

West Cumberland, Route 100 Feasibility Study Planning Partnership Initiative, WIN 26850.00 Cumberland, Maine



FINAL REPORT

December 1, 2023





Table of Contents

Executive Summary	
Introduction	4
Study Area	5
Public Process	6-7
Existing Conditions	8-16
Traffic & Capacity Analysis	17-21
Summary of Options	22-25
Conceptual Plans	26
Construction & Project Costs	27
Property Impacts	28-29
Recommendations	30-35
Appendix A	Concept Plans
Appendix B	
Appendix C	Traffic Analysis
Appendix D	Land Use Growth Projections
Appendix E	
Appendix F	Evaluation Matrix
Appendix G	Public Outreach

Executive Summary

This study focuses on transportation improvements along Route 100 in Cumberland. The purpose of this study is to evaluate, analyze and improve local mobility and accessibility for the West Cumberland Area while also providing for safety and mobility improvements for regional users along the Route 100 corridor connecting Portland and Gray. This study considered a no-build alternative (unsignalized intersection), a signalized intersection, and a roundabout for the reconfiguration of the intersection of Route 100 with Skillin Road/Blackstrap Road, as well as access management, and corridor & intersection improvements for all transportation modes. Both the signalized and roundabout alternatives assume a three-lane section for Route 100 including a continuous two-way left turn lane.

There have been prior studies completed for this area focusing on potential signalization of the intersection as well as recent efforts by the Town to provide enhanced pedestrian, landscaping, and lighting improvements. Some of those recommendations have been implemented including expanded sidewalk facilities along Route 100 and along small portions of Skillin Road and Blackstrap Road.

Route 100 is generally a two-lane roadway section, is classified as a Minor Arterial and corridor priority 3 with a posted speed limit of 35 MPH and a factored AADT of approximately 5,600 vehicles. It suffers from operational challenges including heavy traffic queuing and low levels of service during peak travel times. The intersection has been classified as a High Crash Location for at least three 3-year periods since 2014. The corridor has poor access management, speed control issues and poor pedestrian and bicycle accommodations. In addition to alternative treatments for the intersection, pedestrian, access management and capacity

improvements to the existing roadway network of Route 100, Skillin Road and Blackstrap Road are being proposed.

Traffic analysis and computer simulation modeling have been completed for each of the alternatives for the year 2023 and a future year of 2045. The same analysis has been completed for a No-Build condition, which assumes no improvements to the Route 100 corridor. All the alternatives analyzed have acceptable levels of service for traffic operations (defined as a Level of Service of D or better), and all are equal or better than the No-Build condition. It is noted that while the intersection would meet two of the signal warrants for the 2045 Analysis, it does not currently meet signal warrants in 2023.

Concept plans and cost estimates for each alternative have been generated. Alternatives have been evaluated on how well each meet the purpose and need statement of this study. That evaluation has considered factors such as, is mobility improved, is corridor safety improved, is bicycle and pedestrian accommodations provided, and is traffic calming provided, etc.

After comparing the alternatives to the study purpose and need, the study team has determined that both build alternatives (signalized intersection and roundabout) coupled with improvements to the existing roadways will improve mobility, corridor safety and will improve bicycle and pedestrian accommodations. However, as the intersection does not currently meet signal warrants thereby precluding implementation of the signalized intersection alternative at this time, the study team recommends implementation of the roundabout alternative so that capacity benefits, mobility enhancements and corridor safety benefits can be realized as soon as funding is identified and secured.

In terms of community development goals, there are opportunities to make improvements that advance Cumberland's goals in other areas of part of this transportation system work. There are many ways the town should consider complimentary actions that can be incorporated into the planning and design of transportation improvements, such as open space, economic development and placemaking goals. Specifically, work should include additional pedestrian connections, green space, pocket parks, and improved signage.

The study team has developed an opinion of probable construction costs for each of the alternatives analyzed as part of the Study. Construction costs are the costs needed to build the project. Using the conceptual layouts developed for each of the alternatives, preliminary quantities have been calculated, and construction costs have been estimated using Maine DOT average unit pricing and pay items. Work assumes full-depth construction of the necessary roadway widening as well as the proposed intersection improvements. A 25% contingency has been added to each of the construction cost estimates. The construction costs are presented in 2023 dollars and no escalation to future years has been included. The conceptual construction cost estimate for the recommended alternative (roundabout) is summarized below:

Description	Conceptual Construction Costs				
Roundabout Alternative	\$11,700,000				

Total project cost is a Maine DOT term that includes not only the construction costs, but also the engineering costs, inspection costs and right of way costs associated with a project. The study team has

included engineering costs at 10% of construction costs for each alternative. Inspection costs have been estimated at 10% of the construction cost. Right of way costs are based on anticipated property impacts and the potential acquisition of land that may be needed for the project. The conceptual total project cost for the recommended alternative (roundabout) is summarized below.

Description	Total Project Costs					
Roundabout Alternative	\$14,440,000					

A detailed breakdown of all cost estimates is included in this report, along with the concept plans for each of the alternatives.

Introduction

The Town of Cumberland in collaboration with the Maine Department of Transportation (Maine DOT) pursuant to a Planning Partnership Initiative (PPI) agreement has contracted with Gorrill Palmer, VHB, and Viewshed to perform a West Cumberland Transportation Feasibility Study. This study will complement previous planning initiatives efforts for the West Cumberland area, and will evaluate potential strategies to improve mobility, safety and traffic calming along the Route 100 corridor. This study will consider improving access to the properties and businesses within the study area by means of intersection geometric improvements, increased mobility through optimized traffic analysis, provisions for a center turn lane, better access management, and provisions for new and improved bicycle and pedestrian infrastructure.

Purpose & need

The purpose of this study is to identify a range of implementable alternatives to improve the safety and mobility for all modes of transportation both now and into the future and to create conditions that will allow mixed use, village scale redevelopment. A primary need is to improve safety at the intersection and intersection approaches, control excessive speeds, provide for improved access management, and to create a safer space and accommodations for pedestrians and bicycles.

A secondary purpose is to bring all elements of the transportation system into alignment with local land use, economic development, and quality of place goals. Transportation improvements that make it easier and safer to move within and through West Cumberland will help meet these goals.

Prior planning work

The Route 100 corridor in West Cumberland has been a focus for the Town of Cumberland from both a land development and transportation perspective for at least 15 years. The following is a summary of prior planning work for the Route 100 corridor:

Route 100 Corridor Study – This 2006 study recommended changes to the zoning along Route 100 that would create new zoning including village commercial and village office commercial zones along Route 100 between the Gray town line to the Falmouth town line. A center turn lane was recommended in the village commercial zone to improve access and mobility.

Route 100 Design Guidebook – The purpose of this 2007 document was to encourage high quality, economically viable development that reinforces a sense of place and promotes sustainable development, preserves the rural appearance of the corridor by requiring buffering, landscaping and open space and fosters an attractive, functional and safe environment for housing and commerce all while providing for pedestrian and bicycle accommodations.

Town of Cumberland Comprehensive Plan – This 2009 plan identified the Route 100 as a growth area for economic development, recommended safety improvements to the Route 100/Skillin Road/Blackstrap Road intersection, recommended better and safer accommodations for pedestrians and bicycles and recommended public water infrastructure be added to the Route 100 corridor to support new development.

<u>Intersection and Speed Evaluation Study</u> – In 2016, a signal warrant analysis and speed evaluation study were completed for the Route 100/Skillin Road/Blackstrap Road intersection.

The goal of this study is to enhance and build off the good ideas from the prior studies and develop recommendations that can be supported (by the public, Town and Maine DOT) and can be implemented as an outcome of this study. Recommendations and outcomes of this study will be subject to available local, state and/or federal funding.

Study Area

The overall study area for this project is centered on the intersection of Route 100, Skillin Road and Blackstrap Road. The study area runs along Route 100 (Gray Road) with Castle Rock Drive intersection on the southerly end to the intersection with Forest Ave on the northerly end. The study area includes Blackstrap Road extending from Route 100 intersection to the Maine Turnpike bridge and includes Skillin Road from the Route 100 intersection to Tammy Lane. The length of the study area along Route 100 is approximately 1.06 miles.

The study area includes the intersections with Castle Rock Drive, Rooster Ridge, Mill Road, Faraday Drive, Highland Ave, Forest Ave, George Road, Kathy Lane, and Tammy Lane. There are existing pedestrian sidewalks on Castle Rock Drive and Rooster Ridge but no existing sidewalks on the other side roads. The West Cumberland recreation facility with a playground, ballfields and a basketball court is located on Blackstrap Road, near the community center and West Cumberland fire station. Providing safe pedestrian and bicycle connections to these facilities will be important for this study.



Public Process

Public outreach is a key component to this project. In addition, coordination with town officials and town council members on the progress and outcomes of the study are equally important. Below is a summary of meetings that have occurred for this project, before and during this study:

Early Public Awareness

During the early stages of this project and prior to this study, the Town engaged the community in a series of workshops and meetings to develop a master plan for the Route 100 corridor and a comprehensive plan for the village district that is centered around the Route 100 and Skillin/Blackstrap Roads intersection.

Several years ago, the town requested that Maine DOT evaluate whether a traffic signal is warranted at the intersection of Route 100 and Skillin/Blackstrap Roads. It was determined that a traffic signal was not warranted, and Maine DOT recommended a 4-way stop condition instead. The town was not in favor of a 4-way stop condition due to mobility and safety concerns.

Last year, the town presented a redevelopment plan for the intersection of Route 100, Skillin Road and Blackstrap Road to the public. The plan included a roundabout concept for the intersection with infill redevelopment along the corridor. Most of the public spoke in favor of this redevelopment plan. Concerns were raised during the public process regarding safety, excessive vehicle speeds and the lack of sidewalks along the corridor. The town noted that this redevelopment plan would only be viable if federal government funding is secured for the transportation infrastructure related work. To obtain federal funding, Maine DOT would need to become engaged in the project. With approval from the local tax increment financing (TIF) committee, the town reached out to Maine DOT to discuss the intersection.



The town formally requested that Maine DOT complete a transportation feasibility study for the Route 100 corridor in West Cumberland. It was agreed by both Maine DOT and the town that a jointly funded planning partnership initiative feasibility study would be completed for this project.



Project Public Outreach

The public process for this planning study has included the following two public meetings:

Public Informational Meeting – This meeting was held on May 25, 2023, at the Community Hall in West Cumberland and was well attended by residents, town officials, business owners and abutters. The presentation included introducing the study team, discussing the project background, scope of work, purpose and need statement, safety audit information, summary of crash data, initial traffic assessment, land use redevelopment opportunities, concepts being considered, and the study schedule. The following questions and comments were received during this meeting:

- Extend sidewalks to the study limits.
- Provide mid-block pedestrian crossing at Highland Ave intersection.
- The owner of BruThru business expressed access concerns with the initial concepts presented and stated there is an existing leach field near the intersection.
- There were general questions on the safety, operation, size and cost of the roundabout option.
- The proposed access management in front of the Gulf gas station should be reviewed.

There was general support for the roundabout option as it would provide for traffic calming, improve safety, improve traffic operations, and would provide for a village center.

Council Presentation & Public Meeting – This meeting was held on October 23, 2023, at the council chambers of the Cumberland town hall. The presentation included reintroducing the study team, study limits, and study scope as well as discussing the traffic analysis findings, land use growth projections, summary of concept plans,

review of prior public meeting comments, summary of project costs, evaluation comparison of the options with findings and recommendations, and presentation of renderings. The following questions and comments were received during this meeting:

- Can the proposed mid-block crosswalk on Blackstrap Road be relocated closer to George Road.
- There are property impact concerns for the property located at the southern corner of the Mill Road intersection. The conceptual plans identified a sight distance concern at this location and propose relocation of existing fence, trees and shrubs at this corner.
- There were general questions on next steps in the design and implementation process and whether further public input forums would occur.

After soliciting public input and asking additional questions of the study team and town officials, the town council agreed with the final recommendations of the study and voted unanimously in favor of submitting the report to Maine DOT.

Public meetings were video recorded and were posted on the town's website for viewing after the meetings. Presentation materials from the public outreach process can be found in Appendix G.

Existing Conditions



Transportation System

The Route 100 corridor in West Cumberland is noted as a heavy commuter route between Gray and Portland, Maine. There is a major intersection within the study limits that connects Route 100 with Blackstrap Road to the west and Skillin Road to the east. This intersection is unsignalized with Route 100 having a free flow movement and the minor roads of Blackstrap Road and Skillin Road being stop conditions.

Route 100 is a minor arterial, corridor priority 3 roadway with 5600 vehicles a day. The speed limit on Route 100 consists of 35 mph from the northern study limit (near Forest Ave intersection) and extends to approximately 1200 ft. south of the Blackstrap/Skillin Road intersection where the speed limit changes to 40 mph. The speed limit of 40 mph extends south to a point between the Rooster Ridge intersection and the Castle Rock Drive intersection where the speed limit changes to 50 mph.

Blackstrap Road is a major collector, corridor priority 4 roadway with 3000 vehicles a day. The speed limit on Blackstrap Road is 40 mph.

Skillin Road is a minor collector, corridor priority 4 roadway with 2900 vehicles a day. The speed limit of Skillin Road is 35 mph.

The characteristics of <u>Route 100</u> within the study limits include two travel lanes (one in each direction) with variable width paved and gravel shoulders and small sections of existing sidewalks. There are no existing facilities for bicycles and only limited accommodation for



pedestrians. The roadway is curbed with closed drainage near the intersection and uncurbed with open drainage away from the intersection. There are overhead utilities and utility poles along the corridor and an underground public watermain system. Existing pedestrian scale lighting does exist along the frontage of a few properties that have been redeveloped recently. The roadway has a relatively flat profile and a straight horizontal alignment near the intersection. There are residential and commercial properties along the Route 100 corridor and access management is poor in certain areas.

As you travel south, the roadway characteristics for Route 100 change. A center turn lane (three lane section) begins near Preston Drive and extends southerly to Castle Rock Drive. There is a



horizontal curve and a steep vertical grade heading southbound in this area. There are no existing facilities for pedestrians or bicycles along this section of Route 100.

There are numerous intersections along Route 100 including Forest Ave, Highland Ave, Faraday Drive, Preston Drive, Mill Road, Rooster Ridge, and Castle Rock Drive. The Mill Road intersection was identified as having poor intersection sight distance.

Blackstrap Road includes two travel lanes (one in each direction) with variable width paved shoulders and small sections of existing sidewalks. The roadway is curbed with closed drainage near the intersection and uncurbed with open drainage away from the intersection. There are overhead utilities and utility poles along the corridor. The roadway has a relatively flat profile with a slight horizontal curve as the roadway approaches the Maine Turnpike bridge. There is a fire station, athletic fields, basketball court and playground with a community hall on the south side of Blackstrap



Road and a Maine Turnpike maintenance facility on the north side of the roadway. There is an intersection of Blackstrap Road and George Road, that is located opposite the fire station.

<u>Skillin Road</u> includes two travel lanes (one in each direction) with variable width shoulders and no existing sidewalks. The roadway is



curbed with closed drainage near the intersection and uncurbed with open drainage away from the intersection. There are overhead utilities and utility poles along the corridor. The roadway has a relatively flat profile with a horizontal curve near the study limits. There are residential properties along this section of the roadway. There are intersections with Kathy Lane and Tammy Lane along this section of Skillin Road.

Safety Review

A safety audit of the corridor was completed by the study team on May 19, 2023. The following items were identified from this safety review:

Speed compliance issues were noted along Route 100. The vehicle speeds through the intersection with Blackstrap/Skillin Roads as well as vehicles speeds from the Mill Road intersection to the Castle Rock Drive were observed to be generally higher than the posted speed.



- Pedestrian accommodations were lacking in the corridor.
- Access management is poor in some areas of the corridor.

- The intersection sight distance at the Mill Road intersection with Route 100 is poor.
- The existing flashing beacon system at the Blackstrap/Skillin Roads intersection is old and does not comply with current standards.
- The flashing 'stop ahead' signs on Blackstrap Road and Skillin Road were not fully functional and the placement of the stop signs were not ideal.
- Traffic was observed queuing on Blackstrap Road from the BruThru business, which is not ideal.

The proposed design should include traffic calming measures to better control vehicle speeds through the corridor. Improved access management is needed throughout the corridor. Bicycle and pedestrian accommodations are needed for the full study limits of Route 100 and on the minor roads of Blackstrap Road and Skillin Road. There are existing sidewalks on Rooster Ridge and Castle Rock Drive further justifying the need for similar accommodations on Route 100.

Improvements to the Mill Road intersection sight distance are strongly recommended.

Short-Term Safety Improvements

Regarding the flashing beacon system, stop signs and flashing stop ahead signs at the Route 100 intersection with Blackstrap/Skillin Roads, the study team prepared and developed a short-term safety improvement plan for this intersection, at the town's request, to replace and upgrade these systems at the intersection. It is our understanding that those improvements will be made separate from the recommendations of the study.

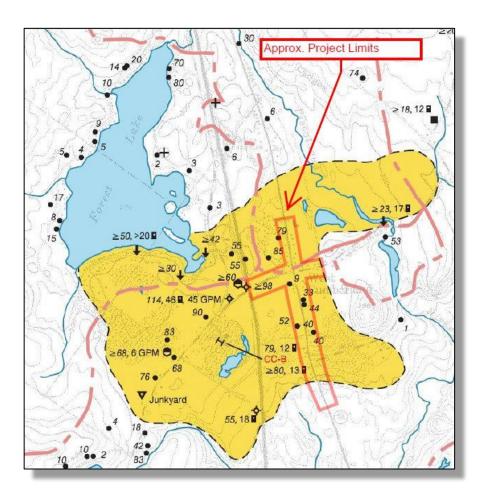
Environmental Review

The study team has reviewed existing data available from the town and from the state regarding assets to consider in the development of recommendations. These assets included a range of environmental and cultural features, such as wetlands, vernal pools, sand and gravel aquifers, deer wintering areas, historic properties, and archaeological sites. These features were inventoried and mapped in GIS. More detailed field verification of existing environmental, cultural, and historic assets will be required in the design phase of recommended projects. This higher-level review of existing data is useful for understanding the types and extents of assets and constraints in the study area.

Environmental and cultural assets

Based on a desktop review of the study limits, there are no regulated wetlands within the anticipated construction footprint.

The existing West Cumberland area is sited on a mapped high-yield aquifer based on the Maine Significant Sand & Gravel Aquifers Map as published by the Maine Geological Survey (snippet to the right). The sandy and gravelly soils in this area of Cumberland provide excellent drainage and are therefore important soils for groundwater recharge considerations. The characteristics of these soils are also excellent for mineral extraction activities and for the development of subsurface wastewater disposal fields. As one might expect, there are several significant sand and gravel pits within and surrounding the study area. In recent years, concerns over groundwater pollution have led to renewed discussions over stormwater runoff and consideration of wastewater collection and treatment systems to protect groundwater and surface water resources. Best Management Practices should be implemented as part of the Final Design for the stormwater improvements to minimize any negative impact to the underlying aquifer.

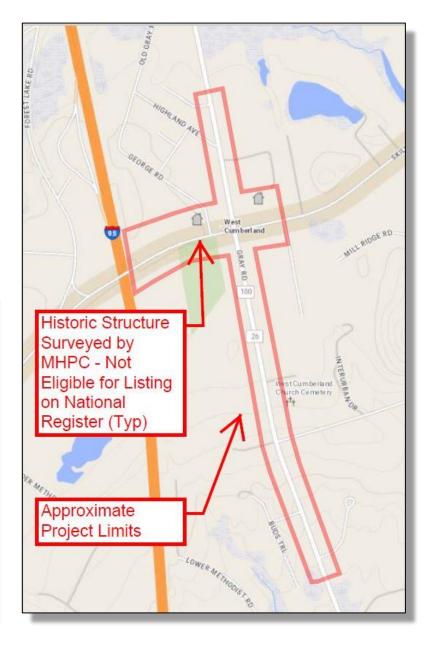


The snippet to the far right is an excerpt of the Maine DOT Map Viewer depicting Historic Properties and Districts. There are no Historic Districts within or adjacent to the Project Limits. There are two historic structures (71 & 72 Gray Road) which have been surveyed by the Maine Historic Preservation Commission, but neither structure was determined to be eligible for listing on the National Register of Historic Places. The proposed project is not anticipated to have a significant adverse impact on either of these historic structures or properties. It is recommended that consultations occur with the MHPC during Preliminary and Final Design to confirm no adverse impact to these structures.

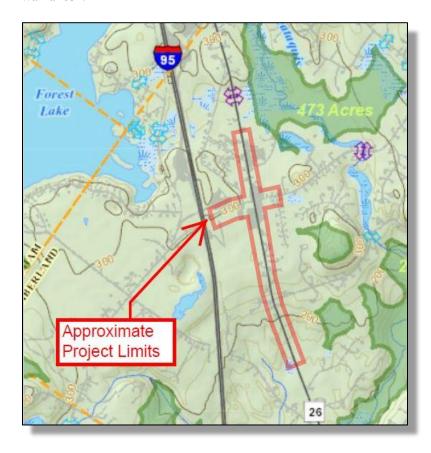
The snippet below is an excerpt of the Beginning with Habitat Map published by the Maine Department of Inland Fisheries & Wildlife, Conservation & Connectivity Planning Resources, depicting

Conserved Lands (green shaded areas). As can be seen, there is a conserved parcel on the southerly side of Blackstrap Road. This parcel is owned by the Town of Cumberland and developed as a recreation complex (playground and athletic fields). Based on a review of the Maine Land & Water Conservation Fund website, it does not appear that the construction of the athletic fields was funded in part by the Land & Water Conservation Fund Grant process, therefore no





coordination with Maine Department of Conservation appears warranted.



The snippet above is an excerpt of the Beginning with Habitat Map published by the Maine Department of Inland Fisheries & Wildlife, Conservation & Connectivity Planning Resources, depicting Undeveloped Habitat Blocks (green shaded area). Based on a review of this Map, it does not appear that the project will result in an adverse impact to an Undeveloped Habitat Block.

The snippet below is an excerpt of the Beginning with Habitat Map published by the Maine Department of Inland Fisheries & Wildlife, Conservation & Connectivity Planning Resources, depicting Wildlife Habitats, including Rare, Threatened or Endangered Animals (orange shaded area). Based on a review of this Map, it does not appear that the project will result in an adverse impact to an Endangered, Threatened or Special Concern Species Habitat.



The following response was received from the Maine Natural Areas Program (MNAP) regarding this project:

"According to the information currently in our Biological and Conservation Data System files, there are no rare botanical features documented specifically within the project area. Based on the information in our files and the landscape context of this project, there is a low probability that rare or significant botanical features occur at this project location."

The following response was received from the United States Department of Interior, Fish and Wildlife Service (USFWS) regarding this project:

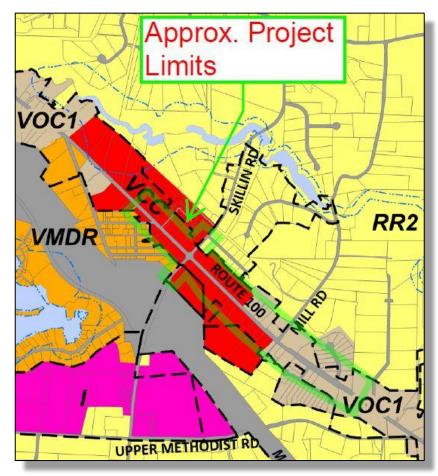
- "With respect to the endangered species act, there are no critical habitats within your project area under this office's jurisdiction."
- "With respect to USFWS national wildlife refuge lands and fish hatcheries, there are no refuge lands or fish hatcheries within your project area."

Land Use Review

Zoning and Development

West Cumberland is a local commercial center that currently is limited to local businesses. There are no state-wide or national users. As can be seen on the snippet to the right, an excerpt of the Cumberland Zoning Map, the Route 100 frontage parcels within the study area are comprised of the Village Center Commercial District (VCC) and Village Office Commercial I District (VOCI). There is a limited area of Village Medium-Density Residential District (VMDR) along the northerly side of Blackstrap Road, and a limited area of Rural Residential 2 District (RR2) on the southside of a portion of Skillin Road.

The Purpose Statement of the VCC District notes that the District is to provide an area that allows a mix of commercial uses such as retail sales, restaurants and business and professional offices. Development within the District needs to demonstrate consistency



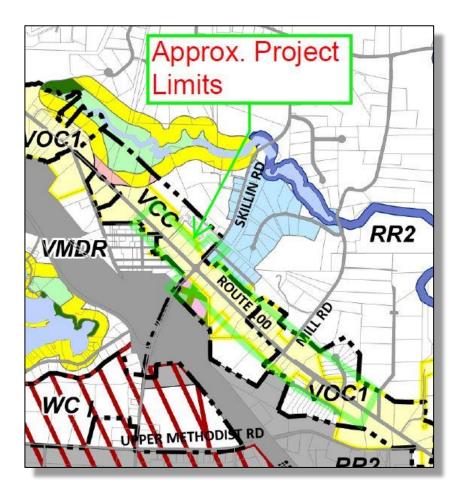
with the Route 100 Design Standards and provide either a twentyfive foot landscape buffer with a sidewalk, trees, and other landscaping and street furniture, as approved by the Planning Board as part of Site Plan Approval for the site, or shall, in the alternative, grant a landscape easement to the Town for the purpose of installation and maintenance of the required sidewalk and other streetscape improvements. As a minimal number of properties have been redeveloped over the last few years, there have been opportunities for reservation of this easement area on various parcels, which should be verified as part of the Preliminary and Final Design process.

There are thirty-three permitted uses in the VCC District, including such auto-centric uses as auto repair service garage, gasoline stations, restaurants, retail stores (maximum 25,000 sf), grocery stores (maximum 35,000 sf), motor vehicle sales, commercial health and recreation facility, etc. There are also four special exception uses allowed in the VCC District, with approval from the Board of Adjustment and Appeals, including home occupations, home-based occupations, and home-based retail.

No residential development is permitted within the VCC District by-right.

Within the southerly limits of the Route 100 Corridor Project Limits, the purpose of the Village Office Commercial I District is to provide substantial areas for integrated development of professional offices and related businesses in a park or campus-like setting which are of a unified architectural design and landscaping, compatible with the natural surroundings. All development in this district shall be consistent with the Town of Cumberland Route 100 Design Standards.

There are twenty-three permitted uses in the VOCI District, including uses such as business and professional offices with drive-through facilities, health & fitness studios, multiplex dwellings, contractor's space, residential care facilities, light manufacturing, etc. There are also four special exception uses allowed in the VOCI District, with approval from the Board of Adjustment and Appeals,



including home occupations, home-based occupations, and home-based retail.

The snippet above is an excerpt of the Cumberland Overlay & Shoreland Zoning Map. Within the Project Limits, the Route 100 Corridor Residential Overlay District exists. This district allows Dwelling; Attached, Dwelling; Detached, Dwelling; Duplex & Dwelling; Multiplex on lots that are not developable for commercial

use due to restrictions on Route 100 access by the Maine Department of Transportation.

Land Use Growth Projections

To assess the future traffic volumes within the Route 100 Corridor,

an assessment was conducted of a probable buildout within and adjacent to the Corridor. The buildout was developed based on discussions with town staff, the study team's collective experience in land use development, projects that are currently proposed and projected needs within the Greater Portland area. The buildout was projected based on various segments of the roadway network so that trip generation and assignment could be completed to determine the incremental change in traffic at the various intersections within the study area. Buildout projections considered various land uses such as single-family units, duplex units, multi-family units, retail, office and lightindustrial users. While multifamily housing is not currently permitted within the VCC District, it was assumed that it would be at some point in the

future due to the identified need for additional housing units within the Greater Portland area. The graphic below depicts the assumptions that were developed for the buildout projections, which were incorporated into the Traffic and Capacity Analysis. See Appendix D for additional information.



Traffic & Capacity Analysis

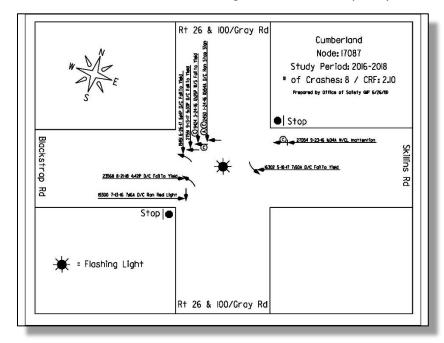
Traffic volumes are a major factor in evaluating safety and vehicle mobility within a community. Assessment of traffic capacity and vehicle mobility is included in the scope of this study. The average annual daily traffic (AADT) for Route 100 within our study limits is 5600 AADT and the traffic on the side roads of Blackstrap Road and Skillin Road are 3000 AADT and 2900 AADT respectively. Route 100 is a heavy commuter route between Gray and Portland and congestion can be observed during the morning and evening



commutes. The intersection of Route 100 with Blackstrap/Skillin Roads is a two-way stop condition with Route 100 having the free flow movement. Vehicle queuing and stacking on the side roads is not uncommon during the morning and evening commutes. One of the goals of this study is to improve access and vehicle mobility for all approaches to this intersection. This study will also look to address safety and operational challenges that exist at this intersection.

Crash Data

To better understand the crash patterns of the corridor, the study team obtained 2020-2022 crash data from Maine DOT (latest available data at the beginning of this study). Based on the information provided, there are no current High Crash Locations (HCL) within the corridor. The Route 100 intersection with Blackstrap/Skillin Roads did have five reported crashes in that three-year period and a critical rate factor (CRF) of 1.34, which is close to being considered a high crash location. To qualify as a high crash location, there needs to be eight or more crashes in a three-year period and a critical rate factor of 1.0 or greater. While this intersection currently does not meet the criteria for a high crash location, it has been considered a high crash location in prior years



and continues to experience T-bone style crashes where the minor side road traffic fails to yield, and the major road traffic is typically traveling too fast. These types of collisions are dangerous and usually result in a higher level of bodily injury and property damage. Below is a summary of the available crash history for the Route 100 intersection with Blackstrap/Skillin Roads:

- 2020-2022: 5 crashes and CRF 1.34
- 2019-2021: 4 crashes and CRF 1.21
- 2016-2018: 8 crashes and CRF 2.10 (HCL)
- 2015-2017: 11 crashes and CRF 3.08 (HCL)
- 2014-2016: 9 crashes and CRF 2.55 (HCL)

This information reaffirms the feedback received from the public input process, that the corridor suffers from operational and safety challenges. While short-term safety improvements are planned for this intersection, as noted in the existing conditions section of this report, long term safety and operational improvements are needed for this intersection.

