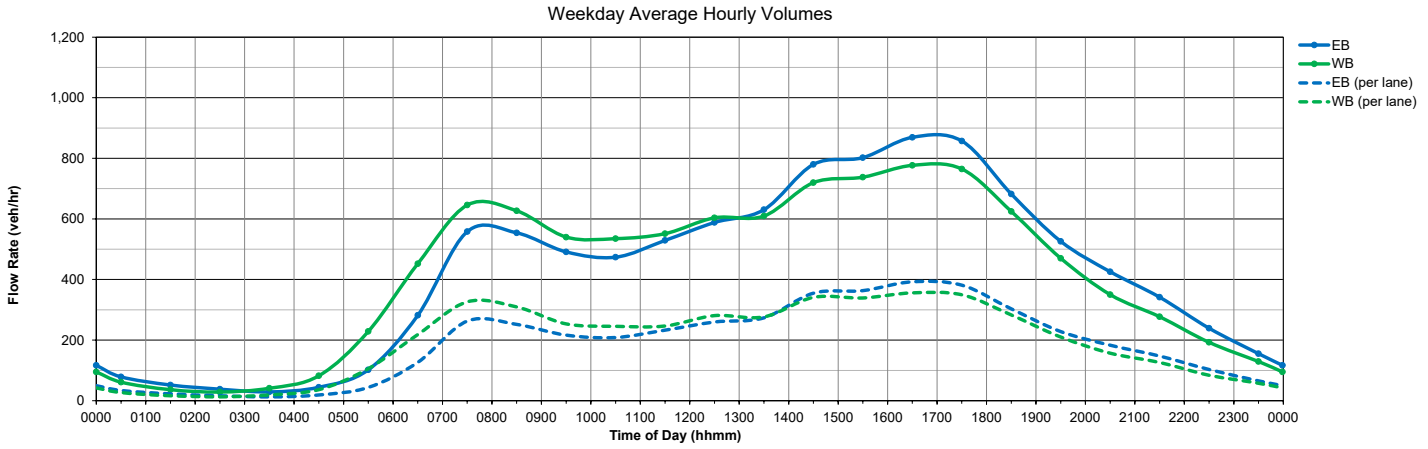
Travel time runs were conducted under both existing and implemented signal timings on Blackwood-Clementon Road (CR 534). Travel time runs for this task were collected through the entire network, ranging from Black Horse Pike (NJ Route 168) to White Horse Pike (NJ Route 30). These data were collected to both fine-tune implemented signal timing as well as provide a field-measured metric by which existing and implemented signal timing can be compared using floating car studies. Travel time data is presented and analyzed in Section 6.4 of this report.

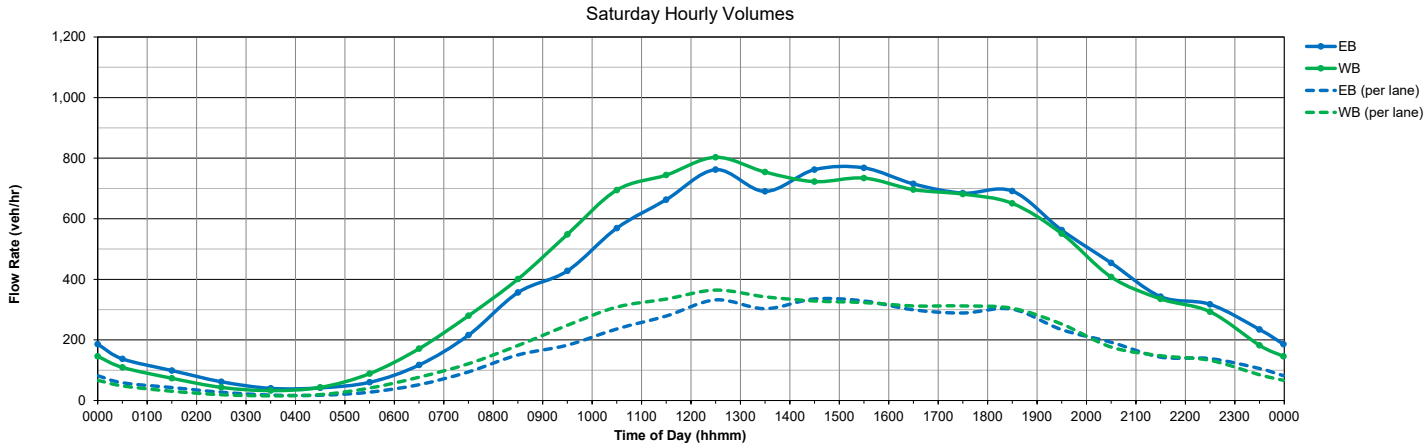
Video was collected during both the existing and implemented conditions travel time runs to be used in developing comparison videos. Complete travel time data can be found in the Tru-Traffic folder on the project website.

Sample Time-Space Diagram from Tru-Traffic Software – Blackwood-Clementon Rd (CR 534) PM Peak Period

Hourly Volumes - Average for Count Locations on Blackwood-Clementon Rd (CR 534) between Black Horse Pike (NJ Route 168) and Kelly Driver Rd

		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Avg. Weekday		Avg. Weekend	
From	To	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
0000	0100	78	63	65	54	78	66	84	54	89	69	137	109	132	109	79	61	135	109
0100	0200	51	38	43	35	48	38	52	37	65	34	99	73	93	66	52	36	96	70
0200	0300	35	29	32	22	37	25	39	33	49	34	62	43	78	47	38	29	70	45
0300	0400	32	43	25	36	26	47	30	37	33	41	40	33	53	33	29	41	47	33
0400	0500	40	84	49	79	45	90	48	78	40	79	42	43	36	37	44	82	39	40
0500	0600	94	236	112	241	101	229	107	224	95	214	60	89	36	57	102	229	48	73
0600	0700	284	472	284	463	276	459	283	436	285	431	117	171	82	108	282	452	100	140
0700	0800	562	661	562	626	566	664	548	620	555	659	216	280	151	167	559	646	184	224
0800	0900	558	609	558	590	572	649	505	640	577	646	357	401	236	289	554	627	297	345
0900	1000	472	520	477	503	499	541	473	545	534	592	428	548	314	426	491	540	371	487
1000	1100	447	512	478	496	497	562	456	491	492	613	569	695	495	593	474	535	532	644
1100	1200	523	527	506	543	511	465	509	571	596	653	663	744	563	624	529	552	613	684
1200	1300	601	572	608	577	534	553	555	627	645	690	762	803	719	728	589	604	741	766
1300	1400	641	579	607	606	616	599	601	580	687	684	690	754	699	767	630	610	695	761
1400	1500	812	679	782	690	748	729	755	735	803	766	762	723	701	669	780	720	731	696
1500	1600	828	715	823	731	769	738	787	727	805	778	768	734	674	660	803	738	721	697
1600	1700	846	762	908	758	880	780	860	805	852	781	715	696	646	638	869	777	681	667
1700	1800	823	687	874	794	838	763	872	807	879	773	685	681	582	583	857	765	634	632
1800	1900	635	566	655	593	737	635	692	652	692	679	691	651	558	522	682	625	625	586
1900	2000	449	396	535	436	538	475	545	499	563	546	562	551	465	416	526	470	514	484
2000	2100	399	308	400	332	467	341	416	392	445	378	454	408	408	331	426	350	431	370
2100	2200	303	214	356	271	330	296	377	283	344	322	343	336	273	255	342	277	308	296
2200	2300	204	155	201	170	241	200	251	198	299	241	317	293	215	182	239	193	266	237
2300	0000	124	96	142	130	144	116	155	129	212	176	235	182	133	113	155	129	184	148
	Sub-total	9,840	9,525	10,083	9,773	10,098	10,060	9,999	10,199	10,637	10,881	9,775	10,043	8,344	8,420	10,131	10,088	9,059	9,232
	Total	19,365		19,856		20,158		20,198		21,518		19,818		16,764		20,219		18,291	





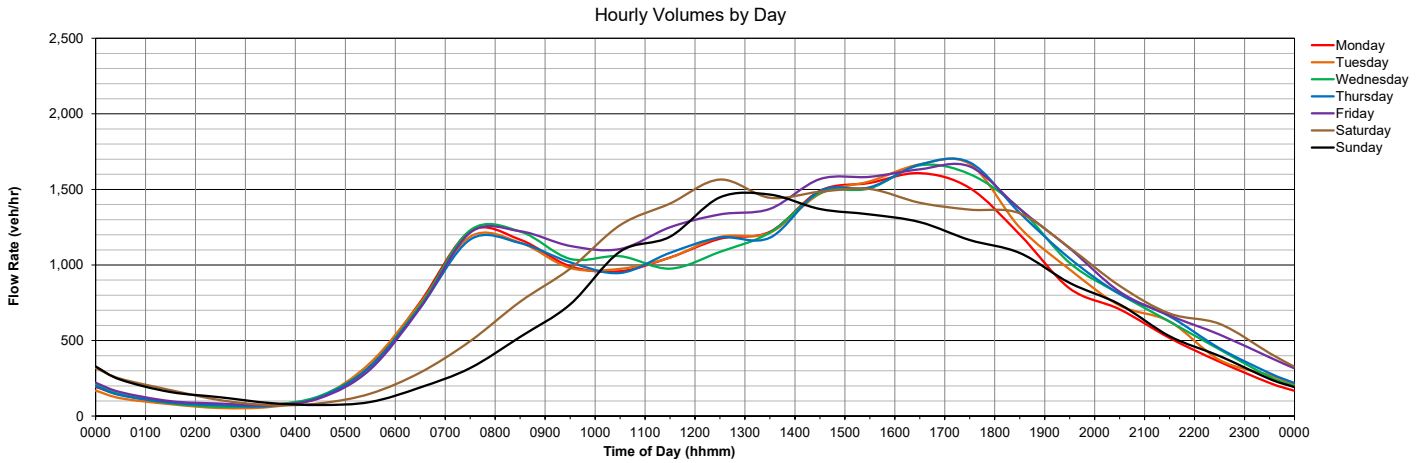
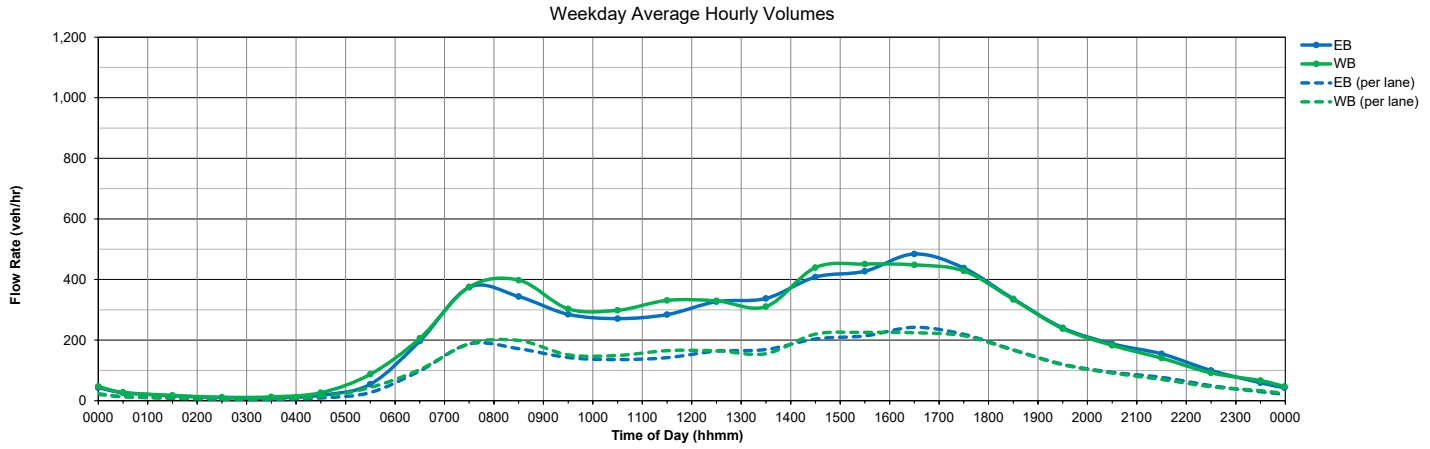
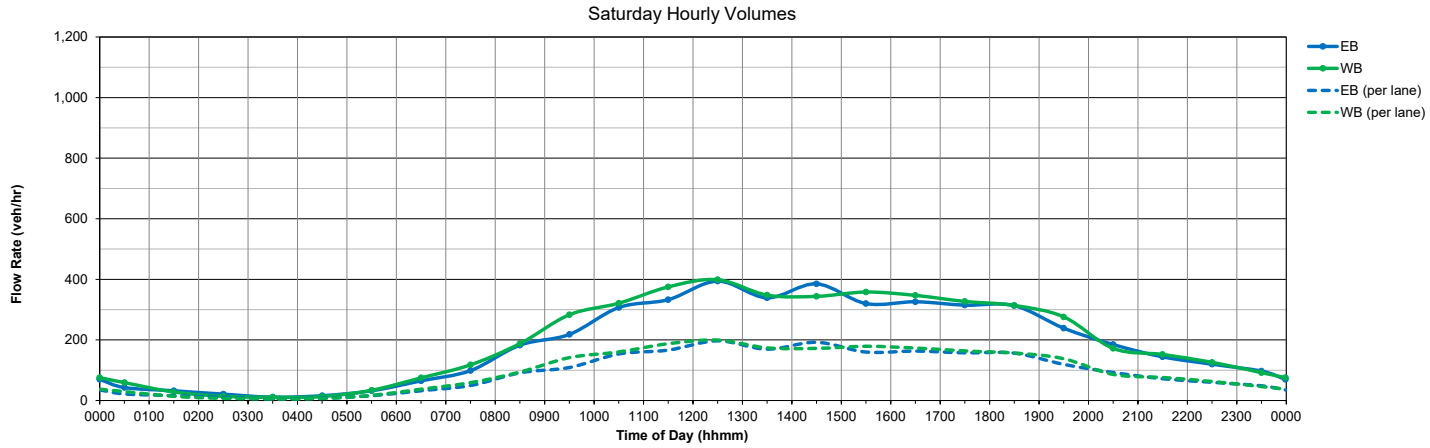


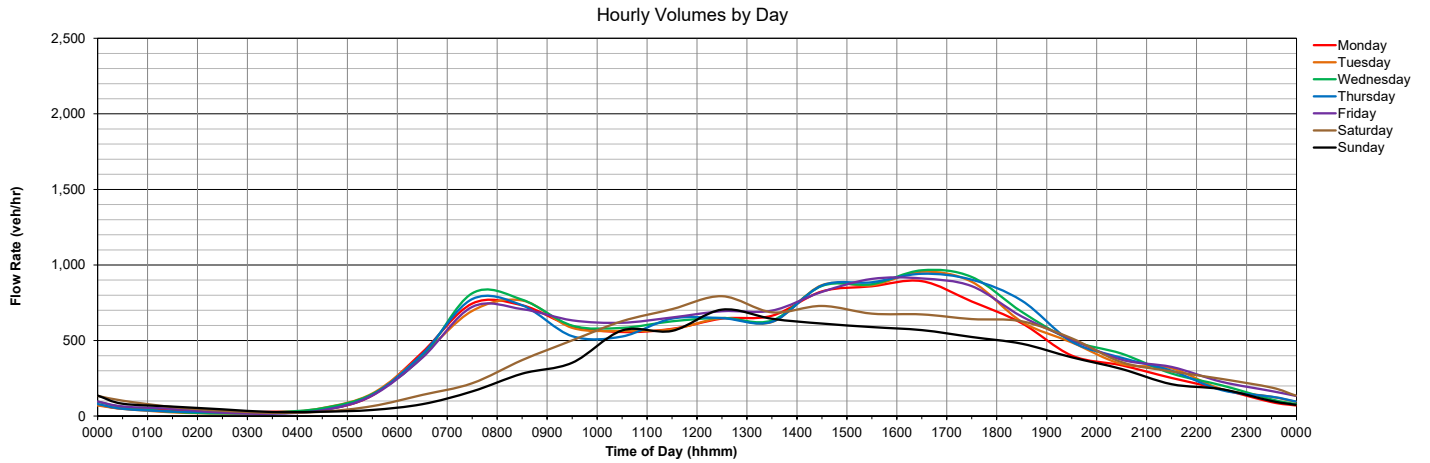
Figure 2
7-Day, 24-Hour Volumes
Average for Count Locations on Blackwood-Clementon Rd (CR 534) between Black Horse Pike (NJ Route 168) and Kelly Driver Rd

Hourly Volumes - Blackwood-Clementon Rd (CR 534) between Black Horse Pike (NJ Route 168) and Blenheim Erial Rd (CR 706)

		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Avg. Weekday		Avg. Weekend	
From	To	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
0000	0100	21	28	24	24	27	34	26	22	35	29	43	59	37	45	27	27	40	52
0100	0200	18	20	10	15	10	19	13	17	31	17	32	28	31	32	16	18	32	30
0200	0300	10	14	7	10	10	7	10	15	12	11	21	14	22	23	10	11	22	19
0300	0400	9	20	8	12	10	15	9	10	9	7	11	11	13	14	9	13	12	13
0400	0500	17	24	23	30	17	35	17	23	17	21	16	13	11	18	18	27	14	16
0500	0600	47	90	65	85	57	89	56	84	47	89	32	34	16	25	54	87	24	30
0600	0700	205	217	196	209	189	203	210	200	185	201	65	75	37	42	197	206	51	59
0700	0800	371	374	360	336	394	419	383	391	365	358	99	118	87	76	375	376	93	97
0800	0900	366	367	341	424	365	405	316	417	331	377	183	188	148	133	344	398	166	161
0900	1000	291	305	305	279	281	318	249	280	299	335	218	283	157	196	285	303	188	240
1000	1100	279	277	284	280	269	315	257	270	267	351	307	321	251	316	271	299	279	319
1100	1200	304	274	276	298	285	342	250	395	307	346	333	375	269	295	284	331	301	335
1200	1300	347	298	329	319	314	336	310	338	336	358	394	399	351	354	327	330	373	377
1300	1400	356	308	346	277	318	315	309	315	359	339	339	348	297	347	338	311	318	348
1400	1500	440	385	439	428	368	493	415	449	379	443	385	344	301	311	408	440	343	328
1500	1600	423	436	429	437	428	445	439	447	418	490	320	358	308	281	427	451	314	320
1600	1700	451	442	515	440	505	460	473	469	479	432	326	347	286	283	485	449	306	315
1700	1800	411	348	418	471	468	453	455	448	438	422	315	327	247	276	438	428	281	302
1800	1900	314	301	312	312	353	337	378	386	324	335	313	314	246	233	336	334	280	274
1900	2000	194	207	256	232	261	240	248	245	244	264	239	276	188	201	241	238	214	239
2000	2100	177	159	165	180	212	201	188	198	197	176	185	172	162	150	188	183	174	161
2100	2200	146	106	186	130	127	155	155	145	159	166	144	152	105	106	155	140	125	129
2200	2300	98	79	90	88	109	95	89	83	113	114	120	126	89	89	100	92	105	108
2300	0000	43	50	56	72	50	61	64	65	82	84	97	92	48	52	59	66	73	72
	Sub-total	5,338	5,129	5,440	5,388	5,427	5,792	5,319	5,712	5,433	5,765	4,537	4,774	3,707	3,898	5,391	5,557	4,122	4,336
	Total	10,467		10,828		11,219		11,031		11,198		9,311		7,605		10,949		8,458	







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CAMDEN COUNTY NEW JERSEY INC. 1844

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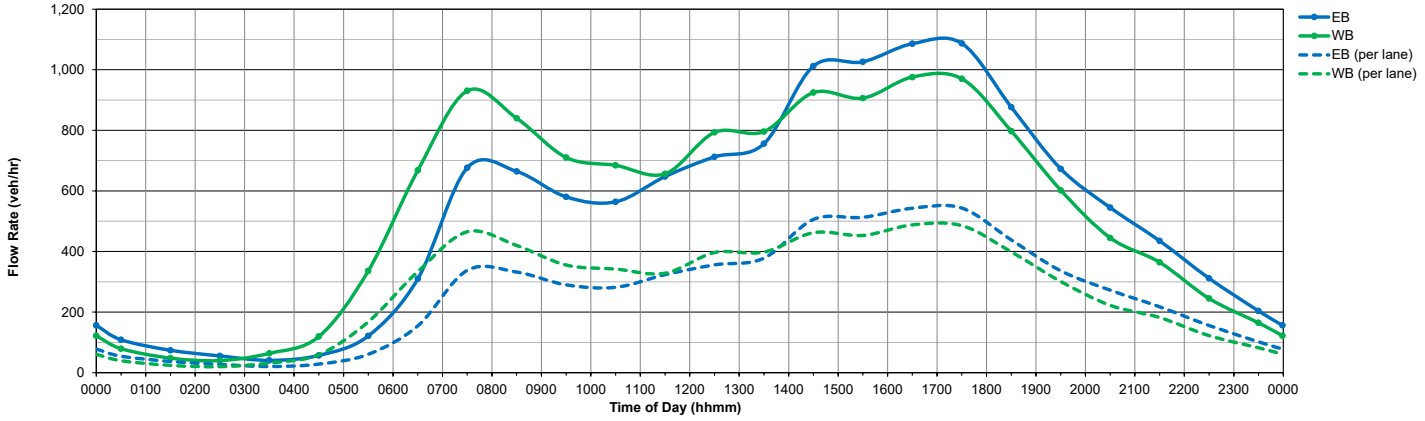
Figure 3
7-Day, 24-Hour Volumes
Blackwood-Clementon Rd (CR 534) between Black Horse Pike (NJ Route 168) and Blenheim Erial Rd (CR 706)

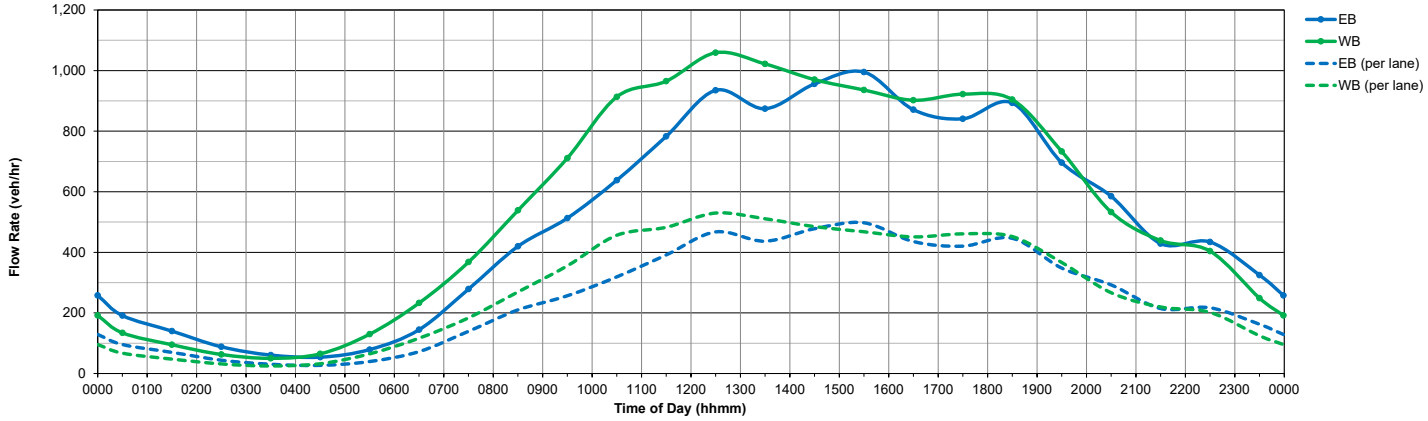
Hourly Volumes - Blackwood-Clementon Rd (CR 534) between Peters Ln and Chews Landing-Little Gloucester Rd (CR 759)

From	To	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Avg. Weekday		Avg. Weekend	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
0000	0100	111	79	85	67	107	87	120	74	121	90	191	134	181	141	109	79	186	138
0100	0200	71	52	61	50	70	47	79	49	90	43	140	95	140	87	74	48	140	91
0200	0300	47	39	46	30	56	38	55	43	73	51	88	63	116	60	55	40	102	62
0300	0400	44	64	38	56	37	72	38	58	47	69	61	50	70	44	41	64	66	47
0400	0500	47	123	60	106	56	133	68	114	55	120	54	65	53	52	57	119	54	59
0500	0600	111	345	133	359	120	334	126	330	117	312	79	130	47	85	121	336	63	108
0600	0700	312	689	297	704	304	699	313	638	324	610	145	233	111	157	310	668	128	195
0700	0800	709	964	681	926	675	951	655	878	663	933	279	368	195	223	677	930	237	296
0800	0900	681	825	666	771	690	870	586	859	698	875	420	539	272	382	664	840	346	461
0900	1000	551	652	540	678	618	719	578	735	615	769	513	711	381	584	580	711	447	648
1000	1100	537	659	565	657	620	717	553	623	545	766	638	913	595	803	564	684	617	858
1100	1200	657	690	614	697	586	368	626	671	754	857	783	965	698	841	647	657	741	903
1200	1300	716	750	762	753	694	791	642	816	748	856	935	1,059	938	929	712	793	937	994
1300	1400	764	751	714	809	734	764	719	767	849	889	874	1,022	892	1,022	756	796	883	1,022
1400	1500	1,070	914	1,035	873	963	926	969	936	1,023	974	956	970	917	923	1,012	925	937	947
1500	1600	1,101	880	1,096	916	974	910	959	881	1,001	944	995	936	878	891	1,026	906	937	914
1600	1700	1,081	924	1,151	978	1,065	968	1,099	1,014	1,034	995	871	902	834	876	1,086	976	853	889
1700	1800	1,054	896	1,160	1,014	1,023	939	1,086	1,001	1,112	1,002	841	922	759	797	1,087	970	800	860
1800	1900	824	743	815	728	959	823	868	784	917	911	893	904	691	690	877	798	792	797
1900	2000	588	505	720	545	672	597	680	635	705	730	696	733	606	548	673	602	651	641
2000	2100	518	391	533	430	617	418	515	493	542	493	585	533	547	449	545	445	566	491
2100	2200	386	296	447	355	417	383	494	370	433	418	429	439	342	345	435	364	386	392
2200	2300	264	192	259	211	304	255	336	255	396	312	434	404	277	233	312	245	356	319
2300	0000	155	122	186	163	189	139	202	163	288	236	325	249	182	157	204	165	254	203
Sub-total		12,399	12,545	12,664	12,876	12,550	12,948	12,366	13,187	13,150	14,255	12,225	13,339	10,722	11,319	12,626	13,162	11,474	12,329
Total		24,944		25,540		25,498		25,553		27,405		25,564		22,041		25,788		23,803	

Weekday Average Hourly Volumes



Saturday Hourly Volumes



Hourly Volumes by Day

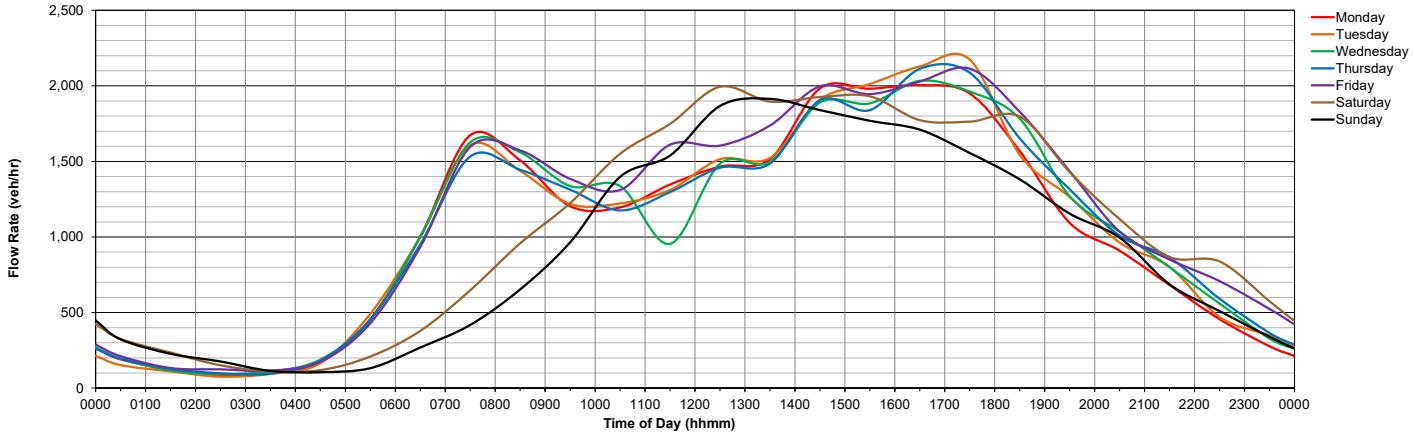
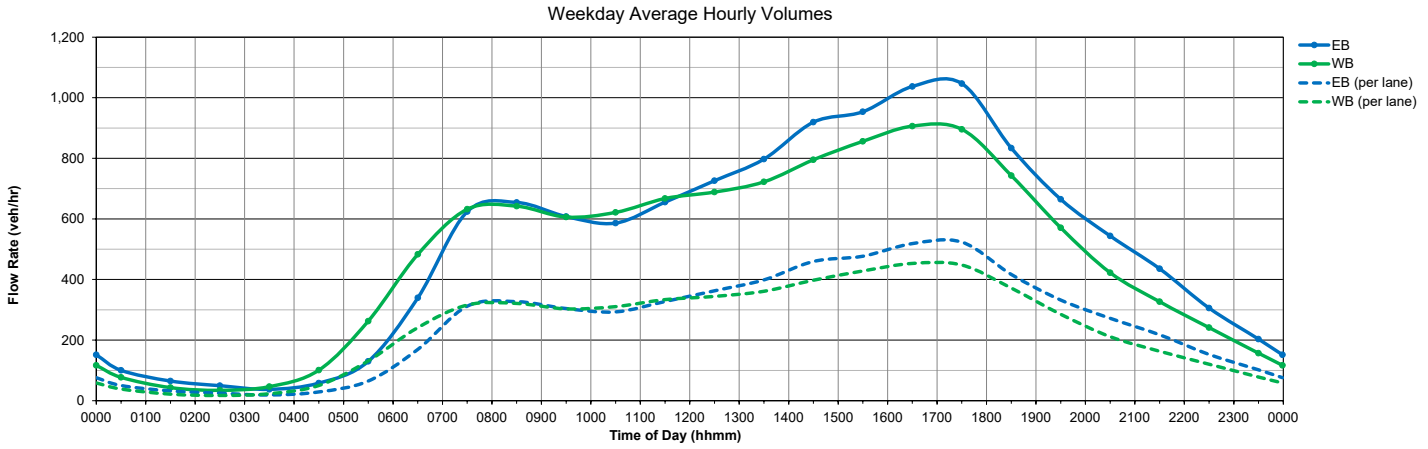
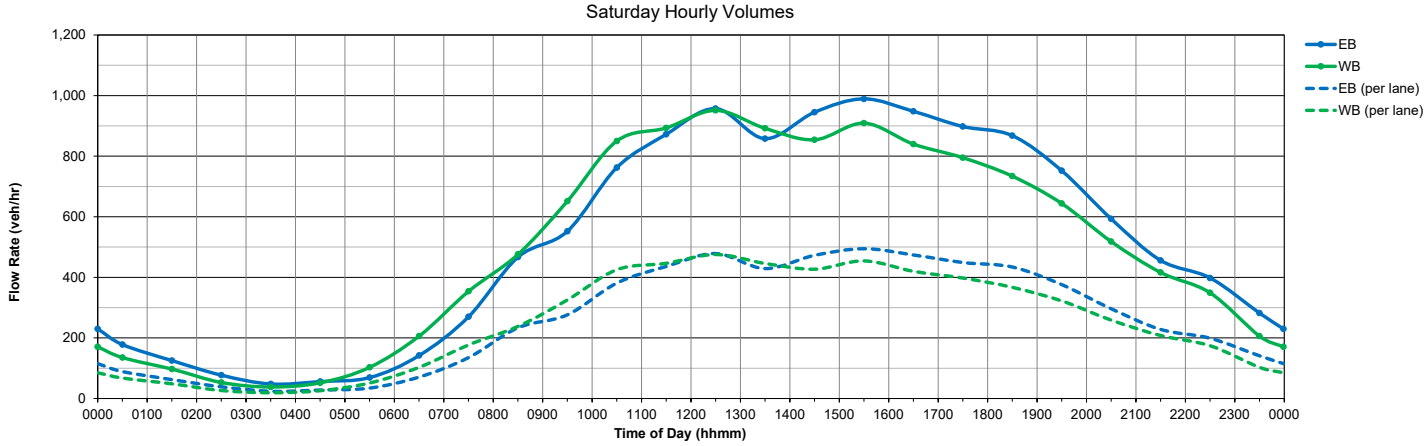


Figure 4
7-Day, 24-Hour Volumes
Blackwood-Clementon Rd (CR 534) between Peters Ln and Chews Landing-Little Gloucester Rd (CR 759)

Hourly Volumes - Blackwood-Clementon Rd (CR 534) between Millbridge Rd and Kelly Driver Rd

From	To	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Avg. Weekday		Avg. Weekend	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
0000	0100	101	83	85	70	100	77	105	67	110	89	178	135	177	140	100	77	178	138
0100	0200	64	42	58	41	64	47	64	45	74	41	125	97	109	78	65	43	117	88
0200	0300	47	35	42	25	45	31	52	42	62	39	77	53	96	57	50	34	87	55
0300	0400	44	45	30	40	30	55	42	44	42	48	48	38	76	42	38	46	62	40
0400	0500	55	106	65	102	61	103	60	96	49	97	56	52	44	42	58	101	50	47
0500	0600	125	272	139	278	126	265	138	257	122	242	69	103	45	62	130	263	57	83
0600	0700	334	510	358	477	334	475	326	471	346	483	142	206	97	125	340	483	120	166
0700	0800	605	646	645	615	629	622	606	592	637	686	270	354	171	203	624	632	221	279
0800	0900	628	636	667	574	662	673	612	644	703	685	467	476	289	351	654	642	378	414
0900	1000	574	602	587	551	599	586	591	620	689	672	552	651	403	497	608	606	478	574
1000	1100	525	599	584	552	601	653	557	581	665	723	762	850	640	661	586	622	701	756
1100	1200	607	617	629	633	661	685	652	646	728	756	872	893	722	736	655	667	797	815
1200	1300	741	669	734	659	594	532	712	727	850	857	957	951	868	902	726	689	913	927
1300	1400	803	679	762	733	795	718	775	657	853	825	858	892	908	932	798	722	883	912
1400	1500	926	739	871	768	913	767	881	820	1,006	882	945	854	884	774	919	795	915	814
1500	1600	960	830	945	839	906	859	963	853	996	900	989	909	837	809	954	856	913	859
1600	1700	1,007	919	1,059	855	1,069	911	1,007	931	1,044	916	948	840	819	754	1,037	906	884	797
1700	1800	1,003	817	1,045	898	1,024	897	1,075	971	1,086	896	898	795	741	675	1,047	896	820	735
1800	1900	767	655	838	739	900	746	831	786	834	790	868	734	737	642	834	743	803	688
1900	2000	565	475	629	530	682	588	707	616	741	645	752	644	601	500	665	571	677	572
2000	2100	501	375	502	385	573	404	546	485	597	464	593	518	516	395	544	423	555	457
2100	2200	377	240	434	327	445	350	482	334	440	383	456	416	372	315	436	327	414	366
2200	2300	251	195	253	211	310	249	328	255	387	296	398	349	280	223	306	241	339	286
2300	0000	173	115	183	154	194	148	200	158	267	209	282	206	170	129	203	157	226	168
Sub-total		11,783	10,901	12,144	11,056	12,317	11,441	12,312	11,698	13,328	12,624	12,562	12,016	10,602	10,044	12,377	11,544	11,582	11,030
Total		22,684		23,200		23,758		24,010		25,952		24,578		20,646		23,921		22,612	





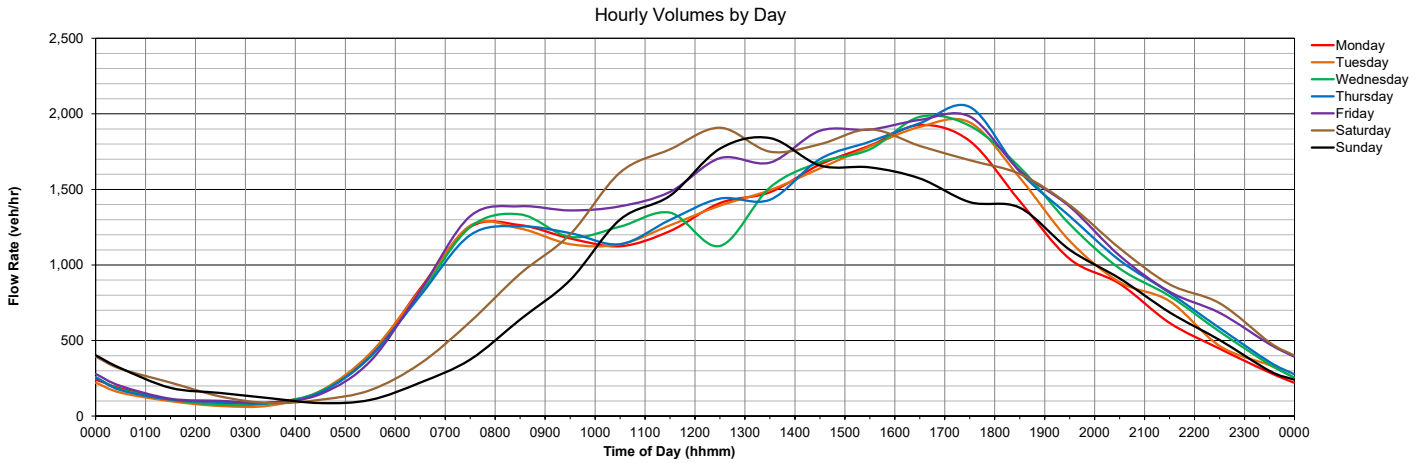
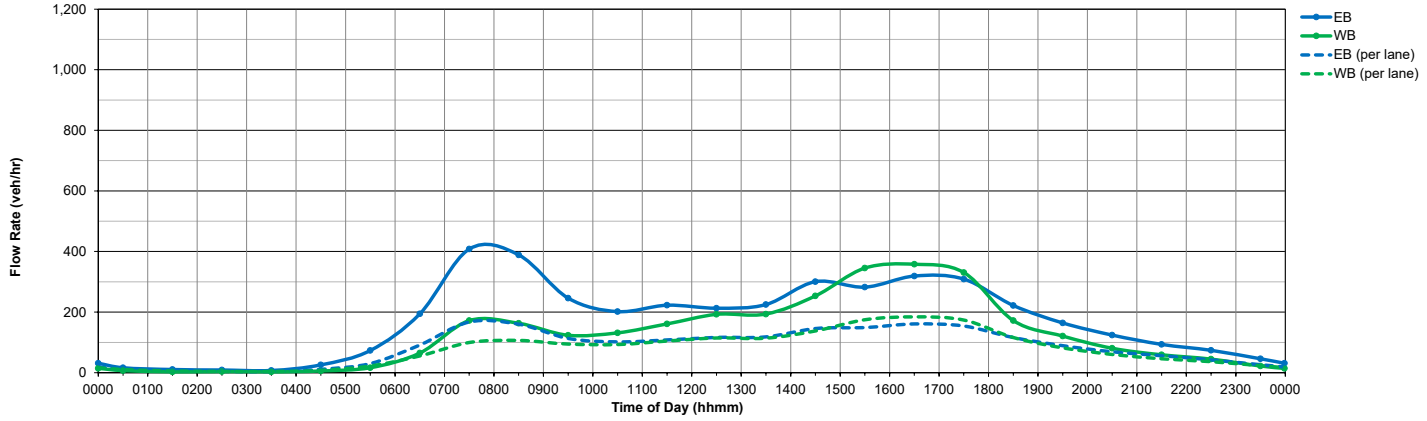


