Technical Memorandum: H2M Corridor Traffic Analysis

To: Pittsburgh Regional Transit
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From: Michael Baker International
Date: April 18, 2023
Subject: Homestead to McKeesport (H2M) Upgraded Transit Traffic Analysis Technical Memorandum

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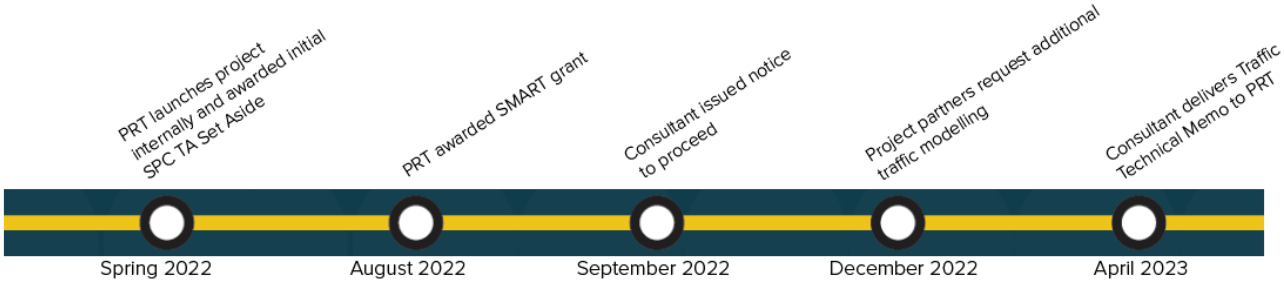
I. Objective

Pittsburgh Regional Transit (PRT) is leading a corridor study to upgrade transit service and amenities on SR 837 between Homestead and McKeesport and SR 148 in McKeesport (H2M Corridor). Michael Baker International performed a Synchro analysis to determine existing and proposed traffic operations along the H2M Corridor. This memorandum summarizes the analysis efforts and results.

While this memorandum focuses on the Synchro analysis of the H2M corridor, this is only a part of a greater project. There are concerns (real and perceived) about pedestrian safety, particularly at signalized intersection crossings. This memorandum discusses general maintenance issues with pavement markings, signage, and lighting. In addition, there is a desire to consider different intersection designs to calm turning movements, reduce pedestrian crossing times, and provide refuge. After presenting these concepts to municipal leadership, the project team will host a discussion with our project partners at PennDOT to deliver the results and desires from the municipalities for the corridor. A timeline of the project progress to date is shown below:



Key Findings

The overarching findings of the Synchro analysis indicate that most of the corridor operates at an acceptable Level of Service (LOS) except for the Homestead area between the Homestead Grays Bridge to Amity St (entrance to The Waterfront). These locations may be improved with modified signal timings. The initial data and analysis highlight a notable finding within the McKeesport segment of the corridor on Lysle Boulevard; for future consideration, there is an opportunity to study further the re-purposing of through lanes for other multi-modal uses.

II. Study Area & Project Background

Why Study this Corridor?

The Homestead to McKeesport transit connection is one of five *Essential Investments* in PRT's 2021 NEXTransit long-range transportation plan. The NEXTransit plan strongly emphasizes improving transit speed, reliability, rider access, and safety in the corridor. This corridor scored highly for improvements because of the significant transit dependence of its riders, as a substantial portion of the corridor falls within areas that rate high on PRT's Equity Index of Mobility Need.

Key Corridor Statistics:

- 7.3 miles (Homestead Grays Bridge to McKeesport Transportation Center).
- Six municipalities: Homestead, Munhall, Whitaker, West Mifflin, Duquesne, and McKeesport.
- Ten PRT bus routes: the 52L, 53, 53L, 55, 56, 57, 59, 60, 61C, and P7.
- 1,150 daily transit boardings (2,100 in 2019, pre-pandemic).