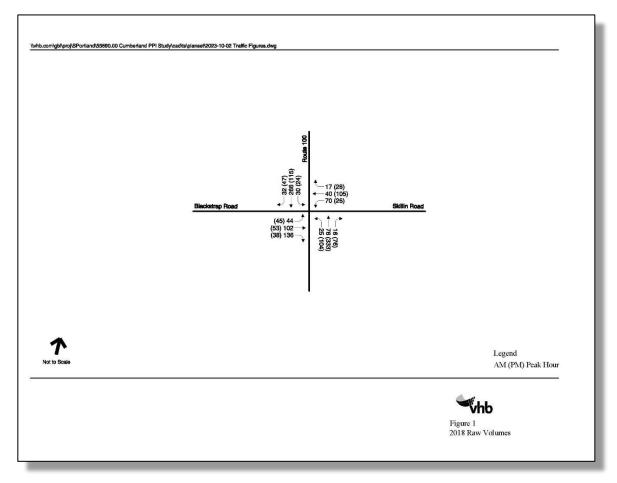
Improving the intersection geometry and providing better access to the intersection for the side streets should reduce the frequency of crashes and improve the safety of the intersection.

See Appendix E for supporting documentation on the 2020-2022 crash data.

Traffic Volumes

Turning movement counts were collected for Route 100 and Blackstrap/Skillin Roads intersection by Maine DOT on October 26, 2018. Both morning and evening peak hour counts were collected.

The traffic data has been compiled in its raw format, then volumes have been balanced, seasonally adjusted to represent the peak



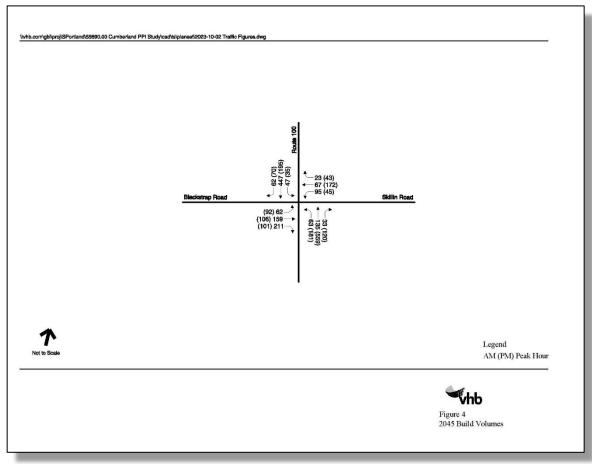
summer months (as necessary), and finally 2023 design hour volumes have been determined.

Traffic Analysis

With the above traffic data and design hour volumes, the study team performed capacity analysis and computer modeling using Synchro & SimTraffic software for the existing condition. The results of the existing condition modeling have been reviewed by the Town and Maine DOT and then calibrated to provide a reasonable representation of the existing conditions.

Next, the study team developed a future No Build traffic model based on a 22-year projection (year 2045). In order to determine a reasonable growth rate factor, an assessment of planned development was completed including projects approved but not yet built, projects in the approval pipeline, projects that have obtained a Maine DOT traffic movement permit and projects that in the Town's judgement should be considered in the 22-year planning horizon. Finally, historic traffic growth was reviewed and considered in the assessment. After considering the above factors, the study team selected an annual growth factor of 0.5% per year for 22 years, for an overall growth factor of 1.12. The resulting 2045 traffic design hour volumes are summarized in the graphic to the right. Next, traffic analysis and modeling of the future 2045 No Build condition was completed and thereafter traffic analysis and modeling was completed for a roundabout alternative and a traffic signal

The analysis focused on the weekday morning and evening peak hour volumes. A detailed description of each of the options is discussed in the next section of this report.



alternative.

Traffic Modeling Results

The findings of the traffic analysis suggest that both alternatives will function at acceptable levels of service, and both will provide better results than the 2045 No Build condition.

In reviewing the findings, the levels of service (LOS), queuing and vehicle delays in the 2023 existing condition are acceptable with minimal delays and levels of service of A in the morning and evening conditions. Forecasting the No-Build condition to 2045 provided less favorable results. Levels of service of F are realized in the morning and evening conditions for the 2045 No-Build condition with long delays and significant vehicle queuing on the side roads of Blackstrap Road and Skilling Road.

Capacity Analysis Comparison

In terms of the future Build conditions, the Roundabout alternative realized levels of service of B and C in the morning and evening conditions respectively and anticipated lower vehicle delays than the No-Build and the Traffic Signal alternative.

The Traffic Signal alternative was analyzed considering both split phasing and lead-lag phasing for the minor approaches to optimize the traffic signal operations. Permitted protected left turn phases were analyzed for the Route 100 approaches. The Traffic Signal alternative realized levels of service of C and C in the morning and evening conditions, using a lead-lag phasing scenario. Vehicle delays and overall vehicle queuing were longer with the Traffic Signal alternative than with the Roundabout alternative. The summary of the modeling findings is shown in the table below.

2023 Existing		ng	2045 No-Build			2045 Build – Signal (Split Phase)			2045 Build – Signal (Lead-Lag)			2045 Build – Roundabout			
Approach	Delaya	LOSb	95 th % Queue ^c	Delay	LOS	95 th % Queue	Delay	LOS	95 th % Queue	Delay	LOS	95 th % Queue	Delay	LOS	95 th % Queue
Morning Peal	Hour														
Eastbound	13.3	LOS B	149	233.1	LOS F	1438	31.4	LOS C	326	30.3	LOS C	292	19	LOS C	163
Westbound	10.2	LOS B	81	25.6	LOS D	141	26.0	LOS C	121	28.9	LOS C	120	6	LOS A	23
Northbound	1.5	LOS A	30	3.1	LOS A	68	17.7	LOS B	128	15.9	LOS B	115	6	LOS A	31
Southbound	2.1	LOS A	23	3.3	LOS A	46	59.5	LOS E	697	27.7	LOS C	349	11	LOS B	128
Total	6.9	LOS A		77.4	LOS F		39.5	LOS D		26.7	LOS C		12	LOS B	
Evening Peak	Hour														
Eastbound	14.4	LOS B	96	624.1	LOS F	1708	31.6	LOS C	227	30.2	LOS C	201	7	LOS A	43
Westbound	18.3	LOS C	114	597.8	LOS F	1664	36.9	LOS D	221	30.4	LOS C	180	17	LOS C	81
Northbound	3.6	LOS A	66	6.9	LOS A	130	48.9	LOS D	918	29.1	LOS C	507	29	LOS D	851
Southbound	1.9	LOS A	42	3.2	LOS A	73	22.0	LOS C	187	18.5	LOS B	165	9	LOS A	48
Total	7.1	LOS A		186.6	LOS F		39.5	LOS D		27.5	LOS C		20	LOS C	

(Roundabout and Traffic Signal) operate at acceptable levels of service, with manageable delays and queuing and are viable options for this study. The No-Build condition operates poorly during morning and evening peak hours in 2045 and is not recommended as a viable option. A summary of the traffic analysis and modeling results can be found in Appendix C.

Both Build alternatives

Table 3

a Delay for movement in seconds

b Level of service for approach

c 95th percentile queue in feet

d Analysis completed with SIDRA software

Signal Warrant Analysis

A traffic signal warrant analysis has been completed at the Route 100 and Blackstrap/Skillin Roads intersection. The analysis followed the guidelines as defined in chapter 4C of the Manual of Uniform Traffic Control Devices (MUTCD). A total of nine warrants are considered in this assessment. Warrants 1 through 3 are based on the number of vehicles moving through the intersection. Warrants 4 through 9 are based on other characteristics of the intersection and surrounding roadway network.



To complete the signal warrant assessment, turning movement counts collected by Maine DOT were adjusted seasonally and an annual growth rate factor was applied to determine traffic volumes for 2045. Future developments were also factored into the forecasted traffic volumes.

Based on a review of the nine signal warrants, none of the warrants are met for average day conditions in 2023 and two warrants are met in 2045.

The intersection does <u>not</u> meet a traffic signal warrant in the existing condition. Based on our analysis using traffic volume and future development projections, the intersection does meet a traffic signal warrant in 2045.

A summary of the traffic signal warrant analysis can be found in Appendix C.

Summary of Options

As part of this study, the following three alternatives have been considered: roundabout, traffic signal and unsignalized intersection.

Detailed graphics for these alternatives are provided in Appendix A of this report. A detailed description of each alternative is provided below:

Roundabout Alternative

This option consists of a single lane roundabout at the intersection of Route 100 with Blackstrap/Skillin Roads. Each of the four roadway approaches will include splitter islands and single lanes entering and exiting the roundabout. The inscribed circle diameter of the proposed roundabout is 140 ft. The layout has been designed to accommodate the turning movements

of large vehicles such as a WB-67 truck, school bus, and fire truck. A concrete truck apron is proposed on the inner circle of the roundabout and sloped granite curbing is proposed around the outside perimeter. Bicycle and pedestrian accommodations are provided for this alternative around the perimeter of the roundabout, to include an esplanade, sidewalk and a separate bike facility. Crosswalks are provided for both bikes and pedestrians on all four roadway approaches.



The Route 100 corridor will include a 3-lane roadway section for the study limits consisting of one through lane in each direction and a continuous two-way center turn lane. The layout will provide for 11' wide travel lanes, 12' wide center turn lane, 5' wide paved shoulders, curbing, closed drainage, esplanades of varying width (5' minimum) and 5'-6' wide paved sidewalks. The esplanades will be grassed or landscaped. Raised center medians of varying width (6' minimum) are proposed in select areas for traffic calming, pedestrian refuge and/or access management.

There are mid-block pedestrian crossings proposed Highland Ave and Rooster Ridge. These crossings will include refuge islands and rectangular rapid flashing beacons (RRFB's).

Pedestrian accommodations include sidewalks extending from the roundabout north on Route 100 to just north of Highland Ave and extending south to Rooster Ridge and Castle Rock Drive.

Bicycle accommodations are provided with 5 ft. wide paved shoulders throughout the study limits.

Access management or reduction of entrance opening widths are

proposed throughout the corridor consistent with Maine DOT standards.

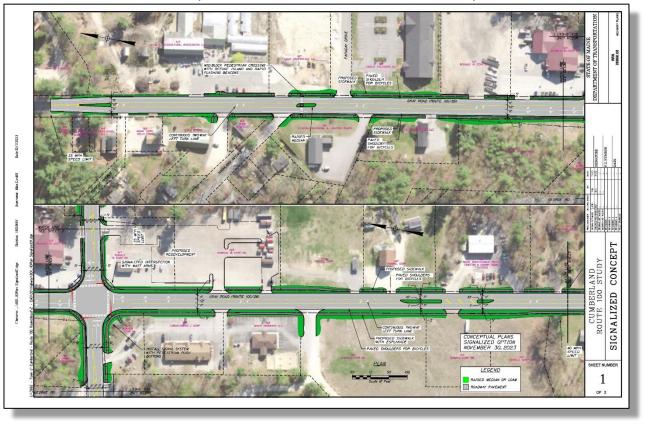
On Blackstrap Road and Skillin Road, 11' wide travel lanes, 5' wide paved shoulders, curbing, closed drainage, esplanades of varying width (5' minimum) and 5'-6' wide paved sidewalks will be provided. The esplanades will be grassed or landscaped.

On Blackstrap Road, sidewalks are proposed on both sides from the intersection to the athletic fields where a mid-block pedestrian crossing is proposed with RRFB's. A sidewalk is proposed on the south side from the athletic fields to the Maine Turnpike bridge.

On Skillin Road, sidewalks are proposed on both sides from the intersection to Tammy Lane, where a mid-block pedestrian crossing is proposed with RRFB's.

Traffic Signal Alternative

This option consists of a signalized intersection of Route 100 with Blackstrap/Skillin Roads. Each of the four roadway approaches will include a left turn lane and thru-right lane. A signal mast arm configuration is assumed for the signal system. The layout has been designed to accommodate the turning movements of large vehicles such as a WB-67 truck, school bus, and fire truck. Granite curbing is proposed around the intersection perimeter. Pedestrian accommodations are provided for this alternative around the perimeter of the intersection, to include an esplanade, sidewalk and



crosswalks. Bicycles are accommodated by use of the shoulders and shared lanes.

The Route 100 corridor north and south of the intersection will generally match the design proposed for the Roundabout alternative. Pedestrian and bicycle accommodation, access management, and the design proposed for Blackstrap Road and Skillin Road will also match the Roundabout alternative.

Unsignalized Alternative

This option consists of an unsignalized raised intersection of Route 100 with Blackstrap/Skillin Roads. The Route 100 roadway approaches will include a left turn lane and thru-right lane while the minor road approaches will include a single lane with a raised center median. The layout has been designed to accommodate the turning movements of large vehicles such as a WB-67 truck, school bus, and fire truck. Granite curbing is proposed around the intersection perimeter. Pedestrian accommodations are

provided around the perimeter of the intersection, to include an esplanade, sidewalk and crosswalks. Bicycles are accommodated by use of the shoulders and shared lanes. Since Route 100 is a minor arterial roadway, the use of vertical traffic calming will require Maine DOT design exception approval as their current policies do not allow for vertical traffic calming on arterial roadways.

The Route 100 corridor north and south of the intersection will generally match the design proposed for the other alternatives. Pedestrian and bicycle accommodation, access management, and the



design proposed for Blackstrap Road and Skillin Road will also match the other alternatives.

Detailed graphics for these alternatives are provided in Appendix A of this report.

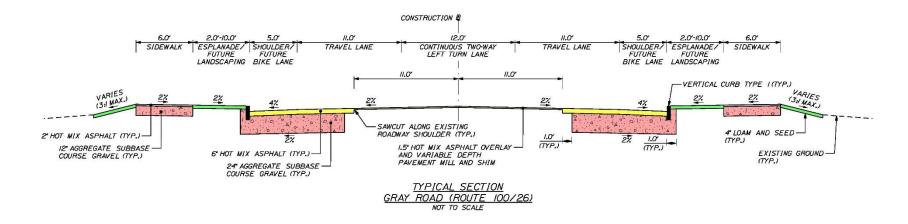
Typical Section

The typical roadway section for the Route 100 corridor will be similar for each alternative and will include two 11 ft. travel lanes, 12 ft. continuous two-way left turn lane, 5 ft. paved shoulders, vertical granite curbing on both sides, 2 ft. to 8 ft. grassed / landscaped esplanades, a 5 ft. to 6 ft. paved sidewalks on each side of the roadway. The core of the existing roadway is assumed to be built and in good condition therefore the middle 22 ft/ of the existing roadway is proposed for pavement mill and overlay only. The outer edges of the proposed roadway template will require full depth reconstruction. Pavement and gravel depth should follow Maine DOT standards. The esplanades will create landscaping and streetscape opportunities and should include shade trees and ornamental lighting.

Raised center medians will be proposed at select locations. Those will consist of slope granite curbing and landscaping, grass or pavement surface treatments.

ADA compliant ramps and crosswalks shall be provided within the study limits. Bicycles will be accommodated with a 5 ft. paved shoulder and shared lanes at the intersection.

Vertical granite curbing with closed drainage and underdrain is proposed along the shoulder edge and sloped granite curbing is proposed at the center medians.



Conceptual Plans

The study team has prepared conceptual plans for each of the alternatives presented in the previous section. Using base plans developed from aerial images and right of way and property line information from available GIS data, conceptual plans have been prepared for the three alternatives: Roundabout, Unsignalized and Signalized intersection. These concept plans show travel lanes, shoulders, curbing, esplanades, raised center medians, multiuse paths, sidewalks and cross walks. The plans are colored, and a color key is provided. A north arrow and bar scale is also provided for reference. A copy of the concept plans can be found in Appendix A of this report.

Construction & Project Costs Construction Costs

The study team has developed an opinion of probable construction costs for each of the alternatives analyzed as part of the Study. Construction costs are the costs needed to build the project. Using the conceptual layouts developed for each of the alternatives, preliminary quantities have been calculated, and construction costs have been estimated using Maine DOT average unit pricing and pay items. Work assumes full-depth construction of the necessary roadway widening as well as the proposed intersection improvements. A 25% contingency has been added to each of the construction cost estimates. The construction costs are presented in 2023 dollars and no escalation to future years has been included. The conceptual construction cost estimate for each alternative is summarized below:

Description	Conceptual Construction Costs
Roundabout Alternative	\$11,700,000
Unsignalized Alternative	\$10,100,000
Signalized Alternative	\$10,700,000

Total project cost is a Maine DOT term that includes not only the construction costs, but also the engineering costs, inspection costs and right of way costs associated with a project. The study team has included engineering costs at 10% of construction costs for each alternative. Inspection costs have been estimated at 10% of the construction cost. Right of way costs are based on anticipated

property impacts and the potential acquisition of land that may be needed for the project. The conceptual total project cost for each alternative is summarized below.

Description	Total Project Costs
Roundabout Alternative	\$14,440,000
Unsignalized Alternative	\$12,420,000
Signalized Alternative	\$13,140,000

A detailed breakdown of all cost estimates can be found in Appendix B of this report, along with the concept plans for each of the alternatives. The cost estimates provided in this report are considered conceptual and further refinements to the estimates can be expected during preliminary and final design.

Property Impacts

Part of the evaluation for each alternative includes an assessment of potential property impact. While it is the goal of any transportation project to stay inside the limits of available public right of way, that is not always possible and the construction of an expanded capacity intersection as well as enhanced pedestrian/bicycle accommodations may require land acquisition.

Using available GIS mapping for property and right of way limits, the study team has developed concept plans for each of the alternatives with a goal of minimizing property impacts, however property impacts are still realized for each alternative in this study. Below is a summary of anticipated property impacts for each of the alternatives.

In terms of disclaimers, please note the information presented in this section are planning level assessments of property impacts based on conceptual plans, tax assessor data, and high-level estimates of land value and are not based on detailed designs with ground survey, accurate right of way and property line information. No certified land appraiser has been used in calculating land value for this study. Further design refinements and adjustments to property impacts will need to be completed during preliminary and final design. Also, the true cost for land and right of way acquisition will need to be completed by qualified professionals during the design process.

As part of this assessment, the study team has identified parcels that will be partially impacted by the footprint of each alternative. Those properties have been identified in Table I on the following page. There are other parcels within the project limits where property impacts will be realized but land acquisition is not needed. At those locations, temporary or permanent grading rights and/or easements

will be obtained. Those costs for obtaining grading rights are excluded for the property costs identified below.

In terms of assessing values for property acquisitions, the study team has reviewed the available parcel data information on the Town's website. Since many of the parcels have little to no sales history information, the current assessed value of the parcels has been used as a base value and a small inflation factor has been added to determine fair market value. Since all of the parcel acquisitions will be land only and no building acquisition, land value has been used in this assessment. As noted previously, if this project moves into the design phase, the study team recommends that the Town hire a ROW appraiser to more accurately determine fair market value for land and any building acquisitions.

Table I on the following page provides a summary of the parcels impacted by each alternative along with an estimated overall cost for property acquisition by alternative.

Roundabout Alternative

This alternative results in forty-nine potential property impacts, totaling approximately 1.77 acres. There are no building impacts with this alternative, only partial land acquisitions and there are no full parcel acquisitions. The total right of way cost is estimated to be **\$400,000**.

Unsignalized Alternative

This alternative results in forty-nine potential property impacts, totaling approximately 1.60 acres. There are no building impacts with this alternative, only partial land acquisitions and there are no full parcel acquisitions. The total right of way cost is estimated to be \$300,000.

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Signalized Alternative

This alternative results in forty-nine potential property impacts, totaling approximately 1.64 acres. There are no building impacts with this alternative, only partial land acquisitions and there are no full parcel acquisitions. The total right of way cost is estimated to be \$300,000.

		Property Info	ROV	V Impact Area (Sq.	Ft.)	
Map and Lot	Ow	rner (Based on Assessor Information)	Roundabout Alternative	Unsignalized Alternative	Signalized Alternative	
J20 / 68	Mark C. Plumm	er	0	0	0	
J20 / 70 D		ral Associates LLC	2025	2025	2025	
J20 / 73	Grun Properties		1425	1425	1425	
120 /74	Faraday Drive C		200	200	200	
J20 / 74 J20 / 70 B	Casco Holdings	o Sr, Ronald W. Copp Jr	2600 1275	2600 1275	2600 1275	
J20 / 77		o Sr, Ronald W. Copp Jr	3175	1875	2025	
J19 / 12		Sr, Ronald W. Copp Jr	4875	3250	3325	
J19 / 13		Sr, Howell Copp	2675	2675	2675	
J19 / 14	Howell Copp		2600	2600	2600	
J19 / 15	Howell Copp		1800	1800	1800	
J19 / 16 B		le Trust, Timothy & Tammy Budd, Trustees	2200	2200	2200	
J19 / 16	Tammy Budd	1.01	1525	1525	1525	
J19 / 17	Alexena Campb	ell	1350 1050	1350	1350 1050	
J19 / 18 J19 / 20	Carol Milan Mayuai Kouth		1050	1050 1225	1050	
J19 / 20 A		ıll Gospel Church	1025	1025	1025	
J19 / 21 B	Judy A. & David		0	0	0	
R7C / 1	Brian H. & Lynd		2550	2550	2550	
R7C / 1 A / OS2	Town of Cumbe	rland	0	0	0	
R7C / 1A-13	Kelly McFarland		0	0	0	675
R7C / 1A-14	Benjamin Bryar	nt	0	0	0	0
R7C / 1A-15	Megan Smart	00	0	0	0	0
R7C / 1A-16	Michael Berger		0	0	0	0
R7C / 1A-17 R7C / 1A-1	Adam Dougher	ness Park LLC / 2 Castlerock Drive **	0	0	0	0
R7C / 1A / OS1		neowners Association	375	375	375	400
R7C / 2	Gary Wilson Jr	neo anti-s rasociation	0	0	0	700
	Maine Turnpike	Authority	0	0	0	1400
J20 / 13	Christopher Ari		1000	1000	1000	1175
	George Road O		175	175	175	2925
J20 / 78	Curtin J. Wetze		925	625	1250	2050
J20 / 79	Kristina L. & Earl N Grant		600	475	625	3575 2650
J20 / 80	Adam & Holli B		425	425	425	2300
J20/81 J20/82	Benjamin Lowe	& Sarah Strohmeyer	675	675 0	675 0	4025
J20 / 66 A	229 Sewell Stre	*	0	0	0	1475
J20 / 65	524 Gray Road,		0	0	0	1325
J20 / 64	524 Gray Road,		0	0	0	1125
J20 / 58	Adam & Kelly C	орр	0	0	0	925
J20 / 56	Gary R. & Nanc	y M. Tims	400	400	400	1050
J20 / 55	John N. Willis	10.11	700	700	700	950
	U19/4 U19/3	Colby Green Rebecca Z. & Megan H. Griffin		2525 450	2525 450	2525 450
	U19/3	Michael & Xue Yu		450 525	450 525	450 525
I	U19 / 1	Wade T. & Michael Hamilton		275	275	275
	U18/6B	Wolfe, Audrey J Keefer, & Brandon S.		100	100	100
I	U18 / 6-1	Joel J. & Samantha J. Thoits		275	275	275
I	U18 / 6-2	Katherine Moulton		0	0	0
	U18 / 6-17	Darren M & Moriah Yorkey		125	125	125
	U18 / 6-18	Hellen Fitzpatrick		0	0	0
	U18/6	Walnut Hill Investments LLC		0	0	0
	U17 / 7	Jean K. & Joseph R. Couillard		0	0	0
I	U17 / 8	Christopher & Christine Byrne		0	0	0
	U19 / 37	Ronald W. Copp Sr Kathy Lane Open Space		2000 275	1600 275	2300 275
	U19 / 23	Clayton E. & Deborah D. Weed		1225	1225	1225
	- 22 / 23		al Permanent Area (sf)	77,025	69,825	71,525
			Permanent Area (acre)	1.77	1.60	1.64
			nd Acquisition Budget	\$400,000	\$300,000	\$300,000
						100000000000000000000000000000000000000

Recommendations

Evaluation Criteria

To assist in evaluating and comparing the alternatives of this study, an evaluation matrix has been developed. The study team has established the following thirteen (13) criteria for evaluating the effectiveness of the alternatives in meeting the purpose & need of the study. A simple definition or explanation of each criterion is below:

Traffic Operations – This criterion identifies and ranks the results of the traffic analysis, specifically the resulting 2045 levels of service (LOS) for each alternative. It is important that each alternative has an acceptable level of service of "D" or better. It is also important that the proposed alternatives provide equal or better results than the 2045 No Build condition.

Meets Warrants in Current Year – This criterion checks to make sure that the alternative meets the purpose and need in both the current year and future year assessments.

Maintains Mobility – This criterion identifies how well each alternative provides access to the major roads within the study area. It is important that regional mobility be maintained with this project.

Improves Safety (vehicles) – This criterion considers how well each alternative improves on the safety of the intersection when considering the crash history, crash patterns and contributing factors for those crashes. Improving vehicle safety is an important goal of this study.

Improves Safety (bicycles and pedestrians) – This criterion considers how well each alternative improves the safety for bicyclists and pedestrians at the intersection. It is important that safety for these modes be improved with this project.

Pedestrian & Bicycle Accommodations – This criterion reviews how complete the proposed bike and pedestrian facilities are for each of the alternatives. This intersection currently lacks good accommodations for bikes and pedestrians.

Encourages Village Scale Redevelopment – This criterion identifies how well the alternative encourages redevelopment and new development in the study area.

Improves on Traffic Calming – This criterion assesses how well each alternative maintains, controls and/or reduces vehicle speeds through the intersection and along the Route 100 corridor. Vehicles travel through this intersection and corridor at speeds above the speed limits resulting in unsafe conditions. Lower speeds are needed for this project.

Creates Confusing Geometry – This criterion considers how user friendly each alternative will be. It will assess whether the proposed design is confusing to the user or is it normal and conventional.

Access Management – How well does each alternative address access management by reducing, combining or eliminating driveway and entrances that are close to the intersection and/or wider than normal. One goal of this study is to reduce or eliminate conflicting movements at and around the intersection to improve overall safety.

Property Impacts – Can each alternative be constructed within the limits of the existing right of way or is acquisition of additional property necessary to construct the alternative. It is our goal to avoid or minimize property impacts if possible.

Gateway Opportunities – How well does each alternative provide a gateway to the community and is there an opportunity to provide a statement of arrival to the village community with each alternative.

Project Costs – How much does each alternative cost and how do the costs compare to each other. Project costs include construction costs, engineering costs, property costs and construction inspection costs.

Many of these criterions are represented in the purpose and need statement which is helpful when the alternatives are compared to each other and to the NO Build condition.

Selection and Scoring Criteria

After evaluating and comparing the alternatives to the purpose and need statement, to each other and to the No Build condition, the study team has populated the results of the evaluation criteria into a selection and scoring matrix. Using the thirteen evaluation criteria established by the study team, the following is a summary of findings for each of the alternatives:

Traffic Operations – The traffic analysis and modeling suggest that the roundabout alternative provides the best traffic operation results and is slightly better than the traffic signal alternative. The Unsignalized alternative and the No Build condition have a "F" LOS and very long delays.

Meets Warrants in the Current Year – The traffic signal alternative does not meet signal warrants in the current year and therefore is not a good solution in the short term for this project. The other alternatives score well with the criteria and will satisfy the purpose and need in the short term.

Maintains Mobility – In terms of maintaining mobility to the major roads, both the roundabout and traffic signal alternatives score high results by providing full access to all major roads. The No-Build and unsignalized alternatives score poorly in 2045.

Improves Safety (vehicles) – All of the alternatives except the No-Build condition do a good job of improving safety.

Improves Safety (bicycles and pedestrians) – Similarly, all the alternatives do a good job of improving safety for bicyclists and pedestrians, except the No-Build condition.

Pedestrian & Bicycle Accommodations – All of the alternatives score well in this category, except the No-Build condition.

Encourages Village Scale Development – The roundabout and traffic signal alternatives will do a good job in creating transportation infrastructure that supports a town center. The unsignalized alternative is less successful since Route 100 traffic does not stop with that alternative.

Improves on Traffic Calming – The roundabout alternative does the best job in controlling or reducing vehicle speeds through the intersection. The unsignalized alternative with the raised intersection also scores well. The traffic signal alternative does not slow traffic down like the other alternatives.

Creates Confusing Geometry – Multilane roundabouts are known for creating confusing geometry for the users. Since the proposed roundabout design is a single lane roundabout, the roundabout and traffic signal alternatives both score well. The unsignalized alternative with the raised intersection is a bit more confusing than the other two options.

Access Management – All alternatives score well for this category.

Property Impacts – All of the alternatives will have a similar level of property impacts, with the traffic signal and unsignalized alternatives having slightly less property impacts than the roundabout alternative.

Gateway Opportunities – The roundabout alternative scores well as it provides good opportunities for gateway treatments. The traffic signal alternative scores less than the roundabout but better than the unsignalized alternative.

Project Costs – The alternatives range in cost between \$12.4M and \$14.4M with the roundabout alternative being the most expensive and the unsignalized alternative being the least expensive. None of the alternatives score a high mark in this category, except the No-Build condition.

To the right are the results of the evaluation and scoring matrix findings. A red, yellow and green color coding has been applied to the findings to assist in drawing conclusions. A green coding is considered a good score, yellow is an average score and a red coding is considered a poor score. This matrix is also provided in Appendix F.

