DelDOT

SUSSEX COUNTY

TRANSPORTATION OPERATIONS MANAGEMENT PLAN

Report published September 2017, based on 2015 data

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ENGINEERING

Executive Summary

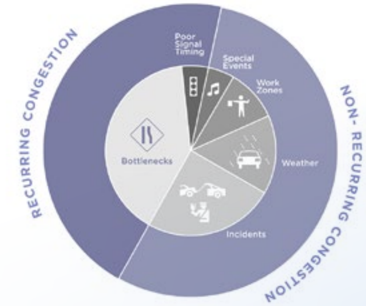
Delaware needs a comprehensive, consistent statewide approach to understanding traffic mobility. The ability to move safely and reliably with minimal delays is key to Delaware's status as a good place to live and conduct business.

Increasingly robust data sources are enabling the Delaware Department of Transportation (DelDOT) to monitor and manage mobility better than ever before. The transportation operations management planning (TOMP) approach uses the vast amount of available monitoring data to improve planning, design, and operations. This report presents recommendations for addressing traffic congestion in Sussex County as traffic volumes continue to grow.

Mobility Issues in Sussex County

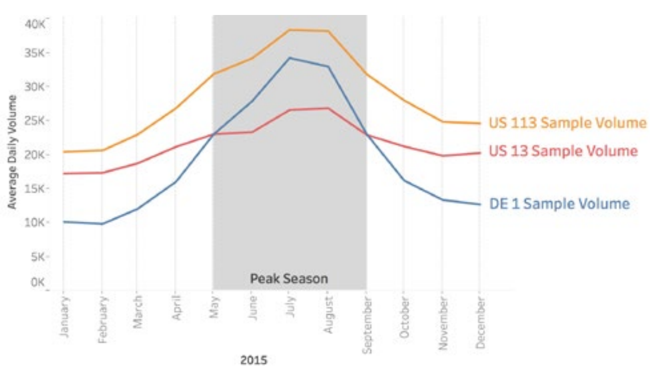
Mobility in Sussex County, Delaware, is critical to the county's residents and businesses and to the hundreds of thousands of visitors who frequent the county's resorts. Once the resort season occurs, there is a relatively major urban area including the Delaware and Maryland beaches. Year-round demands on the county's transportation system are driven largely by agriculture and tourism. Sussex County's transportation system must also have the ability to support potential weather-related evacuations due to the county's position on the coast.

Causes of Recurring and Nonrecurring Congestion

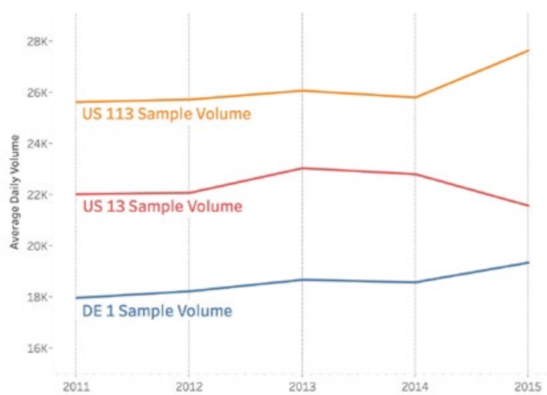


Source: Federal Highway Administration

Seasonal Variation Along Major North-South Routes



Yearly Growth Along Major North-South Routes



Causes of Congestion

There are two types of traffic congestion. Recurring traffic congestion occurs on a regular basis during peak demand periods at capacity bottlenecks. Nonrecurring traffic occurs due to capacity being temporarily reduced (or demand being temporarily increased) by irregular conditions such as inclement weather, traffic incidents, special events, and construction.

Seasonal Variation

There are daily peak traffic times that occur in the off-peak season. The most significant traffic issues generally occur in peak season on summer weekends. A typical summer Saturday peak spans several hours, throughout which tens of thousands of travelers are impacted by delay. Bad weather, traffic incidents, or construction can make the situation worse. Seasonal demand affects some locations more than others. Resort-related traffic follows distinct inbound (Friday), two-way (Saturday), and outbound (Sunday) patterns. Traffic volumes more than double in the summer at resort areas along DE 1 and US 113. By contrast, traffic on US 13 does not vary as much from off-peak to peak season.

Traffic Growth

Traffic growth across Sussex County has varied over the five years featured in this report. In addition to having worse traffic during the summer, routes DE 1 and US 113 have also seen the highest traffic growth overall. In particular, US 113 has seen the highest consistent growth from 2011 to 2015, with a mix of resort and commuter traffic, while routes farther west, such as US 13, have seen little to no growth. Today demand is exceeding capacity in several areas, causing traffic congestion. Mobility will only worsen if solutions are not implemented to deal with increasing traffic demand.

Transportation Management Solutions for Sussex County

Sussex County sees both recurring and nonrecurring traffic congestion, to and from and within resort areas. The congestion is attributable to both increases in demand and decreases in capacity. The complexity of the county's traffic congestion issues requires a variety of ideas for solutions. Short- and mid-term solutions can extend the effective lifespan of the current system while DelDOT continues to investigate the need for long-term investments.

All solutions boil down to increasing capacity or reducing demand at congestion hot spots. Capacity solutions include adding travel lanes, changing intersection designs and associated signal phasing or grade-separating lanes so they pass over other traffic without stopping. These capacity solutions are targeted at locations that are known to have inadequate capacity on a regular basis. Additional solutions are needed to mitigate traffic issues caused by traffic incidents, construction, weather and special events.

We need to manage the transportation system in real time to make the most of available capacity. If we know in real time what is happening, we will be able to respond quickly. Spreading demand over several hours and/or multiple modes can extend the effective lifespan of the system. Solutions like the following ideas contribute to the transportation management approach.

The DelDOT mobile app incorporates many of these transportation management solutions and is currently available to the public.

TRANSIT MANAGEMENT

DelDOT's Delaware Transit Corporation (DTC) provides service to, from, and within Sussex County, with special routes and services designed to handle peak season travel demand. Continued investments in real-time transit information and management tools make transit more accessible and reliable for travelers.

PEDESTRIAN REFUGE AREAS

Roads like DE 1 are pressed to serve both vehicles and pedestrians at traffic signals. All designs should consider integration of modes. An example is providing pedestrians a refuge area in the median to give DelDOT more flexibility in allocating green time at the traffic signal.

PUBLIC INFORMATION SYSTEM

Travelers could avoid traffic by following real-time traveler information from the Transportation Management Center, which is already available through the DelDOT website and mobile app. Traveler information can be an effective solution to enable educated mode, route, and time-of-day choices.

INCIDENT MANAGEMENT

Timely and effective incident and event management is critical to mitigating nonrecurring traffic congestion. DelDOT has the ability to identify issues, respond, and return the transportation system to normal conditions. Strategies can be applied to all stages of incident management: detection, verification, response, and clearance.

MANAGED LANES

In the times of greatest demand, traffic lanes can be managed for efficient use of existing roadways. For example, an outer lane that is marked to serve buses, bicycles, and right-turning vehicles could be used to serve all kinds of vehicles during peak times. Striping and dynamic overhead signage would be needed to control the use of managed lanes.

Congested Areas

Analysis of data over the last five years at locations across the whole county shows traffic congestion in the areas outlined below. Problem areas tend to be at intersections where demand is near or has exceeded capacity. Traffic signals are managed to make the most of system capacity while additional short-, medium -, and long-term solutions are developed.

The color-code system for roadway segments in this report is based on a comparison of measured travel times. Intersections were evaluated using a volume-based level of service (LOS) method. As a rule of thumb, intersections scoring "D" or worse need more capacity (that is, additional lanes) to gain a better score. Intersections scoring "C" or better should experience relatively tolerable delay.

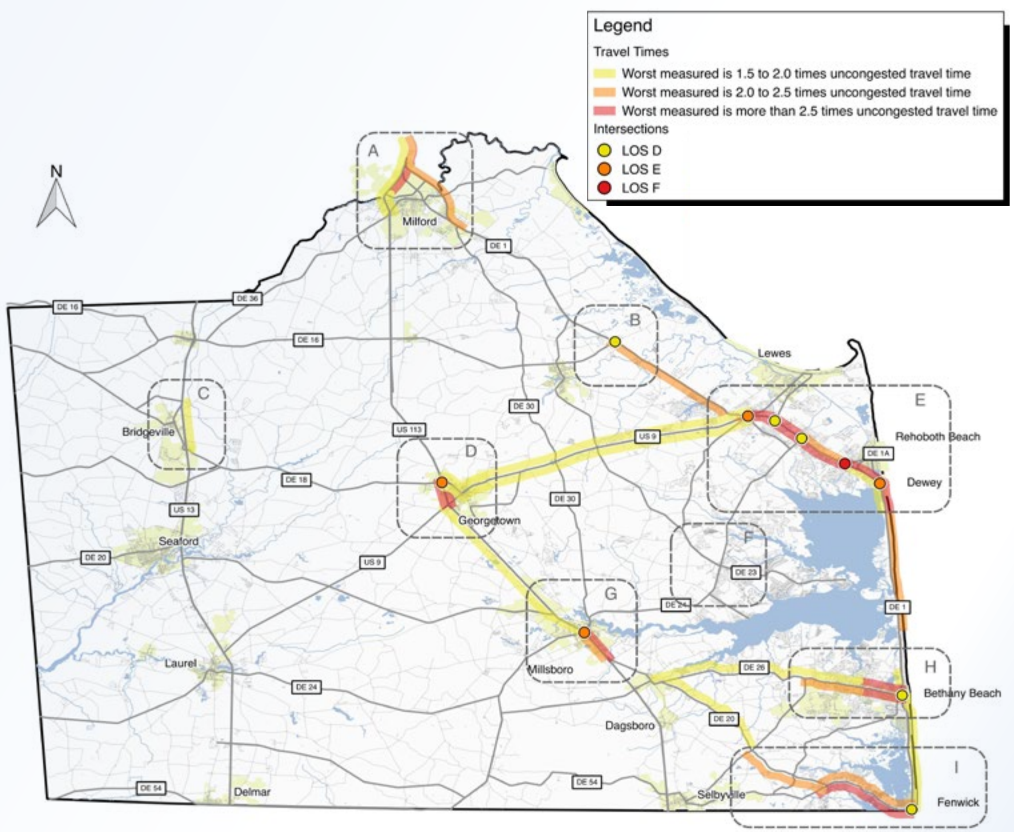
Congested Areas A, B, and C

The areas around Milford, Bridgeville, and DE 1 at DE 16 currently experience unreliable travel times, which will worsen assuming growth trends continue.

Congested Areas D and G

Throughout the year, the areas of Georgetown and Millsboro experience high volumes of both resort and commuter traffic—and volume is growing, with growth rates as high as 4% per year at several locations. Many studies have been done of US 113, both northbound and southbound, and continued focus is needed, particularly at major intersections.

Worst Observed Traffic Congestion in 2015



Congested Area E

DE 1 near Rehoboth experiences significant issues, especially during summer weekends, when it can take travelers six times longer to get from Lewes to Rehoboth than it does in uncongested conditions. Current and planned projects, such as new grade-separated intersections on DE 1 and US 113, will not be enough to prevent bottlenecks caused by resort travel demand. This area is an important target for applying innovative transportation solutions, such as using the bus lane for traffic during peak hours, to extend the effective lifespan of the current system.

Congested Areas F, H, and I

Despite the center turn lane improvements, east-west routes that serve the beaches have capacities limited to one through lane in each direction. Summer congestion will be eased only by increasing capacity or by encouraging drivers to travel at other times or by other modes.

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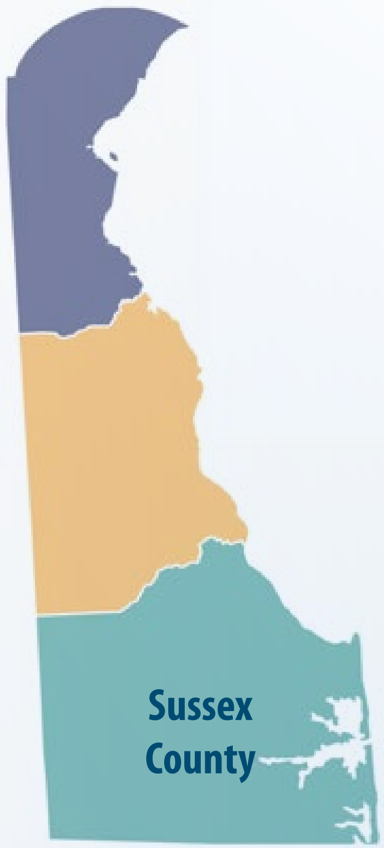


Introduction

Millions of traffic data points collected over several years have enabled unparalleled understanding of travelers' experiences with traffic. This Sussex County Transportation Operations Management Plan is fueled by data collected automatically from various devices and supplemented with data collected manually at select locations. This data helps determine where and when investments should be made by detailing not only how bad traffic gets, but also how often problems occur.

Integrated transportation management system monitoring enables data-driven decisions 24 hours a day, 7 days a week, 365 days a year.

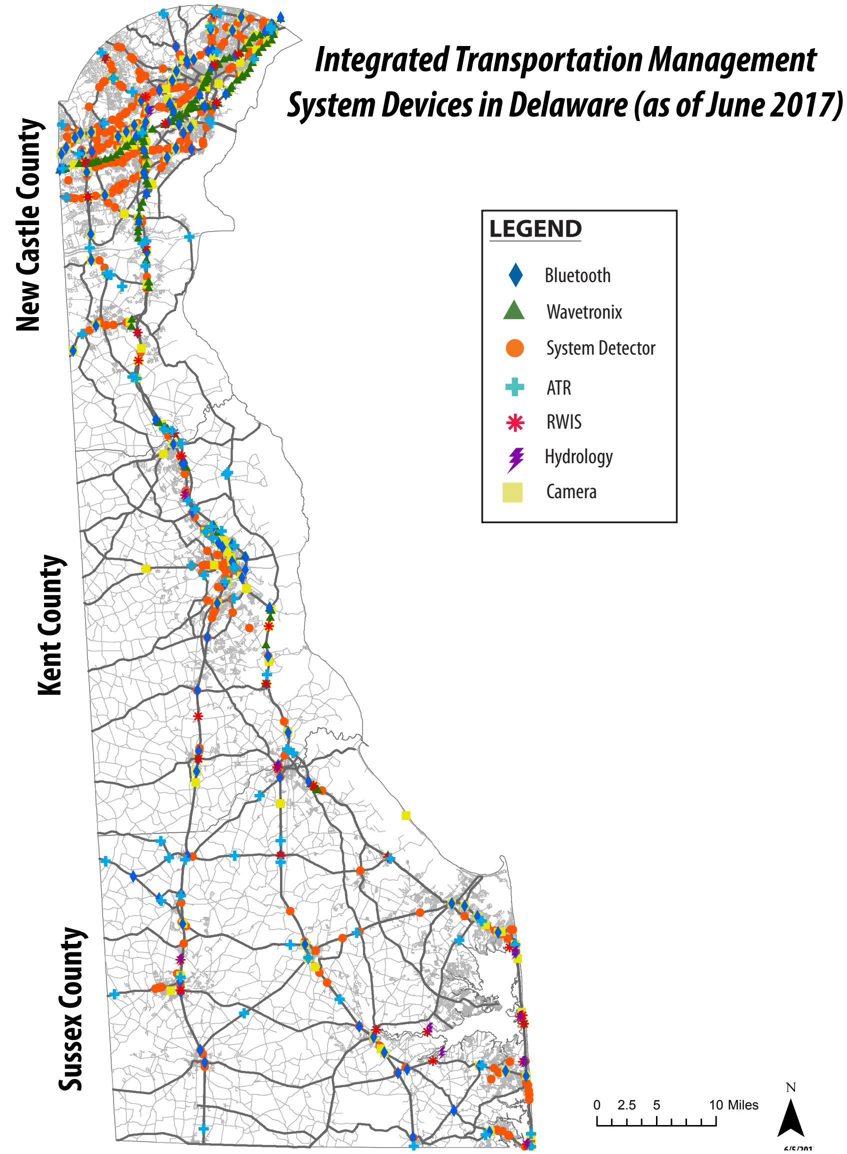
DelDOT's 24/7 real-time data is critical to daily transportation operations, which are managed through the Transportation Management Center (TMC). The data comes from a variety of technologies and can be pulled for any time period.

