Executive Summary

The Maine Department of Transportation (MaineDOT), along with the Bangor Area Comprehensive Transportation System (BACTS) and other stakeholders, conducted a study of Interstate 95 in the City of Bangor. The purpose of the study was to evaluate the long-term needs of the I-95 Corridor in Bangor and to identify a set of recommendations to provide safe and efficient transportation service through the year 2030.

Background

I-95 was constructed as part of the National System of Interstate and Defense Highways (Interstate Highway System), established by Congress in 1956. Most of present-day I-95 through Bangor was opened to traffic in the early 1960s. Rural Interstate connections to Newport and points south and Orono and points north were opened to traffic in the years following.

Since the 1960s, car and truck traffic volumes on I-95 have grown more than fourfold. In 1963, the I-95 traffic volume over the Kenduskeag Stream was less than 12,000 vehicles per day. Now, I-95 at the same location carries 49,000 vehicles per day, making it the most heavily traveled segment of Interstate highway in Maine north of the Greater Portland area.

MaineDOT's 20-Year Transportation Plan of January 2001 recognized that I-95 through Bangor was a highway corridor in danger of becoming highly congested in the next 20 years. At the same time, MaineDOT's bridge engineers recognized that the I-95 bridges in Bangor were aging and that decisions would need to be made in the coming years on whether the bridges should be rehabilitated or replaced by new bridges. The Bangor I-95 Corridor Study was initiated in late 2007 to evaluate existing and future traffic conditions in the Corridor so that improvement recommendations could be developed that would meet the traffic safety and capacity needed and help guide future decisions on bridge structure maintenance, rehabilitation and replacement.

*Connecting Main*e, MaineDOT's current long-range plan, also identified Maine's Interstate system as a critical factor in the health of Maine's economy and identified it as a strategic investment area. The Bangor I-95 Corridor Study is consistent with the stated goals of *Connecting Maine*:

I. Ensure a safe and secure transportation system.
II. Ensure the sustainability of Maine's transportation system.
III. Promote economic viability and competitiveness through transportation investments.
IV. Enhance quality of life by developing and implementing transportation programs that enhance communities and Maine's natural environment.
V. Enhance public awareness and participation.

Purpose and Need

As stated earlier, the purpose of the study is to evaluate the long-term needs of the I-95 Corridor in Bangor and to identify a set of recommendations to provide safe and efficient transportation service through the year 2030. With the growth of traffic that has occurred in the 50 years of its existence, I-95 is facing greater challenges in meeting the safety and mobility needs of its users. Incidents anywhere along the highway create traffic hazards that can temporarily reduce highway capacity and produce massive traffic backups. On- and off-ramps designed over 50 years ago are operating poorly under today's traffic volumes. The goal of the Bangor I-95 Corridor Study is to provide a direction for future investments in this corridor to address these deficiencies and ensure that I-95 can function effectively into the future.