Recommendations

From review of the evaluation matrix, all alternatives score better than the No-Build condition. The No-Build condition and the unsignalized alternative fail from a traffic operations perspective in 2045 and therefore are not viable options for this study. The traffic signal alternative does not meet signal warrants in the current year and scores less than the roundabout alternative on traffic operations, traffic calming and providing for a gateway treatment.

The roundabout alternative scores better than the other alternatives in the evaluation matrix and is the only alternative that meets the purpose and need statement for this project.

It is the recommendation of this study that the <u>roundabout</u> <u>alternative</u> be selected for advancement into the project development and preliminary design phase.

The following pages provide renderings for the roundabout alternative.

	Alternative #1	Alternative #2	Alternative #3	No Build
CRITERIA	Roundabout	Unsignalized with Raised Intersection	Signalized	Do Nothing
Traffic Operations (LOS AM/PM)	LOS B/C	LOS F/F	LOS C/C	LOS F/F
Meets Warrants in current year	Yes	Yes	No	Yes
Maintains Mobility (vehicles)	Yes	No	Yes	No
Improves Safety (vehicles)	Yes	Yes	Yes	No
Improves Safety (peds, bicycles)	Yes	Yes	Yes	No
Pedestrian & Bicycle Accommodations	Yes	Yes	Yes	Poor
Encourages Village Scale Redevelopment	Yes	Less	Yes	No
Improves on Traffic Calming (speeds)	Yes	Yes	Less than others	No
Creates Confusing Geometry	No (single lane roundabout)	Yes	No	No
Provides Access Management	Yes	Yes	Yes	No
Property Impacts	Slightly more	Same as Alt 3	Same as Alt 2	None
Provides for Gateway Opportunities	Yes	Not really	Less than Alt #1	No
Total Project Costs (Construction, PE, CE, ROW)	\$14.4M	\$12.4M	\$13.1M	None
MEET PURPOSE & NEED	YES	NO	NO	NO

Renderings (roundabout)



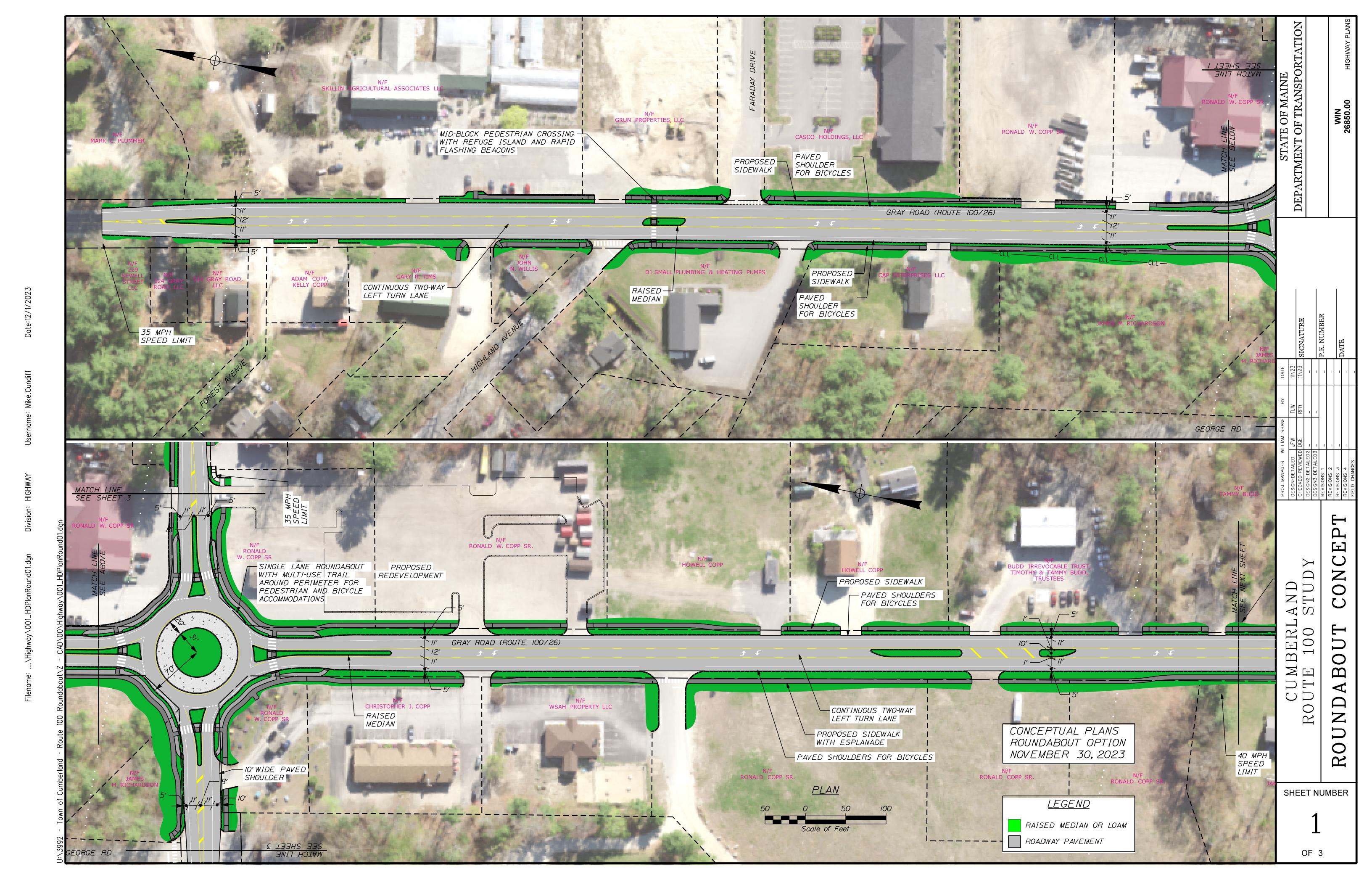
Renderings (roundabout)

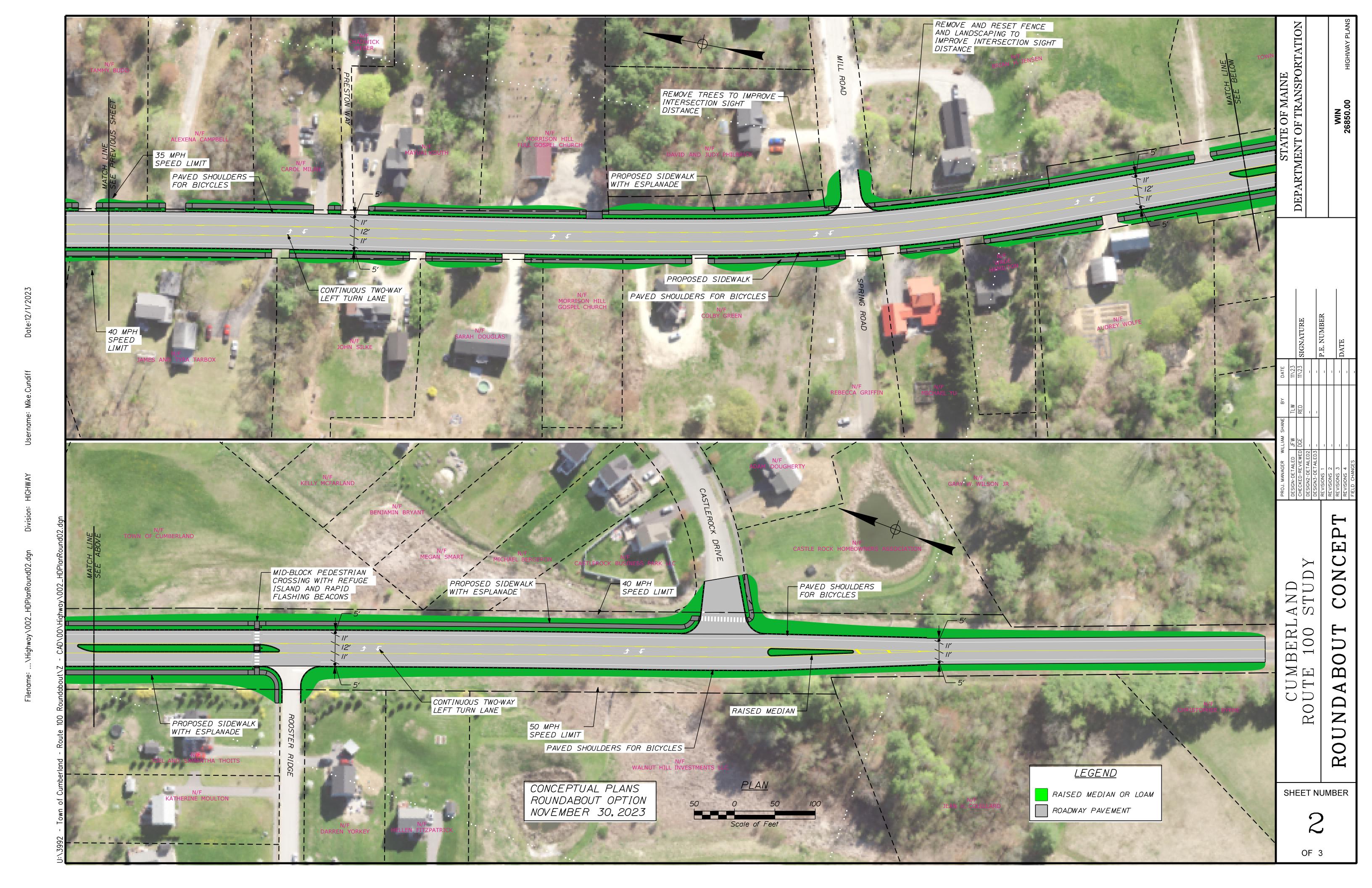


Renderings (roundabout)

Αp	pe	end	dix	Α

Concept Plans (Roundabout)

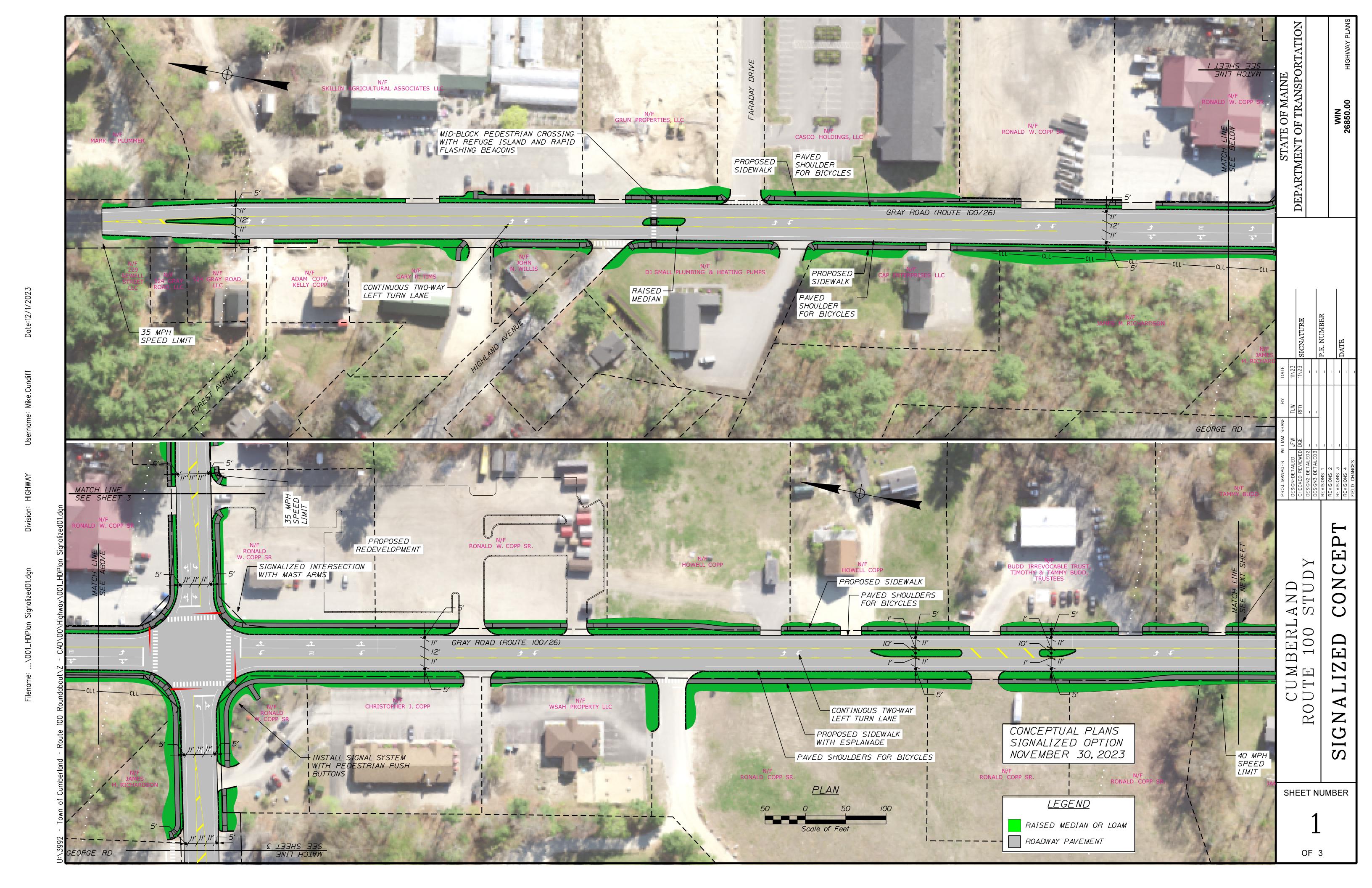


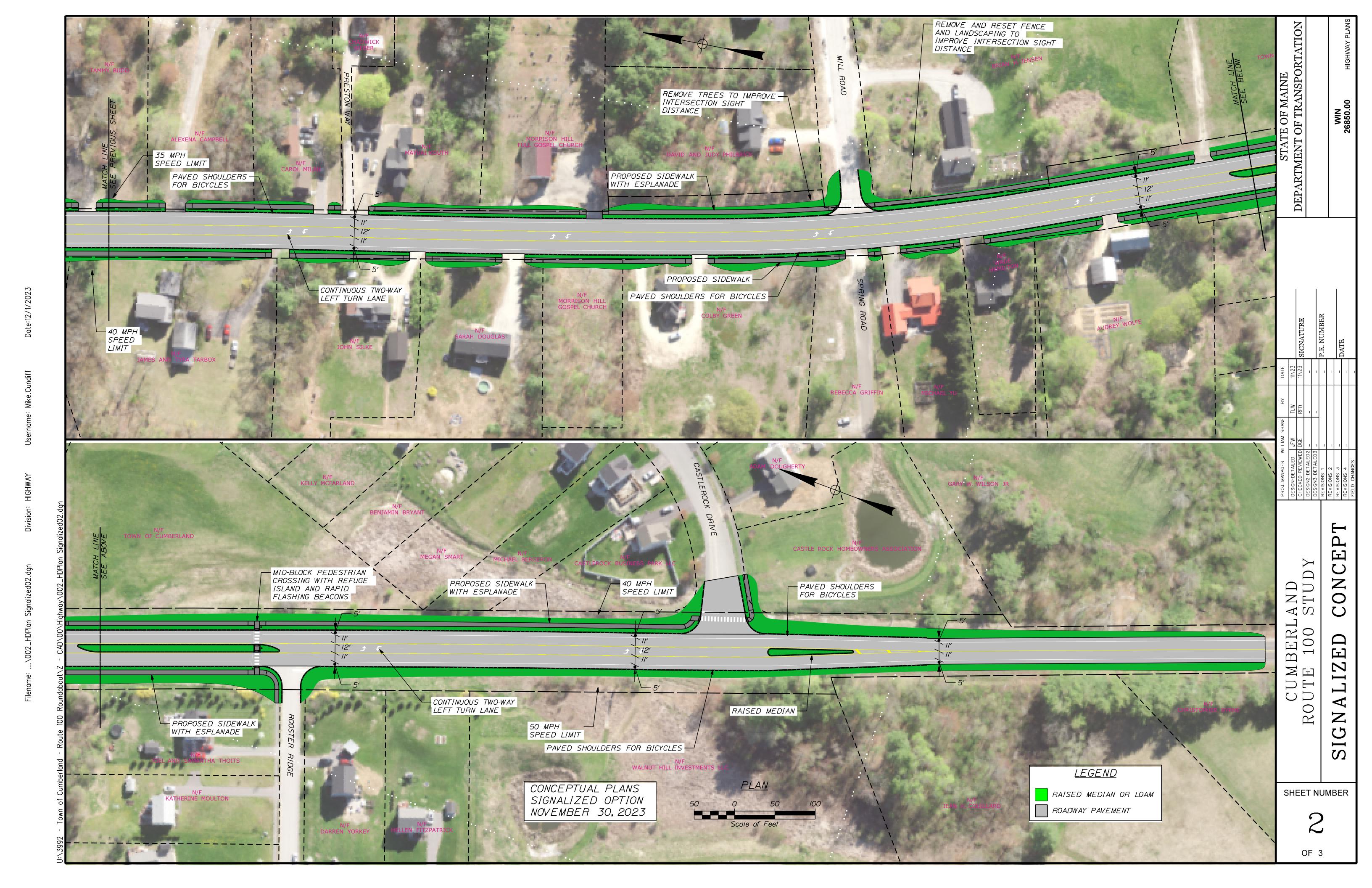




Appendix A	Α
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Concept Plans (Signalized)

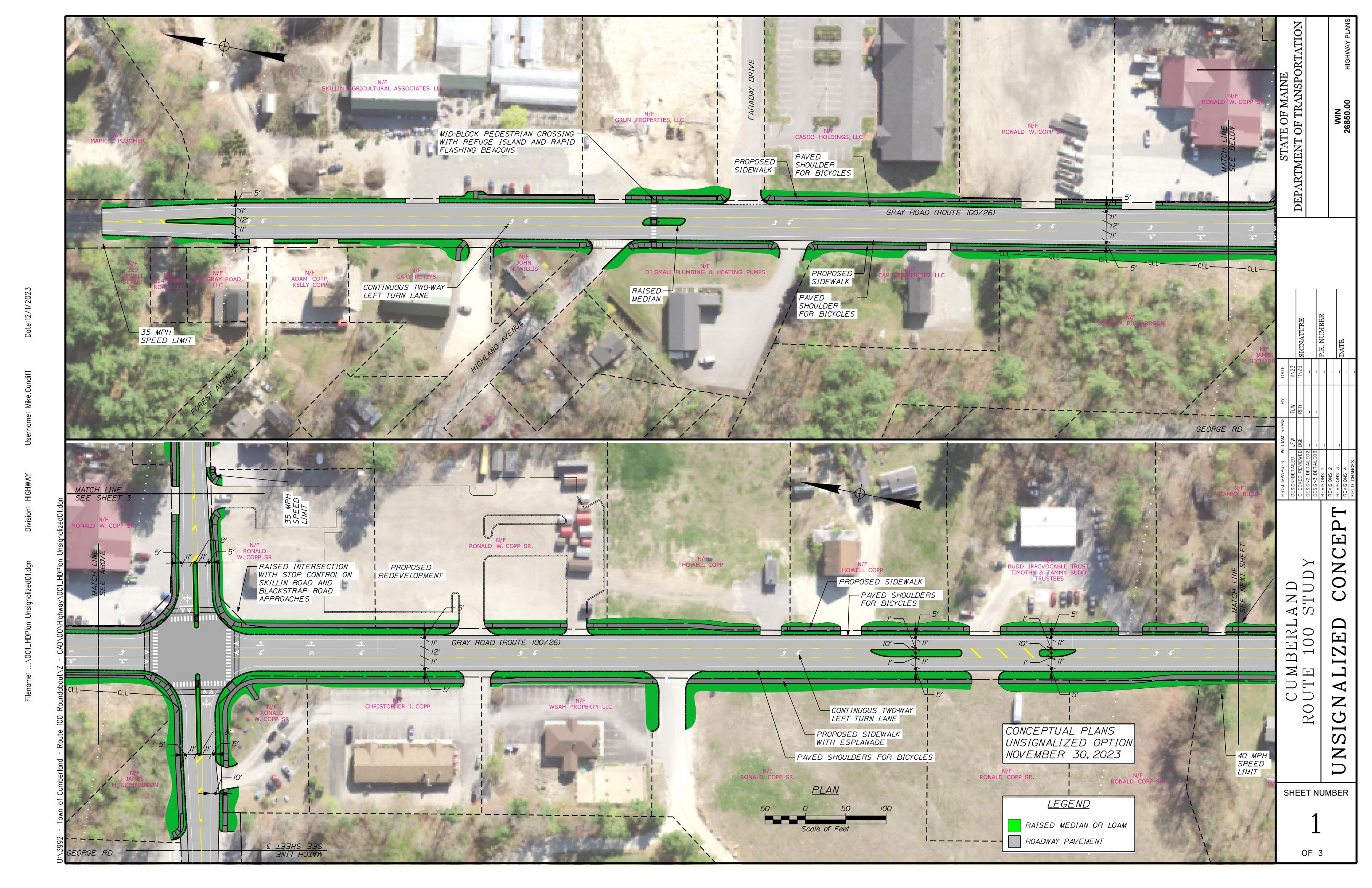


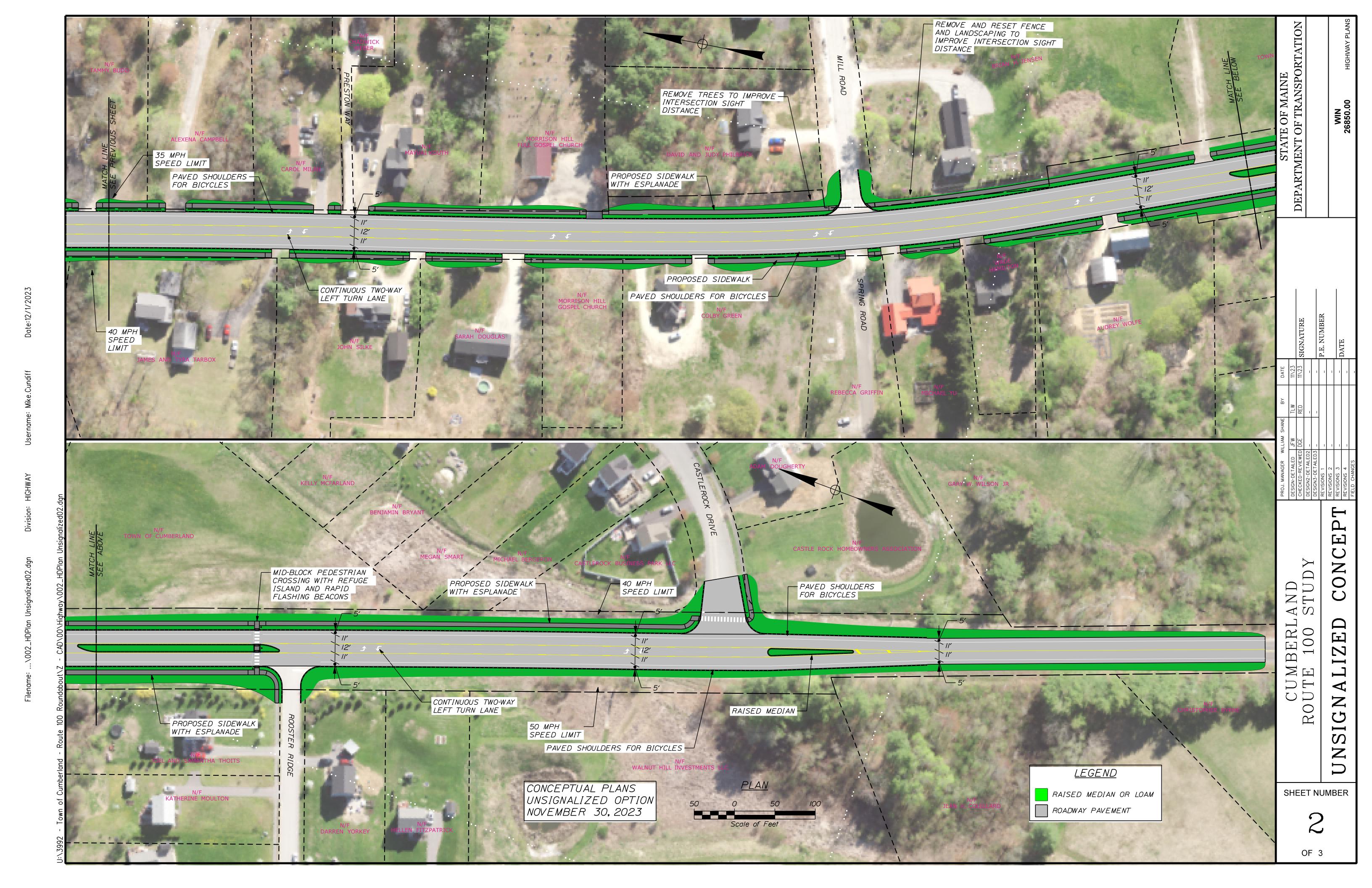




A	p	p	e	n	d	ix	A

Concept Plans (Unsignalized)







Ap	pe	nd	ix	В

Cost Estimates

Gorrill Palmer Opinion of Probable Construction Cost

Job Number: 3992 WIN 26850.00

Project Name: Route 100 Feasibility Study
Project Layout: Roundabout Concept Plan
Project Location: Cumberland, Maine

Comments: Opinion of Probable Cost - Roundabout Concept Plan - Construction Cost Estimate

Date: 11/29/2023

Calculated By: Ellie Robinson, Amelia Nelson Checked By: Jared Winchenbach

Notes: 1. Opinion of probable cost does not include engineering, inspection, right of way, environmental, lighting or utility costs.

- 2. Opinion of probable cost is based on the Roundabout Concept Plan dated August 18, 2023.
- 3. The unit prices are base upon recently constructed and/or bid projects from the Maine DOT and other LAP projects.
- 4. The Concept Plan assumes that widening of the existing roadway corridor will begin at the existing shoulder and that a 1 1/2" overlay is planned for all of the roadways (Route 100, Skillin Road, and Blackstrap Road) within the project limits.
- 5. Concept Plans assumed that full depth reconstruction will be used for the roundabout as well as +/-250' on each approach.
- 6. The Opinion of Probable Cost is based on 2023 Dollars and does not include escalation to future years.

	WIN 026850.00 - Route 100 Feasibility Study - Roundabout Concept Plan - Cumberland, ME						
Item	Item Description	Unit	Quantity	Unit Price		Amount	
202.202	REMOVING PAVEMENT SURFACE	SY	18900	\$ 20.00	\$	378,000.00	
203.20	COMMON EXCAVATION	CY	18700	\$ 70.00	\$	1,309,000.00	
304.10	AGGREGATE SUBBASE COURSE - GRAVEL	CY	13000	\$ 80.00	\$	1,040,000.00	
403.208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE	Т	1250	\$ 275.00	\$	343,750.00	
403.208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE (OVERLAY)	Т	1550	\$ 275.00	\$	426,250.00	
402 200	HOT MIX ASPHALT, 9.5 MM NOMINAL MAXIMUM SIZE	Т	1200	ć 200.00	\$	360,000,00	
403.209	(SIDEWALKS, DRIVES, ISLANDS & INCIDENTALS)	'	1200	\$ 300.00	Þ	360,000.00	
403.213	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE	Т	3700	\$ 275.00	\$	1 017 500 00	
403.213	(BASE AND INTERMEDIATE BASE COURSE)	'	3700	\$ 275.00	Þ	1,017,500.00	
409.15	BITUMINOUS TACK COAT, APPLIED	G	1850	\$ 5.00	\$	9,250.00	
502.342	STRUCTURAL CONCRETE ROADWAY TRUCK APRON	CY	130	\$ 300.00	\$	39,000.00	
603.159	12 INCH CULVERT PIPE OPTION III	LF	300	\$ 100.00	\$	30,000.00	
604.072	CATCH BASIN TYPE A1-C	EA	40	\$ 5,000.00	\$	200,000.00	
605.09	6 INCH UNDERDRAIN TYPE B	LF	2600	\$ 70.00	\$	182,000.00	
605.11	12 INCH UNDERDRAIN TYPE C	LF	11400	\$ 90.00	\$	1,026,000.00	
608.26	CURB RAMP DETECTABLE WARNING FIELD	SF	640	\$ 125.00	\$	80,000.00	
609.11	VERTICAL CURB TYPE 1	LF	12000	\$ 75.00	\$	900,000.00	
609.221	TERMINAL CURB TYPE 1	LF	1200	\$ 100.00	\$	120,000.00	
609.34	CURB TYPE 5	LF	3000	\$ 80.00	\$	240,000.00	
609.341	CURB TYPE 5 - TRUCK APRON	LF	325	\$ 200.00	\$	65,000.00	
615.07	LOAM	CY	1800	\$ 90.00	\$	162,000.00	
618.13	SEEDING METHOD NUMBER 1	UN	150	\$ 70.00	\$	10,500.00	
619.12	MULCH	UN	150	\$ 60.00	\$	9,000.00	
627.733	4" WHITE OR YELLOW PAINTED PAVEMENT MARKING LINE	LF	28000	\$ 0.50	\$	14,000.00	
627.75	WHITE OR YELLOW PAVEMENT & CURB MARKING	SF	3050	\$ 3.00	\$	9,150.00	
629.05	HAND LABOR, STRAIGHT TIME	HR	40	\$ 55.00	\$	2,200.00	
631.12	ALL PURPOSE EXCAVATOR (INCLUDING OPERATOR)	HR	40	\$ 175.00	\$	7,000.00	
631.172	TRUCK - LARGE (INCLUDING OPERATOR)	HR	40	\$ 100.00	\$	4,000.00	
639.18	FIELD OFFICE, TYPE A	EA	1	\$ 15,000.00	\$	15,000.00	
645.292	REGULATORY, WARNING, CONFIRMATION AND ROUTE MARKER ASSEMBLY SIGNS TYPE II	SF	300	\$ 80.00	\$	24,000.00	
652.33	DRUM	EA	200	\$ 65.00	\$	13,000.00	
652.34	CONE	EA	200	\$ 25.00	\$	5,000.00	
652.35	CONSTRUCTION SIGNS	SF	400	\$ 25.00	\$	10,000.00	
652.36	MAINTENANCE OF TRAFFIC CONTROL DEVICES	CD	150	\$ 300.00	\$	45,000.00	
652.38	FLAGGERS	HR	4000	\$ 60.00	\$	240,000.00	
652.381	TRAFFIC OFFICERS	HR	40	\$ 100.00	\$	4,000.00	
656.75	TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL	LS	1	\$100,000.00	\$	100,000.00	
659.10	MOBILIZATION	LS	1	\$850,000.00	\$	850,000.00	
			Cons	struction Total:		9,289,600.00	
			Cont	ingency (25%):	\$	2,322,400.00	
				nstruction Cost:		11,612,000.00	
				Rounded:		11,700,000.00	

Construction: \$ 11,700,000.00
Engineering (10%): \$ 1,170,000.00
Inspection (10%): \$ 1,170,000.00
ROW: \$ 400,000.00

Total: \$ 14,440,000.00

Gorrill Palmer Opinion of Probable Construction Cost

Job Number: 3992 WIN 26850.00

Project Name: Route 100 Feasibility Study

Project Layout: Unsignalized Intersection Concept Plan

Project Location: Cumberland, Maine

Comments: Opinion of Probable Cost - Unsignalized Intersection Concept Plan - Construction Cost Estimate

Date: 11/29/2023

Calculated By: Lucas Bentley, Amelia Nelson Checked By: Jared Winchenbach

Notes: 1. Opinion of probable cost does not include engineering, inspection, right of way, environmental, lighting or utility costs.

