

6 RECOMMENDED IMPROVEMENTS

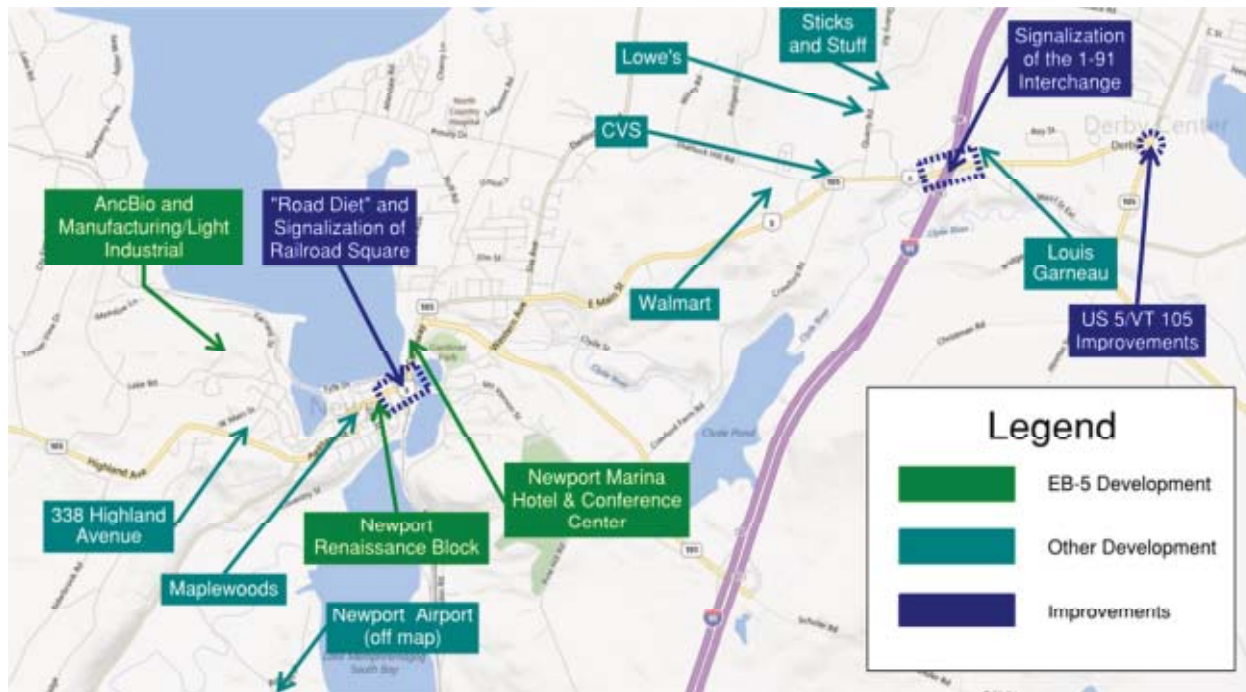
This Section presents a comprehensive summary of the recommended study area improvements, based on the results of the assessment of future traffic conditions and previously-developed improvement recommendations presented in the previous section. The recommendations presented in this section include refinements to previously-developed improvements where feasible, as well as new improvement recommendations as needed to address the projected future traffic levels considering the EB-5 and pother anticipated regional growth through 2025.

The recommended improvements in this section are presented by geographic area, followed by a summary table of all improvements, prioritization, and cost estimates.

6.1 NEWPORT/DERBY STUDY AREA

A map of the assumed developments and recommended improvements in the Newport/Derby study area is shown below. Additional detail on each of the recommendations follows the map.

Figure 45: Newport/Derby Study Area Developments and Recommended Improvements



US 5/COVENTRY STREET

Based on the location of these intersections at a primary gateway into Newport, the projected traffic volumes, and physical constraints, we recommend signalizing the US 5/Causeway/Railroad Square intersection and instituting a “road diet” along Main Street between Railroad Square and Coventry Street. The proposed Main Street “road diet” would consist of reducing the current four lanes of travel to three and installing a raised center median to eliminate crossing movements and provide more of a gateway feel. In both directions the entering roadway would only have one lane and the exiting roadway would have two lanes. This reconfiguration is shown below in Figure 46 and would provide nearly the same capacity as the current four-



lane section, but with increased shoulder width (3-5'; bicycle accessible) and a raised (and potentially landscaped) center median.

In Section 3, it was discussed that this segment of roadway is classified by VTrans as a High Crash Location Section. The installation of a raised center median combined with a reconfiguration of all driveways along this section of US 5 into right in/right out accesses will reduce the number of possible conflict points, which in turn reduces the number of potential future crashes. Additionally, this raised center median will increase pedestrian safety by allowing a refuge point in the middle of the roadway and reduces the total number of lanes pedestrians will need to cross.