Much of the data from integrated transportation management system devices is already made available to travelers through the DelDOT website and mobile app. DelDOT also plans to install many more devices throughout the state, which will help expand reporting coverage in the future.

DelDOT has processes to make sure that the integrated transportation management system is reviewed as part of every capital project and has invested in its transportation management system since its Integrated Transportation Management Strategic Plan was first published in 1997. The members of the Integration of Operations and Planning Advisory Committee , which includes representatives from many stakeholder entities,[1] collaborate to plan the collection of monitoring data. Operators who manage the transportation network 24/7 provide additional insight.

Device Type	What It Provides
Bluetooth Readers	Travel times, origin / destination
Wavetronix Radar Detectors	Traffic volume, speed, and length-based classification
Traffic Signal System Detectors	Traffic volume and delay
Automatic Traffic Recorders (ATRs)	Traffic volume, sometimes speed and axle-based classification
Roadway Weather Information System (RWIS)	Air and road surface temperature, precipitation type, humidity, wind speed, and visibility
Hydrology	Water level
Cameras	Live video

[1] DelDOT Traffic, DelDOT Planning, Wilmington Area Planning Council, Federal Highway Administration, Dover/Kent County Metropolitan Planning Organization, City of Wilmington, and University of Delaware.



Integrated Transportation Management System Devices in Delaware (as of June 2017)

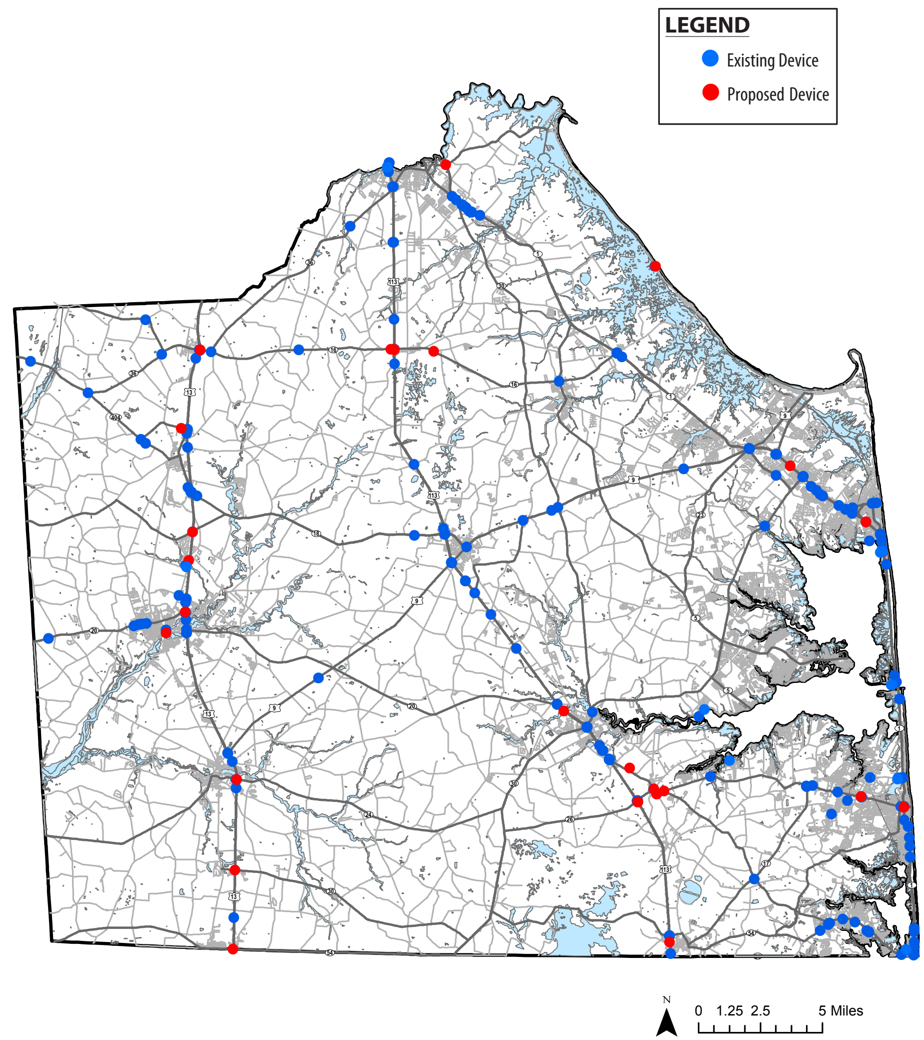
Over 150 integrated transportation management devices in Sussex County supported this TOMP.

Data samples were taken at key locations to enable the traffic engineering analysis in this report. Portable technologies were used for additional monitoring. The future will bring more integrated transportation management system coverage. This continued investment will enable future analysis of:

- More key corridors
- Year-to-year travel time reliability
- Truck volumes
- Origin-destination patterns

Device Type	Number of Devices in Sussex County (as of June 2017)
Bluetooth Readers	35
Wavetronix Radar Detectors	6
Traffic Signal System Detectors	90
Automatic Traffic Recorders (ATRs)	27
Roadway Weather Information System (RWIS)	7
Hydrology	8
Cameras	28

Integrated Transportation Management System Monitoring in Sussex County (as of June 2017)



Of the vast amount of data available, this TOMP focuses on three data sources.

Data Source: Bluetooth Detectors

- **What is it?** Roadside sensors detect passing Bluetooth-enabled devices at multiple points to determine the travel time between those points. Bluetooth devices provide data continuously 24/7/365, providing infinite flexibility to perform studies and follow-ups.
- **How was it applied?** Travel time reliability was calculated by comparing the worst-case travel times to uncongested travel times.

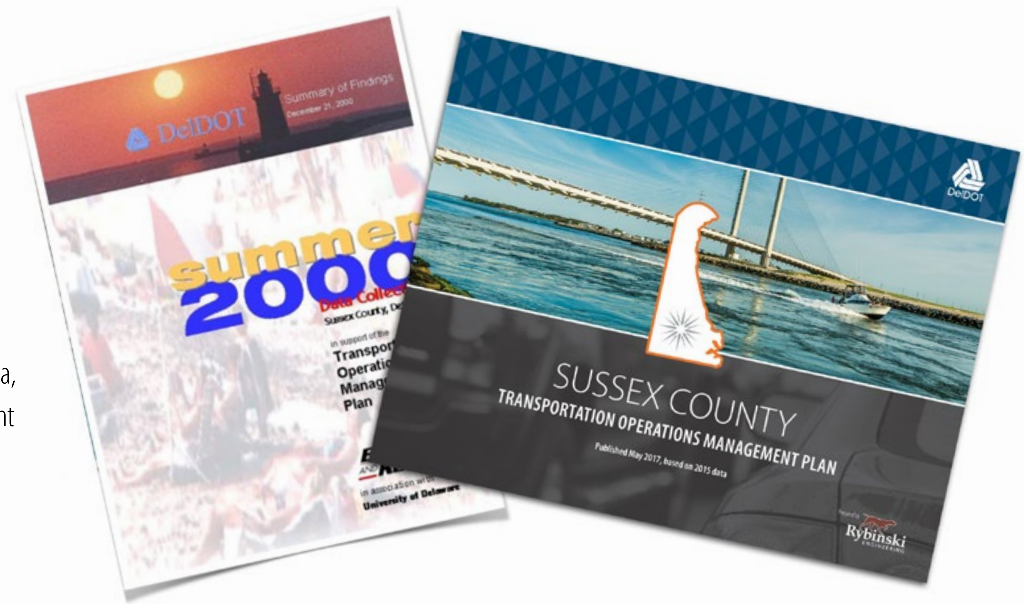
Data Source: Traffic Signal System Detectors

- **What is it?** Traffic signal system detectors, located immediately downstream of select intersections, collect information about the passage or presence of vehicles. These detectors provide real-time information back to DelDOT's TMC where signal timings and coordination between adjacent intersections are adjusted to improve traffic flow. This data source has become a game-changer in Delaware, as DelDOT has access to over 1,000 permanent, continuous volume counters throughout the state.
- **How was it applied?** Five years' worth of traffic volume data was examined at locations throughout the county to identify volume fluctuations and growth trends. System loops also indicate delay by collecting occupancy data, or the amount of time the loop is occupied by a vehicle.

Data Source: Intersection Turning Movement Counts

- **What is it?** Vehicle volumes are collected manually for each movement through an intersection, for a specified duration of time. Truck, bicycle, and pedestrian movements are also manually counted.
- **How was it applied?** Intersection level of service (LOS) was calculated at 18 key locations using intersection counts and the critical movement summation method. This method relates observed critical volumes to the intersection's capacity and assigns a letter score. A good LOS means the location should be able to handle the traffic, and a bad LOS (D or worse) means the intersection cannot be expected to function well even with improved signal timings.

This Sussex County TOMP applies integrated technology to enhance planning and design.



Past

Past studies required extensive manual data collection:

- Intersection and segment counts
- Manual travel time runs (driving each road)
- Not enough data to measure reliability

2017

Since that time, hundreds of monitoring devices have been installed that provide continuous, 24/7 data, allowing us to look at more than just a brief window of time that may or may not be typical. The current TOMP effort includes:

- Intersection counts (used 24/7 data to pinpoint peak hours to be counted)
- Volume and travel time data from permanent sensors (24 hours, 365 days, multiple years)
- Multiple points of data for comparing and confirming measurements
- More than enough data to measure travel time reliability
- Data on the severity and frequency of traffic congestion

Travel Time

Travel time is a meaningful measure of the transportation system, no matter what mode. Where previous travel time studies have been limited to a dozen manual measurements of peak hour travel times on each route, this TOMP takes advantage of data collected year-round for thousands of hours on each route.

For the first time, DelDOT has sufficient data to calculate travel time reliability on a large scale across the whole county.

Travel time reliability is a measure of effectiveness endorsed by the Federal Highway Administration. It relates worst-measured peak conditions to uncongested conditions. The reliability measure requires large samples of data to represent conditions over extended periods of time. Integrated transportation management devices give us the flexibility to sample virtually any scenario over any period of time.

$$\text{Reliability} = \frac{\text{Worst-Measured Travel Time (95th percentile peak travel time)}^{1}}{\text{Uncongested Travel Time (15th percentile travel time)}^{2}}$$

Reliability Color Scale

Worst measured travel time is...

- Green: less than 1.5 times uncongested travel time
- *Unreliable*:
  - Yellow: 1.5 to 2.0 times uncongested travel time
  - Orange: 2.0 to 2.5 times uncongested travel time
  - Red: more than 2.5 times uncongested travel time

In this report, we measured travel time reliability during two different peak periods: summer weekend and summer weekday. We assessed the reliability of each roadway segment by comparing the worst-measured peak travel time to uncongested travel time. The uncongested travel time represents how quickly a driver could reasonably expect to travel through an area during uncongested conditions. Since it is a measured travel time, it accounts for normal influences on the flow of traffic, such as regular signal operations.

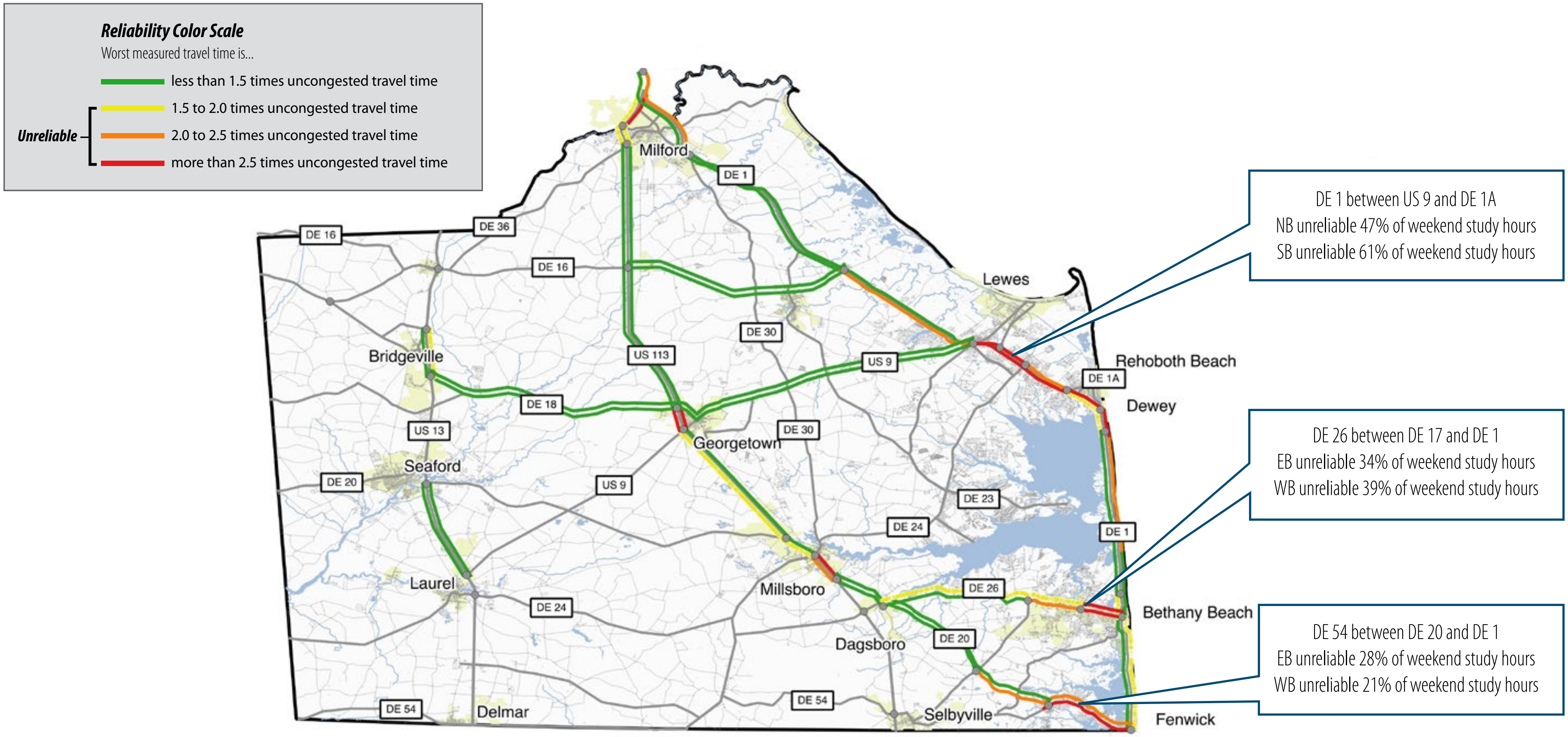
The goal of this comparison is to relate worst conditions to uncongested conditions. If that ratio was greater than 1.5 (in other words, if the 95th percentile travel time was more than 50% longer than the uncongested travel time), the roadway segment was determined to be "unreliable."

