

Appendix J

Belle Hall Parkway Left Turn Vissim Analysis



TECHNICAL MEMORANDUM:
BELLE HALL PARKWAY LEFT TURN
VISSIM ANALYSIS

Prepared for:



Prepared by:



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1.0 INTRODUCTION

The intersection of Long Point Road and Belle Hall Parkway is currently located approximately 390 feet north of the existing traffic signal serving the I-526 westbound off-ramp to Long Point Road. The proposed Alternative 2 concept proposes that this access be converted to a right-in/right-out access only. The existing left-turn traffic would be rerouted to take a left turn at the signalized intersection for Belle Point Drive located 800 feet downstream from the existing Belle Hall Parkway left turn.

Local traffic would use a combination of local roads including Belle Point Drive and Paul Foster Road to access Belle Hall Parkway and Seacoast Parkway. The proposed rerouting requires traffic bound for Seacoast Parkway to travel approximately 3,500 feet further than the current path. The anticipated traffic patterns are shown in **Figure 1** for the existing with a left turn at Belle Hall Parkway (blue) and the proposed Alternative 2 with no left turn at Belle Hall Parkway (gold).

Figure 1: Belle Hall Parkway Access Routes



Note: Turn movements onto Belle Hall Parkway were evaluated with 169 vph in the AM and 327 vph in the PM peak hour volumes. Based on input from the Town of Mount Pleasant and buildout of the area, these volumes were not increased for 2050 analysis.

The removal of the left turn to Belle Hall Parkway during the initial project identification was due to multiple factors including:

- Inadequate spacing between Belle Hall Parkway and the I-526 westbound off-ramp signalized intersection with Long Point Road. The existing layout has 390 feet intersection spacing and the proposed interchange reduces this to 330 feet measured from the outside edges from each intersection.
- Section 3C-4 of the SCDOT Access and Road Management Standards (ARMS) were applied. The standards identified the following:
 - 325 feet is the minimum spacing to allow a right in-right out (RIRO) access to be provided next to an interchange. This would indicate the left turn should be removed.
- Initial 2050 capacity analysis using Synchro software and HCS methods indicated that by 2050, peak period congestion would impact interchange operations. Key initial findings included:
- Queuing would impact operations at the I-526 westbound off-ramp signalized intersection and, as a result, to the Long Point Road interchange operations.

Based on this initial design concept analysis, it was assumed that the left turn from Long Point Road to Belle Hall Parkway would be eliminated as part of the preferred alternative (regardless of which conceptual alternative that would be selected).

2.0 PUBLIC SENTIMENT FOR KEEPING LEFT TURN ACCESS & SUBSEQUENT ANALYSIS

As part of the Public Information Meeting on August 2, 2022, the conversion of the Belle Hall Parkway intersection to RIRO with the removal of the Long Point Road left-turn lane was presented. Based on feedback from the public and subsequently the Town of Mount Pleasant as well as local political representatives, substantial opposition to the closure of the left turn was identified. This included identification by the public of alternate treatments and concepts that would preserve the left turn access.

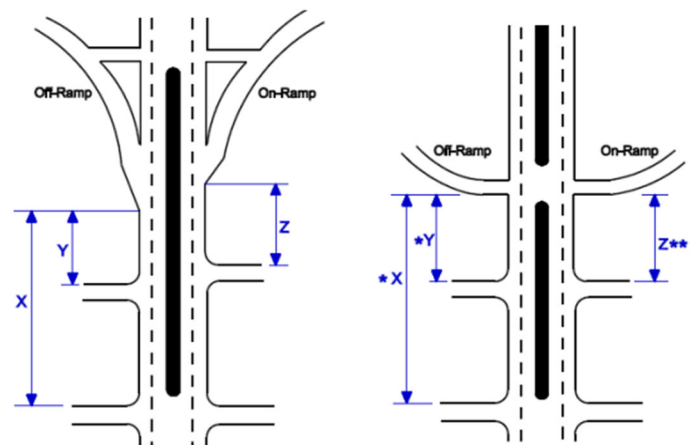
In response to the comments provided, more detailed analysis of the Belle Hall Parkway left turn treatment was completed which examined the 2030 and 2050 No Build, the 2050 Alternative 2 interchange scenario with and without a left-turn lane onto Belle Hall Parkway, and six additional concepts for the interchange layout and operations. This analysis was conducted using Synchro as the primary tool and included review of the SCDOT ARM Standards, a safety analysis of Long Point Road and the Belle Hall Parkway intersection, and capacity analysis (using Synchro and SimTraffic as software tools).

2.1 ACCESS ROAD MANAGEMENT STANDARDS

Section 3C-4 of the SCDOT Access and Road Management Standards (ARMS) were applied. The standards identified the following:

- 325 feet is the minimum spacing to allow a right-in/right-out (RIRO) access to be provided next to an interchange. This would indicate the left turn should be removed since spacing between the outside limits of the two intersections will be 330 feet (less than the existing 390 feet).
- More strict reading of Section 3C-4 of the ARMS could be read to measure the spacing from the beginning of the right turn taper to the freeway ramp. In this case, neither a RIRO or left turn would be allowed. Nevertheless, the RIRO is included as part of the preferred Alternative 2.