Figure 46: Proposed US 5/Coventry Street “Road Diet” Concept Plan

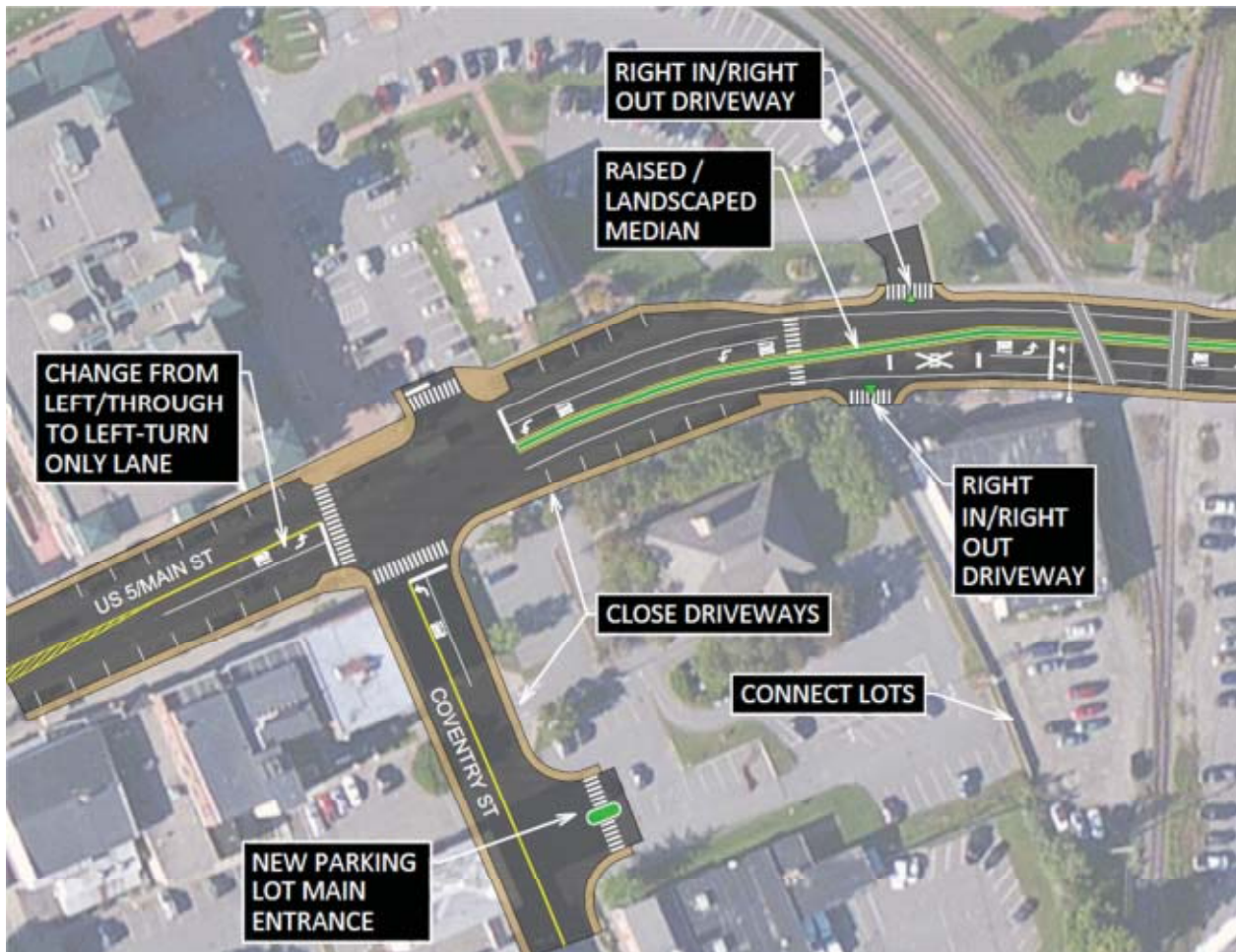


Figure 47: Proposed US 5 Cross-Section between Coventry Street and Railroad Square



This proposed road diet would result in slightly higher vehicle delays in 2019 (LOS D vs. LOS C) and comparable delays in 2024 (LOS D) at the US 5/Coventry Street intersection when compared to maintaining the current intersection geometry and optimizing signal timings. Despite the slight increase in congestion, this alternative has several advantages including improved safety for vehicles, pedestrians, and cyclists, as well as the enhancement of the important downtown gateway for visitors travelling in from the east. It should also be noted that the 2019 and 2024 results include 342 and 556 additional vehicles (in 2019 and 2024, respectively) from projected development. This represents a 21% and 34% increase in traffic volume at this intersection for 2019 and 2024, respectively.

Figure 48: Level-of-Service Results (US 5/Coventry Street)

Newport Intersections	Peak Hour														
	2014 No Build			2019 Signal Opt.			2019 Build + RSC			2024 Signal Opt.			2024 Build + RSC		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
3. US 5 / Coventry St															
Overall	C	30	0.56	C	34	0.64	D	37	0.67	D	40	0.71	D	44	0.76
EB, along US 5	C	33	-	D	37	-	D	39	-	D	38	-	D	44	-
WB, along US 5	C	26	-	C	28	-	C	23	-	D	40	-	C	32	-
NB, exiting Coventry St	C	32	-	D	40	-	D	54	-	D	42	-	C	60	-
SB, exiting Lane St	D	35	-	D	44	-	F	70	-	F	56	-	F	94	-

The road diet enhancements could be constructed as a single project or broken into two phases to confirm the effectiveness of the lane reduction and median using striping before making longer-term curbing improvements to “lock-in” the roadway cross-section more permanently. Under this phased approach, the first phase would involve restriping US 5 to accommodate the proposed lane striping configuration, without the installation of a permanent center median. If it is decided that this is preferable to the existing configuration, the city of Newport could then move forward with phase 2, which would consist of the installation of a curbed center median and reconfiguration and closure of identified parking lot accesses.