Figure 5
7-Day, 24-Hour Volumes
Blackwood-Clementon Rd (CR 534) between Millbridge Rd and Kelly Driver Rd

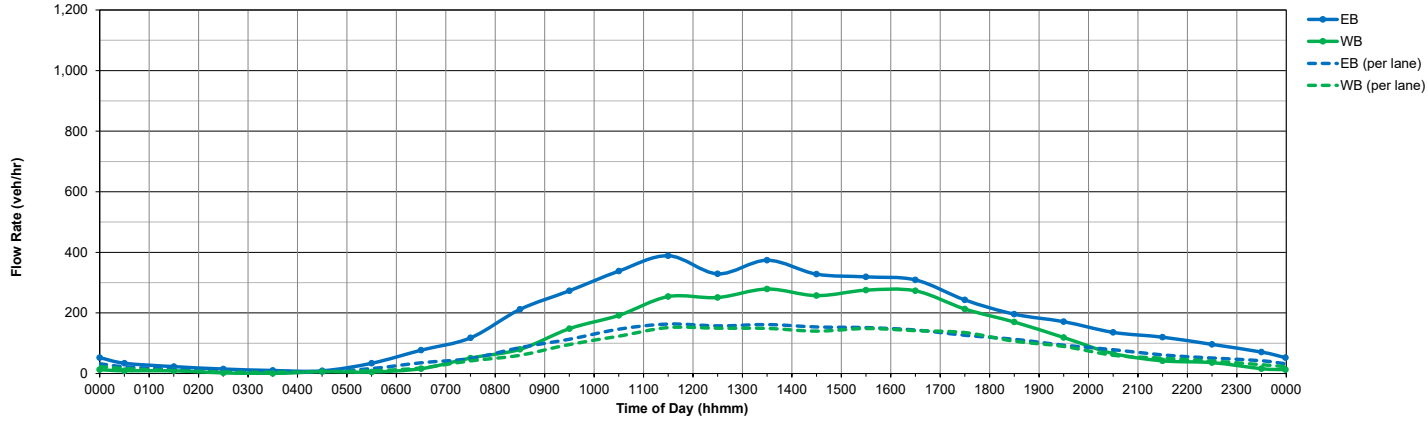
Hourly Volumes - Average for Count Locations on CR 534 between Branch Ave (CR 687) and Franklin Ave (CR 692)

From	To	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Avg. Weekday		Avg. Weekend	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
0000	0100	17	12	10	11	19	5	18	3	18	4	34	9	47	8	16	7	41	9
0100	0200	3	3	10	5	7	2	19	1	13	3	23	9	30	4	10	3	27	7
0200	0300	8	3	7	5	7	2	10	5	13	3	15	2	13	3	9	4	14	3
0300	0400	10	8	3	0	7	2	10	2	7	2	10	0	15	1	7	3	13	1
0400	0500	30	4	23	12	25	2	30	4	21	6	9	6	13	6	26	6	11	6
0500	0600	63	15	63	26	88	12	75	16	77	14	34	5	22	1	73	17	28	3
0600	0700	192	62	171	87	211	55	203	62	196	60	77	16	36	3	195	65	57	10
0700	0800	414	162	367	216	428	168	427	155	406	160	118	51	89	29	408	172	104	40
0800	0900	392	166	348	206	414	131	398	159	393	153	212	80	155	43	389	163	184	62
0900	1000	205	151	178	149	265	99	267	108	315	111	273	148	242	108	246	124	258	128
1000	1100	163	133	183	143	190	129	216	130	257	124	338	192	255	159	202	132	297	176
1100	1200	180	150	199	178	207	162	250	141	278	174	389	254	317	265	223	161	353	260
1200	1300	175	176	227	184	169	169	239	193	255	241	329	251	340	327	213	193	335	289
1300	1400	197	181	199	207	171	167	260	203	298	210	374	279	307	374	225	194	341	327
1400	1500	279	258	265	224	267	237	312	270	381	279	328	257	315	324	301	254	322	291
1500	1600	237	331	231	343	268	355	293	371	383	326	319	275	264	292	282	345	292	284
1600	1700	276	397	259	359	300	355	313	400	448	279	309	273	213	262	319	358	261	268
1700	1800	243	369	228	356	347	294	293	400	434	234	243	213	159	225	309	331	201	219
1800	1900	178	186	177	168	262	168	234	199	259	139	196	170	135	170	222	172	166	170
1900	2000	106	132	152	114	186	95	173	165	205	98	171	119	103	103	164	121	137	111
2000	2100	81	86	123	96	134	85	134	78	150	58	136	66	83	81	124	81	110	74
2100	2200	58	64	77	71	114	69	94	46	124	46	120	42	53	53	93	59	87	48
2200	2300	46	48	47	53	56	31	105	43	115	49	96	36	41	47	74	45	69	42
2300	0000	24	29	42	18	45	18	53	20	66	25	71	16	25	24	46	22	48	20
	Sub-total	3,577	3,126	3,589	3,231	4,187	2,812	4,426	3,174	5,112	2,798	4,224	2,769	3,272	2,912	4,178	3,028	3,748	2,841
	Total	6,703		6,820		6,999		7,600		7,910		6,993		6,184		7,206		6,589	

Weekday Average Hourly Volumes



Saturday Hourly Volumes



Hourly Volumes by Day

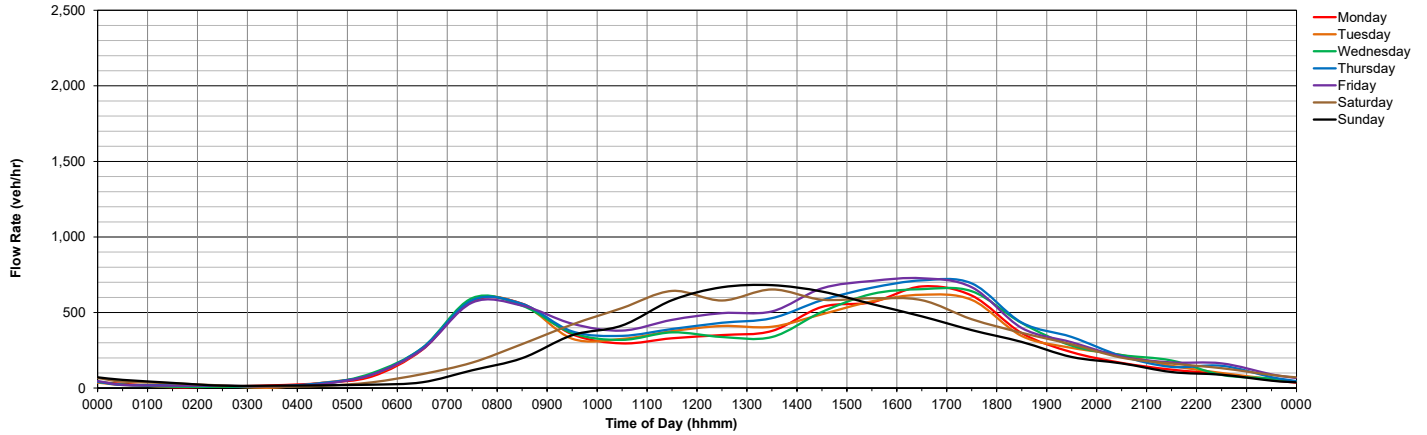
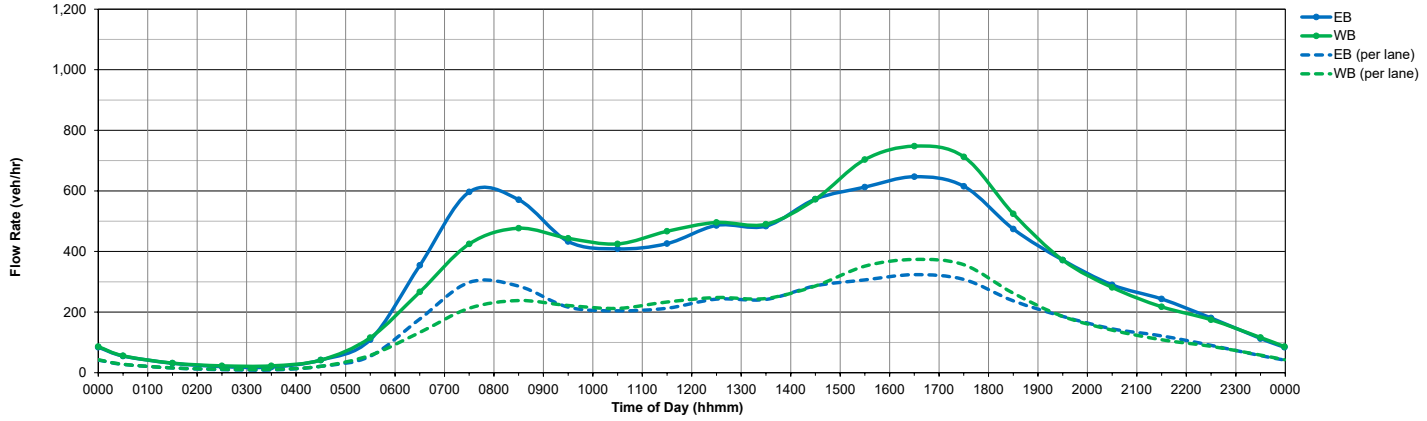


Figure 6
7-Day, 24-Hour Volumes
Average for Count Locations on CR 534 between Branch Ave (CR 687) and Franklin Ave (CR 692)

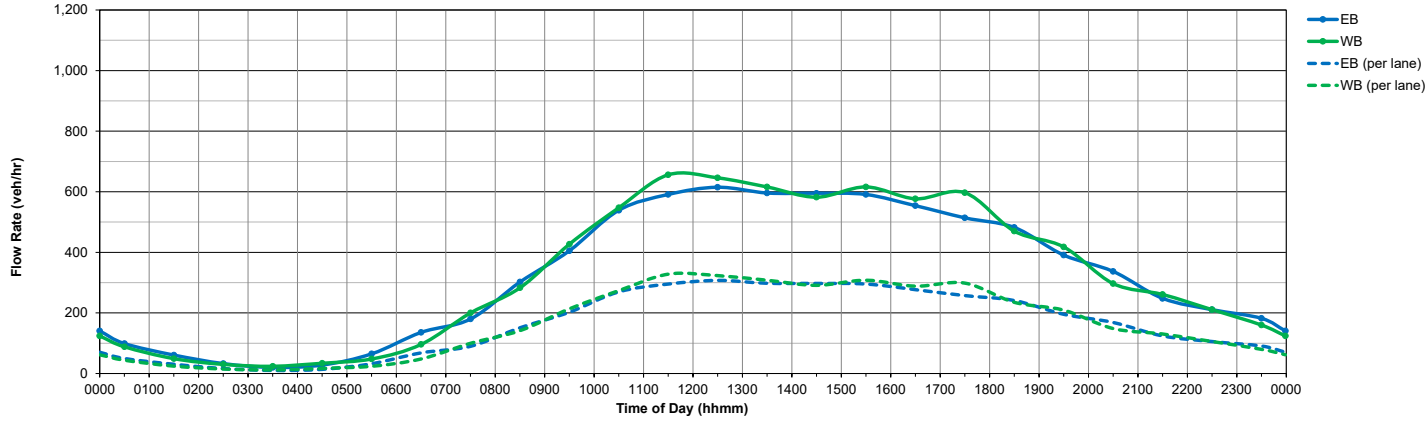
Hourly Volumes - Blackwood-Clementon Rd (CR 534) between Branch Ave (CR 687) and Gibbsboro Rd (CR 686)/Erial Rd (CR 607)

From	To	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Avg. Weekday		Avg. Weekend	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
0000	0100	48	48	42	51	59	68	55	43	71	69	99	88	98	97	55	56	99	93
0100	0200	32	25	24	29	34	38	30	32	37	35	61	49	55	55	31	32	58	52
0200	0300	17	18	18	21	24	27	17	24	24	25	33	30	44	43	20	23	39	37
0300	0400	19	28	17	14	15	20	25	24	16	27	20	24	29	18	18	23	25	21
0400	0500	49	33	40	45	37	38	49	49	35	45	28	34	25	23	42	42	27	29
0500	0600	103	124	113	124	111	119	114	102	104	109	65	48	45	30	109	116	55	39
0600	0700	341	278	369	275	344	259	365	256	354	265	136	96	89	69	355	267	113	83
0700	0800	615	412	615	408	617	441	573	418	563	448	180	200	108	122	597	425	144	161
0800	0900	530	428	595	473	584	504	563	489	584	490	302	283	190	179	571	477	246	231
0900	1000	383	442	432	432	449	457	430	449	471	438	405	427	307	280	433	444	356	354
1000	1100	366	404	409	419	409	411	391	458	469	434	539	547	390	412	409	425	465	480
1100	1200	407	405	417	441	393	467	438	451	475	570	591	656	494	483	426	467	543	570
1200	1300	429	456	457	448	485	511	473	478	587	587	615	646	530	572	486	496	573	609
1300	1400	503	466	461	470	428	420	496	505	531	590	596	616	571	658	484	490	584	637
1400	1500	576	523	547	548	567	576	602	581	574	636	595	582	611	510	573	573	603	546
1500	1600	589	655	586	681	592	707	642	722	654	753	591	616	537	540	613	704	564	578
1600	1700	576	737	674	726	643	740	667	774	676	762	554	577	524	496	647	748	539	537
1700	1800	583	685	561	721	656	707	637	750	640	700	514	597	447	441	615	713	481	519
1800	1900	434	491	493	499	489	534	471	559	485	540	482	470	408	410	474	525	445	440
1900	2000	315	321	376	342	380	369	405	409	384	418	391	418	326	332	372	372	359	375
2000	2100	274	235	283	263	287	279	284	339	322	291	337	297	239	267	290	281	288	282
2100	2200	186	159	272	192	246	257	265	227	248	254	248	261	188	210	243	218	218	236
2200	2300	164	152	161	164	169	172	197	185	212	200	211	211	149	143	181	175	180	177
2300	0000	99	86	79	110	119	112	123	124	144	150	182	160	86	99	113	116	134	130
	Sub-total	7,638	7,611	8,041	7,896	8,137	8,233	8,312	8,448	8,660	8,836	7,775	7,933	6,490	6,489	8,158	8,205	7,133	7,211
	Total	15,249		15,937		16,370		16,760		17,496		15,708		12,979		16,362		14,344	

Weekday Average Hourly Volumes



Saturday Hourly Volumes



Hourly Volumes by Day

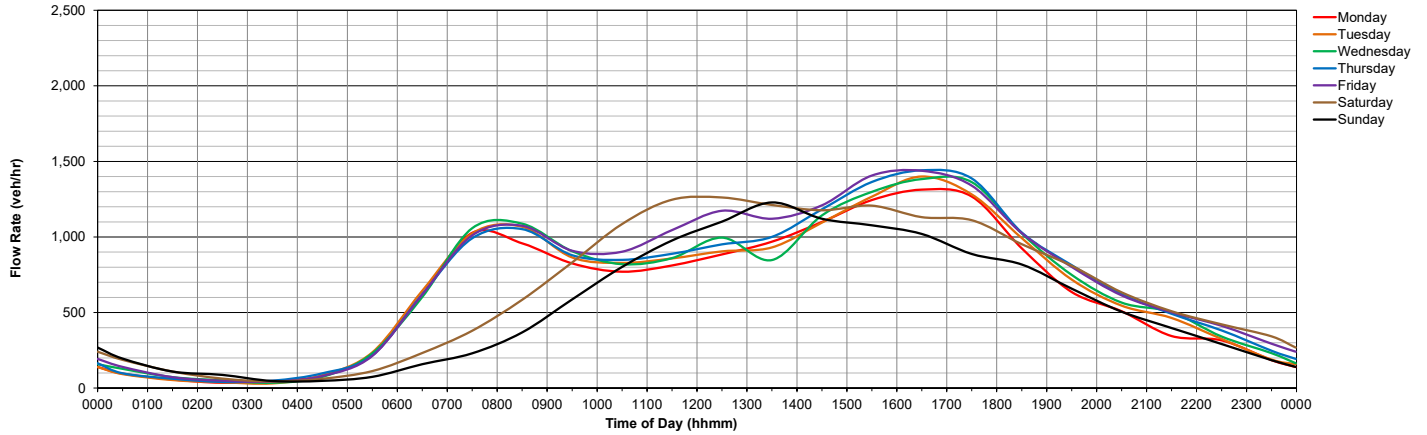
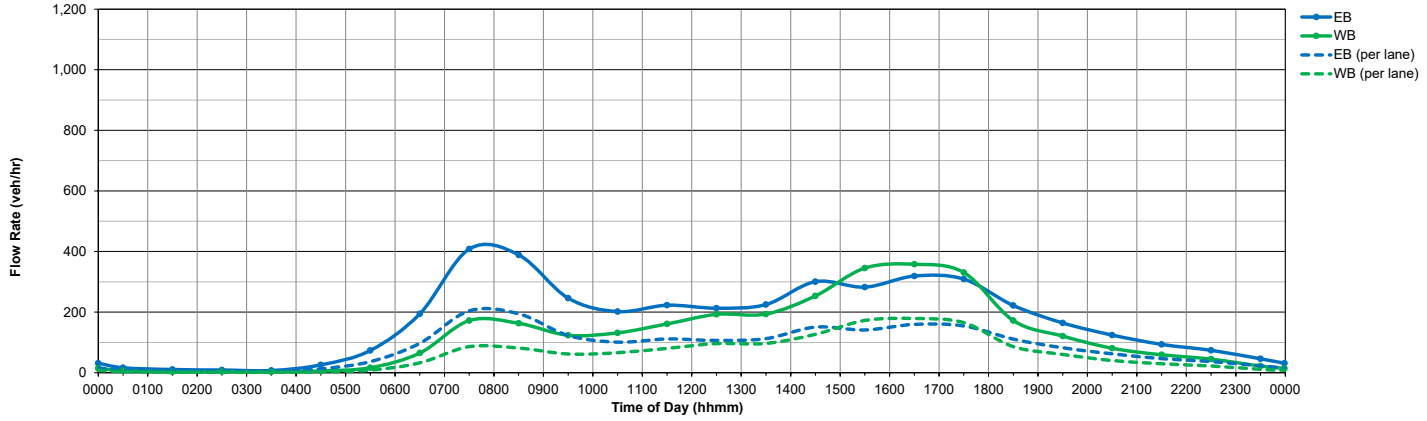


Figure 7
7-Day, 24-Hour Volumes
Blackwood-Clementon Rd (CR 534) between Branch Ave (CR 687) and Gibbsboro Rd (CR 686)/Erial Rd (CR 607)

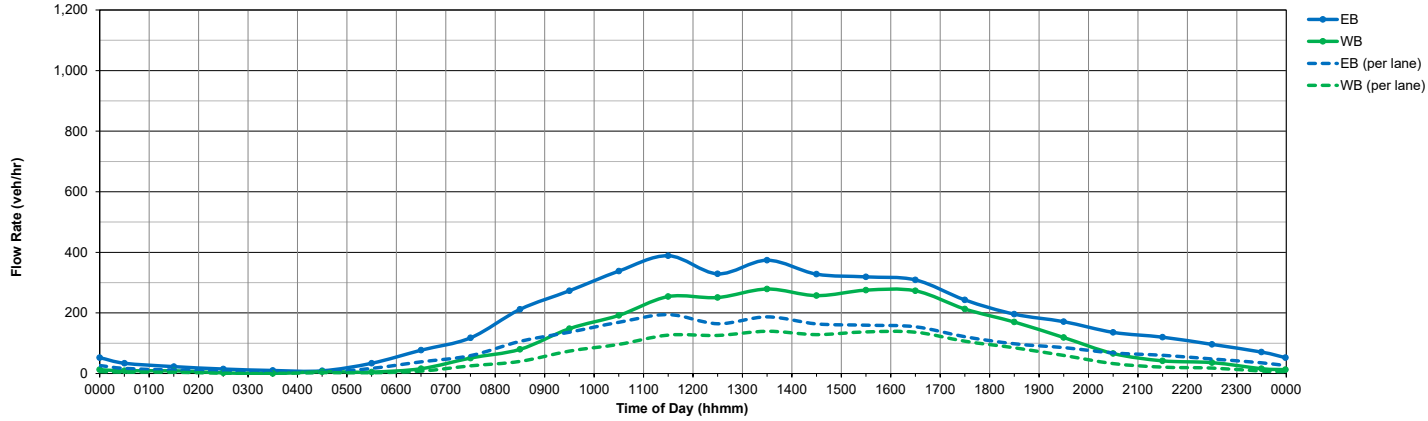
Hourly Volumes - Berlin-Clementon Rd (CR 534) between New Freedom Rd (CR 691) and Franklin Ave (CR 692)

From	To	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Avg. Weekday		Avg. Weekend	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
0000	0100	17	12	10	11	19	5	18	3	18	4	34	9	47	8	16	7	41	9
0100	0200	3	3	10	5	7	2	19	1	13	3	23	9	30	4	10	3	27	7
0200	0300	8	3	7	5	7	2	10	5	13	3	15	2	13	3	9	4	14	3
0300	0400	10	8	3	0	7	2	10	2	7	2	10	0	15	1	7	3	13	1
0400	0500	30	4	23	12	25	2	30	4	21	6	9	6	13	6	26	6	11	6
0500	0600	63	15	63	26	88	12	75	16	77	14	34	5	22	1	73	17	28	3
0600	0700	192	62	171	87	211	55	203	62	196	60	77	16	36	3	195	65	57	10
0700	0800	414	162	367	216	428	168	427	155	406	160	118	51	89	29	408	172	104	40
0800	0900	392	166	348	206	414	131	398	159	393	153	212	80	155	43	389	163	184	62
0900	1000	205	151	178	149	265	99	267	108	315	111	273	148	242	108	246	124	258	128
1000	1100	163	133	183	143	190	129	216	130	257	124	338	192	255	159	202	132	297	176
1100	1200	180	150	199	178	207	162	250	141	278	174	389	254	317	265	223	161	353	260
1200	1300	175	176	227	184	169	169	239	193	255	241	329	251	340	327	213	193	335	289
1300	1400	197	181	199	207	171	167	260	203	298	210	374	279	307	374	225	194	341	327
1400	1500	279	258	265	224	267	237	312	270	381	279	328	257	315	324	301	254	322	291
1500	1600	237	331	231	343	268	355	293	371	383	326	319	275	264	292	282	345	292	284
1600	1700	276	397	259	359	300	355	313	400	448	279	309	273	213	262	319	358	261	268
1700	1800	243	369	228	356	347	294	293	400	434	234	243	213	159	225	309	331	201	219
1800	1900	178	186	177	168	262	168	234	199	259	139	196	170	135	170	222	172	166	170
1900	2000	106	132	152	114	186	95	173	165	205	98	171	119	103	103	164	121	137	111
2000	2100	81	86	123	96	134	85	134	78	150	58	136	66	83	81	124	81	110	74
2100	2200	58	64	77	71	114	69	94	46	124	46	120	42	53	53	93	59	87	48
2200	2300	46	48	47	53	56	31	105	43	115	49	96	36	41	47	74	45	69	42
2300	0000	24	29	42	18	45	18	53	20	66	25	71	16	25	24	46	22	48	20
Sub-total		3,577	3,126	3,589	3,231	4,187	2,812	4,426	3,174	5,112	2,798	4,224	2,769	3,272	2,912	4,178	3,028	3,748	2,841
Total		6,703		6,820		6,999		7,600		7,910		6,993		6,184		7,206		6,589	

Weekday Average Hourly Volumes



Saturday Hourly Volumes



Hourly Volumes by Day

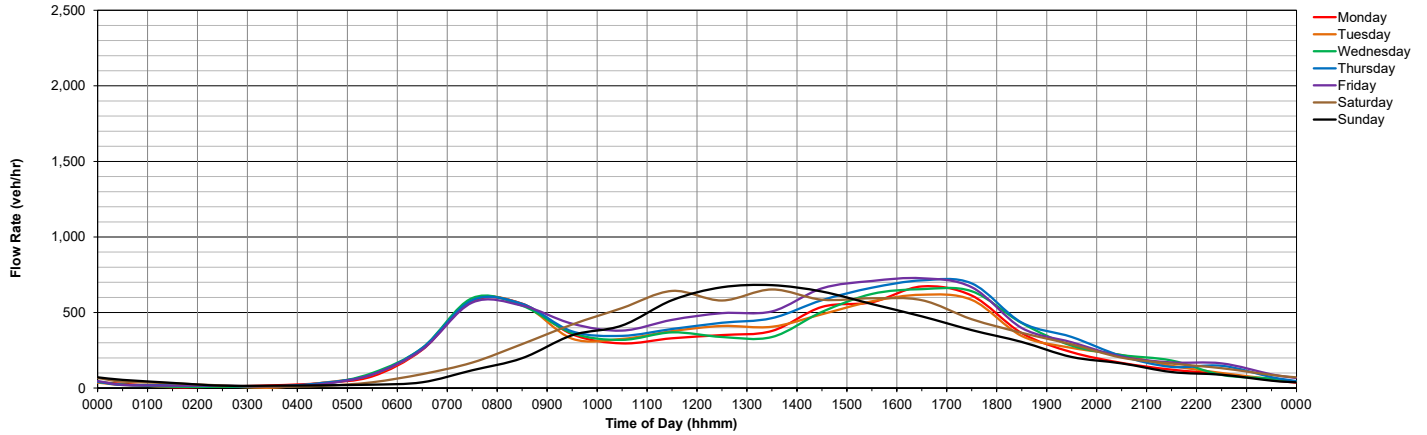


Figure 8
7-Day, 24-Hour Volumes
Berlin-Clementon Rd (CR 534) between New Freedom Rd (CR 691) and Franklin Ave (CR 692)

3.0 SITE SURVEY

Prior to conducting any analysis, a site survey was performed to observe the signal equipment in the cabinet and operation of the traffic signal as well as the geometric, traffic, and signal timing characteristics of each intersection.

3.1 Intersection Observation

A general observation of the interaction between traffic, the signal, and intersection design was also made during the site survey. The purpose of these observations was to note any characteristics (such as low lane utilization) that may not be inferred from any other available data sources but could significantly affect the performance of the new signal timings. Any potential safety hazards observed during the site survey, such as missing, damaged, or obstructed signs, signals, or pavement markings were also noted. All vehicle and pedestrian detectors were observed and tested for proper operation. A summary of those detection issues was included in the Pre-Implementation Memorandum during this project and also included in this report in the Appendix on Figure 13 on page 34. An observation of all signals was conducted during daytime operation under normal conditions.

3.2 Summary of Field Observations

The following observations were noted during the site survey:

General Observations

- Under existing conditions, most signals within this network were either running in free operation or in coordination but not with consistent controller clocks. This resulted in inconsistency throughout the network and unpredictable arrivals at intersections. This created scenarios where a platoon of vehicles could be arriving at a signal and the indications would go to the yellow and red intervals on the primary street at inopportune times, which increases the number of dilemma zone conflicts along the network, resulting in more rear end crashes, hard braking and red light running throughout the network. Also, vehicles could stop at several signals in a row and experience significant delays while travelling down the primary arterials.
- Most existing traffic cabinets were not equipped with any way to maintain a consistent time source, such as a GPS. The two exceptions were both on Blackwood-Clementon Road (CR 534) at Cherrywood Drive and Millbridge Road as both of those locations already had GPS units installed to their cabinets.
- In general, the controller clocks hold time well with a few exceptions. When clocks were set, they were observed to drift together, so weeks after being set, most clocks would be fast by several seconds.
- During the field reviews, several vehicle and pedestrian detection issues were noted which impacted the operations of the signals. The full list of detector and field observations from this task is included on the project website. Some of the detector issues were either addressed or changed over the course of the project, so a summary table for issues at the completion of this project are included in the Appendix in Figure 13.
- There is a 30-mph school zone on Blackwood-Clementon Road (CR 534) in the area of Highland High School posted to be active when children are present. There are no flashing beacons, and the sign was posted around vegetation, so it did not demand attention and was not abided by most traffic along CR 534.

Blackwood-Clementon Road (CR 534) & Blenheim-Erial Road (CR 706)/Peters Lane

- This signal was programmed to run a 120 second cycle length during all times of day, including off-peaks and overnight, which is excessive based on the traffic demands. This resulted in long side street delays while there was little main street traffic along Blackwood-Clementon Road (CR 534).

Blackwood-Clementon Road (CR 534) & Chews Landing-Little Gloucester Road (CR 759)

- During the field notes stage, this signal was controlled by a Peek 3000 controller and was running in free operation, resulting in unpredictable timings along Blackwood-Clementon Road (CR 534) and added delays.

Blackwood-Clementon Road (CR 534) & Kelly Driver Road

- This signal is only 650 feet west of the major intersection at Blackwood-Clementon Road (CR 534) & Laurel Road/College Drive (CR 673) and was running in free operation during existing operations. There is also an approximate three percent grade uphill westbound between the two signals, so there was often queuing between the two signals and abrupt stops for westbound traffic at this intersection after just being released from Laurel Road/College Drive (CR 673).
- During the PM and weekend midday peak periods, westbound queues would extend up to approximately 600 feet and result in cycle failures. This appeared to be caused by the fast cycling at this intersection since the time allotted to the eastbound and westbound movements were not sufficient to clear the demand.

Blackwood-Clementon Road (CR 534) & Laurel Road/College Drive (CR 673)

- During all time periods but primarily the PM and weekend midday peaks, eastbound left-turn queues extended up to approximately 350 feet, extending beyond the turn storage and impacting the adjacent through lane. There was also a short allocation of green time to this movement, so would often experience cycle failures.
- Westbound left-turn queues extended up to approximately 350 feet during the midday, PM, and weekend midday time periods, resulting in cycle failures. Similar to the eastbound left-turn allotment, there was only a short green time given to this movement and the westbound approach was on a significant positive grade.
- Northbound and southbound queues were observed to sporadically experience cycle failures through all time periods, but primarily the midday, PM, and weekend midday peak periods.

Blackwood-Clementon Road (CR 534) & Branch Avenue (CR 687)

- There is a pedestrian push button on the northwest corner, which gives the impression to pedestrians that actuating the button will provide a call and time to cross Blackwood-Clementon Road (CR 534), but it does not place any calls in the controller. Therefore, the pedestrian phase operates in recall, so services every cycle regardless of demand. This is a minor intersection, so results in main street traffic delays while waiting for the pedestrian time to service each cycle.

Blackwood-Clementon Road (CR 534) & Gibbsboro Road (CR 686)/Erial Road (607)

- During all time periods, the eastbound left turn movement would experience cycle failures as queues would reach up to approximately 400 feet and impact the operation of the adjacent eastbound through lane. There was only a short green time allotted to this movement, so during peak periods, vehicles would need multiple cycles to clear the intersection. With the interaction from the left turn movement, the eastbound through movement would also experience cycle failures during the peak periods.
- During all time periods, but specifically the PM and weekend midday periods, southbound queues would extend up to 500 feet and experience cycle failures.

Berlin-Cross Keys Road (CR 534) & White Horse Avenue (CR 695)/Clementon Park Driveway

- The side street vehicle loop detection was failing throughout this project, resulting in unnecessary stops and delay for vehicles travelling along CR 534.

Clementon Road (CR 534) & Franklin Avenue (CR 692)

- Over the course of this retiming project, there was no vehicle or pedestrian detection for the eastbound and westbound movements. Those two movements run sequentially, meaning one at a time instead of servings both eastbound and westbound concurrently. This situation results in long cycle lengths and delays, even during off-peak periods and overnight.
- Berlin Borough schools are just to the south of CR 534 and heavily impact this signal during the school ingress and egress periods. There is a school guard during these times and heavy pedestrian presence was

observed during those times. During the PM school release, southbound queues were observed to extend approximately 400 feet and experienced cycle failures.

White Horse Pike (NJ Route 30) & Clementon Road (CR 534)/North Park Drive

- During the PM peak period, westbound queues from the NJ Route 30 spur extended approximately 200 feet and experienced cycle failures. Only a short green time is allotted to this movement during the PM period while other movements appeared to have plenty of time and unused green time, so cycle time could be redistributed to address this issue.

4.0 SIGNAL TIMING IMPLEMENTATION

4.1 Model Development

The basic link-node structure of the roadway network was built in Synchro on a coordinate-specific, Bing Maps image of roads provided within Synchro. This type of reference ensures precise intersection placement as well as proper link curvature and length. Node numbers (intersection IDs) were assumed based on the proposal provided at the beginning of this project.

Once all existing geometric, volume, and signal timing data were coded into the models and general field observations were completed, new signal timings were developed.

4.2 Basic Signal Timing Parameters

The basic timing parameters, such as minimum green, yellow change, red clearance, vehicle extension, recall mode, walk time, and pedestrian clearance (flashing don't walk), were reviewed and updated as necessary for each traffic signal phase. These parameters are discussed in greater detail below. All clearance intervals were calculated for all intersections.

Minimum Green

Minimum values were reviewed and updated, as necessary. In general, the following were used:

- Main Street through movements: 15-20 seconds depending on detection layout and pedestrian operation.
- Left turn movements: 5 seconds.
- Side street through movements: 7-10 seconds depending on side street volume and detection layout.
- In many cases, existing minimum greens were not reduced but all were reviewed for appropriateness.

Yellow Change and Red Clearance Intervals

The yellow change and red clearance intervals were calculated from equations provided by the NJDOT Traffic Engineering Division as follows:

$$\text{Total Clearance (TC)} = t + \frac{V}{2a} + \frac{w+L}{V}$$

t = perception-reaction time (s)
V = approach speed (ft/sec)
a = deceleration rate (ft/sec^2)
w = width of intersection (stop bar to furthest conflict point)
L = length of vehicle

Yellow time for each movement is calculated based on the approach posted speed limit, with one second per 10 mph and rounded up to the nearest whole number. If speeds vary on the concurrent approaches, the higher value is utilized, and the concurrent phases have matching yellow and red intervals. The red interval is then calculated by subtracting the yellow interval from the Total Clearance equation shown above and rounded up the nearest whole number.

Though a red clearance interval is not necessary under NJDOT guidelines for protected/permissive left turn movements, each red interval was programmed as at least one second. This was done to add an extra buffer time between the end of left turn movements yellow interval and the opposing movement and intended to improve safety.

Walk Time

A value of seven or more seconds based on 2009 MUTCD requirements and engineering judgment was used if pedestrian phases are present. There was one exception to this made at the intersection of Blackwood-Clementon Road (CR 534) & Branch Avenue (CR 687), where there is only one pedestrian pushbutton, no pedestrian displays, and the pedestrian phase is in recall. To limit the impact of the pedestrian phase serving each cycle, the walk time for the movement crossing CR 534 was reduced to the minimum value of 4 seconds, which matched the existing value. Any location that had an actuated pedestrian button present utilized a walk time of 7 seconds or higher.

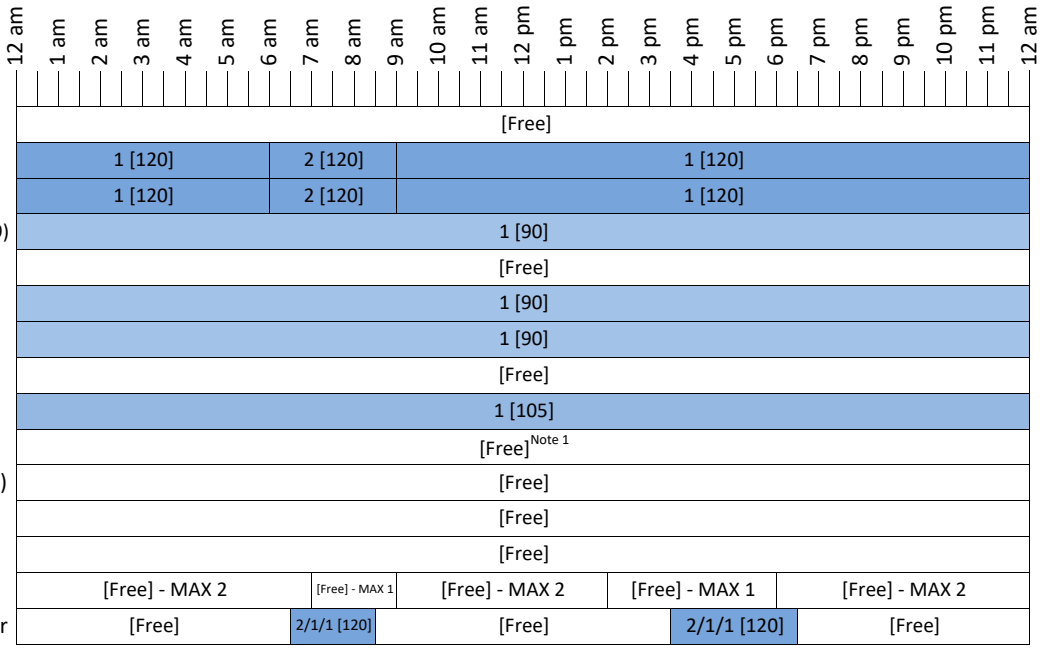
Pedestrian Clearance (Flashing Don't Walk)
The length of this interval is a function of the crosswalk length, pedestrian push button distance from the curb, and a standard pedestrian walking speed of 3.5 ft/s. MUTCD guidelines were utilized in calculating appropriate flashing don't walk times.

For specific information, the existing and implemented timing sheets can be found on the project website. All clearance measurements and calculations for both vehicle and pedestrian movements are provided on the project website.

4.3 Phasing
During the optimization process, it may be determined that the basic phasing structure of the intersection should be changed or further evaluated to improve the operation and/or safety of the intersection or corridor. No such recommendations are being presented for this system.

