Portland Area Comprehensive Transportation Committee

PACTS

Route 22/114 Overlap Study • **Final Report**

May 2002

HNTB

Portland Area Comprehensive Transportation Committee (PACTS)

Route 22/114 Overlap Study

Final Report

Prepared for: PACTS
233 Oxford Street
Portland, ME 04101

Prepared by: HNTB Corporation
2 Thomas Drive
Westbrook, Maine 04092

Date: May, 2002

ARCHITECTS ENGINEERS PLANNERS HNTB

Route 22/114 Overlap Study – Final Report

Table of Contents

Table of Figures

Table of Tables

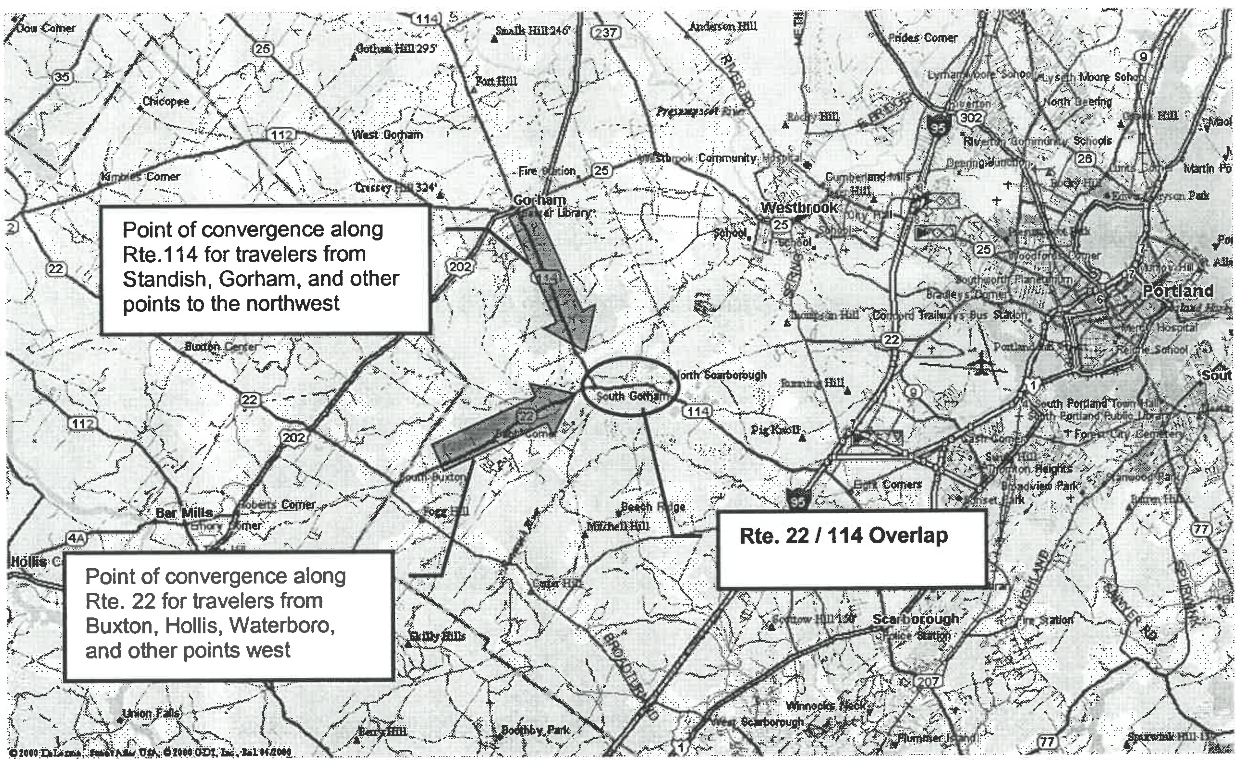
Section 1 – Overview

INTRODUCTION

The Route 22/114 Overlap in South Gorham and North Scarborough is a 1-mile portion of a minor arterial that connects residential communities west of Portland with commercial centers in the Greater Portland area. Commuters from Hollis, Buxton, Limington and Waterboro destined for various Portland area workplaces access the Overlap via Route 22. Likewise, commuters from Gorham, Standish, and Raymond headed to points in South Portland and Scarborough pass through the Overlap via Route 114. Thus, the Overlap marks a singular point of convergence for commuters (and other travelers) from a very broad geographical area.

Figure 1 depicts how the Overlap fits into the broader context of the road network west of Portland.

Figure 1 - Overlap as Part of Greater Portland Transportation Network



The communities lying west of Portland represent some of the fastest-growing towns in the state. Consequently, east-west travel between these communities and the Portland area has increased significantly over the past decade. Much of this travel passes through the Overlap. Thus, with demand growing and the roadway already at capacity, the Overlap is the site of extensive queuing and extremely slow travel during the morning and evening commuter hours.

BACKGROUND

The growing traffic problems on the Overlap have been addressed by numerous studies in recent years. In 1997, the Portland Area Comprehensive Transportation Committee (PACTS) identified the Overlap as a priority area in need of improvements. This led to a 1998 study by VHB, which documented existing problems in the area and proposed alternative approaches to improving these problems. In the fall of 1998, PACTS recommended that a southerly bypass be constructed as a long-term solution to Overlap congestion.

In the past two years, three other separate studies have also addressed the Overlap traffic problems as part of their study scope. These studies are:

- Maine Mall Area Transportation Plan (VHB, 2001). This study noted that a southerly bypass of the Overlap would be one element of a comprehensive effort to improve east-west access to the Maine Mall area.[1]
- Gorham Bypass Study (HNTB, 2002). The nearly completed MDOT Gorham bypass study identified the need to improve traffic flow on the Overlap in order to complement a possible southwest bypass around the village.
- South Portland-Gorham Toll Road Technical Memorandum (HNTB, 2001). A Toll Road Extension study prepared for the Maine Turnpike Authority (MTA) identified the long-term possibility of constructing an east-west tollway that would connect Gorham to the Exit 7 Turnpike Spur (also known as State Route 703). Since a portion of this tollway would parallel the Overlap, it could provide substantial relief to Overlap congestion.

All of these studies identified the Overlap as a problem area in need of relief, either directly (through major widening efforts) or indirectly (through construction of a bypass). In either case, such improvements are likely 10-12 years away. In the meantime, traffic congestion on the Overlap is an immediate concern that demands some kind of relief.

Principals Involved

The principal parties involved in this study are the Maine Department of Transportation (MDOT), PACTS, the Town of Scarborough, and the Town of Gorham.

Purpose

The purpose of the present study is to identify short-term strategies to reduce congestion on the Overlap. The study focuses on improvements that are relatively inexpensive (i.e. less than $2 million) and that can be completed within a 4-year time frame.

Outline

This study contains the following sections:

- **Section 2** will provide a more detailed discussion of the study area. It will document existing traffic and roadway conditions, and it will summarize the study area's recent accident history.
- **Section 3** will discuss anticipated future conditions on the Overlap. This section will address one basic question: What will Overlap traffic look like in 2005 if no changes are made?
- **Section 4** will identify a series of alternative short-term approaches to improving Overlap traffic conditions. This section will (a) describe how the alternatives were analyzed (from a traffic perspective); (b) summarize the results of the traffic analysis; and (c) present the results of a benefit-cost analysis performed on the set of alternatives. This section will also discuss the economic, construction, social, and environmental impact of each alternative.
- **Section 5** will summarize the key outcomes of the study and recommend the next steps toward implementation of a cost-effective, short-term solution.
- The **Appendix** will contain sketches of the final alternatives recommended by this report.

---

[1] Other elements included widening Running Hill Rd. to 4 lanes, widening Spring St. to 4 lanes, and connecting Running Hill Rd. directly to the Exit 7 Turnpike Spur.

Section 2 – Existing Conditions

This section documents the existing conditions in the Overlap study area. The following information is contained in this section:

- Part 1 will provide a general description of the study area.
- Part 2 will summarize the prevailing roadway conditions in the Overlap.
- Part 3 will discuss the five key intersections in the study area.
- Part 4 will document the peak-hour performance of the study area from a traffic perspective. It will provide level-of-service information for all key intersections, and it will highlight operational shortcomings at these intersections.
- Part 5 will review the Overlap's accident history.
- Part 6 will provide a summary of the key points raised throughout the section.

PART 1 – GENERAL DESCRIPTION

The Overlap study area is about one mile in length and runs in an east-west direction. The western end of the study area is marked by the signalized intersection of South St. (State Route 114, running north-south) and County Rd. (State Route 22, running east-west). Routes 114 and 22 are both classified as minor arterial roadways. The easterly end of the study area is the signalized intersection of Gorham Road (Rte. 114) and County Road (Rte. 22). The distance between these two intersections is about 8/10 of a mile and is more commonly referred to as the "Overlap".

Two additional signalized intersections were included as part of the study area for traffic analysis purposes only. The first is the signalized intersection of County Road (Rte. 22) with Saco Road, and the second is the signalized intersection of Gorham Road (Rte. 114) with Beech Ridge Road. Both intersections are located east of the Overlap.

An aerial photo of the study area is presented in Figure 2.

PART 2 – ROADWAY CONDITIONS

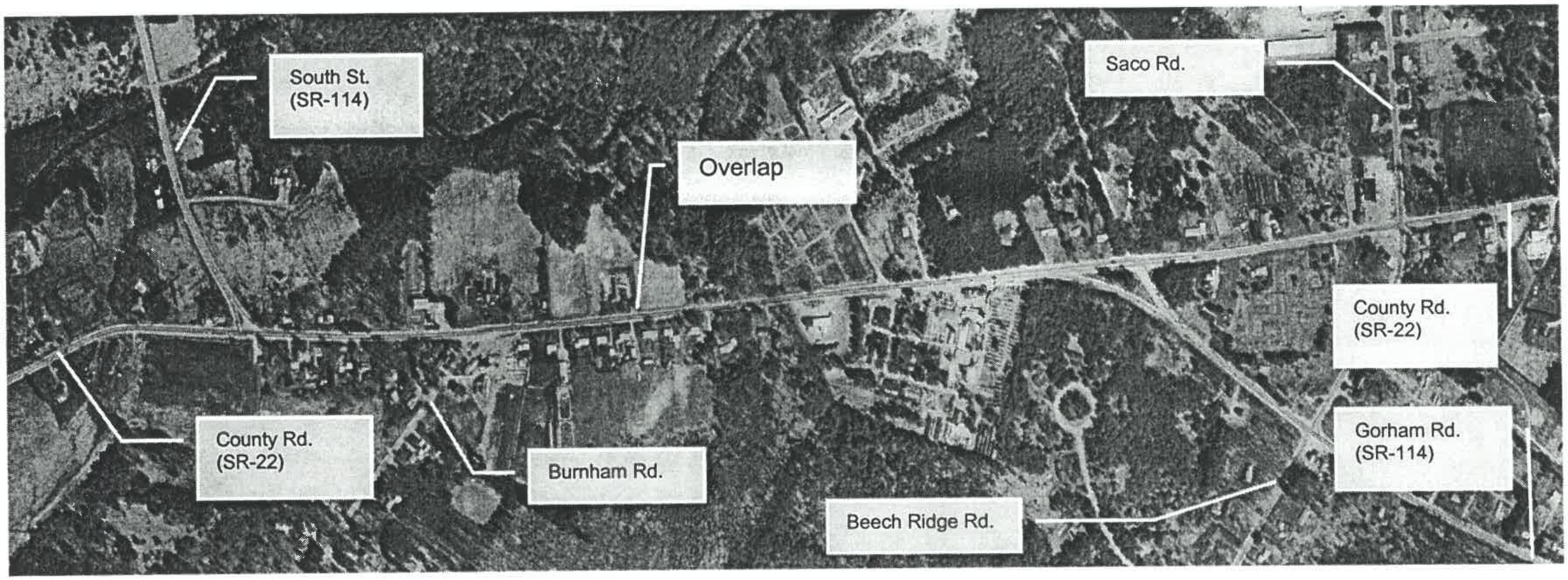
The Route 22/114 Overlap is generally a two-lane roadway consisting of 12-ft.travel lanes and variable width gravel shoulders. Additional auxiliary lanes exist at the South Street and Gorham Road intersections. An eight-foot paved shoulder exists in the westbound direction of Route 22/114 at the Burnham Road intersection. The posted speed limit through the Overlap is 45 MPH.

The land use within the study area consists of both residential and commercial properties. The parking associated with several businesses is located close to the existing roadway; in some instances, the parking is located within the road right-of-way. Many of the residential buildings (homes) are located relatively close to the roadway. A significant number of entrances, both residential and commercial, exist in the study area.

The drainage system within the study area consists of open drainage. Existing roadside ditches collect drainage and direct it into either roadway cross culverts or outlet swales. The drainage outlet swales generally travel to the north and enter into the Nonesuch River, located approximately 500 ft. to the north.

Overhead utilities exist on the northern side of the road. No underground utilities are known to be within the study area. The existing right-of-way width for the study area varies from 66-ft. to 95-ft.