Figure 3-11: Minimum Spacing for Freeway Interchange Areas



* Measured from the end of the lane taper if an acceleration lane exists for the off-ramp
 ** Measured from the beginning of the lane taper if a turn lane for the on-ramp exists

	Distance (ft)	Description
X	750	Distance from the closest interchange ramp to the first full access intersection
Y	325	Distance from the off-ramp to the first right in, right out access point
Z	325	Distance between the last right in, right out access connection and the on-ramp

2.2 SAFETY AND CRASH ANALYSIS

A review of traffic crashes on Long Point Road was conducted focusing on the segments near the Belle Hall Parkway intersection.

Key observations from the Long Point Road safety analysis includes:

- As shown in **Table 1**, Long Point Road has a high overall crash rate (556.1 total crashes per 100mvm). North of I-526 the total crash rate is highest (815.1 total crashes per 100mvm) which is more than double the total crash rate on Long Point Road south of the interchange (539.5 crashes per 100mvm).
- Similarly, the injury crash rate is higher on Long Point Road north of I-526 (154.8 crashes per 100mvm) despite fewer truck crashes as well as lower overall speeds due to congestion on the northern section.

Table 1: Crash Data on Long Point Road – 2015-2019

Long Point Road south of I-526	0.70	27,400	120	342.8	31	88.6
Long Point Road north of I-526	0.64	27,100	258	815.1	49	154.8

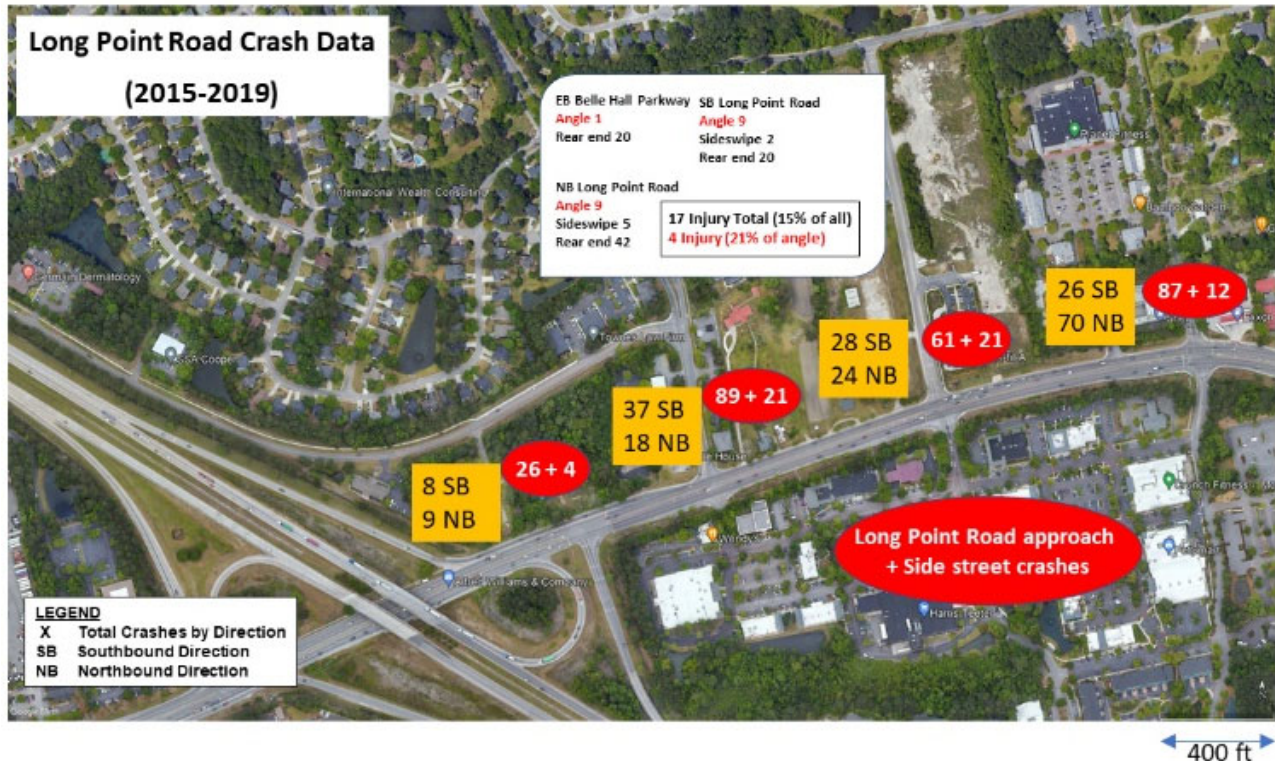
* Crash Rate shown in Crashes per 100 Million Vehicle Miles (100 MVM).