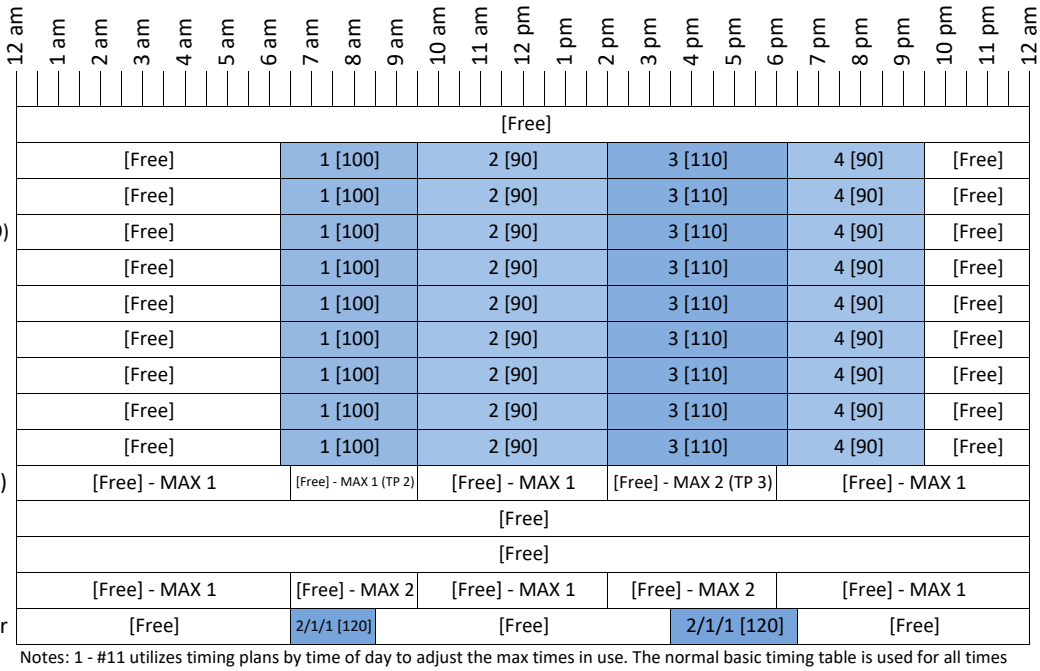
4.4 Day Plan Schedules
The process of determining the day plan schedule is primarily based on 7-day, 24-hour traffic volume counts and engineering judgment. During fine-tuning, several additional patterns from those initially proposed were developed to better address regular fluctuations in traffic along the network. Figure 9 through Figure 11 on pages 18 – 20 illustrate the existing and implemented day plan schedules for all signals along this network.

EXISTING SCHEDULES
Blackwood-Clementon Rd (CR 534)
Weekday (Monday-Friday)



Notes: 1 - Programmed in scheduler to run a 90 second cycle coordinated plan but runs free to programming error

IMPLEMENTED SCHEDULES
Blackwood-Clementon Rd (CR 534)
Weekday (Monday-Friday)



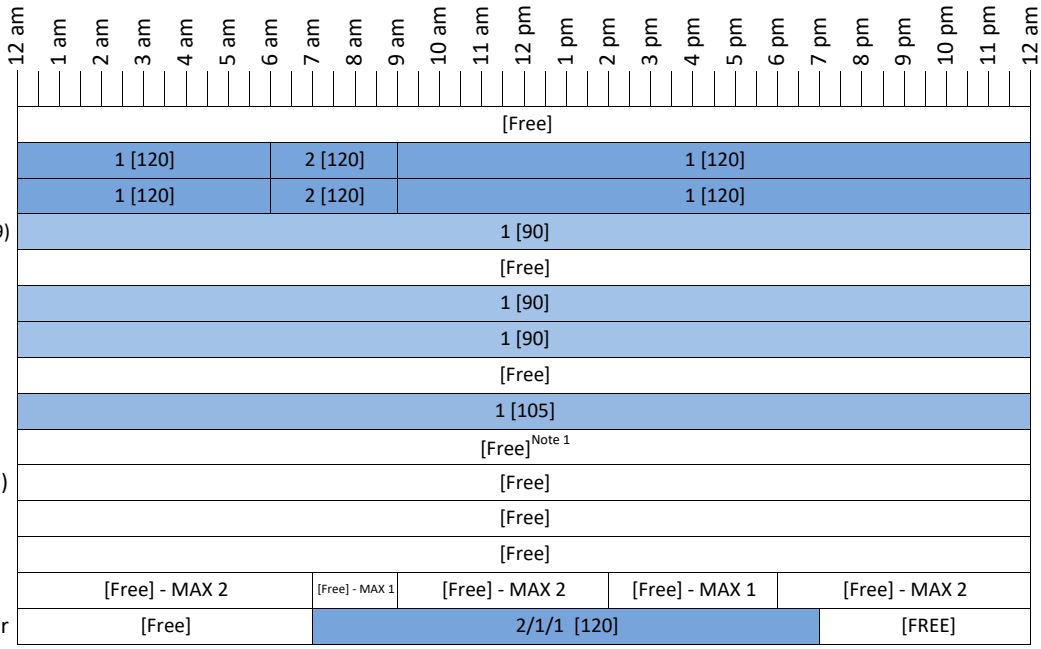
Notes: 1 - #11 utilizes timing plans by time of day to adjust the max times in use. The normal basic timing table is used for all times except when Timing Plan 2 (AM Peak), Timing Plan 3 (PM Peak) or Timing Plan 3 (Weekend midday peak) are being utilized.

LEGEND
A white box indicates free operation, a shaded box indicates coordinated operation.
The first number specifies the pattern, the second number [in brackets] is the cycle length (s).
Darker shades represent a longer cycle length.

Figure 9

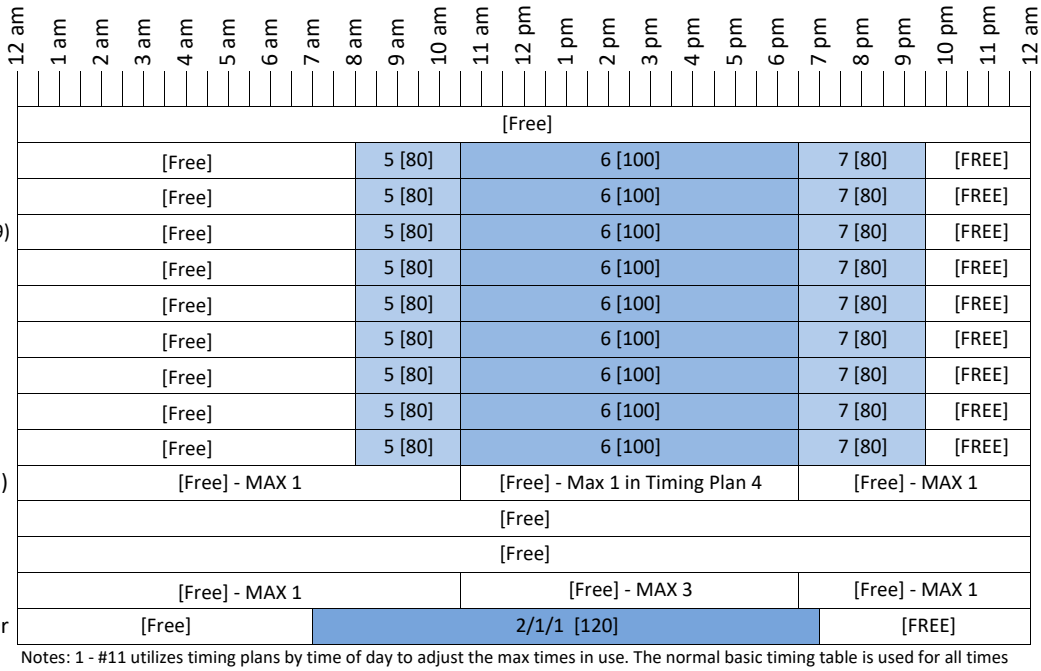
Weekday Day Plan Schedules
Blackwood-Clementon Rd (CR 534)

EXISTING SCHEDULES
Blackwood-Clementon Rd (CR 534)
Saturday



Notes: 1 - Programmed in scheduler to run a 90 second cycle coordinated plan but runs free to programming error

IMPLEMENTED SCHEDULES
Blackwood-Clementon Rd (CR 534)
Saturday



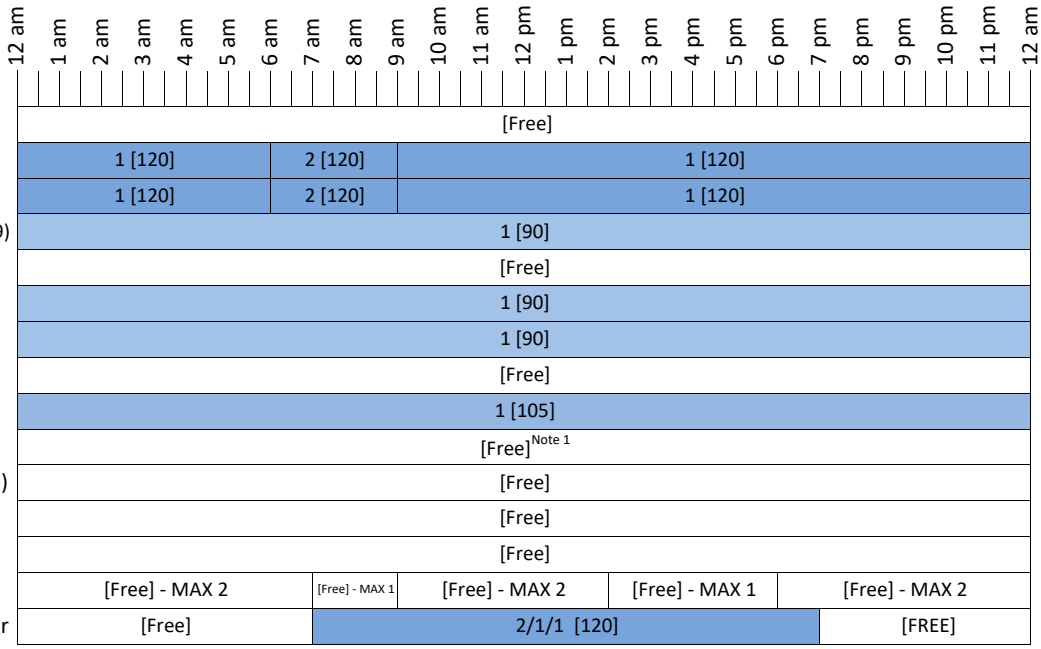
Notes: 1 - #11 utilizes timing plans by time of day to adjust the max times in use. The normal basic timing table is used for all times except when Timing Plan 2 (AM Peak), Timing Plan 3 (PM Peak) or Timing Plan 3 (Weekend midday peak) are being utilized.

LEGEND
A white box indicates free operation, a shaded box indicates coordinated operation.
The first number specifies the pattern, the second number [in brackets] is the cycle length (s).
Darker shades represent a longer cycle length.

Figure 10

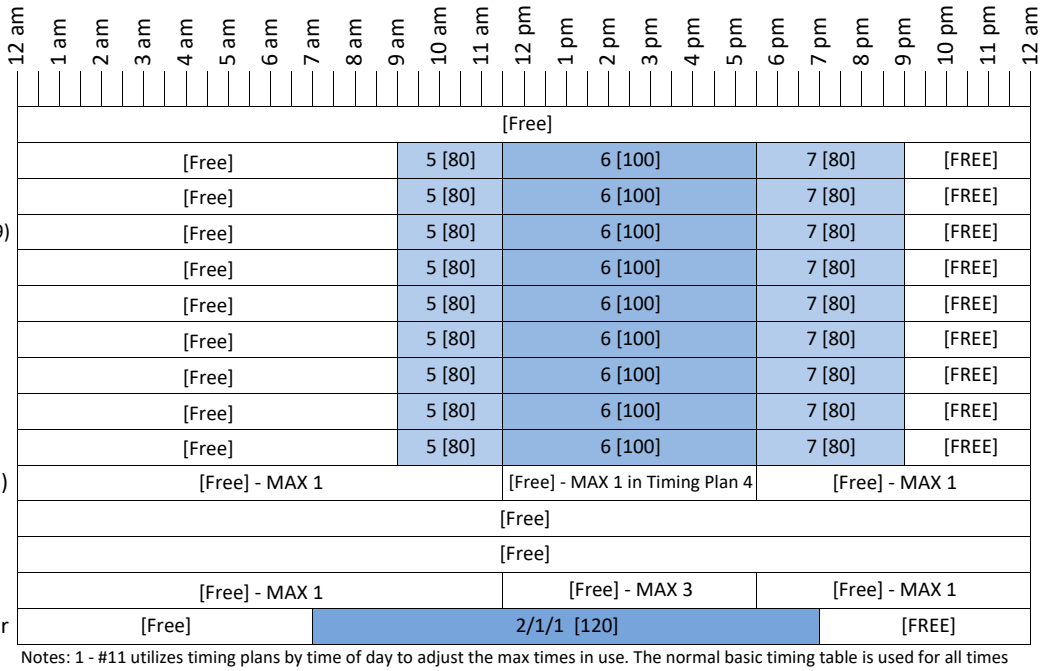
Saturday Day Plan Schedules
Blackwood-Clementon Rd (CR 534)

EXISTING SCHEDULES
Blackwood-Clementon Rd (CR 534)
Sunday



Notes: 1 - Programmed in scheduler to run a 90 second cycle coordinated plan but runs free to programming error

IMPLEMENTED SCHEDULES
Blackwood-Clementon Rd (CR 534)
Sunday



Notes: 1 - #11 utilizes timing plans by time of day to adjust the max times in use. The normal basic timing table is used for all times except when Timing Plan 2 (AM Peak), Timing Plan 3 (PM Peak) or Timing Plan 3 (Weekend midday peak) are being utilized.

LEGEND
A white box indicates free operation, a shaded box indicates coordinated operation.
The first number specifies the pattern, the second number [in brackets] is the cycle length (s).
Darker shades represent a longer cycle length.

Figure 11

Sunday Day Plan Schedules
Blackwood-Clementon Rd (CR 534)

4.5 Pattern Optimization

The list below summarizes each unique pattern that was developed for this system and the overall peak hour that was determined from the volumes collected over the course of this project. Within the network, however, each signal was optimized using volumes from its own individual peak hour within the period for which the pattern was designed to operate instead of the overall peak hour.

Time-of-Day	Abbreviation	Pattern No.	Network Peak Hour
Weekday AM Peak	AM	1	7:30 am – 8:30 am
Weekday Midday Peak	MD	2	1:00 pm – 2:00 pm
Weekday PM Peak	PM	3	4:45 pm – 5:45 pm
Weekday PM Off-peak	PO	4	6:15 pm – 7:15 pm
Weekend AM Peak	WA	5	9:00 am – 10:00 am
Weekend Midday Peak	WM	6	11:45 am – 12:45 pm
Weekend PM Peak	WP	7	6:00 pm – 7:00 pm

There were two primary sections in developing the timing plans and the peaks varied slightly, so the peak hours modeled for each time period are summarized below. The zone that was designed for coordinated signal timings was between Blenheim Erial Road (CR 706) & Branch Ave (CR 687). The other signals were all considered for coordination, but it was determined that each would operate more efficiently in free operation, or non-coordinated operation.

For the coordinated section, cycle lengths were developed in an effort to balance optimal progression along the main CR 534 corridor and limiting the delay experienced by pedestrians and side street traffic. Even though under existing conditions several signals were running in free operation, cycle lengths were selected in an effort to make the adjustment to coordinated timings as unnoticeable as possible to typical drivers on the network.

The two signals owned by NJDOT were both modeled and analyzed for this project. Timing directives and signal plans were acquired from NJDOT and turning movement counts were collected at both locations. Upon request, NJDOT reviewed both signals and indicated neither signal has been included in an active or upcoming adaptive signal control project nor was included in any recent retiming project. The intersection of Black Horse Pike (NJ Route 168) & Church Road (CR 534) runs in free operation at all times and is approximately 3,800 feet west of Blenheim-Erial Road (CR 706) and traffic characteristics change significantly in the area between. This signal runs well generally but some potential timing improvements were noted, which will be communicated to NJDOT for consideration.

The other NJDOT signal at White Horse Pike (NJ Route 30) & Clementon Road (CR 534)/North Park Drive is approximately 3,800 feet east of the nearest County signal included in this project at Franklin Avenue (CR 692). This signal is coordinated along NJ Route 30, so would require further analysis of timings at the surrounding signals before making any adjustments. Therefore, observations and potential improvements will be communicated to NJDOT for consideration. Both of the NJDOT signals run well with existing timings, but both had observations relating to queueing and phase failures which could potentially be improved via signal timing adjustments. The consultant team will provide a summary of observations and potential improvements to NJDOT for consideration. Clearance measurements and calculations were reviewed for both signals and a summary will also be provided to NJDOT.

For the County signals that were not within the coordinated section, new timings were developed utilizing the volumes collected in the data collection stage. The intersection of Blackwood-Clementon Road (CR 534) & Gibbsboro Road (CR 686)/Erial Road (CR 607) had major queuing and phase failure issues, so time of day timings were developed to address the observed issues. Four free operation plans developed at this location to best handle the volume demands throughout a typical week instead of just one set of times to run at all times. That approach of developing only one set of timings to run at all times was appropriate for the signals at White Horse Ave (CR 695) and New Freedom Road (CR 691) since they both are simple intersections which can be run effectively during all times of day with one set of timings. The signal timings at Franklin Avenue (CR 692) were developed primarily around the school traffic which largely impacts that location, so three plans were developed for that location.

4.6 Phase Sequences

Phase sequence diagrams illustrate the phasing at each intersection as well as the sequences that are used with existing and implemented timing patterns. Sequence diagrams are shown in Figure 14 through Figure 15 on pages 35 – 36. For this project, there were no changes in phase sequence from existing to implemented conditions.

4.7 Pre-Implementation Memorandum

Once all timings were developed, the proposed timings were summarized in a series of figures and sent to Camden County and the various municipalities for review. Initial timing directives were created reflecting the proposed timings and simple timing sheets were also developed to match the programming style and terminology in each controller. The provided Pre-Implementation Memorandum is included in the Report folder on the project website. An implementation plan was also proposed to the maintaining jurisdictions and the consultant team scheduled the implementation.

5.0 SIGNAL TIMING IMPLEMENTATION

5.1 Controller Programming

After the basic timing parameters were updated, optimized signal timings were developed, and an updated day plan schedule was created, this information was coded into database files and tested with coordination diagnostic tools and test controllers where appropriate. For this system, the Econolite Aries Zone Manager software was utilized since there was a mix of Econolite ASC 2, ASC 3 and Cobalt controllers. Once each database was programmed and tested successfully, each database was downloaded to the local controllers on Tuesday, June 13th and Wednesday, June 14th. Following the initial downloads, the signals were observed for proper operation and each controller was observed to address any issues that could have occurred during the data transfer.

At three locations, controllers were changed out over the completion of this project, primarily to allow for the installation of GPS units in the respective cabinets. At these locations, programming of the controllers was done on site and tested locally during the implementation step. These locations were as follows:

- Blackwood-Clementon Road (CR 534) & Blenheim-Erial Road (CR 706)/Peters Lane – Changed from Econolite ASC/2 to Econolite Cobalt controller following fine-tuning, so consultant team initially implemented with ASC/2 controller but then reviewed and updated new timings in Cobalt controller once installed.
- Blackwood-Clementon Road (CR 534) & Chews Landing-Little Gloucester Road (CR 759) – Changed from Peek 3000 to Econolite Cobalt controller. This controller change was completed between the Field Notes stage and the implementation, so initial coding was completed on site during implementation.
- Blackwood-Clementon Road (CR 534) & Emerson Drive – Changed from Econolite ASC/2 to Econolite Cobalt controller during the fine-tuning week, so was initial downloaded to ASC/2 but updated once new Cobalt controller installed.

5.2 Fine-Tuning of Signal Timings

Each new timing plan was observed at each intersection at some point during its respective peak hour to ensure each phase split was appropriate for the traffic conditions present. At some intersections, fine-tuning may consist of simply increasing or decreasing a split for one or more phases. If a movement or intersection is over capacity, split adjustments may be required to manage queue spillback and blockage.

In addition to fine-tuning splits, offset adjustments often have a larger effect on the performance of the network. Offset adjustments at coordinated intersections were determined by conducting travel time runs along the corridor. Travel time runs were conducted using Tru-Traffic (v 10.0). Tru-Traffic, in conjunction with a direct connect GPS unit, tracks the location of the test vehicle within the traffic signal system. Because the software uses the actual traffic signal timing settings and an actual vehicle in the traffic stream, this fine-tuning tool can be powerful. This also provides the user dynamic information about the performance of the traffic signal system such as travel time and delay. Results of the travel time runs under existing signal timings (the “before” runs) and implemented signal timings (the “after” runs) are discussed in Section 6.4 of this report.

The fine-tuning process for this project took place over the course of a week and all signals were observed for proper and optimal operation during each time period, including those that only run on both Saturday and Sunday. All changes to the proposed timings presented in the Pre-Implementation Memorandum were documented and updated in each model, timing sheet and timing directive. Once fine-tuning was completed and timings were finalized, timing directives were thoroughly reviewed for accuracy to match the controller programming and were placed in each local cabinet for reference during any maintenance visit that may occur in the future.

Most of the changes made during fine-tuning in this project were minor split or offset changes but particular attention was given to the Highland High School area around Erial-Blenheim Road (CR 706)/Peters Lane and also to the split allocations for all time periods at Laurel Road/College Drive (CR 673). For the signal outside the coordinated section, the consultant team observed the signal of Blackwood-Clementon Road (CR 534) & Gibbsboro Road (CR 686)/Erial Road (CR 607) in depth and several additional timing plans were added due to different queuing characteristics observed throughout the fine-tuning week.

6.0 TRAFFIC OPERATIONS ANALYSIS

Operations analysis was conducted, using the traffic models, on each of the periods with existing signal timings. This analysis established a benchmark by which traffic operations with implemented signal timings are compared. In addition to the models, travel time runs were conducted in the field to specifically measure the change in travel time and delay on the primary corridor.

6.1 Intersection Performance Measures

Synchro (v11) was used to determine the delay (in seconds per vehicle) for each lane group as well as the delay and level of service (LOS) for the intersection. SimTraffic was used to determine the delay for each movement and the intersection by averaging five, one-hour simulations. The intersection capacity utilization (ICU) was also determined for each intersection. The delay, LOS, and ICU for each intersection can be found in Figure 16 through Figure 40 on pages 37 – 61.

The figures illustrate traffic operations at the same intersection for the various periods and scenarios analyzed. The top row illustrates each period with existing hourly volumes. The second row illustrates each period with existing signal timings. The third row illustrates each period with implemented signal timings. The bottom row, if present, summarizes traffic operations for each period if recommended capacity improvements are made at the intersection. These recommended improvements are described in Section 8.2 of this report. This arrangement allows easy comparison of operations across all periods and scenarios.

In general, intersections may experience an increase in overall intersection delay when 1) the cycle length is significantly adjusted from its optimal cycle length to provide coordination, 2) green times are allocated with the objective of providing maximum progression on the major street or 3) green times are allocated to prevent queue spillback and blockage. Table 1, below, summarizes the number of intersections that experienced an increase or decrease in overall intersection delay during each period.

Table 1 – Summary of Changes in Intersection Delay

Number of intersections where:	AM	MD	PM	PO	WA	WM	WP
delay decreased	10	12	11	13	11	12	11
delay increased ≤ 5 sec/veh	5	3	4	2	4	3	4
delay increased > 5 sec/veh	0	0	0	0	0	0	0

While delay largely decreased across all periods, there were several intersections where delay increased slightly. However, no intersections experienced a delay increase greater than 5 seconds/vehicle for any time period. The locations where delay increased slightly generally is caused by several factors, including increased clearance intervals, and converting a signal from free operation to coordinated operation. Free operation may result in reduced delay at single intersection but when coordinated across a network, delay is decreased for the overall system.

6.2 Network Performance Measures

While the figures in Section 6.1 summarize performance of each individual intersection by delay, LOS, and ICU, the tables in this section combine and summarize four performance measures for all intersections in the network: total delay, total stops, total travel time, and total fuel consumption. The tables also summarize the percent reduction of each measure, which illustrates the overall improvement to the network with the implemented signal timings. The performance measures were calculated (not field-measured) by two separate models, Synchro and SimTraffic. The models summarize data for all vehicles in the network. Network performance measures developed by Synchro and SimTraffic can be found below.

Table 2 – Blackwood-Clementon Road (CR 534) Synchro Network Performance Measures

	AM Peak			Midday Peak			PM Peak			PM Off-peak		
	Existing	Implemented	Difference	Existing	Implemented	Difference	Existing	Implemented	Difference	Existing	Implemented	Difference
Total Delay (hr)	251	222	-11.6%	135	120	-11.1%	315	261	-17.1%	154	128	-16.9%
Total Stops	15,719	15,423	-1.9%	13,792	12,930	-6.3%	22,189	20,793	-6.3%	14,633	13,794	-5.7%
Total Travel Time (hr)	507	478	-5.7%	370	354	-4.3%	662	611	-7.7%	405	379	-6.4%
Fuel Consumed (gal)	699	674	-3.6%	569	547	-3.9%	944	888	-5.9%	616	587	-4.7%
	Weekend AM Peak			Weekend Midday Peak			Weekend PM Peak					
	Existing	Implemented	Difference	Existing	Implemented	Difference	Existing	Implemented	Difference			
Total Delay (hr)	109	91	-16.5%	224	194	-13.4%	138	114	-17.4%			
Total Stops	11,149	10,055	-9.8%	18,503	17,003	-8.1%	13,832	12,474	-9.8%			
Total Travel Time (hr)	304	287	-5.6%	520	490	-5.8%	370	347	-6.2%			
Fuel Consumed (gal)	469	442	-5.8%	772	732	-5.2%	573	538	-6.1%			

Table 3 – Blackwood-Clementon Road (CR 534) SimTraffic Network Performance Measures

	AM Peak			Midday Peak			PM Peak			PM Off-peak		
	Existing	Implemented	Difference	Existing	Implemented	Difference	Existing	Implemented	Difference	Existing	Implemented	Difference
Total Delay (hr)	334	265	-20.6%	177	159	-10.3%	737	667	-9.4%	276	193	-30.0%
Total Stops	16,061	15,494	-3.5%	13,756	12,409	-9.8%	25,187	23,794	-5.5%	15,169	13,709	-9.6%
Total Travel Time (hr)	860	749	-12.9%	482	464	-3.9%	1,336	1,228	-8.1%	646	518	-19.8%
Fuel Consumed (gal)	503	479	-4.7%	390	382	-1.9%	665	649	-2.4%	438	410	-6.4%
	Weekend AM Peak			Weekend Midday Peak			Weekend PM Peak					
	Existing	Implemented	Difference	Existing	Implemented	Difference	Existing	Implemented	Difference			
Total Delay (hr)	120	98	-18.1%	399	313	-21.5%	199	196	-1.3%			
Total Stops	10,489	9,028	-13.9%	20,581	18,137	-11.9%	14,667	13,449	-8.3%			
Total Travel Time (hr)	378	354	-6.2%	804	727	-9.6%	498	470	-5.5%			
Fuel Consumed (gal)	323	313	-3.3%	525	512	-2.4%	392	389	-0.7%			

The overall network performance measures improved during all time periods in both Synchro and SimTraffic. Over the expected five-year life of the project and based upon calculated values, the implemented signal timing is estimated to reduce delay by 182,150 hours (14.6%), stops by 5,939,500 (5.9%), and fuel consumption by 206,700 gallons (4.9%). Based on the fuel savings above, the implemented signal timing is estimated to reduce carbon dioxide emissions by 1,837 metric tons over the life of the project. That estimate is calculated utilizing an equation developed by the US Environmental Protection Agency and factors in a number of the measures from Synchro.

6.3 Time-Space Diagrams

Time-space diagrams can be used as a tool for fine-tuning splits and offsets and maximizing corridor bandwidth and progression. Time-space diagrams for each of the implemented patterns for each roadway are included on the project website. These diagrams show the designed progression for each roadway and the relationship between intersections across the network.

6.4 Travel Time Runs

As stated in Section 2.5, travel time runs were conducted as a fine-tuning tool. In addition to fine-tuning, travel time runs also provide the analyst field-measured metrics such as delay and travel time reductions. While only travel time and delay are summarized here, information on other measures such as the number of stops, stopped delay, and average speed can be found on the project website.

Travel time runs for both directions on Blackwood-Clementon Road (CR 534) were conducted before and after the new signal timings were implemented. The average of the "existing" runs was compared to the average of the "implemented" runs to determine travel time savings on the corridor. These performance data are field-measured and apply only to vehicles on the main corridor. Figure 12 on page 27 illustrate the average cumulative travel time on the corridor for each direction with existing and implemented signal timings. The tables at the top of the figure summarizes the average travel time and delay with existing and implemented signal timings and the percent change in those measurements.

Along Blackwood-Clementon Road (CR 534), travel time runs were completed between Black Horse Pike (NJ Route 168) and White Horse Pike (NJ Route 30) but the section between Blenheim-Erial Road (CR 706) and Branch Avenue (CR 687) was utilized for this analysis since it is the section with coordinated timings and will provide a fair analysis. The other signals are either running free or are coordinated along the NJDOT maintained routes, so a comparison would significantly factor in random arrivals and chance. The analysis of the coordinated section does not have that issue. In the eastbound direction, weekday travel times decreased by up to 103 seconds (30.6%) and weekend travel times decreased by up to 82 seconds (26.7%). In the westbound direction, weekday travel times decreased by up to 96 seconds (27.7%) and weekend travel times decreased by up to 98 seconds (31.1%).

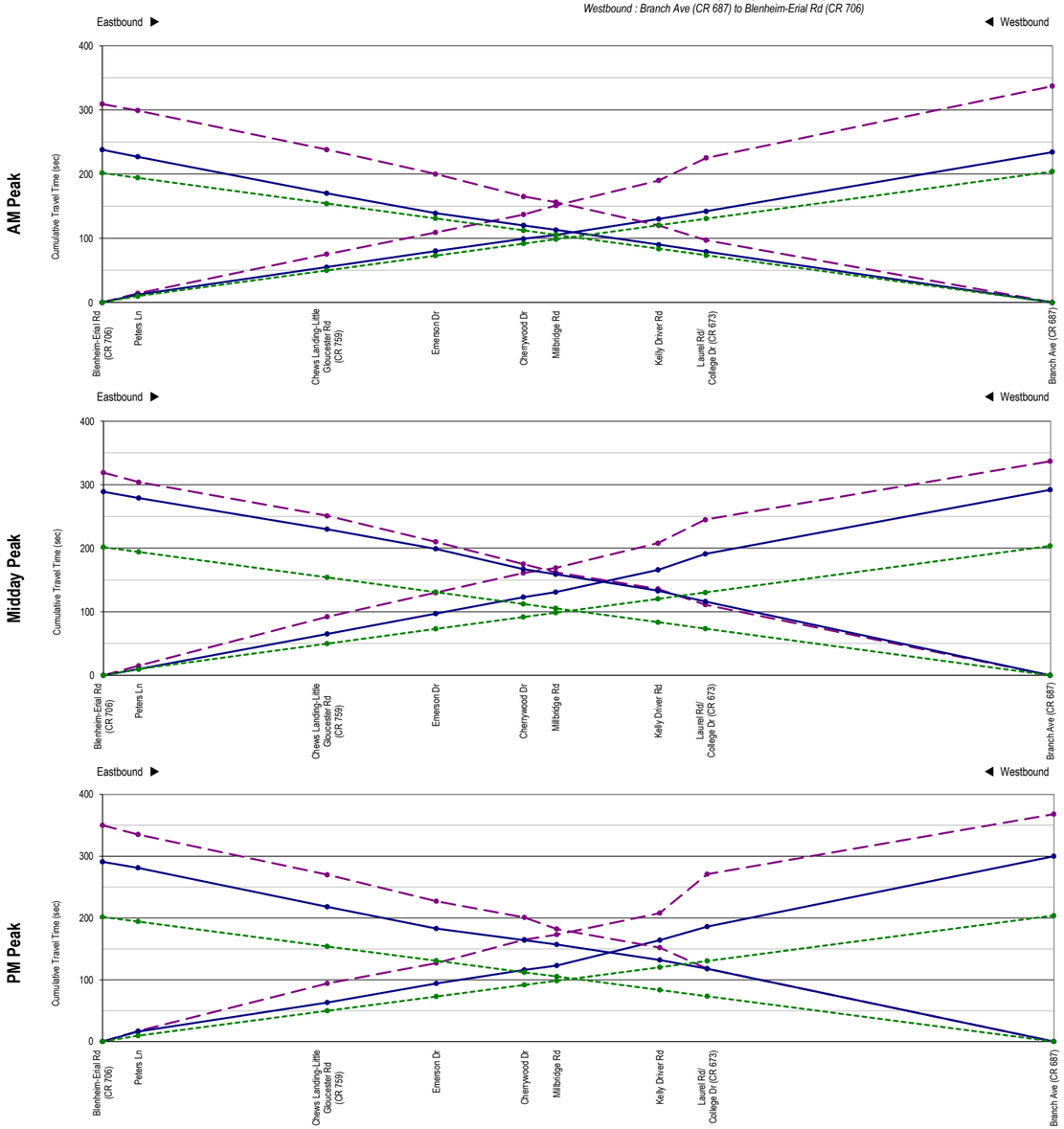
During the travel time runs under both existing and implemented conditions, dash cam video was collected. Those videos were then processed into several comparison videos detailing the improvements along Blackwood-Clementon Road (CR 534). Those analysis videos include the entire network instead of just the coordinated section as described previously. Those videos are available on the project website and were developed for both the AM and PM peak periods in the direction of the higher volumes for each time period.

Average Total Travel Time & Delay

Blackwood-Clementon Rd (CR 534): 2.5 miles

		AM Peak		Midday Peak		PM Peak		PM Off-peak		Weekend AM Peak		Weekend Midday Peak	
		Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)
Eastbound	Existing	337	133	337	133	368	164	322	118	307	103	356	152
	Implemented	234	30	292	89	300	97	272	68	225	21	280	76
	Difference	-103		-45		-68		-50		-82		-76	
	% Difference	-30.6%	-77.4%	-13.4%	-33.8%	-18.5%	-41.5%	-15.5%	-42.4%	-26.7%	-79.6%	-21.3%	-50.0%
Westbound	Existing	309	107	319	117	350	148	347	145	315	114	356	154
	Implemented	238	36	289	87	291	89	251	49	217	15	261	59
	Difference	-71		-30		-59		-96		-98		-95	
	% Difference	-23.0%	-66.4%	-9.4%	-25.6%	-16.9%	-39.9%	-27.7%	-66.2%	-31.1%	-86.0%	-26.7%	-61.7%

Eastbound : Blenheim-Erial Rd (CR 706) to Branch Ave (CR 687)
Westbound : Branch Ave (CR 687) to Blenheim-Erial Rd (CR 706)



Existing
Implemented
Free Flow

Figure 12

Average Travel Time & Delay

Blackwood-Clementon Rd (CR 534)

7.0 TRAFFIC SIGNAL RETIMING BENEFIT-COST ANALYSIS

The purpose of this analysis is to establish a project's merit by economically quantifying the benefits and costs associated with the project over its lifetime. According to the ITE, "signal retiming is a beneficial method for maintaining efficient traffic signal operations" and "is the most cost-effective technique to reduce congestion, improve air quality, and potentially reduce accidents." The following discusses the methodology used to determine the benefits and costs of implementing new signal timings at the intersections within the scope of this project.

There are two types of benefits as they relate to transportation improvements. User benefits, or direct benefits, are enjoyed directly by travelers and are determined by a reduction in three distinct travel costs: travel time costs, operating costs, and crash costs. The second type of benefit is non-user benefits, or indirect benefits. These benefits include environmental impacts, air quality, and reduced motorist frustration.

While improved signal timing reduces certain types of crashes, it is difficult to determine the actual reduction without collecting several years of data. Therefore, this analysis assumes the number of crashes will remain constant throughout the life of the project. However, it should be noted that the implemented signal timing and updated clearance intervals may reduce the frequency of some types of crashes at all intersections. Studies reported by the Federal Highway Administration have shown that total crashes are reduced by an average of 15% through retiming; and right-angle crashes reduced by an average of 25% to 32%.

7.1 Travel Time & Operations Benefit-Cost Analysis

Travel time benefits were calculated by modeling delay with existing and implemented signal timings during each hour modeled within Synchro. Each pattern modeled analyzes only the single peak hour for each time period, so benefits were also estimated for non-peak hours during which implemented timings are in coordinated operation. The total delay was multiplied by a value-of-time and auto occupancy to determine the total weekly benefit as a result of reduction in travel time as shown in Table 4 below. The value of time is determined from the Consumer Price Index while the heavy vehicle percentage of three percent on this system was estimated based on the turning movement count data collected in this project, which includes volume counts by classification.

Table 4 – Weekly Benefit for Change in Travel Time Costs – Blackwood-Clementon Rd (CR 534)

Delay (h)	AM	MD	PM	PO	WA	WM	WP
Existing Timings	251	135	315	154	109	224	138
Implemented Timings	222	120	261	128	91	194	114
Change	-29	-15	-54	-26	-18	-30	-24
Estimated Change during other hours				-63			-46
Total Daily Change				-187			-118
Total Weekly Change in Delay				-935			-235

	Auto	Truck
Vehicle Type	98%	2%
Value-of-Time ($/hr) [1,2]	$11.12	$114.99
Auto Occupancy [1]	1.25	1.00
Total	$15,939	$2,691
Weekly Benefit for Change in Travel Time Costs		**$18,630**

[1] *Taken from* Urban Mobility Report, *Texas Transportation Institute, 2012 and adjusted based on Consumer Price Index for May 2023*

[2] *Adjusted for trip type per AASHTO* User Benefit Analysis for Highways, *2003*

Benefits for the reduction in operating costs were calculated by modeling fuel consumption within Synchro with existing and implemented signal timings during each peak hour and estimating fuel consumption during non-peak hours. The total change in fuel consumption was multiplied by the twelve-month average fuel cost from the US Energy Information Administration (EIA) for the Central Atlantic Region where this corridor is located. The weekly benefit for change in operating costs is shown in Table 5 on page 29.

Table 5 – Weekly Benefit for Change in Operating Costs – Blackwood-Clementon Rd (CR 534)

Fuel Consumption (gal)	AM	MD	PM	PO	WA	WM	WP
Existing Timings	699	569	944	616	469	772	573
Implemented Timings	674	547	888	587	442	732	538
Change	-25	-22	-56	-29	-27	-40	-35
Estimated Change during other hours				-67			-64
Total Daily Change				-199			-166
Total Weekly Change				-995			-332
Fuel Cost [3]							$3.74
Weekly Benefit for Change in Operating Costs							**$4,959**

[3] *52-week average fuel cost, US Energy Information Administration Gasoline Prices for the Central Atlantic Region, June 2023 - www.eia.gov*

Based on the previous tables, the total weekly benefit is $23,590.

In order to calculate the total lifetime benefit present value, it was assumed the life of this project will be five years even though the benefit should long outlive that period. As with most of estimates made in the benefit section, the analysis used conservative values, so actual benefits are likely much higher. A discount rate of 3% was used for this estimate. It was also assumed that 100% of the total daily benefit will be realized in Year 1. However, as traffic volumes change, the benefits will decrease. Therefore, benefits in subsequent years are reduced by 20% each year. Table 6 summarizes the present values of annual benefits.

Table 6 – Present Value of Annual Benefits

Year	Annual Benefit Present Value
Year 1	$1,208,105
Year 2	$938,334
Year 3	$683,253
Year 4	$442,235
Year 5	$214,677

The present value of total lifetime benefits based on the table above is approximately $3,486,000.

Costs

The total cost to conduct all the tasks for the intersections within the scope of this project was $117,561.

Benefit-Cost Ratio

Comparing the anticipated benefits from savings in travel time and operating costs to the overall project costs, the anticipated benefit-cost ratio for this project is 30:1.

8.0 RECOMMENDATIONS

8.1 Recommendations for Safety Improvements

Based on the field observations in Section 2.0, the following improvements are recommended to mitigate potentially hazardous conditions.