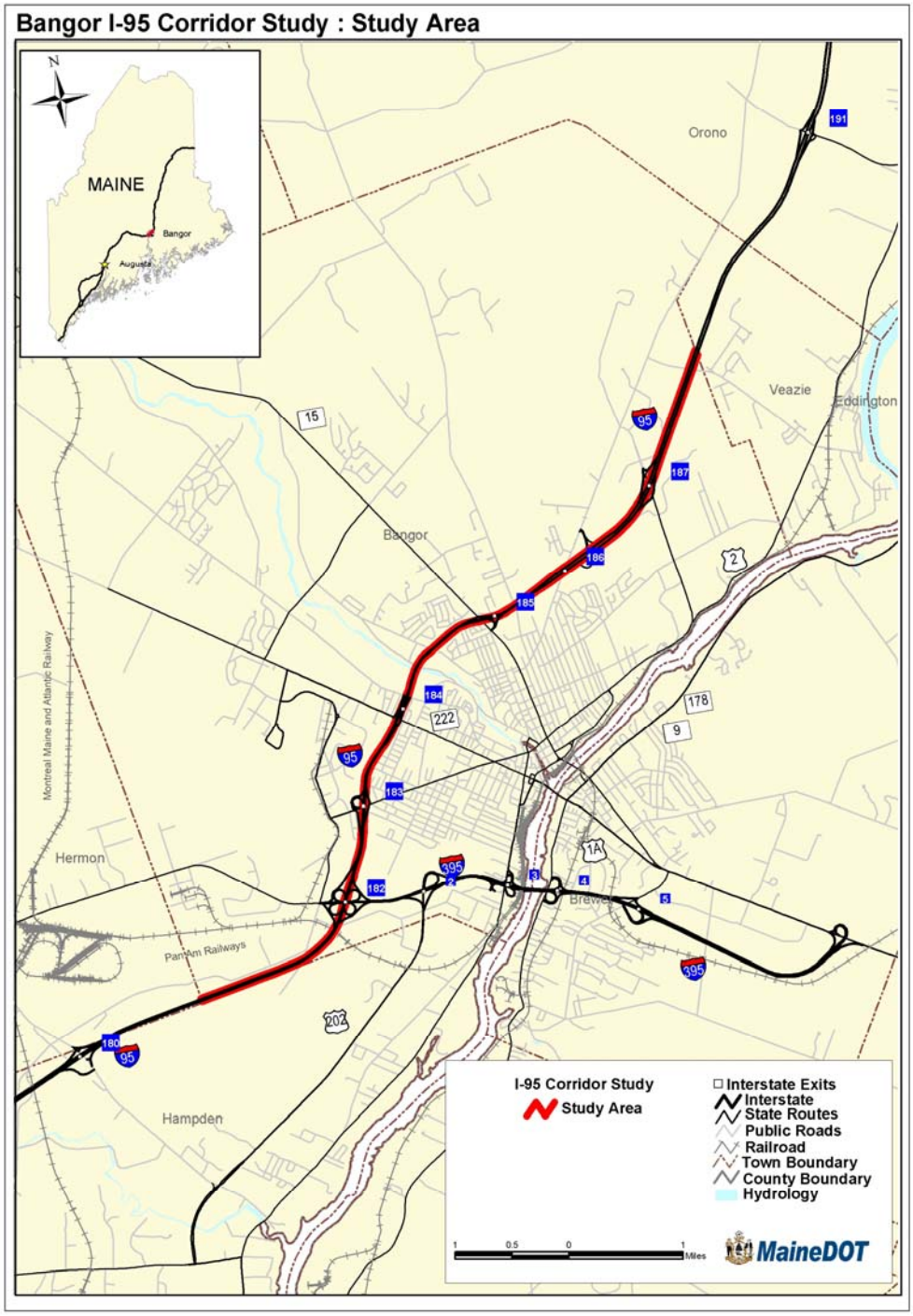
Study Process

After the definition of a study purpose, one of the first steps in the study process was to define a study area for I-95. The Bangor I-95 Corridor Study Area extends the entire length within the City of Bangor from the Hermon town line in the south to the Veazie town line in the north, a distance of 7.5 miles. This study area was chosen because it encompasses the most heavily traveled portions of I-95, from the Exit 182 interchange with I-395 to the Exit 187 interchange at Hogan Road. Figure 1 shows the Bangor I-95 Corridor Study Area.

The study process had two major components: the technical analysis and public participation.

The technical analysis includes a review of existing conditions, a forecast of future conditions, and an analysis of alternatives. The review of existing conditions includes traffic volumes, physical inventory, mobility and safety performance, an inventory of I-95 and related transportation resources, and an environmental overview. The future conditions forecast includes future traffic volumes, mobility performance, and a review of external factors that could influence future conditions. The alternatives are identified from a range of potential strategies, and analyzed to measure their effectiveness and assess their feasibility.

Figure 1 Study Area



Public Participation

The public participation component of the Study included three major elements. The first was a Public Advisory Committee composed of representatives from the following list of entities. The purpose of the Committee was to help identify issues in the I-95 Corridor, offer potential actions, help define future performance expectations, and provide feedback on preliminary findings.

MaineDOT	Federal Highway Administration	Maine State Police
BACTS	City of Bangor	City of Brewer
Bangor Mall	Eastern Maine Medical Center	

A total of four Public Advisory Committee meetings were held between March 2009 and March 2010.

The second element involved a series of public informational meetings held in the City of Bangor. The purpose of these meetings was to give members of the general public the opportunity to receive information during the course of the study, have input on corridor issues, offer potential actions, and provide feedback on preliminary findings. These three public informational meetings were advertised and jointly sponsored by BACTS and MaineDOT and held on May 27, 2009, November 12, 2009, and January 6, 2011.