Key Trip Generators:

- Sandcastle Water Park (Homestead, seasonal)
- The Waterfront shopping center (Homestead/Munhall)
- Kennywood Amusement Park (West Mifflin, seasonal)
- Greater Pittsburgh Community Food Bank (Duquesne)
- Durabond Coating (Duquesne)
- UPMC McKeesport
- Regional Industrial Development Corporation (RIDC) McKeesport
- RIDC Duquesne
- Durabond Pipe (McKeesport)

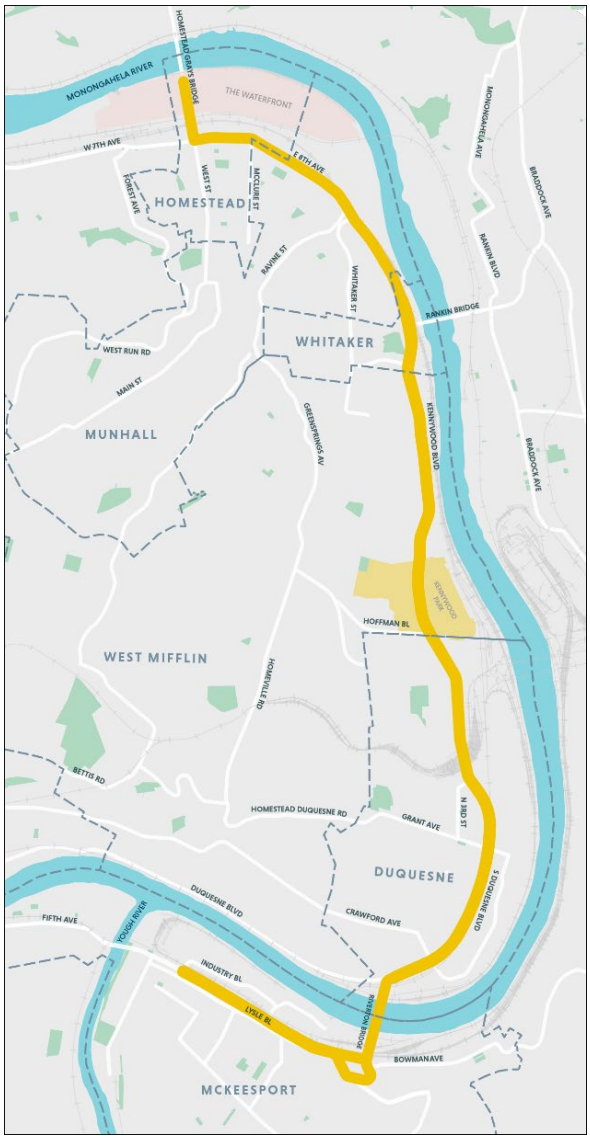
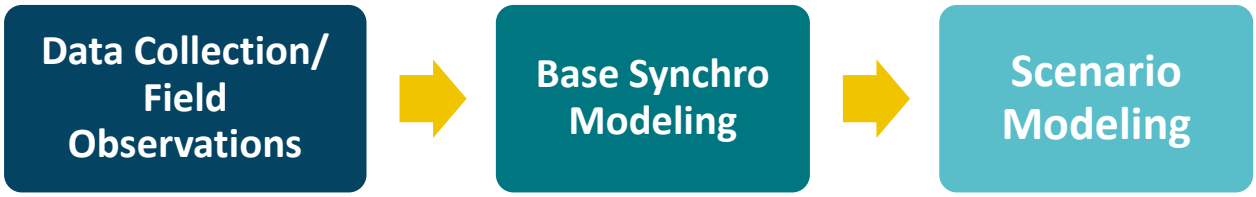


Figure 1 Study Area

Figure 1 illustrates the project's geographic study area and visualizes the 7.3-mile PA Route 837 corridor.

III. Methodology

The Synchro analysis involves three core steps. Data Collection and Field Observations, Base Modeling, and Scenario Modeling.



Data Collection & Field Observations

PRT invested in a substantial data collection effort. The data collection consists of the following:

- Travel time runs using floating car methodology (**Appendix A**)
- Turning movement traffic counts at 30 locations (**Appendix B**)
- TIS traffic speed data
- Transit Automated Vehicle Speed Data (not part of this memo)
- Crash Analysis (not part of this memo)
- Field Observations
    - Train pre-emption impacts in Homestead
    - Pedestrian crossing and push button performance
    - Condition of signing, striping lighting, and equipment
- Review and comparison of Signal Permit Plans to field conditions

This information's accumulation provided insights into issues that must be addressed outside of traffic performance and ensured that the Synchro Analysis reflects observed conditions.