- 2. Opinion of probable cost is based on the Unsignalized Intersection Concept Plan dated August 18, 2023.
- 3. The unit prices are base upon recently constructed and/or bid projects from the Maine DOT and other LAP projects.
- 4. The Concept Plan assumes that widening of the existing roadway corridor will begin at the existing shoulder and that a 1 1/2" overlay is planned for all of the roadways (Route 100, Skillin Road, and Blackstrap Road) within the project limits.
- 5. The Opinion of Probable Cost is based on 2023 Dollars and does not include escalation to future years.

	WIN 026850.00 - Route 100 Feasibility Study - Unsignalized Intersection Concept Plan - Cumberland, ME						
Item	Item Description	Unit	Quantity		Unit Price		Amount
202.202	REMOVING PAVEMENT SURFACE	SY	21300	\$	20.00	\$	426,000.00
203.20	COMMON EXCAVATION	CY	14500	\$	60.00	\$	870,000.00
304.10	AGGREGATE SUBBASE COURSE - GRAVEL	CY	11300	\$	70.00	\$	791,000.00
403.208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE	Т	1110	\$	275.00	\$	305,250.00
403.208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE (OVERLAY)	Т	1760	\$	275.00	\$	484,000.00
403.209	HOT MIX ASPHALT, 9.5 MM NOMINAL MAXIMUM SIZE	Т	1100	Ś	300.00	ć	330,000.00
405.209	(SIDEWALKS, DRIVES, ISLANDS & INCIDENTALS)	•	1100	Ş	300.00	Ş	330,000.00
403.213	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE	Т	3550	\$	275.00	\$	976,250.00
403.213	(BASE AND INTERMEDIATE BASE COURSE)	'	3550	Þ	2/5.00	Þ	976,250.00
409.15	BITUMINOUS TACK COAT, APPLIED	G	1400	\$	5.00	\$	7,000.00
603.159	12 INCH CULVERT PIPE OPTION III	LF	350	\$	100.00	\$	35,000.00
604.072	CATCH BASIN TYPE A1-C	EA	32	\$	5,000.00	\$	160,000.00
605.09	6 INCH UNDERDRAIN TYPE B	LF	2700	\$	70.00	\$	189,000.00
605.11	12 INCH UNDERDRAIN TYPE C	LF	11100	\$	90.00	\$	999,000.00
608.26	CURB RAMP DETECTABLE WARNING FIELD	SF	400	\$	125.00	\$	50,000.00
609.11	VERTICAL CURB TYPE 1	LF	12000	\$	75.00	\$	900,000.00
609.221	TERMINAL CURB TYPE 1	LF	1100	\$	100.00	\$	110,000.00
609.34	CURB TYPE 5	LF	2100	\$	80.00	\$	168,000.00
615.07	LOAM	CY	1700	\$	90.00	\$	153,000.00
618.13	SEEDING METHOD NUMBER 1	UN	140	\$	70.00	\$	9,800.00
619.12	MULCH	UN	140	\$	60.00	\$	8,400.00
627.733	4" WHITE OR YELLOW PAINTED PAVEMENT MARKING LINE	LF	27100	\$	0.50	\$	13,550.00
627.75	WHITE OR YELLOW PAVEMENT & CURB MARKING	SF	3400	\$	3.00	\$	10,200.00
629.05	HAND LABOR, STRAIGHT TIME	HR	40	\$	55.00	\$	2,200.00
631.12	ALL PURPOSE EXCAVATOR (INCLUDING OPERATOR)	HR	40	\$	175.00	\$	7,000.00
631.172	TRUCK - LARGE (INCLUDING OPERATOR)	HR	40	\$	100.00	\$	4,000.00
639.18	FIELD OFFICE, TYPE A	EA	1	\$	15,000.00	\$	15,000.00
645.292	REGULATORY, WARNING, CONFIRMATION AND ROUTE MARKER ASSEMBLY SIGNS TYPE II	SF	200	\$	80.00	\$	16,000.00
652.33	DRUM	EA	200	\$	65.00	\$	13,000.00
652.34	CONE	EA	200	\$	25.00	\$	5,000.00
652.35	CONSTRUCTION SIGNS	SF	400	\$	25.00	\$	10,000.00
652.36	MAINTENANCE OF TRAFFIC CONTROL DEVICES	CD	120	\$	300.00	\$	36,000.00
652.38	FLAGGERS	HR	3000	\$	60.00	\$	180,000.00
652.381	TRAFFIC OFFICERS	HR	40	\$	100.00	\$	4,000.00
656.75	TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL	LS	1	\$	75,000.00	\$	75,000.00
659.10	MOBILIZATION	LS	1	\$	700,000.00	\$	700,000.00
			C	Cons	truction Total:	\$	8,062,650.00
			С	ont	ingency (25%):	\$	2,015,662.50
	Total Construction Cost: \$					\$	10,078,312.50
					Rounded:	\$	10,100,000.00

Total:	\$ 12,420,000.00
ROW:	\$ 300,000.00
Inspection (10%):	\$ 1,010,000.00
Engineering (10%):	\$ 1,010,000.00
Construction:	\$ 10,100,000.00

Gorrill Palmer Opinion of Probable Construction Cost

Job Number: 3992 WIN 26850.00

Project Name: Route 100 Feasibility Study
Project Layout: Signalized Intersection Concept Plan

Project Location: Cumberland, Maine

Comments: Opinion of Probable Cost - Signalized Intersection Concept Plan - Construction Cost Estimate

Date: 11/29/2023

Calculated By: Lucas Bentley, Amelia Nelson, Don Ettinger Checked By: Jared Winchenbach, Don Ettinger

Notes: 1. Opinion of probable cost does not include engineering, inspection, right of way, environmental, lighting or utility costs.

- 2. Opinion of probable cost is based on the Signalized Intersection Concept Plan dated October 19, 2023.
- 3. The unit prices are base upon recently constructed and/or bid projects from the Maine DOT and other LAP projects.
- 4. The Concept Plan assumes that widening of the existing roadway corridor will begin at the existing shoulder and that a 1 1/2" overlay is planned for all of the roadways (Route 100, Skillin Road, and Blackstrap Road) within the project limits.
- 5. The Opinion of Probable Cost is based on 2023 Dollars and does not include escalation to future years.

Item	Item Description	Unit	Quantity		Unit Price		Amount
202.202	REMOVING PAVEMENT SURFACE	SY	21300	\$	20.00	\$	426,000
203.20	COMMON EXCAVATION	CY	15100	\$	60.00	\$	906,00
304.10	AGGREGATE SUBBASE COURSE - GRAVEL	CY	11800	\$	70.00	\$	826,00
403.208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE	Т	970	\$	275.00	\$	266,75
403.208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE (OVERLAY)	Т	1760	\$	275.00	\$	484,00
402.200	HOT MIX ASPHALT, 9.5 MM NOMINAL MAXIMUM SIZE	_	1100		200.00	4	220.00
403.209	(SIDEWALKS, DRIVES, ISLANDS & INCIDENTALS)	Т	1100	\$	300.00	\$	330,00
402.242	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE	-	2750	,	275.00	4	1 021 25
403.213	(BASE AND INTERMEDIATE BASE COURSE)	Т	3750	\$	275.00	\$	1,031,25
409.15	BITUMINOUS TACK COAT, APPLIED	G	1400	\$	5.00	\$	7,00
603.159	12 INCH CULVERT PIPE OPTION III	LF	350	\$	100.00	\$	35,00
604.072	CATCH BASIN TYPE A1-C	EA	32	\$	5,000.00	\$	160,00
605.09	6 INCH UNDERDRAIN TYPE B	LF	2700	\$	70.00	\$	189,00
605.11	12 INCH UNDERDRAIN TYPE C	LF	11100	\$	90.00	\$	999,00
608.26	CURB RAMP DETECTABLE WARNING FIELD	SF	400	\$	125.00	\$	50,00
609.11	VERTICAL CURB TYPE 1	LF	12000	\$	75.00	\$	900,00
609.221	TERMINAL CURB TYPE 1	LF	1100	\$	100.00	\$	110,00
609.34	CURB TYPE 5	LF	2100	\$	80.00	\$	168,00
615.07	LOAM	CY	1700	\$	90.00	\$	153,00
618.13	SEEDING METHOD NUMBER 1	UN	140	\$	70.00	\$	9,80
619.12	MULCH	UN	140	\$	60.00	\$	8,40
627.733	4" WHITE OR YELLOW PAINTED PAVEMENT MARKING LINE	LF	28300	\$	0.50	\$	14,15
627.75	WHITE OR YELLOW PAVEMENT & CURB MARKING	SF	3500	\$	3.00	\$	10,50
629.05	HAND LABOR, STRAIGHT TIME	HR	40	\$	55.00	\$	2,20
631.12	ALL PURPOSE EXCAVATOR (INCLUDING OPERATOR)	HR	40	\$	175.00	\$	7,00
631.172	TRUCK - LARGE (INCLUDING OPERATOR)	HR	40	\$	100.00	\$	4,00
639.18	FIELD OFFICE, TYPE A	EA	1	\$	15,000.00	\$	15,00
643.80	TRAFFIC SIGNAL	LS	1	\$	350,000.00	\$	350,00
645.292	REGULATORY, WARNING, CONFIRMATION AND ROUTE MARKER ASSEMBLY SIGNS TYPE II	SF	200	\$	80.00	\$	16,00
652.33	DRUM	EA	200	\$	65.00	\$	13,00
652.34	CONE	EA	200	\$	25.00	\$	5,00
652.35	CONSTRUCTION SIGNS	SF	400	\$	25.00	\$	10,00
652.36	MAINTENANCE OF TRAFFIC CONTROL DEVICES	CD	120	\$	300.00	\$	36,00
652.38	FLAGGERS	HR	3000	\$	60.00	\$	180,00
652.381	TRAFFIC OFFICERS	HR	40	\$	100.00	\$	4,00
656.75	TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL	LS	1	\$	75,000.00	\$	75,00
659.10	MOBILIZATION	LS	1	\$	700,000.00	\$	700,00
			С	onst	ruction Total:	\$	8,501,05
			C	ontir	ngency (25%):	Ś	2,125,26
					truction Cost:	т.	10,626,31
			Total	-5113	Rounded:		10,700,00

Total:	\$ 13,140,000.00
ROW:	\$ 300,000.00
Inspection (10%):	\$ 1,070,000.00
Engineering (10%):	\$ 1,070,000.00
Construction:	\$ 10,700,000.00

Ap	pe	nd	ix (
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Traffic Analysis



To: Don Ettinger, PE
Gorrill-Palmer
300 Southborough Drive, Suite 200
South Portland, ME 04106

Date: November 10, 2023

Memorandum

Project #: 55690.00

From: Jason Ready, PE, PTOE, PTP Re: Route 100 at Blackstrap Road / Skillin Road Synchro Analysis

Cumberland, Maine

Introduction

VHB has performed a Synchro/SimTraffic (Version 11) traffic model analyses associated with the Cumberland PPI project in Cumberland, Maine at the intersection of Route 100 at Blackstrap Road & Skillin Road for Gorrill Palmer in support of a municipal PPI planning study. The analyses involved evaluating existing conditions (2023), a future (2045) 'No-Build' scenario, and two future (2045) traffic control alternatives (traffic signal and roundabout). The traffic control alternatives are based on certain area land use assumption, as determined by Gorrill Palmer and confirmed by the town. This memorandum summarizes the simulation modeling methodology and results.

Traffic Volumes

In addition to a seasonal adjustment, an annual growth rate was applied to estimate the traffic volumes that will be experienced during the analysis year. An annual growth rate of 0.5% per year has been applied to the seasonally adjusted volumes, as directed by MaineDOT staff. Traffic volumes are attached as an appendix.

Traffic Modeling

Synchro/SimTraffic (Version 11) was utilized to determine the level of service (LOS) at the study area intersection. Level of service is the term that defines the delay conditions that occur on a given roadway or at an intersection when accommodating various traffic volume loads. For the roundabout analysis, SIDRA traffic modeling software was utilized in place of the Synchro software.

The models include the Route 100 at Blackstrap Road & Skillin Road intersection in Cumberland, Maine. The model was created for the weekday morning and evening peak hours under 2023 Existing and 2045 Future conditions using Synchro/SimTraffic (Version 11) software.

Data Compilation and Network Coding

Traffic volumes: The volume inputs for the weekday morning and evening peak hours under 2023 Existing and 2045 Future conditions were obtained from a MaineDOT count on 10/26/2018. No pedestrian, bicyclist or transit activity was included in the analysis.

Signal timings: Optimized signal timings under Build conditions were used based on the following scenarios:

- > Permitted-protected left turn phases on Route 100
- > Split phasing for the minor approaches
- Lead-Lag left turns for the minor approaches

Roadway geometry: Geometry changes were implemented for signalized conditions including a separate left and through-right lane on all approaches. A 125' diameter roundabout was utilized for the Future roundabout scenario.

Gorrill-Palmer Ref: 55690.00 November 10, 2023

Page 2



Model Calibration/Validation

An existing conditions model of the study area was developed based on existing conditions volumes from 2022 and future conditions 2045. Projected 2045 Future conditions were simulated using standard industry settings. The evaluation criteria used to analyze the roadway segments in this simulation evaluation are based on the measures of effectiveness (MOE) provided by the Synchro/SimTraffic model. The Synchro/SimTraffic output includes a variety of MOEs, including capacity, delay, average queues, and maximum queues. All model results reported in this evaluation are based on an average of ten runs for each analysis scenario.

Scenarios Modeled

Three scenarios were modeled and were based on the No-Build Conditions, Optimized Signal Timing, and Roundabout scenarios based on requirements of the project:

- > **No-Build**: Utilizing the existing unsignalized intersection geometry with future projected volumes based on changing land use.
- > **Traffic Signal**: Modeled using separate left and through-right lanes with optimized signal timings for the major and minor roadways with future projected volumes based on changing land use.
- > Roundabout: A 125' diameter circular roadway was implemented with single lane approaches and with future projected volumes based on changing land use.

Traffic Operations Analysis

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic within the study area. To assess quality of flow, roadway capacity analyses were conducted with respect to the 2023 Existing conditions and projected 2045 No-Build and Build traffic volume conditions. Capacity analyses provide an indication of the adequacy of the roadway facilities to serve the anticipated traffic demands.

Level-of-Service and Delay Criteria

The evaluation criteria used to analyze area intersections in this traffic study are based on Synchro/SimTraffic Version 11 software. The term 'level of service' [LOS] is used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads. It is a qualitative measure that considers a number of factors including roadway geometry, speed, travel delay, and freedom to maneuver.

- > Level of service provides an index to the operational qualities of a roadway segment or an intersection. Level-ofservice designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions. Level of service is derived directly from the delay calculation.
- Delay is a complex measure that depends upon a number of variables such as quality of signal progression, cycle length, allocation of green time, and volume-to-capacity (v/c) ratio. Of all the factors cited, v/c ratios have the least effect on delay. Thus, for any given v/c ratio, a range of delay values [and, therefore, levels of service] may result. Conversely, for a given level of service, the v/c ratio may lie anywhere within a broad range. Comparison of intersection capacity results therefore requires that in addition to the LOS, the other measures of effectiveness [MOEs] must also be considered.

Gorrill-Palmer Ref: 55690.00 November 10, 2023

Page 3



The level-of-service designations, which are based on delay, are reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of all traffic entering the intersection and the LOS designation is for overall conditions at the intersection. For unsignalized intersections (including roundabouts), the analysis assumes that traffic on the mainline is not affected by traffic on the side streets. Thus, the LOS designation is for the critical movement exiting the side street and is typically the left turn out of the side street or site driveway. Table 1 shows the LOS criteria for both signalized and unsignalized intersections.

Table 1 Level of Service Criteria

Level of Service	Delay – Signalized Intersection	Delay – Unsignalized Intersection
Α	0 to 10 seconds	0 to 10 seconds
В	10 to 20 seconds	10 to 15 seconds
C	20 to 35 seconds	15 to 25 seconds
D	35 to 55 seconds	25 to 35 seconds
E	55 to 80 seconds	35 to 50 seconds
F	Greater than 80 seconds	Greater than 50 seconds

Source: Highway Capacity Manual, 6th Edition.

Results

Levels-of-service analyses were conducted for the 2023 Existing, 2045 No-Build, and 2043 Build alternative conditions for the study-area intersection. Table 2 presents the overall result outputs for each scenario modeled. These results are based on the average of ten model runs.

Table 2 Overall Level of Service Summary

Scenario	Delay	LOS	Scenario	Delay	LOS
Morning Peak			Evening Peak		
Existing	6.9	LOS A	Existing	7.1	LOS A
Future – No Build	77.4	LOS F	Future – No Build	186.6	LOS F
Future – Signal Split Phasing	39.5	LOS D	Future – Signal Split Phasing	39.5	LOS D
Future – Signal Lead-Lag	26.7	LOS C	Future – Signal Lead-Lag	27.7	LOS C
Future – Roundabout	12	LOS B	Future – Roundabout	20	LOS C

As shown in the comparison of overall capacity analysis summary results for the intersection in Table 2, the overall intersection is expected to operate at LOS D or better under all Build scenarios, with significant increases in capacity during both peak hours compared to the Future No-Build conditions. It is important to note that the signalized intersection with the lead-lag lefts implemented on the minor streets operates at a LOS C during both peak hours compared to the minor streets utilizing split phasing with a LOS D. The No-Build condition operates poorly during both peak hours under 2045 conditions and is not recommended as a viable option.

Table 3 shows the queue and delay summary of each scenario for both morning and evening peak periods for all approaches. As shown in the table and observed in the models, delay and queueing appear to be manageable in all Build scenarios.



 Table 3
 Capacity Analysis Comparison

Amanaaah	2	2023 Existii	ng	2	045 No-B	uild	2045 B	uild – Sigı Phase)	nal (Split		5 Build – : (Lead-Lag	_	2045 E	Build – Ro	undabout ^d
Approach	Delaya	LOSb	95 th % Queue ^c	Delay	LOS	95 th % Queue	Delay	LOS	95 th % Queue	Delay	LOS	95 th % Queue	Delay	LOS	95 th % Queue
Morning Peal	(Hour														
Eastbound	13.3	LOS B	149	233.1	LOS F	1438	31.4	LOS C	326	30.3	LOS C	292	19	LOS C	163
Westbound	10.2	LOS B	81	25.6	LOS D	141	26.0	LOS C	121	28.9	LOS C	120	6	LOS A	23
Northbound	1.5	LOS A	30	3.1	LOS A	68	17.7	LOS B	128	15.9	LOS B	115	6	LOS A	31
Southbound	2.1	LOS A	23	3.3	LOS A	46	59.5	LOS E	697	27.7	LOS C	349	11	LOS B	128
Total	6.9	LOS A		77.4	LOS F		39.5	LOS D		26.7	LOS C		12	LOS B	
Evening Peak	Hour														
Eastbound	14.4	LOS B	96	624.1	LOS F	1708	31.6	LOS C	227	30.2	LOS C	201	7	LOS A	43
Westbound	18.3	LOS C	114	597.8	LOS F	1664	36.9	LOS D	221	30.4	LOS C	180	17	LOS C	81
Northbound	3.6	LOS A	66	6.9	LOS A	130	48.9	LOS D	918	29.1	LOS C	507	29	LOS D	851
Southbound	1.9	LOS A	42	3.2	LOS A	73	22.0	LOS C	187	18.5	LOS B	165	9	LOS A	48
Total	7.1	LOS A		186.6	LOS F		39.5	LOS D		27.5	LOS C		20	LOS C	

a Delay for movement in seconds

b Level of service for approach

c 95th percentile queue in feet

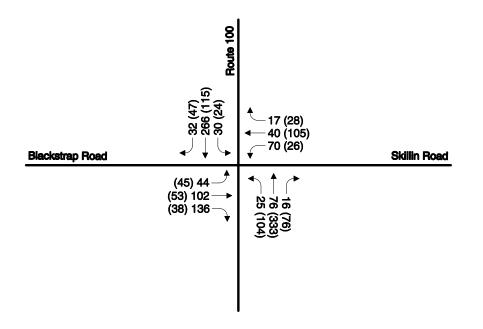
d Analysis completed with SIDRA software



Conclusion

VHB has completed a Synchro/SimTraffic analysis of the Route 100 at Blackstrap Road & Skillin Road intersection. Our review focused on the feasibility of the potential treatments to the intersection for the 2045 design year. As the analysis was completed under certain development assumptions with a 20+ year forecast, the analysis contained herein should be considered a planning exercise with additional monitoring of traffic volumes in response to specific major development occurring.

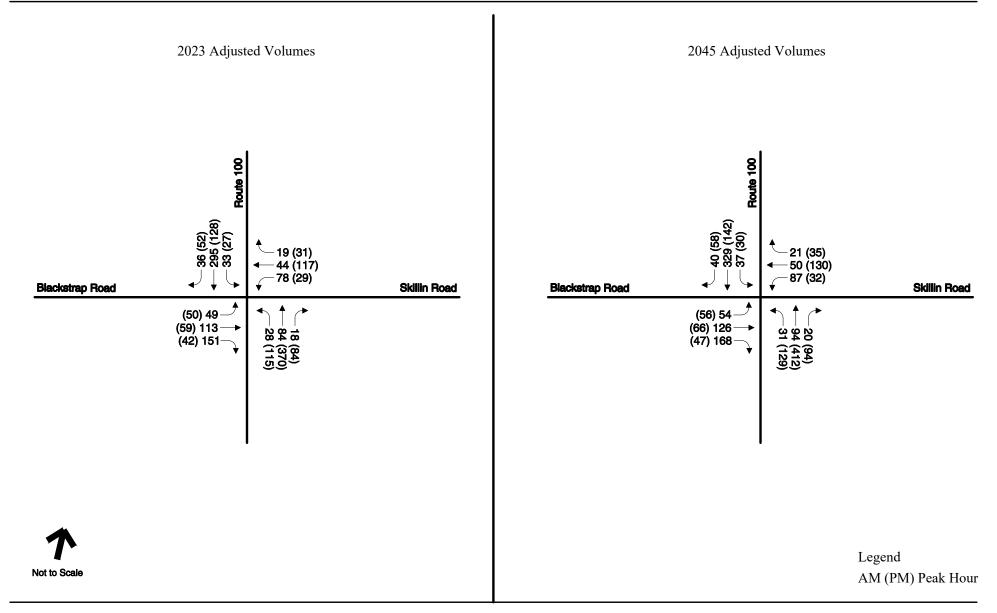
Based on the analysis, we have determined that any of the potential Build treatments (traffic signal, roundabout) would be appropriate for the study intersection. Delay and queueing appear to be manageable in all Build scenarios.



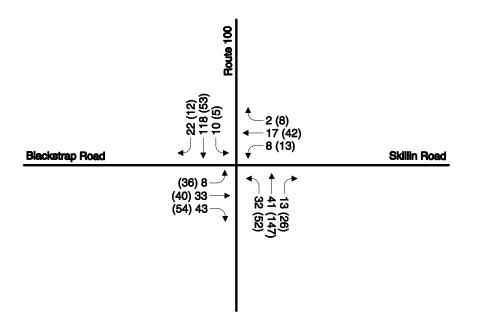


Legend AM (PM) Peak Hour





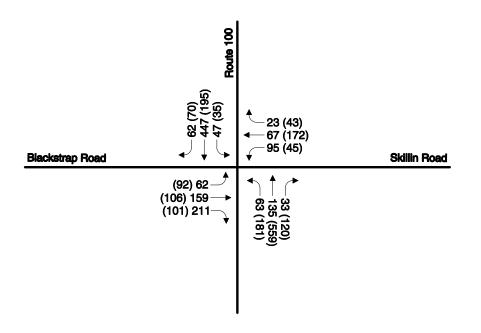






Legend AM (PM) Peak Hour







Legend AM (PM) Peak Hour



Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	911	990	959	949	873	967	972
Vehs Exited	916	988	960	953	871	967	982
Starting Vehs	16	13	19	18	11	18	26
Ending Vehs	11	15	18	14	13	18	16
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Travel Distance (mi)	460	498	484	480	440	487	493
Travel Time (hr)	16.6	18.6	17.5	17.6	15.8	17.9	18.3
Total Delay (hr)	1.8	2.8	2.2	2.3	1.8	2.4	2.6
Total Stops	439	478	478	494	412	485	494
Fuel Used (gal)	14.4	15.7	15.1	15.1	13.6	15.3	15.5

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	943	876	897	932	
Vehs Exited	946	874	902	935	
Starting Vehs	19	18	18	15	
Ending Vehs	16	20	13	16	
Denied Entry Before	0	0	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	476	443	455	472	
Travel Time (hr)	17.2	16.2	16.4	17.2	
Total Delay (hr)	2.1	2.1	1.9	2.2	
Total Stops	464	441	444	462	
Fuel Used (gal)	14.6	13.8	14.1	14.7	

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

UNSIGNAL SimTraffic Report VHB Page 1

Intorval #1	Information	Docording
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Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by G	Frowth Factors.	

Run Number	1	2	3	4	5	6	7
Vehs Entered	911	990	959	949	873	967	972
Vehs Exited	916	988	960	953	871	967	982
Starting Vehs	16	13	19	18	11	18	26
Ending Vehs	11	15	18	14	13	18	16
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Travel Distance (mi)	460	498	484	480	440	487	493
Travel Time (hr)	16.6	18.6	17.5	17.6	15.8	17.9	18.3
Total Delay (hr)	1.8	2.8	2.2	2.3	1.8	2.4	2.6
Total Stops	439	478	478	494	412	485	494
Fuel Used (gal)	14.4	15.7	15.1	15.1	13.6	15.3	15.5

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Gro	owth Factors.

Run Number	8	9	10	Avg	
Vehs Entered	943	876	897	932	
Vehs Exited	946	874	902	935	
Starting Vehs	19	18	18	15	
Ending Vehs	16	20	13	16	
Denied Entry Before	0	0	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	476	443	455	472	
Travel Time (hr)	17.2	16.2	16.4	17.2	
Total Delay (hr)	2.1	2.1	1.9	2.2	
Total Stops	464	441	444	462	
Fuel Used (gal)	14.6	13.8	14.1	14.7	

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	0.3	0.2	0.1	0.3	0.2
Total Del/Veh (s)	13.3	10.2	1.5	2.1	6.9
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Total Network Performance

Denied Del/Veh (s)	0.2	
Total Del/Veh (s)	8.1	
Denied Entry Before	0	
Denied Entry After	0	

Intersection: 3: Route 100 & Blackstrap Road/Skillin Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	200	100	40	46
Average Queue (ft)	80	48	8	4
95th Queue (ft)	149	81	30	23
Link Distance (ft)	1379	1378	1308	1202
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	1127	1153	1109	1065	1057	1107	1130
Vehs Exited	1133	1147	1121	1064	1053	1107	1144
Starting Vehs	21	16	24	15	16	22	30
Ending Vehs	15	22	12	16	20	22	16
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Travel Distance (mi)	568	578	562	534	529	555	569
Travel Time (hr)	20.9	20.9	20.4	19.2	18.8	19.9	20.5
Total Delay (hr)	3.1	2.8	2.9	2.5	2.3	2.6	2.8
Total Stops	374	428	387	345	349	380	360
Fuel Used (gal)	17.8	18.1	17.6	16.5	16.4	17.1	17.4

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	1117	1009	1099	1098	
Vehs Exited	1112	1001	1108	1099	
Starting Vehs	16	17	18	17	
Ending Vehs	21	25	9	19	
Denied Entry Before	0	0	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	560	507	554	551	
Travel Time (hr)	20.0	18.0	20.1	19.9	
Total Delay (hr)	2.5	2.2	2.8	2.6	
Total Stops	358	339	364	368	
Fuel Used (gal)	17.1	15.6	17.2	17.1	

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

UNSIGNAL SimTraffic Report VHB Page 1

Interval #1 Information Recording

Start Time	7:00			
End Time	8:00			
Total Time (min)	60			
Volumes adjusted by Growth Factors.				

Run Number	1	2	3	4	5	6	7
Vehs Entered	1127	1153	1109	1065	1057	1107	1130
Vehs Exited	1133	1147	1121	1064	1053	1107	1144
Starting Vehs	21	16	24	15	16	22	30
Ending Vehs	15	22	12	16	20	22	16
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Travel Distance (mi)	568	578	562	534	529	555	569
Travel Time (hr)	20.9	20.9	20.4	19.2	18.8	19.9	20.5
Total Delay (hr)	3.1	2.8	2.9	2.5	2.3	2.6	2.8
Total Stops	374	428	387	345	349	380	360
Fuel Used (gal)	17.8	18.1	17.6	16.5	16.4	17.1	17.4

Interval #1 Information Recording

Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted b	y Growth Factors.	