Crash type and severity observations on Long Point Road include:

- Rear-end crashes are the most common type of crash on Long Point Road. North of I-526, there is a higher percentage of rear-end crashes reflecting the more extreme congestion and stop and go conditions.
- Angle crashes are the second most common type of crash on Long Point Road. These typically occur in locations where left turns cross opposing through traffic. The percentages are similar throughout Long Point Road.

A detailed review of crashes on Long Point Road was conducted in the vicinity of Belle Hall Parkway and adjacent intersections. The number of crashes at and between intersection on Long Point Road are shown in **Figure 2**.

Figure 2: Crash Frequency at Intersections along Long Point Road and on Cross Streets



Key observations of the Belle Hall Parkway intersection crashes include:

- The Belle Hall Parkway intersection has the highest number of crashes on Long Point Road north of I-526. This is despite lower side street volumes and the fewest number of conflicting movements (left turns only allowed from one direction) than the other intersections on the corridor.
 - 104 crashes near Belle Hall Parkway compared with 30 crashes at the I-526 westbound ramp, 82 crashes at the Belle Point Drive signal and 99 crashes at the Egypt Road signal.
- Crash types (associated with Belle Hall Parkway intersection) – 104 total crashes
 - Rear-end Crashes – 79 percent
 - 42 crashes northbound on Long Point Road toward Belle Point Drive signal potentially related to left turn at Belle Hall Parkway or general queuing on Long Point Road
 - 20 crashes southbound on Long Point Road toward I-526 potentially result of queuing back from I-526 westbound ramps
 - 20 crashes on Belle Hall Parkway approaching Long Point Road potentially issues turning right onto Long Point Road and waiting on the approach to clear
 - Angle crashes – 18 percent potentially related to turns to/from Belle Hall Parkway due to no other turns introduce angle crashes)
 - Primary source of angle crashes is left turning vehicles hitting or hit by southbound Long Point Road traffic

- 21 angle crashes in 5 years (approx. 4 angle crashes per year)
- 4 of these 21 crashes involved injuries (approx. 0.8 injury crashes per year)
- Sideswipe crashes – 5 percent potentially lane changes along Long Point Road

Note that the crash locations and type were identified based on SCDOT database records and not a detailed review of individual crash reports. As a result, the actual cause of specific crashes is not available. Therefore, the potential reasons for specific crash types, such as rear-end crashes typically occur in congested conditions, are based on typical overall causes of crashes, not specific data.

2.3 CAPACITY ANALYSIS USING SYNCHRO & SIMTRAFFIC

Synchro and SimTraffic analyses was used to examine the issues and concepts identified by the public and others. This was an iterative step and was intended for addressing public concerns and not intended as part of the IAR process. The key findings of the capacity analysis were:

- The six concept alternatives proposed by the public examined did not function as well as Alternative 2, had additional impacts, and/or included layouts that were not feasible from a construction or operations perspective.
- Alternative 2 remained the recommended preferred alternative from an interchange perspective. It was tested using Synchro for both the No Left Turn and the Keep Left Turn options. The analysis is summarized in **Table 2**. Findings of the analysis included:
 - With no left turn at Belle Hall Parkway, the proposed rerouting requires traffic bound for Seacoast Parkway to travel approximately 3,500 feet further than the current path.
 - With a left-turn lane onto Belle Hall Parkway, queues on northbound Long Point Road (away from I-526) will exceed 1,000 feet in the 2050 AM peak and approximately 620 feet in the PM peak. In both cases, this exceeds the available 330-foot intersection spacing between the interchange and Belle Hall Parkway. This would indicate that the left turn is negatively impacting interchange operations by 2050.

Table 2. Synchro Traffic Analysis Summary of Long Point Road north of I-526

Test	Scenario	LPR Interchange at WB Ramps LOS AM (V/C) LOS PM (V/C)	Belle Hall Pkwy LOS AM (V/C) LOS PM (V/C)	Belle Point Dr LOS AM (V/C) LOS PM (V/C)	Conclusion
NO BUILD					
Baseline	2022 No Build				Currently functions adequately
Baseline	2050 No Build				High levels of congestion & delays east of interchange. EB Belle Hall left turns queue into interchange.
Proposed	Alt 2 (close left to Belle Hall)		not allowed, divert to Belle Point		No queues onto interchange.
Proposed with Belle Hall Left Turn	Alt 2 (allow left to Belle Hall)				Long Point Road left-turn onto Belle Hall Parkway queues into interchange.

- A review of I-526 ramp queuing was conducted using Synchro and SimTraffic. Key observations included:
 - The Synchro analysis at the adjacent signalized intersection of the I-526 ramp with Long Point Road indicated little to no increase in ramp queuing resulting from the Belle Hall Road queues. This is likely due to a limitation in Synchro methodology that does not dynamically evaluate the full impact of downstream queues on adjacent intersections. For this reason, SimTraffic analysis was evaluated to get a simulation view.
 - The SimTraffic analysis showed substantial queuing on the I-526 ramp with the inclusion of the Long Point Road left-turn lane onto Belle Hall Parkway. As shown in **Figure 3**, SimTraffic shows substantial queuing on the I-526 ramp that would impact I-526 mainline by 2050.