Base Synchro Modeling

The team used Synchro 11 software to analyze the intersections. Synchro 11 is a macroscopic traffic modeling software that analyzes the capacity of the intersections following the *Highway Capacity Manual* (HCM) procedures. Outputs include Measures of Effectiveness (MOEs) such as Vehicle Delay, Level of Service (LOS), and queue lengths. **Table** summarizes the LOS criteria for vehicle delay according to the HCM for signalized intersections:

Table 1: Level of Service Criteria

Level of Service	Average Delay (sec/vehicle)	Qualitative Description
A	0 - 10	Free flow conditions with no delay
B	>10 - 20	Stable flow with a slight delay
C	>20 - 35	Stable flow with acceptable delay
D	>35 - 55	Approaching unstable flow with tolerable delay
E	>55 - 80	Unstable flow with intolerable delay
F	>80	Forced flow with jammed conditions

Adjustments to Base Synchro Model

After examining the initial Synchro Model Results, two modifications were made to the collected data. First, the actual timings in the field are markedly different from the permit signal plan timings for the Eighth St/Homestead Grays Bridge (4–5-minute cycle lengths in the field vs. 120-second cycle length in the permit plans). Next, the traffic counts entering and exiting the Waterfront Mall were significantly lower than on a typical day according to the ITE trip generation manual and observations from other days (see **Appendix C** for ITE Trip Generation Analysis). In both cases, inputs were modified within the model to reflect the higher worse case conditions.

The analysis results will reflect the actual count condition with the higher cycle lengths at Homestead/Grays Bridge and the higher traffic volume scenario.

Scenario Modeling

The team tested a scenario with modifications across the corridor. The primary modifications tested included:

1. Revised timings at Homestead Grays Bridge and Eighth Ave
2. Optimized corridor timings
3. Test of capacity reduction on Lysle Blvd

The intent of the test is to determine basic low-cost options to improve corridor performance.

Future traffic volumes

PennDOT's approved growth rate for Urban Non-Interstate roads (08/2022-07/2023) is 0.00%; therefore, a future-year condition would not increase traffic volumes. As a result, the proposed network analyzed improvements with the existing traffic volumes adjusted based on the ITE Trip Generation Manual. The growth rate reference sheet is in **Appendix D**.

IV. Existing Conditions

A snapshot of H2M corridor traffic performance shown in **Figure 2** shows a screenshot from RITIS data from September 12, 2022, at 5:30 PM. Congestion is pervasive from the Homestead Grays Bridge through the Waterfront Access Road. South of this area, traffic performs well. These conditions are understood and have been further supported through the other data collected and analyzed in this memorandum.

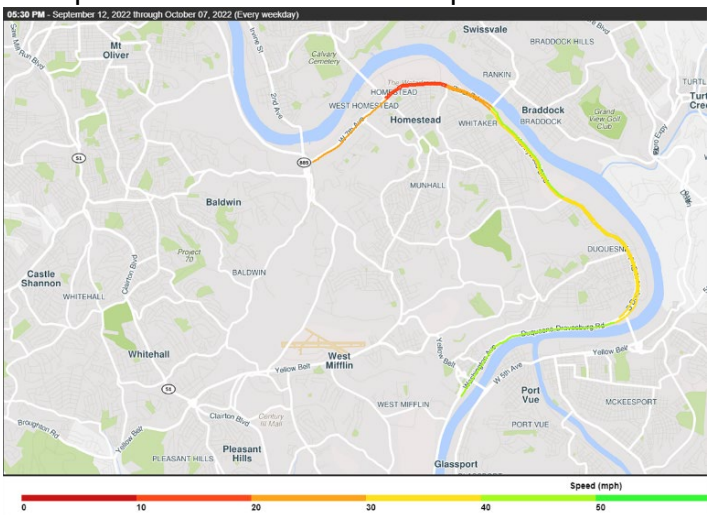


Figure 2: RITIS Congestion Screen Shot

A summary of observations is available in **Appendix A**. Traffic Volume Diagrams are in **Appendix B**.