Run Number	8	9	10	Avg	
Vehs Entered	1117	1009	1099	1098	
Vehs Exited	1112	1001	1108	1099	
Starting Vehs	16	17	18	17	
Ending Vehs	21	25	9	19	
Denied Entry Before	0	0	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	560	507	554	551	
Travel Time (hr)	20.0	18.0	20.1	19.9	
Total Delay (hr)	2.5	2.2	2.8	2.6	
Total Stops	358	339	364	368	
Fuel Used (gal)	17.1	15.6	17.2	17.1	

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All	
Denied Del/Veh (s)	0.2	0.2	0.4	0.2	0.3	
Total Del/Veh (s)	14.4	18.3	3.6	1.9	7.1	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	

Total Network Performance

Denied Del/Veh (s) 0.3
50 To
Total Del/Veh (s) 8.2
Denied Entry Before 0
Denied Entry After 0

Intersection: 3: Route 100 & Blackstrap Road/Skillin Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	116	150	95	69
Average Queue (ft)	54	64	23	12
95th Queue (ft)	96	114	66	42
Link Distance (ft)	1379	1378	1308	1202
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	1398	1412	1436	1391	1315	1393	1408
Vehs Exited	1360	1358	1384	1363	1281	1363	1393
Starting Vehs	41	28	27	24	21	29	33
Ending Vehs	79	82	79	52	55	59	48
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	12	34	6	0	1	0	2
Travel Distance (mi)	689	692	702	689	651	692	705
Travel Time (hr)	71.3	87.6	62.4	48.5	31.5	41.3	43.1
Total Delay (hr)	49.4	65.7	40.3	26.7	10.9	19.3	20.8
Total Stops	577	469	595	648	622	677	655
Fuel Used (gal)	31.8	35.6	30.0	26.7	22.1	25.3	26.0

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	1427	1387	1376	1394	
Vehs Exited	1393	1343	1330	1357	
Starting Vehs	41	23	26	29	
Ending Vehs	75	67	72	66	
Denied Entry Before	0	0	0	0	
Denied Entry After	0	0	0	5	
Travel Distance (mi)	706	686	677	689	
Travel Time (hr)	69.5	47.5	50.3	55.3	
Total Delay (hr)	47.1	25.8	28.9	33.5	
Total Stops	604	657	692	619	
Fuel Used (gal)	31.7	26.4	26.8	28.2	

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors. No data recorded this interval.

UNSIGNAL SimTraffic Report VHB Page 1

Interval #1	Information	Recording
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Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Gro	wth Factors.

Run Number	1	2	3	4	5	6	7
Vehs Entered	1398	1412	1436	1391	1315	1393	1408
Vehs Exited	1360	1358	1384	1363	1281	1363	1393
Starting Vehs	41	28	27	24	21	29	33
Ending Vehs	79	82	79	52	55	59	48
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	12	34	6	0	1	0	2
Travel Distance (mi)	689	692	702	689	651	692	705
Travel Time (hr)	71.3	87.6	62.4	48.5	31.5	41.3	43.1
Total Delay (hr)	49.4	65.7	40.3	26.7	10.9	19.3	20.8
Total Stops	577	469	595	648	622	677	655
Fuel Used (gal)	31.8	35.6	30.0	26.7	22.1	25.3	26.0

Interval #1 Information Recording

Start Time	7:00		
End Time	8:00		
Total Time (min)	60		
Volumes adjusted by Growth Factors.			

Run Number	8	9	10	Avg	
Vehs Entered	1427	1387	1376	1394	
Vehs Exited	1393	1343	1330	1357	
Starting Vehs	41	23	26	29	
Ending Vehs	75	67	72	66	
Denied Entry Before	0	0	0	0	
Denied Entry After	0	0	0	5	
Travel Distance (mi)	706	686	677	689	
Travel Time (hr)	69.5	47.5	50.3	55.3	
Total Delay (hr)	47.1	25.8	28.9	33.5	
Total Stops	604	657	692	619	
Fuel Used (gal)	31.7	26.4	26.8	28.2	

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	20.7	0.2	0.2	0.4	6.6
Total Del/Veh (s)	233.1	25.6	3.1	3.3	77.4
Denied Entry Before	0	0	0	0	0
Denied Entry After	5	0	0	0	5

Total Network Performance

6.6
78.2
0
5

UNSIGNAL SimTraffic Report VHB SimTraffic Report Page 3

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	1145	173	93	73
Average Queue (ft)	758	79	28	13
95th Queue (ft)	1438	141	68	46
Link Distance (ft)	1379	1378	1308	1202
Upstream Blk Time (%)	13			
Queuing Penalty (veh)	0			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

UNSIGNAL SimTraffic Report VHB SimTraffic Report

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	1650	1645	1647	1663	1633	1643	1642
Vehs Exited	1535	1529	1540	1567	1546	1523	1545
Starting Vehs	39	30	41	37	35	33	56
Ending Vehs	154	146	148	133	122	153	153
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	50	139	71	39	7	79	100
Travel Distance (mi)	786	781	785	798	791	780	785
Travel Time (hr)	127.1	161.9	128.2	108.5	75.2	124.0	152.5
Total Delay (hr)	102.6	137.6	103.7	83.6	50.4	99.8	128.1
Total Stops	504	421	539	527	648	520	491
Fuel Used (gal)	46.3	54.0	46.6	42.4	34.9	45.5	52.0

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	1637	1587	1690	1644	
Vehs Exited	1536	1489	1574	1538	
Starting Vehs	51	46	30	40	
Ending Vehs	152	144	146	145	
Denied Entry Before	0	0	0	0	
Denied Entry After	108	73	59	73	
Travel Distance (mi)	783	756	805	785	
Travel Time (hr)	165.6	140.4	131.6	131.5	
Total Delay (hr)	141.2	116.9	106.5	107.0	
Total Stops	427	442	508	503	
Fuel Used (gal)	54.7	48.6	47.6	47.2	

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

UNSIGNAL SimTraffic Report VHB Page 1

Interval #1	Information	Recording
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Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by G	rowth Factors.	

Run Number	1	2	3	4	5	6	7
Vehs Entered	1650	1645	1647	1663	1633	1643	1642
Vehs Exited	1535	1529	1540	1567	1546	1523	1545
Starting Vehs	39	30	41	37	35	33	56
Ending Vehs	154	146	148	133	122	153	153
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	50	139	71	39	7	79	100
Travel Distance (mi)	786	781	785	798	791	780	785
Travel Time (hr)	127.1	161.9	128.2	108.5	75.2	124.0	152.5
Total Delay (hr)	102.6	137.6	103.7	83.6	50.4	99.8	128.1
Total Stops	504	421	539	527	648	520	491
Fuel Used (gal)	46.3	54.0	46.6	42.4	34.9	45.5	52.0

Interval #1 Information Recording

Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by Gro	owth Factors.	

Run Number	8	9	10	Avg	
Vehs Entered	1637	1587	1690	1644	
Vehs Exited	1536	1489	1574	1538	
Starting Vehs	51	46	30	40	
Ending Vehs	152	144	146	145	
Denied Entry Before	0	0	0	0	
Denied Entry After	108	73	59	73	
Travel Distance (mi)	783	756	805	785	
Travel Time (hr)	165.6	140.4	131.6	131.5	
Total Delay (hr)	141.2	116.9	106.5	107.0	
Total Stops	427	442	508	503	
Fuel Used (gal)	54.7	48.6	47.6	47.2	

UNSIGNAL SimTraffic Report VHB SimTraffic Report Page 2

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	180.0	62.0	0.7	0.2	41.6
Total Del/Veh (s)	624.1	597.8	6.9	3.2	186.6
Denied Entry Before	0	0	0	0	0
Denied Entry After	52	21	0	0	73

Total Network Performance

Denied Del/Veh (s)	41.6
Total Del/Veh (s)	186.6
Denied Entry Before	0
Denied Entry After	73

UNSIGNAL SimTraffic Report VHB SimTraffic Report Page 3

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	1408	1318	183	109
Average Queue (ft)	1080	944	60	25
95th Queue (ft)	1708	1664	130	73
Link Distance (ft)	1379	1378	1308	1202
Upstream Blk Time (%)	45	31		
Queuing Penalty (veh)	0	0		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

UNSIGNAL SimTraffic Report VHB SimTraffic Report

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	1410	1446	1442	1391	1315	1393	1408
Vehs Exited	1420	1430	1408	1390	1299	1382	1416
Starting Vehs	48	35	31	29	27	36	46
Ending Vehs	38	51	65	30	43	47	38
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	0	0	0	0	1	0	2
Travel Distance (mi)	715	723	714	698	658	697	711
Travel Time (hr)	40.3	57.8	44.0	36.9	35.5	40.6	38.0
Total Delay (hr)	15.4	32.6	19.2	12.6	12.6	16.3	13.3
Total Stops	1340	1497	1453	1260	1208	1373	1245
Fuel Used (gal)	26.8	31.0	27.4	25.5	24.2	26.3	26.0

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	1426	1387	1376	1399	
Vehs Exited	1426	1364	1374	1391	
Starting Vehs	43	28	34	35	
Ending Vehs	43	51	36	45	
Denied Entry Before	0	0	0	0	
Denied Entry After	1	0	0	0	
Travel Distance (mi)	720	691	692	702	
Travel Time (hr)	46.3	36.9	38.2	41.4	
Total Delay (hr)	21.2	12.9	14.2	17.0	
Total Stops	1537	1258	1279	1343	
Fuel Used (gal)	28.0	25.1	25.6	26.6	

Interval #0 Information Seeding

Start Time	6:57	
End Time	7:00	
Total Time (min)	3	
Volumes adjusted by Grow	th Factors.	

No data recorded this interval.

Interval #1	Information	Recording
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Start Time	7:00		
End Time	8:00		
Total Time (min)	60		
Volumes adjusted by Grov	vth Factors.		

Run Number	1	2	3	4	5	6	7
Vehs Entered	1410	1446	1442	1391	1315	1393	1408
Vehs Exited	1420	1430	1408	1390	1299	1382	1416
Starting Vehs	48	35	31	29	27	36	46
Ending Vehs	38	51	65	30	43	47	38
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	0	0	0	0	1	0	2
Travel Distance (mi)	715	723	714	698	658	697	711
Travel Time (hr)	40.3	57.8	44.0	36.9	35.5	40.6	38.0
Total Delay (hr)	15.4	32.6	19.2	12.6	12.6	16.3	13.3
Total Stops	1340	1497	1453	1260	1208	1373	1245
Fuel Used (gal)	26.8	31.0	27.4	25.5	24.2	26.3	26.0

Interval #1 Information Recording

Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by Grow	th Factors.	

Run Number	8	9	10	Avg	
Vehs Entered	1426	1387	1376	1399	
Vehs Exited	1426	1364	1374	1391	
Starting Vehs	43	28	34	35	
Ending Vehs	43	51	36	45	
Denied Entry Before	0	0	0	0	
Denied Entry After	1	0	0	0	
Travel Distance (mi)	720	691	692	702	
Travel Time (hr)	46.3	36.9	38.2	41.4	
Total Delay (hr)	21.2	12.9	14.2	17.0	
Total Stops	1537	1258	1279	1343	
Fuel Used (gal)	28.0	25.1	25.6	26.6	

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	0.7	1.6	1.1	1.3	1.1
Total Del/Veh (s)	31.4	26.0	17.7	59.5	39.5
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Total Network Performance

Denied Del/Veh (s)	1.1
Total Del/Veh (s)	41.6
Denied Entry Before	0
Denied Entry After	0

Movement	EB	EB	WB	WB	NB	NB	SB	SB	
Directions Served	L	TR	L	TR	L	TR	L	TR	
Maximum Queue (ft)	100	362	80	146	83	154	219	668	
Average Queue (ft)	48	185	51	60	37	68	71	339	
95th Queue (ft)	110	326	86	121	69	128	207	697	
Link Distance (ft)		1373		1371		1302		1196	
Upstream Blk Time (%)								1	
Queuing Penalty (veh)								0	
Storage Bay Dist (ft)	75		55		195		195		
Storage Blk Time (%)	2	41	17	12		0		34	
Queuing Penalty (veh)	6	25	15	11		0		16	

Network Summary

Network wide Queuing Penalty: 73

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBTL	EBTL	NBL	SBTL	WBTL
Maximum Green (s)	5.0	20.0	18.0	5.0	20.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	Min	None	None	Min	None
Avg. Green (s)	5.0	21.2	16.4	5.1	20.2	10.2
g/C Ratio	-0.01	NA	-0.01	-0.01	NA	-0.01
Cycles Skipped (%)	54	0	2	44	0	10
Cycles @ Minimum (%)	46	0	0	56	0	0
Cycles Maxed Out (%)	46	75	71	56	90	2
Cycles with Peds (%)	0	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA Number of Complete Cycles: 0

SimTraffic Report SIGNAL-SPLIT PHASING VHB Page 5

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	1700	1783	1718	1702	1640	1722	1742
Vehs Exited	1700	1745	1721	1685	1639	1703	1750
Starting Vehs	44	36	46	37	45	39	61
Ending Vehs	44	74	43	54	46	58	53
Denied Entry Before	1	0	1	0	1	0	0
Denied Entry After	1	1	1	0	0	0	0
Travel Distance (mi)	855	888	865	851	823	860	879
Travel Time (hr)	51.7	64.3	46.5	54.1	45.0	47.9	47.3
Total Delay (hr)	22.0	33.5	16.6	24.5	16.4	18.1	16.9
Total Stops	1714	2130	1420	1825	1407	1544	1413
Fuel Used (gal)	32.5	36.5	31.7	33.1	30.1	31.7	32.0

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	1745	1661	1749	1716	
Vehs Exited	1768	1665	1746	1712	
Starting Vehs	60	46	42	45	
Ending Vehs	37	42	45	48	
Denied Entry Before	0	1	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	883	835	880	862	
Travel Time (hr)	51.8	45.6	54.0	50.8	
Total Delay (hr)	21.2	16.7	23.6	20.9	
Total Stops	1696	1444	1894	1649	
Fuel Used (gal)	33.0	30.7	33.7	32.5	

Interval #0 Information Seeding

Start Time	6:57	
End Time	7:00	
Total Time (min)	3	
V-1	F4	

Volumes adjusted by Growth Factors.

No data recorded this interval.

Intorval #1	Information	Docording
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Start Time	7:00		
End Time	8:00		
Total Time (min)	60		
Volumes adjusted by Grov	vth Factors.		

Run Number	1	2	3	4	5	6	7
Vehs Entered	1700	1783	1718	1702	1640	1722	1742
Vehs Exited	1700	1745	1721	1685	1639	1703	1750
Starting Vehs	44	36	46	37	45	39	61
Ending Vehs	44	74	43	54	46	58	53
Denied Entry Before	1	0	1	0	1	0	0
Denied Entry After	1	1	1	0	0	0	0
Travel Distance (mi)	855	888	865	851	823	860	879
Travel Time (hr)	51.7	64.3	46.5	54.1	45.0	47.9	47.3
Total Delay (hr)	22.0	33.5	16.6	24.5	16.4	18.1	16.9
Total Stops	1714	2130	1420	1825	1407	1544	1413
Fuel Used (gal)	32.5	36.5	31.7	33.1	30.1	31.7	32.0

Interval #1 Information Recording

Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by Gro	owth Factors.	

Run Number	8	9	10	Avg	
Vehs Entered	1745	1661	1749	1716	
Vehs Exited	1768	1665	1746	1712	
Starting Vehs	60	46	42	45	
Ending Vehs	37	42	45	48	
Denied Entry Before	0	1	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	883	835	880	862	
Travel Time (hr)	51.8	45.6	54.0	50.8	
Total Delay (hr)	21.2	16.7	23.6	20.9	
Total Stops	1696	1444	1894	1649	
Fuel Used (gal)	33.0	30.7	33.7	32.5	

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All	
Denied Del/Veh (s)	1.1	0.7	1.5	0.6	1.2	
Total Del/Veh (s)	31.6	36.9	48.9	22.0	39.5	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	

Total Network Performance

Denied Del/Veh (s)	1.2
Total Del/Veh (s)	41.7
Denied Entry Before	0
Denied Entry After	0

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	100	283	80	258	220	880	119	213
Average Queue (ft)	64	122	33	132	149	467	30	106
95th Queue (ft)	114	227	80	221	277	918	83	187
Link Distance (ft)		1373		1371		1302		1196
Upstream Blk Time (%)						1		
Queuing Penalty (veh)						0		
Storage Bay Dist (ft)	75		55		195		195	
Storage Blk Time (%)	9	25	5	46	0	32		1
Queuing Penalty (veh)	18	23	11	21	0	59		0

Network Summary

Network wide Queuing Penalty: 132

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBTL	EBTL	NBL	SBTL	WBTL
Maximum Green (s)	5.0	40.0	18.0	10.0	35.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	Min	None	None	Min	None
Avg. Green (s)	5.2	39.0	14.6	8.5	29.8	14.0
g/C Ratio	-0.01	NA	NA	-0.01	NA	NA
Cycles Skipped (%)	67	0	0	10	0	0
Cycles @ Minimum (%)	33	0	0	0	0	0
Cycles Maxed Out (%)	33	78	40	40	38	38
Cycles with Peds (%)	0	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA Number of Complete Cycles: 0

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	1410	1446	1442	1391	1314	1393	1407
Vehs Exited	1423	1452	1442	1391	1302	1392	1416
Starting Vehs	45	33	31	29	23	29	39
Ending Vehs	32	27	31	29	35	30	30
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	0	0	0	0	2	0	3
Travel Distance (mi)	715	731	725	699	658	702	709
Travel Time (hr)	36.7	39.1	35.9	33.1	30.7	33.6	32.7
Total Delay (hr)	13.9	15.8	12.9	10.9	9.7	11.2	10.2
Total Stops	1211	1352	1205	1078	1009	1089	1063
Fuel Used (gal)	25.7	26.7	25.6	24.3	22.8	24.6	24.3

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	1426	1387	1376	1399	
Vehs Exited	1439	1362	1385	1400	
Starting Vehs	40	28	33	33	
Ending Vehs	27	53	24	31	
Denied Entry Before	0	0	0	0	
Denied Entry After	1	0	0	0	
Travel Distance (mi)	722	691	695	705	
Travel Time (hr)	35.1	33.0	32.5	34.2	
Total Delay (hr)	12.1	11.0	10.5	11.8	
Total Stops	1155	1088	1049	1130	
Fuel Used (gal)	25.2	24.0	24.1	24.7	

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1	Information	Recording
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Start Time	7:00		
End Time	8:00		
Total Time (min)	60		
Volumes adjusted by Gro	wth Factors.		

Run Number	1	2	3	4	5	6	7
Vehs Entered	1410	1446	1442	1391	1314	1393	1407
Vehs Exited	1423	1452	1442	1391	1302	1392	1416
Starting Vehs	45	33	31	29	23	29	39
Ending Vehs	32	27	31	29	35	30	30
Denied Entry Before	0	0	0	0	1	0	0
Denied Entry After	0	0	0	0	2	0	3
Travel Distance (mi)	715	731	725	699	658	702	709
Travel Time (hr)	36.7	39.1	35.9	33.1	30.7	33.6	32.7
Total Delay (hr)	13.9	15.8	12.9	10.9	9.7	11.2	10.2
Total Stops	1211	1352	1205	1078	1009	1089	1063
Fuel Used (gal)	25.7	26.7	25.6	24.3	22.8	24.6	24.3

Interval #1 Information Recording

Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by Gro	wth Factors.	

Run Number	8	9	10	Avg	
Vehs Entered	1426	1387	1376	1399	
Vehs Exited	1439	1362	1385	1400	
Starting Vehs	40	28	33	33	
Ending Vehs	27	53	24	31	
Denied Entry Before	0	0	0	0	
Denied Entry After	1	0	0	0	
Travel Distance (mi)	722	691	695	705	
Travel Time (hr)	35.1	33.0	32.5	34.2	
Total Delay (hr)	12.1	11.0	10.5	11.8	
Total Stops	1155	1088	1049	1130	
Fuel Used (gal)	25.2	24.0	24.1	24.7	

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All	
Denied Del/Veh (s)	0.8	1.8	1.2	0.8	1.0	
Total Del/Veh (s)	30.3	28.9	15.9	27.7	26.7	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	

Total Network Performance

Denied Del/Veh (s)	1.0
Total Del/Veh (s)	28.8
Denied Entry Before	0
Denied Entry After	0

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	100	322	79	148	81	144	190	396
Average Queue (ft)	51	170	53	58	35	61	39	195
95th Queue (ft)	105	292	85	120	67	115	128	349
Link Distance (ft)		1373		1371		1302		1196
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	75		55		195		195	
Storage Blk Time (%)	4	36	23	9		0		9
Queuing Penalty (veh)	14	22	21	9		0		4

Network Summary

Network wide Queuing Penalty: 70

Phase	1	2	3	4	5	6	7	8
Movement(s) Served	SBL	NBTL	WBL	EBT	NBL	SBTL	EBL	WBT
Maximum Green (s)	5.0	26.0	6.0	19.0	5.0	26.0	6.0	19.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	Min	None	None	None	Min	None	None
Avg. Green (s)	5.1	23.3	6.4	16.6	5.1	22.3	13.5	20.2
g/C Ratio	-0.01	NA	-0.01	-0.01	-0.01	NA	-0.01	-0.01
Cycles Skipped (%)	59	0	20	4	50	0	43	22
Cycles @ Minimum (%)	41	0	0	0	50	0	0	0
Cycles Maxed Out (%)	41	49	57	56	50	51	43	46
Cycles with Peds (%)	0	0	0	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA Number of Complete Cycles: 0

SimTraffic Report SIGNAL-LEAD/LAG VHB Page 5

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	1700	1783	1718	1702	1640	1722	1742
Vehs Exited	1703	1773	1720	1692	1634	1713	1748
Starting Vehs	37	28	38	36	42	38	56
Ending Vehs	34	38	36	46	48	47	50
Denied Entry Before	1	0	1	0	1	0	0
Denied Entry After	1	1	1	0	0	0	0
Travel Distance (mi)	857	896	866	852	824	864	880
Travel Time (hr)	42.6	47.2	41.0	41.5	38.5	41.6	41.9
Total Delay (hr)	15.6	19.0	13.8	14.7	12.6	14.5	14.3
Total Stops	1401	1594	1288	1300	1239	1332	1301
Fuel Used (gal)	29.8	32.0	29.7	29.4	28.1	29.7	30.3

Summary of All Intervals

Run Number	8	9	10	Avg	
Start Time	6:57	6:57	6:57	6:57	
End Time	8:00	8:00	8:00	8:00	
Total Time (min)	63	63	63	63	
Time Recorded (min)	60	60	60	60	
# of Intervals	2	2	2	2	
# of Recorded Intervals	1	1	1	1	
Vehs Entered	1745	1661	1749	1716	
Vehs Exited	1762	1657	1756	1715	
Starting Vehs	53	36	41	40	
Ending Vehs	36	40	34	40	
Denied Entry Before	0	1	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	882	832	882	863	
Travel Time (hr)	44.5	38.8	44.7	42.2	
Total Delay (hr)	16.8	12.7	17.0	15.1	
Total Stops	1483	1212	1523	1367	
Fuel Used (gal)	30.6	28.2	30.9	29.9	

Interval #0 Information Seeding

Start Time	6:57	
End Time	7:00	
Total Time (min)	3	
Volumes adjusted by Grow	th Factors.	

No data recorded this interval.

Interval #1	Information	Recording
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Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by Grov	vth Factors.	

Run Number	1	2	3	4	5	6	7
Vehs Entered	1700	1783	1718	1702	1640	1722	1742
Vehs Exited	1703	1773	1720	1692	1634	1713	1748
Starting Vehs	37	28	38	36	42	38	56
Ending Vehs	34	38	36	46	48	47	50
Denied Entry Before	1	0	1	0	1	0	0
Denied Entry After	1	1	1	0	0	0	0
Travel Distance (mi)	857	896	866	852	824	864	880
Travel Time (hr)	42.6	47.2	41.0	41.5	38.5	41.6	41.9
Total Delay (hr)	15.6	19.0	13.8	14.7	12.6	14.5	14.3
Total Stops	1401	1594	1288	1300	1239	1332	1301
Fuel Used (gal)	29.8	32.0	29.7	29.4	28.1	29.7	30.3

Interval #1 Information Recording

Start Time	7:00	
End Time	8:00	
Total Time (min)	60	
Volumes adjusted by	Growth Factors.	

Run Number	8	9	10	Avg	
Vehs Entered	1745	1661	1749	1716	
Vehs Exited	1762	1657	1756	1715	
Starting Vehs	53	36	41	40	
Ending Vehs	36	40	34	40	
Denied Entry Before	0	1	0	0	
Denied Entry After	0	0	0	0	
Travel Distance (mi)	882	832	882	863	
Travel Time (hr)	44.5	38.8	44.7	42.2	
Total Delay (hr)	16.8	12.7	17.0	15.1	
Total Stops	1483	1212	1523	1367	
Fuel Used (gal)	30.6	28.2	30.9	29.9	

3: Route 100 & Blackstrap Road/Skillin Road Performance by approach

Approach	EB	WB	NB	SB	All	
Denied Del/Veh (s)	1.2	0.7	1.4	0.7	1.1	
Total Del/Veh (s)	30.2	30.4	29.1	18.5	27.7	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	

Total Network Performance

Denied Del/Veh (s)	1.1
Total Del/Veh (s)	29.9
Denied Entry Before	0
Denied Entry After	0

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	100	239	80	210	220	575	71	188
Average Queue (ft)	66	108	37	107	118	280	24	93
95th Queue (ft)	110	201	81	180	242	507	56	165
Link Distance (ft)		1373		1371		1302		1196
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	75		55		195		195	
Storage Blk Time (%)	14	17	8	36	0	17		0
Queuing Penalty (veh)	29	15	17	16	0	30		0

Network Summary

Network wide Queuing Penalty: 108

Phase	1	2	3	4	5	6	7	8
Movement(s) Served	SBL	NBTL	WBL	EBT	NBL	SBTL	EBL	WBT
Maximum Green (s)	5.0	36.0	5.0	20.0	9.0	32.0	7.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	Min	None	None	None	Min	None	None
Avg. Green (s)	5.1	33.7	11.7	18.2	7.9	25.0	7.6	14.9
g/C Ratio	-0.01	NA	-0.01	-0.01	-0.01	NA	-0.01	-0.01
Cycles Skipped (%)	71	0	44	16	14	0	19	6
Cycles @ Minimum (%)	29	0	25	0	0	0	0	0
Cycles Maxed Out (%)	29	65	56	37	41	31	58	31
Cycles with Peds (%)	0	0	0	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA Number of Complete Cycles: 0

SimTraffic Report SIGNAL-LEAD/LAG Page 5 VHB



To: Don Ettinger, PE
Gorrill Palmer
300 Southborough Drive, Suite 200
South Portland, ME 04106

Date: October 20, 2023

Memorandum

Project #: 55690.00

From: Jason Ready, PE, PTOE, PTP Emily Leighton, Michael Cristiani Re: Route 100/Blackstrap Road Signal Warrant Analysis

Cumberland, Maine

VHB was requested to complete a traffic signal warrant analysis for the intersection of Route 100 with Blackstrap Road and Skillin Road in Cumberland, Maine as part of the Planning Partnership Initiative study for the town of Cumberland. The following memorandum summarizes the methodology and results of the analysis.

Signal Warrant Analysis

A traffic signal warrant analysis is completed based on the nine warrants outlined by the 2009 Edition of the Manual on Uniform Traffic Control Devices (MUTCD), Chapter 4C. The nine warrants are as follows:

- Warrant 1 Eight Hour Vehicular Volume
- Warrant 2 Four Hour Vehicular Volume
- > Warrant 3 Peak Hour
- Warrant 4 Pedestrian Volumes
- > Warrant 5 School Crossing

- Warrant 6 Coordinated Signal System
- Warrant 7 Crash Experience
- > Warrant 8 Roadway Network
- > Warrant 9 Intersection Near a Grade Crossing

Warrants 1, 2, and 3 are based on the number of vehicles moving through the intersection and are most commonly used. Warrants 4-9 are based on other characteristics of the intersection and surrounding roadway network. The intersection currently is not warranted for a traffic signal. A traffic signal warrant analysis for 2023 is attached.

Traffic Volumes

Warrants 1-3 are based on the hourly volume of traffic moving through the intersection on an average day. The analysis year for the intersection is 2045. Turning movement counts were completed at the intersection of Route 100 with Blackstrap Road and Skillin Road by MaineDOT on Friday, October 26, 2018 from 6:00 AM to 6:00 PM. Detailed counts are shown in the attached spreadsheet. The following summarizes the adjustments made to the turning movement counts to estimate the future volumes that may be experienced on the average day in 2045.

Seasonal Adjustment

MaineDOT weekly group mean factors were used to adjust the traffic volumes to those anticipated to be experienced on an average day. For turning movement counts collected during the week of October 21, an adjustment of 0.92 was applied to the raw volumes. Traffic volumes are attached as an appendix.

Annual Growth

In addition to a seasonal adjustment, an annual growth rate was applied to estimate the traffic volumes that will be experienced during the analysis year. The signal warrant analysis is being completed for 2045 and an annual growth rate of 0.5% per year has been applied to the seasonally adjusted volumes, as directed by MaineDOT staff.

Don Ettinger, PE Ref: 55690.00 October 20, 2023 Page 2



Future Development

Based on discussions with the Town of Cumberland there are a variety of future projects that are forecast to be developed between now and 2045. These projects include single family housing, multifamily housing, light industrial, office space, retail, bank, high turnover restaurant, and a convenience store with gas station. The forecast trip generation for these proposed projects has been calculated using the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 11th Edition. The following table summarizes the total forecast future development trip generation for the area. Detailed trip generation calculations are attached.

Table 1 Future Development Trip Generation

Time Period	Entering	Exiting	Total
AM Peak Hour	368	485	853
PM Peak Hour	613	522	1135

The future development trip generation has been assigned to the intersection based on the potential development locations, as well as existing traffic patterns. The 2045 average day traffic volumes with future development are shown in the attached spreadsheet.