Figure 3: SimTraffic 2050 Queuing Screenshot with Left Turn at Belle Hall Road



3.0 VISSIM QUEUING ANALYSIS

In further discussions with the Town of Mount Pleasant and other stakeholders, SCDOT determined that the preferred initial treatment for the Belle Hall Parkway intersection was to leave the existing left-turn lane in place for initial construction. Synchro and SimTraffic analysis indicated that the left turn would cause queuing that would eventually impact operations at the Long Point Road signalized intersection interchange at the westbound I-526 off-ramp. By 2050, queues on the I-526 off ramp were predicted to extend onto I-526 in the 2050 AM peak.

The primary purpose of the IAR process is to avoid interchange impacts that can disrupt traffic operations on the mainline I-526. Therefore, more detailed analysis was undertaken to better model the queuing issue with Vissim software, a detailed simulation tool that is more effective at evaluating traffic operations in heavily congested conditions. It was the primary tool used in the overall IAR analysis, but that analysis assumed no left turn at Belle Hall Parkway.

This assessment compares operations between the “No Left Turn” scenario and the “With a Left Turn” scenario at Belle Hall Parkway. The evaluation was conducted for both 2030 and 2050 with both scenarios. Multiple factors were examined with the most critical being queuing on the I-526 westbound off-ramp to identify when spillbacks onto the I-526 mainline may occur.

3.1 2030 AND 2050 VISSIM ANALYSIS & COMPARISON

The Vissim analysis focused on three key factors along Long Point Road and key intersections. These measures include:

- Left turn operations (delay and LOS) at the unsignalized left turn to Belle Hall Parkway (see Error! Reference source not found.). Unlike a traffic signal LOS which provides an average for all movements, the unsignalized left turn delay only reflects left turning traffic because other movements do not yield or stop in normal operation.
- Signalized intersection operations (average delay and LOS) at both (1) the Belle Point Drive signal and (2) the I-526 westbound off ramp signal with Long Point Road (see Error! Reference source not found.).
- Queuing on key approaches on both northbound Long Point Road and, most critically, on the I-526 westbound off-ramp (see **Table 5**).

3.1.1 Left Turn Operations at Belle Hall Drive

Error! Reference source not found. illustrates that the left turn onto Belle Hall Parkway is forecast to operate at LOS E in the 2030 AM and degrade to LOS F in the 2050 AM due to a heavy opposing through movement on Long Point Road traffic driving to I-526. In the PM, the left turn operates at LOS D and LOS

E in 2050. These results are better than the Synchro/SimTraffic analysis indicated. Key reasons for the observed differences include:

- Synchro analysis uses a static gap acceptance for left turns at unsignalized intersections. It also assumes a relatively constant and continuous flow of traffic opposing the left turns. Essentially, the Synchro analysis determined that the average gap in flows was less than the time required to cross the opposing traffic and very few left turns were processed in the 2050 peak periods resulting in queues and delays. The Vissim model does an active simulation and is able to take into account variances in flow on Long Point Road including upstream signal operations, platooning of vehicles, and varying driver characteristics.
- A key observation in the Vissim model was that the congestion at the Belle Point Drive traffic signal resulted in substantial queuing of traffic approaching Belle Hall Parkway from both Long Point Road and the Belle Hall Shopping Center. The metering of traffic volumes at this signal resulted in sufficient gaps for left turns onto Belle Hall Parkway.
- The proposed 2050 analysis with no left turn at Belle Hall Parkway was determined to need some additional signal timing for northbound Long Point Road as well as the I-526 westbound off-ramp. This mitigation measure is prudent and could be considered as part of periodic updates of signal timing if needed before 2050.

Table 3. Vissim Analysis of Belle Hall Parkway Unsignalized Left Turn

Critical Unsignalized Movement	WITH LEFT TURN AT BELLE HALL				NO LEFT TURN AT BELLE HALL			
	2030 AM	2030 PM	2050 AM	2050 PM	2030 AM	2030 PM	2050 AM	2050 PM
	delay & LOS	delay & LOS	delay & LOS	delay & LOS	delay & LOS	delay & LOS	delay & LOS	delay & LOS
Left Turn at Belle Hall Parkway	41.2/E	25.2/D	68.4/F	42.3/E	NA	NA	NA	NA

Legend: Yellow: LOS D (acceptable) Orange: LOS E Red: LOS F

3.1.2 Signal Operations on Long Point Road

Error! Reference source not found. examines signal delays and resulting LOS at the two signals within this sub area.