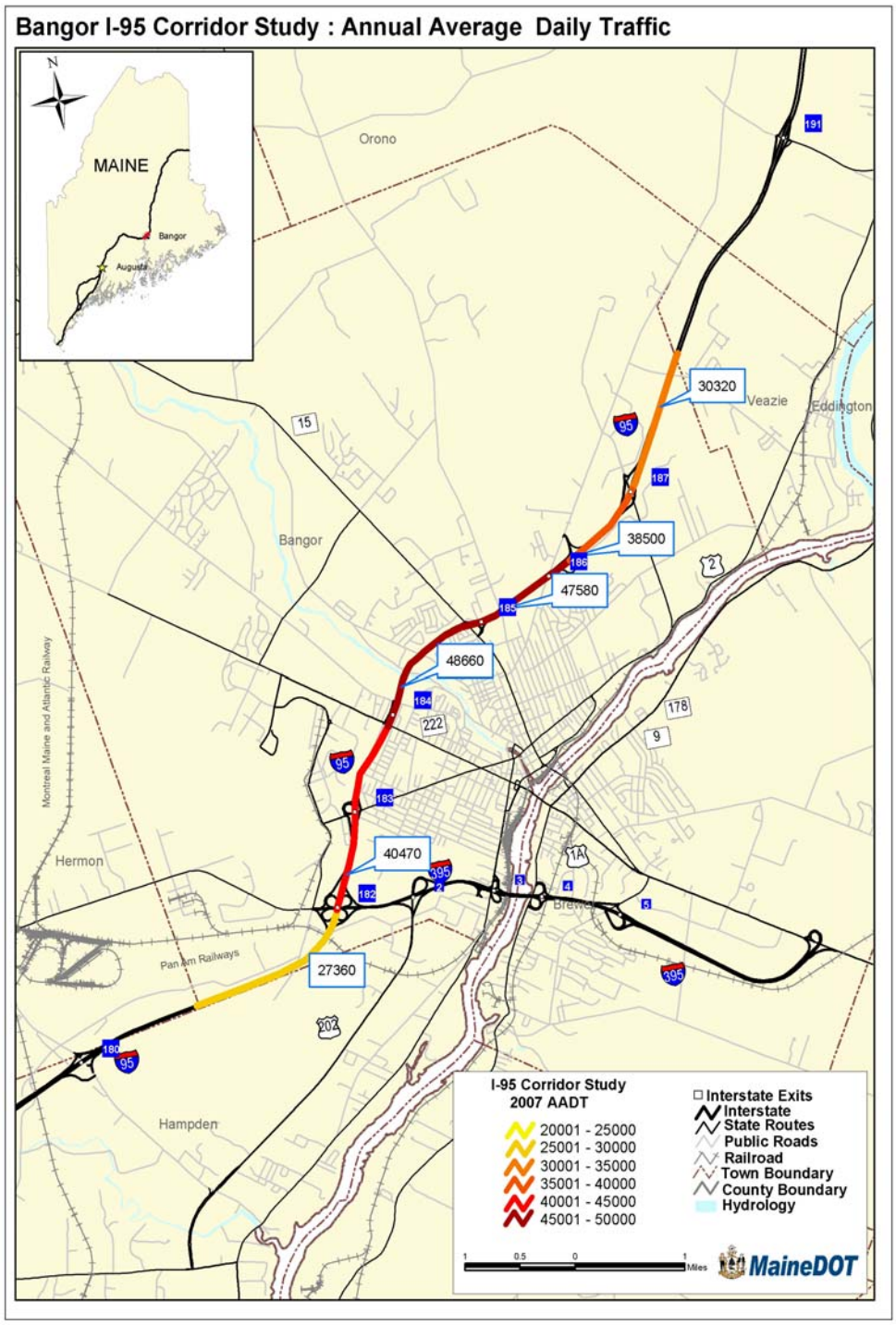
The third element was a Bangor I-95 Corridor Study website to provide information about study objectives, existing and future conditions, Committee meetings, public informational meetings, transportation alternatives, and study findings. The website has provided opportunities for public feedback by way of e-mail messages or by completing an on-line questionnaire about I-95. The website has been accessible from the MaineDOT website at http://www.maine.gov/mdot/bangori95study/index.htm.