General Recommendations

- A thorough list of pedestrian detection issues relating to both pushbuttons and displays is included within the Appendix in Figure 13 on page 34. That list is accurate as of June 2023, so could change in the meantime but consider utilizing that list to update and address all pedestrian detection and display issues to improve pedestrian safety and consistency.
- Over the course of this project, three controllers were replaced from older Econolite ASC/2 and Peek 3000 controllers to new Econolite Cobalt controllers. If this occurs with other intersections in this network in the future, ensure the timings developed in this project are utilized in the new controllers programming.
- Consider analyzing the need for the existing school zone that exists in the area of Highland High School on Blackwood-Clementon Road (CR 534). Traffic largely ignores the current signage for this school zone, so if deemed necessary, consider installing flashing beacons or analyzing other methods to draw attention to this school zone along CR 534 in the area of Highland High School.

Blackwood-Clementon Road & Branch Ave (CR 687)

- The pedestrian displays at this intersection are not consistent with the other signals within the network. Consider adding pedestrian pushbuttons and countdown displays to support the crosswalk on the west side of this intersection. This could result in the removal of the pedestrian recall currently programmed at this intersection since a pushbutton currently exists but cannot place a call in the controller, so must be in recall to ensure pedestrians can safely cross CR 534.

Berlin-Clementon Road & New Freedom Road (CR 691)

- There are currently three pedestrian pushbuttons at this intersection, one on each corner with the exception of the southeast corner where it looks like a stub pole was hit and removed. Consider reviewing this layout and installing a pedestrian pushbutton on that corner for consistency and ensuring all pushbuttons place calls on pedestrian phase 4 in the controller. Beyond push buttons being installed, consider the installation of countdown displays and crosswalks for pedestrians to be able to safely traverse this intersection.

8.2 Recommendations for Capacity and Operational Improvements

Beyond optimizing traffic signal timing, other improvements such as additional capacity can further improve the performance of an intersection and roadway network. Additional consideration should be given to improvements required by future traffic growth and costs of right-of-way, design, construction, etc. However, these considerations are not included in the scope of this project.

General Recommendations

- Consider reviewing and addressing the remaining vehicle detection issues within the network. The known issues found during this retiming project are summarized in the Field Notes Summary provided in the Appendix on Figure 13 on page 34 and was last updated near the completion of this project in June 2023. A priority list of addressing known detection issues is as follows and ranks the locations where functional detection would have the most impact on improving traffic operations. Addressing these detection problems would allow cycle time to be distributed more appropriately at some critical intersections throughout this network and could significantly reduce delays and stops along Blackwood-Clementon Road (CR 534) and reduce driver frustration.

  - Blackwood-Clementon Road (CR 534) & Emerson Drive
    - All vehicle detection was failing during the project, resulting in constant calls on all phases. Repairing the detection at this intersection would significantly improve progression and operations for traffic on CR 534.
  - Blackwood-Clementon Road (CR 534) & Gibbsboro Road (CR 686)/Erial Road (CR 703)
    - This is a major intersection and has heavy volumes on both crossing arterials. Both roadways have major movements with non-functioning detection. Repairing the detection operation would dramatically reduce the necessary cycle length since this signal is in free operation, especially during off-peak periods and improve overall operation.
  - Berlin-Clementon Road (CR 534) & White Horse Ave (CR 695)/Clementon Park Driveway
    - The side street movements at this intersection have loop detection for vehicles but they are failing, resulting in the side street servicing a significant amount of time each cycle despite minimum volume demands. If this detection were addressed, side street movements would only service when there is vehicle demand, which would reduce delay and stops through this signal.
  - Clementon Road (CR 534) & Franklin Avenue (CR 692)
    - There is currently no vehicle or pedestrian detection for both CR 534 movements at this intersection, so each phase must service the full allotment of time regardless of demand, which is inefficient. Consider installing vehicle detection and pedestrian pushbuttons, so the signal can be more reactive to detection inputs. This improvement would reduce cycle lengths and delays at this signal significantly and likely reduce driver frustration caused by long waits, particularly during off-peak time periods.
  - Blackwood-Clementon Road (CR 534) & Cherrywood Drive
    - Northbound (Ø4) detection was failing during the project, resulting in constant calls regardless of vehicle demand.

- Consider installing GPS units to all cabinets where they have not yet been installed to keep all controller clocks on a consistent time source. Where there are no GPS units installed and there is no central communication system, controller clocks will drift over time along the network, gradually reducing the effectiveness of the signal timing and increasing the potential for running timings that are not intended from the controller programming. The installation of GPS units will keep all controllers on the same time and will maintain the programming as completed through this project and as shown on the updated timing directives.

  Though running in free operation, or non-coordinated timings, the signals at Gibbsboro Road (CR 686)/Erial Road (CR 607) and Franklin Avenue (CR 692) both run multiple timing plans by time of day, which are called via the controller scheduler in the programming and reliant on the controller clock. Therefore, it would be beneficial to ensure those controller clocks are accurate to GPS time. The existing controller clocks where GPS units are not present were observed maintaining time well generally but over time, the clocks will drift. The priority for installing GPS units should be as follows:
  - Blackwood-Clementon Road (CR 534) & Branch Avenue (CR 687)
    - Highest priority since only signal running coordinated timings without GPS unit
  - Blackwood-Clementon Road (CR 534) & Gibbsboro Road (686)/Erial Road (CR 607)
    - Runs four timing plans based on time-of-day programming
  - Clementon Road (CR 534) & Franklin Avenue (CR 692)
    - Runs three timing plans based on time-of-day programming

  - Berlin-Clementon Road (CR 534) & White Horse Avenue (CR 695)/Clementon Park Driveway
    - Not critical, GPS would ensure consistency, will not impact timing operation
  - Berlin-Clementon Road (CR 534) & New Freedom Drive (CR 691)
    - Not critical, GPS would ensure consistency, will not impact timing operation

  Another option for the controller clocks is to develop a plan to regularly reset controller clocks manually to maintain consistent time. The clocks at the signals above were observed to drift slowly, so setting the clocks every six to eight weeks should maintain the time enough to continue to realize benefits from this signal retiming. If this is not feasible, consider at least adding a step to the regular preventative maintenance program for these signals to manually set the controller time.

- As this system continues to develop in the future, consider the impact any changes may have to the signal timings for activities such as replacing controllers, upgrading equipment, new developments, or any roadway adjustments. There is a Wawa opening shortly after the completion of this project on the southeast corner of Blackwood-Clementon Road (CR 534) & Cherrywood Drive. Consider collecting volumes and reanalyzing timing needs once that is in full operation as that will be a major traffic generator and traffic characteristics will likely change once that is open.

<u>Blackwood-Clementon Road (CR 534) & Blenheim-Erial Road (CR 706)</u>

- Consider analyzing the installation of an eastbound right-turn overlap at Blackwood-Clementon Road (CR 534) & Blenheim-Erial Road (CR 706). This would entail adding a 5-section signal head in replacement of the existing 3-section signal head and would link an eastbound protected right-turn arrow with the heavy volume northbound movement, allowing them to service simultaneously. The eastbound approach is heavily influenced by vehicles existing Route 42 along with those travelling eastbound from the Black Horse Pike (NJ Route 168) intersection, which both result in random arrivals at this intersection. The northbound movement is given significant cycle time, so this overlap would improve operational efficiency and reduce delay.

  An additional change that would be necessary to support this recommendation would be adjusting the inside shared through/right movement to a through only since a protected movement should not be supported by a shared lane. The eastbound shared through/right lane is generally as a through only lane under existing conditions as very few vehicles were observed making the eastbound right turn movement from that lane.

9.0 APPENDIX

Included in the Appendix within this report are as follows:

- Field Notes Summary with detailed list of detection and operational issues found during project (Figure 13)
- Phase Sequence Diagrams (Figure 14 – Figure 15)
- Traffic Operations Analysis figures (Figure 16 – Figure 47)

Documents included on the project website:

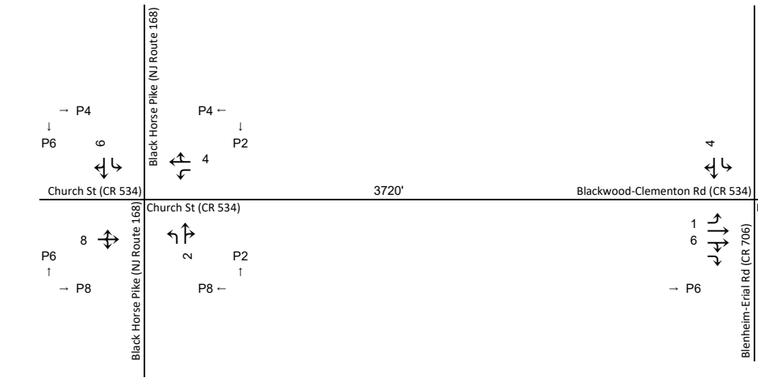
- 7-day, 24-hour directional raw volume counts
- Turning movement counts
- Clearance calculations
- Existing and implemented timing sheets
- Existing and implementing timing directives
- Intersection cabinet, approach, and aerial photographs
- Field notes
- Synchro models with existing and implemented signal timings and report files
- Tru-Traffic files and travel time reports displaying time-space diagrams with implemented signal timings
- Travel time run comparison videos
- Final report

Full NJ Signal Retiming Project URL is as follows:
https://iterisinc1.sharepoint.com/sites/CS-Ext-NJSignalTiming

Individual Project page under Project Page section:
Blackwood-Clementon Rd (CR 534) - Camden County

Please note that permissions must be manually added to access SharePoint website, so please direct any requests for access to Brian Jatzke at bjatzke@iteris.com.

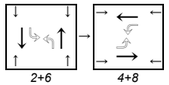
ID	Intersection	Date of Last Observation	Controller Type	Notes and observations from Field Notes *Directionality Notes: CR 534 assumed East-West throughout network*
1	Church St (CR 534) & Black Horse Pike (NJ Route 168)	06/28/2023	Peek 3000E	NJDOT maintained, detection all OK and pedestrians working as expected. Signal running in free operation.
2	Blackwood-Clementon Rd (CR 534) & Blenheim-Erial Rd (CR 706)	06/28/2023	Econolite Cobalt	These two intersections run off one controller located at Peters Ln. All detection working, Wavetronix vehicle detection installed and operational at completion of project. Controller changed from Econolite ASC/2 to Econolite Cobalt controller during retiming project and GPS unit was installed. At time of initial field notes, there were constant calls on the Ø3 (northbound), Ø4 (southbound) and Ø5 (westbound left turn) detection but those issues were addressed.
3	Blackwood-Clementon Rd (CR 534) & Peters Ln	06/28/2023	Econolite Cobalt	
4	Blackwood-Clementon Rd (CR 534) & Chews Landing-Little Gloucester Rd (CR 759)	06/28/2023	Econolite Cobalt	GPS installed and changed to Econolite Cobalt controller during project. All detection OK.
5	Blackwood-Clementon Rd (CR 534) & Emerson Dr	06/28/2023	Econolite Cobalt	Ø1 (eastbound left-turn) and Ø4 (northbound+southbound) loop detection had constant calls during entirety of project, so servicing full allotment of time each cycle regardless of volume demand. GPS installed and changed to Econolite Cobalt controller during project.
6	Blackwood-Clementon Rd (CR 534) & Cherrywood Dr	06/28/2023	Econolite ASC/3-2100	Ø4 (northbound) vehicle detection (Wavetronix) had constant call through full project, so serviced each cycle regardless of demand and utilized full allotment of time. Pedestrian countdown for display for Ø4 (northbound) pedestrian movement on southwest corner not illuminating. GPS unit was already installed at beginning of project.
7	Blackwood-Clementon Rd (CR 534) & Millbridge Rd	06/28/2023	Econolite ASC/3-2100	Pedestrian countdown for display for Ø2 (westbound) pedestrian movement on north median facing west not illuminating. Pedestrian countdown also not illuminating for Ø4 (southbound) for display on northwest corner. GPS unit was already installed at beginning of project.
8	Blackwood-Clementon Rd (CR 534) & Kelly Driver Rd	06/28/2023	Econolite Cobalt	Pedestrian countdown for display for Ø8 (northbound) pedestrian movement on southeast corner not illuminating. Otherwise all detection OK for both vehicles and pedestrians. GPS installed toward end of project and installation point on top of cabinet not completely sealed, so needs to be reviewed to ensure no water damage to cabinet or components. Reviewed following rain and noticed small puddle of water on top shelf. Consultant team cleaned up and put paper towels on top, but GPS hole needs to be sealed.
9	Blackwood-Clementon Rd (CR 534) & Laurel Rd/College Dr (CR 673)	06/28/2023	Econolite ASC/3-2100	The outside three-section head for the westbound movement has green ball out. All pedestrian and vehicle detection OK. The UPS system in the cabinet appeared to be shorting out as it is clicking consistently and the screen would flash without turning on. This does not impact signal typical signal operations but may not work with battery backup as operating at completion of project.
10	Blackwood-Clementon Rd (CR 534) & Branch Ave (CR 687)	06/28/2023	Econolite ASC/3-2100	There is only one pedestrian pushbutton at signal and is located on the northwest corner and it does not place calls in the controller. Therefore, the pedestrian phase is in recall for side street Ø4 (northbound). So this phase services each cycle, regardless of demand. There is no detection for Ø2 (eastbound+westbound) but Ø4 vehicle detection (loops) is working properly.
11	Blackwood-Clementon Rd (CR 534) & Gibbsboro Rd (CR 686)-Erial Rd (CR 703)	06/28/2023	Peek ATC-1000	Ø2 (westbound) and Ø7 (northbound+southbound) vehicle detection both had constant calls throughout project, so utilized full allotment of time regardless of volume demand. Ø1, Ø5 and Ø6 detection all worked properly along with pedestrian pushbuttons. There is inconsistent signage for pedestrians instructions around intersection and some have only the pushbutton with no signing.
12	Berlin-Clementon Rd (CR 534) & White Horse Ave (CR 695)/Clementon Park Driveway	06/28/2023	Econolite ASC/2S-2100	Ø4 (northbound+southbound) loop vehicle detection had constant call throughout project. The pedestrian button for pedestrian phase 4 on the southwest corner was broken, so could not place call in controller. The pedestrian display on the northwest corner for pedestrian Ø4 (southbound) looks to have been tilted ~45 degrees away from crosswalk, so cannot see from crosswalk.
13	Berlin-Clementon Rd (CR 534) & New Freedom Rd (CR 691)	06/28/2023	Econolite ASC/3-2100	Ø2 (eastbound+westbound) video detection had constant call throughout project, so mimics a maximum recall. The stub pole for southbound pedestrian phase 4 on the southeast corner was missing throughout the project as well. The base at ground level is still present but cut clean, so likely hit and never replaced. The cabinet was insect infested as well, so should be treated to avoid potential issues or further infestation.
14	Clementon Rd (CR 534) & Franklin Ave (CR 692)	06/28/2023	Econolite ASC/2S-2100	No vehicle or pedestrian detection for Ø2 (westbound) or Ø3 (eastbound), so both in maximum recall. Ø4 (northbound+southbound) detection does not drop calls at times but generally worked properly through project. It could be very helpful to have vehicle detection and pedestrian pushbuttons added to this intersection so phase 2 and phase 3 do not have to service the full split time every cycle.
15	White Horse Pike (NJ Route 30) & Clementon Rd (CR 534)/N Park Dr	06/28/2023	Peek 3000E	NJDOT maintained, detection all OK and pedestrians working as expected.

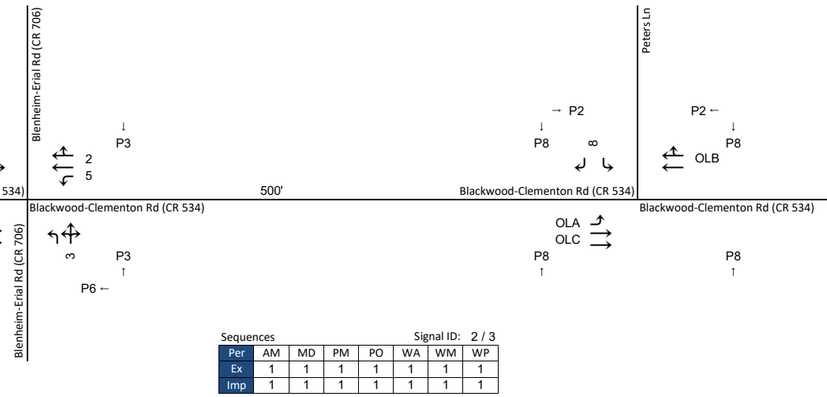


Sequences — Signal ID: 1

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

SEQUENCE 1

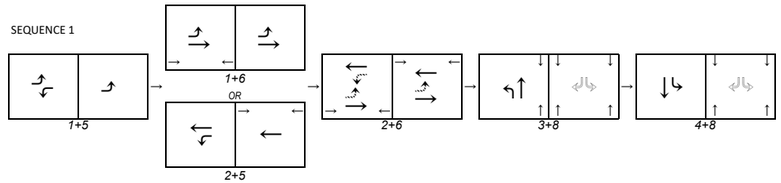


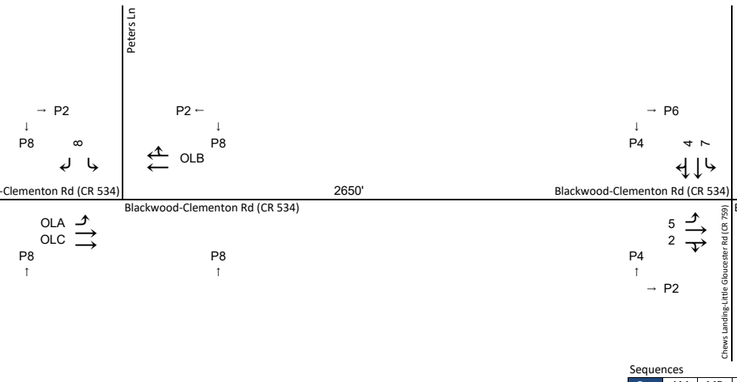


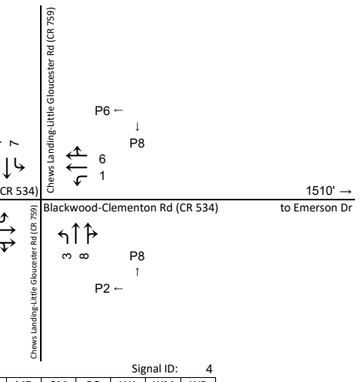
Sequences — Signal ID: 2 / 3

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

SEQUENCE 1



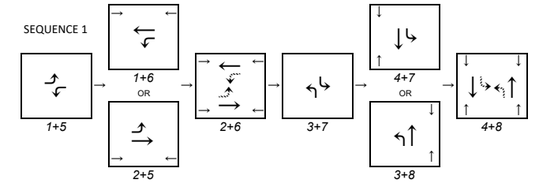




Sequences — Signal ID: 4

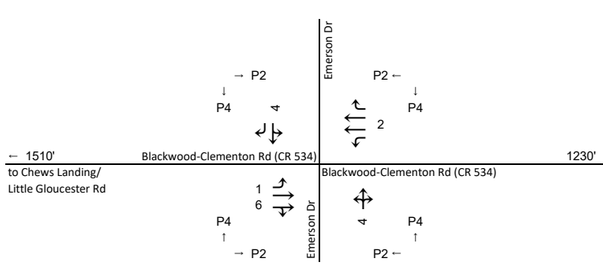
Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

SEQUENCE 1



Note: These two intersections are operated by one controller located at signal ID 3.

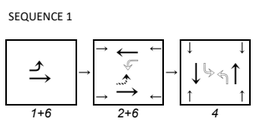
On diagrams, Erial-Blenheim shown on left and Peters Ln shown on right.

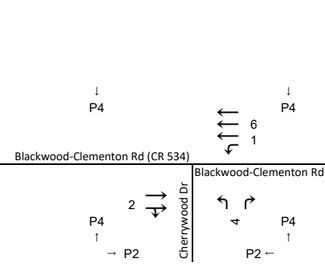


Sequences — Signal ID: 5

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

SEQUENCE 1

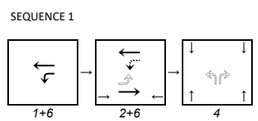


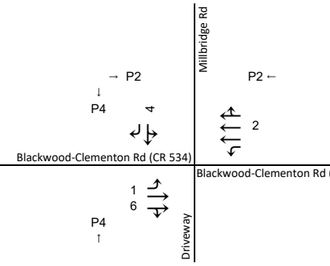


Sequences — Signal ID: 6

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

SEQUENCE 1

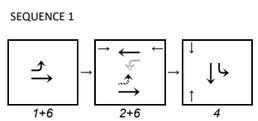


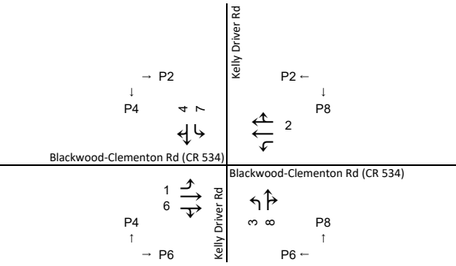


Sequences — Signal ID: 7

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

SEQUENCE 1

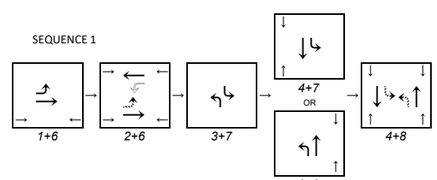




Sequences — Signal ID: 8

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

SEQUENCE 1



Phase Diagrams

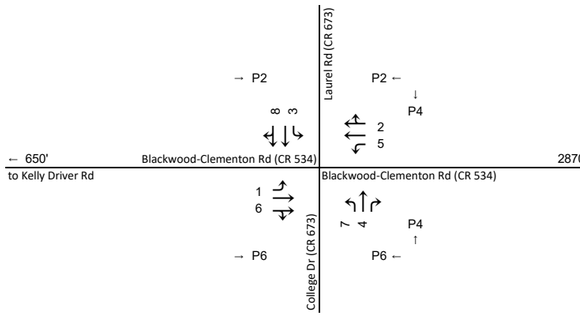
- Permissive Movement
- Protected + Permissive Movement
- Protected-Only Movement

NTS

Figure 14

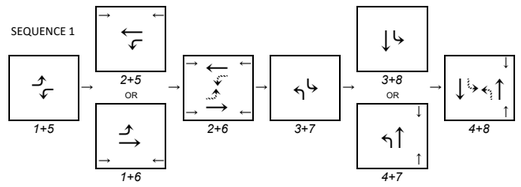
Phase Sequence Diagrams

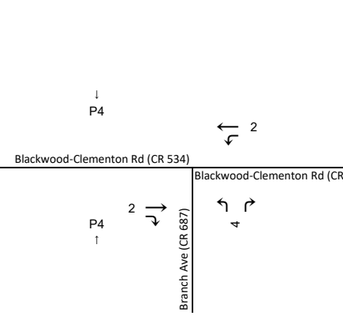
Blackwood-Clementon Rd (CR 534) - Black Horse Pike (NJ Route 168) to Kelly Driver Rd



Sequences — Signal ID: 9

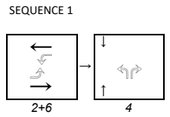
Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

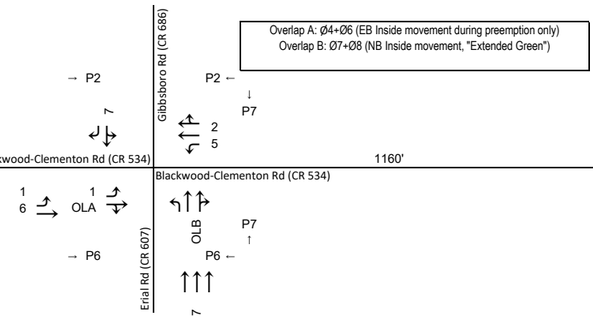




Sequences — Signal ID: 10

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

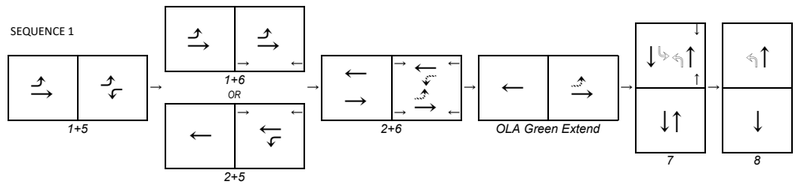


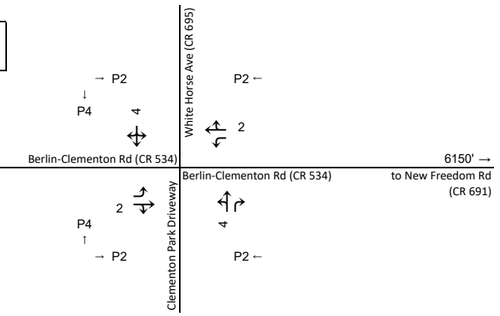


Overlap A: Ø4+Ø6 (EB Inside movement during preemption only)
Overlap B: Ø7+Ø8 (NB Inside movement, "Extended Green")

Sequences — Signal ID: 11

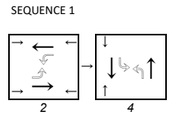
Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1



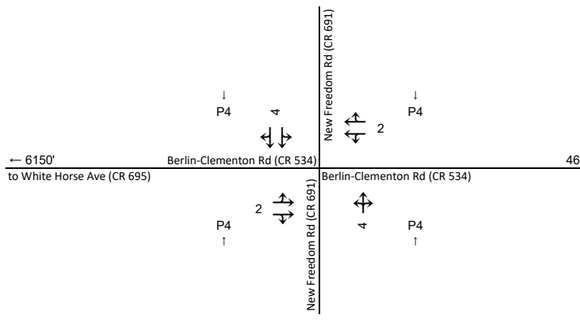


Sequences — Signal ID: 12

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

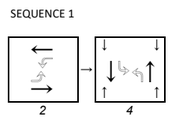


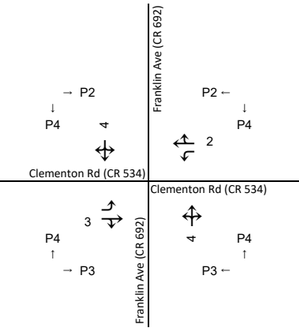
Railroad crosses over CR 534 just to west of primary intersection and also just to south of primary intersection. Left box shows the signal operation on the west side of the railroad crossing. For N-S diagrams, bottom box shows operation of signals south of rail crossing. Simplified typical operation shown in the diagram above.



Sequences — Signal ID: 13

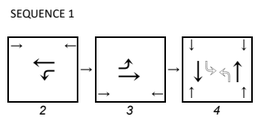
Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1

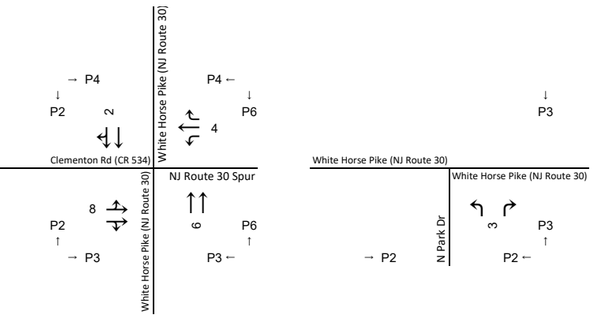




Sequences — Signal ID: 14

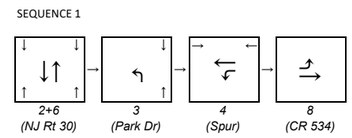
Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1





Sequences — Signal ID: 15

Per	AM	MD	PM	PO	WA	WM	WP
Ex	1	1	1	1	1	1	1
Imp	1	1	1	1	1	1	1



Note: This is a five legged intersection.
N Park Dr is Ø3, North East leg is shown in the diagram to right

Phase Diagrams

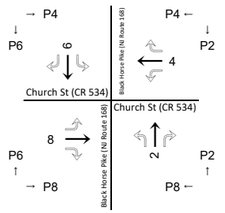
- Permissive Movement
- Protected + Permissive Movement
- Protected-Only Movement

N NTS

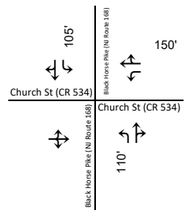
Figure 15

Phase Sequence Diagrams

Blackwood-Clementon Rd (CR 534) - Laurel Rd/College Dr (CR 673) to White Horse Pike (NJ Route 30)

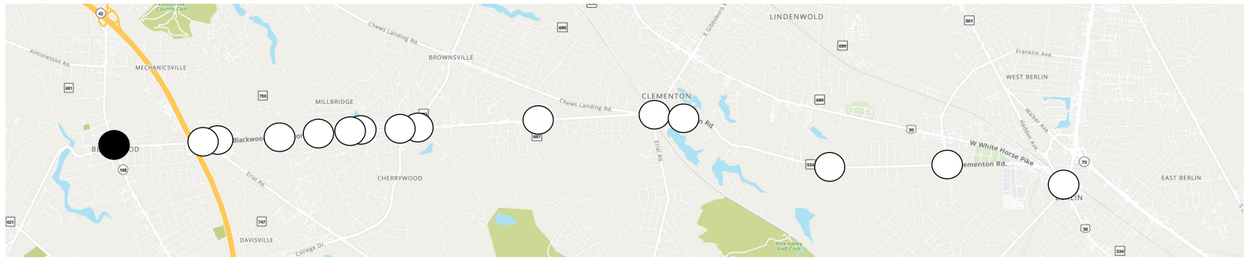


Phasing Diagram



Intersection Geometry

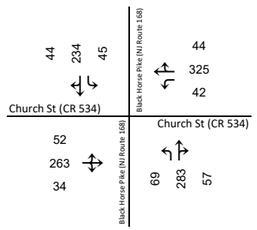
Intersection ID #
1



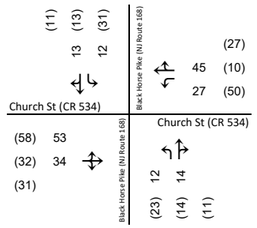
N
NTS

AM Peak

Hourly Volumes

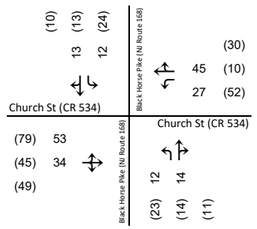


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	83.9
Max v/C	0.87
Syn Delay	27 C
Sim Delay	(16)
ICU	**102%** G

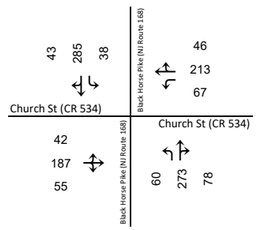
Implemented Operations



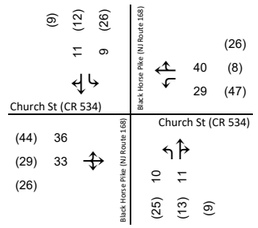
Summary	
Timing Pattern	FREE
Actuated Cycle	83.9
Max v/C	0.87
Syn Delay	27 C
Sim Delay	(19)
ICU	**102%** G

MD Peak

Hourly Volumes

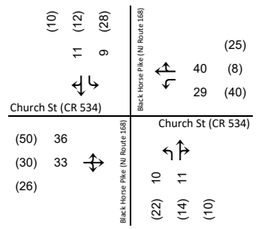


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	77.4
Max v/C	0.78
Syn Delay	21 C
Sim Delay	(15)
ICU	88% E

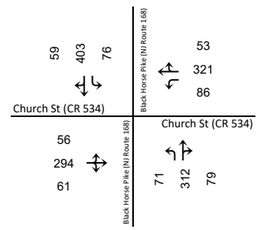
Implemented Operations



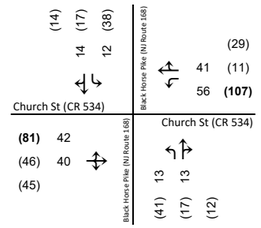
Summary	
Timing Pattern	FREE
Actuated Cycle	77.4
Max v/C	0.78
Syn Delay	21 C
Sim Delay	(15)
ICU	88% E

PM Peak

Hourly Volumes

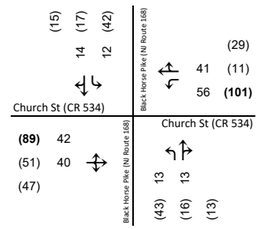


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	81.3
Max v/C	0.83
Syn Delay	27 C
Sim Delay	(23)
ICU	**108%** G

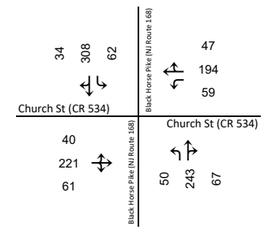
Implemented Operations



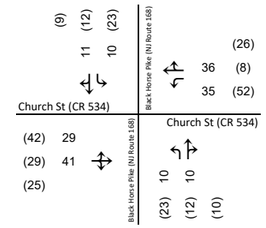
Summary	
Timing Pattern	3
Actuated Cycle	81.3
Max v/C	0.83
Syn Delay	27 C
Sim Delay	(24)
ICU	**108%** G

PM Off-peak

Hourly Volumes

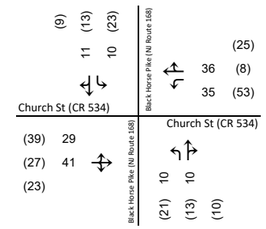


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	78.1
Max v/C	0.80
Syn Delay	23 C
Sim Delay	(14)
ICU	91% E

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	78.1
Max v/C	0.80
Syn Delay	23 C
Sim Delay	(15)
ICU	91% E

Operations with Improvements

No operational improvements recommended at this time.

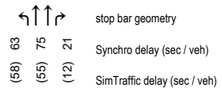
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



Hourly Volume Diagrams

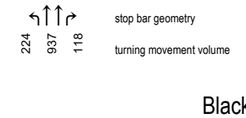
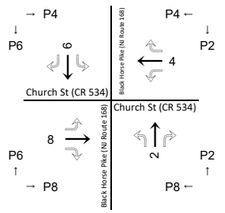


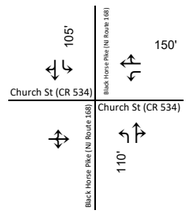
Figure 16

Weekday Traffic Operations Analysis

Black Horse Pike (NJ Route 168) & Church St (CR 534)

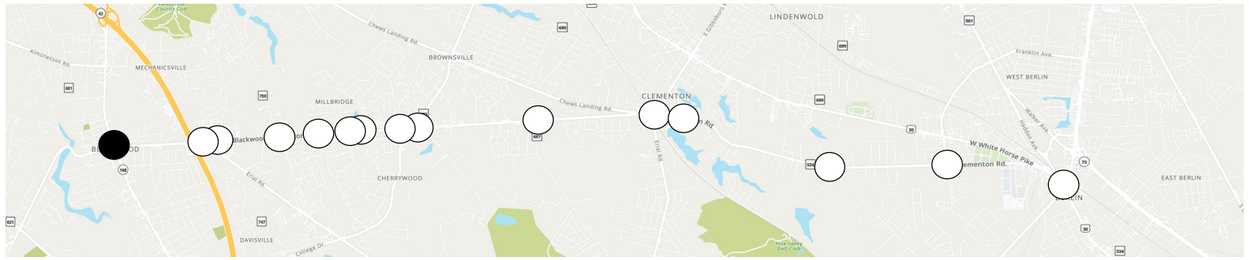


Phasing Diagram



Intersection Geometry

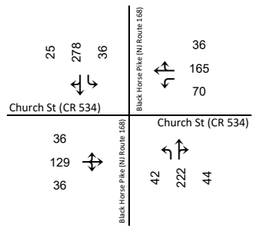
Intersection ID #
1



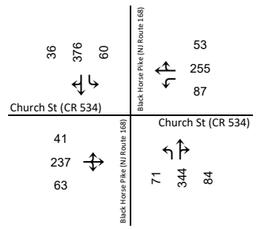
NTS

Hourly Volumes

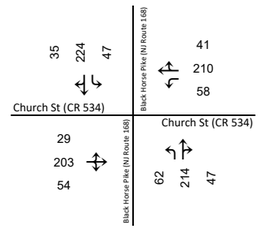
Weekend AM Peak



Weekend MD Peak

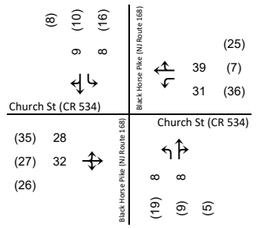


Weekend PM Peak



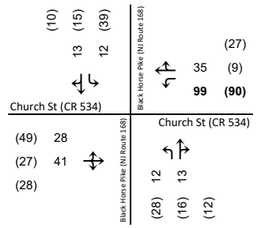
Existing Operations

Weekend AM Peak



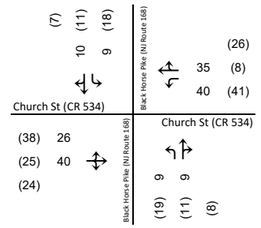
Summary	
Timing Pattern	FREE
Actuated Cycle	74.6
Max v/C	0.74
Syn Delay	20 B
Sim Delay	(12)
ICU	71% C

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	80.4
Max v/C	0.96
Syn Delay	28 C
Sim Delay	(18)
ICU	**100%** G

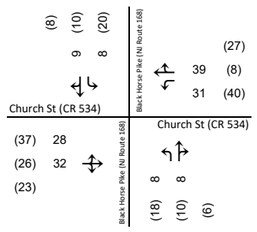
Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	76.9
Max v/C	0.78
Syn Delay	23 C
Sim Delay	(13)
ICU	90% E

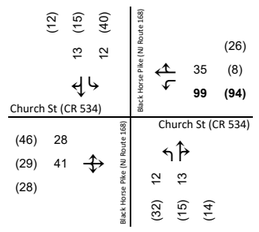
Implemented Operations

Weekend AM Peak



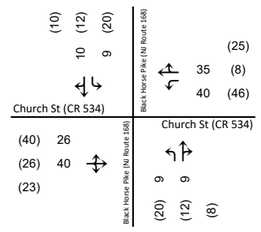
Summary	
Timing Pattern	FREE
Actuated Cycle	74.6
Max v/C	0.74
Syn Delay	20 B
Sim Delay	(12)
ICU	71% C

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	80.4
Max v/C	0.96
Syn Delay	28 C
Sim Delay	(18)
ICU	**100%** G

Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	76.9
Max v/C	0.78
Syn Delay	23 C
Sim Delay	(13)
ICU	90% E

Operations with Improvements

No operational improvements recommended at this time.