- Belle Point Drive at Long Point Road signal
 - In previously Synchro analysis the signal operated at LOS F in 2050 for both the options with and without the Belle Hall Parkway left turn. Due to diversion of left turns from Belle Hall Parkway to Belle Point Drive, the V/C was slightly worse with the Belle Hall Parkway left turns removed.
 - The Vissim analysis similarly shows a degradation of flow at this intersection with the removal of Belle Hall Parkway left turns, but the differences are more pronounced. Specifically, with the left turn preserved at Belle Hall Parkway, LOS is at LOS E in both 2050 peaks. With the left turn diverted to Belle Point Drive, operations are LOS E in the 2050 AM, but degrade to LOS F in 2050.
 - Improvements to this intersection have been discussed but are considered outside the scope of the present interchange project.
 - In the 2050 PM peak, signal timings have been adjusted slightly (adding 10 seconds to the cycle length and extra green time to Long Point Road through phases) with both design

scenarios. This is done to increase northbound through movements on Long Point Road in order to minimize impacts upstream from the intersection at the interchange. Detailed signal timing would be required as part of the final design process.

- I-526 westbound off-ramp at Long Point Road (i.e. the interchange signal)
 - If Belle Hall Parkway remains open to allow left turns, the 2050 PM operations degrade to LOS D in the PM peak. Delays at the intersection more than triple from the 2030 PM to 2050 PM in this scenario, but remain at an acceptable LOS D.
 - As previously identified, the intersection operates at LOS C or better in both the 2050 AM and PM peak if the left turn at Belle Hall Parkway is removed.
 - As part of the aforementioned mitigation along Long Point Road, the 2050 signal timings have been adjusted slightly (adding 10 seconds to the cycle length and extra green time to the westbound off-ramp) to improve the vehicle throughput on the westbound off-ramp and balance out delays between Long Point Road northbound and the westbound off-ramp for both scenarios. Detailed signal timing would be required as part of the final design process.

Table 4. Vissim Analysis of Signalized Intersections on Long Point Road North of I-526

Signalized Intersection Operations	WITH LEFT TURN AT BELLE HALL				NO LEFT TURN AT BELLE HALL			
	2030 AM	2030 PM	2050 AM	2050 PM	2030 AM	2030 PM	2050 AM	2050 PM
	Delay (sec/veh) & LOS				Delay (sec/veh) & LOS			
Long Point Road at Belle Point Drive	24.7/C	30.2/C	70.5/E	71.6/E	35.3/D	59.8/E	76.6/E	105.2/F
Long Point Road at I-526 WB Off-Ramp	8.9/A	12.9/B	14.0/B	48.1/D	7.9/A	36.3/D	12.4/B	33.9/C

Legend: No highlighting: LOS C or better (desirable) Yellow: LOS D (acceptable) Orange: LOS E Red: LOS F

Note: The 2050 scenarios include prioritized timings (10 extra seconds of green time) for the northbound Long Point Road and for the I-526 westbound off-ramp for these two signals.

3.1.3 Queuing on Long Point Road and I-526 Westbound Off-Ramp

Table 5 illustrates queuing at three critical approaches. For each location both the average queue as well as the maximum queue are identified. The maximum queue is computed by taking an average of the maximum queue from ten model simulations.

Methodology and Assumptions

The queues are color coded to show the impacts of the maximum queue as compared with the available storage, the maximum storage before the queue extends into the next adjacent intersection, as well as comparing length of ramp queues and whether there is a potential impact to I-526.

Queuing on Long Point Road

Queuing on Long Point Road was tested to determine if queues from either the signalized Belle Point Drive or the unsignalized Belle Hall Parkway left turn could queue backwards ultimately impacting operations at the I-526 westbound off-ramp signal. Conclusions from the Table 5 analysis includes:

- Queuing on Long Point Road approaching Belle Point Drive Signal
 - Flow from the interchange to the Belle Point Drive signal is anticipated to exceed the available spacing to the Belle Hall Parkway intersection in the 2050 PM peak whether the left turn at Belle Hall Parkway remains in place or not. The queues are expected to be longer if there is no left turn at Belle Hall Parkway. Signing and or marking treatments may be required to prevent Long Point Road northbound traffic from blocking the intersection between signal phases.
- Queuing on Long Point Road approach to Belle Hall Parkway Left Turn
 - Based on discussions with the Town, very low to no growth is anticipated for the residential communities served by left turns onto Belle Hall Parkway. Therefore, no growth has been considered in left turning traffic in the future. Turn movements onto Belle Hall Parkway were evaluated with 169 vph in the AM and 327 vph in the PM peak.
 - With the Belle Hall Parkway left turn maintained, the maximum peak hour queues (both AM and PM) are expected to be similar to but slightly exceed the available 330 foot spacing to the interchange in 2030. This would be expected to only increase slightly by 2040 impact operations at the interchange and potentially the I-526 off ramp. Note, however that the queues increase only slightly through 2050. Nevertheless, operational impacts are anticipated.