Existing and Future Conditions

Baseline information about the Study Area was compiled to provide a picture of the Bangor I-95 Corridor in terms of traffic characteristics, safety, mobility, and environment. In addition to compiling and evaluating this information for existing conditions, traffic volumes, mobility characteristics, and other factors, MaineDOT also looked at changes that could be expected under future conditions.

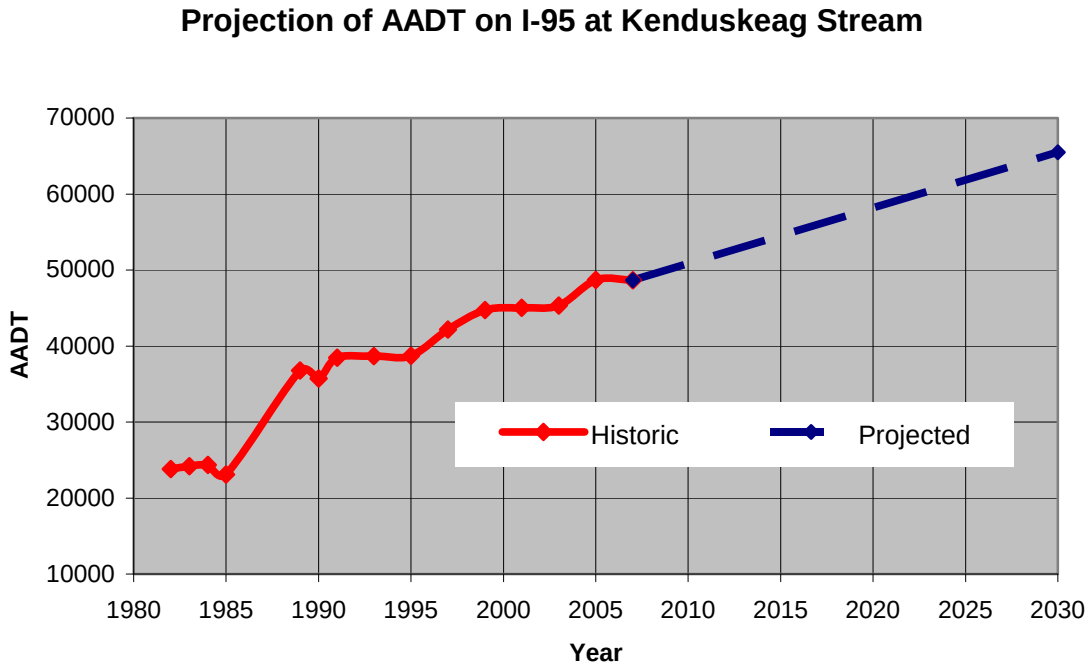
Figure 2 shows the ranges of Annual Average Daily Traffic (AADT) that exist in the I-95 Corridor. Volumes within the Study Area vary from a low of 27,360 vehicles per day south of Exit 182 (I-395) to a high of 48,660 vehicles per day on the segment between Exits 184 (Union Street) and 185 (Broadway). Volumes are nearly as high between Exits 185 and 186 (Stillwater Avenue).

Figure 2 AADT on I-95 in Bangor



Historic trends in traffic growth indicate that traffic volumes in the I-95 Corridor would be expected to continue. Figure 3 shows the historic and projected trend in traffic volume between Exits 185 and 186. Projection of this growth trend suggests a linear growth in traffic at an annual rate of 1.5% from the 2007 base year. Extended to year 2030, the traffic volume on I-95 would increase by 34.5% over the 23-year period.

Figure 3 Bangor I-95 Traffic Projection



Highway Crashes

Highway crash experience is the safety record of a highway facility. Table 1 summarizes the crash experience in years 2005 through 2007 on the Bangor I-95 mainline in terms of numbers of crashes and severities of injury. As the table shows, over 400 crashes occurred, resulting in three fatalities and 128 personal injuries.

Table 1 Crash Experience on Bangor I-95 Mainline , 2005-07

	Injury Type				
	K	A	B	C	PD
Crashes	3	3	53	52	293
Injuries	3	3	65	60	-

Note: Injury Type: K = fatality, A = incapacitating injury, B = non-incapacitating injury, C = possible injury, PD = no injuries (property damage).