MAIN STREET (US 5/VT 105)/ CAUSEWAY/RAILROAD SQUARE

Currently the through movement, US 5, makes a sweeping 90 degree bend at this intersection with no stop control. This creates safety and congestion issues for all vehicles using the Railroad Square Bridge or entering/exiting from Poulin Grain. In addition to signalization, we recommend that the intersection be realigned so that US 5 and Railroad Square are the through movement. This creates a more traditional intersection design and thus improves safety over the current configuration. As discussed in Section 5, this realignment, along with signalization, significantly reduces delays with overall LOS improving from F to C.



Additionally, an exclusive pedestrian phase would be installed, thus improving circulation and safety for pedestrians.

In order to minimize queuing over the railroad tracks coordination between the signal and the railroad crossing would be implemented. Additionally, a signal would be installed to the west of the railroad crossing for the eastbound approach to further minimize queuing over the railroad tracks.

Ideally these improvements would be combined with the “road diet” along Main Street, but could be implemented with or without these improvements. The figure below presents a design plan for the Main Street (US 5/VT 105)/ Causeway/Railroad Square with the “road diet” implemented.

Figure 49: Railroad Square Intersection Signalization Design Plan



US 5/QUARRY ROAD

The US 5/Quarry Road is projected to operate adequately in both 2019 and 2024. In 2024, due to the Lowe’s and Sticks and Stuff developments on Quarry Road, and the increased traffic along US 5, it recommended that a protected left-turn phase be examined for the movement from US 5 onto Quarry Road. According to the Federal Highway Administration (FHWA) publication *Signalized Intersections: Informational Guide*⁸ it recommended that a protected left-turn phase be considered if the product of opposing and left-turn hourly volumes exceed 50,000⁹. The product of the left-turn movement off of US 5 onto Quarry Road and the opposing movement is projected to be 69,000 in 2024. Due to this, we recommend considering protected left-turn phasing when future development on Quarry Road occurs.

⁸ Federal Highway Administration, Research Publications, *Signalized Intersections: Informational Guide* (Washington, DC: United States Department of Transportation, August 2004).

⁹ Platoon arrivals (other traffic signals with 0.5 mile), one opposing lane of travel.



US 5/SHAW'S PLAZA

Although the US 5/Shaw's Plaza and US 5/Commerce Drive intersections were not in our study area, we recommend that they be analyzed for potential signalization in the future. According to the *US 5 Corridor Study*¹⁰ the US 5/Shaw's Plaza intersection experienced LOS F conditions during the PM peak hour on the southbound left-turn approach exiting Shaw's Plaza. Similar conditions likely exist at the US 5/Commerce Drive intersection and will worsen with more development along Commerce Drive.

Consolidating the main entrance from Shaw's Plaza with Commerce Way and signalizing one of the accesses and converting the other access to right in/right out should be considered to improve access management along the corridor. This same approach could be considered for the Vermont Pie & Pasta Company as well.

US 5/I-91 RAMPS

In 2019 and 2024, the left-turning movements from the northbound and southbound ramps are projected to operate at LOS F conditions. Based on projected future traffic volumes, a signal is recommended at both sides of the interchange due to improved overall operations and safety.

Traffic volumes at both stop-controlled interchange intersections were evaluated to see if they meet the 8-hour, 4-hour, and/or peak-hour traffic signal warrants as defined in the *Manual on Uniform Traffic Control Devices (MUTCD)*. The results of the signal warrant assessment found that all three volume-based warrants are met starting in 2019 for both intersections.

The installation of a signal at both sides of the interchange improves the overall operations to LOS B. The table below (Figure 52) shows congestion results with and without the installation of a signal. Additionally, we recommend that the right-turn slip lane on the northbound on-ramp approach to US 5 be reconstructed to reduce the overall approach radius (Figure 50). This realignment will help to improve safety by reducing right-turn movement speeds and by lengthening the distance from this movement to the US 5/West Street intersection to the east.

¹⁰ Resource Systems Group, *US 5 Corridor Study: Final Report* (19 May 2006)



Figure 50: US 5/I-91 Ramps Intersection Signalization Design Plan (I-91 SB ramps)



Figure 51: US 5/I-91 Ramps Intersection Signalization Design Plan (I-91 NB ramps)