Queuing on I-526 Westbound Off-Ramp

The most critical queuing evaluation was conducted for the I-526 westbound off-ramp approach to Long Point Road to determine if queuing extended on the ramp onto I-526 mainline. (The previously examined Synchro/SimTraffic analysis had identified queuing impact backing onto I-526 before 2050 if the Belle Hall Parkway left turn was provided.) Conclusions from this analysis include:

- Traffic patterns
 - The peak period of queuing on the ramp is the PM peak. This is because flows from Long Point Road south of I-526 (combination of Port and other local traffic) combine with the triple left movement for the I-526 eastbound exit ramp.
 - The right turn to Long Point Road from the off-ramp is critical for queuing.
- Ramp Design and Available Storage
 - As currently design, the proposed reconstructed ramp has roughly 500 feet of four lane approach (serving dual lefts and dual rights) with another 800 feet to the proposed physical gore. For purposes of this analysis, this (i.e. a 1,300 foot queue) was considered the critical point where the ramp queues impact I-526 operations.
 - There is approximately an additional 700 feet of storage including the deceleration lane formed from I-526. Note that this is a two lane exit with an exclusive right lane deceleration lane, a shared exit/through lane, and the through lanes on I-526.
- With Left Turn at Belle Hall Parkway Scenario
 - Queuing of the I-526 westbound off-ramp onto I-526 occurs in the 2050 PM peak with the Belle Hall Parkway left turn kept in place.
 - The average queue on the off-ramp is calculated to be 325 feet, and the maximum queue is 1,369 feet. The maximum queue is expected to exceed the 1,300 feet of available ramp storage before 2050.

- The 2050 AM peak operates acceptably with an average queue of 119 feet and a maximum queue of 411 feet. This indicates that the queuing is primarily a PM peak hour issue.
- No Left Turn at Belle Hall Parkway Scenario
 - The analysis with the no left turn at Belle Hall Parkway (i.e., left turn removed) has maximum queues of less than 300 feet in 2030 and maximum queues of 476 feet and 796 feet in the 2050 AM and PM peaks, respectively. In all cases, the proposed design shows no ramp queuing impacts to I-526 through at least 2050.
- Screenshots of 2050 PM Peak Vissim Operations
 - **Figure 4** shows a snapshot of the 2050 PM peak operations with the No Left Turn at Belle Hall Parkway scenario. As shown, queuing does not extend back to I-526 mainline.
 - **Figure 5** shows a similar snapshot for the With Left Turn at Belle Hall Parkway scenario. As illustrated, queuing is observed on the I-526 off ramp extending back onto I-526.

3.1 QUEUING OBSERVATIONS ON THE I-526 WESTBOUND OFF-RAMP

In examining the potential impacts to traffic flow on I-526 from the longer queue with no left turn, the proposed ramp layout and geometric characteristics were compared. The proposed ramp has approximately 500 feet of widened four lane approach to the signal, 800 feet of two-lane ramp (including the proposed bridge structure), and approximately 700 feet of deceleration lane that allows ramp traffic to pull out of the I-526 mainline. In all, there is 1,300 feet available for queuing on the ramp plus the 700-foot deceleration lane. The goal of the 2050 operations would be to minimize the queue so that it does not extend past the 1,300-foot ramp section.

As noted, the 2050 simulation analysis assumes that signal timing will include 10 extra seconds for the I-526 off-ramp to prioritize operations on the ramp and to minimize ramp queuing to prevent operational impacts to the I-526 mainline. This extra signal timing is assumed in both the with and without a left turn at Belle Hall Parkway scenarios in the 2050 analysis.

As shown in Table 5 and Figure 5, a queue is anticipated on the I-526 off-ramp that extend 1,354 feet in the 2050 PM peak (i.e. average maximum queue observed from ten simulations) with the Belle Hall left turn remaining in place. As shown, the queue has reached I-526, but is still contained in the deceleration lane. Some minimal degradation of flow on I-526 is occurring that could be mitigated with refined signal prioritization for the ramp signal with Long Point Road. In comparison, with the left turn closed to Belle Hall Parkway closed, the ramp queue does not extend down the entire ramp length (see Figure 4).

Based on these observations, the ramp queuing technically exceeds the critical 1,300 feet by less than 100 feet but could be further reduced if needed with prioritized signal timing.

Based on this conclusion (i.e., that the 1,354-foot queue is acceptable in 2050), it was determined that an interim year analysis was not required. Nevertheless, it is recommended that periodic signal timing updates be completed to ensure that signal timing priority is provided optimally in the interim years leading to 2050. It is possible/likely that this timing mitigation will need to be implemented before 2050. The traffic signal system provided as part of the project construction should include the ability to make these timing enhancements in the future.