Crash data for the same three years were used to identify high crash locations (HCLs) in the Study Area. A HCL is a location that has had eight (8) or more traffic crashes and a Critical Rate Factor (CRF) greater than 1.00 in a three-year period. A highway location

with a CRF greater than 1.00 has a frequency of crashes that is greater than the statewide average for similar locations.

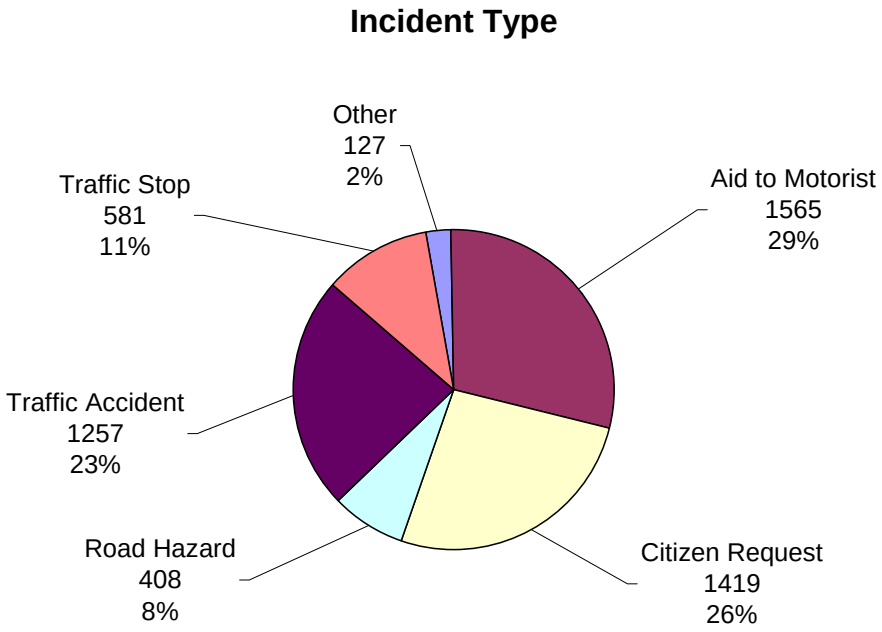
Based on the results of the crash research, fourteen locations within the Study Area meet the criteria for placement on MaineDOT's list of High Crash Locations (HCLs). Collision Diagrams were prepared for these locations to determine if there are any crash patterns or trends evident that may indicate correctable roadway/ intersection deficiencies.

Highway Incidents

Along with the reportable crash data, the MaineDOT received incident data from the Maine State Police. Incidents are defined as accidents, breakdowns and other random events that occur on the highway. They contribute to a large percentage of the traffic congestion delay on the nation's highways, lead to major road closures, and adversely affect the safety of our transportation network. Furthermore, incidents increase drivers' exposure to hazardous conditions and are known to lead to secondary crashes as well.

The Maine State Police reporting system includes details regarding the incident type, location, incident time, time closed and disposition type. During the period from January 2005 to December 2008 there were more than 5,000 incidents reported to the State Police in the study area. Figure 2.16 pie chart shows that largest percentage is Aid to Motorist (29%) followed by Citizen Requests (26%) and Traffic Accidents (23%).

Figure 4 Types of Traffic Incidents on I-95 in Bangor from 2005 through 2008



Freeway Mobility

The mainline segments and ramp junctions along the I-95 Corridor were analyzed for their ability to provide adequate capacity and level of service for existing and future traffic volumes. The analysis of existing and future traffic volumes indicated that these freeway facilities had adequate capacity for now and in year 2030. The analysis of level of service indicated that current levels of service would be level of service C or better, and that future levels of service would be D or better in 2030. A level of service E or F would normally be considered poor. The analysis results led to a determination that additional through lanes on the I-95 Corridor in Bangor would not be needed in the foreseeable future. Tables 2 and 3 show the expected levels of service on mainline segments and ramp junctions for the 2030 AM and PM peak hours, respectively.