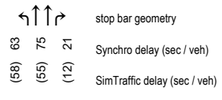
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

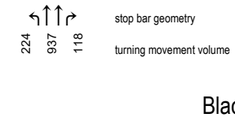
LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

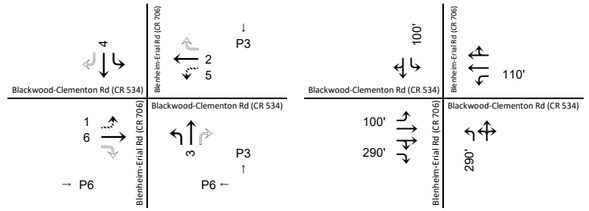


stop bar geometry
turning movement volume

Figure 17

Weekend Traffic Operations Analysis

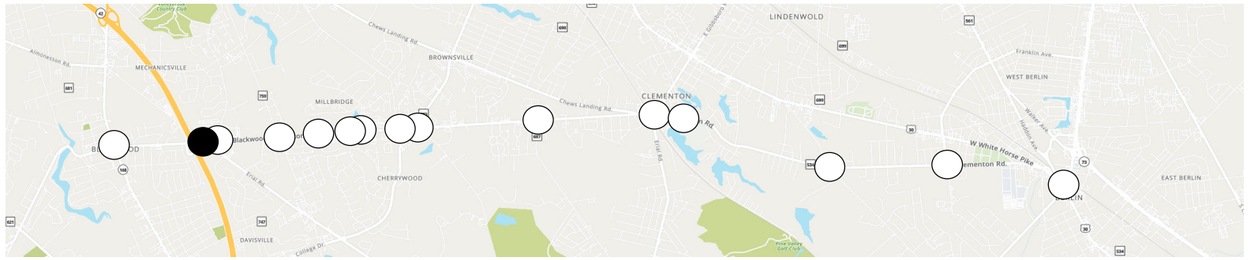
Black Horse Pike (NJ Route 168) & Church St (CR 534)



Phasing Diagram

Intersection Geometry

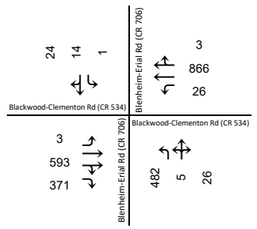
Intersection ID #
2



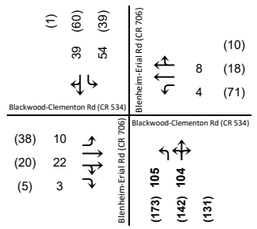
N
NTS

AM Peak

Hourly Volumes

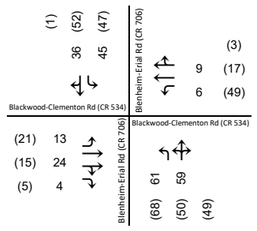


Existing Operations



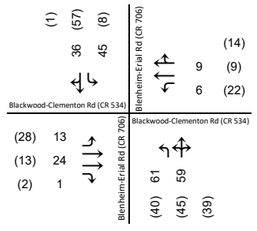
Summary	
Timing Pattern	2
Actuated Cycle	120
Max v/C	1.03
Syn Delay	33 C
Sim Delay	(49)
ICU	59% B

Implemented Operations



Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.88
Syn Delay	24 C
Sim Delay	(26)
ICU	59% B

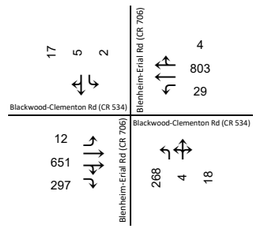
Operations with Improvements



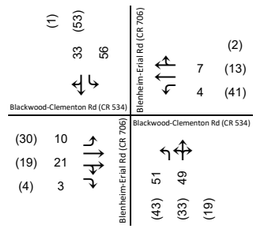
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.88
Syn Delay	24 C
Sim Delay	(16)
ICU	59% B

MD Peak

Hourly Volumes

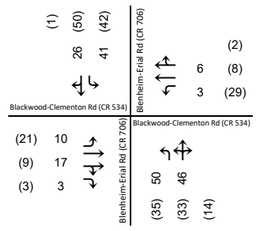


Existing Operations



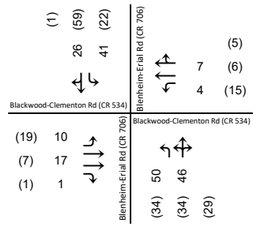
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.56
Syn Delay	17 B
Sim Delay	(18)
ICU	52% A

Implemented Operations



Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.70
Syn Delay	15 B
Sim Delay	(12)
ICU	52% A

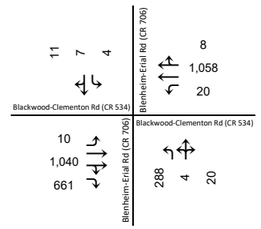
Operations with Improvements



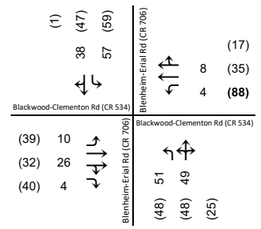
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.70
Syn Delay	15 B
Sim Delay	(10)
ICU	52% A

PM Peak

Hourly Volumes

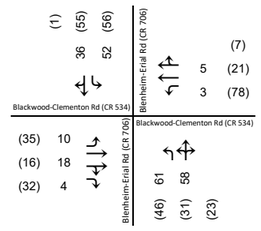


Existing Operations



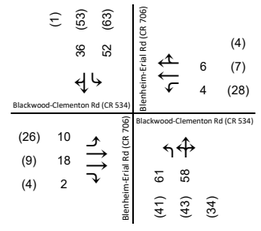
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.72
Syn Delay	18 B
Sim Delay	(37)
ICU	66% C

Implemented Operations



Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.74
Syn Delay	15 B
Sim Delay	(25)
ICU	66% C

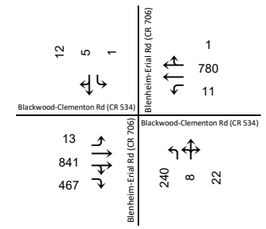
Operations with Improvements



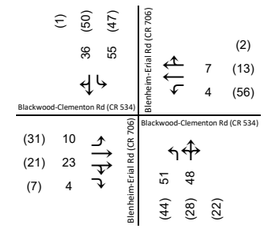
Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.74
Syn Delay	15 B
Sim Delay	(11)
ICU	66% C

PM Off-peak

Hourly Volumes

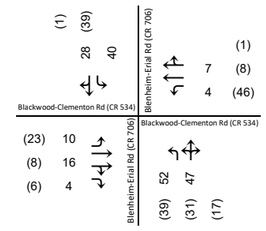


Existing Operations



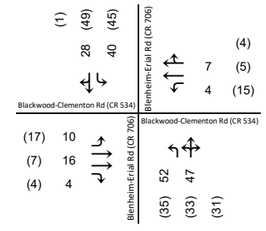
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.56
Syn Delay	17 B
Sim Delay	(18)
ICU	54% A

Implemented Operations



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.73
Syn Delay	15 B
Sim Delay	(11)
ICU	54% A

Operations with Improvements



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.73
Syn Delay	15 B
Sim Delay	(9)
ICU	54% A

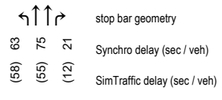
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

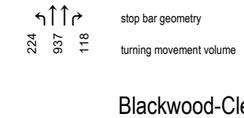


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



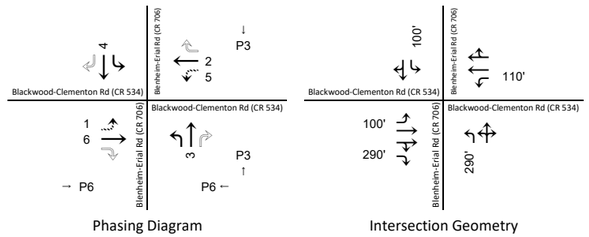
stop bar geometry

turning movement volume

Figure 18

Weekday Traffic Operations Analysis

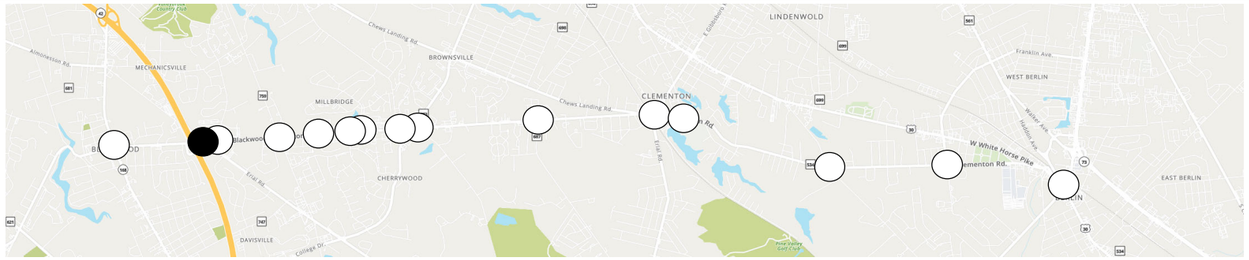
Blackwood-Clementon Rd (CR 534 & Blenheim-Erial Rd (CR 706)



Phasing Diagram

Intersection Geometry

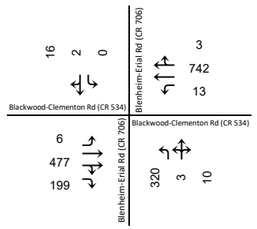
Intersection ID #
2



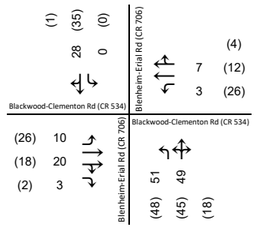
N
NTS

Weekend AM Peak

Hourly Volumes

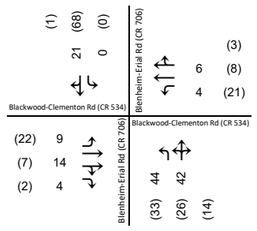


Existing Operations



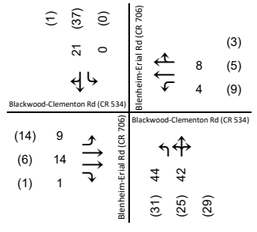
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.56
Syn Delay	18 B
Sim Delay	(19)
ICU	50% A

Implemented Operations



Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.69
Syn Delay	15 B
Sim Delay	(11)
ICU	50% A

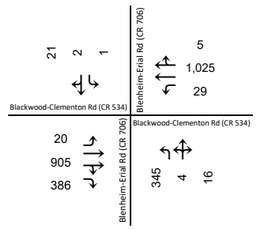
Operations with Improvements



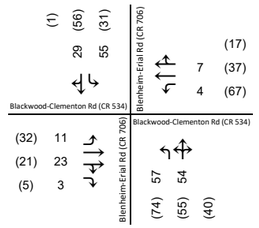
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.69
Syn Delay	15 B
Sim Delay	(10)
ICU	50% A

Weekend MD Peak

Hourly Volumes

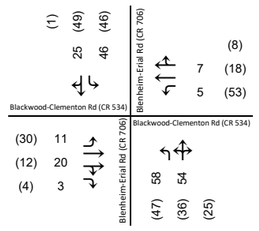


Existing Operations



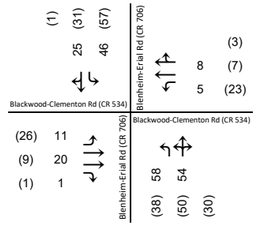
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.70
Syn Delay	19 B
Sim Delay	(32)
ICU	59% B

Implemented Operations



Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.79
Syn Delay	18 B
Sim Delay	(18)
ICU	59% B

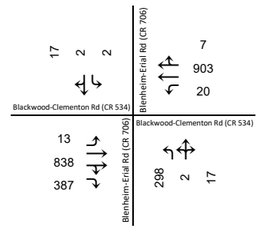
Operations with Improvements



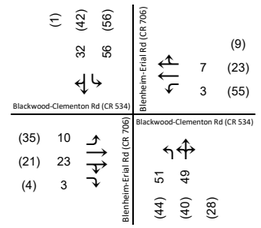
Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.79
Syn Delay	18 B
Sim Delay	(11)
ICU	59% B

Weekend PM Peak

Hourly Volumes

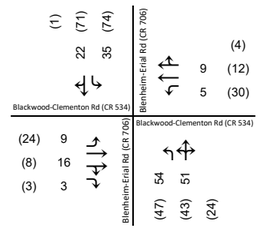


Existing Operations



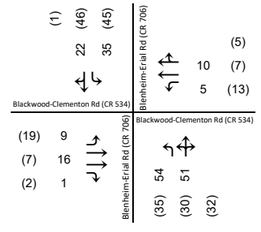
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.62
Syn Delay	18 B
Sim Delay	(22)
ICU	54% A

Implemented Operations



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.77
Syn Delay	16 B
Sim Delay	(14)
ICU	54% A

Operations with Improvements



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.77
Syn Delay	16 B
Sim Delay	(10)
ICU	54% A

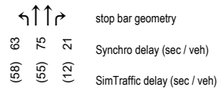
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

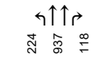


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



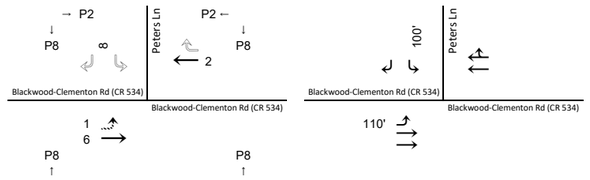
stop bar geometry

turning movement volume

Figure 19

Weekend Traffic Operations Analysis

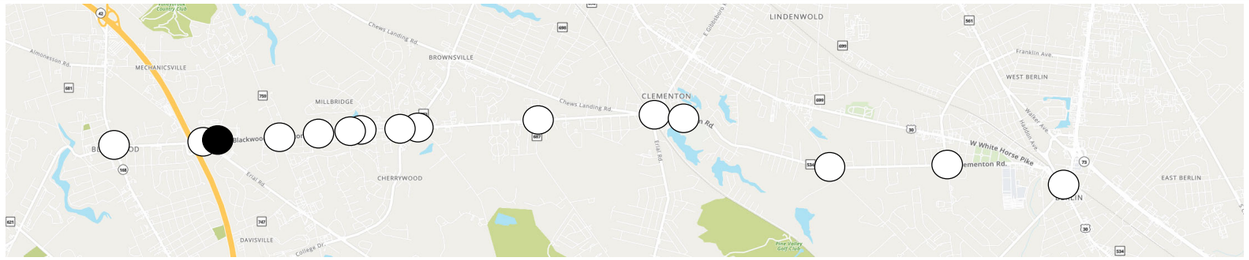
Blackwood-Clementon Rd (CR 534 & Blenheim-Erial Rd (CR 706)



Phasing Diagram

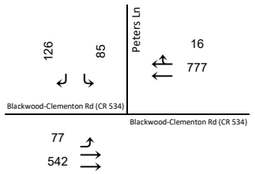
Intersection Geometry

Intersection ID #
3

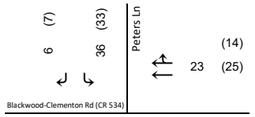


AM Peak

Hourly Volumes

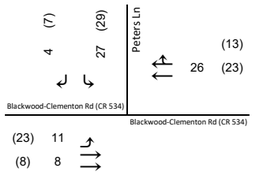


Existing Operations



Summary	
Timing Pattern	2
Actuated Cycle	120
Max v/C	1.03
Syn Delay	17 B
Sim Delay	(19)
ICU	48% A

Implemented Operations



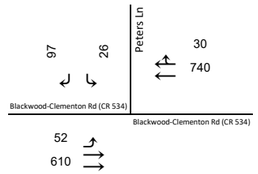
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.88
Syn Delay	18 B
Sim Delay	(17)
ICU	48% A

Operations with Improvements

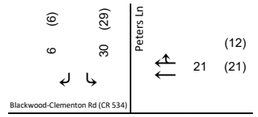
No operational improvements recommended at this time.

MD Peak

Hourly Volumes

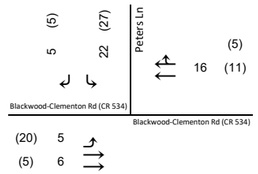


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.56
Syn Delay	14 B
Sim Delay	(15)
ICU	47% A

Implemented Operations



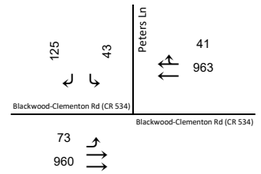
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.70
Syn Delay	11 B
Sim Delay	(9)
ICU	47% A

Operations with Improvements

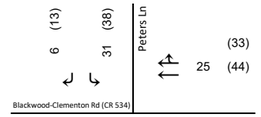
No operational improvements recommended at this time.

PM Peak

Hourly Volumes

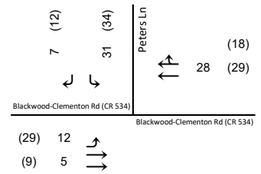


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.72
Syn Delay	16 B
Sim Delay	(32)
ICU	54% A

Implemented Operations



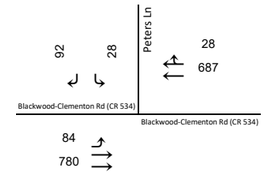
Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.74
Syn Delay	17 B
Sim Delay	(19)
ICU	54% A

Operations with Improvements

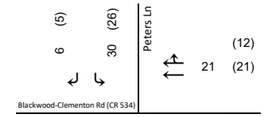
No operational improvements recommended at this time.

PM Off-peak

Hourly Volumes

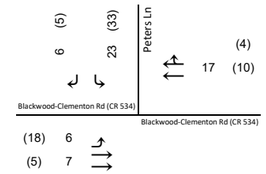


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.56
Syn Delay	13 B
Sim Delay	(15)
ICU	46% A

Implemented Operations



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.73
Syn Delay	11 B
Sim Delay	(8)
ICU	46% A

Operations with Improvements

No operational improvements recommended at this time.

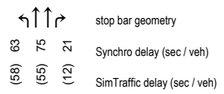
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



Hourly Volume Diagrams

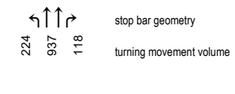
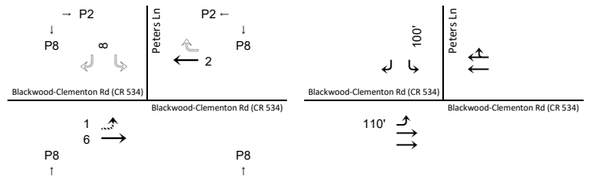


Figure 20

Weekday Traffic Operations Analysis

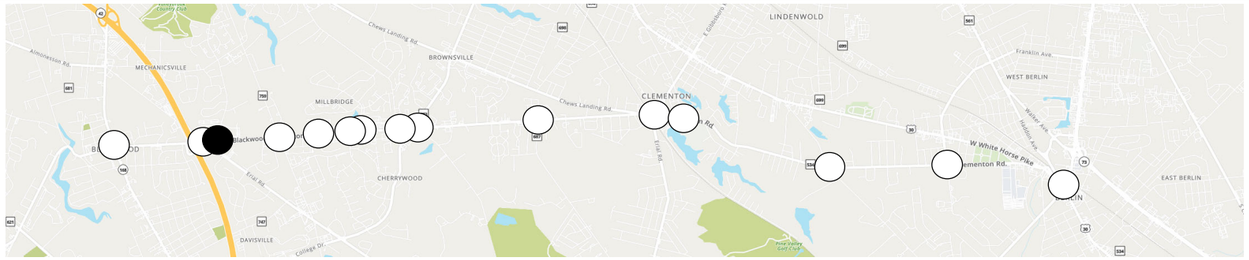
Blackwood-Clementon Rd (CR 534) & Peters Ln



Phasing Diagram

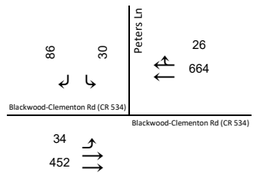
Intersection Geometry

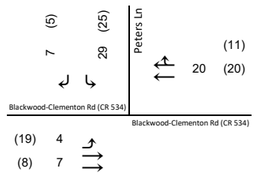
Intersection ID #
3



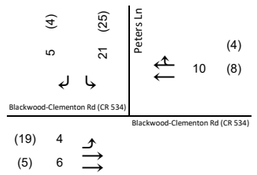
NTS

Weekend AM Peak



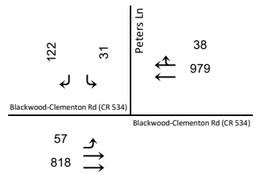


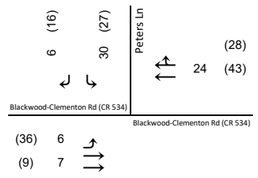
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.56
Syn Delay	14 B
Sim Delay	(15)
ICU	44% A



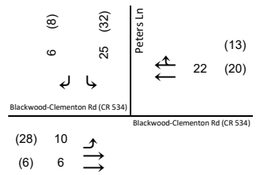
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.69
Syn Delay	8 A
Sim Delay	(7)
ICU	44% A

Weekend MD Peak



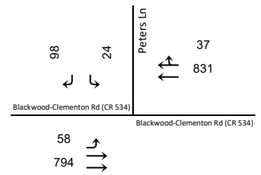


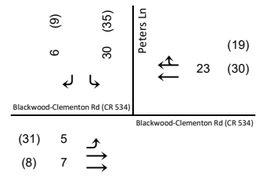
Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.70
Syn Delay	15 B
Sim Delay	(27)
ICU	54% A



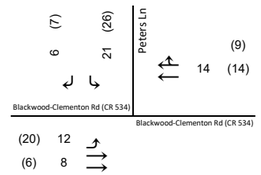
Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.79
Syn Delay	14 B
Sim Delay	(14)
ICU	54% A

Weekend PM Peak





Summary	
Timing Pattern	1
Actuated Cycle	120
Max v/C	0.62
Syn Delay	15 B
Sim Delay	(20)
ICU	50% A



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.77
Syn Delay	11 B
Sim Delay	(10)
ICU	50% A

Hourly Volumes

Existing Operations

Implemented Operations

Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams

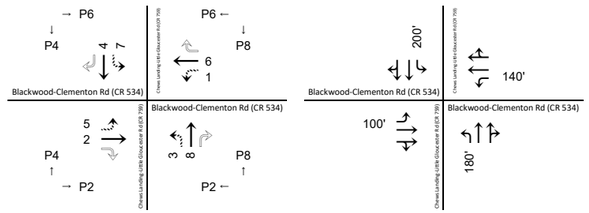
stop bar geometry

turning movement volume

Figure 21

Weekend Traffic Operations Analysis

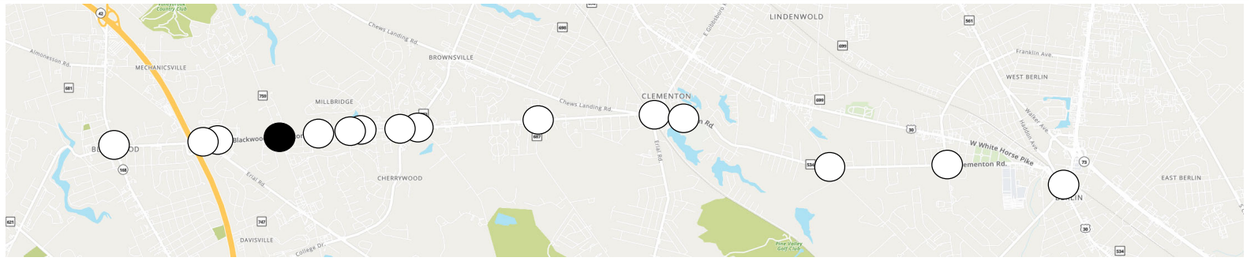
Blackwood-Clementon Rd (CR 534) & Peters Ln



Phasing Diagram

Intersection Geometry

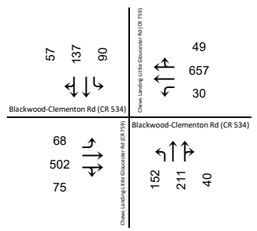
Intersection ID # 4



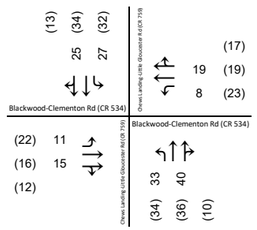
N
NTS

AM Peak

Hourly Volumes

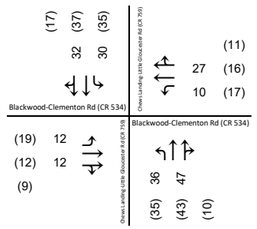


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.71
Syn Delay	22 C
Sim Delay	(22)
ICU	57% B

Implemented Operations



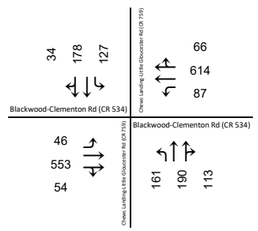
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.75
Syn Delay	26 C
Sim Delay	(21)
ICU	58% B

Operations with Improvements

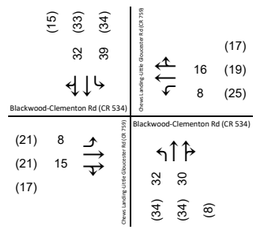
No operational improvements recommended at this time.

MD Peak

Hourly Volumes

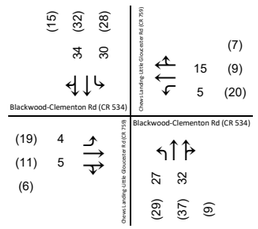


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.69
Syn Delay	22 C
Sim Delay	(23)
ICU	58% B

Implemented Operations



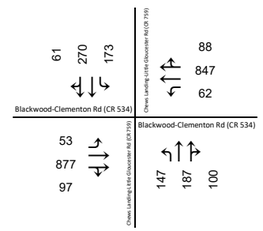
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.71
Syn Delay	18 B
Sim Delay	(17)
ICU	59% B

Operations with Improvements

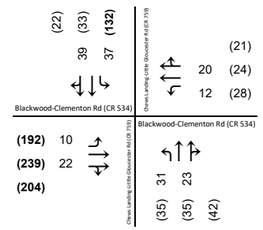
No operational improvements recommended at this time.

PM Peak

Hourly Volumes

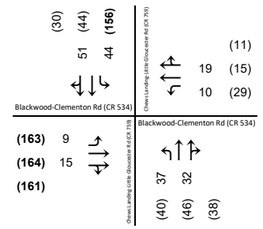


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.69
Syn Delay	24 C
Sim Delay	(103)
ICU	69% C

Implemented Operations



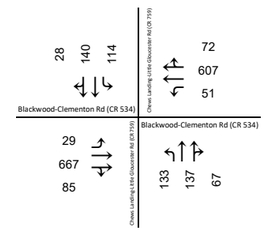
Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.75
Syn Delay	24 C
Sim Delay	(81)
ICU	70% C

Operations with Improvements

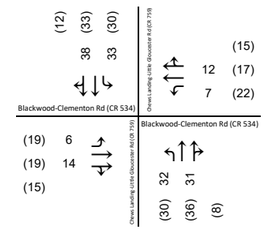
No operational improvements recommended at this time.

PM Off-peak

Hourly Volumes

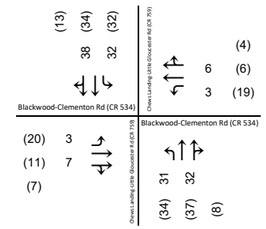


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.62
Syn Delay	19 B
Sim Delay	(21)
ICU	57% B

Implemented Operations



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.62
Syn Delay	15 B
Sim Delay	(15)
ICU	58% B

Operations with Improvements

No operational improvements recommended at this time.

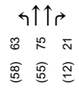
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

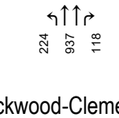


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



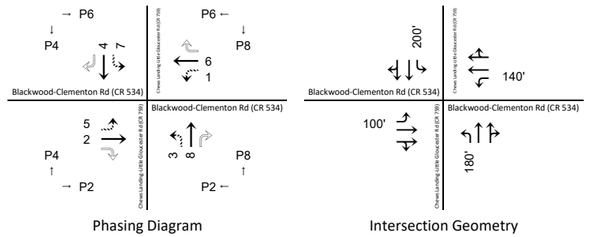
stop bar geometry

turning movement volume

Figure 22

Weekday Traffic Operations Analysis

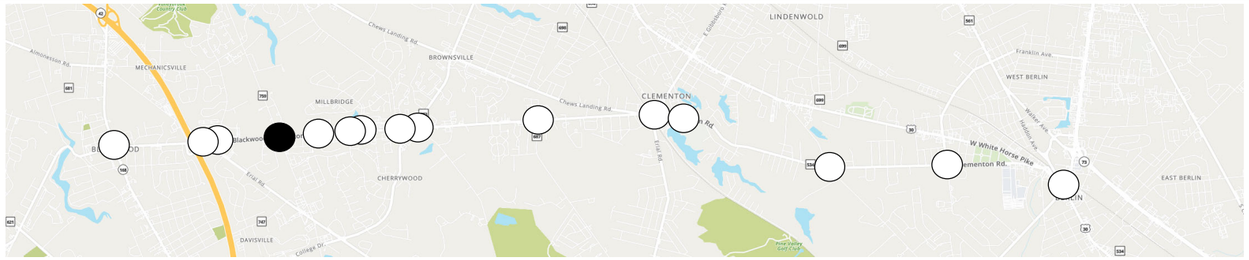
Blackwood-Clementon Rd (CR 534) & Chews Landing-Little Gloucester Rd (CR 759)



Phasing Diagram

Intersection Geometry

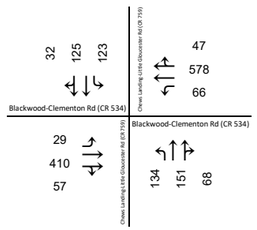
Intersection ID # 4



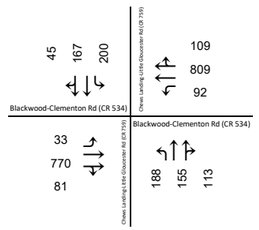
N
NTS

Hourly Volumes

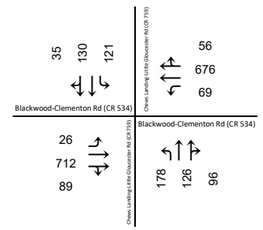
Weekend AM Peak



Weekend MD Peak

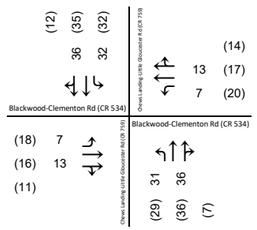


Weekend PM Peak



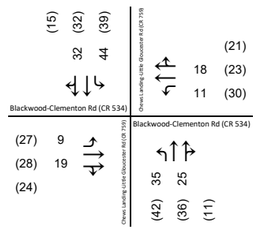
Existing Operations

Weekend AM Peak



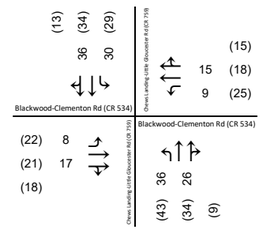
Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.66
Syn Delay	21 C
Sim Delay	(21)
ICU	54% A

Weekend MD Peak



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.78
Syn Delay	23 C
Sim Delay	(28)
ICU	69% C

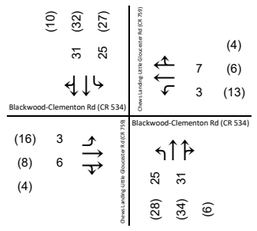
Weekend PM Peak



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.65
Syn Delay	20 C
Sim Delay	(23)
ICU	62% B

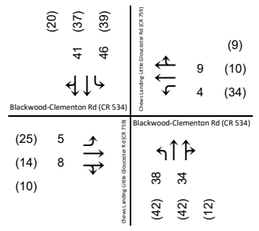
Implemented Operations

Weekend AM Peak



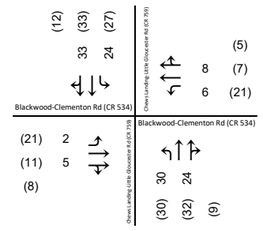
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.63
Syn Delay	14 B
Sim Delay	(14)
ICU	55% A

Weekend MD Peak



Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.77
Syn Delay	19 B
Sim Delay	(20)
ICU	70% C

Weekend PM Peak



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.62
Syn Delay	13 B
Sim Delay	(15)
ICU	62% B

Operations with Improvements

No operational improvements recommended at this time.

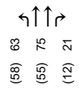
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

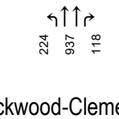
LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

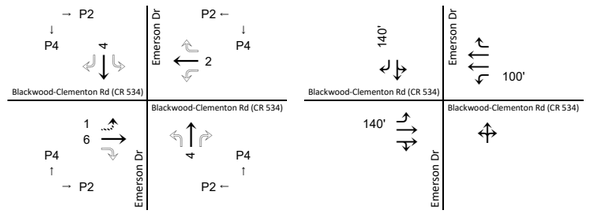


stop bar geometry
turning movement volume

Figure 23

Weekend Traffic Operations Analysis

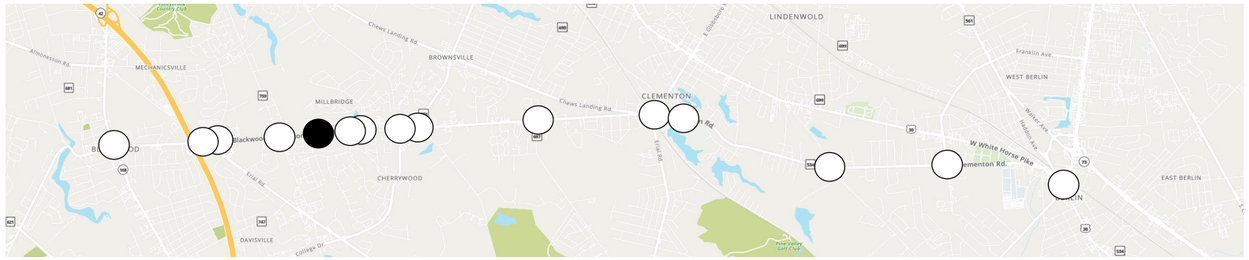
Blackwood-Clementon Rd (CR 534) & Chews Landing-Little Gloucester Rd (CR 759)



Phasing Diagram

Intersection Geometry

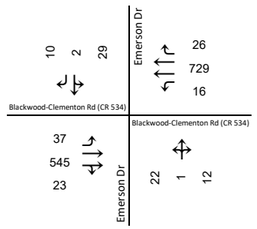
Intersection ID # 5



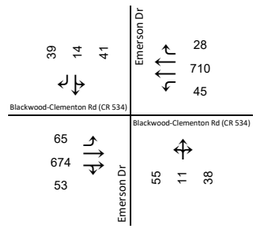
N
NTS

Hourly Volumes

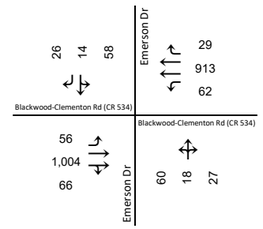
AM Peak



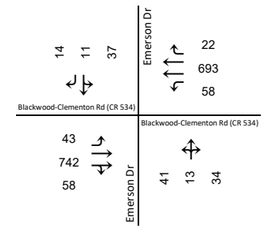
MD Peak



PM Peak

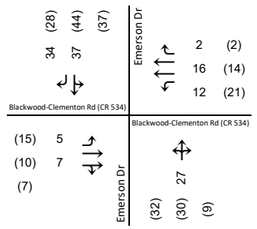


PM Off-peak



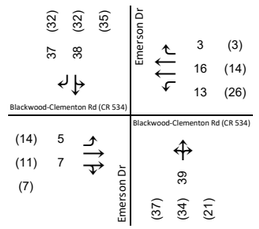
Existing Operations

AM Peak



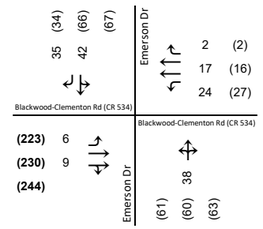
Summary	
Timing Pattern	FREE
Actuated Cycle	106
Max v/C	0.46
Syn Delay	13 B
Sim Delay	(13)
ICU	63% B

MD Peak



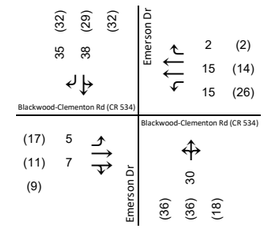
Summary	
Timing Pattern	FREE
Actuated Cycle	106
Max v/C	0.51
Syn Delay	15 B
Sim Delay	(15)
ICU	79% D

PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	106
Max v/C	0.57
Syn Delay	15 B
Sim Delay	**(113)**
ICU	76% D

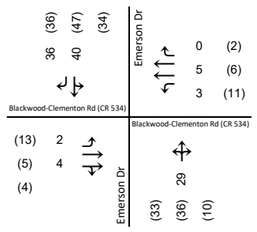
PM Off-peak



Summary	
Timing Pattern	FREE
Actuated Cycle	106
Max v/C	0.41
Syn Delay	13 B
Sim Delay	(14)
ICU	72% C

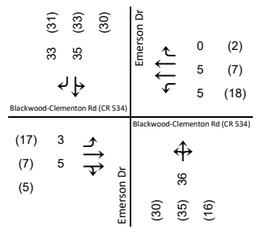
Implemented Operations

AM Peak



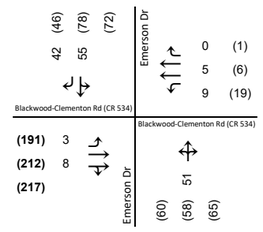
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.44
Syn Delay	6 A
Sim Delay	(7)
ICU	52% A

MD Peak



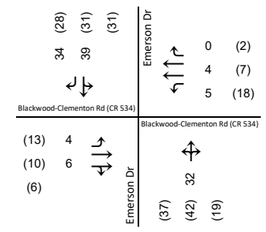
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.56
Syn Delay	9 A
Sim Delay	(10)
ICU	68% C

PM Peak



Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.60
Syn Delay	10 B
Sim Delay	**(102)**
ICU	78% D

PM Off-peak



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.48
Syn Delay	8 A
Sim Delay	(10)
ICU	69% C

Operations with Improvements

No operational improvements recommended at this time.