Existing Network Description

The H2M study area contains 28 signalized intersections. Any future signal retiming efforts to enhance transit priority/reliability must consider the existing signal operations, coordinated systems, and signal equipment. Coordination will also be necessary with all the municipalities that own and maintain these signals. To better understand these challenges, an inventory of the study area signals was completed utilizing PennDOT's Traffic Signal Asset Management System (TSAMS). **Table A-1** summarizes the permit plan information for each traffic signal.

All six municipalities in the study area maintain 28 traffic signals located along Route 837. Of the 28 total intersections in the corridor, 25 of them are a part of four coordinated signal systems. Three signals are uncoordinated. Several types of coordination exist along the corridor, including spread spectrum radio, GPS, time-based coordination, and interconnection.

Nine intersections provide a dedicated pedestrian phase; all others have a concurrent pedestrian phase with the green interval. The pedestrian phase is activated by actuation only at all intersections.

A comprehensive summary of existing conditions along the corridor has been compiled in a Map: https://arcg.is/1aGenu0

Homestead Area Causes of Congestion

Recurring congestion is primarily in the Homestead area, where queueing extends between intersections. Causes of vehicle queues include actuated dedicated pedestrian phases, train pre-emption, and other typical business district activities. Short blocks exacerbate these factors, though the traffic queues typically resolve within a few signal cycles.

There are two intersections with operational deficiencies that require mitigation – Eighth Ave/Homestead Grays Bridge and Eighth Ave/Waterfront Dr. Issues include:

- Poor intersection operation on Eighth and Homestead Grays Bridge
- Impacts of trains interrupting traffic on Amity St
- Waterfront trip generation

Eighth Ave/Homestead Grays Bridge Queuing

Existing queues regularly extend from Eighth Avenue on the Homestead bridge through the Fifth Ave intersection and beyond across the river. One of the primary reasons the queues extend this far is the long cycle lengths (4-5 minutes) currently in operation. The green time nears two minutes long in the southbound direction which is an attempt to clear the queue. While many vehicles are served during this phase, it was clear that efficiency drops after the first 45 seconds. After 45 seconds of green time, the gaps (headway) between vehicles increase to the point that fewer and fewer vehicles are being served from 45 seconds to the end of the phase.

Queue on Homestead Grays Bridge

Increasing vehicle headway

Figure 3: Homestead-Gray Bridge Turning Movements & Train Operations

Two active rail lines impact operations in Homestead; the Norfolk Southern and CSX railroad runs alongside the Waterfront development. These railroads have at-grade crossings on Amity St, between Fifth Ave and Sixth Ave. There are 42 trains per day at these crossings, stopping traffic for several minutes at a time. These stoppages cause substantial delays and create restrictions to the access to and from the Waterfront. The resulting queues extend through several intersections and impact operations along the side streets, including Eighth Ave. Our field observations confirmed that the traffic queues would dissipate, and operations would revert to normal within a few minutes of the train passing. These stoppages negatively impact transit service by causing increased delays and unpredictability to bus schedules.