Table 2 2030 No-Build LOS AM Peak

		Level of Service					
		A	B	C	D	E	F
On/Off Ramps	South Bound		10	5			
	North Bound		3	3	7		
Segments Between On/Off Ramps	South Bound	2	9	5			
	North Bound		5	5	4		

Table 3 2030 No-Build LOS PM Peak

		Level of Service					
		A	B	C	D	E	F
On/Off Ramps	South Bound		1	10	4		
	North Bound		4	7	2		
Segments Between On/Off Ramps	South Bound		2	10	4		
	North Bound	1	4	7	2		

Intersection Mobility

In addition to analyzing mobility along the I-95 mainline, MaineDOT analyzed the levels of service and capacities at intersections at or near the I-95 interchanges. Table 4 shows a summary of the 2030 operating conditions at these intersections. The analysis showed that the delays at two intersections would lead to level of service E or F in the future.

Table 4 Future Overall Operating Conditions at Intersections

Interchange Location and Intersection		Level of Service	Delay	V/C Ratio
			(sec/veh)	
Exit 182	Outer Hammond and Odlin Rd	E/D	55.3	0.77
Exit 184	I-95 SB and Union St	B	14.5	0.67
	I-95 NB and Union St	B	16.5	0.75
	14th Street and Union St	B	11.5	0.64
Exit 185	Falvey Street and Broadway	A	8.2	0.48
	I-95 SB and Broadway	D	37.4	0.81
	I-95 NB and Broadway	C	23.4	0.75
Exit 186	I-95 and Stillwater Ave	C	32.9	0.85
	Bangor Mall and Stillwater Ave	C	24.8	0.73
Exit 187	Bangor Mall and Hogan Road	F	101.5	0.86
	I-95 SB and Hogan Road	C	22.1	0.78
	I-95 NB and Hogan Road	C	28.7	0.88

Alternatives Analysis

To address safety and mobility concerns in the I-95 Corridor, MaineDOT considered a range of improvement strategies including use of auxiliary lanes, intelligent transportation systems (ITS), transportation demand management (TDM), interchange improvements, and others. Within each of these strategies, specific actions were conceived and analyzed in terms of effectiveness at addressing safety and mobility concerns, capital cost, and implementation challenges.

Effectiveness

In Table 5, the effectiveness of each of the candidate actions is summarized. Each action would have an impact on safety or mobility or both. For auxiliary lane improvements modest improvements would be expected in safety and mobility, but a larger safety impact would be expected where there are high crash locations. For intelligent transportation systems, fewer incidents, shorter incidents, fewer crashes, and reduced delays would be expected. Use of TDM facilities and services would reduce vehicle-miles traveled. In general, improvements at intersections at or near interchanges would reduce delays at those intersections, but could improve safety as well. The major interchange improvement actions would reduce crashes and/or reduce delays on intersecting roads such as Hogan Road. Effective signing improvements would reduce conflicts between vehicles, which affect both safety and mobility. A median barrier would have safety impacts, but it could also reduce maintenance costs.

Table 5 Effectiveness of Actions

Strategies	Actions	Locations	Safety Impact	Mobility Impact
Auxiliary Lanes	Increase acceleration and/or deceleration lengths at interchange ramp junctions	NB 182A off-ramp	reduce vehicle conflicts	minor savings in VHT, some improvements in level of service
		NB 182B on-ramp		
		NB 183 on-ramp		
		NB 184 off-ramp		
		NB 184 on-ramp	address 2 HCLs	
		NB 185 off-ramp	address HCL	
		NB 185 on-ramp	address 2 HCLs	
		NB 187 on-ramp	reduce vehicle conflicts	
		SB 187 on-ramp		
		SB 186 on-ramp		
		SB 185 off-ramp		
		SB 185 on-ramp		
		SB 184 on-ramp		
		SB 183 on-ramp (northern)		
		SB 182A on-ramp		
Intelligent Transportation Systems (ITS)	Establish traffic monitoring facilities	I-95 (and I-395)	reduce crashes on I-95	reduce delays on I-95
	Install variable message signing	I-95 (and I-395)		
	Establish service patrol	I-95 (and I-395)	shorten duration of incidents	
Transportation Demand Management (TDM)	Establish park & ride facility	Exit 185 area		reduce VMT
	Increase carpooling and vanpooling	Greater Bangor area		
Interchange Improvements	Improve intersections at/near interchanges	Exit 182, Odlin @ Outer Hammond		reduce delays
		Exit 185, Broadway @ SB ramps		reduce delays
		Exit 186, Stillwater @ ramps		minor change
		Exit 187, Hogan @ SB off-ramp	address HCL	
		Exit 187, Hogan @ SB on-ramp		reduce delays
	Construct flyover ramp	Exit 182, WB to SB	address 2 HCLs	
	Construct median lanes	Exit 182, NB and SB	address HCL	
	Realign northbound on-ramp	Exit 184	address 3 HCLs	
	Construct northbound on-ramp	Exit 186		mixed results
	Construct new interchange	north of Exit 187		reduce delays
Other	Modify signing	I-95	reduce vehicle conflicts	
	Install median barrier	Between Mile 183 and Mile 186	mixed results	