Figure 2 - Aerial View of Overlap Study Area



PART 3 – INTERSECTIONS

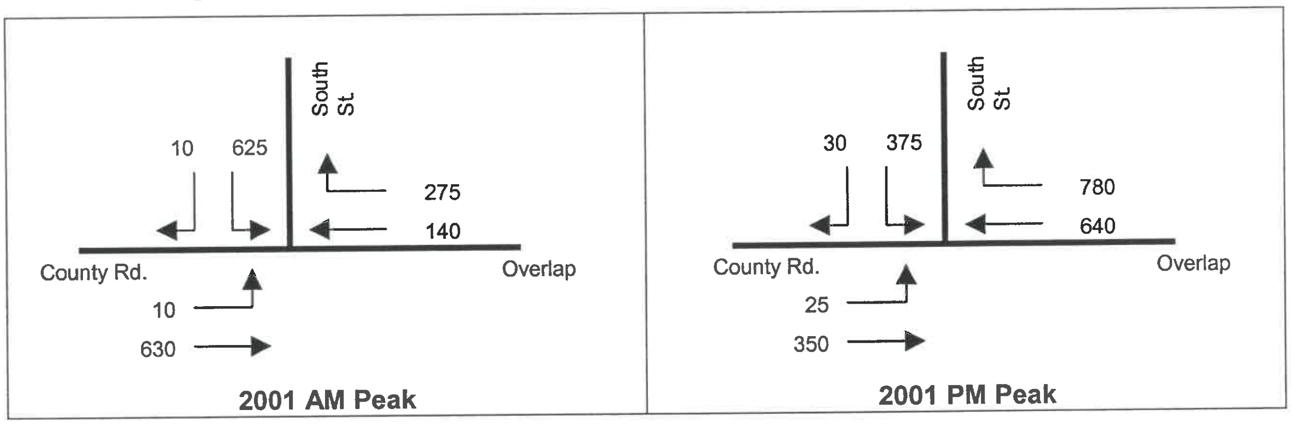
There are five key intersections in the study area—four signalized and one unsignalized. They are described in bullet form in the subsections that follow.

County Rd. (Rte. 22) @ South St. (Rte. 114) – West End of Overlap

- This is a three-legged signalized intersection.[2]
- The eastbound approach (County Rd.) consists of two lanes—a left-turn lane and a thru lane.
- The southbound approach (South St.) also consists of two lanes—a left-turn lane and a right-turn lane.
- The westbound approach (that is, the Overlap) consists of a thru lane and a right-turn lane. Traffic turning right onto South St. (a common movement during the PM peak) has a virtually continuous green signal, since there are no conflicting movements.

Figure 3 summarizes the existing AM and PM peak-hour demands at this intersection.[3]

Figure 3 – Existing Peak-Hour Demand, County Rd. @ South St.



Overlap @ Burnham Rd.

- This is three-legged unsignalized intersection.
- Overlap traffic can move freely; Burnham Rd. traffic is stop-controlled.
- The Overlap's eastbound approach consists of 1 shared thru-right lane.
- The Overlap's westbound approach consists of 1 shared left-thru lane. A small paved shoulder exists in order to allow thru traffic to bypass vehicles turning left onto Burnham Rd.[4]
- The Burnham Rd. approach is not striped. However, there is sufficient room to support two approach lanes—one for left-turning traffic, and one for right-turning traffic. A planter lies in the middle of the approach in order to divide the two streams of turning traffic.

Figure 4 summarizes the existing AM and PM peak-hour demands at this intersection.

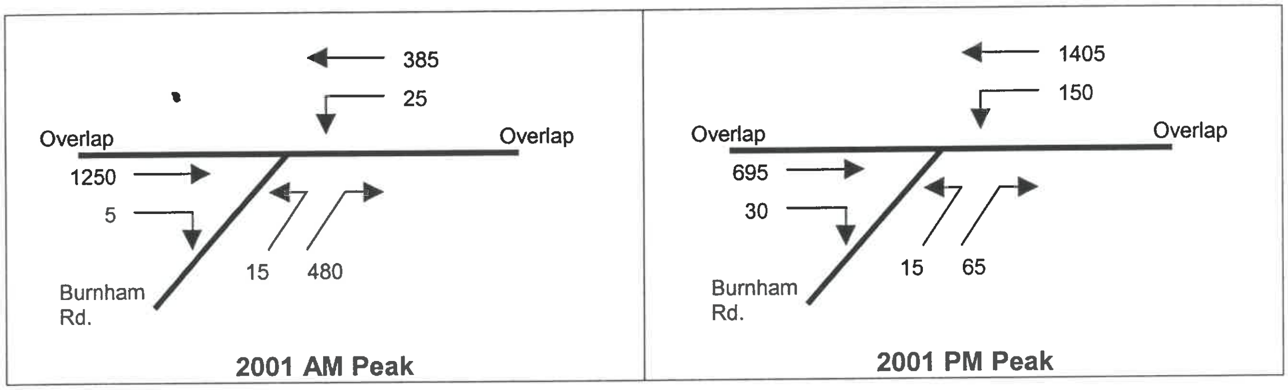
---

[2] Actually, this is a four-legged intersection. However, no traffic enters the intersection via this leg, since it is a one-way driveway that runs away from the intersection to the south. Moreover, only about 10 peak-hour vehicles exit the intersection via this leg. Therefore, it will be treated as a three-way intersection.

[3] The volumes listed in Figures 3 through 7 are *demand* volumes, not peak-hour counts. They estimate the volume of traffic that *desires* to pass through the intersection during the peak hour. They tend to be slightly higher than peak-hour counts, which simply measure what *is able* to pass through the intersection. The demand volumes were determined by incrementally increasing the peak-hour counts in the simulation model such that the simulation queues closely matched the queues observed in the field.

[4] The paved shoulder is less than 50 feet in length. If there is a queue of three or more vehicles seeking to turn left onto Burnham Rd., then thru traffic can't bypass.

Figure 4 – Existing Peak-Hour Demand, Overlap @ Burnham Rd.

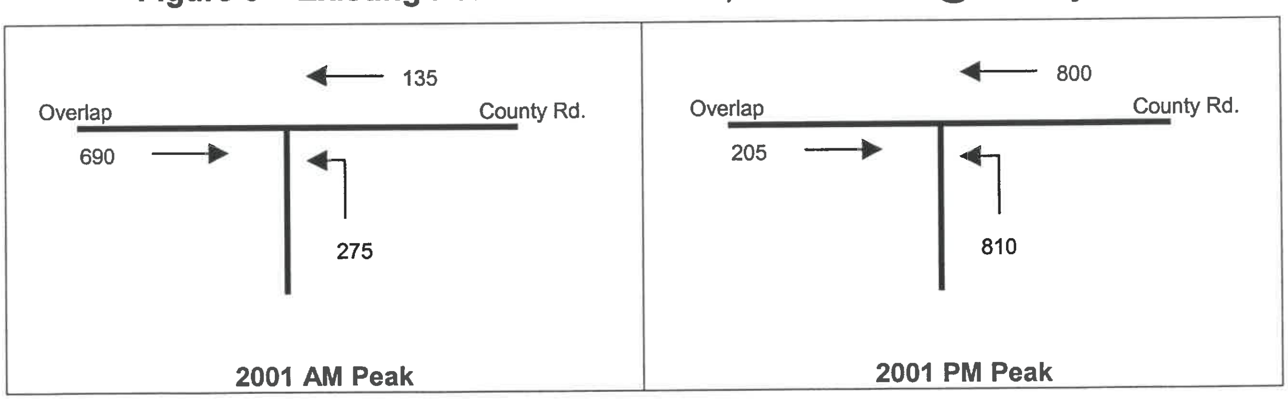


County Rd. (Rte. 22) @ Gorham Rd. (Rte. 114) – East end of Overlap

- This is a three-legged signalized intersection.
- The eastbound approach (Overlap) consists of a single lane for thru traffic only. About 200 feet upstream of the intersection, a free-right turn is provided to eastbound vehicles wishing to turn onto Gorham Rd.
- The westbound approach (County Rd.) consists of two lanes—a shared left-thru lane and a thru lane. However, virtually no westbound vehicles turn left at this intersection, and the "thru only" lane only has about 50' of storage. Therefore, this essentially functions as a single lane approach serving all thru traffic.
- The northbound approach (Gorham Rd.) also consists of two lanes—a left-turn lane and a shared left-right turn lane. However, since virtually no northbound vehicles turn right at this intersection, the shared lane essentially provides a second (albeit lightly-used) left-turn lane.

Figure 5 summarizes the existing peak-hour demands at this intersection.

Figure 5 – Existing Peak-Hour Demand, Gorham Rd. @ County Rd.

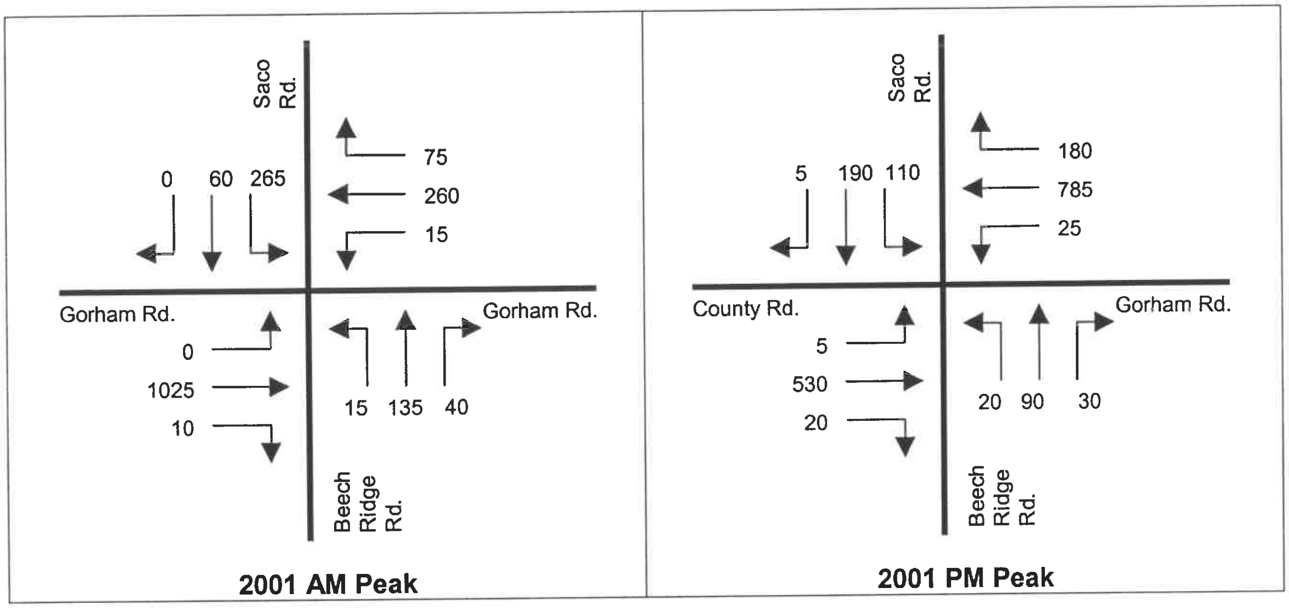


Gorham Rd. @ Beech Ridge Rd.

- This is a four-way signalized intersection.
- All approaches have a single lane for shared left-thru-right movements.
- All approaches have gravel shoulders, thus limiting the ability of thru traffic to sneak around turning traffic.

Figure 6 summarizes the existing peak-hour demands at this intersection.

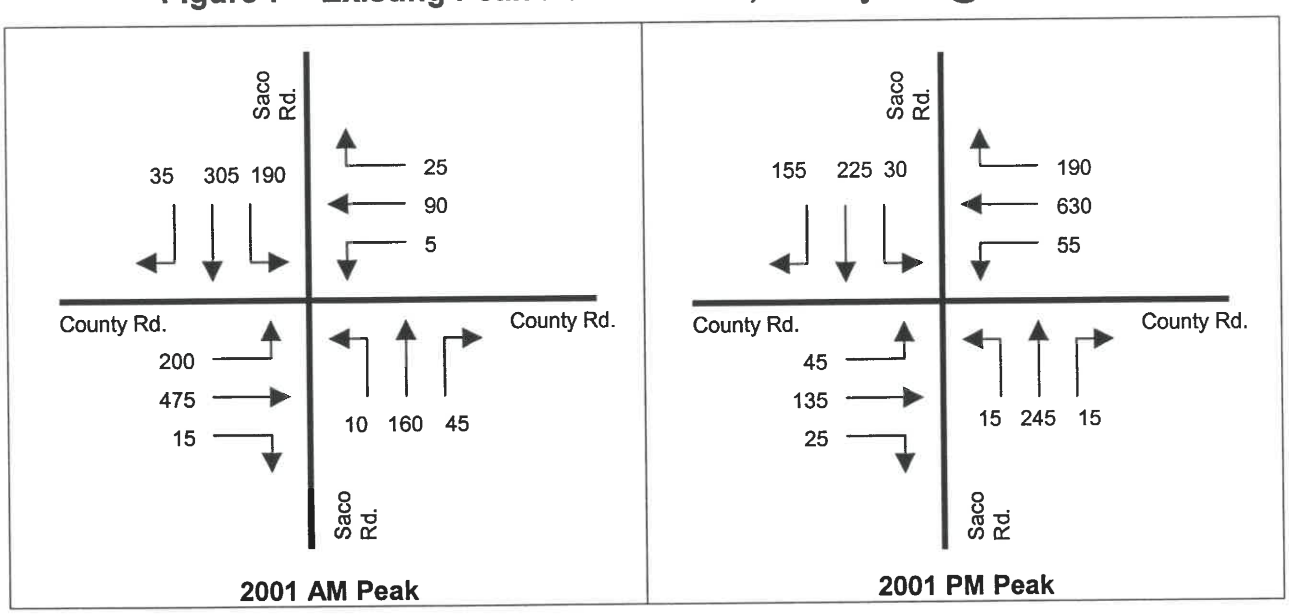
Figure 6 – Existing Peak-Hour Demand, Gorham Rd. @ Beech Ridge Rd.