ITE trip generation estimates the traffic volumes for the peak hours of the proposed development. Additional traffic from the proposed development is also anticipated to be generated outside of peak hours. To estimate the traffic volumes from the proposed development that may occur outside of peak hours two primary assumptions were made:

- > Development traffic that occurs during the hours directly before and after the peak hours is equal to 85% of the peak hour volumes
- > Forecast development traffic is further reduced by 20% during each additional hour away from the peak hour It should be further stressed at this point that the volumes described here are projected based on development assumptions provided by the town and that additional warrant analyses will need to be completed in response to actual traffic conditions.

Warrant 1 - Eight Hour Vehicular Volume

This warrant is met when traffic volumes on both the major and minor streets meet or exceed the threshold volumes during eight hours of the average day. Based on a review of the projected present volume and 2045 traffic volumes with the future development, the threshold volumes are not met for at least 8 hours. Therefore, **Warrant 1 is not met in 2023 and is met in 2045**.

Warrant 2 - Four Hour Vehicular Volume

This warrant is met when traffic volumes on both the major and minor streets meet or exceed the threshold volumes during four hours of the average day. Based on a review of the projected present volume and 2045 traffic volumes with the future development, the threshold volumes are not met for at least 4 hours and therefore **Warrant 2 is not met in 2023 and is met in 2045**.

Don Ettinger, PE Ref: 55690.00 October 20, 2023

Page 3



Warrant 3 – Peak Hour Vehicular Volume

This warrant is met when the traffic volumes on both the major and minor streets meet or exceed the threshold volumes during any peak hour of the average day. However, this warrant is intended for use in unique cases such as locations that generate or discharge large numbers of vehicles during a short period of time such as office complexes or industrial facilities. Therefore, **Warrant 3 is not applicable**.

Warrant 4 - Pedestrian Volume

This warrant is met when the pedestrian volumes and vehicular volumes on the major street meet or exceed the threshold volumes shown on Figure 4C-5 in the MUTCD during any four hours of an average day or meet or exceed the threshold volumes shown on Figure 4C-7 in the MUTCD during any one hour of an average day. The pedestrian volumes at the intersection are very low and do not meet the minimum required volumes. Therefore, **Warrant 4 is not met**.

Warrant 5 - School Crossing

This warrant used when the intersection is in a location where schoolchildren are expected to cross the major street. The intersection is not near a school and does not experience significant pedestrian activity. Therefore **Warrant 5 is not applicable**.

Warrant 6 - Coordinated Signal System

This warrant is used when the intersection is in a location with adjacent signalized intersections that would benefit from vehicle platooning. There are no adjacent signalized intersections so **Warrant 6 is not applicable**.

Warrant 7 – Crash Experience

This warrant is intended for use when the severity and frequency of crashes are the reasons to consider a traffic control signal. Based on a review of MaineDOT crash data, five collisions have occurred during 2020-2022, three of which occurred in 2022. This is less than the threshold of five collisions during one year and therefore **Warrant 7 is not met**. Further, the crash pattern would need to be correctable by signalization and that other safety countermeasures were attempted before moving to signalization.

Warrant 8 – Roadway Network

This warrant is intended for use in locations where installing a traffic signal would be justified to encourage concentration and organization of traffic flow on a roadway network. This warrant is met when the intersection has a total entering volume of 1,000 vehicles per hour during the peak hour of a typical weekday and has five year projected traffic volumes that meet at least one of Warrants 1, 2, or 3. Additionally, the major route is required to be part of principal roadway network for through traffic flow, includes a rural or suburban highway around a city, or appears as a major route on an official plan.

The 5-year volume forecast of the intersection does not meet the 1,000 entering vehicle threshold. Therefore, **Warrant** 8 is not met.

Don Ettinger, PE Ref: 55690.00 October 20, 2023 Page 4



Warrant 9 – Intersection Near a Grade Crossing

This warrant is intended for use at a location where the proximity to a grade crossing is the principal reason to consider installing a traffic control signal. There are no grade crossings in the vicinity of the intersection, therefore **Warrant 9 is not applicable**.

Conclusion

Based on a review of the nine signal warrants outlined in the MUTCD, none of the warrants are met for average day conditions at the intersection of Route 100 with Blackstrap Road and Skillin Road in Cumberland, Maine in 2023 but may be met in projected 2045 conditions. As the signal warrant analysis was completed under certain development assumptions with a 20+ year forecast to 2045, the analysis contained herein should be considered a planning exercise with additional analysis to be completed with monitoring of traffic volumes in response to specific major development occurring. Further, the MUTCD is explicit that meeting a warrant is not in itself a justification for a traffic signal. For any future traffic pattern changes or developments which may occur that provide more certainty for warranting a traffic signal, intermediate steps should be taken before the installation of a traffic signal.

2023 Adjusted Volumes

Start Time	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	<u>NB RT</u>	SB LT	SB TH	SB RT
6:00 AM	34	39	78	16	11	19	18	60	6	14	244	30
7:00 AM	49	113	151	78	44	19	28	84	18	33	295	36
8:00 AM	32	68	85	52	38	23	29	113	34	22	215	38
9:00 AM	32	50	54	28	33	20	26	103	21	17	164	26
10:00 AM	29	32	41	22	30	14	38	114	18	12	135	43
11:00 AM	39	19	45	21	33	17	34	126	22	20	138	29
12:00 PM	28	49	34	21	52	21	32	120	28	21	133	39
1:00 PM	33	48	40	14	40	18	43	142	23	22	119	38
2:00 PM	41	51	31	12	30	17	44	161	22	18	123	42
3:00 PM	32	58	31	16	65	21	59	215	38	20	120	42
4:00 PM	43	50	42	21	119	38	103	346	58	22	128	48
5:00 PM	50	62	48	31	109	24	110	318	79	32	128	47

2009 MUTCD

TRAFFIC SIGNAL WARRANT ANALYSIS (VOLUME BASED)

Intersection: Route 100 with Blackstrap Road and Skillin Road

Major Street Direction: Northbound-Southbound ▼

Year: 2023 Condition: Existing

Operating speed on major roadway: 35 mph

Population of Community: 8,605 people U.S. Census Bt Required approach volumes

Warrant 1	EIGHT-HOUR VEHICULAR VOL	LIME	Minimum*	Adjusted Minimum**
			William	William
Warrant 1A	MINIMUM VEHICULAR VOLUME	E (8 nours of day)		
	Major Street :	1 Lane(s) on each approach	500	500
	Minor Street :	1 Lane(s) on each approach	150	150
Warrant 1B	INTERRUPTION OF CONTINUC	OUS TRAFFIC (8 hours of day)		
	Major Street :	1 Lane(s) on each approach	750	750
	Minor Street :	1 Lane(s) on each approach	75	75
80 PERCENT S	SATISFACTION OF WARRANT 1A	AND WARRANT 1B	Warrant 1A	Warrant 1B
	Major Street :	1 Lane(s) on each approach	400	600
	Minor Street :	1 Lane(s) on each approach	120	60

Warrant 2	FOUR HOUR VEHICULAR VC	<u>LUME</u>	
	Major Street :	1 Lane(s) on each approach	If "verify" indicated, see Figure 4C-1 or 4C-2.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

Warrant 3	PEAK HOUR VOLUME		
	Major Street :	1 Lane(s) on each approach	If "verify" indicated, see Figure 4C-3 or 4C-4.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

			Entering Vol.	Entering Vol.	on Major Road	Tot. Ent. Vol.	Mee	ts the follow	ing volume-base	d warrants	?
Hour			Minor Road+	Northbound	Southbound	On Major Rd	1A	1B	80%(1A&1B)	2	3
						0	No	No	No	0	0
6:00 -	7:00	AM	151	83	288	372	No	No	No	No	No
7:00 -	8:00	AM	313	130	364	494	No	No	No	Yes	Verify
8:00 -	9:00	AM	185	176	275	452	No	No	No	No	No
9:00 -	10:00	AM	136	150	206	356	No	No	No	No	No
10:00 -	23:00	AM	102	170	191	361	No	No	No	No	No
11:00 -	12:00	PM	103	183	186	369	No	No	No	No	No
12:00 -	1:00	PM	111	180	193	373	No	No	No	No	No
1:00 -	2:00	PM	121	209	179	387	No	No	No	No	No
2:00 -	3:00	PM	123	227	183	410	No	No	No	No	No
3:00 -	4:00	PM	121	312	182	494	No	No	No	No	No
4:00 -	5:00	PM	178	507	197	704	Yes	No	Yes	Verify	Yes
5:00 -	6:00	PM	164	507	206	713	Yes	No	Yes	Verify	No
							No	N/A	N/A	No	Yes
						Warrants		1		2	3
						Met?		NO		No	N/A

^{*}From the criteria described for the warrant in the MUTCD.

NON-VOLUME-BASED WARRANTS

Warrant 4, Minimum Pedestrian Volume:	Warrant 5, School Crossing: No
Peak Four Hour Pedestrian Volumes: 1	See MUTCD for details.
(non-concurrent) 2	
0	
0	
Total Peds per hour at Broadway/Willow Inters	ection
Warrant 6, Coordinated Signal System: See MUTCD for details.	Warrant 7, Crash Experience: No # of accidents "correctable by
Gee WOTOD for details.	signalization" occuring in the last 12 months:
Warrant 8, Roadway Network:	Warrant 9, Near a Grade Crossing: No
See MUTCD for details.	See MUTCD for details.

Source: Manual on Uniform Traffic Control Devices (MUTCD); 2009 Edition [2009]

^{**}FOR SAFETY ANALYSIS Warrant 7: If the operating speed is higher than 40mph or the population is less than 10,000 then the volumes can be adjusted to 56%. (If no adjusted minimum, the minimum from the previous column is shown)

⁺If more than one approach, report the approach that has the higher volume.

Build Adjusted Volumes 2045

Start Time	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
6:00 AM	45	71	123	24	27	23	47	101	17	25	372	52
7:00 AM	62	159	211	94	66	23	63	135	33	47	446	61
8:00 AM	43	103	132	65	56	28	59	161	49	33	340	61
9:00 AM	41	78	90	36	49	24	50	143	32	25	263	43
10:00 AM	36	54	69	29	43	17	59	149	27	19	215	60
11:00 AM	47	35	69	27	44	19	52	159	30	27	204	42
12:00 PM	40	70	59	28	71	26	54	174	39	27	185	51
1:00 PM	53	70	68	22	63	23	71	222	37	27	155	47
2:00 PM	65	79	64	21	56	23	78	259	39	22	166	53
3:00 PM	60	91	71	26	101	29	101	339	60	26	169	55
4:00 PM	79	90	93	34	168	49	159	510	86	29	187	63
5:00 PM	92	109	107	48	163	35	174	501	114	41	195	64
6:00 PM	31	34	46	11	36	7	44	125	22	4	45	10

2009 MUTCD

TRAFFIC SIGNAL WARRANT ANALYSIS (VOLUME BASED)

Intersection: Route 100 with Blackstrap Road and Skillin Road

Major Street Direction: Northbound-Southbound ▼

Year: 2045 Condition: With Future Development

Operating speed on major roadway: 35 mph

Population of Community: 8,605 people U.S. Census Bt Required approach volumes

Warrant 1	EIGHT-HOUR VEHICULAR VOLUME	Minimum*	Adjusted Minimum**
Warrant 1A	MINIMUM VEHICULAR VOLUME (8 hours of day)		
	Major Street: 1 Lane(s) on each approach	500	350
	Minor Street: 1 Lane(s) on each approach	150	105
Warrant 1B	INTERRUPTION OF CONTINUOUS TRAFFIC (8 hours of day)		
	Major Street: 1 Lane(s) on each approach	750	525
	Minor Street: 1 Lane(s) on each approach	75	53
80 PERCENT S	SATISFACTION OF WARRANT 1A AND WARRANT 1B	Warrant 1A	Warrant 1B
	Major Street: 1 Lane(s) on each approach	400	600
	Minor Street : 1 Lane(s) on each approach	120	60

Warrant 2	FOUR HOUR VEHICULAR VC	<u>LUME</u>	
	Major Street :	1 Lane(s) on each approach	If "verify" indicated, see Figure 4C-1 or 4C-2.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

Warrant 3	PEAK HOUR VOLUME		
	Major Street :	1 Lane(s) on each approach	If "verify" indicated, see Figure 4C-3 or 4C-4.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

			Entering Vol.	Entering Vol.	on Major Road	Tot. Ent. Vol.	Meets the following volume-base			ed warrants?	
Hour	•		Minor Road+	Northbound	Southbound	On Major Rd	1A	1B	80%(1A&1B)	2	3
						0	No	No	No	0	0
6:00 -	7:00	AM	239	166	448	614	Yes	Yes	Yes	Verify	Yes
7:00 -	8:00	AM	432	230	555	785	Yes	Yes	Yes	Yes	Yes
8:00 -	9:00	AM	277	269	434	703	Yes	Yes	Yes	Yes	Yes
9:00 -	10:00	AM	209	225	332	557	Yes	Yes	No	No	Verify
10:00 -	23:00	AM	159	236	294	529	Yes	Yes	No	No	No
11:00 -	12:00	PM	151	241	273	514	Yes	No	No	No	No
12:00 -	1:00	PM	170	268	263	530	Yes	Yes	No	No	No
1:00 -	2:00	PM	191	330	229	559	Yes	Yes	No	No	Verify
2:00 -	3:00	PM	208	375	242	617	Yes	Yes	Yes	Verify	No
3:00 -	4:00	PM	223	500	250	750	Yes	Yes	Yes	Yes	No
4:00 -	5:00	PM	261	755	279	1,034	Yes	Yes	Yes	Yes	Yes
5:00 -	6:00	PM	308	789	300	1,088	Yes	Yes	Yes	Yes	No
							Yes	N/A	N/A	Yes	N/A
						Warrants		1		2	3
						Met?		Yes		Yes	N/A

^{*}From the criteria described for the warrant in the MUTCD.

NON-VOLUME-BASED WARRANTS

Warrant 4, Minimum Pedestrian Volume: No No	Warrant 5, School Crossing: No
Peak Four Hour Pedestrian Volumes: 1	See MUTCD for details.
(non-concurrent) 2	
0	
0	
Total Peds per hour at Broadway/Willow Intersection	
Warrant 6, Coordinated Signal System:	Warrant 7, Crash Experience: No
See MUTCD for details.	# of accidents "correctable by
	signalization" occuring in the last 12 months:
Warrant 8, Roadway Network:	Warrant 9, Near a Grade Crossing: No
See MUTCD for details.	See MUTCD for details.

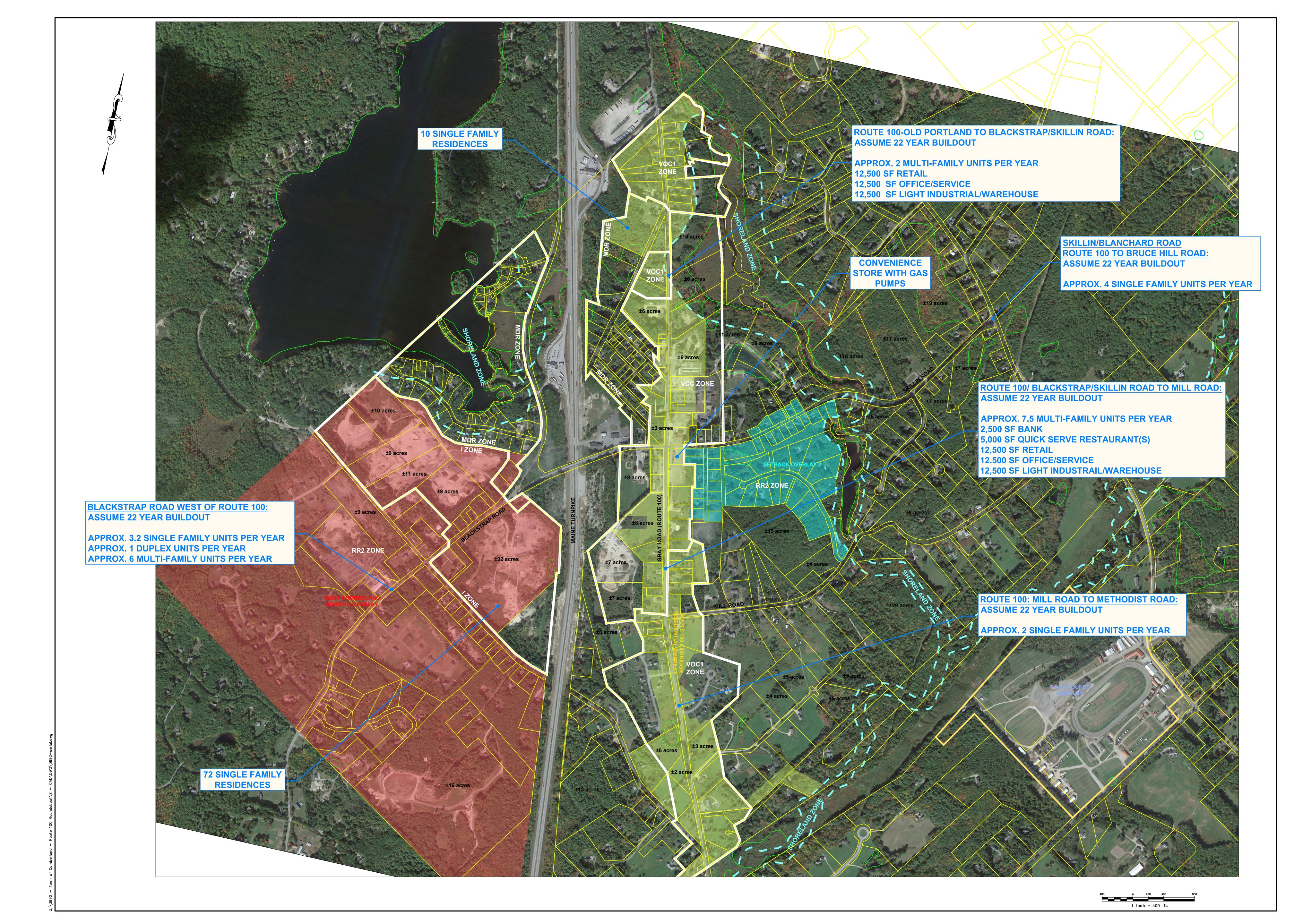
Source: Manual on Uniform Traffic Control Devices (MUTCD); 2009 Edition [2009]

^{**}FOR SAFETY ANALYSIS Warrant 7: If the operating speed is higher than 40mph or the population is less than 10,000 then the volumes can be adjusted to 56%. (If no adjusted minimum, the minimum from the previous column is shown)

⁺If more than one approach, report the approach that has the higher volume.

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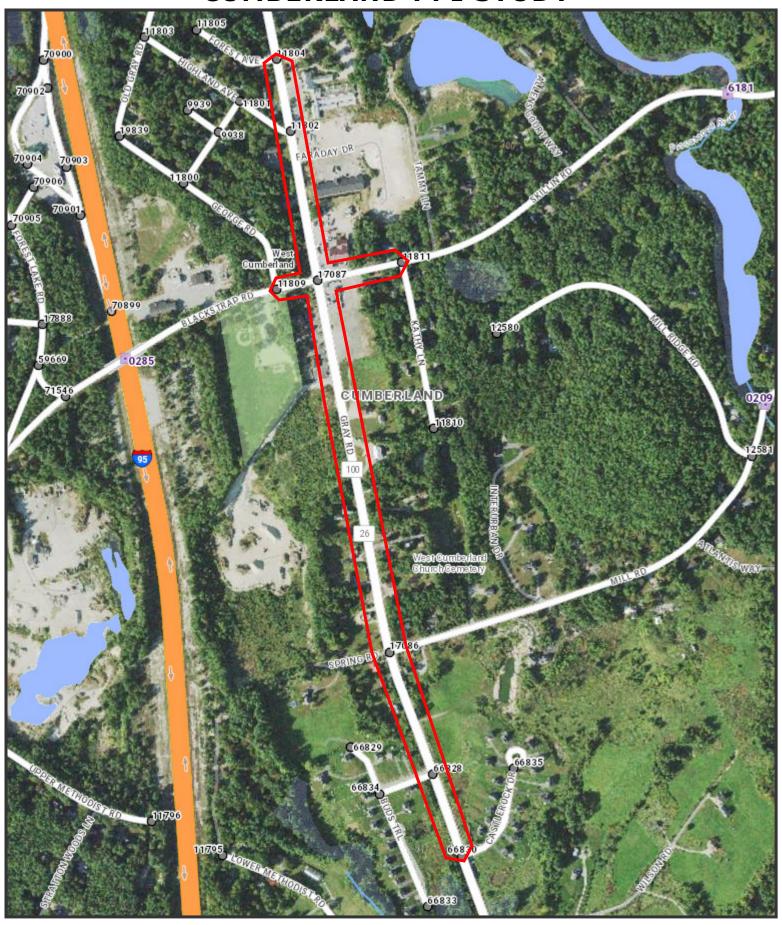
Land Use Growth Projections



Appendix E	A	g	g	e	n	d	ix	E
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Crash Data

CUMBERLAND PPI STUDY



The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch.

0.1 Miles
1 inch = 0.15 miles

Date: 5/17/2023 Time: 10:35:12 AM

Crash Summary Report

			Report Selections and In	put Parameters		
REPORT	SELECTIONS					
✓ Crash \$	Summary I	Section Detail		☐1320 Public	☐1320 Private	☐1320 Summary
Cumberlar Cumberlar The project through the aforement REPORT	nd PPI Study ct study area includes a	Road, Blackstrap	0.87-mile section of Gray Road (Ro Road, and Skillin Road in Cumberla Month: 12	,		•
Route: 0	0026X	Start Node: 6683 End Node: 1186			☐ Exclude First No	
Route: 0	0500443	Start Node: 1186 End Node: 1708		•	☐ Exclude First No	
Route: 0	0500443	Start Node: 1708 End Node: 118			✓ Exclude First No	

				Nodes										
Node	Route - MP	Node Description	U/R	Total		Injur	y Cra	shes		Percent A	Annual M	Crash Rate	Critical	CRF
				Crashes	K	Α	В	С	PD	Injury	Ent-Veh	Orașii Rate	Rate	Oiti
11804	0026X - 11.74	Int of FOREST AV GRAY RD	1	0	0	0	0	0	0	0.0	2.124 Sta	0.00 atewide Crash Rate	0.37 e: 0.11	0.00
17086	0026X - 11.07	Int of GRAY RD MILL RD	1	1	0	0	0	1	0	100.0	2.059 Sta	0.16 atewide Crash Rate	0.37 e: 0.11	0.00
11802	0026X - 11.66	Int of GRAY RD HIGHLAND AV	1	1	0	0	0	0	1	0.0	2.142 Sta	0.16 atewide Crash Rate	0.37 e: 0.11	0.00
17087	0026X - 11.49	Int of BLACKSTRAP RD GRAY RD SKILLIN RD	2	5	0	0	0	1	4	20.0	3.097 Sta	0.54 atewide Crash Rate	0.40 e: 0.14	1.34
66830	0026X - 10.83	Int of CASTLEROCK DR GRAY RD	1	0	0	0	0	0	0	0.0	1.947 Sta	0.00 atewide Crash Rate	0.38 e: 0.11	0.00
66828	0026X - 10.93	Int of GRAY RD ROOSTER RDG	1	0	0	0	0	0	0	0.0	1.942 Sta	0.00 atewide Crash Rate	0.38 e: 0.11	0.00
11809	0500443 - 6.69	Int of BLACKSTRAP RD GEORGE RD	2	0	0	0	0	0	0	0.0	1.098 Sta	0.00 atewide Crash Rate	0.46 e: 0.12	0.00
11811	0500443 - 6.84	Int of KATHY LN SKILLIN RD	2	0	0	0	0	0	0	0.0	1.008 Sta	0.00 atewide Crash Rate	0.50 e: 0.13	0.00
Study Y	'ears: 3.00	NODE TO	TALS:	7	0	0	0	2	5	28.6	15.417	0.15	0.24	0.64

Crash Summary I

							Secti	ons									
Start	End	Element	Offset	Route - MP	Section I	J/R	Total		Inju	ry Cra	shes		Percent	Annual	Crash Rate	Critical	CRF
Node	Node		Begin - End		Length		Crashes	K	Α	В	С	PD	Injury	HMVM		Rate	
66830 Int of CAST		4767284 DR GRAY RD	0 - 0.10	0026X - 10.83 ST RTE 26	0.10	1	3	0	0	0	0	3	0.0	0.00194	516.25 Statewide Crash R	477.80 Rate: 149.99	1.08
66828 Int of GRAY		3225053 STER RDG	0 - 0.14	0026X - 10.93 ST RTE 26	0.14	1	1	0	0	0	1	0	100.0	0.00271	122.92 Statewide Crash R	438.30 Rate: 149.99	0.00
17086 Int of GRA		3939633 .RD	0 - 0.42	0026X - 11.07 ST RTE 26	0.42	1	2	0	0	0	0	2	0.0	0.00852	78.22 Statewide Crash R	327.73 Rate: 149.99	0.00
11802 Int of GRA		3119177 HLAND AV	0 - 0.17	0026X - 11.49 ST RTE 26	0.17	1	1	0	0	0	0	1	0.0	0.00348	95.76 Statewide Crash R	410.83 Rate: 149.99	0.00
11802 Int of GRA		3106104 HLAND AV	0 - 0.08	0026X - 11.66 ST RTE 26	0.08	1	0	0	0	0	0	0	0.0	0.00176	0.00 Statewide Crash R	489.65 Rate: 149.99	0.00
11809 Int of BLAC		3117876 RD GEORGE	0 - 0.05 RD	0500443 - 6.69 RD INV 05 00443	0.05	2	0	0	0	0	0	0	0.0	0.00054	0.00 Statewide Crash R	645.48 Rate: 155.59	0.00
11811 Int of KATH		3106106 LLIN RD	0 - 0.10	0500443 - 6.74 RD INV 05 00443	0.10	2	0	0	0	0	0	0	0.0	0.00104	0.00 Statewide Crash R	574.99 Rate: 157.15	0.00
Study Ye	ears: 3	.00		Section Totals:	1.06		7	0	0	0	1	6	14.3	0.01999	116.73	271.23	0.43
				Grand Totals:	1.06		14	0	0	0	3	11	21.4	0.01999	233.45	321.77	0.73

Crash Summary

						Sect	ion D	etails						
Start	End	Element	Offset	Route - MP	Total		Inju	Injury Crashes		;	Crash Report	Crash Date	Crash	Injury
Node	Node		Begin - End		Crashes	K	Α	В	С	PD			Mile Point	Degree
66830	66828	4767284	0 - 0.10	0026X - 10.83	3	0	0	0	0	3	2021-30114	11/04/2021	10.84	PD
											2022-22714	08/05/2022	10.90	PD
											2021-29958	11/02/2021	10.91	PD
66828	17086	3225053	0 - 0.14	0026X - 10.93	1	0	0	0	1	0	2021-36292	12/18/2021	11.04	С
17086	17087	3939633	0 - 0.42	0026X - 11.07	2	0	0	0	0	2	2021-33994	12/01/2021	11.20	PD
											2022-2646	01/25/2022	11.43	PD
11802	17087	3119177	0 - 0.17	0026X - 11.49	1	0	0	0	0	1	2020-22269	09/17/2020	11.55	PD
11802	11804	3106104	0 - 0.08	0026X - 11.66	0	0	0	0	0	0				
11809	17087	3117876	0 - 0.05	0500443 - 6.69	0	0	0	0	0	0				
11811	17087	3106106	0 - 0.10	0500443 - 6.74	0	0	0	0	0	0				

Maine Department Of Transportation - Office of Safety, Crash Records Section Crash Summary II - Characteristics

										Cr	ashes	by D	ay an	d Ho	ur											
					AM Hour of Day PM																					
Day Of Week	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	Un	Tot
SUNDAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
MONDAY	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
TUESDAY	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
WEDNESDAY	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2
THURSDAY	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
FRIDAY	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
SATURDAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2
Totals	0	0	0	0	0	0	2	4	0	0	0	0	1	0	0	1	1	0	2	0	1	0	2	0	0	14

			Vehicle Counts	by Type
Unit Type	Total		Unit Type	Total
1-Passenger Car	11	23-Bicyclist		0
2-(Sport) Utility Vehicle	6	24-Witness		1
3-Passenger Van	0	25-Other		0
4-Cargo Van (10K lbs or Less)	0	26-Construction		0
5-Pickup	3	27-Farm Vehicle		0
6-Motor Home	0	28-Horse and Bugg	Jy	0
7-School Bus	0	Total		21
8-Transit Bus	0			2.
9-Motor Coach	0			
10-Other Bus	0			
11-Motorcycle	0			
12-Moped	0			
13-Low Speed Vehicle	0			
14-Autocycle	0			
15-Experimental	0			
16-Other Light Trucks (10,000 lbs or Less)	0			
17-Medium/Heavy Trucks (More than 10,000 lbs)	0			
18-ATV - (4 wheel)	0			
20-ATV - (2 wheel)	0			
21-Snowmobile	0			
22-Pedestrian	0			

Crashes by Driv	ver Ac	tion at	Time	of Cra	sh		
Driver Action at Time of Crash	Dr 1	Dr 2	Dr 3	Dr 4	Dr 5	Other	Total
No Contributing Action	5	5	0	0	0	0	10
Ran Off Roadway	2	0	0	0	0	0	2
Failed to Yield Right-of-Way	3	0	0	0	0	0	3
Ran Red Light	1	0	0	0	0	0	1
Ran Stop Sign	0	0	0	0	0	0	0
Disregarded Other Traffic Sign	0	0	0	0	0	0	0
Disregarded Other Road Markings	0	0	0	0	0	0	0
Exceeded Posted Speed Limit	0	0	0	0	0	0	0
Drove Too Fast For Conditions	1	0	0	0	0	0	1
Improper Turn	0	0	0	0	0	0	0
Improper Backing	0	0	0	0	0	0	0
Improper Passing	0	0	0	0	0	0	0
Wrong Way	0	0	0	0	0	0	0
Followed Too Closely	0	1	0	0	0	0	1
Failed to Keep in Proper Lane	0	0	0	0	0	0	0
Operated Motor Vehicle in Erratic, Reckless, Careless, Negligent or Aggressive Manner	1	0	0	0	0	0	1
Swerved or Avoided Due to Wind, Slippery Surface, Motor Vehicle, Object, Non-Motorist in Roadway	0	0	0	0	0	0	0
Over-Correcting/Over-Steering	0	0	0	0	0	0	0
Other Contributing Action	1	0	0	0	0	0	1
Unknown	0	0	0	0	0	0	0
Total	14	6	0	0	0	0	20

Crashes by Appa	rent Phy	sical C	onditi	on An	d Driv	er	
Apparent Physical Condition	Dr 1	Dr 2	Dr 3	Dr 4	Dr 5	Other	Total
Apparently Normal	13	6	0	0	0	0	19
Physically Impaired	0	0	0	0	0	0	0
Emotional(Depressed, Angry, Disturbed, etc.)	0	0	0	0	0	0	0
III (Sick)	0	0	0	0	0	0	0
Asleep or Fatigued	0	0	0	0	0	0	0
Under the Influence of Medications/Drugs/Alcohol	1	0	0	0	0	0	1
Other	0	0	0	0	0	0	0
Total	14	6	0	0	0	0	20

		Drive	r Age by Uni	t Type		
Age	Driver	Bicycle	SnowMobile	Pedestrian	ATV	Total
09-Under	0	0	0	0	0	0
10-14	0	0	0	0	0	0
15-19	2	0	0	0	0	2
20-24	5	0	0	0	0	5
25-29	3	0	0	0	0	3
30-39	5	0	0	0	0	5
40-49	1	0	0	0	0	1
50-59	2	0	0	0	0	2
60-69	1	0	0	0	0	1
70-79	0	0	0	0	0	0
80-Over	1	0	0	0	0	1
Unknown	0	0	0	0	0	0
Total	20	0	0	0	0	20

Crash Summary II - Characteristics

Total

0

0

0

0

20

Most Harmful Event

38-Other Fixed Object (wall, building, tunnel, etc.)