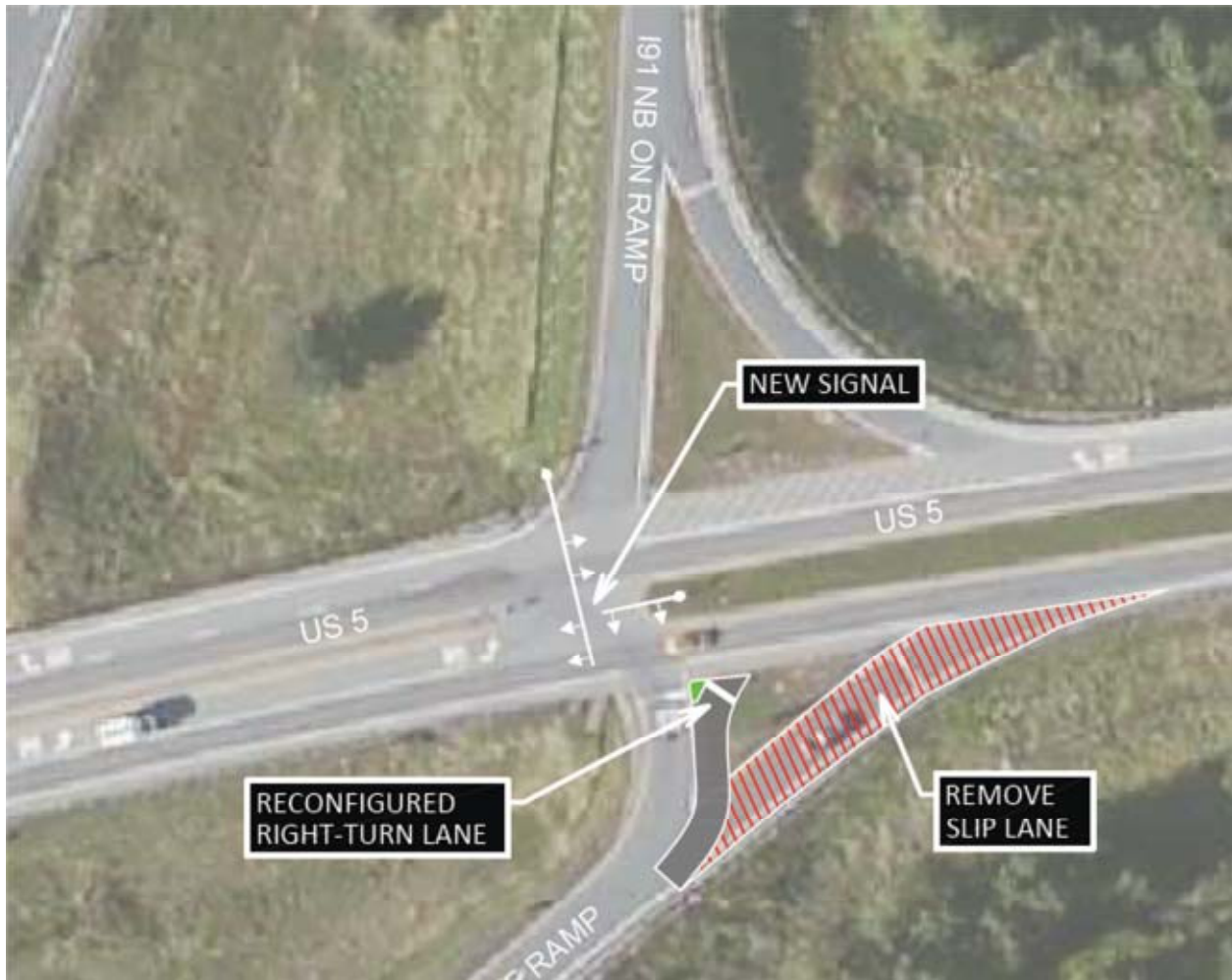


Figure 52: Level-of-Service Results (US 5/I91 Ramps)

Derby Intersections	2014 No Build		2019 Build		Peak Hour			2024 Build			2024 Build + RSG			
	LOS	Delay	v/c	LOS	Delay	v/c	2019 Build + RSG	LOS	Delay	v/c	2024 Build + RSG	LOS	Delay	v/c
3A. US 5 / I91 SB Ramps														
EB Left, exiting US 5	A	9	0.09	A	9	0.13		A	10	0.15				
SB Left, exiting I91 SB	D	31	0.06	F	63	0.13	N/A	F	82	0.16				
SB Right, exiting I91 SB	B	12	0.07	B	14	0.18		C	15	0.21				
Overall							B 12 0.75					B 12 0.75		
EB, along US 5							A 9 -					A 9 -		
WB, along US 5	N/A			N/A			B 16 -	N/A				B 16 -		
SB, exiting I91 SB							C 21 -					C 21 -		
3B. US 5 / I91 NB Ramps														
EB Left, exiting US 5	A	9	0.04	A	9	0.10		A	10	0.12				
NB Left, exiting I91 NB	D	29	0.20	F	87	0.52	N/A	F	>100	0.69				
NB Right, exiting I91 NB	B	14	0.17	C	18	0.22		C	20	0.26				
Overall							B 13 0.73					B 13 0.73		
EB, along US 5							A 8 -					A 8 -		
WB, along US 5	N/A			N/A			B 19 -	N/A				B 19 -		
NB, exiting I91 NB							C 22 -					C 22 -		



US 5/WEST STREET

Despite relatively high delays for the northbound approach from West Street, we recommend that this intersection be left in its current state. This decision is based on the relatively small number of northbound vehicles that are affected by this insufficient LOS and the fact that this roadway serves mostly cut-through traffic between Derby Center and US 5.

Conditions at this intersection should continue to be monitored with increased traffic along US 5. If significant delays prove to be an issue in the future (e.g. crash rates escalate as drivers get frustrated and try to enter US 5 with insufficient gaps), then an alternative that re-routes West Street east of the Shell gas station to intersect US 5 across from the Louis Garneau site entrance should be considered. Given the West Street and Louis Garneau projected volumes, a traffic signal should be considered at this reconfigured intersection in the future. It should be noted that improving the operations of the West Street approach could result in increased usage of West Street as a short-cut.