County Rd. @ Saco Rd.
The same comments apply here as applied to the intersection of Gorham Rd. and Beech Ridge Rd. It is a four-legged signalized intersection with all one-lane approaches. Narrow lanes and gravel shoulders limit the ability of thru traffic to bypass turning vehicles.

Figure 7 summarizes the AM and PM peak-hour conditions at this intersection.

Figure 7 – Existing Peak-Hour Demand, County Rd. @ Saco Rd.



PART 4 – INTERSECTION CAPACITY ANALYSIS

HNTB collected information on peak-hour volumes, lane configurations, and signal phasing and timing, and input these data into Synchro. A one-hour simulation was subsequently run in SimTraffic, a micro-simulation tool that draws inputs from Synchro and records the movements of individual vehicles through the study area.[5] The results of the AM and PM peak-hour analysis are documented in Table 1.

Table 1 – Intersection Capacity Analysis, Existing Demands

	AM Peak			PM Peak		
	ICU[1]	Delay[2]	LOS[3]	ICU[1]	Delay[2]	LOS[3]
County Rd. (22) @ South St. (114)	**82.0%**	**127.1**	**F**	**70.0%**	**41.1**	**D**
Route 114 SB Approach		175.7	F		31.6	C
Route 22 EB Approach		152.5	F		34.5	C
Overlap WB Approach		13.0	B		46.2	D
Overlap @ Burnham Rd.	**111.5%**	**43.0**	**D**	**87.8%**	**8.3**	**A**
Burnham Rd. NB Approach:		23.0	C		31.1	C
Overlap EB Approach:		62.7	E		4.6	A
Overlap WB Approach:		11.3	B		9.1	A
County Rd. (22) @ Gorham Rd. (114)	**63.9%**	**10.8**	**B**	**98.2%**	**112.6**	**F**
Gorham Rd. (114) NB Approach:		20.5	C		102.0	F
Overlap EB Approach:		7.6	A		10.9	B
County Rd. (22) WB Approach:		9.0	A		59.8	E
Gorham Rd. (114) @ Beech Ridge Rd.	**101.9%**	**57.3**	**E**	**126.0%**	**159.1**	**F**
Beech Ridge Rd. NB Approach:		25.3	C		20.0	B
Saco Rd. SB Approach:		69.9	E		35.9	D
Gorham Rd. (114) EB Approach:		68.3	E		17.5	B
Gorham Rd. (114) WB Approach:		30.9	C		307.0	F
County Rd. (22) @ Saco Rd.	**106.6%**	**63.8**	**E**	**114.9%**	**91.3**	**F**
Saco Rd. NB Approach:		21.0	C		30.6	C
Saco Rd. SB Approach:		108.2	F		72.6	E
County Rd. (22) EB Approach:		52.6	D		67.8	E
County Rd. (22) WB Approach:		11.0	B		123.7	F
Network-Wide Measures						
Average Delay per Vehicle (seconds):		303.7			312.5	
Average Speed thru Study Area (MPH):		15			15	
Average Stops per Vehicle:		5.90			6.66	

[1] ICU = Intersection Capacity Utilization, which serves as a volume-to-capacity ratio for the entire intersection

[2] Delay is measured in seconds per vehicle

[3] LOS = Level of Service, on a scale from A (best) to F (worst)

---

[5] Synchro and SimTraffic are commercially available companion programs used to analyze signalized and unsignalized intersections. Synchro is a "static" model that takes traffic inputs (such as those mentioned above) and estimates delays based on a series of formulas outlined in the Highway Capacity Manual. SimTraffic draws on these same inputs and creates a two-dimensional simulation of the intersections. For more information on these software packages, please see the *Alternatives Analysis Technical Memorandum*.

Table 1 summarizes both intersection-specific and network-wide measures of effectiveness. A quick glance at this table reveals some interesting trends:

- During both the morning and evening peak, three of the five intersections are at or above capacity. This explains the extraordinary delays observed for certain movements.[6]
- Vehicles traveling through the study area during peak hours experience an average of over 5 minutes of delay. This is significant, since the study area is only about 1 mile in length.
- During the morning peak, the delays are most significant at the west end of the Overlap, where vehicles from South St. combine with vehicles from County Rd.
- During the evening peak, the delays are most significant at the east end of the study area, where westbound commuters heading toward the Overlap from both Gorham Rd. (Rte. 114) and County Rd. (Rte. 22) encounter cross traffic on Beech Ridge Rd. and Saco Rd.

The paragraphs below present a more detailed description of the existing operational problems in the Overlap area. The operational descriptions are summarized by intersection.

County Rd. @ South St.
The Overlap (westbound) approach has a relatively short right-turn lane. When queues in the thru lane extend to five vehicles or more (which frequently happens during the PM peak), vehicles seeking to turn right onto South St. are blocked.

Overlap @ Burnham Rd.
In the morning peak, there is a heavy flow of vehicles on Burnham Rd. seeking to turn right onto the Overlap. Oftentimes, eastbound vehicles on the Overlap slow down and "wave on" these vehicles. Given the heavy eastbound flow of traffic during this time, such maneuvers quickly create upstream problems, as thru traffic (blocked by the act of courtesy) backs up into the South St. intersection. Once this happens, the heavy volumes seeking to access the Overlap from the north and west are blocked, and extensive queues form.

Another point of confusion at this intersection is the planter, which serves as a divider on the Burnham Rd. approach. Vehicles turning left from Burnham Rd. onto the Overlap are often unsure of how to maneuver around the planter. Similarly, westbound vehicles turning left onto Burnham Rd. are often unsure whether to turn in front of or behind the planter.

County Rd. @ Gorham Rd.
The critical time for this intersection is during the evening peak, when northbound commuting traffic on Gorham Rd. (Rte. 114) combines with westbound commuter traffic on County Rd. (Rte. 22). Both approaches have two lanes to serve traffic seeking to go west on the Overlap. However, the two departure lanes merge to one within 250' of the intersection. Because the departure lanes are so short—and because merging can therefore be difficult—vehicles tend to avoid using both lanes of their respective approaches. Thus, they essentially function as single-lane approaches. As a result, queues extend more quickly upstream, often backing traffic up through the Saco Rd. and Beech Ridge Rd. intersections.

County Rd. @ Saco Rd. / Gorham Rd. @ Beech Ridge Rd.
These two signalized intersections have four important features in common:

1. Both have a dominant thru movement on the major street (County Rd. and Gorham Rd., respectively);
2. Both have a relatively high volume of cross-street traffic (particularly at the County/Saco intersection);
3. A high proportion of cross-street traffic is turning traffic; and
4. All approaches have only one lane.

---

[6] For example, westbound traffic on Rte. 114 faces over 5 minutes of delay at the intersection of Gorham Rd. and Beech Ridge Rd. It is important to keep in mind that this represents an *average* delay through the peak hour. It is likely that some westbound vehicles experience delays of 10 minutes or more at this intersection.

These characteristics lead to substantial delays during the peak hour. Lengthy queues develop on the major approaches, as high cross-street volumes demand a relatively high proportion of green time. Substantial queues also develop on the minor approaches, as the combination of poor shoulders and high turning volumes hinder the progress of thru traffic. This is why these intersections are over-capacity during both the AM and PM peak.

PART 5 – ACCIDENT HISTORY

The MDOT Accident Records Section provided HNTB with accident data for the study area from 1998 to 2000. The data provided by MDOT contains two critical pieces of information.

- First, it documents the total number of accidents recorded at each link and node over the three-year study period.[7] In order to be reported to MDOT, an accident must result in either (a) property damage of at least $1,000, or (b) personal injury.
- Second, it calculates a critical rate factor (CRF) for each link and node. Generally speaking, the CRF compares the actual accident rate at a link or node with accident rates seen at other links or nodes with the same functional class.[8] A critical rate factor higher than 1.00 indicates that the actual accident rate significantly exceeds the expected accident rate.

One of the primary purposes of MDOT's accident data is to identify High Crash Locations (HCL's). In order to be considered an HCL, a link or node must meet two criteria. First, it must experience eight or more accidents in a three-year period. And second, it must have a CRF that exceeds 1.00.

In the Overlap study area, a total of 243 accidents were reported in the three-year period from 1998 to 2000. Ninety-two of these accidents occurred at the five key intersections noted earlier; the remaining 151 accidents occurred on the links. The high proportion of accidents occurring on the links can be divided into two accident types. The first are rear-end accidents occurring during congested stop-and-go periods. The second are angled accidents involving vehicles turning into and out of any of the numerous curb cuts in the study area.

Despite the high number of accidents reported, only one location—the intersection of Burnham Rd. and the Overlap—actually qualified as a High Crash Location.

Figure 8 summarizes the accident data for each link in the study area, while Figure 9 provides the same information for each node. At each location, the number of accidents and the CRF is documented.

[7] A "node" is typically an intersection. A "link" is a stretch of roadway that connects two nodes.
[8] In mathematical terms, CRF = Actual Accident Rate / Critical Rate. Each functional class has its own critical rate, which is based on the average accident rate for that functional class throughout the state.

Figure 8 – Accidents on the Links, 1998-2000

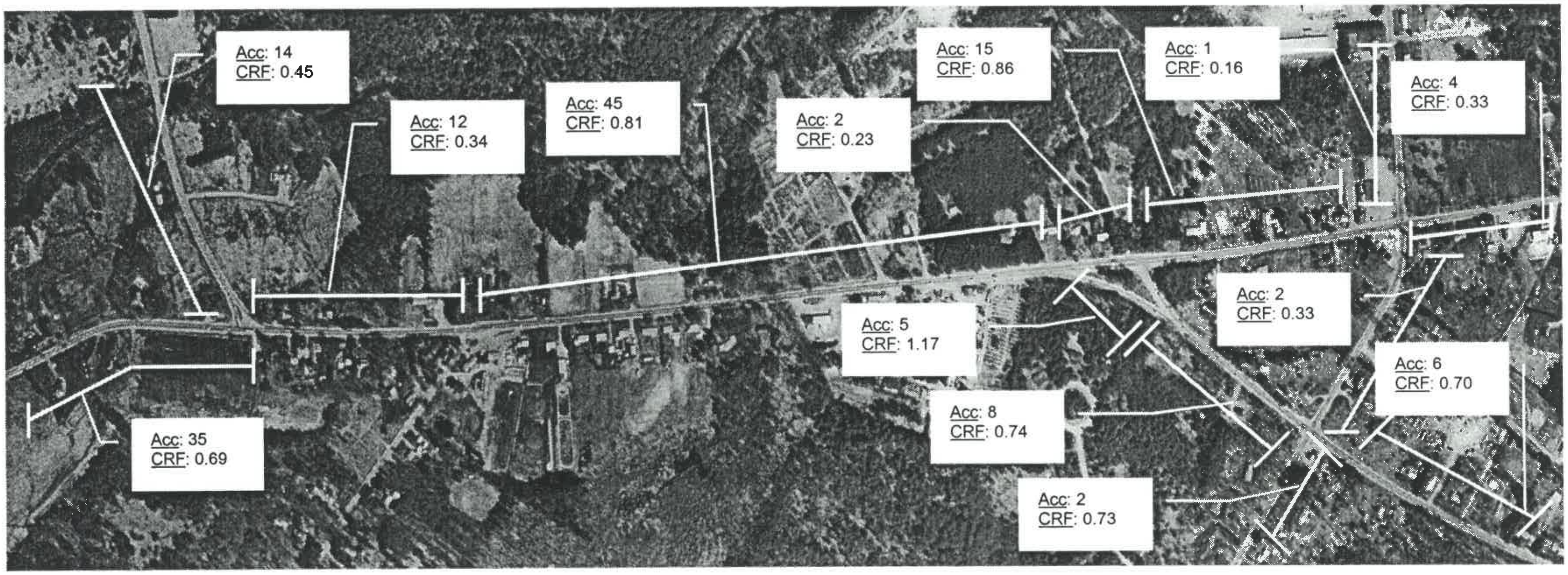
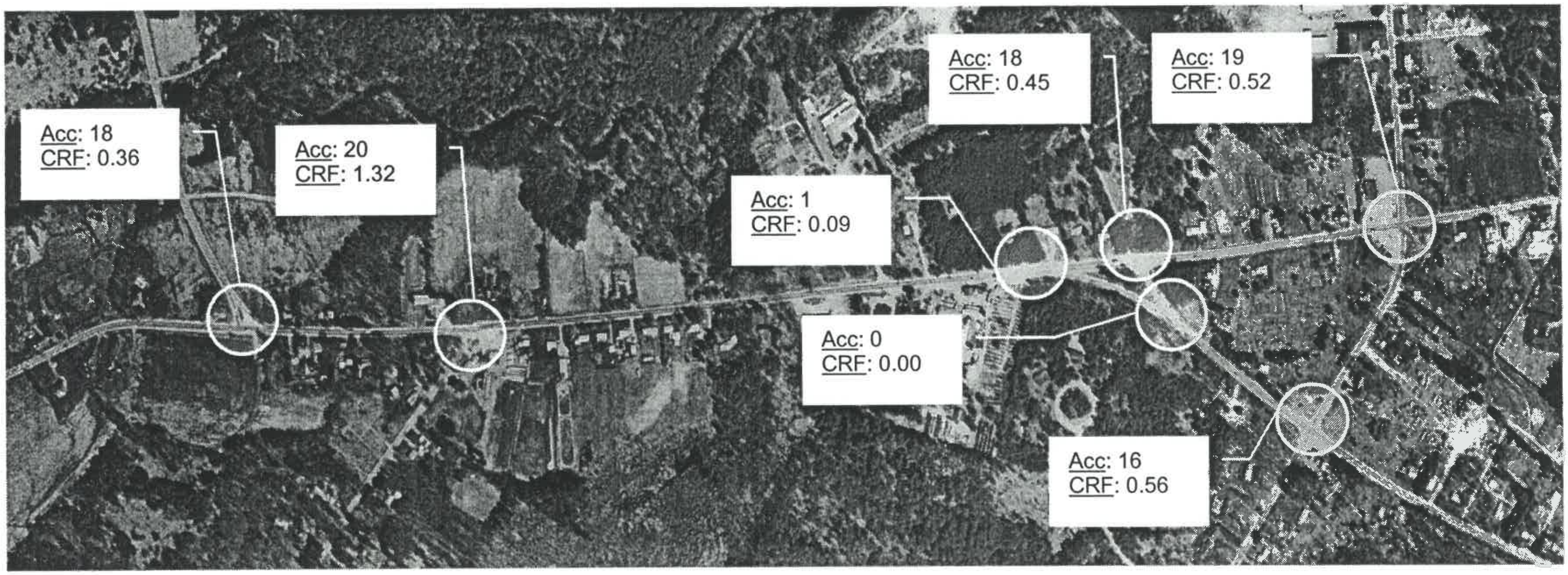