Costs and Implementation Challenges

Table 6 summarizes the costs and implementation challenges of each action analyzed. For most of the auxiliary lane improvement actions, costs are relatively low and implementation challenges would be minimal. ITS improvement actions would also be low in cost, but would require development and coordination of a freeway management plan. TDM improvement actions would be low in cost, but locating a convenient park & ride lot could be a challenge. Intersection improvement actions at interchanges are moderate in cost, but may involve some right-of-way acquisition. Major interchange improvement actions such as new ramps or a new interchange are the most costly and may involve an extensive planning process if they involve acquiring new right-of-way.

Table 6 Costs and Implementation Challenges

Strategies	Actions	Locations	Capital Cost	Implementation Challenges
Auxiliary Lanes	Increase acceleration and/or deceleration lengths at interchange ramp junctions	NB 182A off-ramp	$75,000	minimal
		NB 182B on-ramp	$85,000	
		NB 183 on-ramp	$175,000	
		NB 184 off-ramp	$90,000	
		NB 184 on-ramp	undetermined	right-of-way and bridge impacts
		NB 185 off-ramp	$70,000	minimal
		NB 185 on-ramp	$140,000	
		NB 187 on-ramp	$130,000	
		SB 187 on-ramp	$130,000	
		SB 186 on-ramp	$130,000	
		SB 185 off-ramp	$70,000	
		SB 185 on-ramp	$160,000	
		SB 184 on-ramp	$110,000	
		SB 183 on-ramp (northern)	$180,000	
		SB 182A on-ramp	$75,000	
Intelligent Transportation Systems (ITS)	Establish traffic monitoring facilities	I-95 (and I-395)	undetermined	implementation plan for freeway management system
	Install variable message signing	I-95 (and I-395)	(in place) $0	
	Establish service patrol	I-95 (and I-395)	(annual) $105,000	
Transportation Demand Management (TDM)	Establish park & ride facility	Exit 185 area	variable	location selection
	Increase carpooling and vanpooling	Greater Bangor area	variable	minimal
Interchange Improvements	Improve intersections at/near interchanges	Exit 182, Odlin @ Outer Hammond	$470,000	possible right-of-way impact
		Exit 185, Broadway @ SB ramps	$190,000	minimal
		Exit 186, Stillwater @ ramps	$690,000	
		Exit 187, Hogan @ SB off-ramp	$300,000	
		Exit 187, Hogan @ SB on-ramp	$1,300,000	
	Construct flyover ramp	Exit 182, WB to SB	$30,000,000	cost, possible right-of-way impact
	Construct median lanes	Exit 182, NB and SB	$15,500,000	cost
	Realign northbound on-ramp	Exit 184	$650,000	coordination with bridge projects
	Construct northbound on-ramp	Exit 186	$5,000,000	cost, mixed mobility impact
	Construct new interchange	north of Exit 187	$9,000,000	cost, environmental effects
Other	Modify signing	I-95	variable	minimal
	Install median barrier	Between Mile 183 and Mile 186	undetermined	potential cost, mixed safety impact

The potential actions were also evaluated and compared with the use of a benefit/cost analysis, which provided indications of which actions were more cost effective and economically feasible. In the development of recommendations from the Bangor I-95 Corridor Study, the effectiveness, the costs, and the implementation challenges all needed to be weighed.

Recommendations

The recommendations from the Study include a mix of actions from several strategies, as shown in Figure 5. Recommended actions have been shown by location along the I-95 Corridor and by a proposed implementation timeline. Those actions identified for implementation within 10 years are considered near-term recommendations. Those actions to be implemented after 10 years are considered long-term recommendations. Implementation of these near-term and long-term recommendations should help I-95 in Bangor operate safely and efficiently well into the future.

Figure 5 Bangor I-95 Corridor Study Recommendations