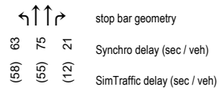
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

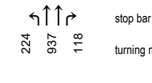


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



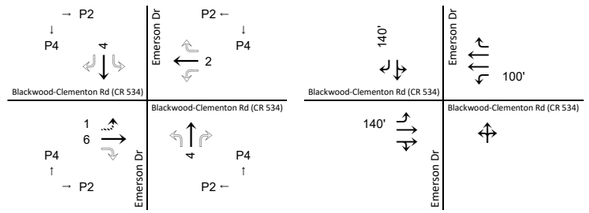
stop bar geometry

turning movement volume

Figure 24

Weekday Traffic Operations Analysis

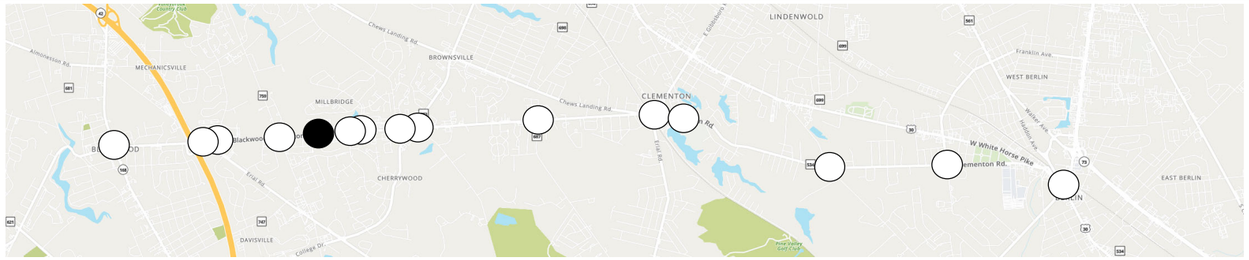
Blackwood-Clementon Rd (CR 534) & Emerson Dr



Phasing Diagram

Intersection Geometry

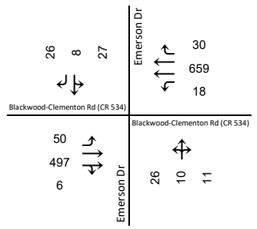
Intersection ID # 5



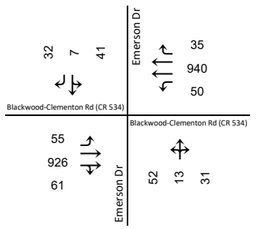
N
NTS

Hourly Volumes

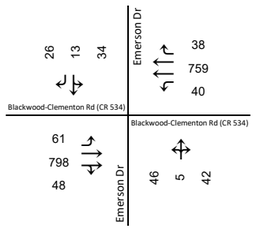
Weekend AM Peak



Weekend MD Peak

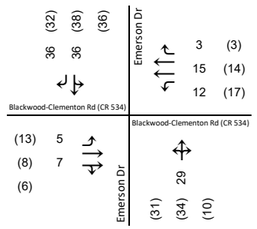


Weekend PM Peak



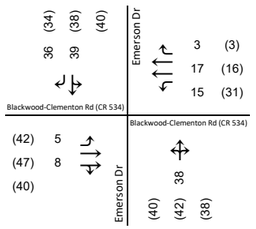
Existing Operations

Weekend AM Peak



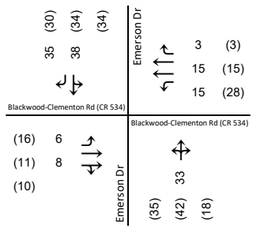
Summary	
Timing Pattern	FREE
Actuated Cycle	106
Max v/C	0.41
Syn Delay	13 B
Sim Delay	(13)
ICU	63% B

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	106
Max v/C	0.55
Sim Delay	15 B
Sim Delay	(32)
ICU	70% C

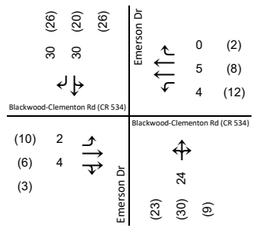
Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	106
Max v/C	0.49
Sim Delay	14 B
Sim Delay	(15)
ICU	75% D

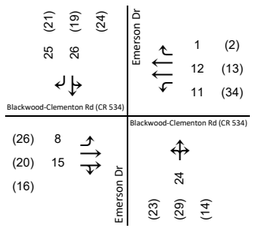
Implemented Operations

Weekend AM Peak



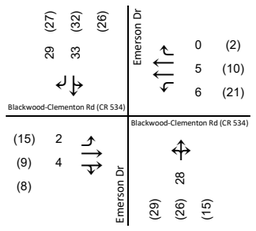
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.44
Syn Delay	6 A
Sim Delay	(8)
ICU	59% B

Weekend MD Peak



Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.69
Sim Delay	14 B
Sim Delay	(17)
ICU	71% C

Weekend PM Peak



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.55
Syn Delay	7 A
Sim Delay	(11)
ICU	70% C

Operations with Improvements

No operational improvements recommended at this time.

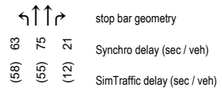
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

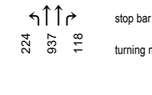


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



stop bar geometry

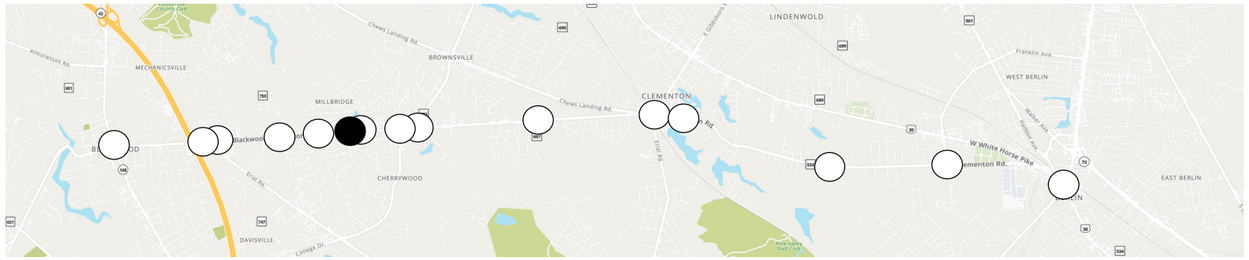
turning movement volume

Figure 25

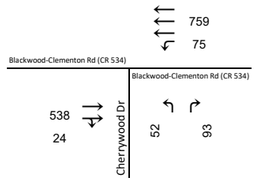
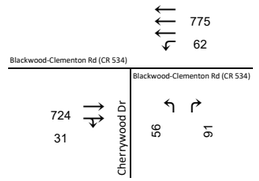
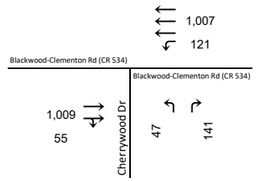
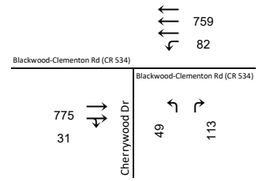
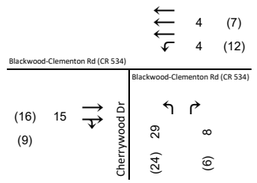
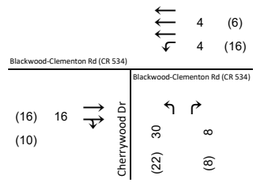
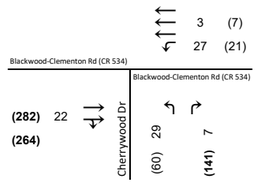
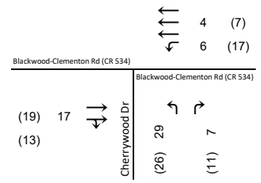
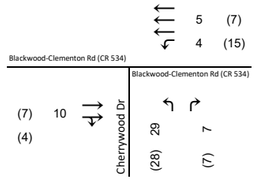
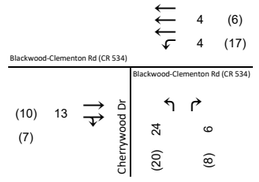
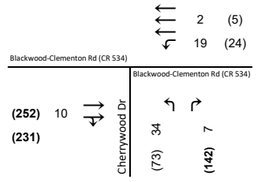
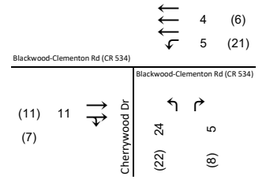
Weekend Traffic Operations Analysis

Blackwood-Clementon Rd (CR 534) & Emerson Dr

Intersection ID #
6



NTS

	AM Peak	MD Peak	PM Peak	PM Off-peak
Hourly Volumes				
Existing Operations				
	Summary	*Summary*	*Summary*	*Summary*
	Timing Pattern 1	*Timing Pattern* 1	*Timing Pattern* 1	*Timing Pattern* 1
	Actuated Cycle 90	*Actuated Cycle* 90	*Actuated Cycle* 90	*Actuated Cycle* 90
	Max v/C 0.40	*Max v/C* 0.46	*Max v/C* 0.72	*Max v/C* 0.52
	Syn Delay 10 A	*Syn Delay* 10 B	*Syn Delay* 14 B	*Syn Delay* 11 B
	Sim Delay (11)	*Sim Delay* (11)	*Sim Delay* **(123)**	*Sim Delay* (13)
	ICU 44% A	*ICU* 50% A	*ICU* 60% B	*ICU* 51% A
Implemented Operations				
	Summary	*Summary*	*Summary*	*Summary*
	Timing Pattern 1	*Timing Pattern* 2	*Timing Pattern* 3	*Timing Pattern* 4
	Actuated Cycle 100	*Actuated Cycle* 90	*Actuated Cycle* 110	*Actuated Cycle* 90
	Max v/C 0.39	*Max v/C* 0.50	*Max v/C* 0.64	*Max v/C* 0.57
	Syn Delay 8 A	*Syn Delay* 8 A	*Syn Delay* 8 A	*Syn Delay* 8 A
	Sim Delay (8)	*Sim Delay* (9)	*Sim Delay* **(113)**	*Sim Delay* (9)
	ICU 41% A	*ICU* 46% A	*ICU* 58% B	*ICU* 48% A

Operations with Improvements

No operational improvements recommended at this time.

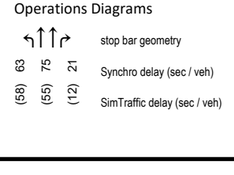
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



Hourly Volume Diagrams

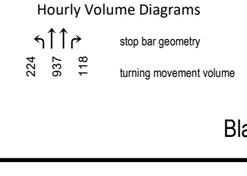
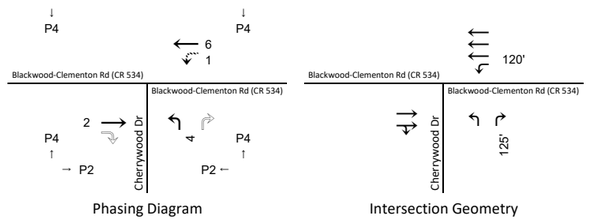


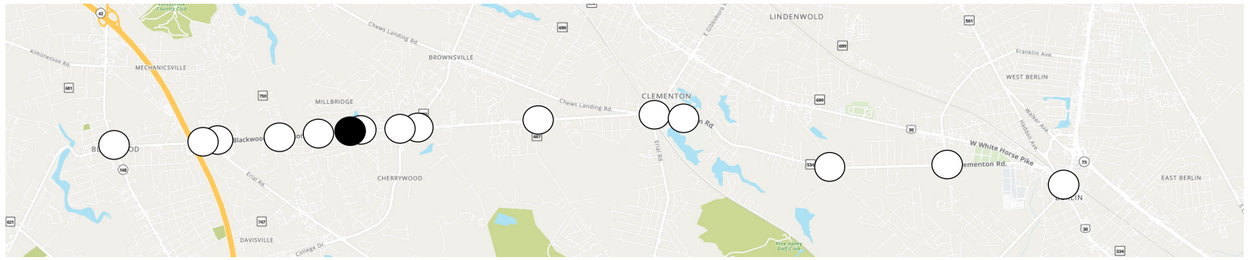
Figure 26

Weekday Traffic Operations Analysis

Blackwood-Clementon Rd (CR 534) & Cherrywood Dr



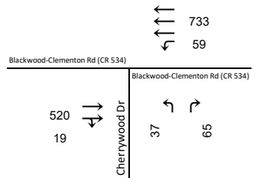
Intersection ID #
6



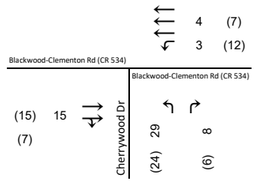
N
NTS

Weekend AM Peak

Hourly Volumes

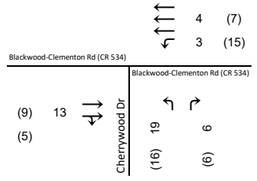


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.38
Syn Delay	9 A
Sim Delay	(10)
ICU	43% A

Implemented Operations



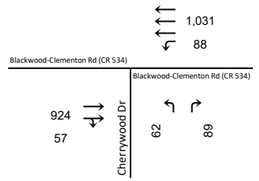
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.49
Syn Delay	8 A
Sim Delay	(8)
ICU	41% A

Operations with Improvements

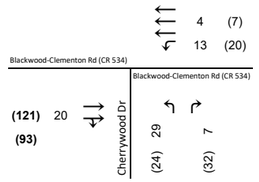
No operational improvements recommended at this time.

Weekend MD Peak

Hourly Volumes

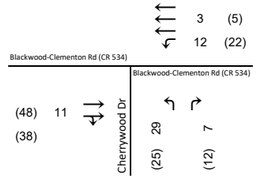


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.65
Syn Delay	12 B
Sim Delay	(56)
ICU	56% B

Implemented Operations



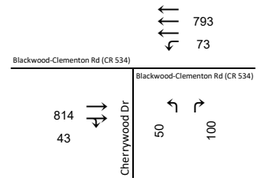
Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.63
Syn Delay	8 A
Sim Delay	(25)
ICU	54% A

Operations with Improvements

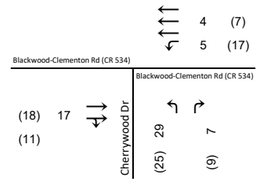
No operational improvements recommended at this time.

Weekend PM Peak

Hourly Volumes

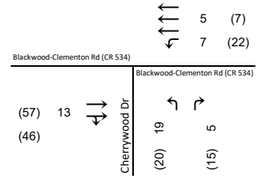


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.53
Syn Delay	11 B
Sim Delay	(13)
ICU	53% A

Implemented Operations



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.68
Syn Delay	9 A
Sim Delay	(31)
ICU	49% A

Operations with Improvements

No operational improvements recommended at this time.

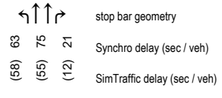
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

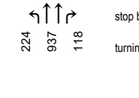
LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

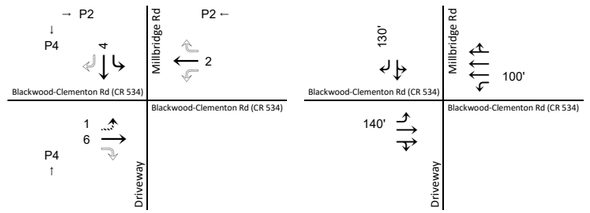


stop bar geometry
turning movement volume

Figure 27

Weekend Traffic Operations Analysis

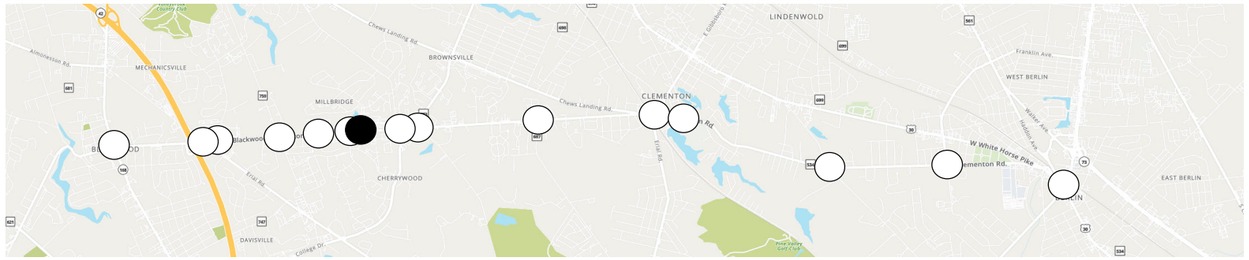
Blackwood-Clementon Rd (CR 534) & Cherrywood Dr



Phasing Diagram

Intersection Geometry

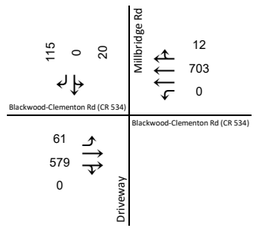
Intersection ID # 7



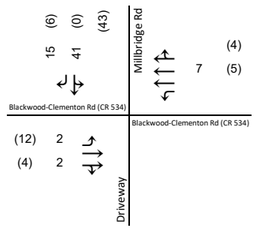
N
NTS

AM Peak

Hourly Volumes

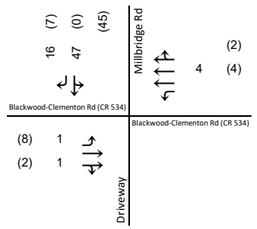


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.58
Syn Delay	7 A
Sim Delay	(6)
ICU	49% A

Implemented Operations



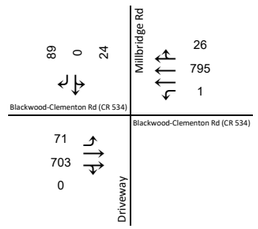
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.60
Syn Delay	4 A
Sim Delay	(4)
ICU	56% B

Operations with Improvements

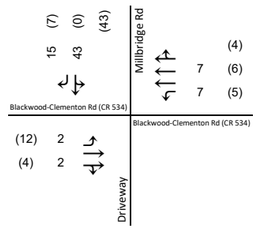
No operational improvements recommended at this time.

MD Peak

Hourly Volumes

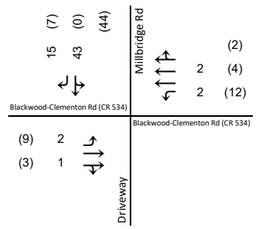


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.48
Syn Delay	6 A
Sim Delay	(6)
ICU	52% A

Implemented Operations



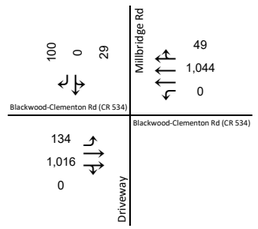
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.48
Syn Delay	3 A
Sim Delay	(4)
ICU	60% B

Operations with Improvements

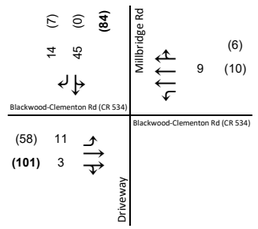
No operational improvements recommended at this time.

PM Peak

Hourly Volumes

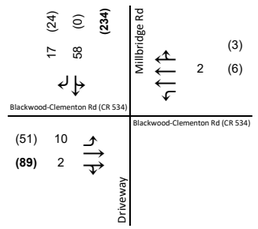


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.50
Syn Delay	8 A
Sim Delay	(45)
ICU	61% B

Implemented Operations



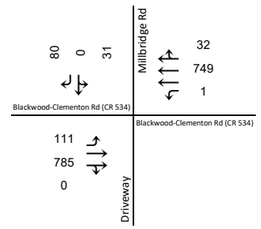
Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.53
Syn Delay	4 A
Sim Delay	(42)
ICU	69% C

Operations with Improvements

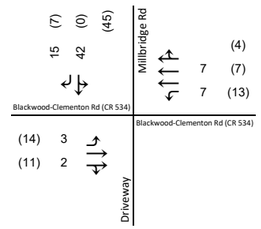
No operational improvements recommended at this time.

PM Off-peak

Hourly Volumes

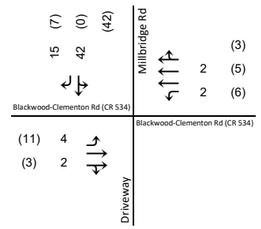


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.48
Syn Delay	6 A
Sim Delay	(10)
ICU	55% A

Implemented Operations



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.48
Syn Delay	3 A
Sim Delay	(5)
ICU	62% B

Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

63 75 21
(58) (55) (12)

stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

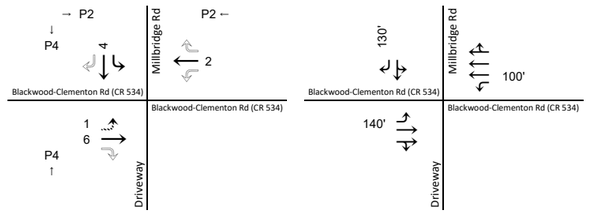
224 937 118

stop bar geometry
turning movement volume

Figure 28

Weekday Traffic Operations Analysis

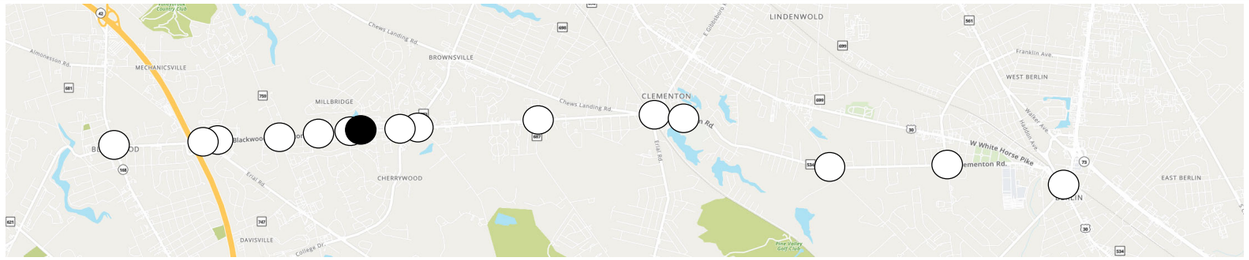
Blackwood-Clementon Rd (CR 534) & Millbridge Rd



Phasing Diagram

Intersection Geometry

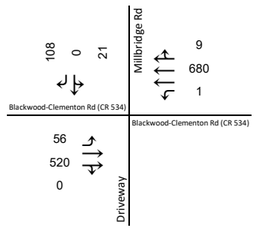
Intersection ID #
7



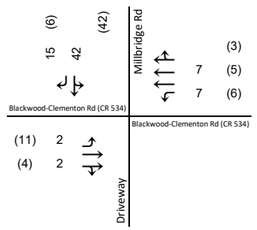
N
NTS

Weekend AM Peak

Hourly Volumes

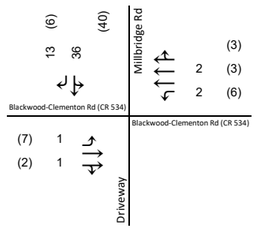


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.50
Syn Delay	6 A
Sim Delay	(6)
ICU	47% A

Implemented Operations



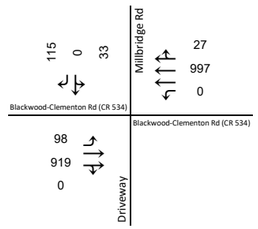
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.47
Syn Delay	3 A
Sim Delay	(4)
ICU	56% B

Operations with Improvements

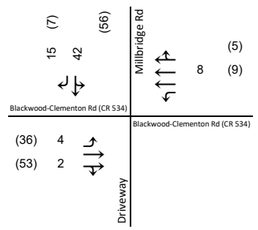
No operational improvements recommended at this time.

Weekend MD Peak

Hourly Volumes

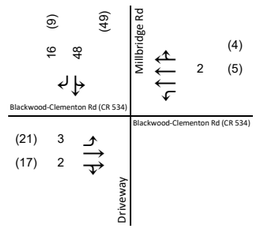


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.53
Syn Delay	6 A
Sim Delay	(28)
ICU	58% B

Implemented Operations



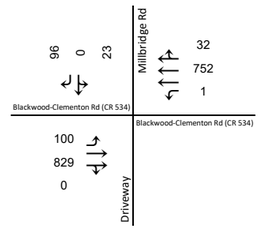
Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.55
Syn Delay	4 A
Sim Delay	(11)
ICU	66% C

Operations with Improvements

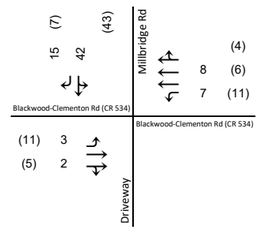
No operational improvements recommended at this time.

Weekend PM Peak

Hourly Volumes

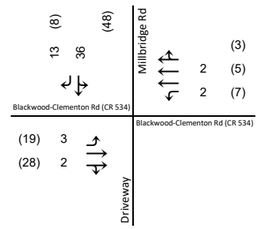


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	90
Max v/C	0.49
Syn Delay	6 A
Sim Delay	(6)
ICU	56% B

Implemented Operations



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.46
Syn Delay	3 A
Sim Delay	(16)
ICU	63% B

Operations with Improvements

No operational improvements recommended at this time.

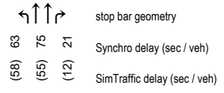
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



Hourly Volume Diagrams

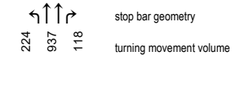
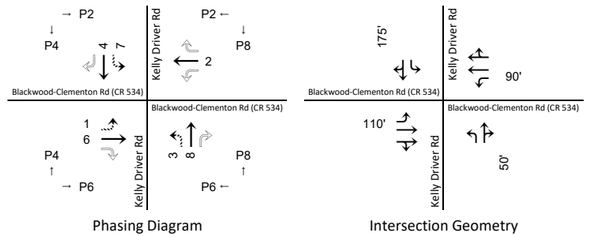


Figure 29

Weekend Traffic Operations Analysis

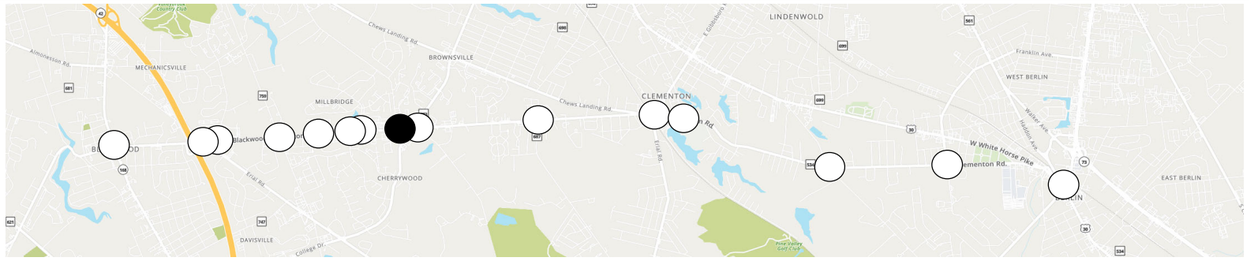
Blackwood-Clementon Rd (CR 534) & Millbridge Rd



Phasing Diagram

Intersection Geometry

Intersection ID # 8



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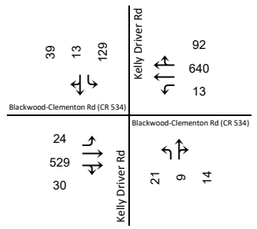
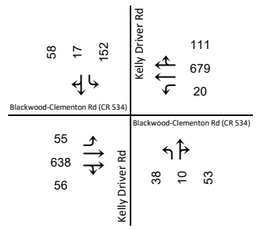
NTS

Hourly Volumes

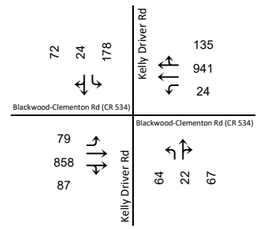
AM Peak



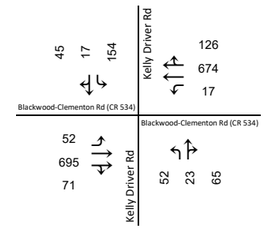
MD Peak



PM Peak

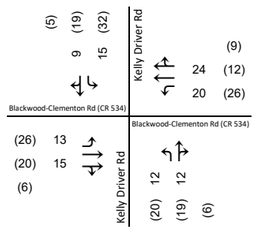


PM Off-peak



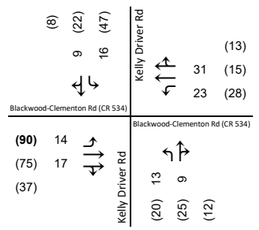
Existing Operations

AM Peak



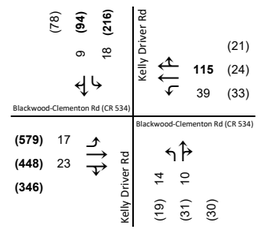
Summary	
Timing Pattern	FREE
Actuated Cycle	64.6
Max v/C	0.67
Syn Delay	19 B
Sim Delay	(17)
ICU	46% A

MD Peak



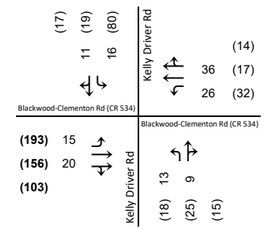
Summary	
Timing Pattern	FREE
Actuated Cycle	67.2
Max v/C	0.80
Syn Delay	22 C
Sim Delay	(41)
ICU	69% C

PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	74.8
Max v/C	1.17
Syn Delay	58 E
Sim Delay	(185)
ICU	78% D

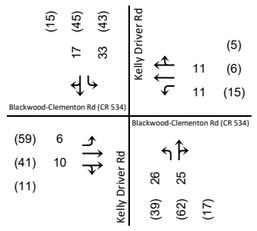
PM Off-peak



Summary	
Timing Pattern	FREE
Actuated Cycle	73.7
Max v/C	0.86
Syn Delay	25 C
Sim Delay	(78)
ICU	71% C

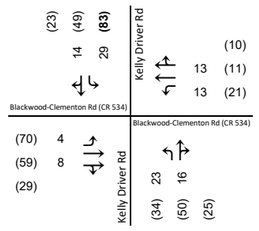
Implemented Operations

AM Peak



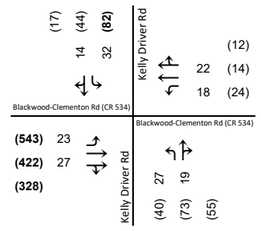
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.51
Syn Delay	14 B
Sim Delay	(24)
ICU	47% A

MD Peak



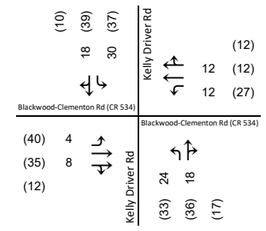
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.59
Syn Delay	13 B
Sim Delay	(37)
ICU	69% C

PM Peak



Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.77
Syn Delay	24 C
Sim Delay	(159)
ICU	78% D

PM Off-peak



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.55
Syn Delay	13 B
Sim Delay	(24)
ICU	72% C

Operations with Improvements

No operational improvements recommended at this time.

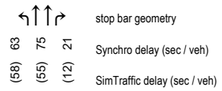
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

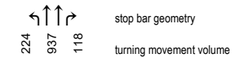
LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

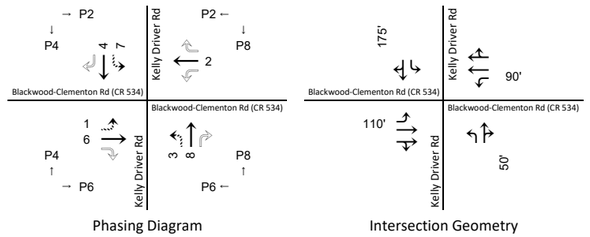


stop bar geometry
turning movement volume

Figure 30

Weekday Traffic Operations Analysis

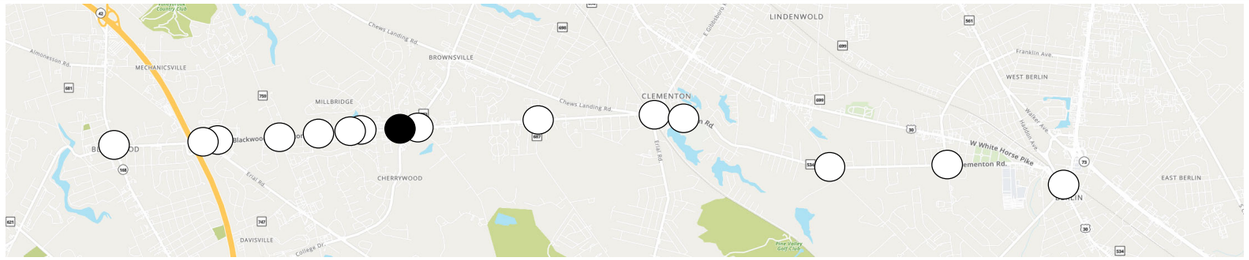
Blackwood-Clementon Rd (CR 534) & Kelly Driver Rd



Phasing Diagram

Intersection Geometry

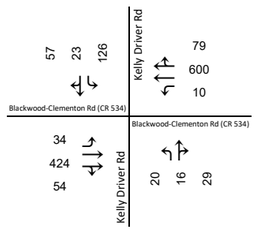
Intersection ID # 8



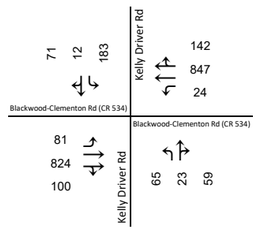
N
NTS

Hourly Volumes

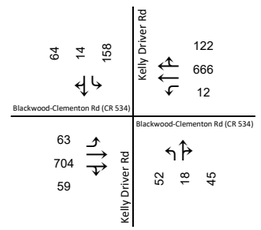
Weekend AM Peak



Weekend MD Peak

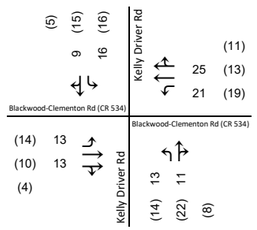


Weekend PM Peak



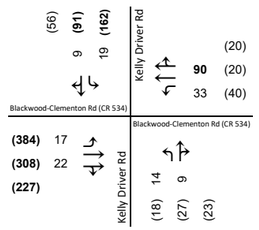
Existing Operations

Weekend AM Peak



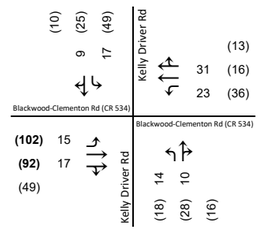
Summary	
Timing Pattern	FREE
Actuated Cycle	69.1
Max v/C	0.64
Syn Delay	18 B
Sim Delay	(12)
ICU	54% A

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	74.5
Max v/C	1.11
Syn Delay	47 D
Sim Delay	(134)
ICU	78% D

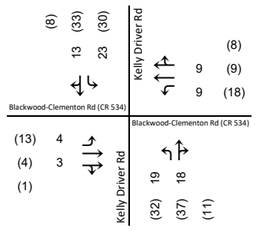
Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	69.3
Max v/C	0.81
Syn Delay	22 C
Sim Delay	(49)
ICU	72% C

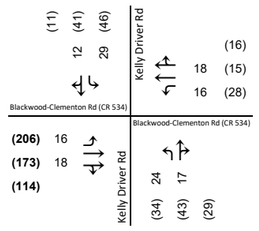
Implemented Operations

Weekend AM Peak



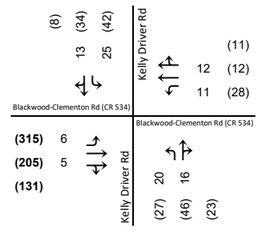
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.50
Syn Delay	9 A
Sim Delay	(10)
ICU	55% A

Weekend MD Peak



Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.75
Syn Delay	19 B
Sim Delay	(79)
ICU	78% D

Weekend PM Peak



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.59
Syn Delay	11 B
Sim Delay	(95)
ICU	72% C

Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

63 75 21
(58) (55) (12)

stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

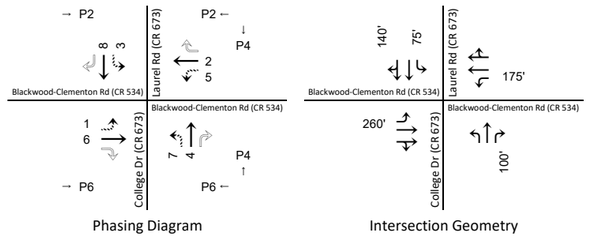
224 937 118

stop bar geometry
turning movement volume

Figure 31

Weekend Traffic Operations Analysis

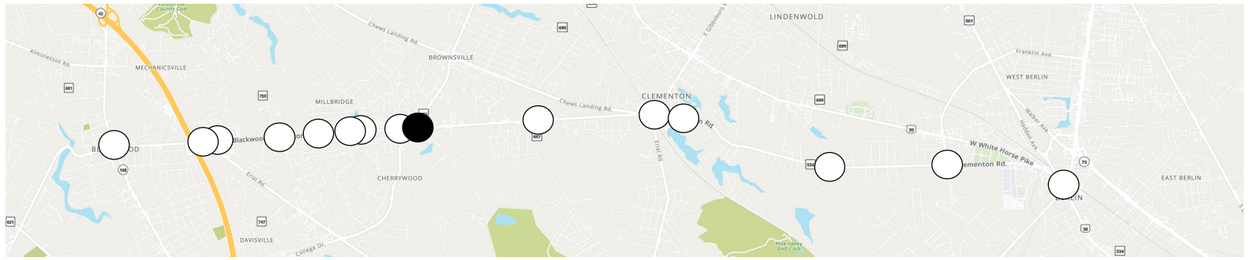
Blackwood-Clementon Rd (CR 534) & Kelly Driver Rd



Phasing Diagram

Intersection Geometry

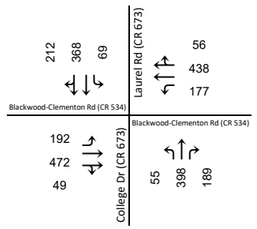
Intersection ID # 9



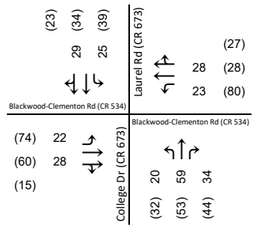
N
NTS

AM Peak

Hourly Volumes

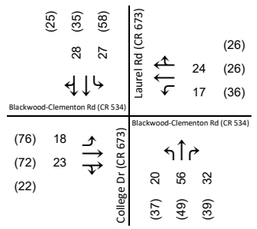


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	105
Max v/C	0.91
Syn Delay	32 C
Sim Delay	(46)
ICU	71% C

Implemented Operations



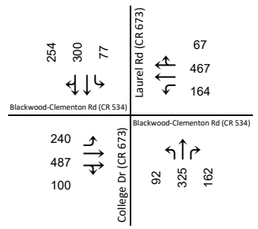
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.90
Syn Delay	29 C
Sim Delay	(45)
ICU	70% C

Operations with Improvements

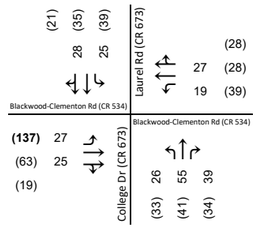
No operational improvements recommended at this time.

MD Peak

Hourly Volumes

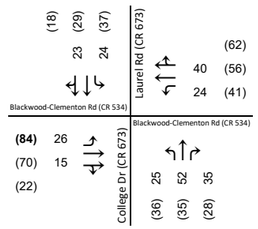


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	105
Max v/C	0.85
Syn Delay	30 C
Sim Delay	(47)
ICU	71% C

Implemented Operations



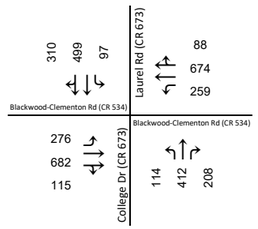
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.87
Syn Delay	29 C
Sim Delay	(47)
ICU	71% C

Operations with Improvements

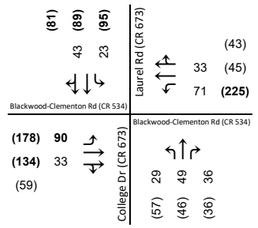
No operational improvements recommended at this time.

PM Peak

Hourly Volumes

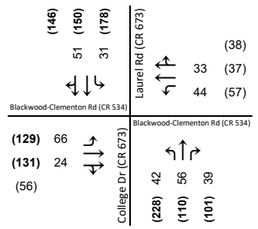


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	105
Max v/C	1.06
Syn Delay	44 D
Sim Delay	(89)
ICU	88% E

Implemented Operations



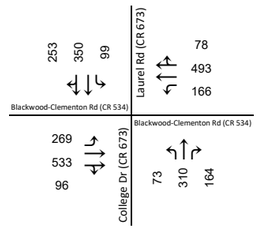
Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.93
Syn Delay	41 D
Sim Delay	(108)
ICU	89% E

Operations with Improvements

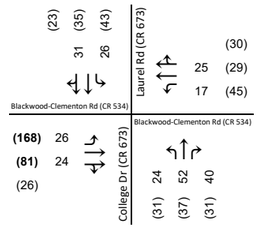
No operational improvements recommended at this time.