Train Causes Queue along Amity Street

Train Queue blocks left-turns Onto Amity St from Eighth Ave

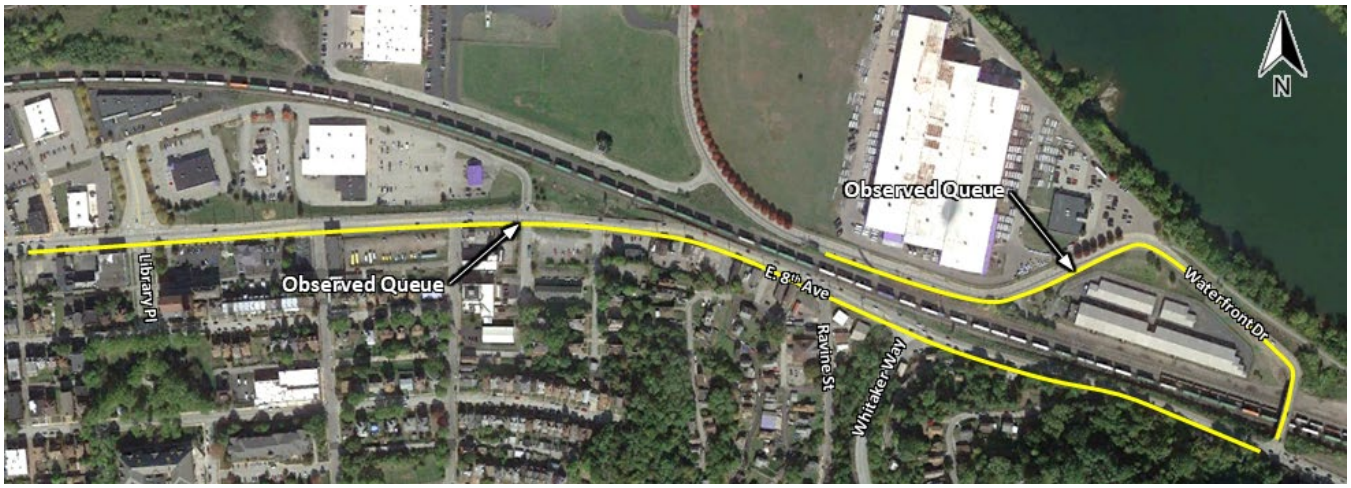
Train Queue blocks left-turns Onto Amity St from Seventh Ave

Traffic Queues – Homestead and Waterfront

In one location, the existing condition Synchro model did not replicate the field-observed queues. The team observed pervasive congestion in the PM peak along eastbound Eighth Ave between Waterfront Dr and Dickson St, and on Waterfront Dr in February of 2023.

Figure 3 illustrates the extent of queues we observed. This congestion along Eighth Ave results from the left-turn movement spilling back into the through lane. The traffic counts in Fall 2022 had poor weather conditions, and Waterfront shopping center traffic seemed low. Therefore, the team recommended adjusting the traffic counts to reflect increased traffic to the Waterfront.

Figure 3: Field Observed Traffic Queuing (PM Peak)



Existing Synchro Analysis

The Synchro model replicates the existing road network geometry, signal phasing/timing, and traffic volumes. Signal phasing and timings for the 28 signalized intersections were determined from the traffic signal permit plans and field observations. In addition, travel time data, field-observed queue lengths, and general operations of the corridor were used to validate the model's accuracy. Synchro models were created for both the morning peak and evening peak periods.

Table 2 (on the following page) shows the results of the two existing conditions. The first scenario includes the volumes that were counted in Fall 2022. The second scenario includes the volumes adjusted to reflect Trip Generation Manual levels near the Waterfront access points.

Table 2: Existing Conditions Synchro Delay and Level of Service

District	Intersection #	Existing Intersections		Delay Sec/Vehicle			
				Existing (Fall 2022 Counts)		With Adjusted Existing Volumes	
		Primary Street (Corridor R)	Cross Street	AM	PM	AM	PM
Homestead / Munhall	1	Fifth Ave	Homestead/Grays Br.	14.0	38.8	16.8	45.8
	4	Eighth Ave	Homestead/Grays Br.	75.6	69.9	75.5	69.5
	5	Eighth Ave	Amity St	15.7	21.3	15.7	21.3
	6	Eighth Ave	Ann St	9.3	10.6	9.3	10.6
	7	Eighth Ave	McClure St	11.0	16.7	11.0	16.7
	8	Eighth Ave	Dickson St	4.5	3.8	4.5	3.8
	9	Eighth Ave	Library Pl	4.3	6.9	4.3	6.9
	10	Eighth Ave	Grant St	2.9	5.4	2.9	5.4
	11	Eighth Ave	Ravine St	10.3	10.2	10.3	10.2
	12	Eighth Ave	Whitaker Way	13.3	9.0	13.3	9.0
	13	Eighth Ave	Waterfront Dr	18.0	35.7	21.7	58.0
Whit-aker	14	River Rd	Rankin Bridge	9.1	23.9	9.3	27.3
	15	River Rd	Mifflin St	12.7	13.1	12.7	13.0
West Mifflin	16	Kennywood Blvd	Glenn St	5.7	4.7	5.7	4.7
	17	Kennywood Blvd	Kennywood Lot	0.1	0.1	0.1	0.1
	18	Kennywood Blvd	Hoffman Blvd	13.2	17.5	13.2	17.5
Duquesne	19	Duquesne Blvd	Commonwealth Blvd	8.3	9.0	8.3	9.0
	20	Duquesne Blvd	Grant Ave	14.4	15.0	14.4	15.0
	21	Duquesne Blvd	Library Pl	5.1	5.8	5.1	5.8
	22	Duquesne Blvd	Wylie St	0.7	3.1	0.7	3.1
	23	Duquesne Blvd	Center St	12.2	18.8	12.2	18.8
McKeesport	24	Lysle Blvd	Fifth Ave	16.5	17.3	16.5	17.3
	25	Lysle Blvd	Evans Ave	6.3	5.8	6.3	5.8
	26	Lysle Blvd	Center St	3.3	4.9	3.3	4.9
	27	Lysle Blvd	Coursin St	6.8	11.7	6.8	11.7
	28	Lysle Blvd	Huey St	9.1	8.4	9.1	8.4
	29	Lysle Blvd	Sheridan St	1.1	1.5	1.1	1.5
	30	Lysle Blvd	Sinclair St	6.6	7.9	6.6	7.9