[1] Only 5% of hours recorded have travel times higher than the 95th percentile travel time. [2] 85% of hours recorded have travel times higher than the 15th percentile travel time.

In some areas, travel in high-demand conditions can take five or six times as long as during uncongested periods.

During peak summer hours, if drivers want to travel from Lewes to Rehoboth beach, they need to plan 45 minutes for a trip they could make in 8 minutes during uncongested conditions. This is more than five times longer than the baseline travel time.

Travel Time Reliability, Summer Weekend

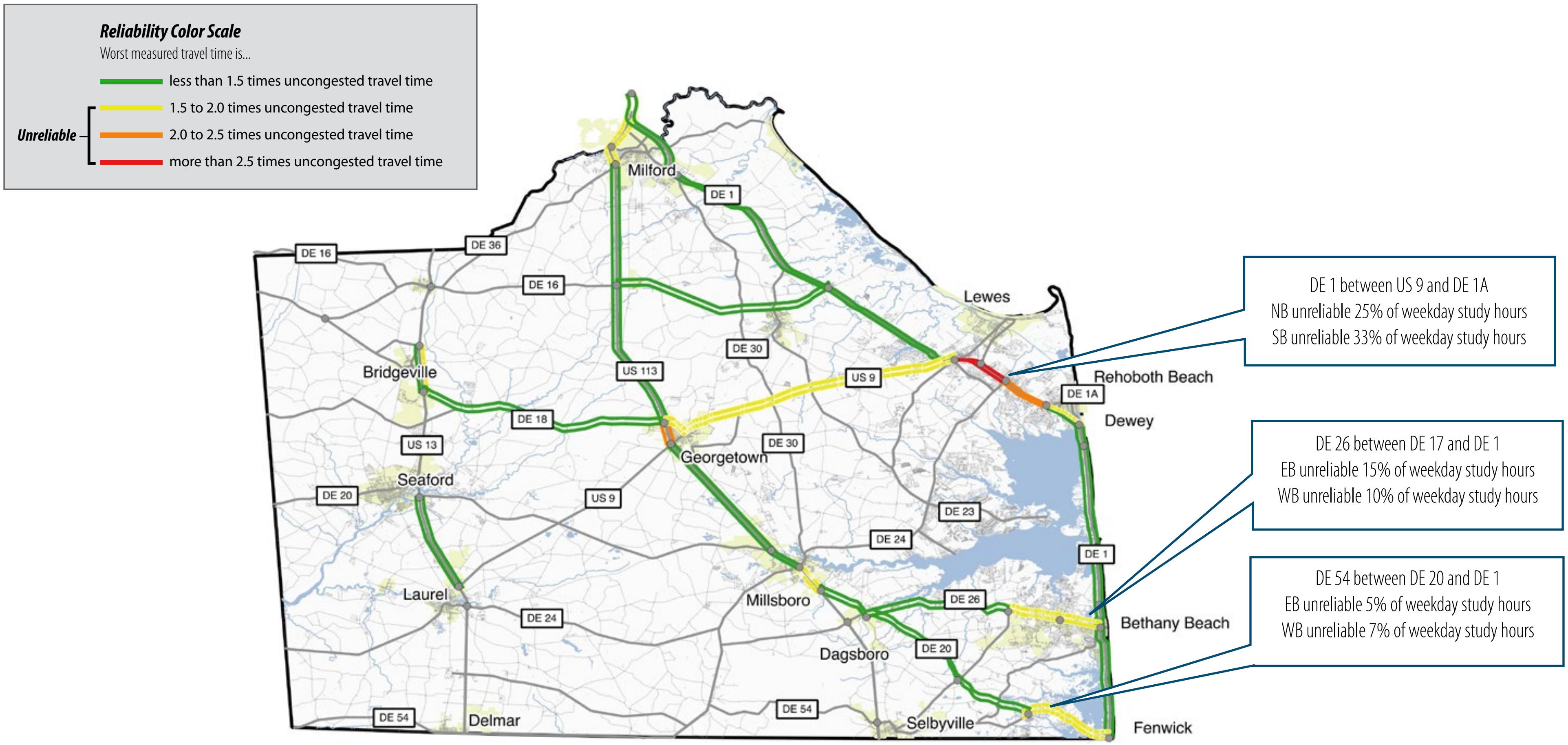


Weekend Study Hours: June 2015 - August 2015: Friday 4 PM - 8 PM; Saturday 10 AM - 5 PM; Sunday 10 AM - 2 PM, 5 PM - 7 PM
Segment lengths are based on Bluetooth device locations.

The same areas stand out as problems on summer weekdays, but to a lesser extent.

Segments with a ratio higher than 1.5 (shown in yellow, orange, or red) are considered to be unreliable.

Travel Time Reliability, Summer Weekday



Weekday Study Hours: June 2015 - August 2015: Tuesday - Thursday, 7 AM - 9 AM, 4 PM - 6 PM
Segment lengths are based on Bluetooth device locations.

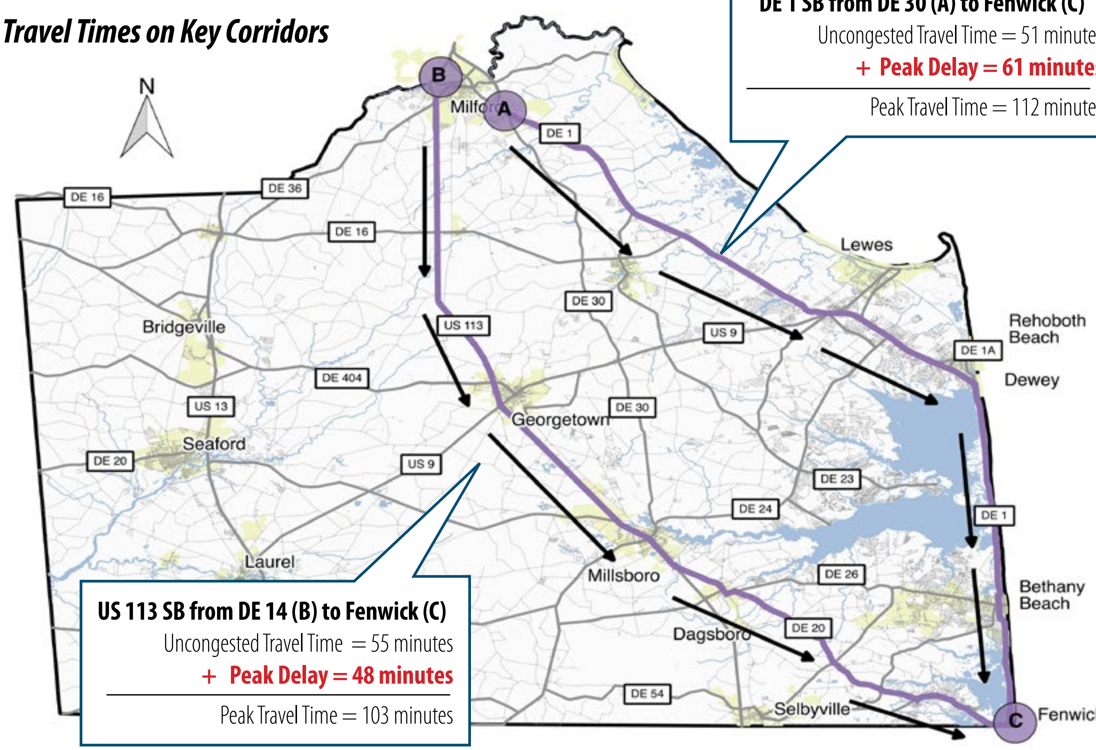
For an extended period of time on Fridays and Saturdays, travelers can expect an hour of delay trying to get to the beach on either DE 1 or US 113.

Travel times on southbound US 113 have increased by nearly 75% since 2000. Traffic volume and growth analyses later in this report show that US 113 has had higher growth rates than other Sussex County corridors. This growth is likely a contributing factor to the increase in travel times.

When approaching the DE 1/US 113 split, drivers must make a quick decision about which route to take based on road signs, DelDOT's real-time traveler information, and previous experiences.

The numbers below represent one specific day. Delaware travelers can always see travel times in real time on the DelDOT mobile app to make travel decisions about which beach route to take.

Travel Times on Key Corridors



DE 1 SB from DE 30 (A) to Fenwick (C)
Uncongested Travel Time = 51 minutes
+ Peak Delay = 61 minutes
Peak Travel Time = 112 minutes

US 113 SB from DE 14 (B) to Fenwick (C)
Uncongested Travel Time = 55 minutes
+ Peak Delay = 48 minutes
Peak Travel Time = 103 minutes

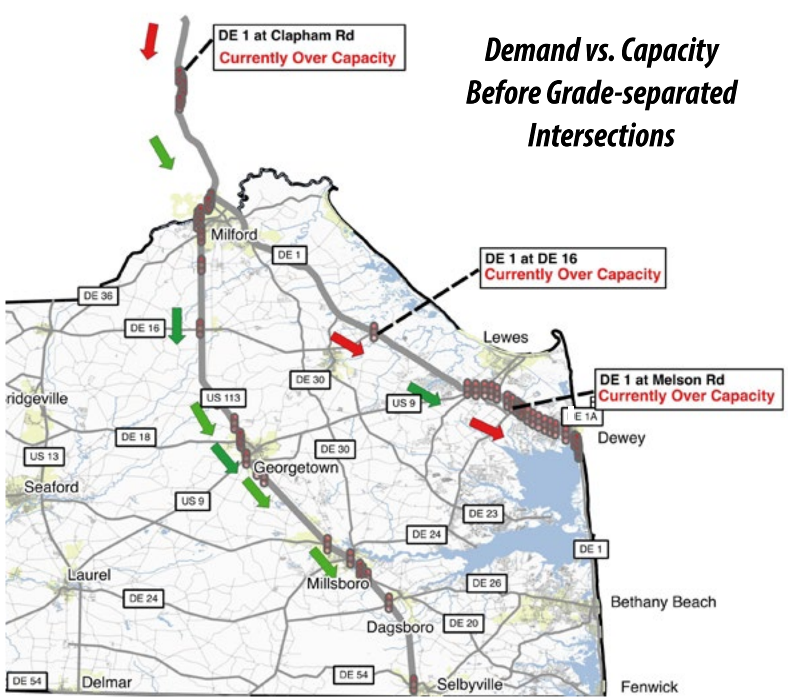
Study Hours: Saturday, July 25, 2015: 12 PM - 1 PM

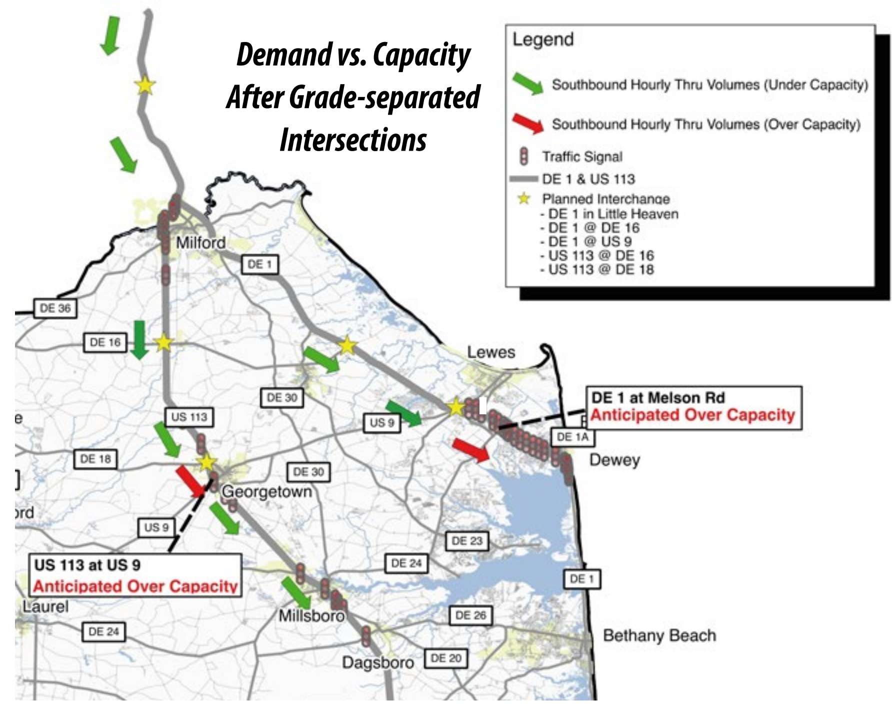
In contrast to years past, we now have enough data to measure the transportation network as a system rather than examining one location at a time.

As part of this TOMP, we looked at how the DE 1 and US 113 grade-separated intersection projects will impact the surrounding network for typical summer Friday peak southbound travel.

Removing slowdowns at intersections by constructing grade-separated intersections on DE 1 and US 113 to pass over roads without stopping will allow a higher throughput at those locations. However, there will still be downstream intersections that will not be able to handle the increase in volume.

This analysis is based on present-day volumes and does not account for growth. After the completion of planned grade-separated intersections, traffic conditions at the remaining signalized intersections on DE 1 and US 113 are expected to worsen. For example, queues will extend further on DE 1 southbound while vehicles wait through multiple signal cycles to pass Melson Road and on US 113 southbound while vehicles wait to pass US 9. In other words, these signalized intersections will become bottlenecks: approaching vehicles are likely to wait in a queue for at least one more signal cycle than they do now. It is important to plan ahead to mitigate these problems.