Table 5. Vissim Queuing Analysis at Three Key Intersection Approaches

Average Maximum Queues from Vissim	Critical Queue Lengths	WITH LEFT TURN AT BELLE HALL PARKWAY				NO LEFT TURN AT BELLE HALL PARKWAY			
		2030 AM	2030 PM	2050 AM	2050 PM	2030 AM	2030 PM	2050 AM	2050 PM
		Average Queue(feet) / Average Max Queue (feet)				Average Queue(feet) / Average Max Queue (feet)			
Long Point Road NB approach to Belle Point Drive	485 ft storage bay 750 ft to Belle Hall Pkwy (with left)	53/320	128/579	74/421	246/890	332/727	702/894*	374/713	577/892*
Long Point Road NB approach to Belle Hall Parkway	160 ft left turn bay 330 ft to interchange	53/302	68/379	60/356	129/398	3/78	111/324	11/157	66/325
I-526 WB Off-Ramp approach to Long Point Road	500 ft of 4 In storage 1,300 ft to I-526 gore (critical) 2,000 ft to begin of deceleration lane	74/350	45/284	117/467	326/1,354	71/289	44/260	114/476	144/796

Notes:

1. Maximum queue presented is the average maximum queues from a series of 10 one-hour simulations. Both the average and maximum queues reflect the peak hour period analyzed (i.e., the average does not reflect off-peak conditions).
2. Note: The 2050 scenarios include prioritized timings (10 extra seconds of green time) for the northbound Long Point Road and for the I-526 westbound off-ramp. It is recommended that periodic signal timing updates be completed to ensure that signal timing priority is provided optimally in the interim years to 2050. It is possible/likely that this timing mitigation may need to be included before 2050. The traffic signal system provided as part of the project construction should include the ability to make these timing enhancements in the future.

Legend:

No highlighting: Maximum queue shorter than critical length. Desirable.

Yellow: Maximum queue exceeds storage provided. (* Yellow shown because removal of left turn makes overlap with Belle Hall Parkway acceptable)

Orange: Maximum queue exceeds critical storage impacting adjacent facility.

Red: Maximum queue impacts I-526.

Figure 4: Vissim Screenshot of 2050 PM Peak with No Left Turn at Belle Hall Parkway

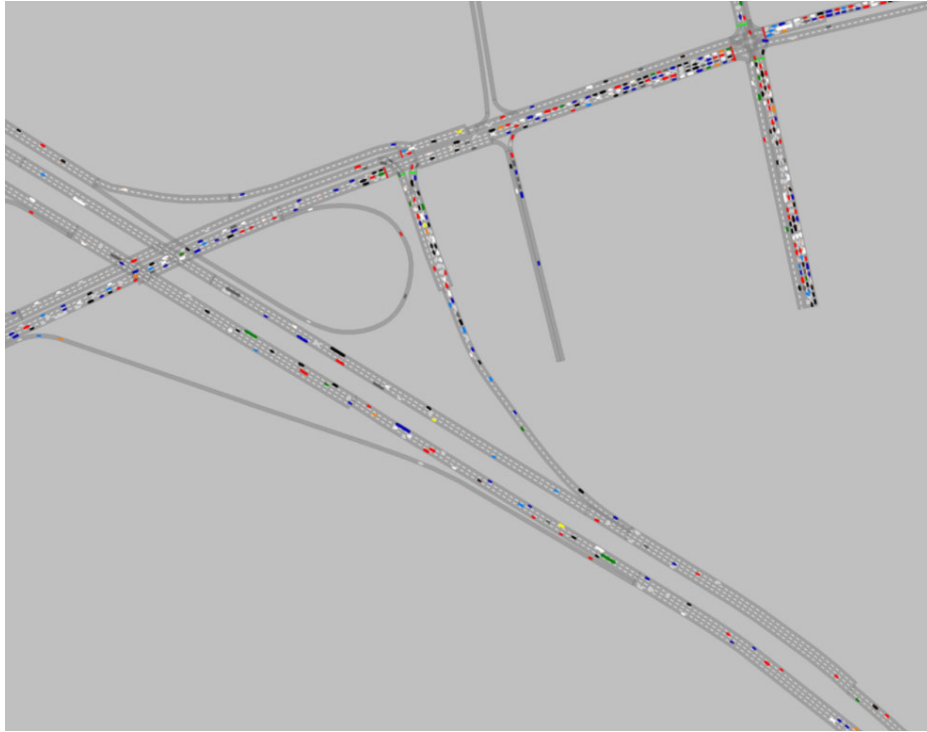
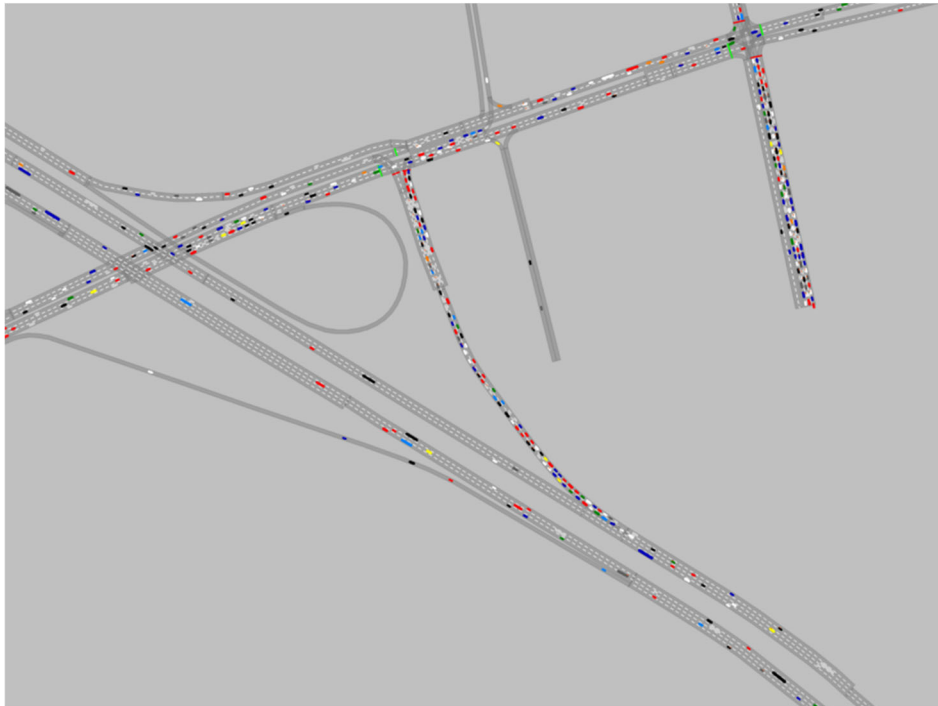