Figure 9 - Accidents on the Nodes, 1998-2000



PART 6 – SUMMARY

The following bullets highlight the key points brought out by the existing conditions analysis:

- Though pavement width through the study area is narrow (typically involving two 12-foot lanes with little-to-no paved shoulder), the right-of-way exists for moderate expansion.
- During both the AM and PM peak hours of travel, vehicles traveling through the study area face an average of five-plus minutes of delay. This represents the average delay faced by *all* vehicles in the Overlap; vehicles traveling in the peak direction (eastbound in the morning, westbound in the evening) face even greater average delays.
- In the morning peak, capacity and operational issues at the Burnham Rd. intersection create problems for the heavy eastbound commuter flow.
- In the evening peak, capacity issues at the three eastern signalized intersections significantly hinder the flow of westbound commuter traffic. As a result, substantial queues (of ½ mile or more) build up on both Gorham Rd. and County Rd.
- The only High Crash Location in the study area is the intersection of Burnham Rd. and the Overlap.

The next section examines the anticipated future conditions (2005) on the Overlap.

Section 3 – Future Conditions

As Section 1 noted, the purpose of this study is to identify short-term strategies for improving traffic flow through the Overlap. Such strategies should be both relatively inexpensive (less than $2 million) and easily completed within a four-year time frame. At the beginning of the study, MDOT and PACTS participants directed HNTB to use 2005 as the "future conditions" year for this study.

In order to evaluate any alternative, it is necessary to first develop a reasonable "no-build" condition. Thus, HNTB developed a 2005 "no-build" (or "baseline") model, against which each competing alternative would be compared. The baseline model was developed in three steps, as outlined below.

Step 1 – Develop Baseline Volumes

The first step involved growing out the 2001 input volumes (as depicted in Figures 3 thru 7) to 2005 levels. In order to do this, an annual peak-hour growth rate of 0.75% was used.[9] This modest rate of growth is typical of congested roadways, where severe delays deter growth in peak-hour demand. In such areas, peak-hour growth tends to shift to less-congested alternative routes or alternative times.

Figures 10 and 11 depict AM and PM peak-hour traffic volumes for the baseline (2005) condition.

Step 2 – Input Baseline Data into Traffic Model

The second step involved taking the volumes from Figures 10 and 11 and inputting them into the "existing conditions" Synchro model[10], thus creating the Baseline traffic model. In performing this step, HNTB assumed that there are no planned changes (outside of this study) to the Overlap's roadway geometrics, lane configurations, or signal phasing and timing.

[9] This yielded an increase of 3.0% over the four-year period from 2001 to 2005.
[10] See Section 2 for a discussion of the development of this model.

Figure 10 – 2005 AM Peak Hour Demand – Baseline

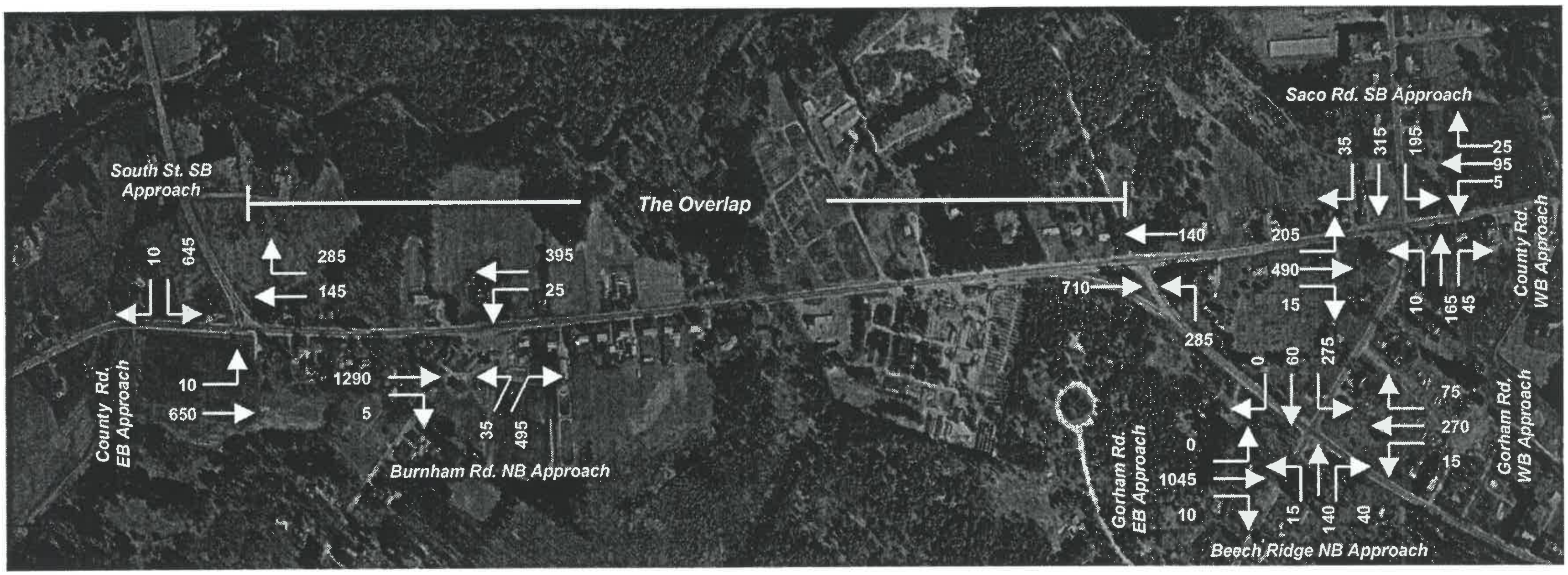
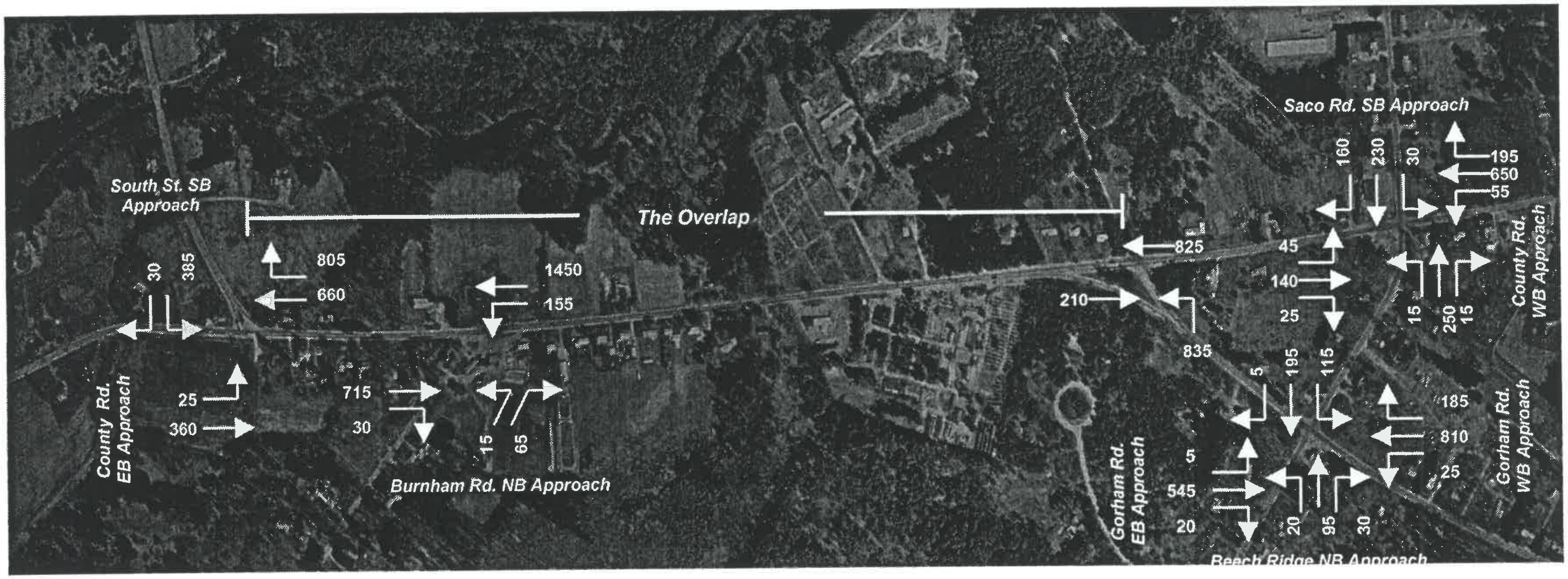


Figure 11 – 2005 PM Peak Hour Demand – Baseline



STEP 3 – PERFORM THE SIMULATION

This final step involved taking the baseline model from Step 2 and running five independent one-hour simulations using SimTraffic.[11] The need to perform multiple simulations arises from the nature of congested traffic networks. In such networks, where volume-to-capacity ratios exceed (or nearly exceed) 1.0, delays can become quite volatile, and independent runs can yield dissimilar results. Thus, HNTB decided to run multiple simulations. For each run, the average network delay per vehicle was tabulated. The run that yielded the median value for this measure of effectiveness was selected as the most representative simulation, and its results were documented for subsequent analysis.

Table 2 summarizes the intersection and network capacity analysis for the Baseline condition.

Table 2 – Intersection Capacity Analysis, Baseline (2005) Conditions

	AM Peak			PM Peak		
	ICU[1]	Delay[2]	LOS[3]	ICU[1]	Delay[2]	LOS[3]
County Rd. (22) @ South St. (114)	**84.4%**	**135.4**	**F**	**71.6%**	**38.7**	**D**
Route 114 SB Approach		167.4	F		22.8	C
Route 22 EB Approach		190.9	F		47.0	D
Overlap WB Approach		16.9	B		28.8	C
Overlap @ Burnham Rd.	**114.8%**	**40.3**	**D**	**90.3%**	**8.3**	**A**
Burnham Rd. NB Approach:		20.7	C		37.9	D
Overlap EB Approach:		60.9	E		4.8	A
Overlap WB Approach:		9.2	A		9.1	A
County Rd. (22) @ Gorham Rd. (114)	**65.7%**	**15.1**	**B**	**101.1%**	**142.3**	**F**
Gorham Rd. (114) NB Approach:		28.9	C		135.3	F
Overlap EB Approach:		9.0	A		15.7	B
County Rd. (22) WB Approach:		14.4	B		73.3	E
Gorham Rd. (114) @ Beech Ridge Rd.	**104.0%**	**50.8**	**D**	**129.4%**	**182.3**	**F**
Beech Ridge Rd. NB Approach:		23.6	C		30.5	C
Saco Rd. SB Approach:		65.0	E		33.9	C
Gorham Rd. (114) EB Approach:		59.7	E		17.6	B
Gorham Rd. (114) WB Approach:		27.8	C		363.5	F
County Rd. (22) @ Saco Rd.	**109.2%**	**51.3**	**D**	**117.4%**	**84.4**	**F**
Saco Rd. NB Approach:		18.5	B		27.3	C
Saco Rd. SB Approach:		98.8	F		34.6	C
County Rd. (22) EB Approach:		32.8	C		62.7	E
County Rd. (22) WB Approach:		12.3	B		132.0	F
Network-Wide Measures						
Average Delay per Vehicle (seconds):		326.1			333.1	
Average Speed thru Study Area (MPH):		14			15	
Average Stops per Vehicle:		6.20			6.81	

[1] ICU = Intersection Capacity Utilization, which serves as a volume-to-capacity ratio for the entire intersection

[2] Delay is measure in seconds per vehicle

[3] LOS = Level of Service, on a scale from A (best) to F (worst)

[11] SimTraffic allows the user to generate independent runs by inputting a unique "seed number". Thus, no two SimTraffic runs are exactly alike.