40-Gate or Cable

41-Pressure Ridge

	Most Har	mful Event
Most Harmful Event	Total	
1-Overturn / Rollover	0	38-Other Fixe
2-Fire / Explosion	0	39-Unknown
3-Immersion	0	40-Gate or C
4-Jackknife	0	41-Pressure
5-Cargo / Equipment Loss Or Shift	0	Total
6-Fell / Jumped from Motor Vehicle	0	
7-Thrown or Falling Object	0	
8-Other Non-Collision	0	
9-Pedestrian	0	
10-Pedalcycle	0	
11-Railway Vehicle - Train, Engine	0	
12-Animal	3	
13-Motor Vehicle in Transport	16	
14-Parked Motor Vehicle	0	
15-Struck by Falling, Shifting Cargo or Anything	0	
Set in Motion by Motor Vehicle		
16-Work Zone / Maintenance Equipment	0	
17-Other Non-Fixed Object	0	1-Traffic Signature
18-Impact Attenuator / Crash Cushion	0	2-Traffic Signature
19-Bridge Overhead Structure	0	3-Advisory/
20-Bridge Pier or Support	0	4-Stop Sigr
21-Bridge Rail	0	5-Stop Sigr
22-Cable Barrier	0	6-Yield Sig
23-Culvert	0	7-Curve Wa
24-Curb	0	8-Officer, F
25-Ditch	0	9-School B
26-Embankment	0	10-School 2
27-Guardrail Face	0	11-R.R. Cro
28-Guardrail End	0	12-No Pass
29-Concrete Traffic Barrier	0	13-None
30-Other Traffic Barrier	0	14-Other
31-Tree (Standing)	0	
32-Utility Pole / Light Support	1	Total
33-Traffic Sign Support	0	
34-Traffic Signal Support	0	
35-Fence	0	
36-Mailbox	0	
37-Other Post, Pole, or Support	0	

Traffic Control Devices	
Traffic Control Device	Total
1-Traffic Signals (Stop & Go)	1
2-Traffic Signals (Flashing)	4
3-Advisory/Warning Sign	0
4-Stop Signs - All Approaches	0
5-Stop Signs - Other	2
6-Yield Sign	0
7-Curve Warning Sign	0
8-Officer, Flagman, School Patrol	0
9-School Bus Stop Arm	0
10-School Zone Sign	0
11-R.R. Crossing Device	0
12-No Passing Zone	0
13-None	7
14-Other	0
Total	14

	Injury Data	
Severity Code	Injury Crashes	Number Of Injuries
K	0	0
Α	0	0
В	0	0
С	3	4
PD	11	0
Total	14	4

	Road Character	
	Road Grade	Total
1-Level		9
2-On Grade		4
3-Top of Hill		0
4-Bottom of Hill		1
5-Other		0
Total		14

Light	
Light Condition	Total
1-Daylight	8
2-Dawn	1
3-Dusk	1
4-Dark - Lighted	1
5-Dark - Not Lighted	3
6-Dark - Unknown Lighting	0
7-Unknown	0
Total	14

Crash Summary II - Characteristics

Crashes by Year and Month

Month	2020	2021	2022
JANUARY	0	0	2
FEBRUARY	0	0	0
MARCH	0	0	1
APRIL	0	2	0
MAY	0	0	1
JUNE	0	0	0
JULY	0	0	1
AUGUST	0	0	1
SEPTEMBER	1	0	0
OCTOBER	0	0	0
NOVEMBER	0	2	0
DECEMBER	0	2	1
Total	1	6	7

Report is limited to the last 10 years of data.

					Crashes	s by Crash	Type ar	nd Type of L	ocation						
Crash Type	Straight Road	Curved Road	Three Leg Intersection	Four Leg Intersection	Five or More Leg Intersection	Driveways	Bridges	Interchanges	Other	Parking Lot	Private Way	Cross Over	Railroad Crossing	Traffic Circle- Roundabout	Total
Object in Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rear End - Sideswipe	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Head-on - Sideswipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intersection Movement	0	0	2	3	0	0	0	0	0	0	0	0	0	0	5
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Train	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Went Off Road	2	0	0	0	0	1	0	0	0	0	0	0	0	0	3
All Other Animal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jackknife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rollover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fire	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Submersion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thrown or Falling Object	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deer	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Moose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	6	0	2	5	0	1	0	0	0	0	0	0	0	0	14

			Crashe	s by Wea	ther, Light (Condition a	and Road S	Surface				
Weather Light	Dry	Ice/Frost	Mud, Dirt, Gravel	Oil	Other	Sand	Slush	Snow	Unknown	Water (Standing, Moving)	Wet	Total
Blowing Sand, Soil, Dirt												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Blowing Snow												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Clear												
Dark - Lighted	1	0	0	0	0	0	0	0	0	0	0	1
Dark - Not Lighted	1	0	0	0	0	0	0	0	0	0	0	1
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	7	0	0	0	0	0	0	1	0	0	0	8
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Cloudy												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	1	0	0	0	0	0	0	0	0	0	0	1
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	1	0	0	0	0	0	0	0	0	0	0	1
Unknown	0	0	0	0	0	0	0	0	0	0	0	0

Weather Light	Dry	Ice/Frost	Mud, Dirt, Gravel	Oil	Other	Sand	Slush	Snow	Unknown	Water (Standing, Moving)	Wet	Total
Fog, Smog, Smoke												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Other												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Rain												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	1	1
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Severe Crosswinds												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0

			Crashes	s by Wea	ther, Light (Condition a	and Road S	urface				
Weather Light	Dry	Ice/Frost	Mud, Dirt, Gravel	Oil	Other	Sand	Slush	Snow	Unknown	Water (Standing, Moving)	Wet	Total
Bleet, Hail (Freezing Rain or D	rizzle)											
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Snow												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	1	0	0	0	1
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
OTAL	11	0	0	0	0	0	0	2	0	0	1	14

A	p	p	e	n	d	ix	F
•	_				•		•

Evaluation Matrix

	Alternative #1	Alternative #2	Alternative #3	No Build
CRITERIA	Roundabout	Unsignalized with Raised Intersection	Signalized	Do Nothing
Traffic Operations (LOS AM/PM)	LOS B/C	LOS F/F	LOS C/C	LOS F/F
Meets Warrants in current year	Yes	Yes	No	Yes
Maintains Mobility (vehicles)	Yes	No	Yes	No
Improves Safety (vehicles)	Yes	Yes	Yes	No
Improves Safety (peds, bicycles)	Yes	Yes	Yes	No
Pedestrian & Bicycle Accommodations	Yes	Yes	Yes	Poor
Encourages Village Scale Redevelopment	Yes	Less	Yes	No
Improves on Traffic Calming (speeds)	Yes	Yes	Less than others	No
Creates Confusing Geometry	No (single lane roundabout)	Yes	No	No
Provides Access Management	Yes	Yes	Yes	No
Property Impacts	Slightly more	Same as Alt 3	Same as Alt 2	None
Provides for Gateway Opportunities	Yes	Not really	Less than Alt #1	No
Total Project Costs (Construction, PE, CE, ROW)	\$14.4M	\$12.4M	\$13.1M	None
MEET PURPOSE & NEED	YES	NO	NO	NO

Appendix G

Public Outreach

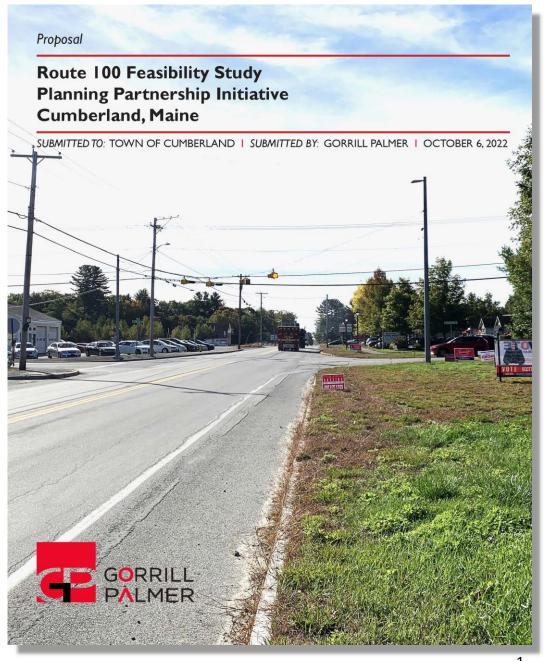
<u>Cumberland</u> Route 100 Study

Safety & Economic Development Improvements

Public Information Meeting

May 25, 2023





Study Team

(Planning Partnership Initiative)

Consultant

- Gorrill Palmer
- **VHB**
- Terrence J DeWan & Associates

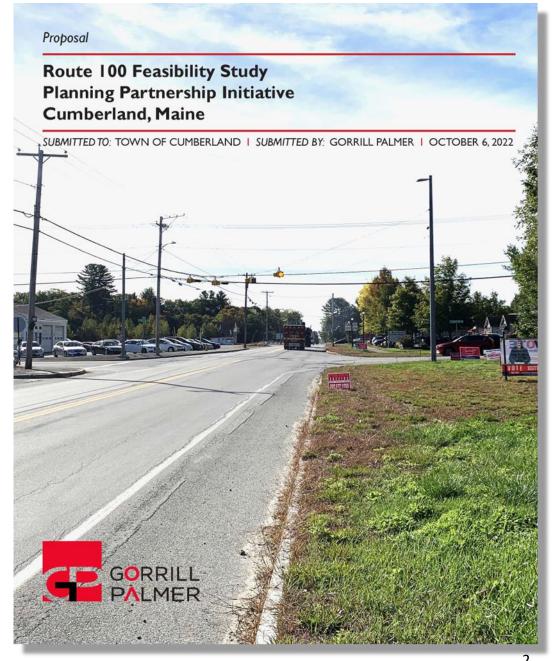
Municipality

Cumberland (William Shane)

MaineDOT

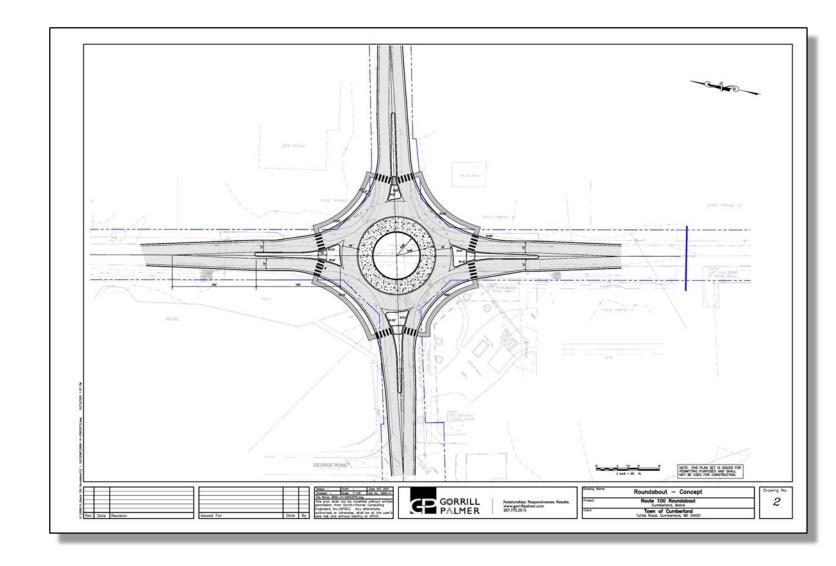
Stephen Cole





Background

- Prior Planning Work
- Town Initiative
- State Roadways (Route 100/26)
- PPI Study (State Involvement)
- Leverage State & Federal Funds





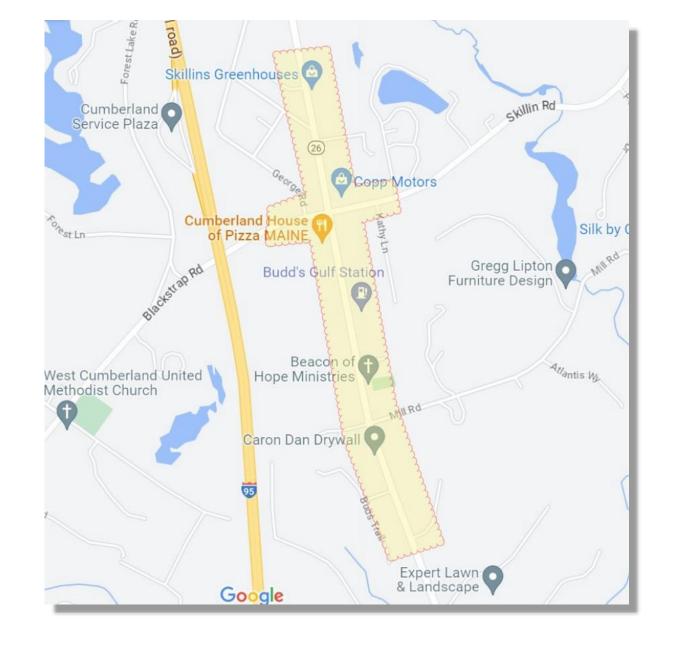
Location Map

Gray Road (Route 100/26)

- Skillins Greenhouse to Castle Rock Drive
- Length = 0.89 Miles

Blackstrap Road

Skillin Road





Study Scope

(Transportation Planning Study)

- Traffic Operations
- Corridor Safety (HCL)
- Reduce Speeds
- Review Access Management
- Pedestrian and Bicycle Accommodations
- Economic Development
- Land Use Goals











Purpose & Need Statement

The <u>purpose</u> of this study at the Route 100 intersection with Blackstrap Road and Skillin Road is to identify a range of implementable alternatives to improve the safety and mobility for all modes of transportation both now and into the future and to create conditions that will allow for mixed-use, village scale redevelopment.

The <u>needs</u> of this study include improving safety at the intersection and intersection approaches, controlling excessive speeds along Route 100 and providing for improved access management within the study area while maintaining mobility.



Site Visit / Safety Audit

Blackstrap Road & Skillin Road

- Flashing Stop Ahead Signs
- Supplemental Oversized Stop Signs
- HCL Mitigation Measures







Site Visit / Safety Audit

- Flashing Beacon System
- Intersection Sight Distance
- Utility Pole Offsets
- Coffee Shop Backups







Site Visit / Safety Audit

- High Speeds (35 to 50 mph)
- Intersection Sight Distance at Mill Road
- Pedestrian Accommodations
- Traffic Calming







Crash Data

2020-2022: 5 crashes and CRF 1.34

2019-2021: 4 crashes and CRF 1.21

2016-2018: 8 crashes and CRF 2.10 (HCL)

2015-2017: 11 crashes and CRF 3.08 (HCL)

2014-2016: 9 crashes and CRF 2.55 (HCL)

HCL = high crash location







Traffic Assessment

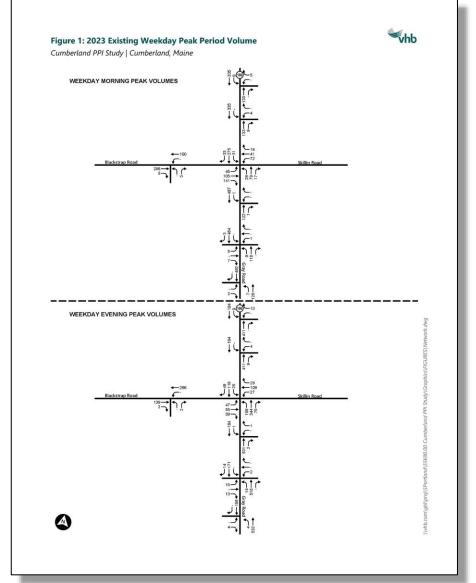
Traffic Counts Traffic Analysis Vissim Modeling

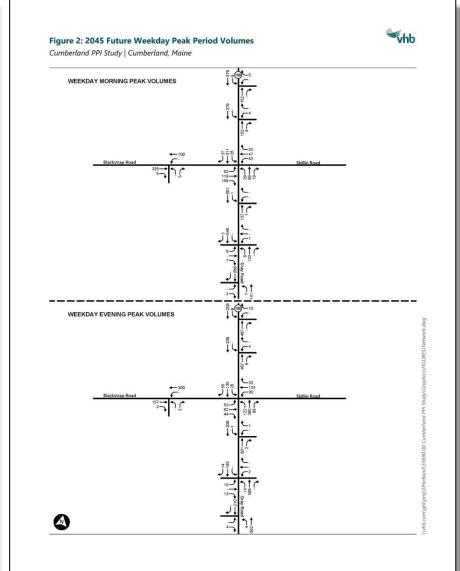
- Existing Condition
- Future No Build Condition (2045)
- Future Build Scenarios





Traffic Assessment







Traffic Assessment

Future Build Scenarios

- Roundabout
- Signal/Unsignalized Intersection
- Land Use Redevelopment
- Future Trip Generations
- Signal Warrant Analysis



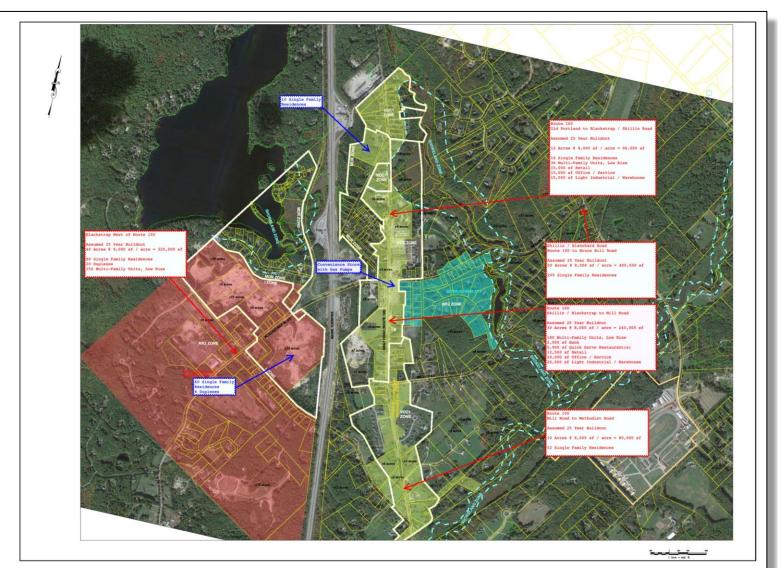


Land Use Redevelopment

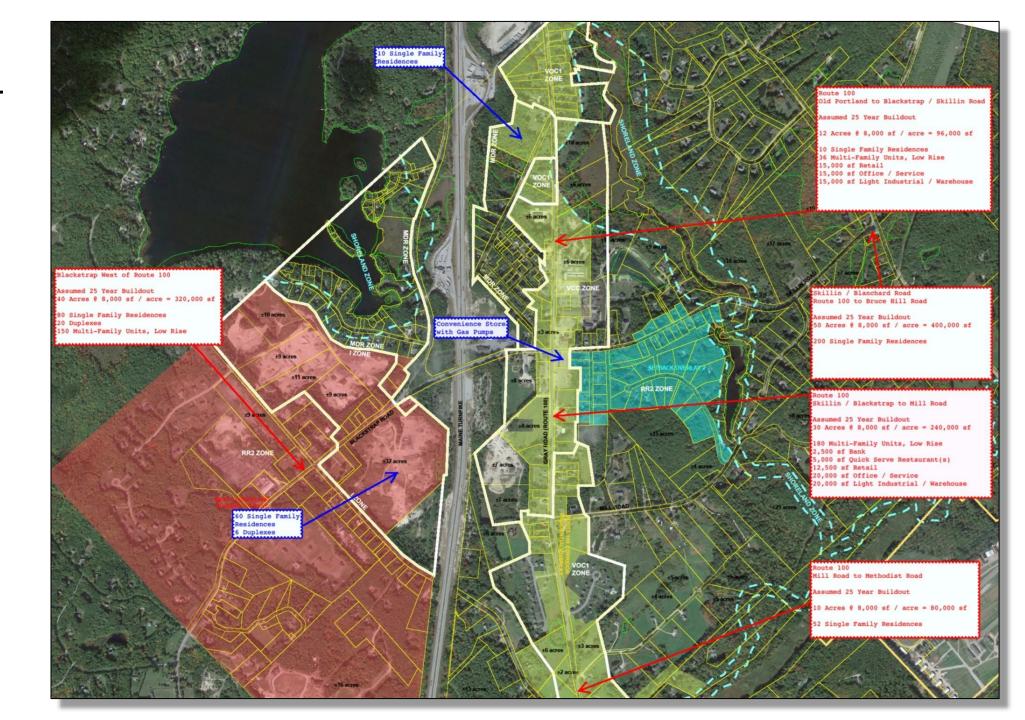
Potential Buildout Assumptions

- Buildout Prior 25 years
- Past /Current Zoning
- Comprehensive Plan
- New Development
- Town Planner Discussions (highest & best uses)
- State Initiatives for Attainable & Affordable Housing
- Recent Development Trends





Potential Buildout





- Roundabout
- Unsignalized Intersection
- Pedestrian / Bike Accommodations
- Safety Improvements
- Traffic Calming
- Access Management
- Center Turn Lane
- Supported by Traffic Analysis



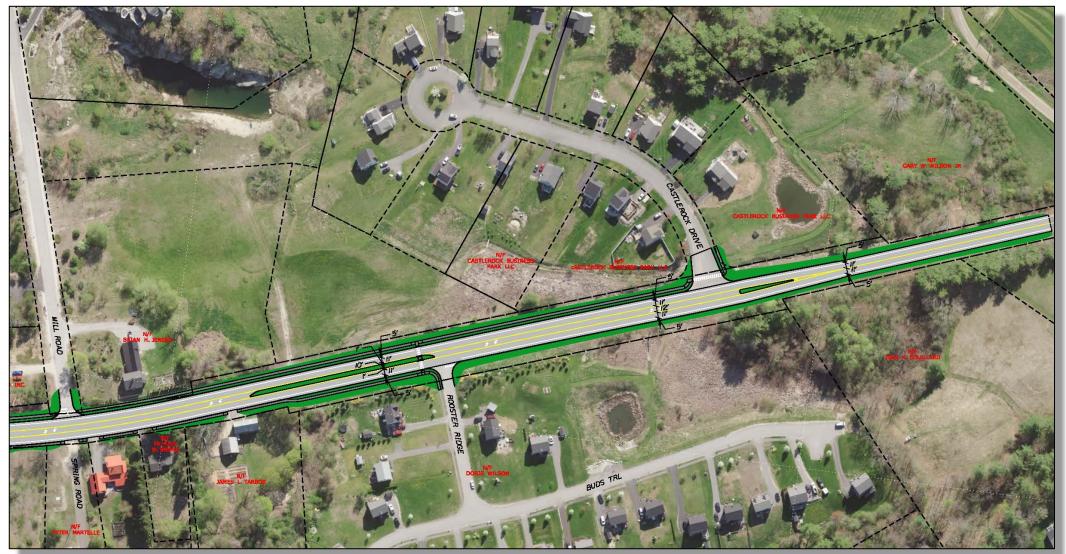






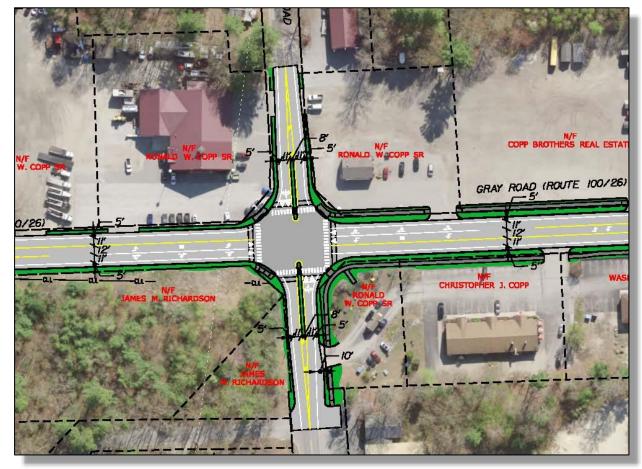








- Roundabout
- Unsignalized Intersection
- Pedestrian / Bike Accommodations
- Safety Improvements
- Traffic Calming
- Access Management
- Center Turn Lane
- Supported by Traffic Analysis



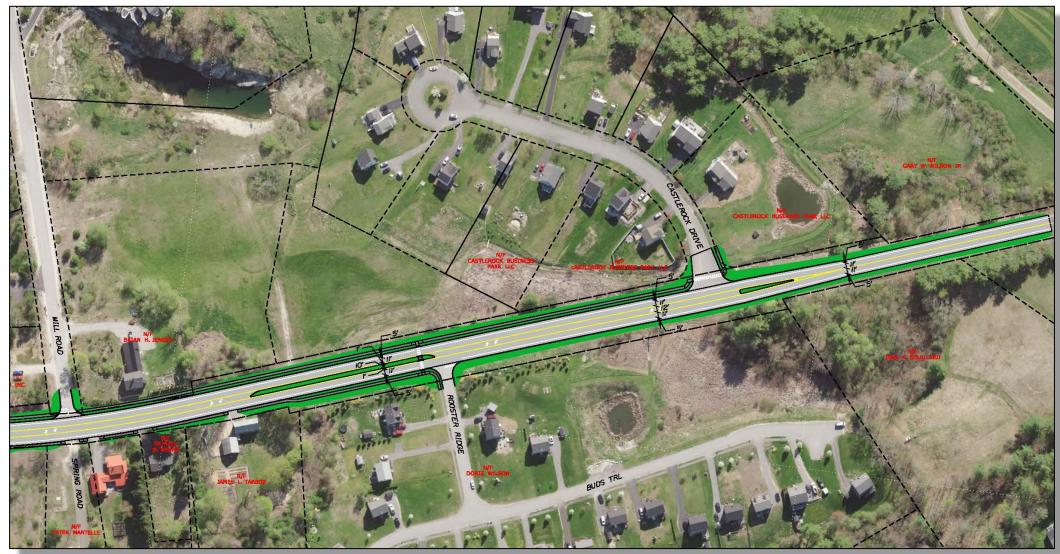














Scope & Schedule

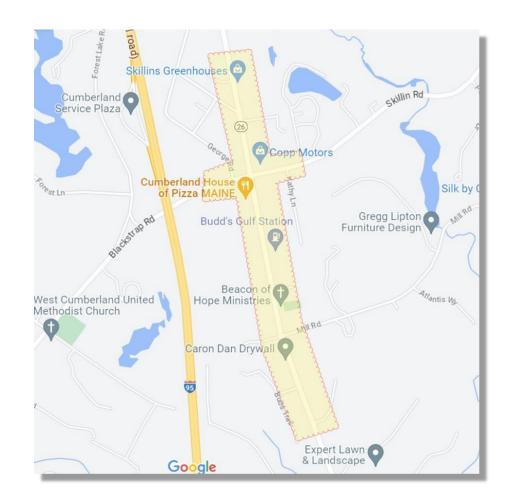
- Study Startup January 2023
- Data Gathering March 2023
- Preliminary Traffic Analysis, Land Use
 Assessment, Concepts April/May 2023
- Site Visit & Safety Audit May 2023
- Public Mtg 1 May 2023
- Concepts, Analysis, Findings, Team Mtgs
- Public Mtg 2 Summer 2023
- Draft/Final Reports –Summer/Fall 2023