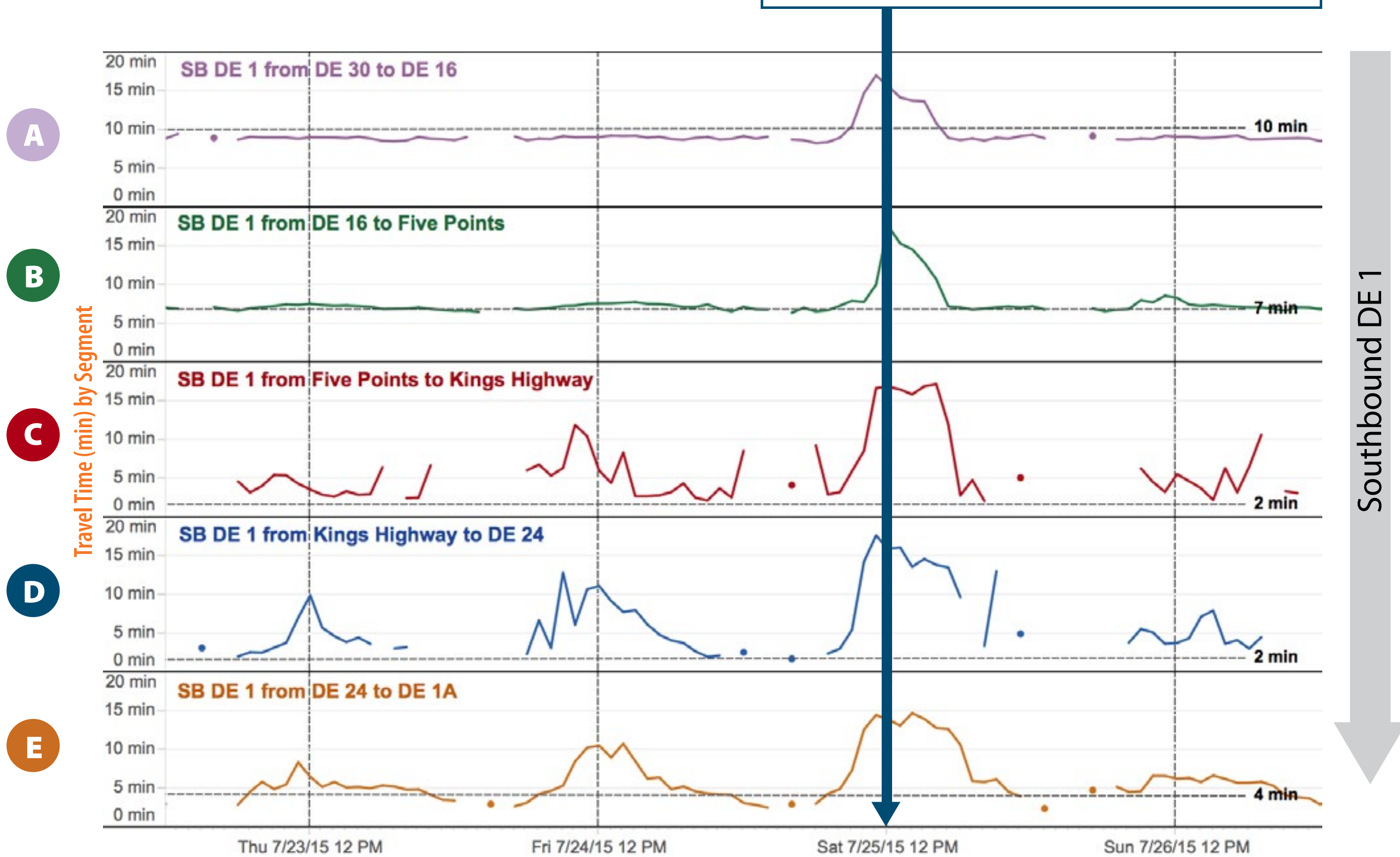


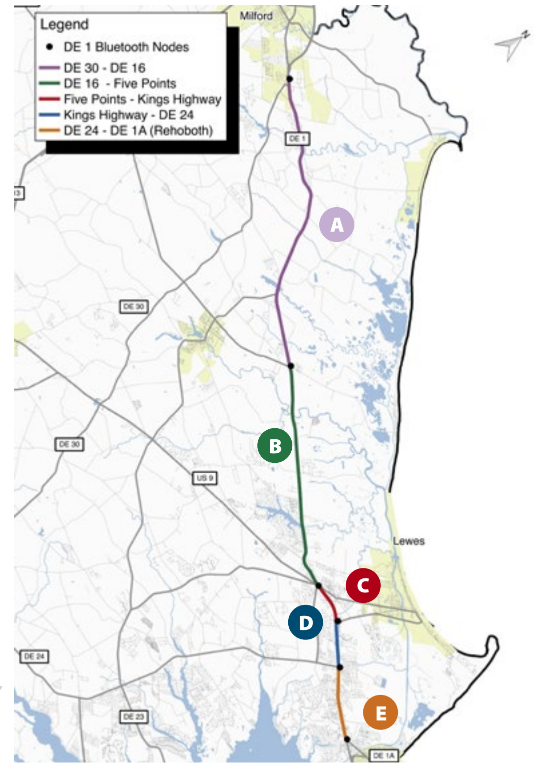
Study Hours: July 2015: Friday, 4 PM - 5 PM

DE 1 Southbound Travel Times: on a typical peak Saturday at noon, it took more than three times longer than normal to travel down DE 1, with most of the delay occurring between Five Points and DE 1A.

DE 1 SB from DE 30 to DE 1A (Saturday 7/25/15, 12 PM)

Uncongested Travel Time	= 25 minutes
+ Peak Delay	= 57 minutes
Peak Travel Time	= 82 minutes

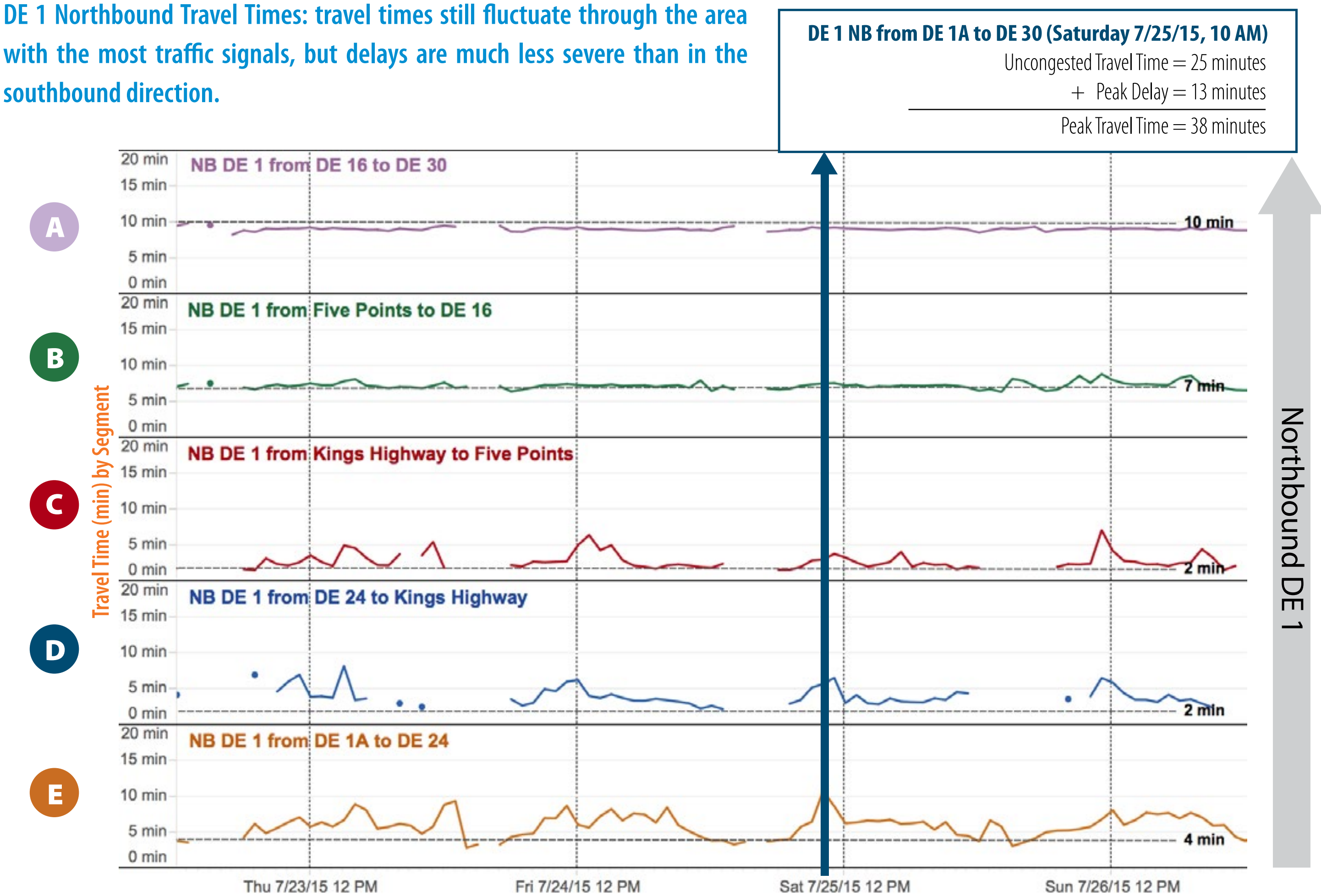


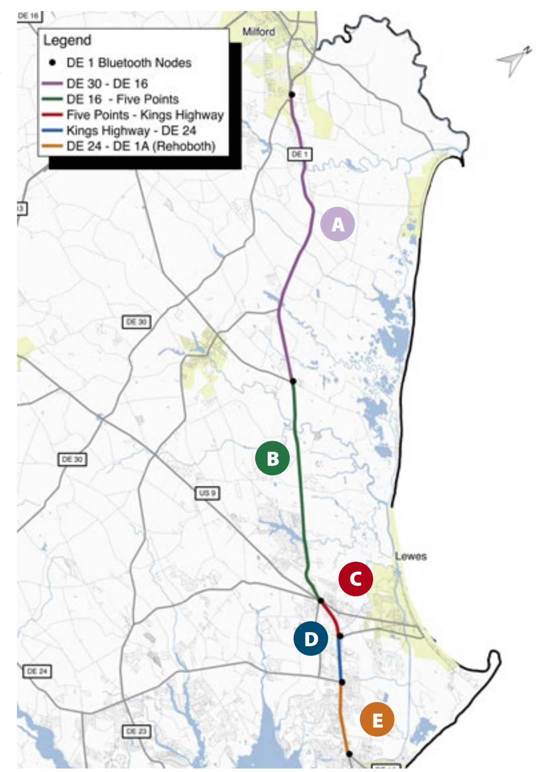


Dashed horizontal lines represent the travel time in uncongested conditions. Gaps in the graphs represent timeframes with less than the desired sample size.

The two most northern segments (A and B) reliably offer travel times similar to those in uncongested conditions except on Saturdays from roughly 10 AM to 3 PM. The three southern segments (C - E) have more variable travel times for a longer portion of the day and are therefore less reliable, probably because these segments have many traffic signals.

DE 1 Northbound Travel Times: travel times still fluctuate through the area with the most traffic signals, but delays are much less severe than in the southbound direction.





Dashed horizontal lines represent the travel time in uncongested conditions. Gaps in the graphs represent timeframes with less than the desired sample size.

At the same five locations during a typical summer weekend in the problem area of DE 1 headed northbound away from Rehoboth Beach, the travel times fluctuate much less than in the southbound direction. The northbound peak occurs slightly earlier than the southbound, with travel times peaking at 10 AM on Saturday.

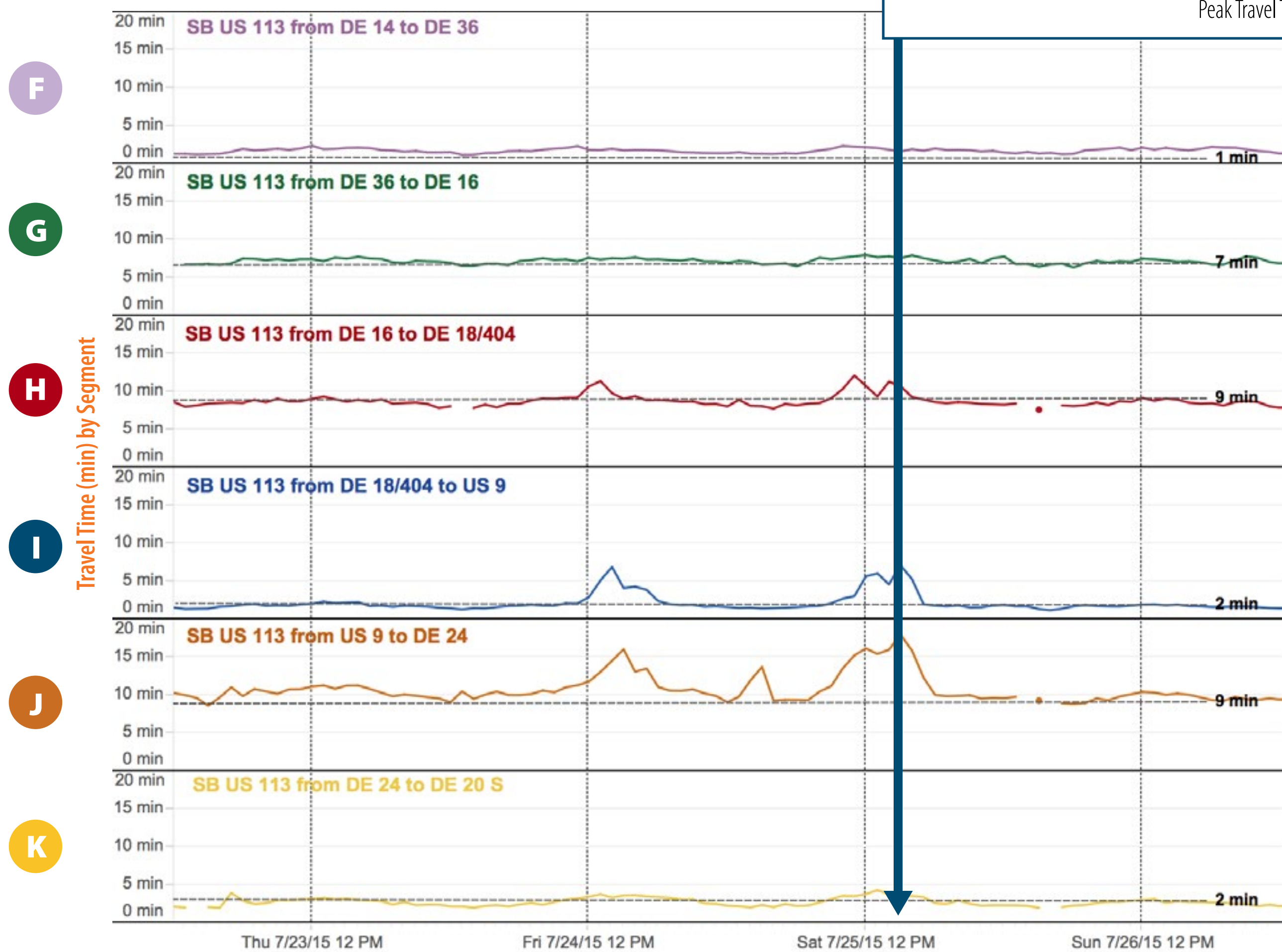
Based on the travel time reliability assessment outlined on pages 7 - 9, only segments A and B can be considered reliable, with travel time ratios lower than 1.5 during summer weekends.