US 5/VT 105

Currently the eastbound approach at the US 5/VT 105 intersection is stop controlled while the northbound and southbound approaches are free. In future years this results in the eastbound approach experiencing failing conditions, while the northbound and southbound approaches experience essentially no delay. By changing this intersection to an all way stop delay is balanced between approaches in a more equal manner, thus improving overall LOS. As discussed in Section 5 changing the US 5/VT 105 intersection to an all way stop improves the overall LOS from F to D.



Figure 53: US 5/VT 105 Intersection All Way Stop Design Plan



Additionally, a sidewalk should be installed on the eastern edge of the intersection to provide pedestrian connectivity through this intersection. Shown in Figure 54 below is a treaded path in front of the Derby Cow Palace where a sidewalk should be installed. The missing sidewalk segment is approximately 225 feet in length.

The Derby Corner Mini-Mart and gas station access points should be consolidated to one curb cut along each roadway. These curb cuts should be as far removed for the intersection of US 5 and VT 5A as possible without resulting in major renovations at the Mini-Mart.



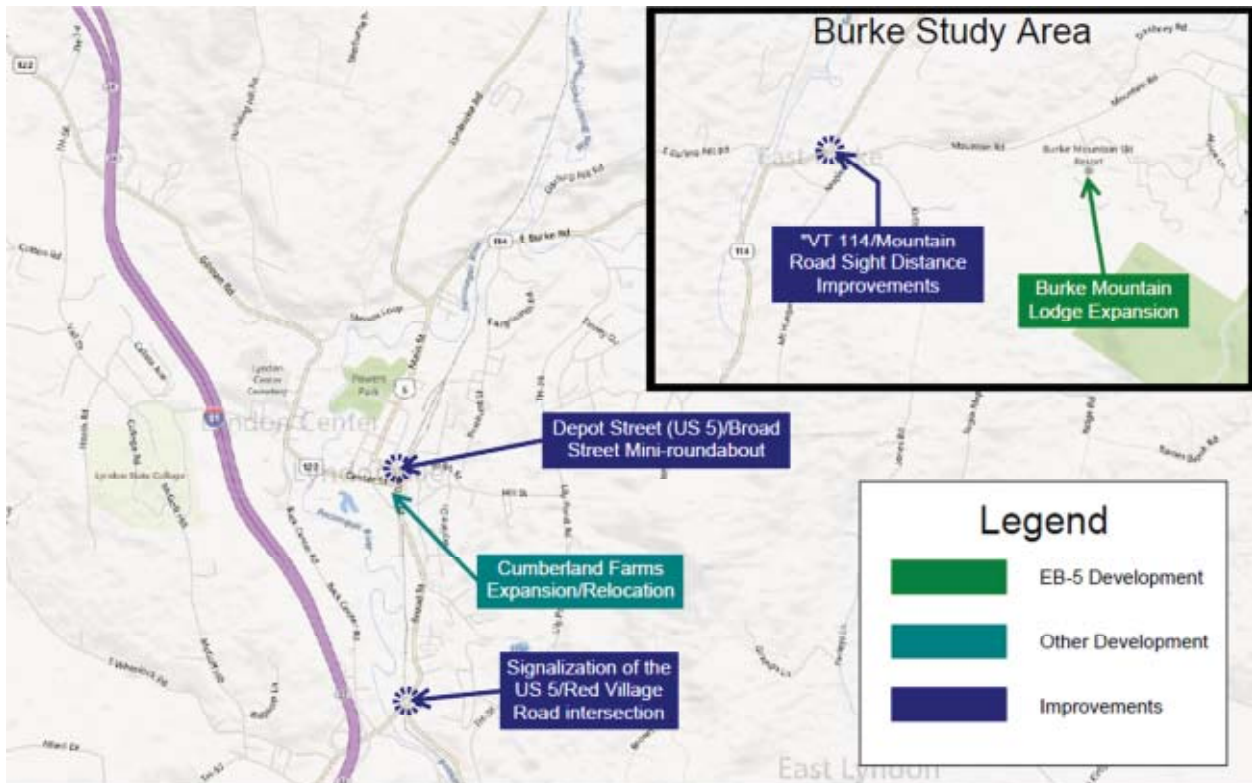
Figure 54: Missing Sidewalk Segment at US 5/VT 105 intersection



6.2 BURKE/LYNDON STUDY AREA

A map of the assumed developments and recommended improvements in the Burke/Lyndon study area is shown below. Additional detail on each of the recommendations follows the map.

Figure 55: Burke/Lyndon Study Area Developments and Recommended Improvements



VT 114/MOUNTAIN ROAD

Although the VT 114/Mountain Road intersection does not present congestion concerns in future years, limited sight distances on the Mountain Road approach could result in safety concerns due to increased traffic in the future. This intersection is part of a designated High Crash Location section (2008-2012).¹¹

The VT 114/Mountain Road intersection serves as the primary access to Burke Mountain Resort. This intersection, located on a horizontal and vertical curve, had two crashes, one of which resulted in an injury. Both collisions were broadside crashes between left turning vehicles attempting to pull out of Mountain Road and northbound through vehicles on VT 114. Of note is that despite the limited corner sight distance for cars pulling out of Mountain Road available to see southbound VT 114 vehicles, these types of collisions were not reported.