Figure 5: Vissim Screenshot of 2050 PM Peak with Left Turn Allowed at Belle Hall Parkway



4.0 CONCLUSIONS

This analysis was developed to examine in additional depth the potential operational impacts of maintaining the existing unsignalized left turn at Belle Hall Parkway. Prior to input from the public, the preferred design had proposed the removal of this left turn and diverting the turning traffic to the nearest downstream signalized intersection (i.e., Belle Point Drive) to take a left turn. This analysis examines and compares the differences in operations between the two treatments of Belle Hall Parkway with a primary focus being potential negative impacts to traffic operations at the proposed redesign of the Long Point Road interchange as well as on I-526 mainline traffic.

4.1 TRAFFIC OPERATIONS & POTENTIAL I-526 IMPACTS

As discussed in this analysis, there are multiple reasons to consider closing the Belle Hall Parkway left turn including consistency with SCDOT Access and Road Management Standards (ARMS), a high frequency of crashes on Long Point Road near the Belle Hall Parkway intersection and impacts of congestion and queuing that could potentially impact operations on Long Point Road and the proposed Long Point Road interchange. Despite these issues, SCDOT performed this analysis based on feedback from the public involvement process and the Town of Mount Pleasant to maintain the Belle Hall Parkway left turn.

This analysis expanded upon the previous Belle Hall Parkway analysis to perform a detailed Vissim analysis comparing operations in 2030 and 2050, both with and without the Belle Hall Parkway left turn. The key evaluation was examining the operations of the I-526 westbound off ramp to the Long Point Road. The traffic signal was examined, and queues were evaluated. The analysis identified two key thresholds for mitigation in order to prevent queuing and impacts onto I-526.

- First, as part of the development of the alternative with no left turn access to Belle Hall, it was identified that signalization should be provided to increase green times for ramp traffic to minimize the ramp queue. For the additional analysis with the left turn at Belle Hall maintained, a similar treatment was assumed for the 2050 PM peak. Signal prioritization is recommended for the off-ramp to minimize and prevent queuing impacts onto I-526 with or without a left turn at Belle Hall Parkway.
- With the increased signal timing for the ramp in place, the ramp queuing in 2050 (with the existing left turn to Belle Hall Parkway remaining in place) was shown to extend 1,354 feet (average maximum of 10 simulations) barely exceeding the 1,300-foot ramp length. With the current ramp layout, the deceleration lane provides an additional 700 feet of storage to allow for vehicles to exit out of the I-526 through lane.
- In comparison, the no left turn scenario has a maximum queue of 796 feet in the 2050 PM peak with no anticipated impacts to I-526 mainline operations.
- It is recommended that periodic signal timing updates be completed to ensure that signal timing priority is provided optimally in the interim years leading to 2050. It is possible that timing

adjustments may be needed before 2050. The traffic signal system provided as part of the project construction should include the ability to make these timing enhancements in the future.

- Lengthening of the ramp and/or the provision of a longer deceleration lane was examined and could be an option to provide additional ramp storage for queuing if desired. This measure could be considered as part of future widening of I-526.
- As part of the Design Build procurement, SCDOT will offer quality credits to Teams offering innovative solutions that incorporate design elements that minimize queuing and delays. The value-added benefits of alternative design treatments that mitigate congestion issues related to left turn access to Belle Hall Parkway would be included in a value-added process.