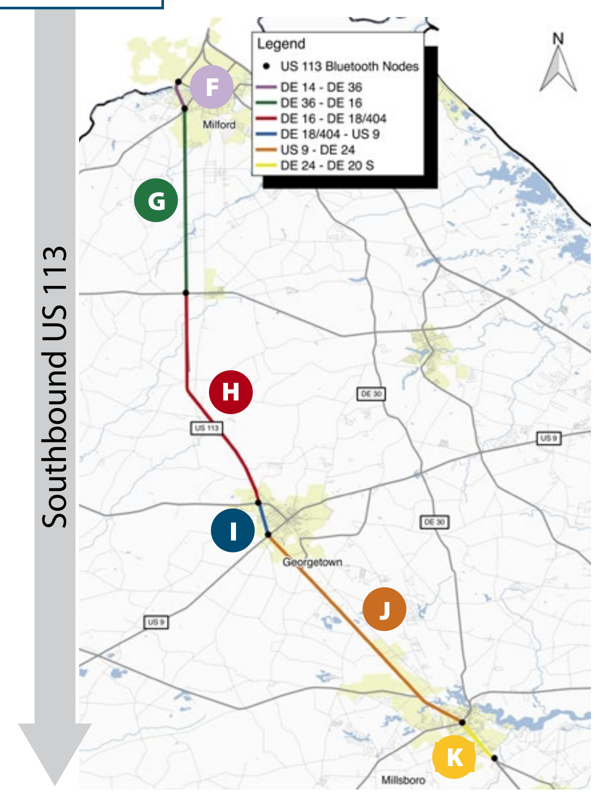
US 113 Southbound Travel Times: though travel times on US 113 do not fluctuate as much as on DE 1, travelers still experienced 21 minutes of delay traveling southbound on US 113 during the Saturday peak, 11 AM - 4 PM.

US 113 SB from DE 14 to DE 20 S (Saturday 7/25/15, 3 PM)

Uncongested Travel Time = 30 minutes
\+ Peak Delay = 21 minutes

Peak Travel Time = 51 minutes





Dashed horizontal lines represent the travel time in uncongested conditions. Gaps in the graphs represent timeframes with less than the desired sample size.

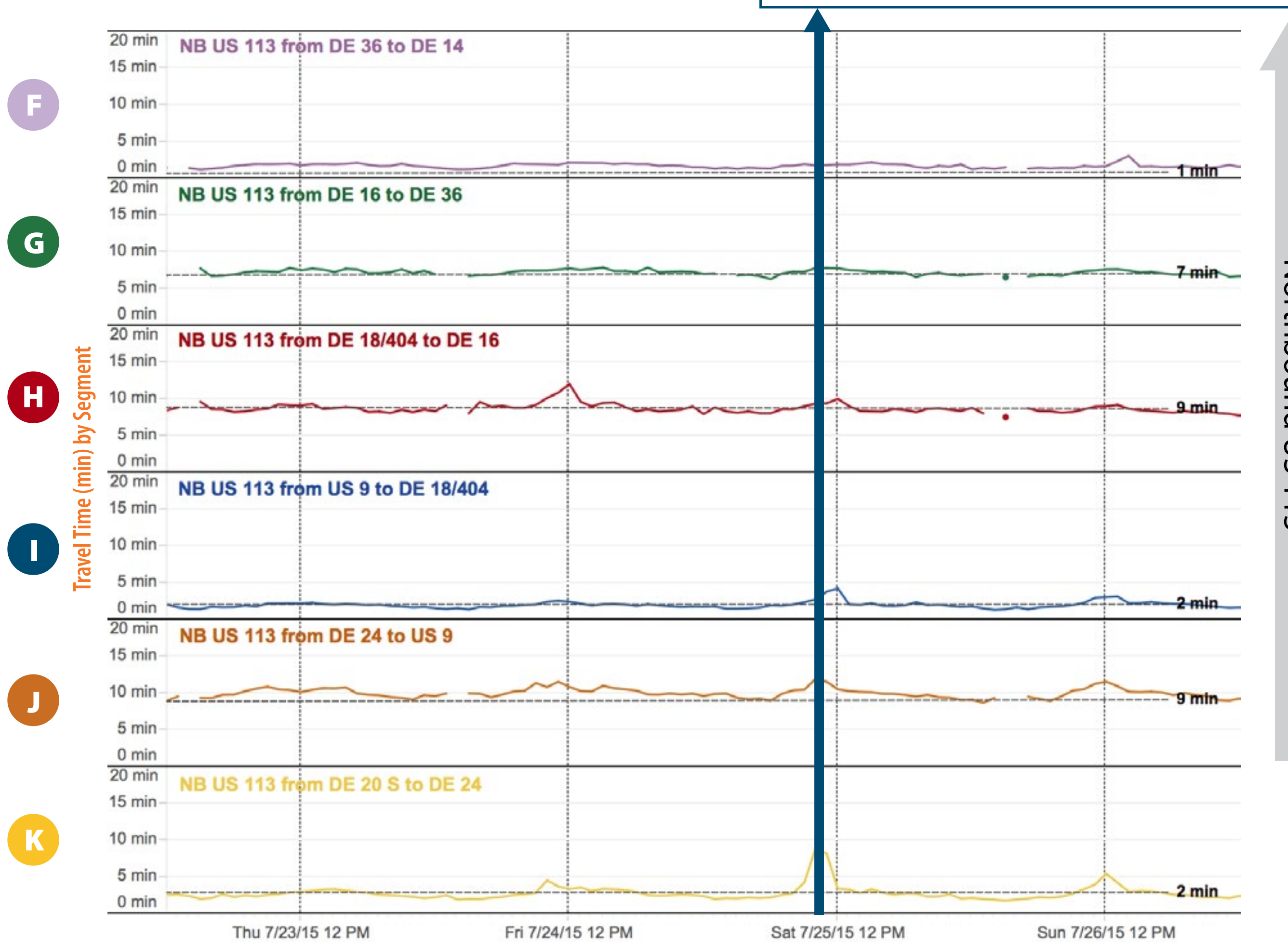
During a typical summer weekend on US 113 southbound, segments approaching US 9 and DE 24 show spikes in travel times on Friday afternoon and all day Saturday, with the peak travel time occurring at 3 PM on Saturday.

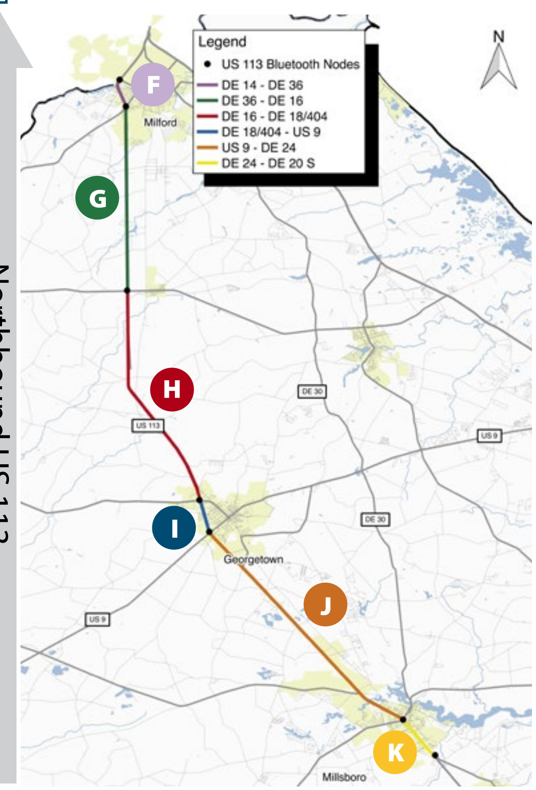
US 113 Northbound Travel Times: during a typical summer weekend on US 113 northbound, most segments appear to operate with travel times consistently close to uncongested conditions.

US 113 NB from DE 20 S to DE 14 (Saturday 7/25/15, 10 AM)

Uncongested Travel Time = 30 minutes
\+ Peak Delay = 14 minutes

Peak Travel Time = 44 minutes





Dashed horizontal lines represent the travel time in uncongested conditions. Gaps in the graphs represent timeframes with less than the desired sample size.

A spike in travel times can be seen for a short window from 10 AM to 11 AM on Saturday in the Millsboro area. Overall, US 113 travel times do not fluctuate as much as those on DE 1.

Delay

A close relative of travel time, delay is the difference between how long travelers expect to take (in uncongested conditions) and how long they actually take to arrive at their destination. In other words, delay is time spent stopped or going slower than desired. Delay can be measured using the Bluetooth travel time system, the Wavetronix system, and the traffic signal system.

Delay can be split into two categories: recurring and nonrecurring.

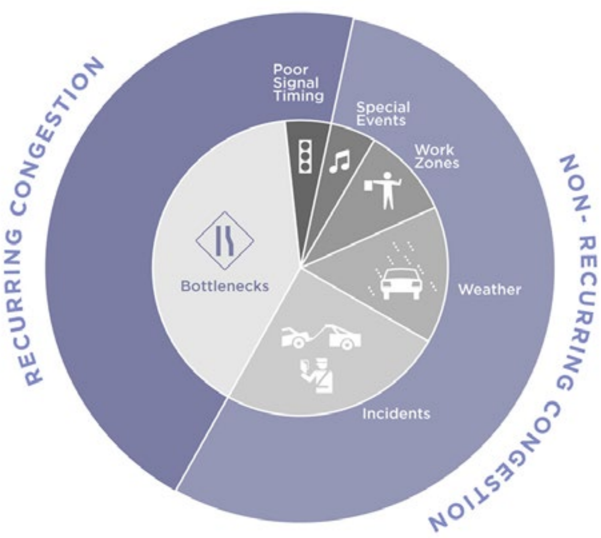
Since transportation systems have only so much capacity, some locations will become congested when the system's demand exceeds the capacity. When congestion happens regularly, such as every morning during rush hour, it is considered to be **recurring congestion**.

Nonrecurring congestion occurs when there are one-time disruptions on the roadway, such as accidents, weather, construction, and special events. Nonrecurring congestion makes up over 50% of all congestion, according to the Federal Highway Administration.

In Sussex County, some locations experience recurring congestion due to insufficient capacity to accommodate regular demands throughout the year. For the most part, however, the county's traffic issues are considered nonrecurring, as they do not occur regularly. In rural areas, nonrecurring congestion is believed to comprise close to 100% of congestion.

DelDOT's 24/7 data can be used to plan and design solutions to both recurring and nonrecurring congestion. Continuous data helps us pinpoint the issues so we can invest in improvements wisely.

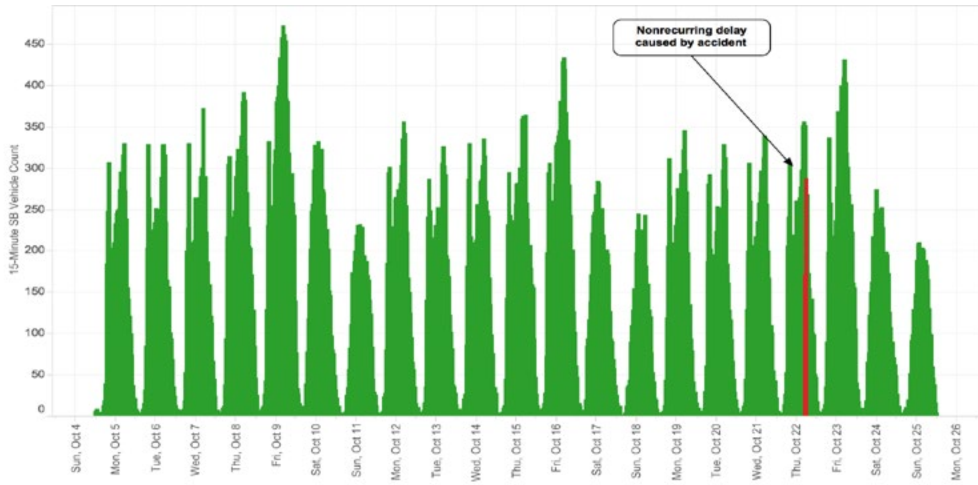
Causes of Recurring and Nonrecurring Congestion



Source: FHWA

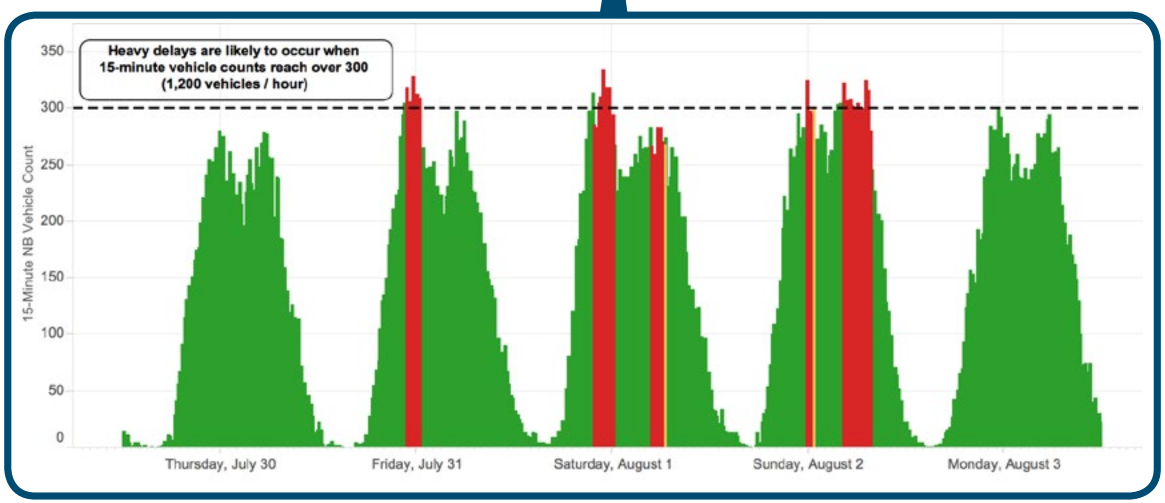
Traffic signal system data shows recurring congestion on summer Saturdays and Sundays for traffic headed northbound at a sample intersection on DE 1.