Table 2 presents the same information as Table 1 for 2005 Baseline traffic conditions. A comparison of the two tables reveals three important observations[12]:

- Average network delay grew from 303.7 to 326.1 seconds per vehicle (s/veh) in the AM peak, and from 312.5 to 333.1 s/veh in the PM peak. In other words, a 3% increase in traffic yielded a 7% increase in delay.
- During the PM peak, average delay at the intersection of Gorham Rd. and County Rd. jumped by over 25%, from 112.6 to 142.3 s/veh. This illustrates an important fact—that critical intersections at either end of the Overlap simply can't handle more vehicles. Small increases in traffic will yield noticeable increases in delays.
- The intersections at the downstream ends of the Overlap (i.e. east end during AM peak, west end during PM peak) operate acceptably. The constraints at the "entry" points of the Overlap essentially meter the flow of traffic to these intersections. If the entry points are improved, then the problems would likely shift and create more congestion downstream.

SUMMARY – FUTURE TRAFFIC CONDITIONS

The bottom line of the future conditions analysis can be summed up as follows:

- The Overlap is already at capacity during the peak hour; and
- Small increases in peak-hour traffic will yield substantial increases in delay.

These two observations support the premise that motivated this study—namely, that current conditions warrant some relief in advance of the already-identified long-term improvements.

The next section will identify and evaluate several, short-term approaches to addressing these problems.

[12] A careful comparison of the two tables will reveal that some intersections actually experienced a modest *reduction* in delay from 2001 to 2005. However, this apparent drop is actually due to the random nature of the simulation program, in which different runs can yield different results, particularly when viewed from the perspective of individual intersections. Nevertheless, the simulation capability is invaluable when evaluating the interactions among closely spaced intersections. And the phenomenon of "different results for different runs" is an accurate reflection of actual traffic conditions, which can fluctuate wildly in congested networks.

Section 4 – Identification and Analysis of Alternatives

This section will summarize the method by which HNTB identified and analyzed a range of short-term approaches to addressing the Overlap's traffic and safety problems.[13] The section will proceed in the following manner.

- Part 1 will discuss the preliminary analysis that served as the foundation for all subsequent study.
- Part 2 will identify the final set of alternatives for which a more thorough impact analysis was performed.
- Part 3 will highlight the basic design parameters for the physical layout of the improved roadway.
- Part 4 will summarize the traffic analysis performed on the final set of alternatives.
- Part 5 will provide an overview of the benefit-cost analysis performed on the final set of alternatives.
- Part 6 will identify other impacts (such as economic, construction, and environmental impacts) associated with each of the alternatives.
- Part 7 will summarize the key results of HNTB's impact study.

PART 1 – PERFORM PRELIMINARY ANALYSIS

Once the existing and Baseline conditions were established, HNTB—in conjunction with the PACTS Rte. 22 / 114 Committee—developed a preliminary series of 15 alternative short-term strategies for alleviating Overlap congestion. The alternatives fell into one of 5 general categories: (1) general intersection improvements, (2) Burnham Rd. improvements, (3) rotaries, (4) 3-lane options, and (5) 4-lane options.

The alternatives are summarized below:

General Intersection Improvements

- Signal interconnection with phasing and timing improvements
- Departure widening

Burnham Rd. Improvements

- Westbound left-turn lane onto Burnham
- Signalization of Burnham Rd.
- Relocation of Burnham Rd.

Rotaries

- East rotary
- West rotary
- East and west rotary
- West rotary with relocated Burnham Rd.

3-Lane Options

- 2 Travel lanes eastbound from Burnham Rd. to the eastern Gorham Rd. / County Rd. split
- Two-way left-turn lane (TWLTL) for entire length of project
- Relocated Burnham Rd. with TWLTL

4-Lane Options

- Two travel lanes in each direction
- Two travel lanes in each direction, with approach widening
- Two travel lanes in each direction, with Burnham Rd. relocation

---

[13] See Section 2 for a summary of these problems.

A preliminary impact analysis was performed on these alternatives, and the results were presented to a meeting of town officials, MDOT personnel, state representatives, and PACTS staff. The group concluded the meeting by making five important decisions. These decisions included:

1. **Exclusion of rotaries.** Rotaries perform well in conditions where traffic is evenly distributed among all legs. However, this is not the case in the Overlap study area, where traffic flow is directionally oriented (eastbound in the AM, westbound in the PM). Thus, from an operational perspective, the rotaries did not perform well. This, combined with their high cost and right-of-way impacts, rendered them cost-ineffective. They were therefore excluded from further consideration.
2. **Exclusion of Burnham Road relocation alternatives.** The group feared that relocating Burnham Rd. could trigger an environmental assessment, thus extending the time frame for project completion. Since the option only had marginal congestion-reducing benefits, it was eliminated from further consideration.
3. **Inclusion of signalization improvements into all further analysis.** The preliminary analysis indicated that modest improvements[14] could be made very cheaply, simply by replacing the traffic signal controllers, interconnecting the eastern three signals, and improving the phasing and timing plan. The group decided that all future analysis should assume that these improvements would be included.
4. **Access to O'Donal's.** A significant number of vehicles turn into and out of O'Donal's during the peak hour. The committee therefore felt that any alternative should address access and safety issues associated with this facility.
5. **Evaluation of various 3- and 4-lane cross-sections.** The group thought it would be more helpful to think in terms of "cross sections" rather than "travel lanes". Therefore, HNTB was asked to develop a series of three- and four-lane options, each of which would include a mix of travel lanes and center turn lanes. This was primarily motivated by discussion of the proposed four-lane alternative, which simply provided two travel lanes in each direction. It was felt that this configuration could be accident-prone, given the high number of curb cuts throughout the study area.

Part 2 – Identify Final Set of Alternatives

Based on the results of the first meeting, HNTB—in coordination with PACTS—developed a final set of alternatives to be explored in greater detail. These alternatives fell into one of three broad categories: intersection improvements, three-lane options, and four-lane options. They are described in detail below.

Group 1 – Intersection Improvements

Eastbound and Westbound Departure Widening

- 250' Turn bay on South St. SB
- 250' Right-turn bay from Overlap WB to South St.
- 600' Dual departure lanes EB from South/County intersection
- 600' Dual departure lanes WB from Gorham/County intersection
- 500' TWLTL in front of O'Donal's

Departure Widening with Burnham Rd. Improvements

- Same features as "Eastbound and Westbound Departure Widening", *plus*
- 75' Left-turn bay from Overlap WB to Burnham Rd.
- Restriping Burnham Rd. w/ 100' left-turn bay

[14] I.e., on the order of a 5% reduction in average delay per vehicle on the network.

Departure Widening with Signalization
- Same features as "Departure Widening with Burnham Rd. Improvements", *plus*
- Traffic signal at Burnham Rd.

Signalization of Burnham Rd.
- Traffic signal at Burnham Rd.
- 75' Left-turn bay from Overlap WB to Burnham Rd.
- Restriping Burnham Rd. w/ 100' left-turn bay

Group 2 – Three-Lane Alternatives

Each of the three-lane alternatives included the following:
- 75' Left-turn bay from Overlap WB to Burnham Rd.
- Restriping Burnham Rd. w/ 100' left-turn bay

The alternatives also included the following improvements:

3-Lane Section with TWLTL
- 250' Turn bay on South St. SB
- 250' Right-turn bay from Overlap WB to South St.
- 600' Dual departure lanes EB from South/County intersection
- 600' Dual departure lanes WB from Gorham/County intersection
- TWLTL between Burnham Rd. and O'Donal's

TWLTL with Signal
- Same features as "3-Lane Section with TWLTL", *plus*
- Traffic signal at Burnham Rd.

3-Lane Split
- 250' Turn bay on South St. SB
- 2 Lanes EB from South St. to 850' east of Burnham; taper to 1
- 2 Lanes WB from Gorham Rd. to 850' east of Burnham; taper to 1

Modified Partial EB Widening
2 Lanes EB from Burnham Rd. to Gorham/County split

Group 3 – Four-Lane Alternatives

Each of the four-lane alternatives included the following:
- 250' Shared left-right turn bay on South St. SB
- 75' Left-turn bay from Overlap WB to Burnham Rd.
- Restriping Burnham Rd. with 100' left-turn bay

The alternatives also included the following improvements:

4 Lanes
- 2 Lanes Overlap EB, South St. to Gorham/County Split
- 2 Lanes Overlap WB, Gorham/County "T" to South St.

4 Lanes with Signal
Same as "4 Lanes" alternative, with the addition of a traffic signal at Burnham Rd.

2 Lanes WB w/ TWLTL and Signal

- 600' Dual departure lanes EB from South/County intersection
- 2 Lanes Overlap WB, Gorham/Count "T" to South St.
- TWLTL between Burnham Rd. and O'Donal's
- Traffic signal at Burnham Rd.

2 Lanes EB w/ TWLTL

- 2 Lanes Overlap EB, South St. to Gorham/County Split
- 600' Dual departure lanes WB from Gorham/County intersection
- TWLTL between Burnham Rd. and O'Donal's

3 Lane Split w/ TWLTL and Signal

- 2 Lanes EB from South St. to 850' east of Burnham; taper to 1
- 2 Lanes WB from Gorham Rd. to 850' east of Burnham; taper to 1
- TWLTL between Burnham Rd. and O'Donal's
- Traffic signal at Burnham Rd.

PART 3 – HIGHLIGHT ROADWAY PARAMETERS

In order to present some conceptual designs of the various alternatives listed above, it was necessary to make some decisions about the physical layout of the improved roadway. This would be particularly important in evaluating the costs associated with each alternative.

HNTB's conceptual designs were based on the following roadway parameters:

- The alternatives shall be designed in accordance with the Urban Arterial geometric design criteria, as established by Maine Design Guide and AASHTO Standards. The existing horizontal geometry of the Overlap generally meets the design standards, so no major adjustments will be proposed. Analysis of vertical geometry is not considered part of this study.

- Typical cross sections for each alternative will consist of 11-ft. travel lanes and four-ft. paved shoulders. Center turn lanes will be 14 feet wide. Center islands will be either painted or raised with curbing.

- The typical roadway elevation will generally match the existing roadway vertical alignment. Minor cut or fill conditions may be necessary to meet MDOT design standards.

- Curbing will be recommended in cut conditions in order to control drainage and reduce property impacts. HNTB recommends 4:1 slopes in fill conditions for fill heights up to 15 ft. For fill heights over 15 ft, a slope of 2:1 with guardrail will be used.

PART 4 – PERFORM TRAFFIC IMPACT ANALYSIS

Once the alternatives were identified and the design parameters established, the next step was to evaluate the performance of each alternative. Each alternative's performance would be compared to the Baseline (2005) conditions outlined in Table 2. The results of this analysis would be used later in the process to help answer two fundamental questions. First, which alternative provides the most cost-effective way of reducing congestion on the Overlap? And second, can this alternative be constructed within a 4-year time frame?

For each alternative, the following four tasks were performed.

First, the improvements were coded into the Synchro traffic network.

Second, traffic volumes were adjusted to account for possible attraction. Under current traffic conditions in the study area, many commuters divert to more circuitous yet less congested parallel roads. For example:

- During the morning peak hour, many southbound commuters on South St. avoid the Overlap by turning left onto Day Rd. and then connecting to Saco Rd. via Brackett Rd. Saco Rd. in turn connects to the east end of the Overlap and provides access to either Rte. 22 or Rte. 114.
- Also during the morning peak hour, many eastbound commuters on County Rd. avoid the west end of the Overlap by turning onto Burnham Rd. (either via Hodgdon Rd. or Broadturn Rd.). Burnham Rd. subsequently connects to the Overlap just east of the intersection of South St. and County Rd., thus bypassing a very congested signalized intersection.

Any improvements to the Overlap would likely encourage some of these diverting travelers to shift back to the more direct route. This, in turn, would have an impact on the alternative's level of service.