PM Off-peak

Hourly Volumes

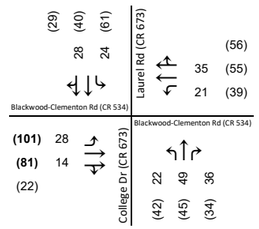


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	105
Max v/C	0.80
Syn Delay	29 C
Sim Delay	(54)
ICU	75% D

Implemented Operations



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.81
Syn Delay	28 C
Sim Delay	(56)
ICU	74% D

Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

63 75 21
(58) (55) (12)

stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

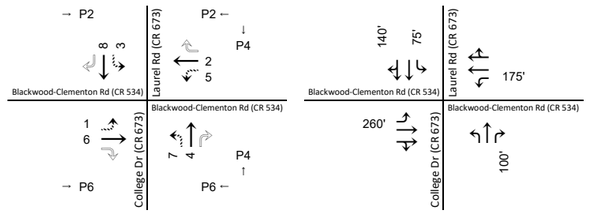
224 937 118

stop bar geometry
turning movement volume

Figure 32

Weekday Traffic Operations Analysis

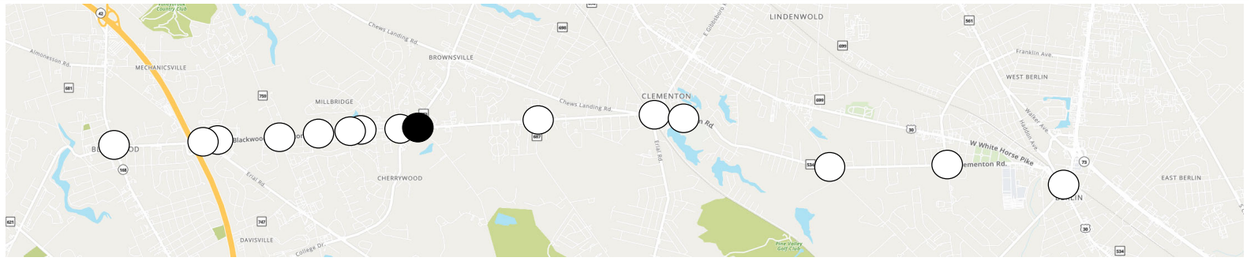
Blackwood-Clementon Rd (CR 534) & Laurel Rd/College Dr (CR 673)



Phasing Diagram

Intersection Geometry

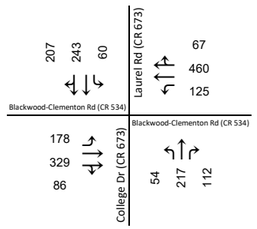
Intersection ID #
9



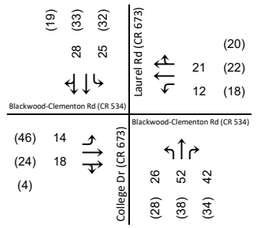
N
NTS

Weekend AM Peak

Hourly Volumes

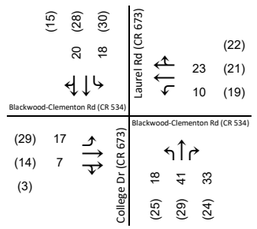


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	105
Max v/C	0.75
Syn Delay	25 C
Sim Delay	(27)
ICU	63% B

Implemented Operations



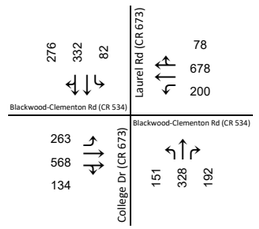
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.73
Syn Delay	20 C
Sim Delay	(21)
ICU	63% B

Operations with Improvements

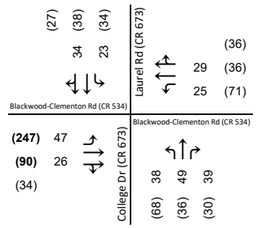
No operational improvements recommended at this time.

Weekend MD Peak

Hourly Volumes

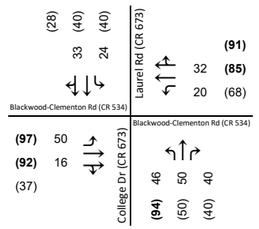


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	105
Max v/C	0.89
Syn Delay	33 C
Sim Delay	(62)
ICU	83% E

Implemented Operations



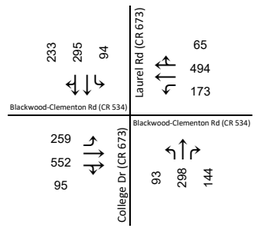
Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.82
Syn Delay	32 C
Sim Delay	(68)
ICU	84% E

Operations with Improvements

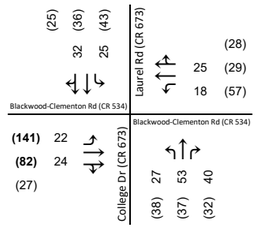
No operational improvements recommended at this time.

Weekend PM Peak

Hourly Volumes

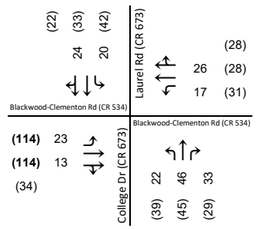


Existing Operations



Summary	
Timing Pattern	1
Actuated Cycle	105
Max v/C	0.80
Syn Delay	29 C
Sim Delay	(53)
ICU	71% C

Implemented Operations



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.81
Syn Delay	24 C
Sim Delay	(55)
ICU	72% C

Operations with Improvements

No operational improvements recommended at this time.

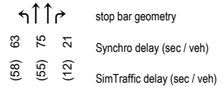
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

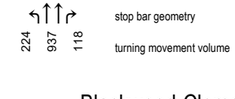
LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

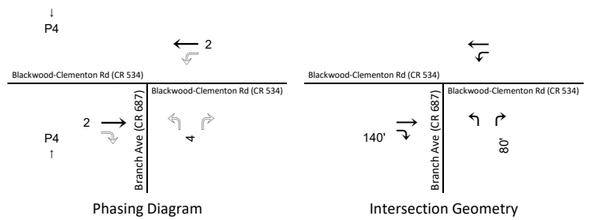


stop bar geometry
turning movement volume

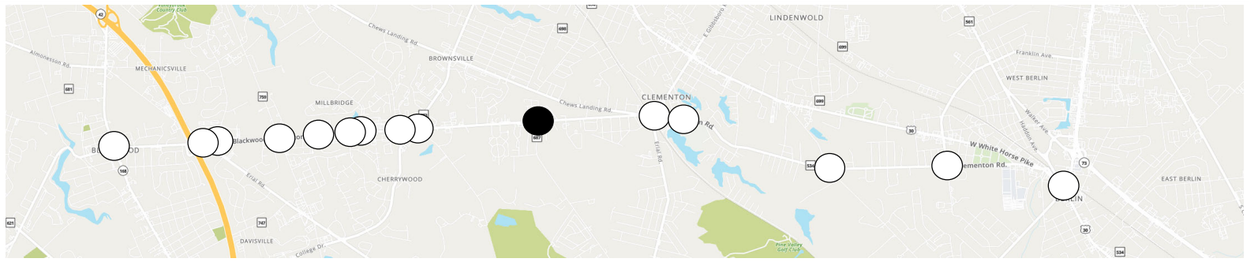
Figure 33

Weekend Traffic Operations Analysis

Blackwood-Clementon Rd (CR 534) & Laurel Rd/College Dr (CR 673)



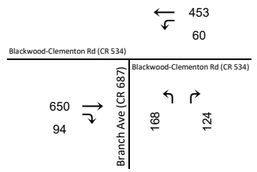
Intersection ID #
10



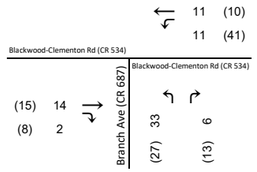
NTS

AM Peak

Hourly Volumes

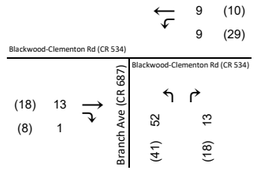


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	71.9
Max v/C	0.67
Syn Delay	14 B
Sim Delay	(15)
ICU	83% E

Implemented Operations



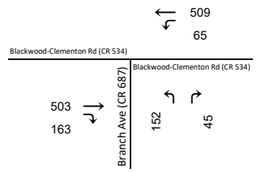
Summary	
Timing Pattern	1
Actuated Cycle	100
Max v/C	0.73
Syn Delay	15 B
Sim Delay	(17)
ICU	77% D

Operations with Improvements

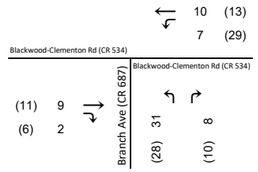
No operational improvements recommended at this time.

MD Peak

Hourly Volumes

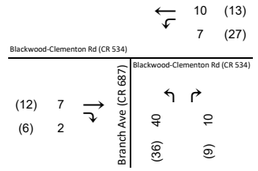


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	70.1
Max v/C	0.55
Syn Delay	11 B
Sim Delay	(13)
ICU	83% E

Implemented Operations



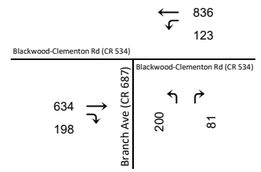
Summary	
Timing Pattern	2
Actuated Cycle	90
Max v/C	0.55
Syn Delay	11 B
Sim Delay	(15)
ICU	79% D

Operations with Improvements

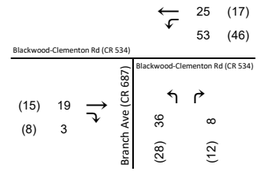
No operational improvements recommended at this time.

PM Peak

Hourly Volumes

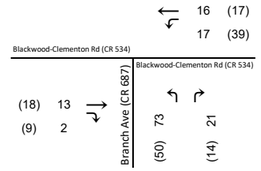


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	74.3
Max v/C	0.87
Syn Delay	23 C
Sim Delay	(18)
ICU	**107%** G

Implemented Operations



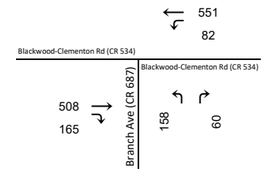
Summary	
Timing Pattern	3
Actuated Cycle	110
Max v/C	0.90
Syn Delay	21 C
Sim Delay	(21)
ICU	**94%** F

Operations with Improvements

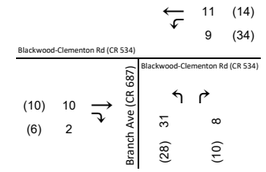
No operational improvements recommended at this time.

PM Off-peak

Hourly Volumes

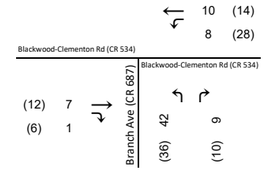


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	70.5
Max v/C	0.57
Syn Delay	11 B
Sim Delay	(14)
ICU	**92%** F

Implemented Operations



Summary	
Timing Pattern	4
Actuated Cycle	90
Max v/C	0.60
Syn Delay	11 B
Sim Delay	(15)
ICU	79% D

Operations with Improvements

No operational improvements recommended at this time.

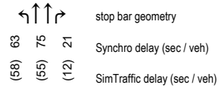
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

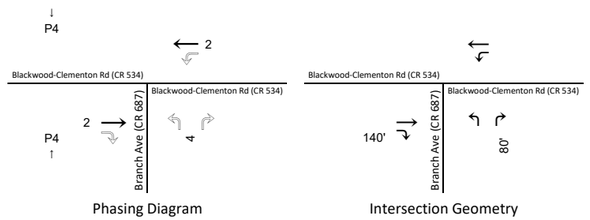
Hourly Volume Diagrams

stop bar geometry
turning movement volume

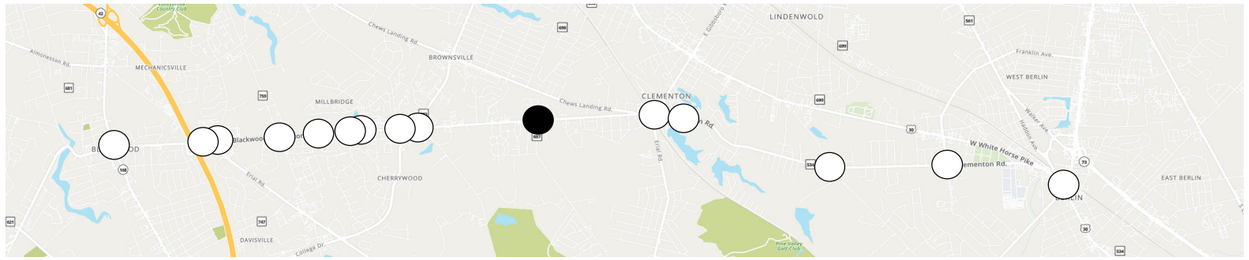
Figure 34

Weekday Traffic Operations Analysis

Blackwood-Clementon Rd (CR 534) & Branch Ave (CR 687)



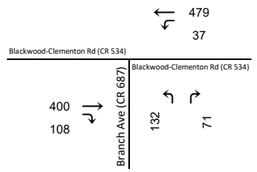
Intersection ID #
10



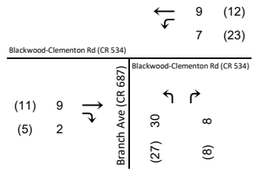
NTS

Weekend AM Peak

Hourly Volumes

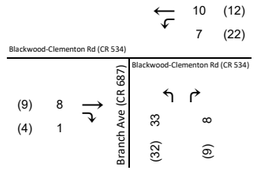


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	69.9
Max v/C	0.51
Syn Delay	10 B
Sim Delay	(13)
ICU	83% E

Implemented Operations



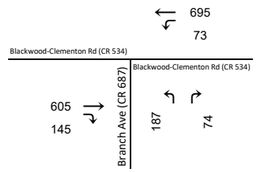
Summary	
Timing Pattern	5
Actuated Cycle	80
Max v/C	0.51
Syn Delay	11 B
Sim Delay	(13)
ICU	57% B

Operations with Improvements

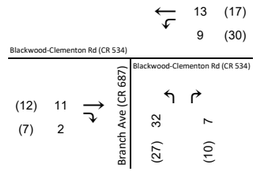
No operational improvements recommended at this time.

Weekend MD Peak

Hourly Volumes

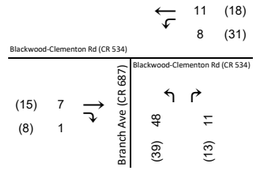


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	70.9
Max v/C	0.66
Syn Delay	13 B
Sim Delay	(16)
ICU	85% E

Implemented Operations



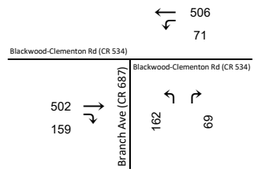
Summary	
Timing Pattern	6
Actuated Cycle	100
Max v/C	0.66
Syn Delay	13 B
Sim Delay	(18)
ICU	84% E

Operations with Improvements

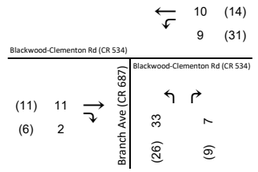
No operational improvements recommended at this time.

Weekend PM Peak

Hourly Volumes

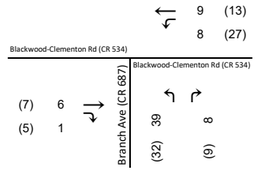


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	71.8
Max v/C	0.62
Syn Delay	12 B
Sim Delay	(14)
ICU	83% E

Implemented Operations



Summary	
Timing Pattern	7
Actuated Cycle	80
Max v/C	0.66
Syn Delay	11 B
Sim Delay	(13)
ICU	79% D

Operations with Improvements

No operational improvements recommended at this time.

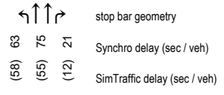
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

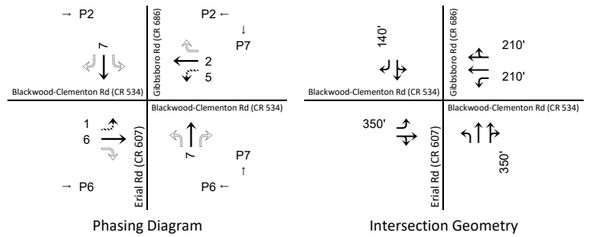
Hourly Volume Diagrams

stop bar geometry
turning movement volume

Figure 35

Weekend Traffic Operations Analysis

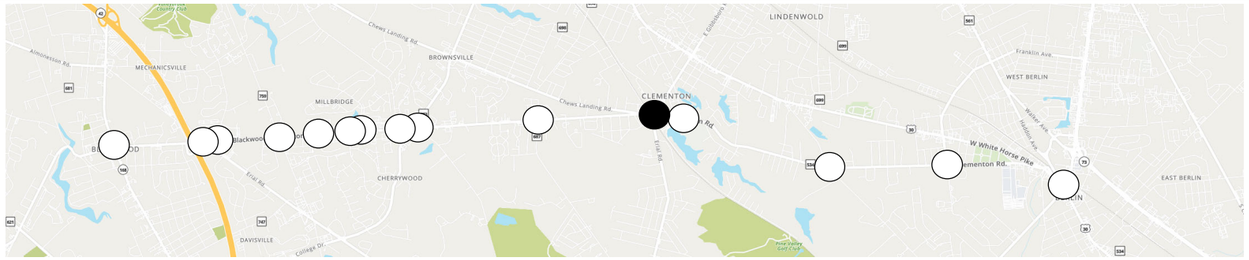
Blackwood-Clementon Rd (CR 534) & Branch Ave (CR 687)



Phasing Diagram

Intersection Geometry

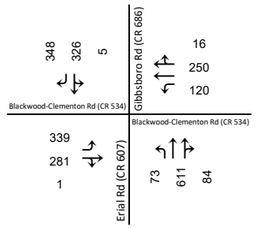
Intersection ID # 11



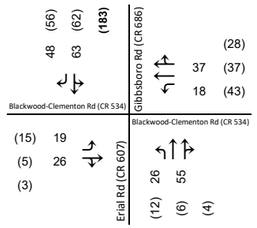
N
NTS

AM Peak

Hourly Volumes

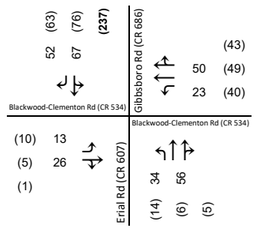


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	119
Max v/C	1.40
Syn Delay	43 D
Sim Delay	(28)
ICU	90% E

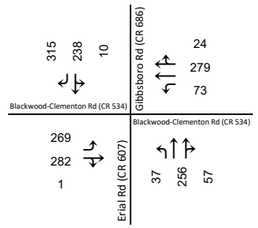
Implemented Operations



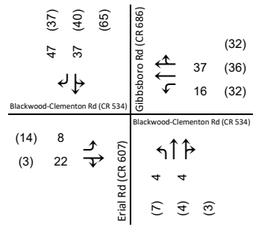
Summary	
Timing Pattern	FREE
Actuated Cycle	141.4
Max v/C	1.36
Syn Delay	45 D
Sim Delay	(32)
ICU	**92%** F

MD Peak

Hourly Volumes

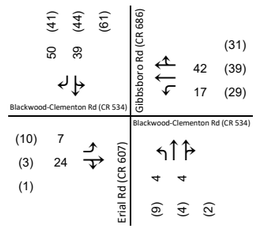


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	116.8
Max v/C	0.77
Syn Delay	25 C
Sim Delay	(22)
ICU	72% C

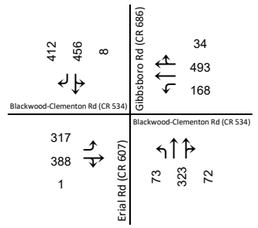
Implemented Operations



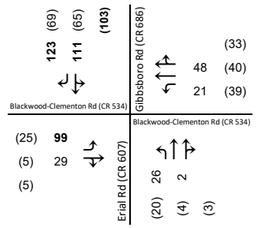
Summary	
Timing Pattern	FREE
Actuated Cycle	119.7
Max v/C	0.78
Syn Delay	27 C
Sim Delay	(23)
ICU	73% D

PM Peak

Hourly Volumes

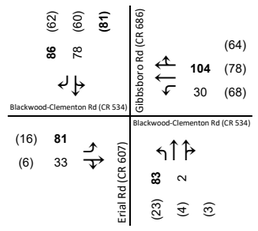


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	119
Max v/C	1.14
Syn Delay	68 E
Sim Delay	(38)
ICU	**101%** G

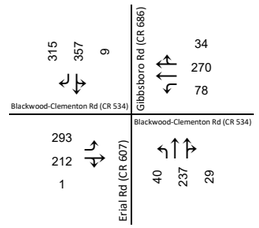
Implemented Operations



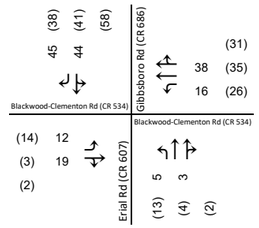
Summary	
Timing Pattern	FREE
Actuated Cycle	150
Max v/C	1.04
Syn Delay	66 E
Sim Delay	(44)
ICU	**102%** G

PM Off-peak

Hourly Volumes

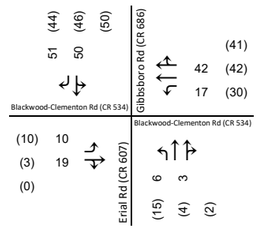


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	116.8
Max v/C	0.75
Syn Delay	28 C
Sim Delay	(24)
ICU	80% D

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	122.9
Max v/C	0.78
Syn Delay	30 C
Sim Delay	(27)
ICU	81% D

Operations with Improvements

No operational improvements recommended at this time.

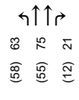
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

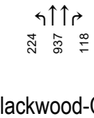


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



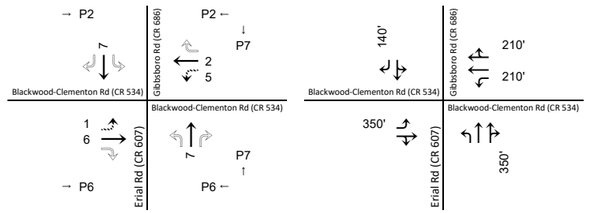
stop bar geometry

turning movement volume

Figure 36

Weekday Traffic Operations Analysis

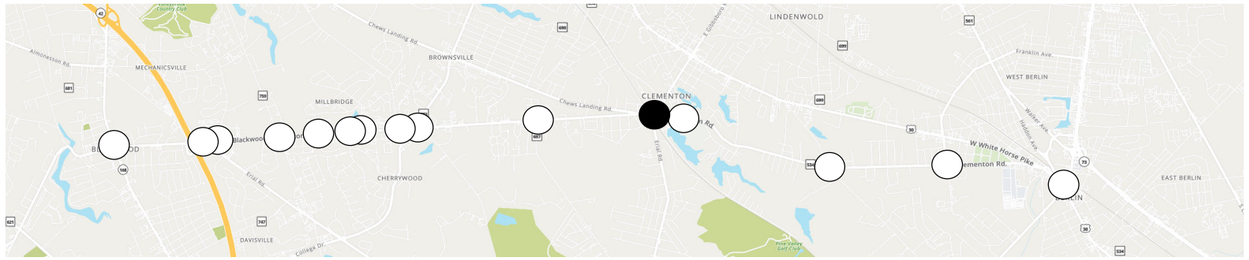
Blackwood-Clementon Rd (CR 534) & Gibbsboro Rd (CR 686)/Erial Rd (CR 607)



Phasing Diagram

Intersection Geometry

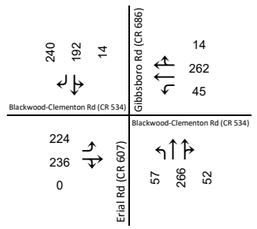
Intersection ID #
11



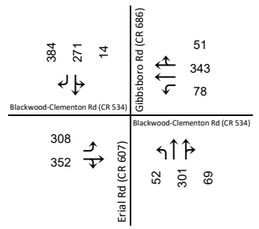
N
NTS

Hourly Volumes

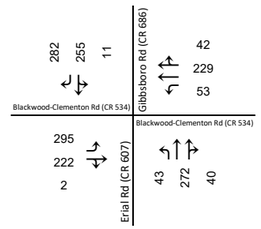
Weekend AM Peak



Weekend MD Peak

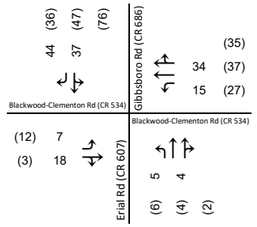


Weekend PM Peak



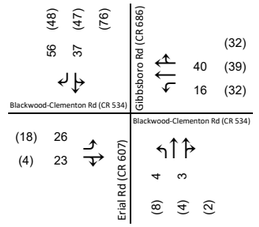
Existing Operations

Weekend AM Peak



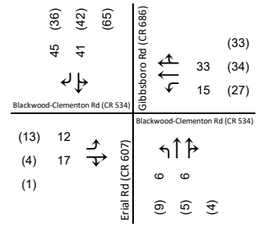
Summary	
Timing Pattern	FREE
Actuated Cycle	112.1
Max v/C	0.79
Syn Delay	22 C
Sim Delay	(22)
ICU	66% C

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	117.2
Max v/C	0.87
Syn Delay	30 C
Sim Delay	(26)
ICU	80% D

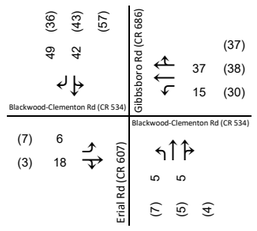
Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	113.9
Max v/C	0.72
Syn Delay	24 C
Sim Delay	(22)
ICU	74% D

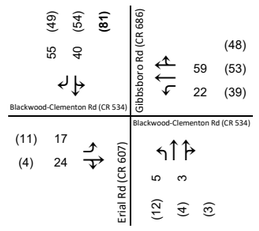
Implemented Operations

Weekend AM Peak



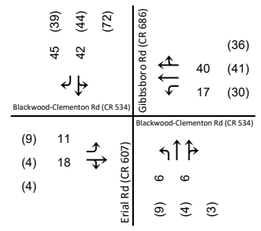
Summary	
Timing Pattern	FREE
Actuated Cycle	118.4
Max v/C	0.82
Syn Delay	24 C
Sim Delay	(21)
ICU	68% C

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	138.3
Max v/C	0.82
Syn Delay	33 C
Sim Delay	(30)
ICU	81% D

Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	119.4
Max v/C	0.71
Syn Delay	25 C
Sim Delay	(23)
ICU	75% D

Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

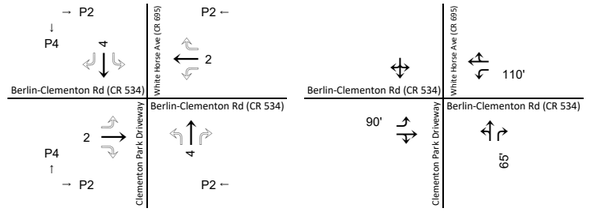
Hourly Volume Diagrams

stop bar geometry
turning movement volume

Figure 37

Weekend Traffic Operations Analysis

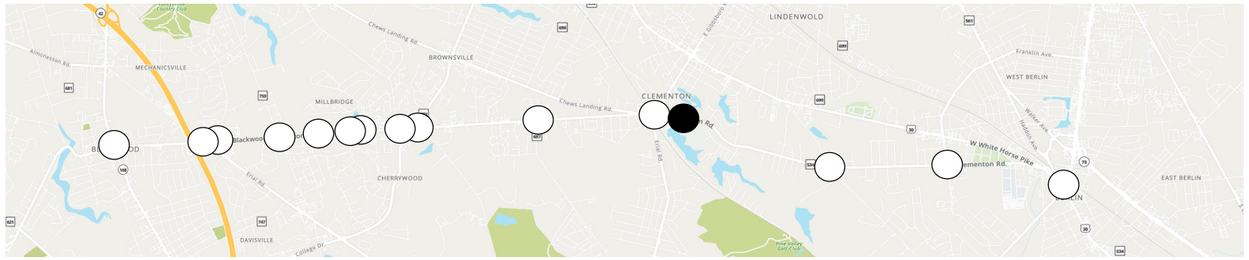
Blackwood-Clementon Rd (CR 534) & Gibbsboro Rd (CR 686)/Erial Rd (CR 607)



Phasing Diagram

Intersection Geometry

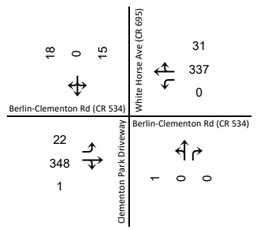
Intersection ID # 12



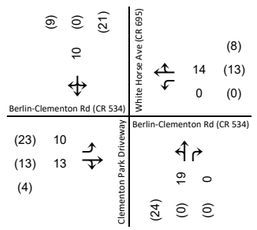
NTS

AM Peak

Hourly Volumes

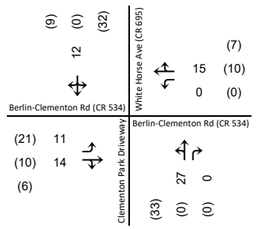


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	78
Max v/C	0.55
Syn Delay	13 B
Sim Delay	(13)
ICU	44% A

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.51
Syn Delay	14 B
Sim Delay	(11)
ICU	46% A

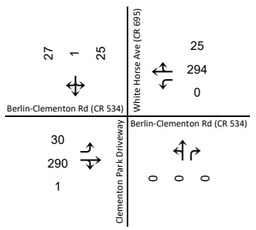
Operations with Improvements

Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.51
Syn Delay	14 B
Sim Delay	(11)
ICU	46% A

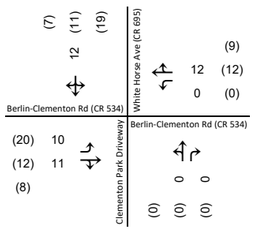
No operational improvements recommended at this time.

MD Peak

Hourly Volumes

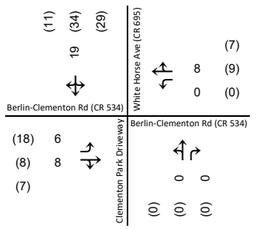


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	78
Max v/C	0.39
Syn Delay	11 B
Sim Delay	(12)
ICU	45% A

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	92
Max v/C	0.32
Syn Delay	9 A
Sim Delay	(10)
ICU	46% A

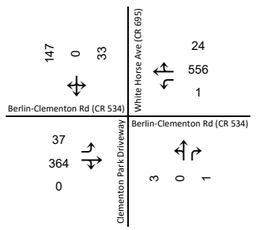
Operations with Improvements

Summary	
Timing Pattern	FREE
Actuated Cycle	92
Max v/C	0.32
Syn Delay	9 A
Sim Delay	(10)
ICU	46% A

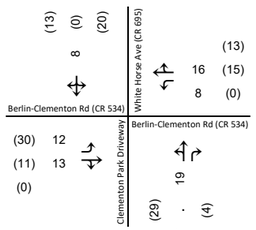
No operational improvements recommended at this time.

PM Peak

Hourly Volumes

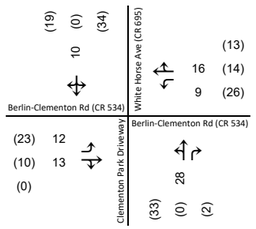


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	78
Max v/C	0.63
Syn Delay	13 B
Sim Delay	(14)
ICU	60% B

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.59
Syn Delay	14 B
Sim Delay	(14)
ICU	63% B

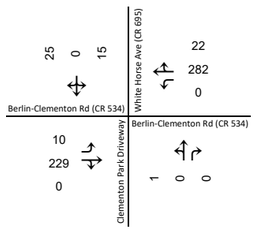
Operations with Improvements

Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.59
Syn Delay	14 B
Sim Delay	(14)
ICU	63% B

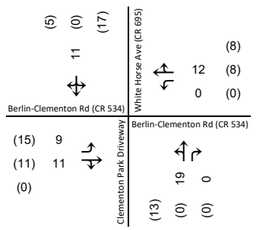
No operational improvements recommended at this time.

PM Off-peak

Hourly Volumes

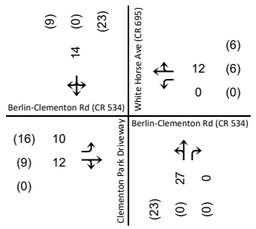


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	78
Max v/C	0.41
Syn Delay	11 B
Sim Delay	(9)
ICU	44% A

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.38
Syn Delay	12 B
Sim Delay	(8)
ICU	47% A

Operations with Improvements

Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.38
Syn Delay	12 B
Sim Delay	(8)
ICU	47% A

No operational improvements recommended at this time.

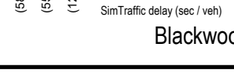
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

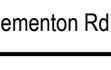


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



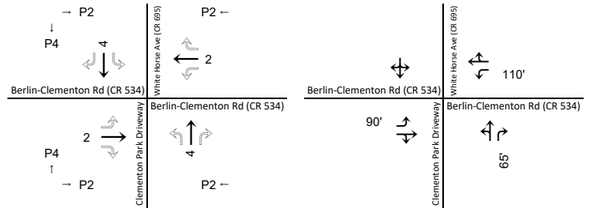
stop bar geometry

turning movement volume

Figure 38

Weekday Traffic Operations Analysis

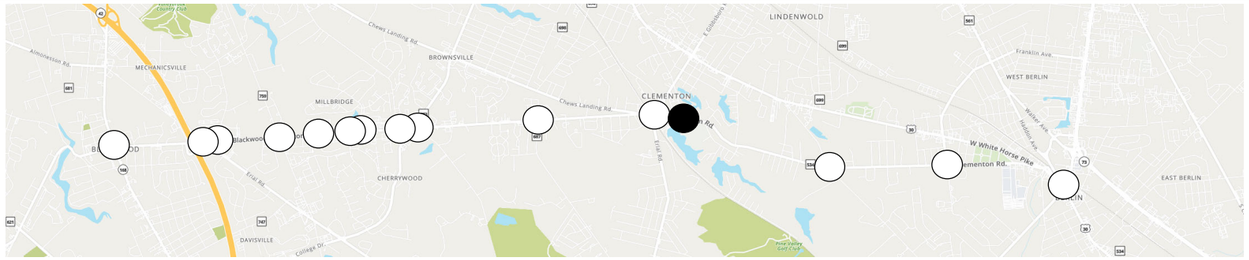
Blackwood-Clementon Rd (CR 534) & White Horse Ave (CR 695)/Clementon Park Driveway



Phasing Diagram

Intersection Geometry

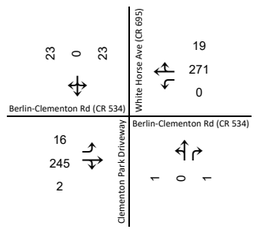
Intersection ID #
12



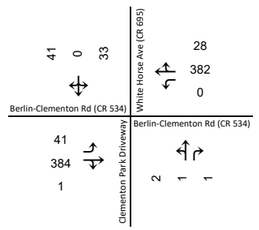
N
NTS

Hourly Volumes

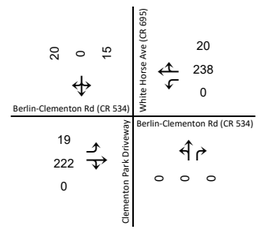
Weekend AM Peak



Weekend MD Peak

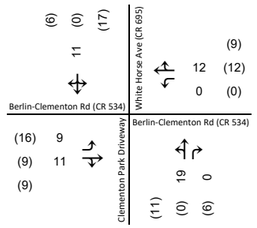


Weekend PM Peak



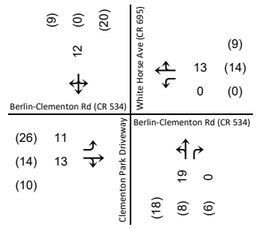
Existing Operations

Weekend AM Peak



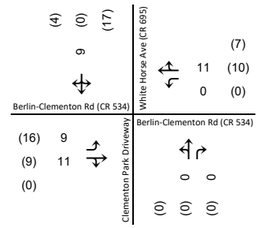
Summary	
Timing Pattern	FREE
Actuated Cycle	78
Max v/C	0.40
Syn Delay	11 B
Sim Delay	(11)
ICU	57% B

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	78
Max v/C	0.48
Syn Delay	13 B
Sim Delay	(15)
ICU	57% B

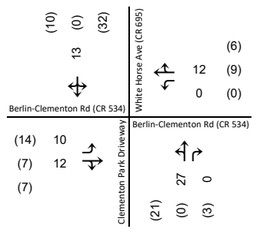
Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	78
Max v/C	0.31
Syn Delay	11 B
Sim Delay	(10)
ICU	43% A

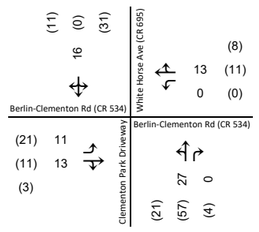
Implemented Operations

Weekend AM Peak



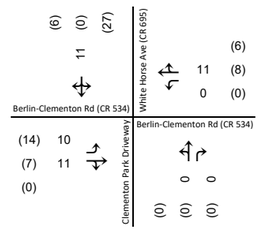
Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.37
Syn Delay	12 B
Sim Delay	(9)
ICU	60% B

Weekend MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.45
Syn Delay	14 B
Sim Delay	(12)
ICU	60% B

Weekend PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	103
Max v/C	0.29
Syn Delay	11 B
Sim Delay	(8)
ICU	46% A

Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

63 75 21
(58) (55) (12)

stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

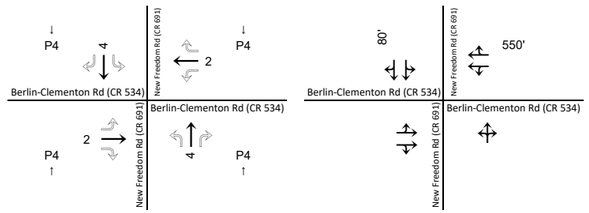
224 937 118

stop bar geometry
turning movement volume

Figure 39

Weekend Traffic Operations Analysis

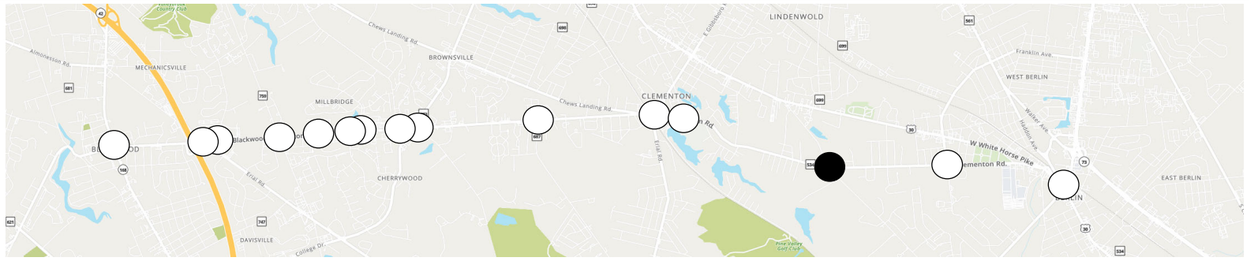
Blackwood-Clementon Rd (CR 534) & White Horse Ave (CR 695)/Clementon Park Driveway



Phasing Diagram

Intersection Geometry

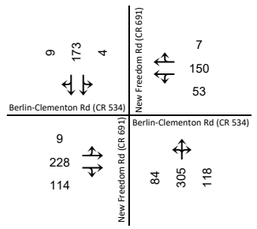
Intersection ID # 13



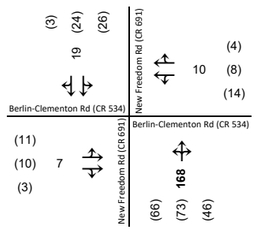
NTS

AM Peak

Hourly Volumes

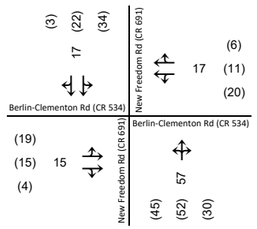


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	76
Max v/C	1.28
Syn Delay	74 E
Sim Delay	(30)
ICU	**100%** F

Implemented Operations



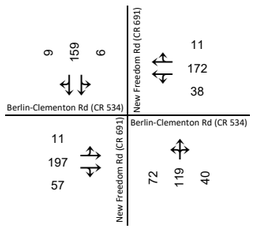
Summary	
Timing Pattern	FREE
Actuated Cycle	93.1
Max v/C	0.98
Syn Delay	33 C
Sim Delay	(26)
ICU	**102%** G

Operations with Improvements

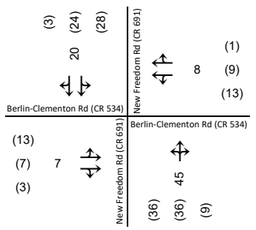
No operational improvements recommended at this time.