Figure 56: Sight Distance Views at VT 114/Mountain Road Intersection

View from Mountain Road Toward East Burke Village

View from VT 114 in East Burke Village Toward Mountain Rd



The American Association of State Highway Transportation Officials (AASHTO) defines two types of sight distances: stopping sight distance (SSD) and intersection sight distance (ISD). Stopping sight distance is the distance required for a vehicle, traveling at the design speed, to stop before reaching a stationary object in its path, such as a stopped vehicle. The provision of adequate stopping sight distance is critical for safe operations. The *2004 Policy on Geometric Design of Highways and Streets* states that, “[i]f the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions.” The *2004 Policy on Geometric Design of Highways and Streets* goes on to state that, “intersection sight distances that exceed stopping sight distances are desirable along the major road.” The minimum stopping sight distances are calculated based on factors such as design speed, response times, and grades as reported in the *2004 Policy on Geometric Design of Highways and Streets*.¹²

At the VT 114/Mountain Road intersection, adequate southbound stopping sight distance (SSD) means southbound vehicles on VT 114 can see far enough ahead to stop to avoid a vehicle exiting Mountain Road. Given the 30 mph posted speed limit, AASHTO recommends the stopping sight distance be at least 200 feet on this approach. As measured in the field, there is 285 feet of stopping sight distance. Thus, the stopping sight

¹¹ At the time Section 3 of this report was submitted 2008-2012 data was not yet available. This is why this section is not labeled as a High Crash Location in the crash maps in Section 3.

¹² American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Fifth Edition (Washington D.C.: American Association of State Highway and Transportation Officials, 2004), pg. 651-659.



distance is adequate for safe operations. As an additional measure, there is also a sign posted on VT 114 alerting southbound vehicles that they are approaching an intersecting road (Figure 57).

Figure 57: Sign along VT 114 Indicating Mountain Road and Curve in Road



Adequate intersection sight distance (ISD) to the north means vehicles exiting Mountain Road can see far enough along VT 114 to decide whether it is safe to enter VT 114 without colliding with another vehicle. The ISD measured in the field is 150 feet, but it should be at least 200 feet. It would be desirable to have 335 feet of intersection sight distance.

Figure 58 illustrates the *stopping sight distance* and *intersection sight distance* at the VT 114/Mountain Road intersection.

Figure 58: Sight Distance Photographs

SSD for Southbound Vehicles on VT 114



ISD for Vehicles Exiting Mountain Rd



As this intersection serves as the primary access/egress point for the Burke Mountain Ski Resort, it is important to ensure safe conditions are maintained at this intersection. Although the minimum stopping sight distance requirements are currently met, the vertical curvature of VT 114 north of Mountain Road and the presence of a steep bank on the east side of VT 114 do limit sight distances to and from the north.

To fully address sight distance limitations, we recommend a more comprehensive engineering assessment be conducted to identify the feasibility and potential benefits associated with reducing the vertical curve and cutting back the side slope on VT 114 north of Mountain Road as shown below in Figure 59.

Figure 59: Potential Improvements to the VT 114/Mountain Road Intersection



DEPOT STREET (US 5)/BROAD STREET

As discussed in Section 5, the northbound approach (left turns from Broad Street onto Main Street) currently operates at LOS F and is projected to continue to fail in both future year No Build scenarios. A roundabout was examined in the previous *Burke Mountain Area Transportation Infrastructure Study* (NVDA, 2007), and was found to significantly improve traffic operations of the intersection. However, Lyndonville Village Trustees have been reluctant to pursue the roundabout alternative due to its potential costs and impacts to on-street parking.

Recently the Federal Highway Administration (FHWA) has been performing research regarding the implementation of “mini-roundabouts” in the United States, since they have proven to be quite successful in Europe. Mini-roundabouts are implemented where there are physical constraints that do not allow for the installation of a traditional roundabout. Mini-roundabouts are characterized by a much smaller inscribed center diameter (50 to 80 feet) than a traditional roundabout and a center island/medians that are traversable by large vehicles. This allows for a smaller footprint that can still accommodate large vehicles. Additionally, the mini-roundabout benefits pedestrians by shortening the crossing distance at all three approaches and providing refuge in the middle of the crossing with a median.



The installation of a mini-roundabout at the Depot Street (US 5)/Broad Street intersection improves the overall operations to LOS B in 2019 and LOS C in 2024. Figure 60 below compares congestion results for existing intersection control and a mini-roundabout.

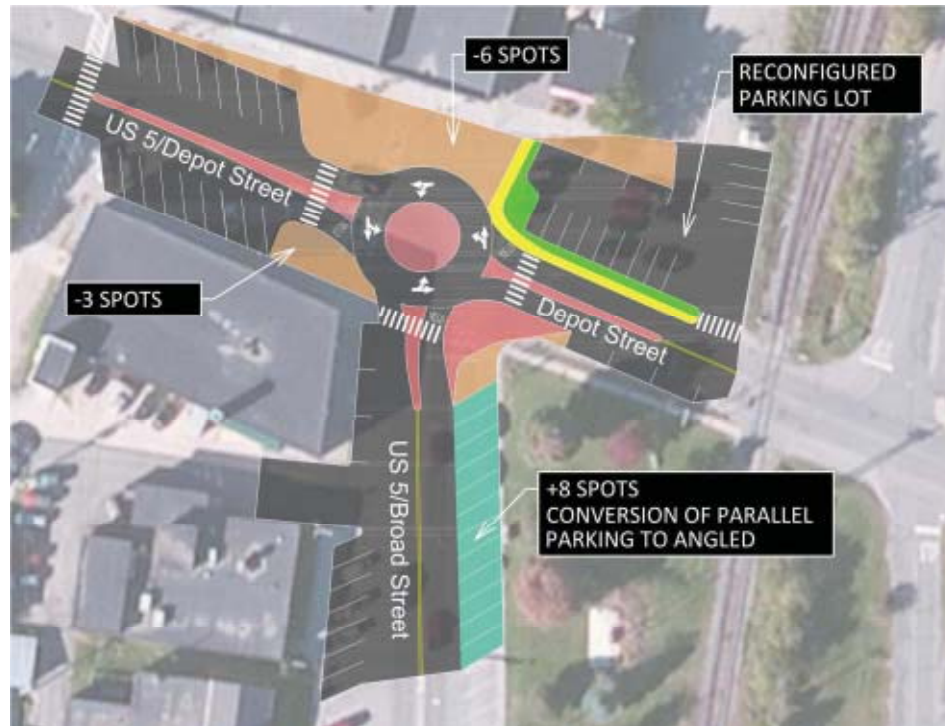
Figure 60: Level-of-Service Results (US 5/Depot St/Broad St)