Table 3 summarizes the general assumptions made by HNTB concerning shifts in travel patterns. It estimates the number of travelers who will shift away from alternative routes back to the Overlap.

Table 3 – Estimated Shifts in Traffic in Response to Overlap Improvements

Time Period	Condition	Shift (vehicles per hour)
AM Peak	Signal installed at Burnham Rd.	100 vph shift from Burnham Rd. to Route 22 EB
	2 EB Travel lanes provided	100 vph shift from Burnham Rd. to Overlap EB
		100 vph shift from McClellan Rd. bypass to Overlap EB
	3-Lane Split Scenario, w/ TWLTL	100 vph shift from Burnham Rd. to Overlap EB
		50 vph shift from McClellan Rd. bypass to Overlap EB
PM Peak	2 WB Travel lanes provided	100 vph shift from McClellan Rd. bypass to Overlap WB
	3-Lane Split Scenario, w/ TWLTL	50 vph shift from McClellan Rd. bypass to Overlap WB

Third, the adjusted traffic volumes were inputted into the "improved" Synchro traffic network.

Finally, five different one-hour simulation runs were conducted. The run that generated the most representative value for average delay was selected for evaluation and comparison purposes.

Once a representative run was chosen for each alternative, the results were tabulated. These results are summarized in Table 4 (AM Peak) and Table 5 (PM Peak). The alternatives are listed in order of cost, with the least expensive alternatives on the left and the most expensive on the right.

One new term introduced in Tables 4 and 5 is the "performance index", or PI. The PI is a performance measure that facilitates the comparing of alternatives. It takes three individual performance measures—the % reduction in average delay, the % increase in average speed, and the % reduction in the number of stops per vehicle—and combines them into a single term. The higher the PI, the more effective the alternative in terms of improving traffic flow. A negative performance index indicates that a particular alternative actually degrades the flow of traffic.

Table 4 – Intersection Capacity Analysis, 2005 AM Peak Hour

		No Build	Intersection Improvements				Three-Lane Alternatives				Four-Lane Alternatives				
		Baseline Condition	Burnham Signal Only	EB & WB Dep Widening	Depart Widening w/ Signal	Dep Widening, Burnham Improvements	Partial EB Widening	Split 3 Lanes	TWLTL, No Signal	TWLTL, with Signal @ Burnham	2 Lanes EB w/ TWLTL	4 Lanes, No Signal	2 Lanes WB w/ TWLTL and Signal	3 Lane Split w/ TWLTL and Signal	4 Lanes with Signal
County Rd. (22) @ South St. (114)	Route 114 SB:	167.4	169.5	219.7	188.7	201.3	74.9	35.9	180.0	194.3	20.1	19.8	190.5	35.9	21.3
	Route 22 EB:	190.9	146.2	173.4	154.9	131.4	100.2	97.9	127.8	138.2	48.2	38.9	118.4	35.3	43.2
	Overlap WB:	16.9	12.4	10.2	6.8	8.3	11.8	7.6	6.7	5.7	10.1	7.2	6.6	7.6	8.4
	Intersection:	**135.4**	**119.3**	**145.3**	**132.5**	**126.8**	**69.8**	**51.7**	**111.2**	**126.2**	**29.4**	**24.7**	**114.7**	**28.8**	**27.5**
Overlap @ Burnham Rd.	Burnham Rd. NB:	20.7	478.7	27.9	360.5	43.4	20.2	340.1	20.3	245.9	56.7	46.6	434.9	138.2	25.1
	Overlap EB:	60.9	40.3	26.0	20.9	25.0	6.40	71.2	25.7	22.0	3.3	3.4	19.9	102.70	9.9
	Overlap WB:	9.2	12.3	15.0	11.2	11.7	2.80	2.0	6.1	7.7	2.2	2.4	5.6	4.50	4.5
	Intersection:	**40.3**	**111.3**	**24.2**	**81.7**	**25.9**	**8.0**	**123.1**	**20.1**	**59.2**	**12.7**	**11.0**	**91.8**	**0.9**	**11.6**
County Rd. (22) @ Gorham Rd. (114)	Gorham Rd. (114) NB:	28.9	59.4	47.7	46.3	47.0	41.7	40.2	39.4	45.2	42.0	50.0	41.0	46.0	49.9
	Overlap EB:	9.0	7.4	8.6	8.5	7.8	8.7	7.3	11.8	7.3	9.9	7.7	6.3	7.2	6.4
	County Rd. (22) WB:	14.4	16.1	12.9	11.3	10.8	7.1	5.7	17.0	12.8	8.2	6.9	8.6	9.4	7.7
	Intersection:	**15.1**	**22.5**	**19.5**	**18.8**	**19.5**	**17.3**	**16.2**	**20.8**	**18.2**	**16.4**	**17.6**	**16.3**	**18.0**	**17.6**
Gorham Rd. (114) @ Beech Ridge Rd.	Beech Ridge Rd. NB:	23.6	29.8	27.4	24.5	24.6	41.7	29.5	26.7	29.0	34.3	29.3	26.8	28.4	31.7
	Saco Rd. SB:	65	56.1	163.8	92.6	228.4	325.1	167	205.1	145.6	167.2	234.2	122.5	146.5	363.8
	Gorham Rd. (114) EB:	59.7	29.3	27.6	24.1	56.6	30.2	33.6	40.1	27.4	55.1	45.5	41.2	34.6	37.1
	Gorham Rd. (114) WB:	27.8	35.2	29.2	32.3	25.5	37.5	34.3	38.8	30.3	44.7	22	31.5	31.5	29.8
	Intersection:	**50.8**	**34.9**	**52.7**	**38.6**	**76.3**	**72.0**	**55.9**	**67.8**	**48.1**	**64.5**	**64.8**	**51.6**	**50.9**	**78.5**
County Rd. (22) @ Saco Rd.	Saco Rd. NB:	18.5	26.8	22.9	19.8	19.8	23.9	20	15.6	21.3	27.4	30.7	15.5	20.4	26.7
	Saco Rd. SB:	98.8	291.8	127.1	163.4	65.1	68.5	141.5	137.5	152.5	302.7	582.9	83.3	273.9	394
	County Rd. (22) EB:	32.8	43	48.6	37.1	33.4	65.9	38.2	80.9	33.3	66.7	42.9	37.3	31.7	27.3
	County Rd. (22) WB:	12.6	15.9	17.2	14.9	11.1	17.2	9.7	20.2	14.7	11.5	10.2	14.6	13.3	14.8
	Intersection:	**51.3**	**119.4**	**70.2**	**80.3**	**40.5**	**56.0**	**70.7**	**87.2**	**71.7**	**119.1**	**185.1**	**48.4**	**107.4**	**129.3**
Network-Wide Measures															
	Ave. Delay per Vehicle (s):	326.1	342.2	305.4	310.0	295.0	175.5	273.7	254.8	288.4	174.3	199.7	266.3	232.4	177.6
	Ave. Speed thru Study Area (mph):	14	14	15	15	15	20	16	16	15	20	19	16	17	20
	Ave. Stops per Vehicle:	6.2	5.21	5.17	6	5.66	2.93	4.54	4.99	5.44	2.93	3.3	5.11	3.67	2.78
	AM Performance Index:	**6.20**	**-0.09**	**0.70**	**0.49**	**0.78**	**4.12**	**1.50**	**1.72**	**0.91**	**4.14**	**3.48**	**1.52**	**2.49**	**4.11**

Table 5 – Intersection Capacity Analysis, 2005 PM Peak Hour

Intersection	Movement	No Build	Intersection Improvements				Three-Lane Alternatives				Four-Lane Alternatives				
		Baseline Condition	Burnham Signal Only	EB & WB Dep Widening	Dep Widening, Burnham Improvements	Depart Widening w/ Signal	Partial EB Widening	Split 3 Lanes	TWLTL, No Signal	TWLTL, with Signal @ Burnham	2 Lanes EB w/ TWLTL	4 Lanes, No Signal	2 Lanes WB w/ TWLTL and Signal	3 Lane Split w/ TWLTL and Signal	4 Lanes with Signal
County Rd. (22) @ South St. (114)	Route 114 SB:	28.8	31.6	28.2	36.1	35.2	29.5	27.5	34.7	34.9	33.8	38.3	39.1	35.7	33.9
	Route 22 EB:	22.8	14.4	11.1	14.8	14.5	66.6	12.8	10.8	19.2	13.0	13.6	65.1	15.8	31.0
	Overlap WB:	47	20.0	11.4	12.7	12.1	46.3	19.8	7.9	9.3	10.6	11.3	9.9	15.9	11.8
	Intersection:	**38.7**	**21.3**	**14.5**	**17.5**	**17.0**	**46.3**	**20.1**	**13.5**	**15.8**	**15.4**	**16.5**	**24.4**	**19.7**	**19.0**
Overlap @ Burnham Rd.	Burnham Rd. NB:	37.9	21.3	24.3	31.8	35.7	90.4	23.3	8.6	25.6	6.3	12.2	27.9	22.2	20.7
	Overlap EB:	4.8	12.4	2.0	2.8	15.7	4.50	2.8	2.0	10.0	2.8	2.8	14.0	17.30	22.9
	Overlap WB:	9.1	7.5	5.6	2.6	8.2	6.80	7.3	2.0	5.0	2.0	1.5	2.8	4.00	2.6
	Intersection:	**8.5**	**9.7**	**5.2**	**3.8**	**11.6**	**8.4**	**6.3**	**2.2**	**7.2**	**2.4**	**2.2**	**7.0**	**8.9**	**9.4**
County Rd. (22) @ Gorham Rd. (114)	Gorham Rd. (114) NB:	135.3	115.2	32.0	54.8	69.0	94.1	26.5	46.9	42.4	30.8	52.8	34.2	24.4	60.0
	Overlap EB:	15.7	8.2	12.4	11.8	16.0	9.4	11.9	10.1	12.7	11.6	11.7	13.3	11.3	12.0
	County Rd. (22) WB:	73.3	173.8	28.7	50.1	111.4	66.3	36.0	34.8	43.4	70.8	92.1	43.9	82.6	72.0
	Intersection:	**92.0**	**124.0**	**28.1**	**47.8**	**80.8**	**71.4**	**29.2**	**37.8**	**39.5**	**46.7**	**65.2**	**36.0**	**49.3**	**60.2**
Gorham Rd. (114) @ Beech Ridge Rd.	Beech Ridge Rd. NB:	30.5	42.2	27.5	26.7	33.2	28.1	25.6	31.7	34.5	24.1	43	34.0	28.4	34.3
	Saco Rd. SB:	33.9	105.6	176.4	293.1	81.2	32	118.6	204.6	183.9	69.9	377.1	273.7	190.2	376.3
	Gorham Rd. (114) EB:	17.6	15	13.9	10.7	19.6	25.9	11.6	15.2	14.5	16.8	12.6	17.8	11.1	11.4
	Gorham Rd. (114) WB:	363.5	338.2	52.3	73	65.5	366.6	139.9	122.7	80.1	83.1	139	118	68	60.5
	Intersection:	**182.3**	**191.3**	**57.4**	**85.8**	**52.4**	**192.8**	**92.0**	**95.7**	**72.9**	**57.5**	**127.3**	**106.2**	**66.1**	**87.5**
County Rd. (22) @ Saco Rd.	Saco Rd. NB:	27.3	43.8	31.1	32.2	32.2	26.1	49.8	48.1	29.4	39.7	21.6	25.5	30.1	24.1
	Saco Rd. SB:	34.6	107.8	381.5	117.3	303.2	128.2	134.9	136.7	281.4	210.1	127.5	201.1	294	252.5
	County Rd. (22) EB:	62.7	53.8	36.5	29	35.8	24.1	70.6	36.8	39.9	38.6	31.1	36.3	68.9	22.8
	County Rd. (22) WB:	132	104.3	118.1	108.4	71.8	91.6	100.4	90.4	105.5	102.5	92.2	45.5	86.3	82.6
	Intersection:	**84.4**	**88.8**	**154.8**	**89.7**	**114.3**	**82.4**	**96.6**	**88.3**	**125.3**	**109.8**	**83.1**	**79.6**	**123.0**	**108.4**
Network-Wide Measures															
	Ave. Delay per Vehicle (s):	333.1	313.1	218.2	206.1	244.8	282.6	185.5	173.9	192.5	186.2	196.3	176.3	187.8	188.6
	Ave. Speed thru Study Area (mph):	15	15	19	19	17	16	20	21	20	20	20	21	20	20
	Ave. Stops per Vehicle:	6.81	6.66	3.8	3.79	4.17	5.73	3.69	3.26	3.52	3.66	3.83	3.12	3.31	3.18
	PM Performance Index:		**0.32**	**2.97**	**3.15**	**2.11**	**1.12**	**3.67**	**4.11**	**3.59**	**3.67**	**3.49**	**4.10**	**3.69**	**3.70**

Tables 4 and 5 illustrate six important points relative to the traffic impact of the various alternatives.