Volume and Occupancy on DE 1 at Collins Street



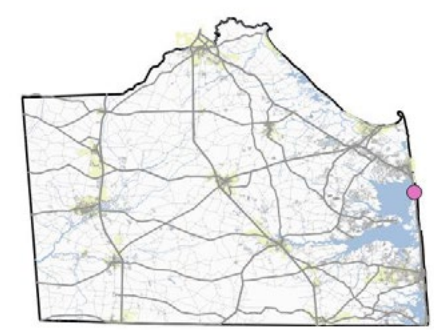
Congestion Indicated by System Loop Occupancy

MAJOR DELAY > 20% DELAY 15-20% NO DELAY 15 %



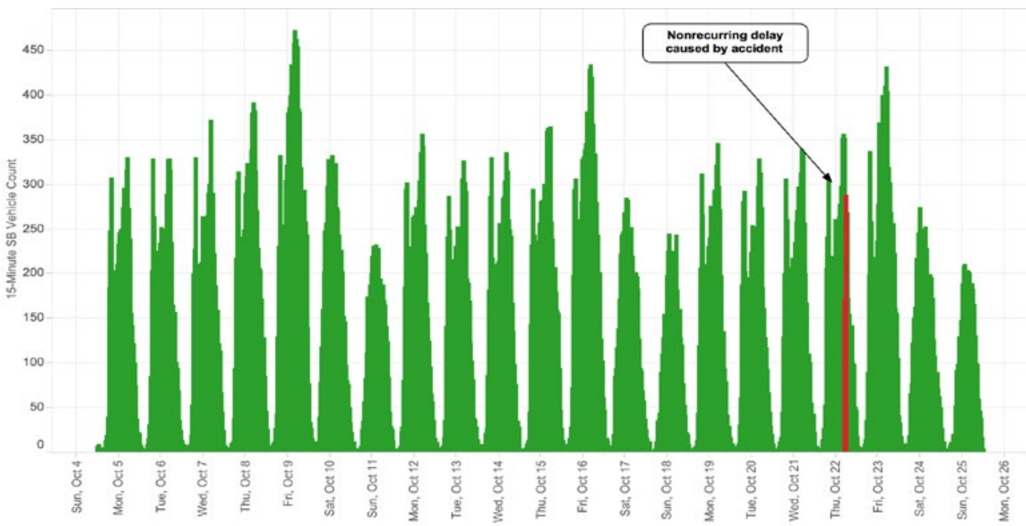
The traffic on northbound DE 1 at Collins Street is metered and controlled through the TMC's traffic signal system. The term "meter" is used in traffic engineering to describe the deliberate control of traffic flow. Without the TMC's monitoring and adjustments, more severe congestion would likely occur. This is an urban area with little opportunity for expansion, so alternative solutions should be explored, such as enhancing public education to encourage travel at alternate times or by alternate modes.

The height of the bars indicates volume. The colors indicate delays, which can be independent of volume. In cases where traffic volumes approach the roadway capacity, the occupancy (or delay) increases. High occupancy indicates a backup, with drivers experiencing delay as they get through the backup. When traffic slows due to delay, less volume may be able to get through.

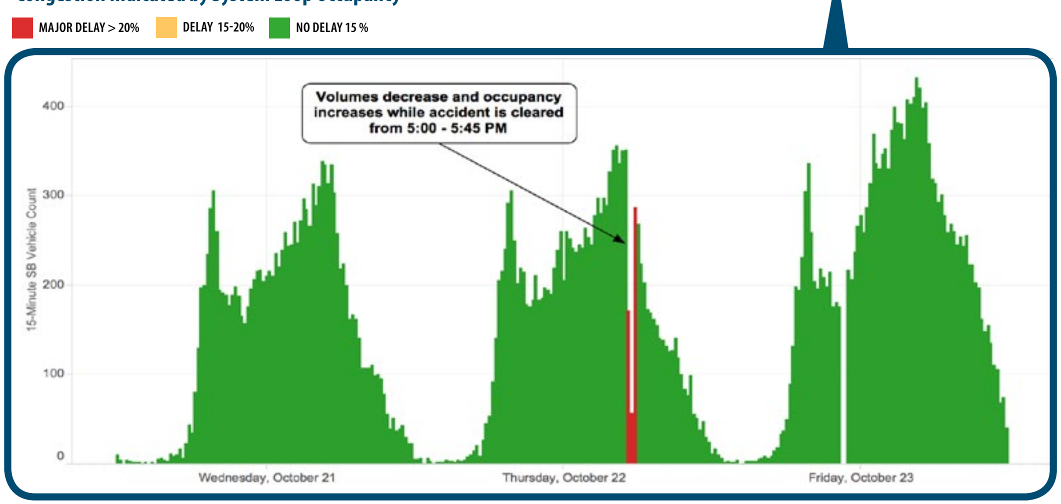


An example from an intersection that usually has no delays illustrates nonrecurring congestion.

Volume and Delay on US 113 Southbound at Town Center Boulevard



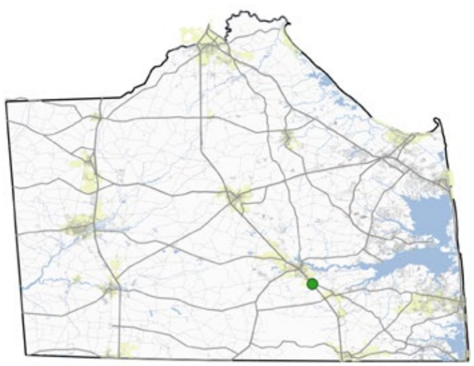
Congestion Indicated by System Loop Occupancy



A slice of data from the intersection of US 113 and Town Center Boulevard in Millsboro shows no delays for southbound traffic -- except on October 22, 2015.

DelDOT's real-time travel information shows that an accident occurred around 5 PM on this day, resulting in southbound road closures on US 113.

Delays are shown to have gone on for nearly an hour, likely exacerbated by traffic demand approaching the affected area. Nonrecurring issues like this one can be addressed by encouraging the use of DelDOT's real-time travel information.

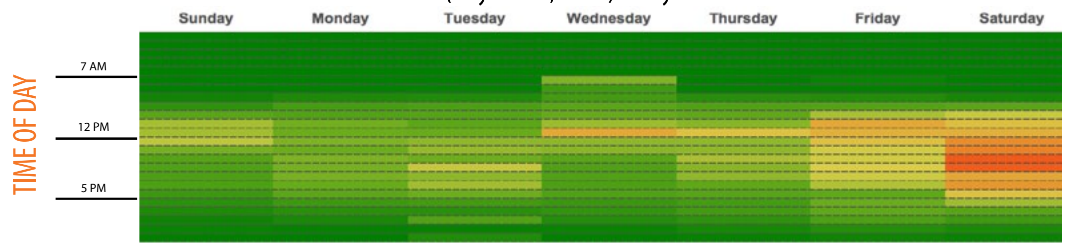


Continuous monitoring enables us to study how much delay occurs in a year.

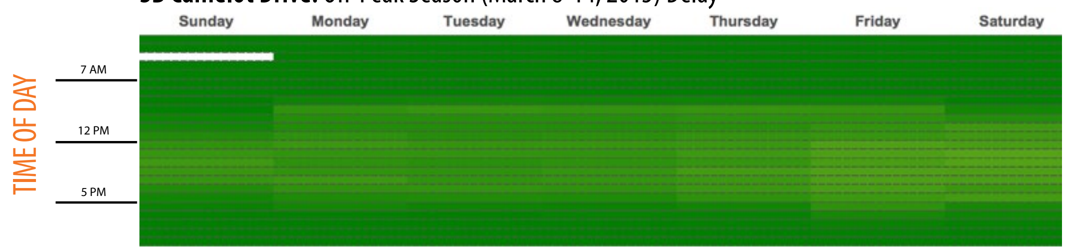
At DE 1 near Camelot Drive, there is recurring delay during summer peak weekends, especially in the southbound direction. These delays are due mainly to the urban nature of the area, signal density, and pedestrian crossings.

Throughout 2015, 372 total hours of SB delay impacted approximately 552,100 vehicles. 68% of this delay occurred in the peak season (May-September).

SB Camelot Drive: Peak Season (July 19-25, 2015) Delay

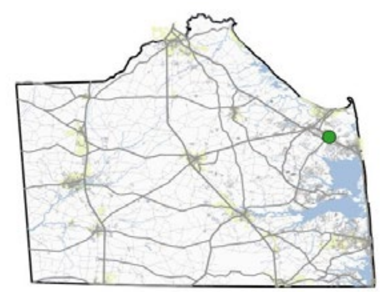


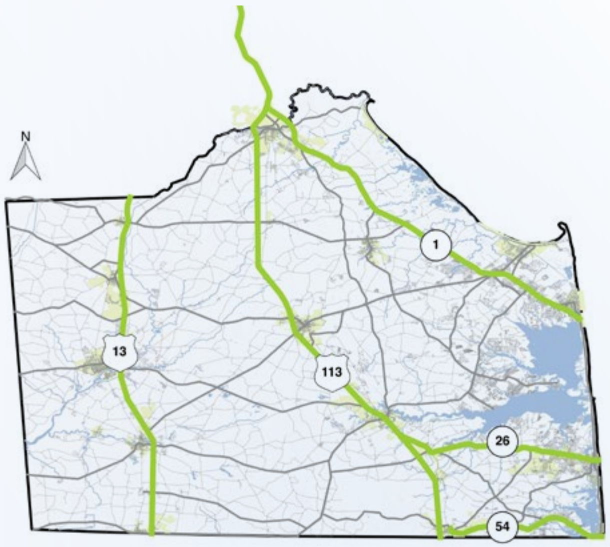
SB Camelot Drive: Off-Peak Season (March 8-14, 2015) Delay



Congested indicated by System Loop Occupancy

No Delay — **Major Delay**



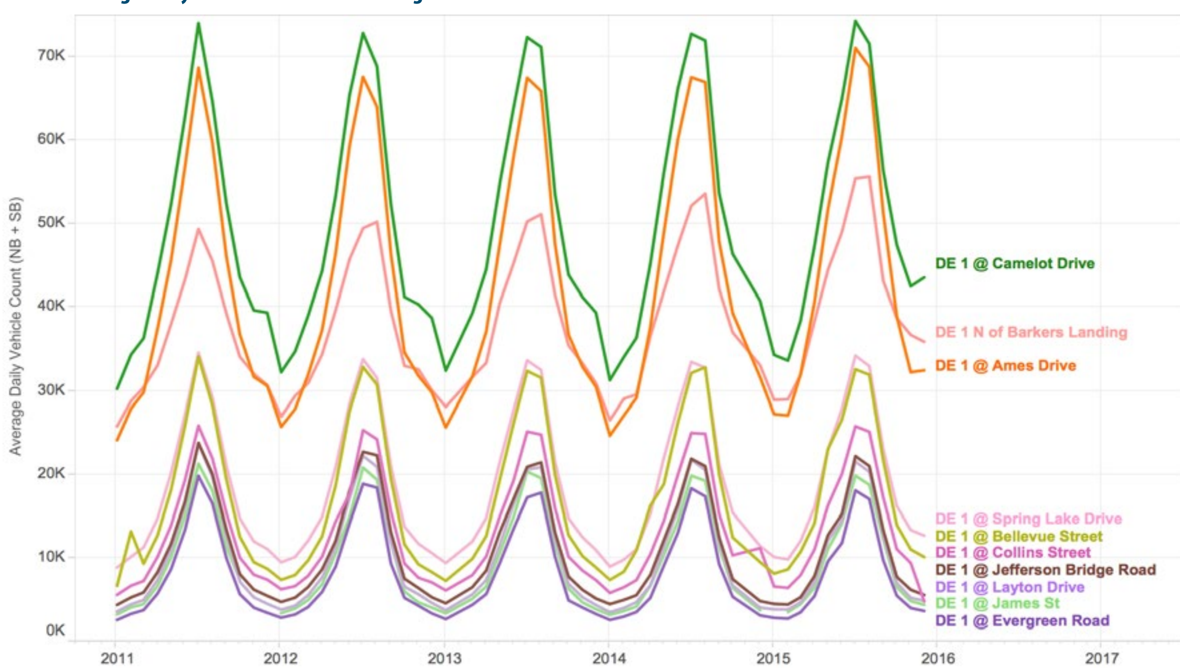


Traffic Volume and Growth

Planners and engineers have long used measures of traffic volume. But the amount of data DelDOT has, now that we've integrated operations and planning, is exponentially greater than in the past. Wavetronix and traffic signal system loops give us over 1,000 sites that provide data continuously, adding to automatic traffic recorder sites that are approaching 100 in number. Since the data comes in continuously, we can now perform historical studies that pair traffic volumes with travel times and/or delay measurements.

DE 1 Traffic Volume and Growth: Volumes on DE 1 have increased through the higher-volume Rehoboth and Dewey areas and have remained steady near Bethany and Fenwick Island.

Average Daily Volume and Growth along DE 1



Compared with other major routes in Sussex, DE 1 consistently experiences the most drastic fluctuation between off-peak and peak season traffic, with peak season extending from May through September.