LOS	Delay (s)
A	0-10
B	>10-20
C	>20-35
D	>35-55
E	>55-80
F	>80

V. Model Scenario - Optimizing Operations

This project aims to improve the efficiency of PRT bus operations on the H2M corridor. By improving the overall efficiency of intersections, both regular traffic and transit operations will improve. This project does not include a continuous transit-only lane. However, there are considerations for queue jump lanes and Transit Signal Priority (TSP). Synchro software cannot analyze queue jumps lanes or TSP; therefore, these features are not part of this analysis. However, these features will still be considered during the design phase.

Table 3: Description of Modifications

Location	Description
Homestead Grays Bridge to Amity St	The proposed signal optimizations include upgrading it to fully actuated and shortening the cycle length. In addition, since this signal is in coordination with the adjacent signals, the entire system was optimized in the Synchro model.
Eighth Avenue and Waterfront Dr	This section of Eighth Ave is constrained on both sides by steep slopes, existing utilities, and limited right-of-way. The Waterfront Dr approach is on the structure. Based on these constraints, near-term improvements are limited to signal optimizations and pedestrian safety improvements to create safer access to transit stops. The EB left turn movement is protected/prohibited. The WB right turn movement is posted "No Turn on Red" due to the tight turn radius and limited sight distance. Due to these limitations, the proposed signal optimizations include revising the splits and the overall cycle length.
Lysle Blvd Capacity Assessment	The project team analyzed traffic on Lysle Blvd and found a large excess of roadway capacity provides an opportunity for potential road diets and additional street design treatments which can be explored in the future.

Results

The optimized network operates as well or better than the existing network during the AM and PM peak periods. The optimized network improves all locations where a LOS D or E is present, resulting in all areas having LOS D or better. **Table** summarizes LOS and Delay results for the Existing Condition (Trip Gen Adjusted), and Proposed Condition (Trip Gen Adjusted) — the modifications associated with each intersection. Full Synchro 11 reports from the capacity analysis are in **Appendix F**.