Lyndon Intersections	2014 No Build			2019 No Build			Peak Hour 2019 Build			2024 No Build			2024 Build		
	LOS	Delay	v/L	LOS	Delay	v/L	LOS	Delay	v/L	LOS	Delay	v/L	LOS	Delay	v/L
3. US 5/Depot St/Broad St															
EB Through exiting US 5	B	11	0.14	B	11	0.14				B	11	0.14			
EB Right, along US 5	C	19	0.63	C	25	0.71				D	31	0.79			
WB Left, exiting Depot St	B	13	0.21	B	13	0.22				B	13	0.23			
WB Through, exiting Depot St	B	11	0.14	B	12	0.15				B	12	0.15			
NB Left, along US 5	F	>100	>1.07	F	>100	>1.07	N/A			F	>100	>1.16	N/A		
NB Right, exiting US 5	A	10	0.13	A	10	0.13				A	10	0.13			
SB, exiting Angies Alley	B	10	0.04	B	11	0.04				B	11	0.04			
3. US 5/Depot St/Broad St															
EB, from US 5							B	10	0.54				B	12	0.59
WB, from Depot St							B	10	0.31				B	11	0.33
NB, from US 5							B	14	0.66	N/A			C	15	0.72
SB, exiting Angies Alley							A	8	0.04				A	8	0.05

Figure 61 below shows a conceptual plan of a proposed mini-roundabout at the Depot Street/Broad Street intersection.

In the design plan below it is shown that the Angies Alley access is closed to the mini-roundabout. We recommend this because it allows for a large open outdoor to the north of the mini-roundabout that can be used for outdoor seating, green areas, etc. If desired, Angies Alley could have access to the mini-roundabout with negligible effect on the traffic operations of the mini-roundabout.

Figure 61: Depot Street (US 5)/Broad Street Mini-roundabout Conceptual Design Plan



When examining improvements at the Depot Street (US 5)/Main Street intersection traffic operations were not the only concern. Due the downtown location of this intersection there are many other important aspects beyond traffic operations that need to be addressed. We feel that, in addition to improving traffic operations, a mini-roundabout significantly improves pedestrian access, safety, and the overall look and feel of downtown Lyndon.

The mini-roundabout recommended for this intersection would have an inscribed center diameter of approximately 65 feet, which would fit within the footprint of the current intersection configuration. This would eliminate any costly acquisition of land from adjacent property owners.

Additionally, the mini-roundabout would result in a net loss of one parking spot. The table below shows where parking spots would be gained and lost with the installation of a mini-roundabout.

Figure 62: Parking Reconfiguration

Location	Change in parking spots
East of intersection	No change
West of intersection	-6
North of intersection	-3
South of intersection	+8
Net Change	-1

As seen in the figure above the area north and west of the intersection would lose a fair number of parking spots as result of the mini-roundabout and adjacent pedestrian crossing. This loss of parking is mostly offset by the conversion of parallel parking to angled parking to the south of the intersection. The conversion of parallel parking to angled parking is made possible by the mini-roundabout only requiring one approach lane instead of the two that currently exist.

With the reconfiguration of parking due to a mini-roundabout a significant amount of new open space will reclaimed to north of the intersection that was previous used by the intersection and parking. This new space could be used for landscaping, open space, outdoor seating, etc.

In additional to the installation of the mini-roundabout we recommend reconfiguring the parking lot on the northeastern edge of the intersection. Currently access to this parking lot is gained through a 100 foot wide curb cut adjacent to the intersection. We recommend significantly tightening up this entrance and moving it as far east as possible to allow for maximum spacing between curb cuts and the mini-roundabout.