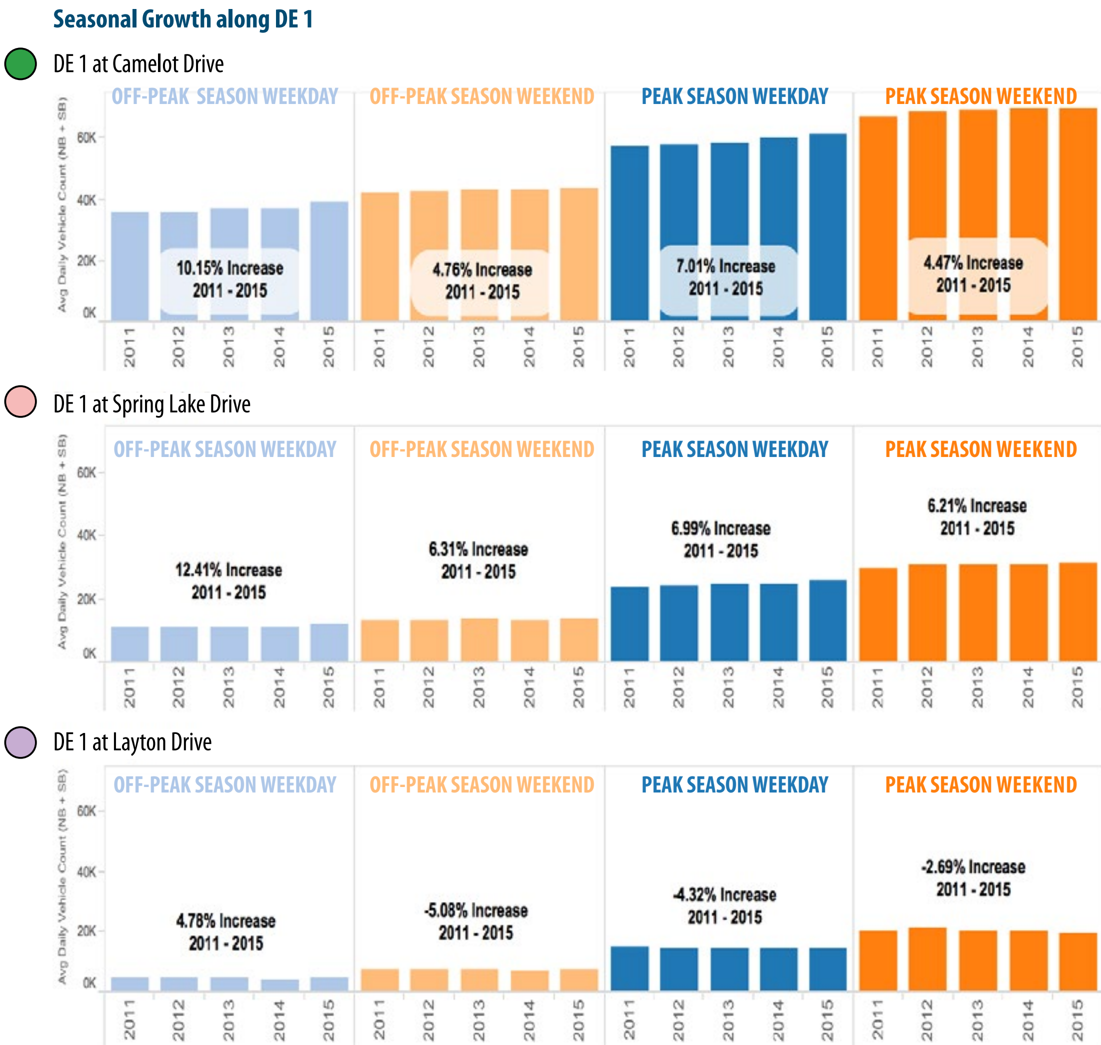
Instead of comparing a few days' or weeks' worth of data from one year to another, we can compare entire years' worth of data for multiple years.

Data of this quantity and quality is available at many locations to ensure quality of analysis when forecasting future traffic volumes for long-term projects.

LOCATION (FROM NORTH TO SOUTH)	2011 AADT	2015 AADT	2011-2015 VOLUME CHANGE	YEARLY GROWTH RATE
DE 1 N OF BARKERS LANDING	35,950	40,750	**4,800**	3.2%
DE 1 at CAMELOT DRIVE	47,950	51,150	**3,200**	1.6%
DE 1 at SPRING LAKE DRIVE	17,950	19,350	**1,400**	1.9%
DE 1 at COLLINS STREET	12,650	13,500	**850**	1.6%
DE 1 at JEFFERSON BRIDGE ROAD	10,800	10,500	**-300**	-0.7%
DE 1 at LAYTON DRIVE	10,100	9,800	**-300**	-0.8%

Annual Average Daily Traffic (AADT)

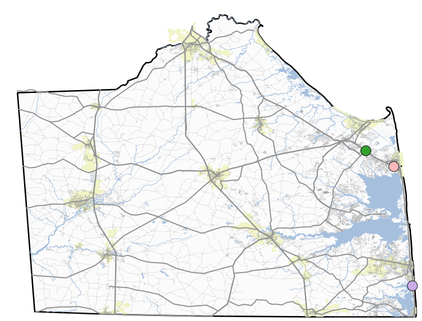
DE 1 Traffic Volume and Growth: While peak weekends have the highest traffic volumes on DE 1, weekdays throughout the year have seen the highest growth rates on this corridor.



DE 1 at Camelot Drive is located within the problem area of DE 1 previously identified in the Delay and Travel Time sections of this report. This report includes recommendations for improving travelers' experiences in this area.

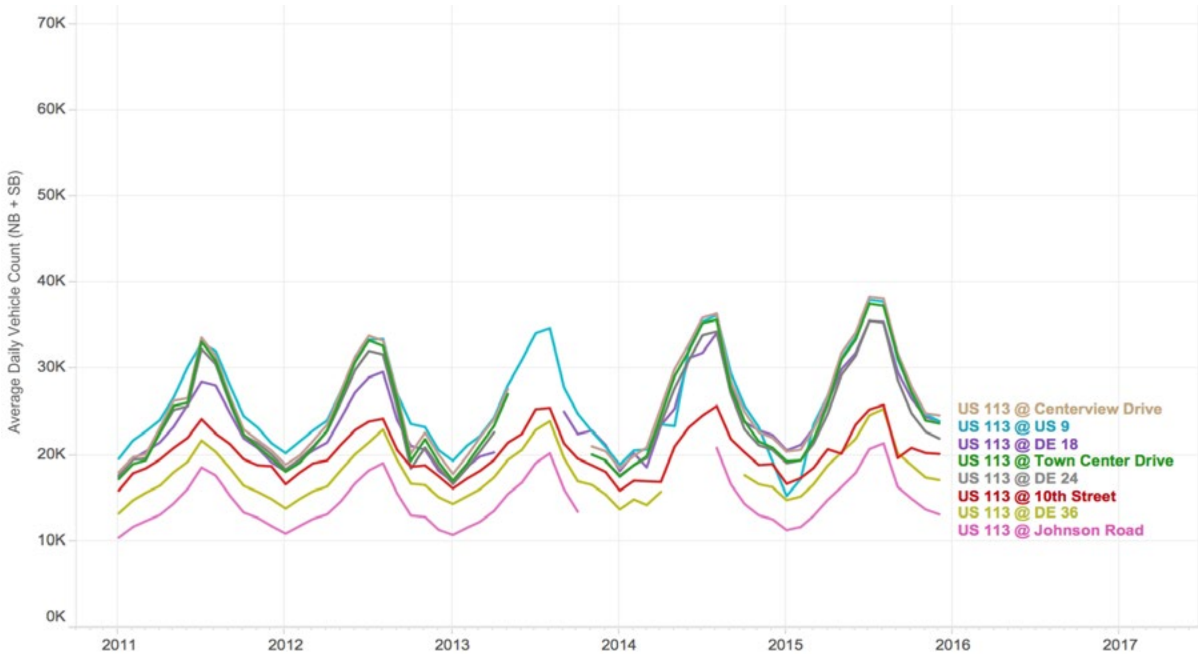
DE 1 at Spring Lake Drive has experienced growth over the past five years consistently, throughout the week and throughout the year.

DE 1 at Layton Drive near Fenwick has experienced decreasing volumes over the past five years. However, this location still follows the trend of higher growth rates during off-peak weekdays.



US 113 Traffic Volume and Growth: Since 2011, US 113 has seen the most significant average annual daily traffic growth of all the major Sussex County routes, particularly in the Millsboro area.

Average Daily Volume and Growth along US 113



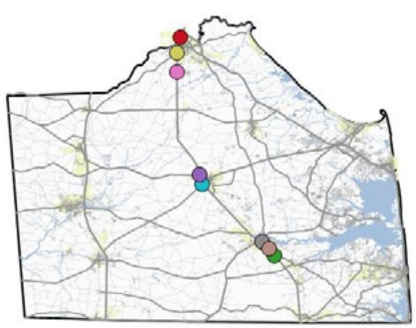
As a central north-south corridor through Sussex County, US 113 sees a mix of consistent commuter traffic throughout the year and resort traffic during the peak season. All four of the key locations used for annual average daily traffic comparison have seen an increase in volume over the past five years.

Compared to the volumes on DE 1, the seasonal fluctuation along US 113 is not as extreme.

Accurate volume and growth numbers are critical to devising workable solutions to traffic problems.

LOCATION (FROM NORTH TO SOUTH)	2011 AADT	2015 AADT	2011-2015 VOLUME CHANGE	YEARLY GROWTH RATE
US 113 at 10TH STREET	20,000	20,750	**750**	0.9%
US 113 at DE 18	22,650	27,400	**4,750**	4.9%
US 113 at CENTERVIEW DR	24,250	28,600	**4,350**	4.2%
US 113 at TOWN CENTER	23,600	27,750	**4,150**	4.1%

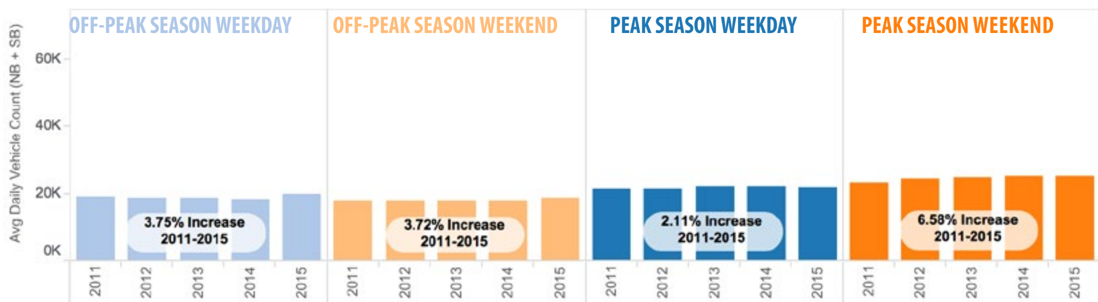
Annual Average Daily Traffic (AADT)



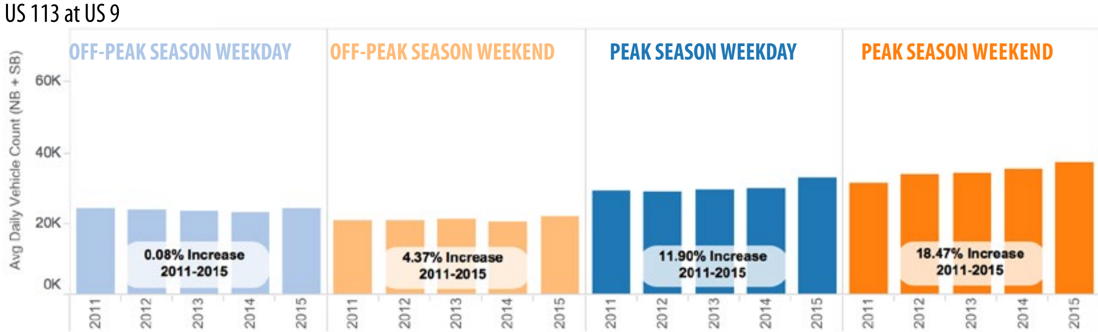
US 113 Traffic Volume and Growth: Peak season weekends have seen the highest seasonal growth along US 113, as more people take advantage of Sussex County's resort areas.

Seasonal Growth along US 113

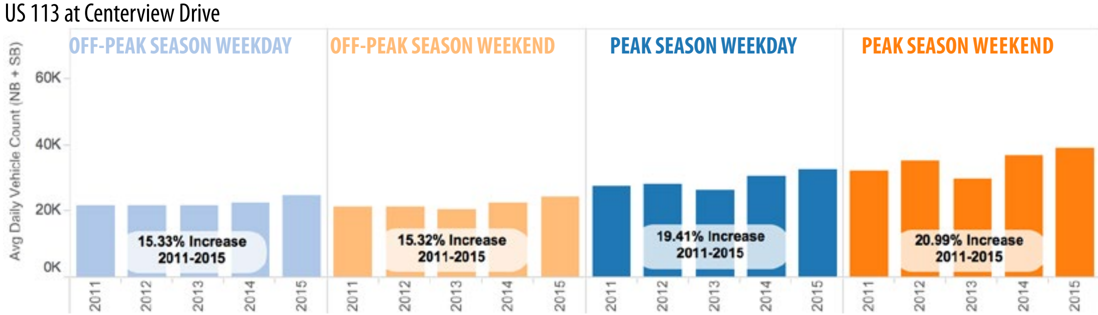
US 113 at 10th Street



US 113 at US 9



US 113 at Centerview Drive



The past five years have seen consistent seasonal travel patterns and growth along US 113. In fact, US 113 has seen the most significant growth of all Sussex County key corridors.

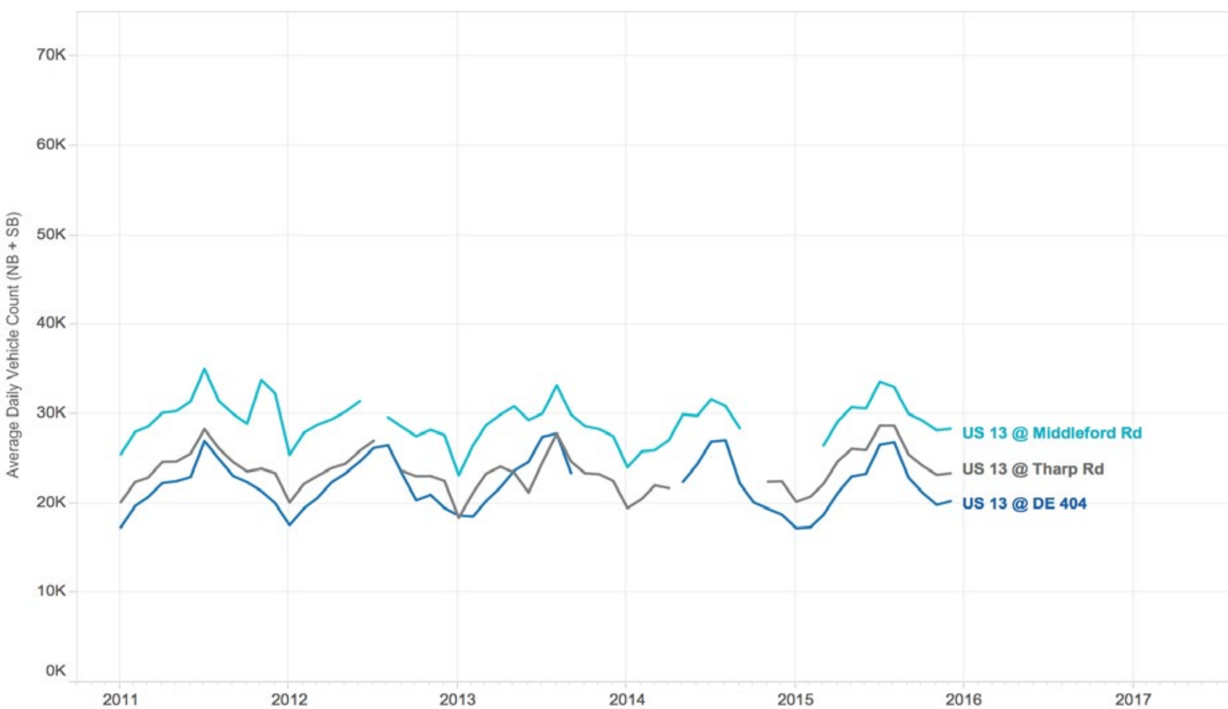
US 113 at 10th Street is one of the most northern intersections in this analysis, just south of the DE 1-US 113 split. Growth during peak season weekends is greater than the other periods, likely due to more people taking advantage of US 113 to travel to the beaches.