Public Input











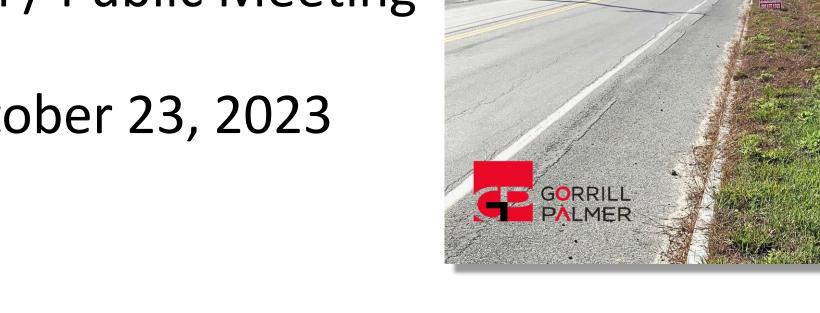


Cumberland Route 100 Study

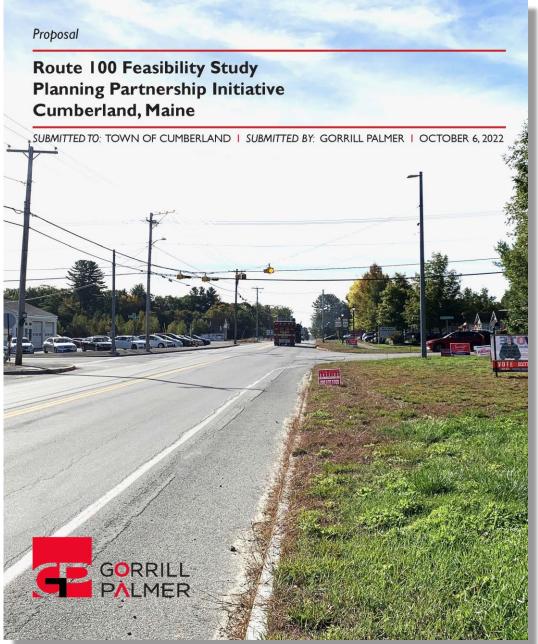
Safety & Economic Development **Improvements**

Council / Public Meeting

October 23, 2023







Study Team

(Planning Partnership Initiative)

Consultant

- Gorrill Palmer
- VHB
- Viewshed (TJD&A)

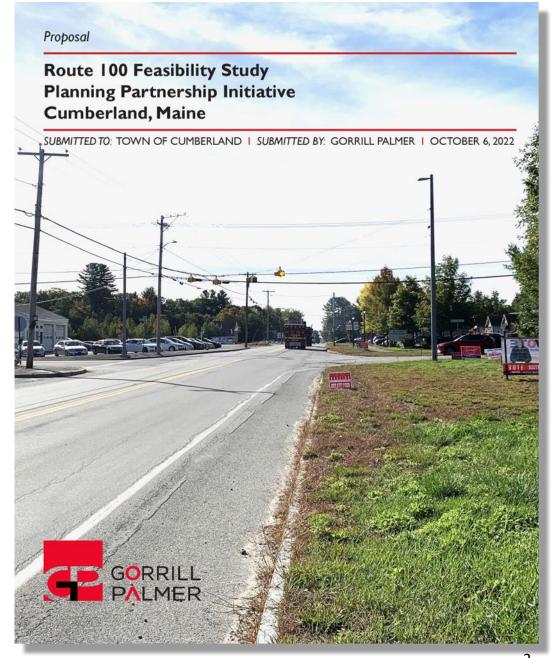
Municipality

Cumberland

MaineDOT

Stephen Cole





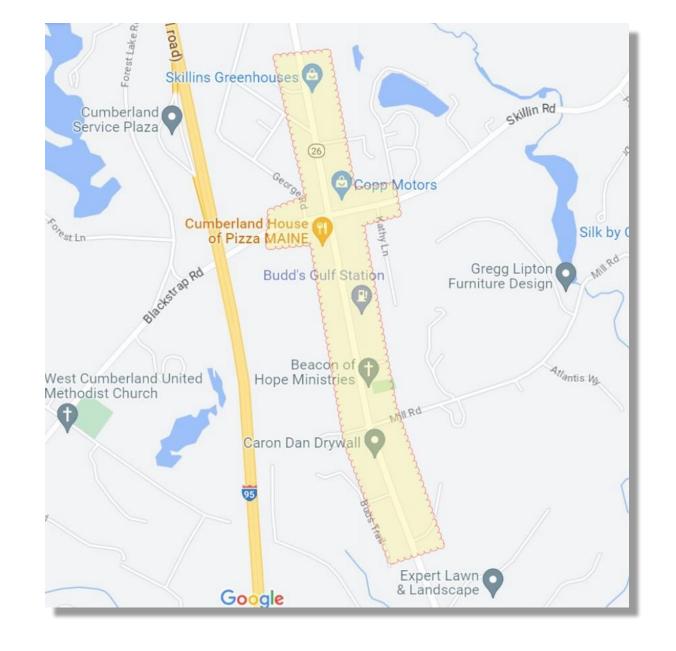
Study Limits

Gray Road (Route 100/26)

- Skillins Greenhouse to Castle Rock Drive
- Length = 1.06 Miles

Blackstrap Road (to MTA)

Skillin Road (to Tammy Lane)





Study Scope

(Transportation Planning Study)

- Traffic Operations
- Safety
- Controlling Speeds
- Access Management
- Pedestrian and Bicycle Accommodations
- Economic Development













Date: October 20, 2023 Memorandum

Re: Route 100 at Blackstrap Road / Skillin Road VISSIM Analysis

Project #: 55690.00

Jason Ready, PE, PTOE, PTP Cumberland, Maine

Introduction

To: Don Ettinger, PE

From: Adam Prichard, PE

Gorrill-Palmer

300 Southborough Drive, Suite 200 South Portland, ME 04106

VHB has performed VISSIM and SIDRA traffic model analyses associated with the Cumberland PPI project in Cumberland, Maine at the intersection of Route 100 at Blackstrap Road & Skillin Road for Gorrill Palmer in support of a municipal PPI planning study. The analyses involved evaluating existing conditions (2023), a future (2045) 'No-Build' scenario, and two future (2045) traffic control alternatives (traffic signal and roundabout). The traffic control alternatives are based on certain area land use assumption, as determined by Gorrill Palmer and confirmed by the

This memorandum summarizes the simulation modeling methodology and results.

Traffic Volumes

In addition to a seasonal adjustment, an annual growth rate was applied to estimate the traffic volumes that will be experienced during the analysis year. An annual growth rate of 0.5% per year has been applied to the seasonally adjusted volumes, as directed by MaineDOT staff. Traffic volumes are attached as an appendix.

VISSIM Modeling

VISSIM is a transportation planning and operations software package designed to provide a visual and analytical representation of traffic operations on a full range of functionally classified roadways. VISSIM has been widely used in various urban and highway applications and can effectively simulate complicated driving behavior on modern roadway facilities. VISSIM was utilized because of its powerful capability to simulate traffic operations and address transportation challenges in complex networks.

SIDRA Modeling

For the roundabout analysis, SIDRA traffic modeling software was utilized in place of the VISSIM software. SIDRA is recognized as a better choice for the specific traffic modeling that roundabouts experience.

Model Description

The models includes the Route 100 at Blackstrap Road & Skillin Road intersection and several adjacent driveways in Cumberland, Maine. The VISSIM model was created for the weekday morning and evening peak hours under 2023 Existing and 2045 Future conditions using VISSIM 2021 software.

Simulation Methodology

The model development primarily consists of three steps:



Delay - Unsignalized Intersection 0 to 10 seconds 10 to 15 seconds 15 to 25 seconds 25 to 35 seconds 35 to 50 seconds Greater than 50 seconds

Existing, 2045 No-Build, and 2043 Build alternative conditions

ario modeled. These results are based on the average of ten

п	Scenario	Volume ^a	Delay	LOS	
	Evening Peak				
	Existing	1,123	11	LOS B	
	Future - No Build	1,586	61	LOS F	
	Future - Signal	1,587	31	LOS C	
-1	Future - Roundabout	1,868	20	LOS C	

of the peak hour. This number will vary with each distinct model run.

summary results for the intersection in Table 2, the overall ider all Build scenarios, with significant increases in capacity d conditions. The No-Build condition operates poorly during nmended as a viable option.

enario for both morning and evening peak periods for all nodels, delay and queueing appear to be manageable in all (each Build scenario is based on a single lane for each ueuing results.



Traffic Analysis

Current Year – 2023

Design Year - 2045

Unsignalized Alt.

Roundabout Alt.

Signalized Alt.

No Build Alt.

Land Use Growth Projections

- Inputs into Traffic Modeling
- Reasonable Growth Assumptions
- Input from Town





Traffic Analysis – Findings

Table 3: Capacity Analysis - Comparison

ĺ		2023 Ex	isting			2045 No	o-Build		2	2045 Build	d - Signal		204	5 Build -	Roundab	oute
Approach	Volume ^a	Delay ^b	LOSc	95 th % Queue ^d	Volume	Delay	LOS	95 th % Queue	Volume	Delay	LOS	95 th % Queue	Volume	Delay	LOS	95 th % Queue
Morning Peak																
Eastbound	316	27	LOS D	360	332	119	LOS F	1,634	428	28	LOS C	513	470	19	LOS C	163
Westbound	144	13	LOS B	132	187	24	LOS C	215	186	33	LOS C	282	201	6	LOS A	23
Northbound	135	5	LOS A	84	239	9	LOS A	189	239	22	LOS C	328	251	6	LOS A	31
Southbound	368	5	LOS A	101	563	6	LOS A	193	561	21	LOS C	492	604	11	LOS B	128
Total	963	13	LOS B		1,321	37	LOS E		1,414	25	LOS C		1,526	12	LOS B	
Evening Peak																
Eastbound	155	21	LOS C	222	196	211	LOS F	1,629	304	31	LOS C	378	325	7	LOS A	43
Westbound	180	21	LOS C	193	221	182	LOS F	582	266	23	LOS C	303	283	17	LOS C	81
Northbound	576	7	LOS A	385	868	13	LOS B	715	715	40	LOS D	757	935	29	LOS D	851
Southbound	213	6	LOS A	133	303	17	LOS C	368	303	17	LOS B	319	326	9	LOS A	48
Total	1,124	11	LOS B		1,588	62	LOS F		1,588	31	LOS C		1,868	20	LOS C	

a Volume processed for the movement for the peak hour. This number will vary with each distinct model run.

e Analysis completed with SIDRA software



b Delay for movement in seconds

c Level of service for movement

d 95th percentile queue in feet

Project #: 55690.00

Memorandum

et are forecast to be v housing, light industrial,

The forecast trip

rtation Engineers' (ITE) Trip

development trip generation

Γotal	
853	
1135	

ajor street. arrant 5 is

d benefit

he potential development ture development are shown

lopment. Additional traffic rs. To estimate the traffic ary assumptions were made:

urs is equal to 85% of the

vay from the peak hour assed on development ampleted in response to

rrant 7 ounter-

ceed the threshold volumes e and 2045 traffic volumes refore, **Warrant 1** is **not met**

and 2045 traffic volumes

herefore Warrant 2 is not

or ed the threshold volumes

appears as a ore, Warrant

ear projected

part of

Don Ettinger, PE



To: Don Ettinger, PE
Gorrill Palmer
300 Southborough Drive, Suite 200
South Portland, ME 04106

From: Jason Ready, PE, PTOE, PTP Re: Route 100/Blackstrap Road Signal Warrant Analysis

The following memorandum summarizes the methodology and results of the analysis.

Emily Leighton, Michael Cristiani Cumberland, Maine

VHB was requested to complete a traffic signal warrant analysis for the intersection of Route 100 with Blackstrap Road and Skillin Road in Cumberland. Maine as part of the Planning Partnership Initiative study for the town of Cumberland.

Signal Warrant Analysis

A traffic signal warrant analysis is completed based on the nine warrants outlined by the 2009 Edition of the Manual on Uniform Traffic Control Devices (MUTCD), Chapter 4C. The nine warrants are as follows:

Warrant 1 – Eight Hour Vehicular Volume

Warrant 6 – Coordinated Signal System
 Warrant 7 – Crash Experience

Warrant 2 – Four Hour Vehicular Volume
 Warrant 3 – Peak Hour

> Warrant 8 – Roadway Network

> Warrant 4 – Pedestrian Volumes

> Warrant 9 - Intersection Near a Grade Crossing

Memorandum

> Warrant 5 - School Crossing

Warrants 1, 2, and 3 are based on the number of vehicles moving through the intersection and are most commonly used. Warrants 4-9 are based on other characteristics of the intersection and surrounding roadway network. The intersection currently is not warranted for a traffic signal. A traffic signal warrant analysis for 2023 is attached.

Traffic Volumes

Warrants 1-3 are based on the hourly volume of traffic moving through the intersection on an average day. The analysis year for the intersection is 2045. Turning movement counts were completed at the intersection of Route 100 with Blackstrap Road and Skillin Road by MaineDOT on Friday, October 26, 2018 from 6:00 AM to 6:00 PM. Detailed counts are shown in the attached spreadsheet. The following summarizes the adjustments made to the turning movement counts to estimate the future volumes that may be experienced on the average day in 2045.

Seasonal Adjustment

MaineDOT weekly group mean factors were used to adjust the traffic volumes to those anticipated to be experienced on an average day. For turning movement counts collected during the week of October 21, an adjustment of 0.92 was applied to the raw volumes. Traffic volumes are attached as an appendix.

Annual Growth

In addition to a seasonal adjustment, an annual growth rate was applied to estimate the traffic volumes that will be experienced during the analysis year. The signal warrant analysis is being completed for 2045 and an annual growth rate of 0.5% per year has been applied to the seasonally adjusted volumes, as directed by MaineDOT staff.

GORRILL PALMER

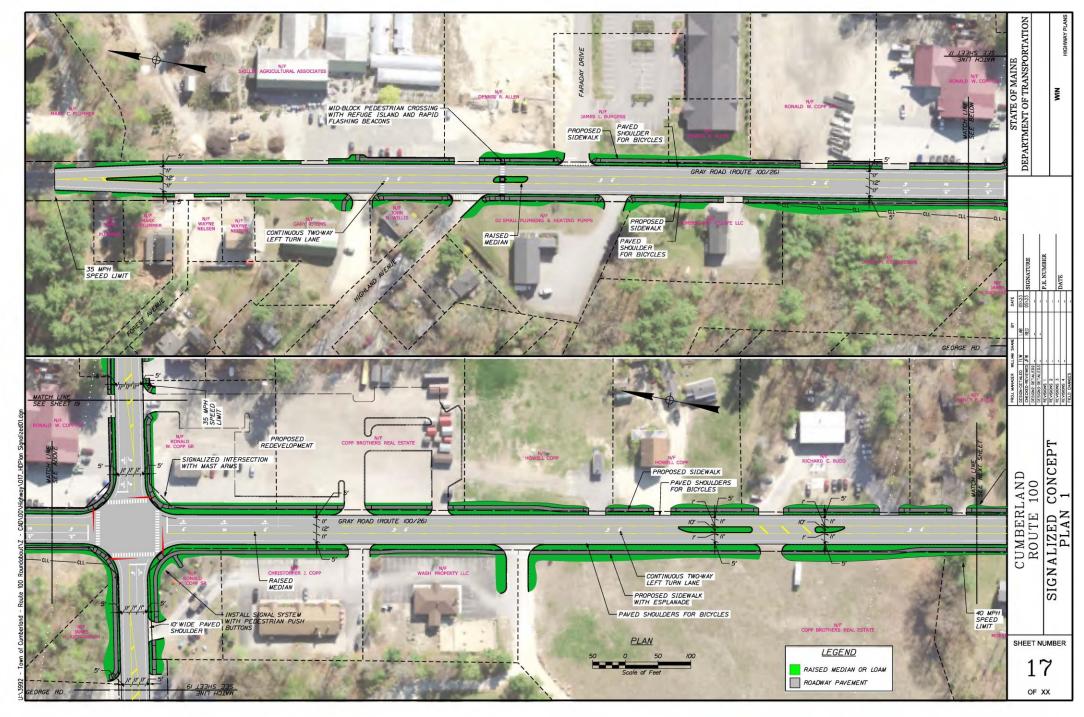
Traffic Analysis

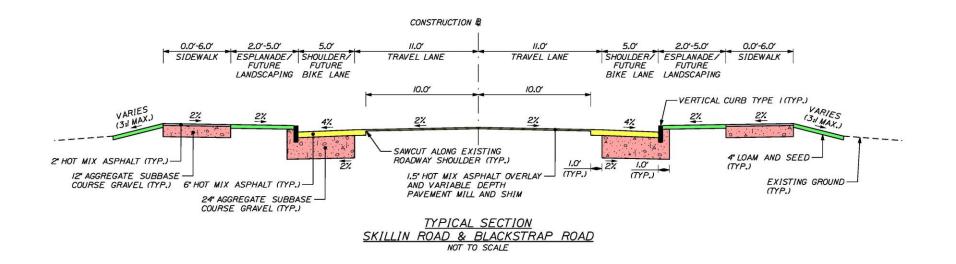
Signal Warrants

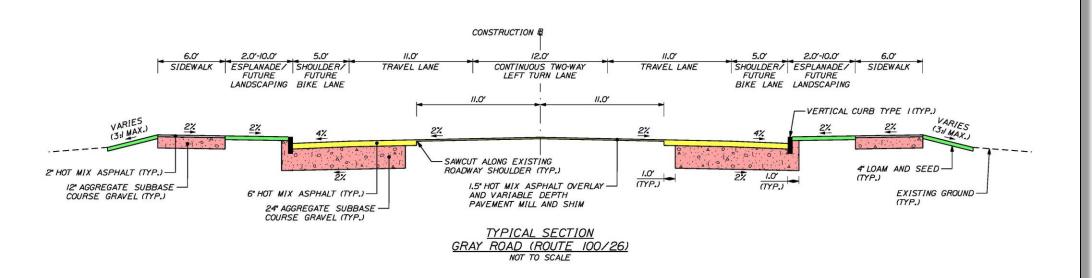
Current Year – 2023

Design Year - 2045

Engineers Scientists Planners Designers
500 Southborough Drive, Suite 1058, South Portland, Maine 04106
P 207.889.3150 F 207.253.5596 www.vhb.com







Prior Comments

- ✓ Cost of options
- ✓ Extending sidewalks
- ✓ Mid-block crossing at Highland
- ✓ BruThru access concerns
- ✓ Gulf Gas access concerns
- ✓ Size of roundabout
- ✓ Property impacts
- ✓ Short term safety concerns





Project Costs

- Roundabout \$12.4M
- Unsignalized \$10.7M
- Signalized \$11.2M
- Total Costs (construction, engineering, inspection, right of way)

Gorrill Palmer Opinion of Probable Construction Cost

Job Number: 3992
VINN 2885 00
Project Name: Route 100 Feasibility Study
Project Layout: Roundabout Concept Plan
Project Loadion: Cumberfand, Maine
Comments: Opinion of Probable Cost - Roundabout Concept Plan - Construction Cost Estimate
Date: 8/23/2023

Calculated By: Ellie Robinson, Amelia Nel Checked By: Jared Winchenbach

Notes:
1. Opinion of probable cost does not include engineering, inspection, right of way, environmental, lighting or utility costs.

3. The unit prices are base upon recently constructed and/or bid projects from the Maine DOT and other LAP projects.

4. The Concept Plan assumes that widening of the existing roadway corridor will begin at the existing shoulder and that a 1 1/2" overlay is planned for all of the roadways (Route 100, Skillin Road, and Blackstrap Road) within the project limits.

Concept Plans assumed that full depth reconstruction will be used for the roundaout as well as +/-250' on each approach

	Item	Item Description	Unit	Quantity	U	nit Price		Amount
_	202.202	REMOVING PAVEMENT SURFACE	SY	18900	\$	20.00	ş	378,000.0
_	203.20	COMMON EXCAVATION	CY	18700	\$	70.00	\$	1,309,000.0
1	304.10	AGGREGATE SUBBASE COURSE - GRAVEL	CY	13000	S	80.00	S	1,040,000.0
7)	403,208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE	Т	1250	S	275.00	S	343,750.0
	403.208	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE (OVERLAY)	T	1550	S	275.00	S	426,250.0
	403.209	HOT MIX ASPHALT, 9.5 MM NOMINAL MAXIMUM SIZE (SIDEWALKS, DRIVES, ISLANDS & INCIDENTALS)	Т	1200	\$	300.00	\$	360,000.0
	403.213	HOT MIX ASPHALT, 12.5 MM NOMINAL MAXIMUM SIZE (BASE AND INTERMEDIATE BASE COURSE)	т	3700	\$	275.00	s	1,017,500.0
4	409.15	BITUMINOUS TACK COAT, APPLIED	G	1850	\$	5.00	5	9,250.0
Į.	502.342	STRUCTURAL CONCRETE ROADWAY TRUCK APRON	CY	130	S	300.00	\$	39,000.0
Ξ	603.159	12 INCH CULVERT PIPE OPTION III	LF	300	S	100.00	S	30,000.0
	604.072	CATCH BASIN TYPE A1-C	EA	40	\$	5,000.00	\$	200,000.0
	605.09	6 INCH UNDERDRAIN TYPE B	LF	2600	\$	70.00	S	182,000.0
8	605.11	12 INCH UNDERDRAIN TYPE C	LF	11400	\$	90.00	5	1,026,000.0
	608.26	CURB RAMP DETECTABLE WARNING FIELD	SF	640	\$	125.00	\$	80,000.0
Т	609.11	VERTICAL CURB TYPE 1	LF	12000	5	75.00	\$	900,000.0
Т	609.221	TERMINAL CURB TYPE 1	LF	1200	\$	100.00	\$	120,000.0
Т	609.34	CURB TYPE 5	LF	3000	\$	80.00	\$	240,000.0
	609.341	CURB TYPE 5 - TRUCK APRON	LF	325	\$	200.00	\$	65,000.0
	615.07	LOAM	CY	1800	\$	90.00	S	162,000.0
	618.13	SEEDING METHOD NUMBER 1	UN	150	\$	70.00	\$	10,500.0
Т	619.12	MULCH	UN	150	\$	60.00	Ś	9,000.0
	627.733	4" WHITE OR YELLOW PAINTED PAVEMENT MARKING LINE	LF	28000	\$	0.50	\$	14,000.0
	627.75	WHITE OR YELLOW PAVEMENT & CURB MARKING	SF	3050	\$	3.00	5	9,150.0
T	629.05	HAND LABOR, STRAIGHT TIME	HR	40	5	55.00	5	2,200.0
	631.12	ALL PURPOSE EXCAVATOR (INCLUDING OPERATOR)	HR	40	\$	175.00	5	7,000.0
	631.172	TRUCK - LARGE (INCLUDING OPERATOR)	HR	40	\$	100.00	\$	4,000.0
_	639.18	FIELD OFFICE, TYPE A	EA	1	\$	15,000.00	\$	15,000.0
	645.292	REGULATORY, WARNING, CONFIRMATION AND ROUTE MARKER ASSEMBLY SIGNS TYPE II	SF	300	s	80.00	\$	24,000.0
8	652.33	DRUM	EA	200	S	65.00	ş	13,000.0
	652.34	CONE	EA	200	\$	25.00	5	5,000.0
	652.35	CONSTRUCTION SIGNS	SF	400	\$	25.00	S	10,000.0
	652.36	MAINTENANCE OF TRAFFIC CONTROL DEVICES	CD	150	\$	300.00	\$	45,000.0
	652.38	FLAGGERS	HR	4000	\$	60.00	\$	240,000.0
	652.381	TRAFFIC OFFICERS	HR	40	\$	100.00	5	4,000.0
ì	656.75	TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL	LS	1	\$1	00,000.00	\$	100,000.0
1	659.10	MOBILIZATION	LS	1	S8	50,000.00	S	850,000.0
8		Construction Total:						
		Contingency (15%):						
		Total Construction Cost						
-						Rounded:	_	10,683,040.0

SP :Special Provisions

Total:	5	12,400,000.00
ROW:	5	400,000.00
CE (6%):	\$	650,000.00
PE (6%):	S	650,000.00
Construction:	5	10,700,000.00

Page 1 of 1



8, 2023. other LAP projects. ig shoulder and that a within the project limits

uantity		Jnit Price	Amount	
21300	Ş	20.00	\$	426,000.00
14500	Ş	60.00	\$	870,000.00
11300	ş	70.00	\$	791,000.00
1110	\$	275.00	\$	305,250.00
1760	\$	275.00	\$	484,000.00
1100	\$	300.00	\$	330,000.00
3550	\$	275.00	\$	976,250.00
1400	\$	5.00	\$	7,000.00
350	\$	100.00	\$	35,000.00
32	\$	5,000.00	\$	160,000.00
2700	\$	70.00	\$	189,000.00
11100	Ş	90.00	\$	999,000.00
400	\$	125.00	\$	50,000.00
12000	Ş	75.00	5	900,000.00
1100	Ś	100.00	\$	110,000.00
2100	\$	80.00	S	168,000,00
1700	S	90.00	S	153,000.00
140	ş	70.00	\$	9,800.00
140	ş	60.00	\$	8,400.00
27100	S	0.50	\$	13,550.00
3400	S	3.00	\$	10,200.00
40	Ś	55.00	S	2,200.00
40	Ś	175.00	S	7,000.00
40	\$	100.00	\$	4,000.00
1	\$	15,000.00	\$	15,000.00
200	\$	80.00	\$	16,000.00
200	Ş	65.00	\$	13,000.00
200	\$	25.00	\$	5,000.00
400	\$	25.00	\$	10,000.00
120	\$	300.00	\$	36,000.00
3000	\$	60.00	\$	180,000.00
40	\$	100.00	\$	4,000.00
1	\$	75,000.00	\$	75,000.00
1	\$	700,000.00	\$	700,000.00
(onstr	uction Total:	\$	8,062,650.00
(ontin	gency (15%):	s	1,209,397.50
		ruction Cost:	Ś	9,272,047.50
		Doundade		0.300.000.00

700,000.00 8,501,050.00 1,275,157.50 9,776,207.50 9,800,000.00

9,800,000.00 550,000.00 550,000.00 300,000.00

Page 1 of



Evaluation Matrix

- Compare Alternatives to NO BUILD
- Compare Alternatives to Purpose & Need Statement
- Roundabout scores highest
- Roundabout meets P/N



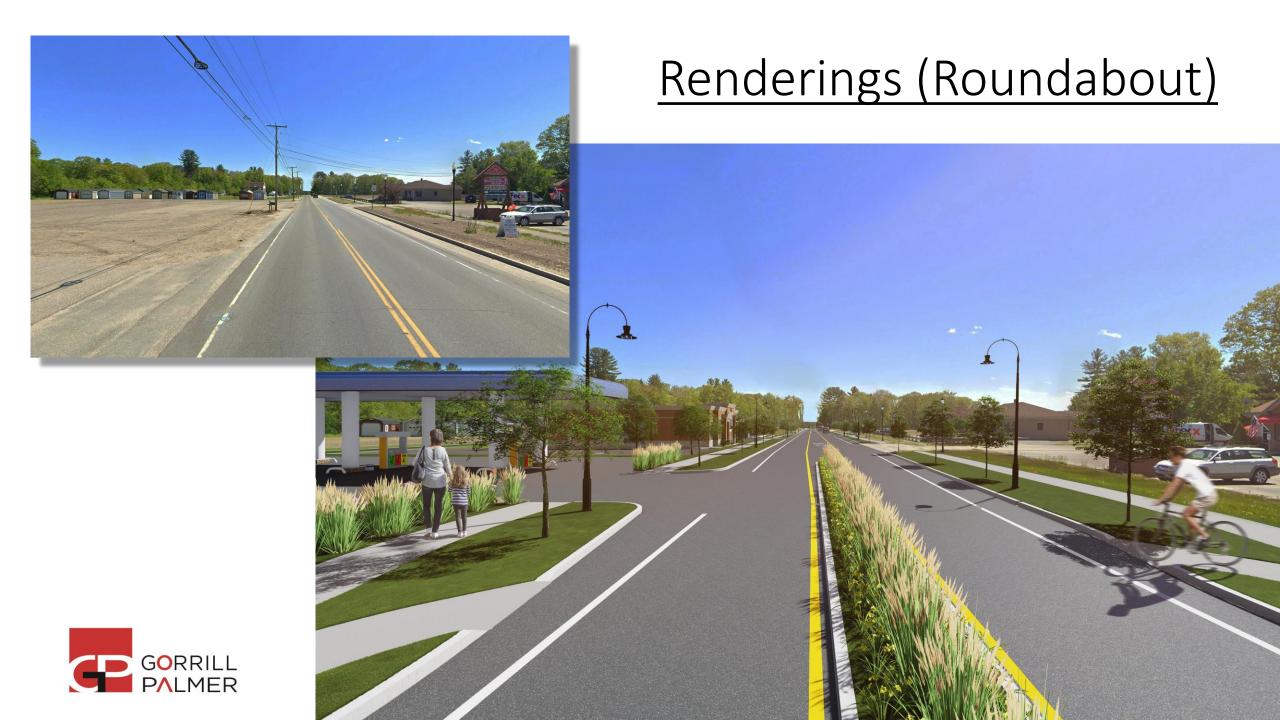
	Alternative #1	Alternative #2	Alternative #3	No Build
CRITERIA	Roundabout	Unsignalized with Raised Intersection	Signalized	Do Nothing
Traffic Operations (LOS AM/PM)	LOS B/C	LOS E/F	LOS C/C	LOS E/F
Meets Warrants in current year	Yes	Yes	No	Yes
Maintains Mobility (vehicles)	Yes	No	Yes	No
Improves Safety (vehicles)	Yes	Yes	Yes	No
Improves Safety (peds, bicycles)	Yes	Yes	Yes	No
Pedestrian & Bicycle Accommodations	Yes	Yes	Yes	Poor
Encourages Village Scale Redevelopment	Yes	Less	Yes	No
Improves on Traffic Calming (speeds)	Yes	Yes	Less than others	No
Creates Confusing Geometry	No (single lane roundabout)	Yes	No	No
Provides Access Management	Yes	Yes	Yes	No
Property Impacts	Slightly more	Same as Alt 3	Same as Alt 2	None
Provides for Gateway Opportunities	Yes	Not really	Less than Alt #1	No
Total Project Costs (Construction, PE, CE, ROW)	\$12.4M	\$10.7M	\$11.2M	None
MEET PURPOSE & NEED	YES	NO	NO	NO

Renderings (Roundabout)



Renderings (Roundabout)





Next Steps

- ✓ Public Input
- ✓ Council Input
- ✓ Draft Report
- ✓ Review & Comment
- ✓ Final Report