MD Peak

Hourly Volumes

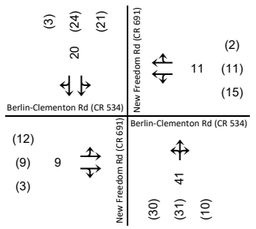


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	72.1
Max v/C	0.86
Syn Delay	21 C
Sim Delay	(16)
ICU	70% C

Implemented Operations



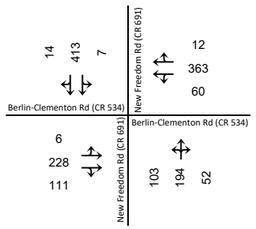
Summary	
Timing Pattern	FREE
Actuated Cycle	76.4
Max v/C	0.83
Syn Delay	21 C
Sim Delay	(16)
ICU	73% C

Operations with Improvements

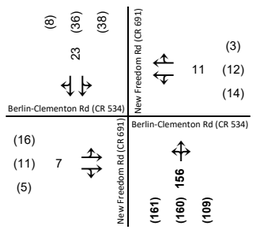
No operational improvements recommended at this time.

PM Peak

Hourly Volumes

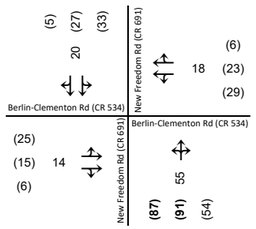


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	76
Max v/C	1.24
Syn Delay	47 D
Sim Delay	(40)
ICU	**107%** G

Implemented Operations



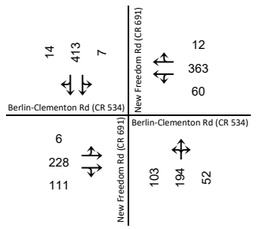
Summary	
Timing Pattern	FREE
Actuated Cycle	89.4
Max v/C	0.94
Syn Delay	26 C
Sim Delay	(35)
ICU	**98%** F

Operations with Improvements

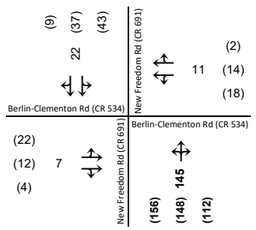
No operational improvements recommended at this time.

PM Off-peak

Hourly Volumes

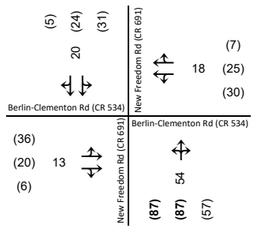


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	76
Max v/C	1.21
Syn Delay	44 D
Sim Delay	(40)
ICU	**107%** G

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	88.9
Max v/C	0.94
Syn Delay	26 C
Sim Delay	(35)
ICU	**98%** F

Operations with Improvements

No operational improvements recommended at this time.

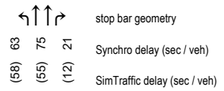
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

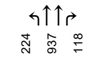
LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

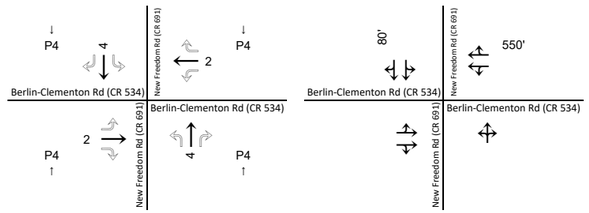


stop bar geometry
turning movement volume

Figure 40

Weekday Traffic Operations Analysis

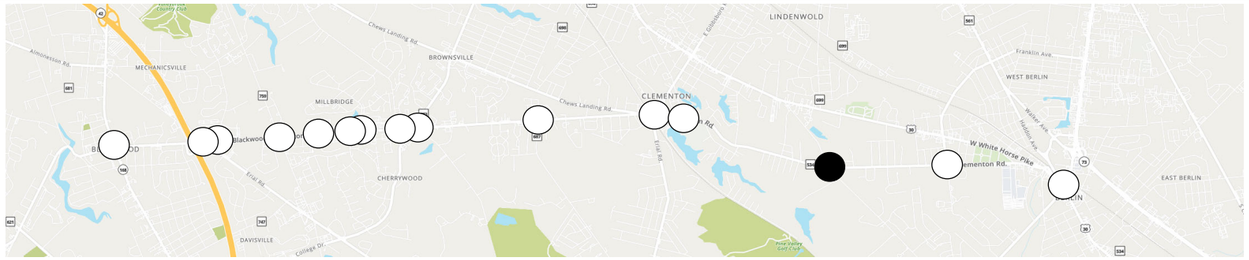
Blackwood-Clementon Rd (CR 534) & New Freedom Rd (CR 691)



Phasing Diagram

Intersection Geometry

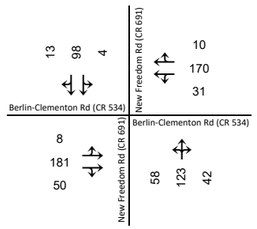
Intersection ID # 13



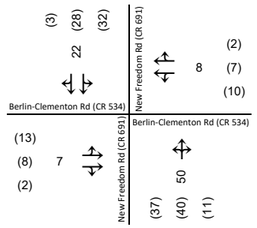
NTS

Weekend AM Peak

Hourly Volumes

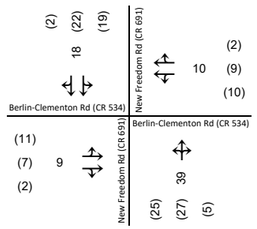


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	82.4
Max v/C	0.86
Syn Delay	22 C
Sim Delay	(17)
ICU	60% B

Implemented Operations



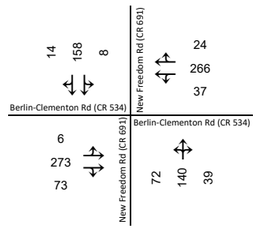
Summary	
Timing Pattern	FREE
Actuated Cycle	73.6
Max v/C	0.80
Syn Delay	19 B
Sim Delay	(13)
ICU	61% B

Operations with Improvements

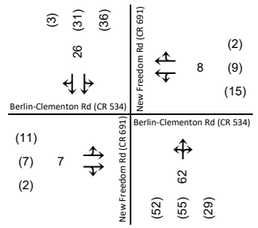
No operational improvements recommended at this time.

Weekend MD Peak

Hourly Volumes

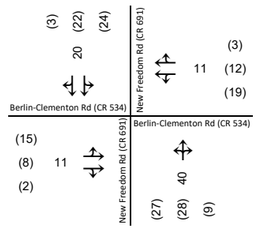


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	88.6
Max v/C	0.92
Syn Delay	25 C
Sim Delay	(20)
ICU	77% D

Implemented Operations



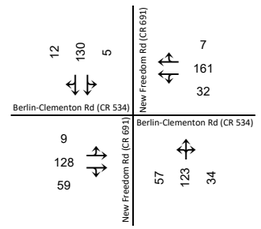
Summary	
Timing Pattern	FREE
Actuated Cycle	76.1
Max v/C	0.82
Syn Delay	20 B
Sim Delay	(14)
ICU	80% D

Operations with Improvements

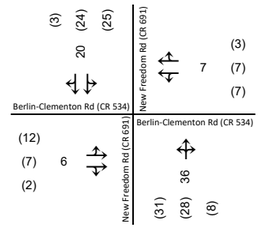
No operational improvements recommended at this time.

Weekend PM Peak

Hourly Volumes

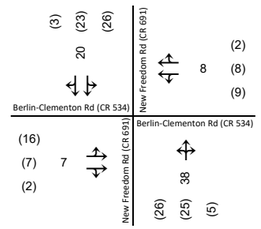


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	68.5
Max v/C	0.76
Syn Delay	17 B
Sim Delay	(15)
ICU	65% C

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	70.8
Max v/C	0.78
Syn Delay	18 B
Sim Delay	(14)
ICU	68% C

Operations with Improvements

No operational improvements recommended at this time.

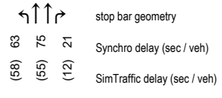
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

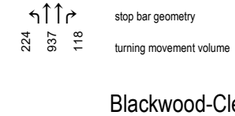
LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

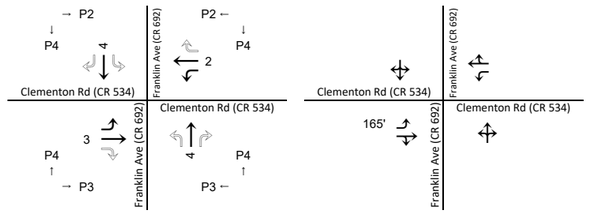


stop bar geometry
turning movement volume

Figure 41

Weekend Traffic Operations Analysis

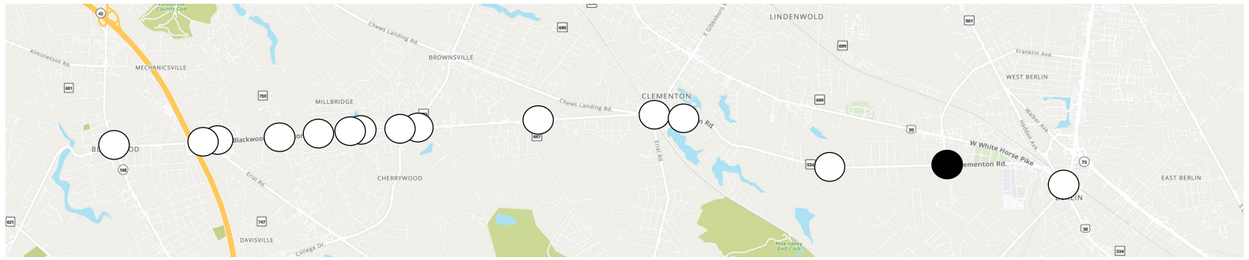
Blackwood-Clementon Rd (CR 534) & New Freedom Rd (CR 691)



Phasing Diagram

Intersection Geometry

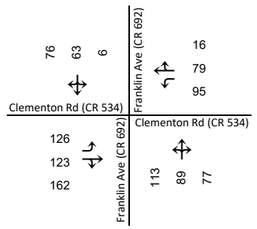
Intersection ID # 14



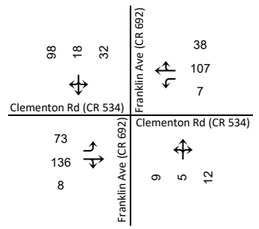
N NTS

Hourly Volumes

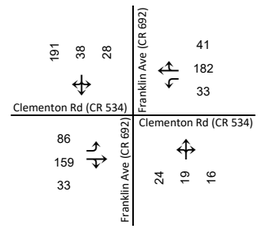
AM Peak



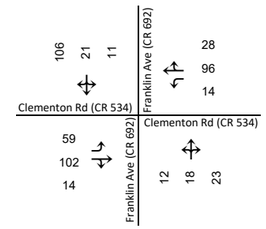
MD Peak



PM Peak

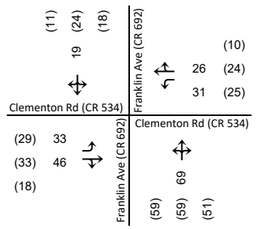


PM Off-peak



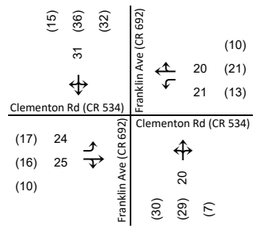
Existing Operations

AM Peak



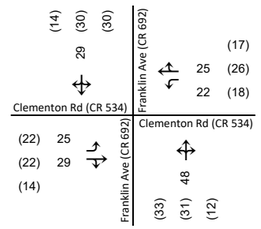
Summary	
Timing Pattern	FREE
Actuated Cycle	89.3
Max v/C	0.96
Syn Delay	43 D
Sim Delay	(33)
ICU	75% D

MD Peak



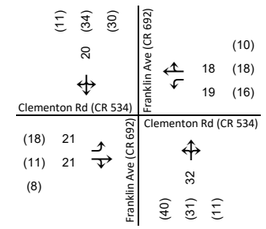
Summary	
Timing Pattern	FREE
Actuated Cycle	79.5
Max v/C	0.72
Syn Delay	25 C
Sim Delay	(18)
ICU	47% A

PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	76.6
Max v/C	0.77
Syn Delay	29 C
Sim Delay	(21)
ICU	55% B

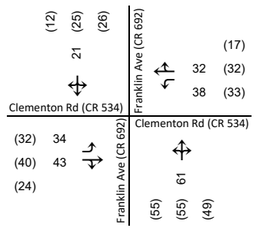
PM Off-peak



Summary	
Timing Pattern	FREE
Actuated Cycle	76.7
Max v/C	0.62
Syn Delay	22 C
Sim Delay	(15)
ICU	46% A

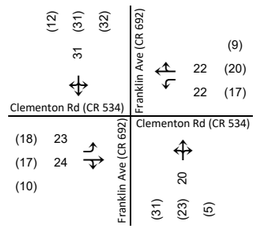
Implemented Operations

AM Peak



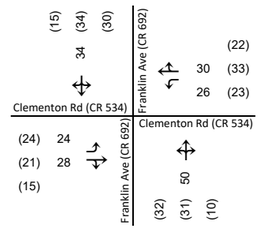
Summary	
Timing Pattern	FREE
Actuated Cycle	99.6
Max v/C	0.92
Syn Delay	42 D
Sim Delay	(35)
ICU	78% D

MD Peak



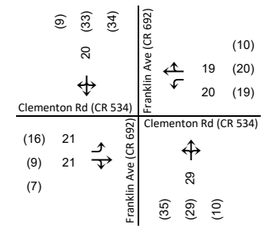
Summary	
Timing Pattern	FREE
Actuated Cycle	78.4
Max v/C	0.72
Syn Delay	25 C
Sim Delay	(17)
ICU	53% A

PM Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	83.8
Max v/C	0.79
Syn Delay	31 C
Sim Delay	(24)
ICU	59% B

PM Off-peak



Summary	
Timing Pattern	FREE
Actuated Cycle	75.6
Max v/C	0.62
Syn Delay	21 C
Sim Delay	(14)
ICU	52% A

Operations with Improvements

No operational improvements recommended at this time.

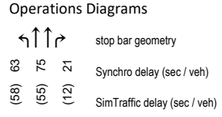
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

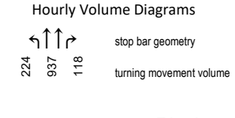


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



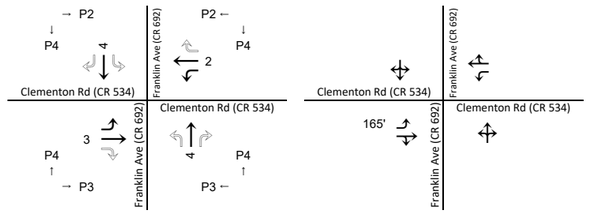
stop bar geometry

turning movement volume

Figure 42

Weekday Traffic Operations Analysis

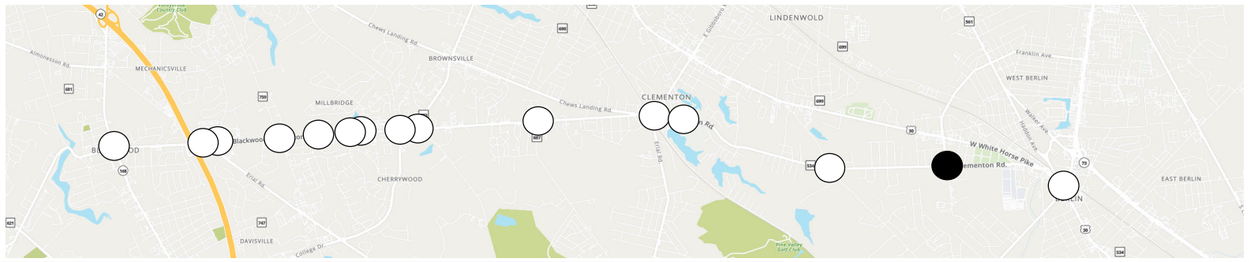
Blackwood-Clementon Rd (CR 534) & Franklin Ave (CR 692)



Phasing Diagram

Intersection Geometry

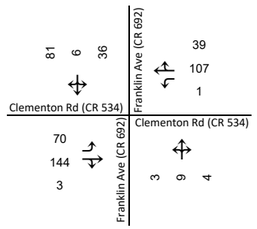
Intersection ID # 14



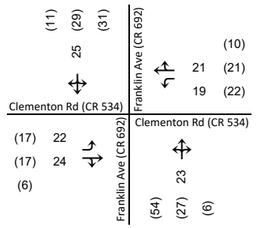
NTS

Weekend AM Peak

Hourly Volumes

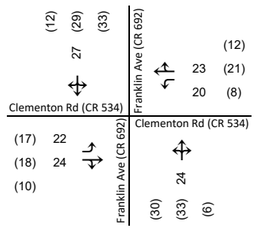


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	73.2
Max v/C	0.62
Syn Delay	23 C
Sim Delay	(17)
ICU	49% A

Implemented Operations



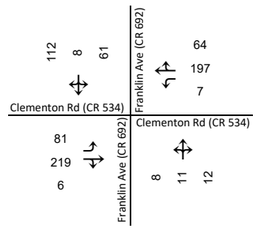
Summary	
Timing Pattern	FREE
Actuated Cycle	76.5
Max v/C	0.63
Syn Delay	24 C
Sim Delay	(18)
ICU	55% A

Operations with Improvements

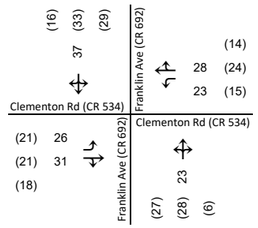
No operational improvements recommended at this time.

Weekend MD Peak

Hourly Volumes

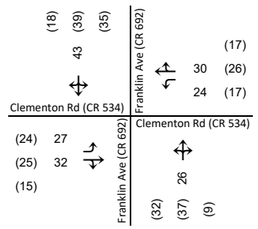


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	81.9
Max v/C	0.76
Syn Delay	30 C
Sim Delay	(21)
ICU	57% B

Implemented Operations



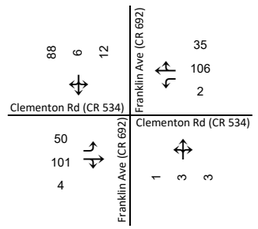
Summary	
Timing Pattern	FREE
Actuated Cycle	90
Max v/C	0.78
Syn Delay	33 C
Sim Delay	(24)
ICU	62% B

Operations with Improvements

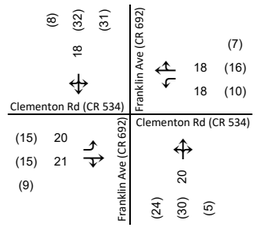
No operational improvements recommended at this time.

Weekend PM Peak

Hourly Volumes

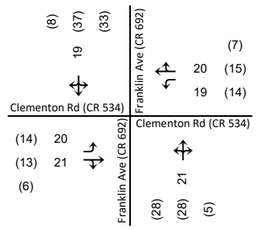


Existing Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	72
Max v/C	0.54
Syn Delay	19 B
Sim Delay	(14)
ICU	45% A

Implemented Operations



Summary	
Timing Pattern	FREE
Actuated Cycle	75.1
Max v/C	0.55
Syn Delay	20 C
Sim Delay	(13)
ICU	51% A

Operations with Improvements

No operational improvements recommended at this time.

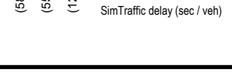
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams

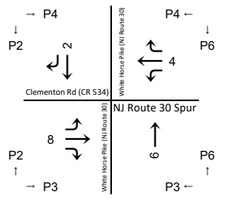
stop bar geometry

turning movement volume

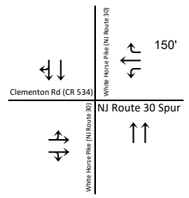
Figure 43

Weekend Traffic Operations Analysis

Blackwood-Clementon Rd (CR 534) & Franklin Ave (CR 692)

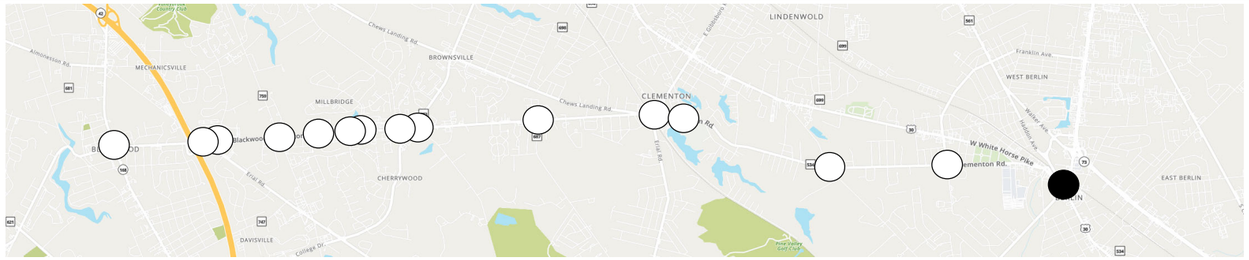


Phasing Diagram



Intersection Geometry

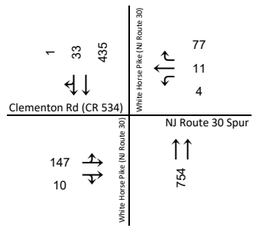
Intersection ID # 15



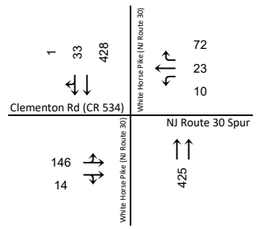
N
NTS

Hourly Volumes

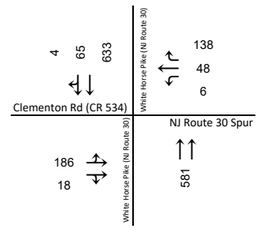
AM Peak



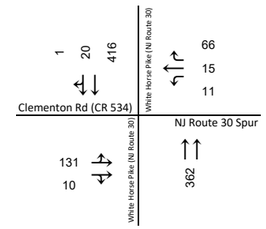
MD Peak



PM Peak

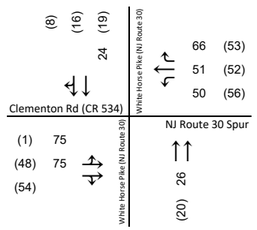


PM Off-peak



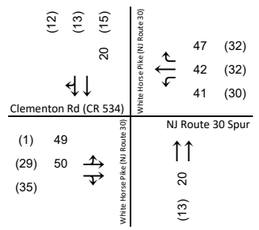
Existing Operations

AM Peak



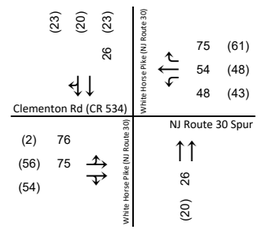
Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.94
Syn Delay	40 D
Sim Delay	(26)
ICU	74% D

MD Peak



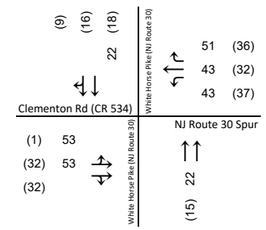
Summary	
Timing Pattern	FREE
Actuated Cycle	87.6
Max v/C	0.53
Syn Delay	26 C
Sim Delay	(18)
ICU	74% D

PM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.77
Syn Delay	37 D
Sim Delay	(30)
ICU	78% D

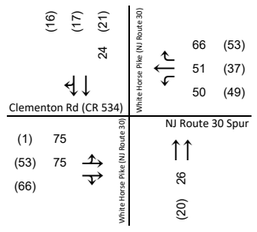
PM Off-peak



Summary	
Timing Pattern	FREE
Actuated Cycle	92.8
Max v/C	0.54
Syn Delay	29 C
Sim Delay	(21)
ICU	74% D

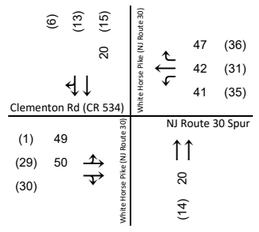
Implemented Operations

AM Peak



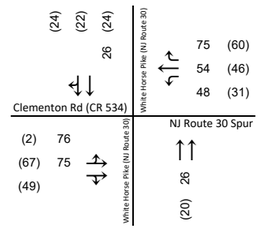
Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.94
Syn Delay	40 D
Sim Delay	(28)
ICU	74% D

MD Peak



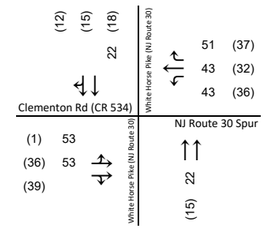
Summary	
Timing Pattern	FREE
Actuated Cycle	87.6
Max v/C	0.53
Syn Delay	26 C
Sim Delay	(18)
ICU	74% D

PM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.77
Syn Delay	37 D
Sim Delay	(32)
ICU	78% D

PM Off-peak



Summary	
Timing Pattern	FREE
Actuated Cycle	92.8
Max v/C	0.54
Syn Delay	29 C
Sim Delay	(21)
ICU	74% D

Operations with Improvements

No operational improvements recommended at this time.

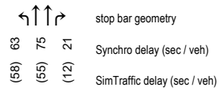
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

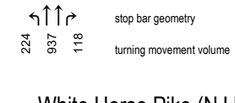


stop bar geometry

Synchro delay (sec / veh)

SimTraffic delay (sec / veh)

Hourly Volume Diagrams



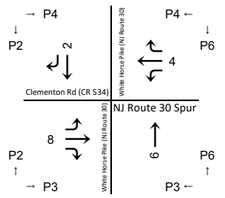
stop bar geometry

turning movement volume

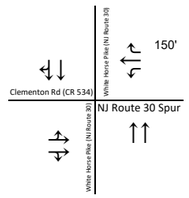
Figure 44

Weekday Traffic Operations Analysis

White Horse Pike (NJ Route 30) & Clementon Rd (CR 534)/Route 30 Spur

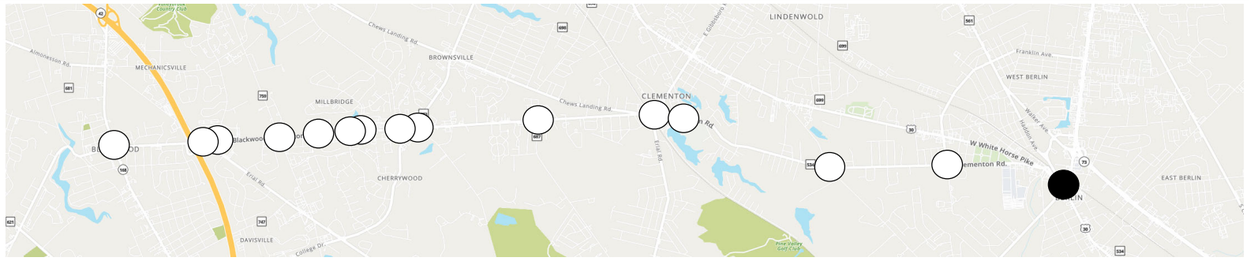


Phasing Diagram



Intersection Geometry

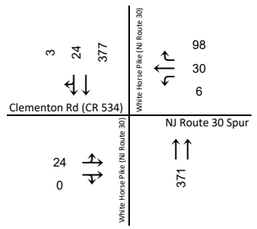
Intersection ID # 15



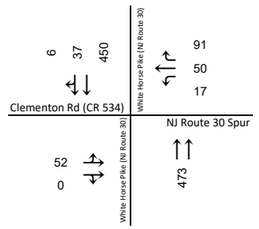
N NTS

Hourly Volumes

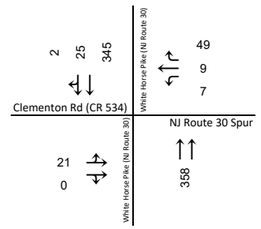
Weekend AM Peak



Weekend MD Peak

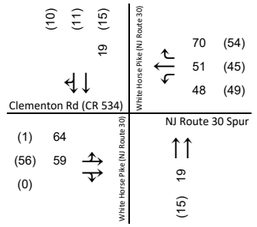


Weekend PM Peak



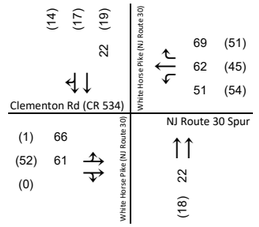
Existing Operations

Weekend AM Peak



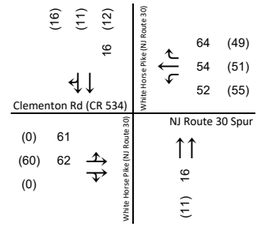
Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.87
Syn Delay	35 D
Sim Delay	(23)
ICU	73% D

Weekend MD Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.50
Syn Delay	66 E
Sim Delay	(41)
ICU	73% D

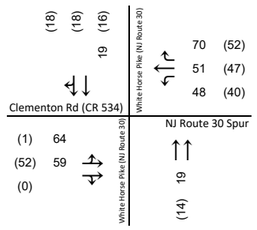
Weekend PM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.09
Syn Delay	41 D
Sim Delay	(24)
ICU	73% D

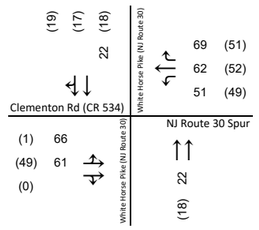
Implemented Operations

Weekend AM Peak



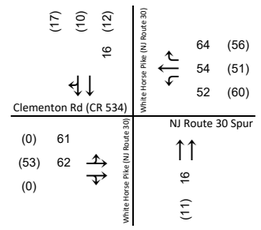
Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.87
Syn Delay	35 D
Sim Delay	(23)
ICU	73% D

Weekend MD Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.50
Syn Delay	66 E
Sim Delay	(41)
ICU	73% D

Weekend PM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.09
Syn Delay	41 D
Sim Delay	(23)
ICU	73% D

Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams

63 75 21
(58) (55) (12)

stop bar geometry
Synchro delay (sec / veh)
SimTraffic delay (sec / veh)

Hourly Volume Diagrams

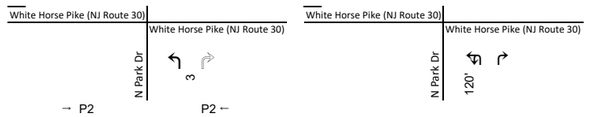
224 937 118

stop bar geometry
turning movement volume

Figure 45

Weekend Traffic Operations Analysis

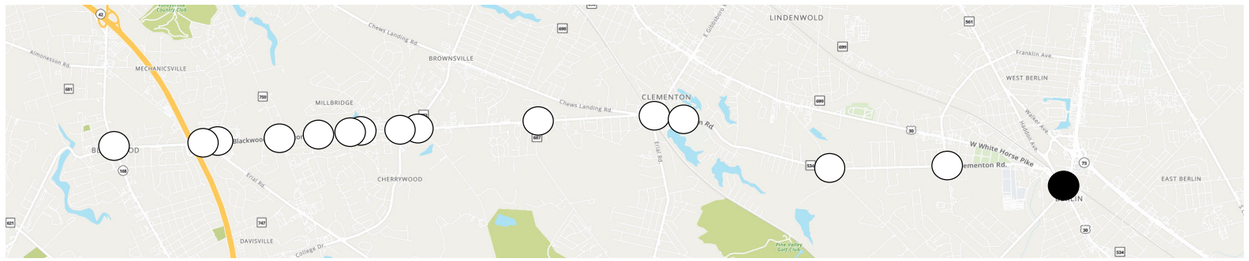
White Horse Pike (NJ Route 30) & Clementon Rd (CR 534)/Route 30 Spur



Phasing Diagram

Intersection Geometry

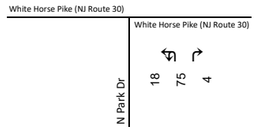
Intersection ID # 15



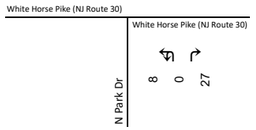
NTS

Hourly Volumes

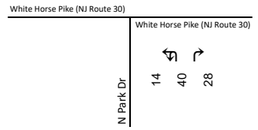
AM Peak



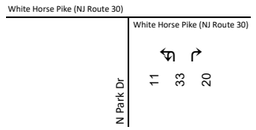
MD Peak



PM Peak

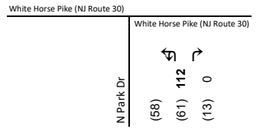


PM Off-peak



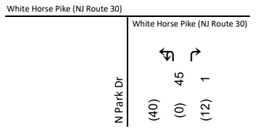
Existing Operations

AM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.94
Syn Delay	40 D
Sim Delay	(26)
ICU	74% D

MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	87.6
Max v/C	0.53
Syn Delay	26 C
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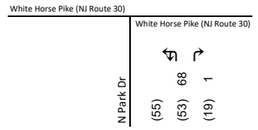
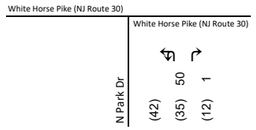
ICU	74% D

PM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.77
Syn Delay	37 D
Sim Delay	(30)
ICU	78% D

PM Off-peak



Summary	
Timing Pattern	FREE
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Max v/C	0.54
Syn Delay	29 C
Sim Delay	(21)
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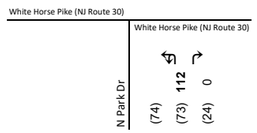
Implemented Operations

AM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.94
Syn Delay	40 D
Sim Delay	(28)
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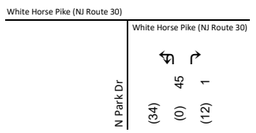
MD Peak



Summary	
Timing Pattern	FREE
Actuated Cycle	87.6
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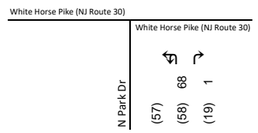
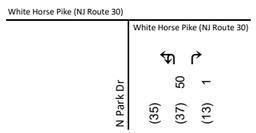
ICU	74% D

PM Peak



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.77
Syn Delay	37 D
Sim Delay	(32)
ICU	78% D

PM Off-peak



Summary	
Timing Pattern	FREE
Actuated Cycle	92.8
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Syn Delay	29 C
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Operations with Improvements

No operational improvements recommended at this time.

HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
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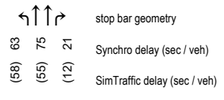
Operations Diagrams



Hourly Volume Diagrams

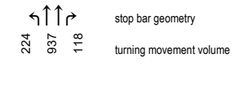
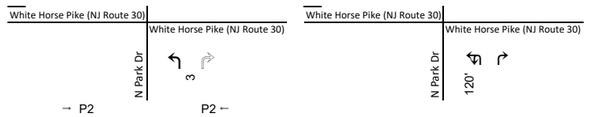


Figure 46

Weekday Traffic Operations Analysis

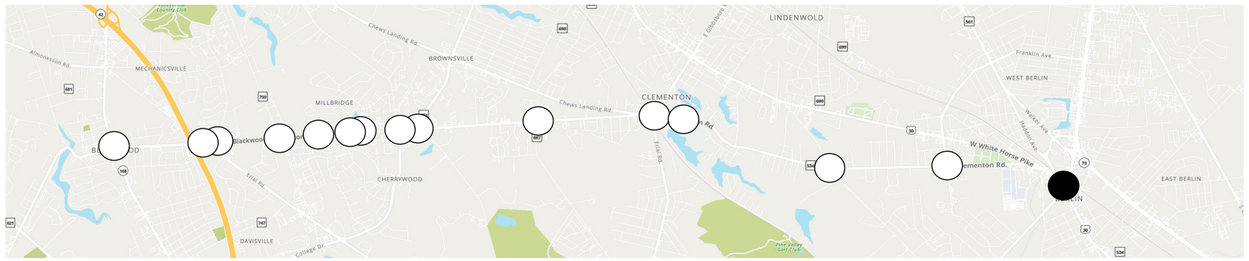
White Horse Pike (NJ Route 30) & N Park Dr



Phasing Diagram

Intersection Geometry

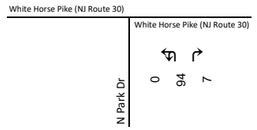
Intersection ID # 15



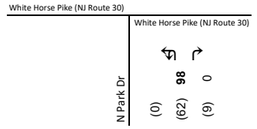
NTS

Weekend AM Peak

Hourly Volumes



Existing Operations



Summary	
Timing Pattern	2/1/1
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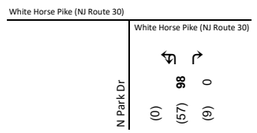
Max v/C	0.87
Syn Delay	35 D
Sim Delay	(23)
ICU	73% D

Implemented Operations



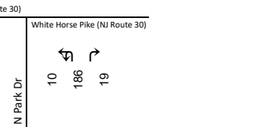
Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	0.87
Syn Delay	35 D
Sim Delay	(23)
ICU	73% D

Operations with Improvements

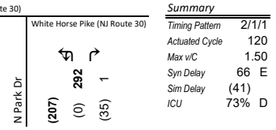
No operational improvements recommended at this time.

Weekend MD Peak

Hourly Volumes

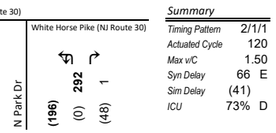


Existing Operations



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.50
Syn Delay	66 E
Sim Delay	(41)
ICU	73% D

Implemented Operations



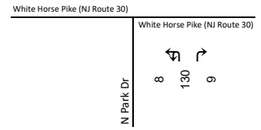
Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.50
Syn Delay	66 E
Sim Delay	(41)
ICU	73% D

Operations with Improvements

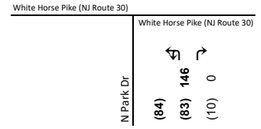
No operational improvements recommended at this time.

Weekend PM Peak

Hourly Volumes

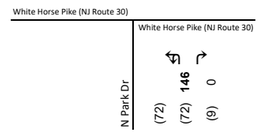


Existing Operations



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.09
Syn Delay	41 D
Sim Delay	(24)
ICU	73% D

Implemented Operations



Summary	
Timing Pattern	2/1/1
Actuated Cycle	120
Max v/C	1.09
Syn Delay	41 D
Sim Delay	(23)
ICU	73% D

Operations with Improvements

No operational improvements recommended at this time.

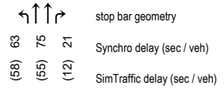
HCM Levels of Service

LOS	Delay/Veh (s)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

ICU Levels of Service

LOS	Utilization (%)
A	≤55%
B	>55% and ≤64%
C	>64% and ≤73%
D	>73% and ≤82%
E	>82% and ≤91%
F	>91% and ≤100%
G	>100% and ≤109%
H	>109%

Operations Diagrams



Hourly Volume Diagrams

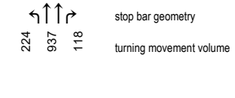


Figure 47

Weekend Traffic Operations Analysis

White Horse Pike (NJ Route 30) & N Park Dr