1. The performance of a particular alternative can vary significantly based on the time of day. For example, the "Partial EB Widening" alternative had a PI of 4.12 in the AM peak and of only 1.12 in the PM peak.
2. This leads to an important observation: an effective alternative is one that can perform well during both the morning and evening peak hours.
3. In general, the more aggressive the strategy, the better the performance. For example, in the AM peak, the average PI for the "Intersection Improvements" alternatives was 0.47; for the "Three-Lane" alternatives, 2.06; and for the "Four-Lane" alternatives, 3.94.
4. However, there are exceptions to this trend. For example, in the AM peak, the PI for the "Partial EB Widening" alternative (a three-lane option) was higher than the PI for the "2 Lanes WB with TWLTL and Signal" alternative (a four-lane option). This reiterates point #2—an effective alternative should perform consistently well at all times of day.
5. There is a limit to how effective the alternatives can be. In both the AM and PM peak, the most effective four-lane alternative still experienced an average delay of nearly three minutes per vehicle.
6. In the AM peak, the average delay at the two easternmost intersections (Gorham Rd. @ Beech Ridge Rd., Saco Rd. @ County Rd.) actually *increased* with the three- and four-lane alternatives. The reason: These alternatives help reduce queues at the intersection of County Rd. and South St., thus allowing more traffic to reach the eastern intersections. Since no significant improvements are proposed for the two eastern intersections (County Rd. @ Saco Rd., Gorham Rd. @ Beech Ridge Rd.)[15], the increase in traffic simply leads to increased delays.

Part 5 – Perform Benefit-Cost Analysis

Another tool employed by HNTB to compare the various alternatives was a benefit-cost analysis. This analysis was conducted in two phases—a straight benefit-cost evaluation, and a comparative benefit-cost assessment. These two phases are described below.

Phase 1 – Benefit-Cost Evaluation

In this phase, each alternative's benefits (as measured by the dollar value of annual travel-time savings) were compared with its costs (as measured by the annualized cost of construction). If the benefits outweighed the costs, then the alternative was accepted for further evaluation.

Two sets of costs were developed for the benefit-cost study. The first set assumed that the new roadway could simply be overlaid on the existing roadway, with some widening occurring as necessary. The second set assumed that any alternative would require full-depth reconstruction. The study group felt that the "overlay" set of costs was probably more realistic, given the relatively favorable condition of the existing roadway. However, in order to create an "upper bound" for construction costs, the full-depth set of costs were retained as well.

Table 6 summarizes the results of the benefit-cost assessment.

[15] I.e., other than improved signal phasing, timing, and coordination.

Table 6 – Benefit-Cost Ratio Summary

Category	Alternative	Description	Benefit-Cost Ratio	
			Overlay	Full-Depth
Intersection Improvements	Alt. #1	Burnham Signal Only	1.2	1.0
	Alt. #2	EB & WB Departure Widening	13.2	8.6
	Alt. #3	Departure Widening, Burnham Improvements	12.7	8.3
	Alt. #4	Departure Widening w/ Burnham Signal	7.8	5.3
3-Lane Alternatives	Alt. #5	Partial EB Widening	9.0	5.3
	Alt. #6	Split 3 Lanes	6.9	4.2
	Alt. #7	TWLTL, No Signal	7.9	4.8
	Alt. #8	TWLTL w/ Signal at Burnham	5.5	3.4
4-Lane Alternatives	Alt. #9	2 Lanes EB w/ TWLTL, no Signal	6.6	4.2
	Alt. #10	4 Lanes, no Signal	5.8	3.7
	Alt. #11	2 Lanes WB w/ TWLTL + Signal	4.7	3.0
	Alt. #12	3 Lanes Split w/ TWLTL + Signal	5.1	3.3
	Alt. #13	4 Lanes w/ Signal	6.0	3.9

As Table 6 indicates, all 13 alternatives are cost-effective to the extent that their costs outweigh their benefits. Therefore, each alternative warrants further analysis in Phase 2 of the benefit-cost analysis.

Phase 2 – Incremental Benefit-Cost Assessment

This phase begins by comparing the two lowest-cost alternatives whose b/c ratio is greater than 1.0. An incremental benefit-cost calculation is performed, using the following formula:

Incremental b/c ratio = $(B_2 - B_1) / (C_2 - C_1)$

where,

B_2 = Annual benefits of more expensive alternative
B_1 = Annual benefits of less expensive alternative
C_2 = Annualized costs of more expensive alternative
C_1 = Annualized costs of less expensive alternative

An incremental b/c ratio greater than 1.0 indicates that every additional dollar spent on the more expensive alternative yields more than one dollar in benefits. Therefore, the more expensive alternative is retained. On the other hand, an incremental b/c ratio less than 1.0 indicates that every additional dollar spent on the more expensive alternative yields less than one dollar in benefits. Therefore, the more expensive alternative is not cost-effective and is removed from further consideration.[16]

The process of comparing alternatives and eliminating those that are not cost-effective is repeated until all alternatives have been evaluated. Table 7 summarizes this process for each of the 13 Overlap alternatives. (The alternatives in this table are referenced by the alternative numbers assigned in Table 6.)

[16] A negative incremental b/c ratio indicates that the more expensive alternative actually yields fewer benefits than the less expensive alternative.

Table 7 – Incremental B/C Ratio Summary

Alternative		Incremental b/c ratio		Superior Alternative		Comment
High Cost	Low Cost	Overlay	Full-Depth	Overlay	Full-Depth	
Alt #2	Alt #1	22.1	12.4	Alt #2	Alt #2	Alt. #2 retained
Alt #3	Alt #2	9.3	6.5	Alt #3	Alt #3	Alt. #3 retained
Alt #4	Alt #3	-33.6	-32.3	Alt #3	Alt #3	Alt. #4 rejected
Alt #5	Alt #3	4.2	2.2	Alt #5	Alt #5	Alt. #5 retained
Alt #7	Alt #5	4.8	3.0	Alt #7	Alt #7	Alt. #7 retained
Alt #8	Alt #7	-15.7	-12.5	Alt #7	Alt #7	Alt. #8 rejected
Alt #9	Alt #7	4.2	3.0	Alt #9	Alt #9	Alt. #9 retained
Alt #12	Alt #9	-29.6	-29.6	Alt #9	Alt #9	Alt. #12 rejected
Alt #13	Alt #9	-1.7	-1.4	Alt #9	Alt #9	Alt. #13 rejected

As Table 7 indicates, four alternatives (numbers 4, 8, 12, and 13) were rejected based on an unfavorable incremental benefit-cost ratio. Three other alternatives (number 6, 10, and 11) were rejected because they provided fewer benefits than an identically priced competing alternative. The remaining six alternatives—spanning a broad range of construction costs—were retained.

Table 8 provides a list of the most cost-effective alternatives based on various budget constraints. The table (based on the Overlay costs) is designed to answer this question for decision-makers: Based on the financial resources available for this project, which alternative provides the most cost-effective solution?

Table 8 – Preferred Alternatives from Incremental Benefit-Cost Analysis

Available Funding		Preferred Alternative
Lower Limit	Higher Limit	
$ -	$ 149,370	Nothing
$ 149,370	$ 353,340	Alt. #1 - Burnham Signal Only
$ 353,340	$ 414,700	Alt. #2 - EB & WB Departure Widening
$ 414,700	$ 736,970	Alt. #3 - Departure Widening, Burnham Improvements
$ 736,970	$ 997,230	Alt. #5 - Partial EB Widening
$ 997,230	$ 1,515,800	Alt. #7 - TWLTL, No Signal
$ 1,515,800	n / a	Alt. #9 - 2 Lanes EB w/ TWLTL, no Signal

PART 6 – IMPACT ANALYSIS

Additional criteria were developed to further assess the impacts of each alternative identified in Part 2 of this section. *Economic* criteria identified the order-of-magnitude costs associated with each individual alternative. *Construction* criteria evaluated the ability to construct each alternative within the existing MDOT right-of-way, and within the desired 4-year timeframe. And *social and environmental* criteria provided a basis for evaluating the impact on businesses, residences, and the natural environment within the study area. The No-Build condition was established as the base case, against which all short-term improvements were compared.

The performance measures associated with each of these criteria are listed below:

Economic Impacts

- Estimated Construction Costs (Widening and Overlay assumed)
- Estimated Construction Costs (Full Depth Reconstruction assumed)

Construction Impacts

- Ability to Construct within Current Right of Way
- Estimated Years to Construction

Social Impacts

- Properties Displaced
- Properties Impacts

Environmental Impacts

- Estimated Environmental Impacts (Minimal/Moderate/Severe)
- Environmental Assessment Likely

Table 9 summarizes the performance measures for each of the 13 final alternatives. The table also summarizes the traffic related performance measures from Part 4, as well as the benefit-cost information calculated in Part 5.

Table 9 – Impact Assessment Summary Matrix

Impact	Intersection Improvements *(Lower Cost)*				3-Lane Alternatives *(Moderate Cost)*				Four-Lane Alternatives *(Higher Cost)*				
	Alt. #1 - Burnham Signal Only	Alt. #2 - EB & WB Dep Widening	Alt. #3 - Dep Widening, Burnham Improvements	Alt. #4 - Depart Widening w/ Signal	Alt. #5 - Partial EB Widening	Alt. #6 - Split 3 Lanes	Alt. #7 - TWLTL, No Signal	Alt. #8 - TWLTL, with Signal @ Burnham	Alt. #9 - 2 Lanes EB w/ TWLTL	Alt. #10 - 4 Lanes, No Signal	Alt. #11 - 2 Lanes WB w/ TWLTL and Signal	Alt. #12 - 3 Lane Split w/ TWLTL and Signal	Alt. #13 - 4 Lanes with Signal
Traffic Impacts													
AM - % Reduction in Delay (vs. No-Build)	-5%	6%	8%	5%	46%	16%	22%	12%	47%	39%	18%	29%	46%
PM - % Reduction in Delay (vs. No-Build)	6%	35%	38%	27%	15%	44%	48%	42%	44%	41%	47%	44%	43%
Ave. Performance Index	0.12	1.86	1.90	1.32	2.58	2.61	2.94	2.28	3.90	3.48	2.84	3.10	3.90
Level of Operational Improvement	Min	Mod	Mod	Min	Mod	Mod	Mod	Mod	Sig	Sig	Mod	Sig	Sig
Min (PI<1.5), Mod (1.5-3.0), Sig (>3.0)													
Economic Impacts													
Est. Construction Costs $k *(overlay)*	$150.0	$354.0	$414.0	$464.0	$737.0	$997.5	$977.5	$1,108.0	$1,516.0	$1,516.0	$1,581.0	$1,581.0	$1,626.5
Est. Construction Costs $k *(full-depth)*	$178.0	$542.0	$630.0	$680.0	$1,236.0	$1,647.0	$1,647.0	$1,786.0	$2,369.0	$2,369.0	$2,434.0	$2,434.0	$2,507.5
Benefit/Cost Assessment													
Annual Benefits/Annualized Cost	1.0	8.6	8.3	5.3	5.3	4.2	4.8	3.4	4.2	3.7	3.0	3.3	3.9
B/C Ratio >= 1.0? *(Yes/No)*	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Incremental B/C Assessment	Retain	Retain	Retain	**Reject**	Retain	**Reject**	Retain	**Reject**	Retain	**Reject**	**Reject**	**Reject**	**Reject**
Construction Impacts													
Construct within current Right of Way	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Estimated Years to Construction	0 to 1	0 to 1	0 to 1	0 to 1	1 to 2	1 to 2	1 to 2	1 to 2	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4
Social Impacts													
Properties Displaced	0	0	0	0	0	0	0	0	0	0	0	0	0
Properties Impacted	0	0	0	0	0	0	0	0	0	0	0	0	0
Environmental Impacts													
Estimated Environmental Impacts *(Minimal, Moderate, Significant)*	Minimal	Minimal	Minimal	Minimal	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Environmental Assessment Likely ? (Y/N)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 9 brings out four key points germane to this study:

1. Only one of the alternatives retained in the incremental benefit-cost analysis provides a "significant" level of operational improvement. This was Alt. #9, a four-lane alternative with two lanes running eastbound and a TWLTL.

2. However, the cost of constructing the four-lane alternatives (in excess of $1.5 million) pushes the upper limit of what the region is able to afford. Additionally, the time frame (up to four years to complete) could be an issue, since the traffic problem is acute right now.

3. The most cost-effective alternative costing less than $1 million is Alt. #7, a three-lane alternative that provides a center turn lane throughout the entire corridor. This alternative has the highest average performance index of all the three-lane alternatives, indicating that it is effective at improving traffic flow during both the morning and evening peak hours. And it can be completed within two years, which is appealing to towns that have been wrestling with Overlap congestion for years.

4. If budget constraints require any solution to focus solely on intersection improvements, then Alt. #3 ("Departure Widening with Burnham Improvements") would be the best selection. Its cost is less than half of Alt. #7 (see point 3 above), yet it still provides a moderate level of operational improvement. Its primary drawback is that it provides minimal improvement to morning peak-hour traffic.

Part 7 – Impact Analysis Summary

This section began by identifying an initial list of short-term alternatives for reducing Overlap congestion. A preliminary analysis was performed on this initial list, and this analysis served two purposes. First, it allowed the study team to eliminate some options, such as constructing rotaries or relocating Burnham Rd. And second, it pointed out the need to explore various 3- and 4-lane configurations for further analysis.