Table 4: H2M Corridor LOS & Delay Summary – Proposed Condition

District	Intersection #	Intersection		Sec/vehicle				Proposed Mods
				Existing w/Adjusted Volumes		Proposed w/ Adjusted Volumes		
		Primary Street (Corridor R)	Cross Street	AM	PM	AM	PM	
Homestead / Munhall	1	Fifth Ave	Homestead Grays Br	17	46	21	25	Signal timing revisions
	4	Eighth Ave	Homestead Grays Br	76	70	41	29	
	5	Eighth Ave	Amity St	16	21	12	24	
	6	Eighth Ave	Ann St	9	11	9	9	
	7	Eighth Ave	McClure St	11	17	10	13	
	8	Eighth Ave	Dickson St	5	4	3	3	
	9	Eighth Ave	Library Pl	4	7	5	5	
	10	Eighth Ave	Grant St	3	5	4	7	
	11	Eighth Ave	Ravine St	10	10	11	7	
	12	Eighth Ave	Whitaker Way	13	9	14	9	
	13	Eighth Ave	Waterfront Dr	22	58	20	54	
Whit-aker	14	River Rd	Rankin Bridge	9	27	9	27	No changes
	15	River Rd	Mifflin St	13	13	13	13	
West Mifflin	16	Kennywood Blvd	Glenn St	6	5	6	5	No changes
	17	Kennywood Blvd	Kennywood Lot	0	0	0	0	
	18	Kennywood Blvd	Hoffman Blvd	13	18	13	18	
Duquesne	19	Duquesne Blvd	Commonwealth Blvd	8	9	8	9	No changes
	20	Duquesne Blvd	Grant Ave	14	15	14	15	
	21	Duquesne Blvd	Library Pl	5	6	5	6	
	22	Duquesne Blvd	Wylie St	1	3	1	3	
	23	Duquesne Blvd	Center St	12	19	12	19	
McKeesport	24	Lysle Blvd	Fifth Ave	17	17	17	18	Study future capacity needs
	25	Lysle Blvd	Evans Ave	6	6	7	7	
	26	Lysle Blvd	Center St	3	5	7	7	
	27	Lysle Blvd	Coursin St	7	12	10	13	
	28	Lysle Blvd	Huey St	9	8	15	14	
	29	Lysle Blvd	Sheridan St	1	2	5	5	
	30	Lysle Blvd	Sinclair St	7	8	12	12	

LOS	Delay (s)
A	0-10
B	>10-20
C	>20-35
D	>35-55
E	>55-80
F	>80

VI. Next Steps

While the Synchro analysis tells the story of the corridor from a vehicular standpoint, further steps are forthcoming. We will explore other adjustments to intersections, such as geometry, signals, lanes (through and turning), and transit-supportive infrastructure to ensure people have safe access to transit. These adjustments will also benefit walkable amenities in neighborhoods.

Other analyses to formulate the final technical report for this corridor include Pedestrian Quality of Service (PQoS) and Transit Quality of Service (TQoS).

The PQoS element quantitatively analyzes all intersections along the corridor for pedestrian safety and performance. The pedestrian safety index (PISI) is the method for evaluation published by FHWA (FHWA-HRT-06-130). The PISI index uses existing conditions as a basis. The analysis is a function of traffic speed, traffic volume, roadway width, traffic control, and other intersection conditions. The index will provide a relative safety assessment and help prioritize intersectional improvements.

The TQoS portion analyzes the transit quality of service of the corridor utilizing the frameworks and methodology outlined in the *Transit Capacity and Quality of Service Manual (Part E)*. In addition, transit performance measures will be analyzed, and scores/Levels of Service will identify areas of deficiency and recommended improvements.

Final Technical Report

A final report will be prepared to summarize the results of the above tasks. In addition, the final report will incorporate comments received and measures of effectiveness obtained through Synchro and SimTraffic's built-in calculations of delay, number of stops, travel time, and emissions, as well as the outcomes of the PQoS and TQoS analyses. Other benefits of this project include the following:

- Increased safety for all modes
- Transit efficiency
- Reduced travel time
- Reduced fuel consumption
- Reduced pollutant emissions and user savings) related to these factors

The report will also include recommended signal phasing, timings, and coordination. In addition, other recommended changes will be marked up on signal permit drawings—explanations of the rationale for said changes will also be included (safety, conflict elimination, sightlines, etc.). Finally, a State of PA Professional Engineer (P.E.) will stamp and seal the final technical report.

VII. Supporting Appendices

Supporting appendices for this technical memorandum are listed in the table below and attached to this PDF. To access the attachments in the PDF, either:

- On the top of the toolbar, go to View > Show/Hide > Navigation Panes > Attachments,

- Or click on the arrow on the left-hand side of the Adobe Window to open the Navigation Pane, then click on the Paperclip (Attachments) icon.

#	File Name
1	Appendix A-Data collection
2	Appendix B-Traffic Volume Diagrams
3	Appendix C-Waterfront Trip Generation
4	Appendix D-Traffic Projections
5	Appendix E-Turn Lane Elimination Analysis
6	Appendix F-SYNCHRO Reports