Pedestrian safety and mobility would be improved through a significant reduction in crossing distance (maximum crossing distance is reduced from 60 to 30 feet) and by installation of a crosswalk on the westbound approach. Pedestrian safety would also be improved through tightening up the parking lot entrance as discussed in the previous paragraph. US 5/Red Village Road

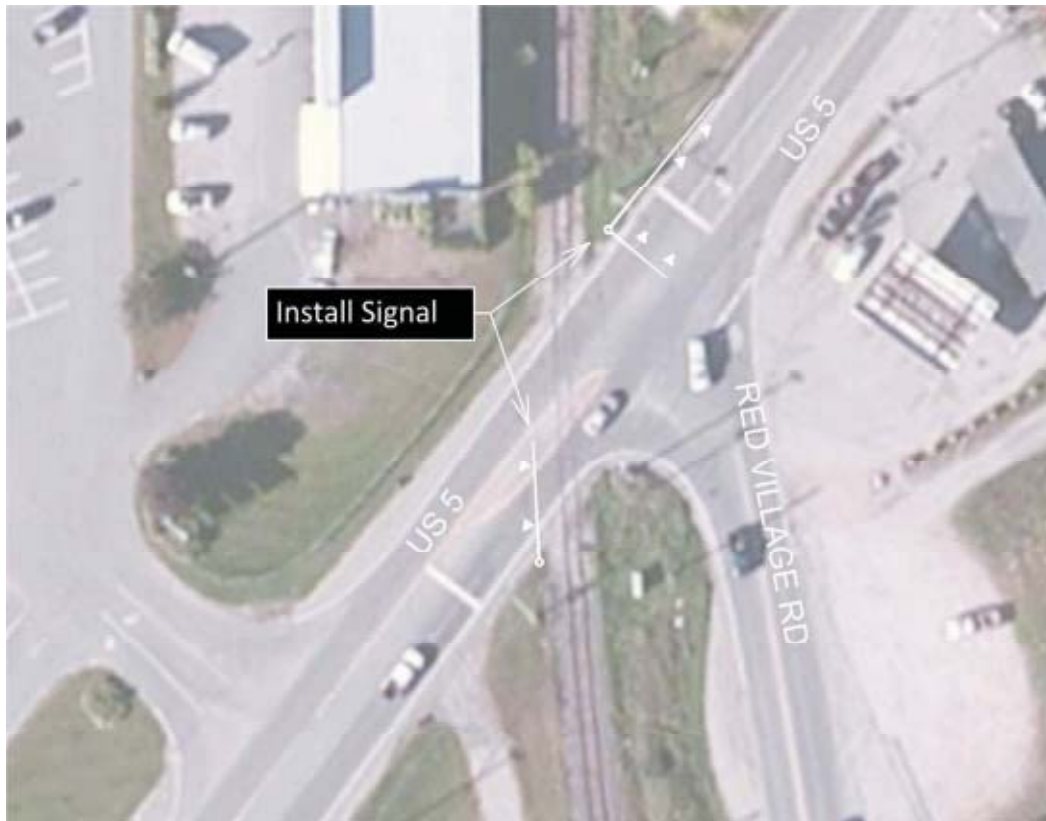
As discussed in Section 5, the westbound approach (turning onto US 5 from Red Village Road) at this intersection is projected to operate at LOS E in the 2019 Build Scenario and LOS F in the 2024 Build Scenario. Traffic volumes at this stop-controlled intersection were evaluated to see if they met the 8-hour, 4-hour, and/or peak-hour traffic signal warrants as defined in the *Manual on Uniform Traffic Control Devices (MUTCD)*. The results of the signal warrant assessment are that all three volume-based warrants are



currently met. Additional future growth will result in even greater delays and need for signalization of the US 5/Red Village Road intersection.

Figure 63 below shows a schematic plan of the proposed signalization of the US 5/Red Village Road intersection. Given the proximity of the Washington County Railroad crossing, any signalization of the Red Village Road intersection will need to include adequate rail pre-emption and upstream signalization to avoid signal conflicts when a train crosses US 5.

Figure 63: US 5/Red Village Road Intersection Signalization Diagram



7 IMPLEMENTATION PLAN

Figure 64 below shows each of the recommended roadway, bicycle, and pedestrian projects identified for the Newport/Derby and Burke/Lyndon study areas. The improvement matrix includes a cost estimate; a listing of potential funding sources, and an identification of implementing partners for each recommendation.



Figure 64: Draft Roadway Improvement Matrix

	Improvement	Cost Estimate	Potential Funding Source(s)*
Newport/Derby	Main Street Newport and Railroad Square Improvements Signalization and reconfiguration of Railroad Square intersection and "road diet" along US 5	\$1,500,000	STP, MUNI, HSIP, PRIVATE, B/P, TA
	US 5/I-91 Interchange Improvements Signalization and slip lane improvements	\$900,000	STP, MUNI, PRIVATE
	US 5/VT 105 Intersection Improvements Convert to an all-way stop, install sidewalk, curbing	\$80,000	STP, MUNI, PRIVATE, HSIP, B/P, TA
Burke/Lyndon	US 5/VT 114 Safety Improvements Reconfigure US 5 northbound slip lane	\$400,000	STP, MUNI, HSIP, PRIVATE
	VT 114/Mountain Road Sight Distance Improvements Minimize vertical curve on VT 114	\$600,000	STP, MUNI, HSIP, PRIVATE
	Depot Street (US 5)/Broad Street Improvements Install mini roundabout, parking lot improvements, and general downtown improvements	\$400,000	STP, MUNI, HSIP, PRIVATE, B/P, TA
	US 5/Red Village Road signalization	\$600,000	STP, MUNI, HSIP, PRIVATE

* The following funding source abbreviations are used:

- (B/P) - Bike/Ped
- (TA) - Transportation Alternatives
- (STP) - Surface Transportation Program
- (MUNI) - Municipal/Local
- (PRIVATE) - Private landowners, developers
- (HSIP) - Highway Safety Improvement Program