In the end, the study team identified 13 final alternatives—four intersection improvement alternatives, four three-lane alternatives, and five four-lane alternatives. Each alternative was studied in further detail through AM and PM peak-hour traffic simulation. The simulation analysis revealed that, in general, the more expensive alternatives provided greater operational improvement. However, even the best alternative still yielded three minutes of average delay during the peak hour.

After evaluating the traffic impacts of each alternative, a benefit-cost analysis was performed. This analysis identified the most cost-effective alternative for each possible level of funding. In broad terms, the benefit-cost analysis said the following:

- If a half-million dollars is available, then Alt. #3 ("Departure Widening with Burnham Improvements") is the best alternative.
- If a million dollars is available, then Alt. #7 ("TWLTL, No Signal") is best.
- If $1.5 million is available, then Alt. #9 ("2 Lanes EB w/ TWLTL") is the most cost-effective.

An examination of the economic, construction, social, and environmental impacts of each alternative highlighted two key points:

1. All alternatives can be built within the existing right-of-way.
2. The four-lane alternatives represent a significant jump in both cost and construction time frame.

The final section will present the recommendations of the study team and will add some concluding remarks.

Section 5 – Conclusions and Recommendations

PACTS, MDOT, and the Towns of Gorham and Scarborough undertook this study to develop feasible short-term improvement alternatives for the Overlap area. This short-term improvement strategy is not intended to solve the Overlap's transportation deficiencies for the next 20 years. Rather, it is simply intended to temper the delays until a more permanent, long-term solution can be identified and implemented.

The study began by identifying an initial list of short-term alternatives, ranging from rotaries to relocated intersections to widened roadways. After some preliminary analysis and a round of screening, this list was pared down to 13 distinct final alternatives. This final list was divided into three categories:

- Intersection improvements (relatively inexpensive alternatives costing less than $0.5 million and able to be completed within a year)
- Three-lane options (more costly alternatives, costing between $0.5-$1.0 million and able to be completed within 1 to 2 years)
- Four-lane options (most expensive alternatives, costing in excess of $1.5 million with a 2-4 year construction timeframe)

HNTB evaluated each of the final alternatives in terms of its traffic, economic, construction, social, and environmental impacts. Additionally, a benefit-cost analysis was performed to identify the most cost-effective alternatives. The results of the analysis were presented to the study team. The team drew the following conclusions.

1. The four-lane alternatives, though offering the greatest potential for improvement, would not be recommended for construction. The three primary reasons for this conclusion are:
   a. The construction costs are prohibitive;
   b. The time frame for construction is too long; and
   c. A four-lane roadway is not consistent with the community's character.

2. Two alternatives should be carried forward and presented to the towns for review and comment.[17]
   a. **Alt. #3 – Departure Widening with Burnham Rd. Improvements.** This is a low-cost alternative that focuses on intersection improvements. It is particularly helpful in the evening peak, where it provides a 38% reduction in average delay.
   b. **Alt. #7 – Two-way Left-Turn Lane (TWLTL) with No Signal.** This is a moderate-cost alternative that provides a center turn lane throughout the Overlap. By separating left-turning traffic from the heavy stream of thru traffic, this alternative improves traffic flow during both the morning and evening peak hours. It reduces average delay by 22% in the AM peak and 48% in the PM peak.

Both alternatives meet the study team's objective—to reduce current congestion levels on the Overlap while meeting stringent budgetary and time constraints. And neither represents a significant change to the character of the communities involved.

Two additional points should be made in closing.

- This study has made it clear that there are no cheap, silver-bullet solutions to the Overlap's congestion woes. The Overlap must simultaneously serve a heavy volume of thru traffic and accommodate a significant number of turning vehicles. Substantial improvements can only come at substantial costs.
- This study focused exclusively on the Overlap. However, as Section 4 noted, the two signalized intersections at the eastern end of the study area (Beech Ridge @ Gorham Rd., Saco Rd. @ County Rd.) are also at capacity. Any improvements to the Overlap itself may be moderated by the fact that these intersections, as currently configured, cannot accommodate much more volume.

[17] See Section 4, Part 2 for a detailed description of these alternatives.

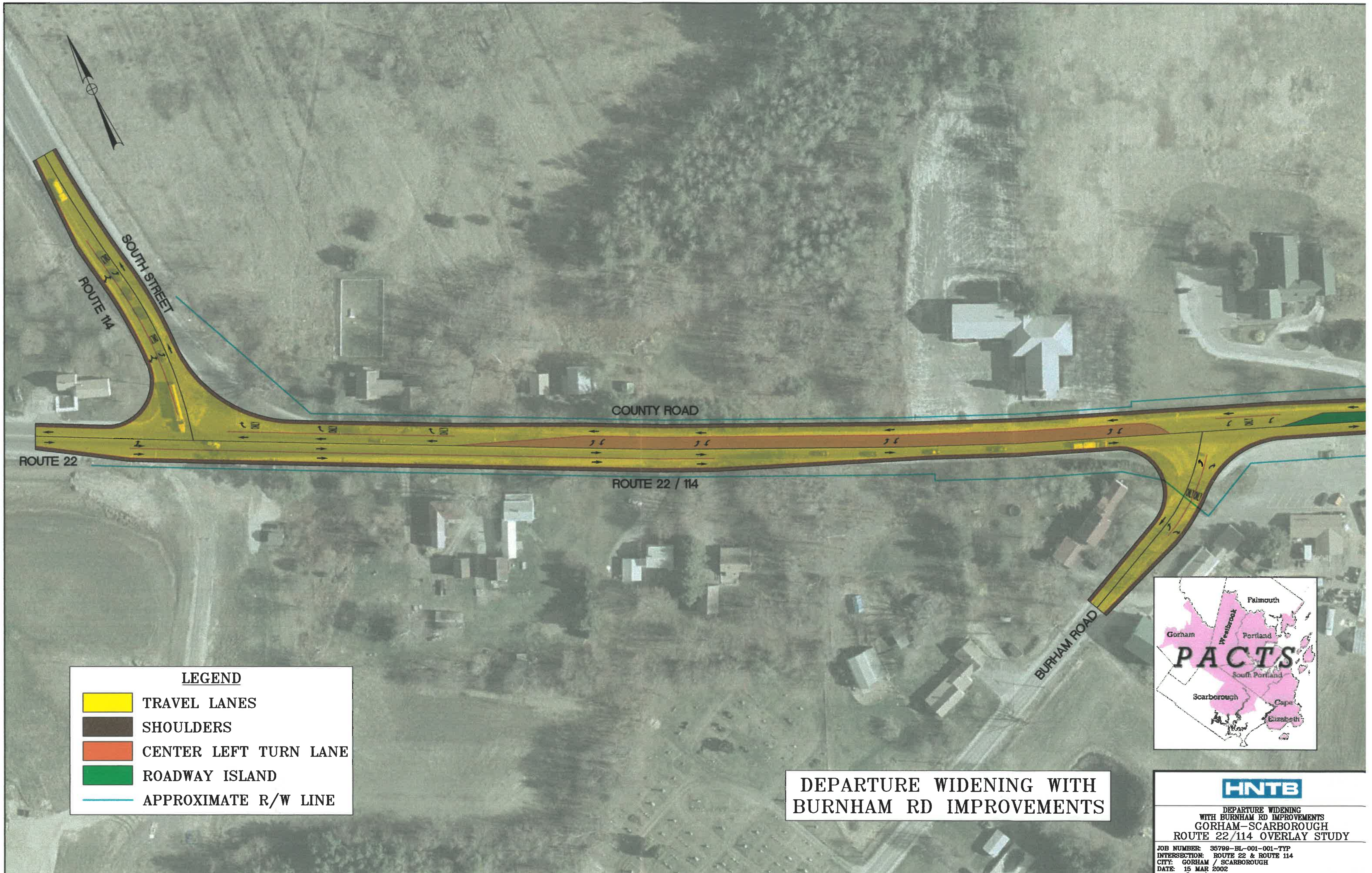
Appendix – Sketches of Final Alternatives

HNTB

STUDY AREA MAP
GORHAM–SCARBOROUGH
ROUTE 22/114 OVERLAY STUDY

JOB NUMBER: 35799-BL-001-001-P500
INTERSECTION: ROUTE 22 & ROUTE 114
CITY: GORHAM / SCARBOROUGH
DATE: 15 MAR 2002

SCALE: 1"=500' SHEET 1 OF 1


SOUTH STREET
ROUTE 114
COUNTY ROAD
ROUTE 22
ROUTE 22 / 114
BURHAM ROAD
LEGEND
TRAVEL LANES
SHOULDERS
CENTER LEFT TURN LANE
ROADWAY ISLAND
APPROXIMATE R/W LINE
Falmouth
Gorham
Westbrook
Portland
PACTS
South Portland
Scarborough
Cape
Elizabeth
DEPARTURE WIDENING WITH
BURNHAM RD IMPROVEMENTS
HNTB
DEPARTURE WIDENING
WITH BURNHAM RD IMPROVEMENTS
GORHAM-SCARBOROUGH
ROUTE 22/114 OVERLAY STUDY
JOB NUMBER: 35799-BL-001-001-TYP
INTERSECTION: ROUTE 22 & ROUTE 114
CITY: GORHAM / SCARBOROUGH
DATE: 15 MAR 2002
SCALE: 1"=100'
SHEET 1 OF 3


COUNTY ROAD
ROUTE 22 / 114
COUNTY ROAD ROUTE 22
GORHAM ROAD
ROUTE 114
GORHAM
SCARBOROUGH
TOWN LINE
GORHAM
SCARBOROUGH
TOWN LINE
LEGEND
TRAVEL LANES
SHOULDERS
CENTER LEFT TURN LANE
APPROXIMATE R/W LINE
Falmouth
Gorham
Westbrook
Portland
PACTS
South Portland
Scarborough
Cape Elizabeth
DEPARTURE WIDENING WITH BURNHAM RD IMPROVEMENTS
HNTB
DEPARTURE WIDENING
WITH BURNHAM RD IMPROVEMENTS
GORHAM–SCARBOROUGH
ROUTE 22/114 OVERLAY STUDY
JOB NUMBER: 35799-BL-001-001-TYP
INTERSECTION: ROUTE 22 & ROUTE 114
CITY: GORHAM / SCARBOROUGH
DATE: 15 MAR 2002
SCALE: 1"=100'
SHEET 3 OF 3


SOUTH STREET
ROUTE 114
COUNTY ROAD
ROUTE 22
ROUTE 22 / 114
BURHAM ROAD
LEGEND
TRAVEL LANES
SHOULDERS
CENTER LEFT TURN LANE
APPROXIMATE R/W LINE
Falmouth
Gorham
Westbrook
Portland
PACTS
South Portland
Scarborough
Cape
Elizabeth
3 LANE SECTION
WITH CENTER TURN LANE
HNTB
3 LANE SECTION
WITH CENTER TURN LANE
GORHAM-SCARBOROUGH
ROUTE 22/114 OVERLAY STUDY
JOB NUMBER: 35799-BL-001-001-TYP
INTERSECTION: ROUTE 22 & ROUTE 114
CITY: GORHAM / SCARBOROUGH
DATE: 15 MAR 2002
SCALE: 1"=100'
SHEET 1 OF 3


COUNTY ROAD
ROUTE 22 / 114
LEGEND
TRAVEL LANES
SHOULDERS
CENTER LEFT TURN LANE
APPROXIMATE R/W LINE
3 LANE SECTION
WITH CENTER TURN LANE
Falmouth
Gorham
Westbrook
Portland
PACTS
South Portland
Scarborough
Cape
Elizabeth
HNTB
3 LANE SECTION
WITH CENTER TURN LANE
GORHAM-SCARBOROUGH
ROUTE 22/114 OVERLAY STUDY
JOB NUMBER: 35799-BL-001-001-TYP
INTERSECTION: ROUTE 22 & ROUTE 114
CITY: GORHAM / SCARBOROUGH
DATE: 15 MAR 2002
SCALE: 1"=100'
SHEET 2 OF 3


TOWN LINE
GORHAM
SCARBOROUGH
COUNTY ROAD ROUTE 22
GORHAM ROAD
ROUTE 114
COUNTY ROAD
ROUTE 22 / 114
TOWN LINE
GORHAM
SCARBOROUGH
LEGEND
TRAVEL LANES
SHOULDERS
CENTER LEFT TURN LANE
APPROXIMATE R/W LINE
Falmouth
Gorham
Westbrook
Portland
PACTS
South Portland
Scarborough
Cape
Elizabeth
3 LANE SECTION
WITH CENTER TURN LANE
HNTB
3 LANE SECTION
WITH CENTER TURN LANE
GORHAM-SCARBOROUGH
ROUTE 22/114 OVERLAY STUDY
JOB NUMBER: 35799-BL-001-001-TYP
INTERSECTION: ROUTE 22 & ROUTE 114
CITY: GORHAM / SCARBOROUGH
DATE: 15 MAR 2002
SCALE: 1"=100'
SHEET 3 OF 3