US 113 at US 9 is centrally located in the county and has seen significantly more growth during the peak season than during the off-peak season, on both weekdays and weekends.

US 113 at Centerview Drive has seen the greatest growth on US 113 over the past five years, at all times of the week and year. Located just south of the intersection of US 113 and DE 24, this road segment carries both commuters and resort-goers.

US 13 Traffic Volume and Growth: US 13 traffic volumes fluctuate between 20,000 and 30,000 vehicles per day, depending on the season. Since 2011, there has been virtually no growth in traffic volumes.

Average Daily Volume and Growth along US 13



LOCATION (FROM NORTH TO SOUTH)	2011 AADT	2015 AADT	2011-2015 VOLUME CHANGE	YEARLY GROWTH RATE
US 13 at DE 404	22,050	21,600	**-450**	-0.5%
US 13 at THARP ROAD	24,200	24,500	**300**	0.3%
US 13 at MIDDLEFORD ROAD	30,500	30,000	**-500**	-0.4%

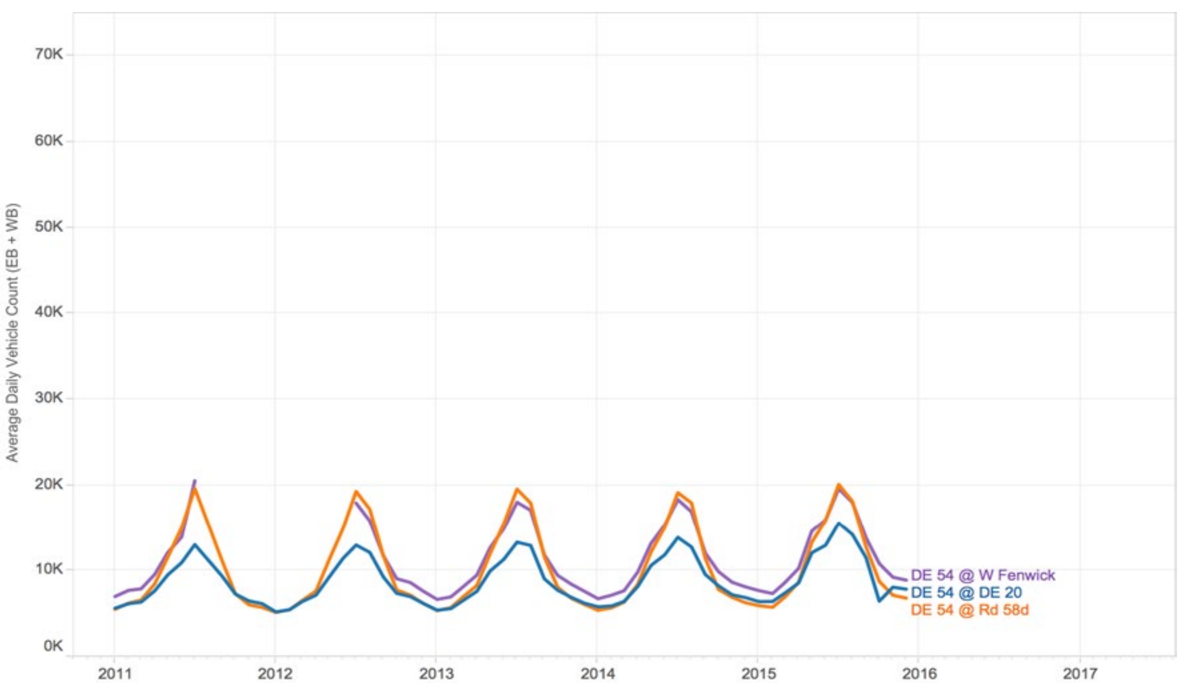
Annual Average Daily Traffic (AADT)

Compared to DE 1 and US 113, US 13 has the least amount of seasonal fluctuation, as well as the smallest volume changes across the five years.

US 13 does not have as much integrated transportation management system coverage as the roads in the eastern part of the county, resulting in less complete data along the corridor. More valuable data is on the horizon as data sources continued to expand.

DE 54 Traffic Volume and Growth: Traffic volumes on DE 54 typically fluctuate between 8,000 and 20,000 vehicles per day. The traveling experience along the route can be quite different depending on the season.

Average Daily Volume and Growth along DE 54

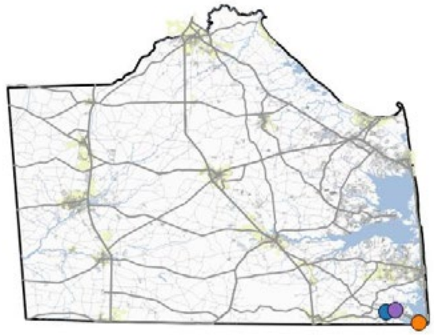


While the volumes on DE 54 are not as high as they are on DE 1, the level of fluctuation between peak and off-peak volumes is similar. DE 54 experiences seasonal fluctuation, with drivers headed into the Fenwick area during the summer. This resort traffic can lead to longer travel times.

Between 2010 and 2012, construction took place along DE 54 to provide a center left-turn lane, bike lanes, and sidewalks. Construction projects can affect the collection of traffic data, so 2011 and 2012 data was omitted from AADT comparison due to incomplete coverage.

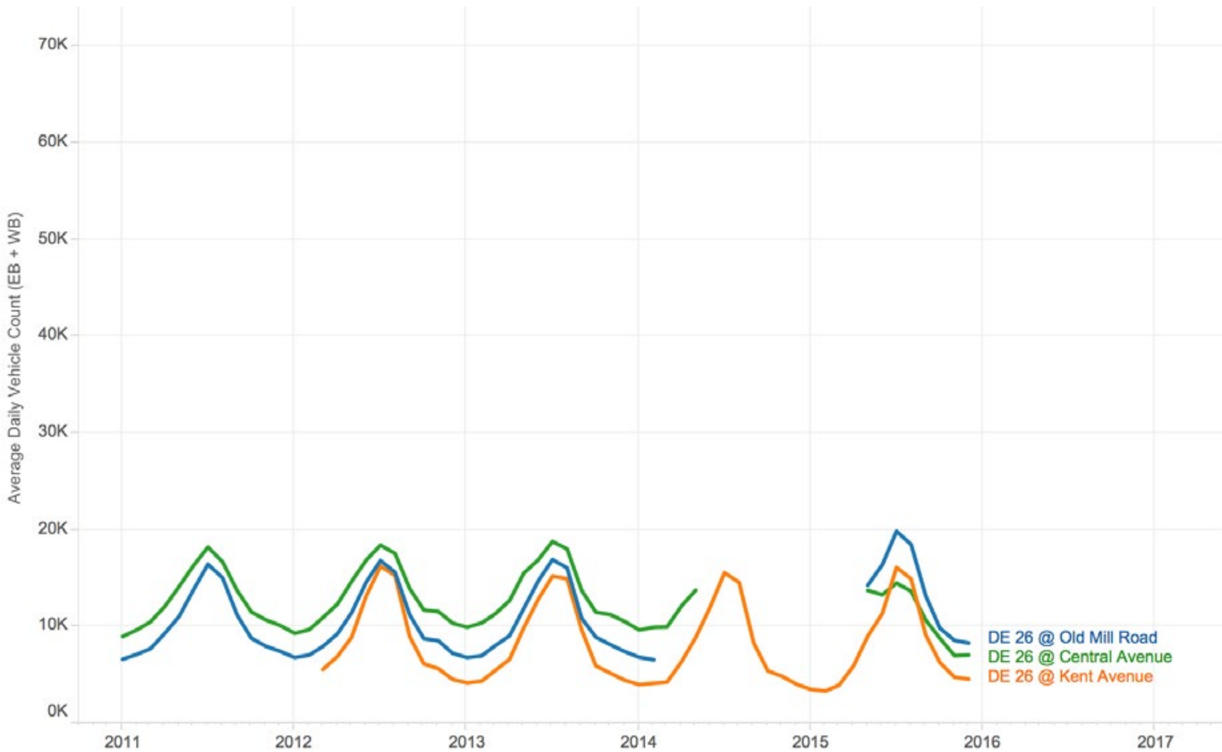
LOCATION (FROM EAST TO WEST)	2013 AADT	2015 AADT	2013-2015 VOLUME CHANGE	YEARLY GROWTH RATE
DE 54 at DE 20	8,650	9,850	**1,200**	6.7%
DE 54 at W FENWICK	11,050	12,100	**1,050**	4.6%
DE 54 at RD 58D	10,500	10,900	**400**	1.9%

Annual Average Daily Traffic (AADT)



DE 26 Traffic Volume and Growth: DE 26 operates similarly to DE 54, with daily volumes doubling during the peak season.

Average Daily Volume along DE 26

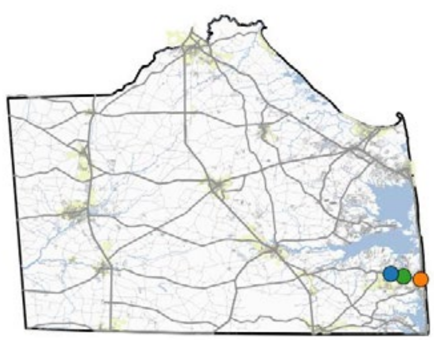


Between 2010 and 2012, there was construction at a number of intersections along DE 26 to construct 11-foot lanes, two five-foot shoulders, and turn lanes.

DE 26 was closed in the area of Central Avenue for several months in 2014-2015 in order to construct two precast concrete box culverts. These road closures resulted in incomplete data along DE 26.

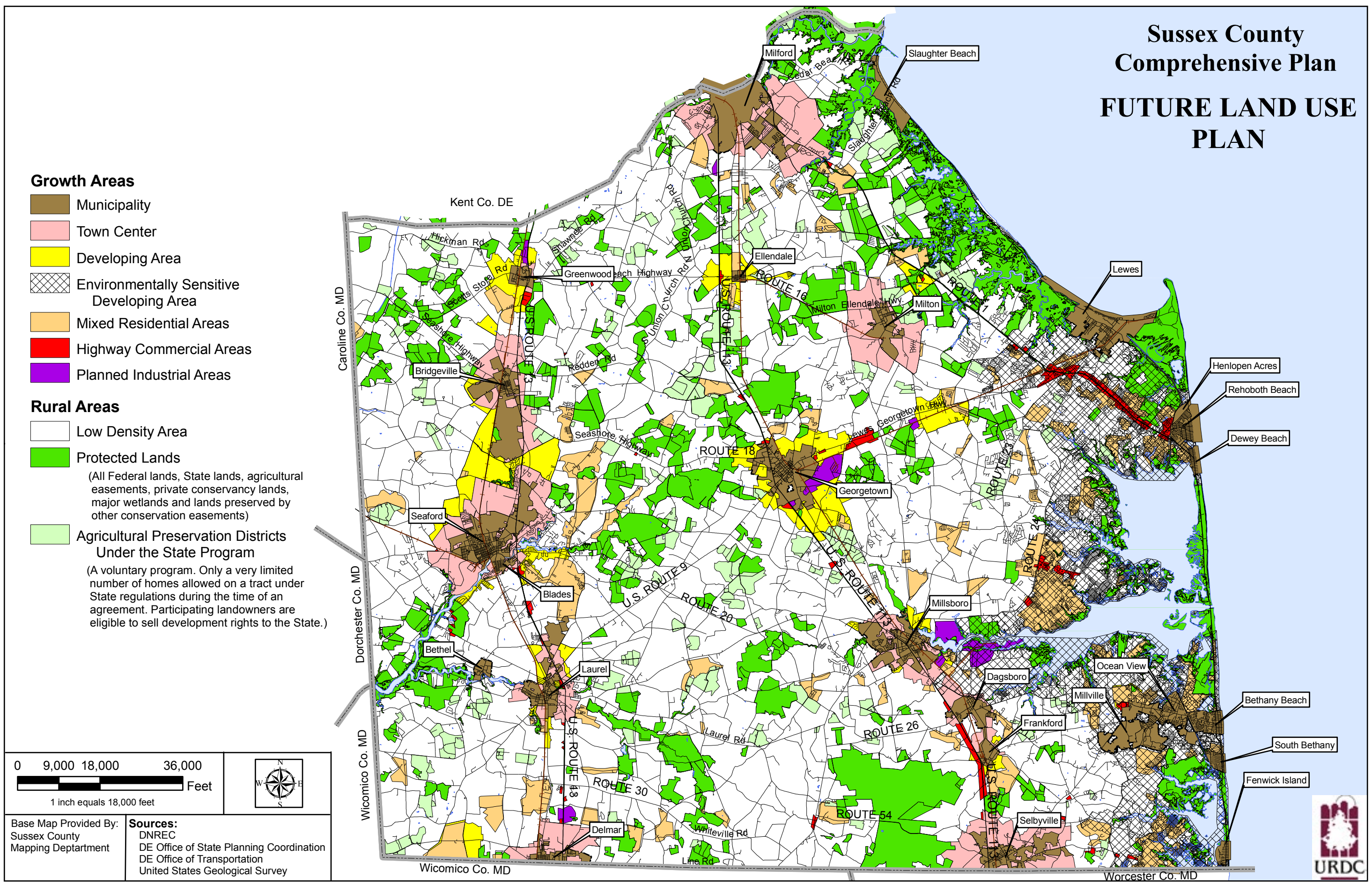
Traffic volumes on DE 26 typically fluctuate between 8,000 and 20,000 vehicles per day.

Over the past five years, multiple construction projects have been completed on DE 26, resulting in road closures and gaps in traffic data. Due to data gaps, growth patterns from 2011 to 2015 are not reported.



As DelDOT continues its successful practice of integrating operations and planning, land use plans will be combined with historical data and operational analysis to identify focus areas and prioritize funding.

Sussex County has many developing areas (shown in yellow), particularly along US 113 and US 13. According to a 2015-2016 update of the Sussex County Comprehensive Plan Annual Report, the population has grown roughly 2.5% each year, from 114,000 residents in 1990 to around 210,000 today. Agriculture and tourism are Sussex County's main economic drivers, contributing nearly a billion dollars into the county economy during the 2016 fiscal year.



Source: Sussex County Comprehensive Plan, adopted June 2008

Intersection Critical Movement Summation

We add critical movement summations to the blend of traffic analyses to ask an important question: Can intersections with traffic signals process their demand? That question cannot be answered simply by measuring delay. If an intersection scores a "C" or better in a critical movement summation but is known to experience delay, its traffic signal settings should be improved. Many adjustments are possible at a traffic signal: phasing, timing for each movement, overall cycle length, and offset relative to other intersections.

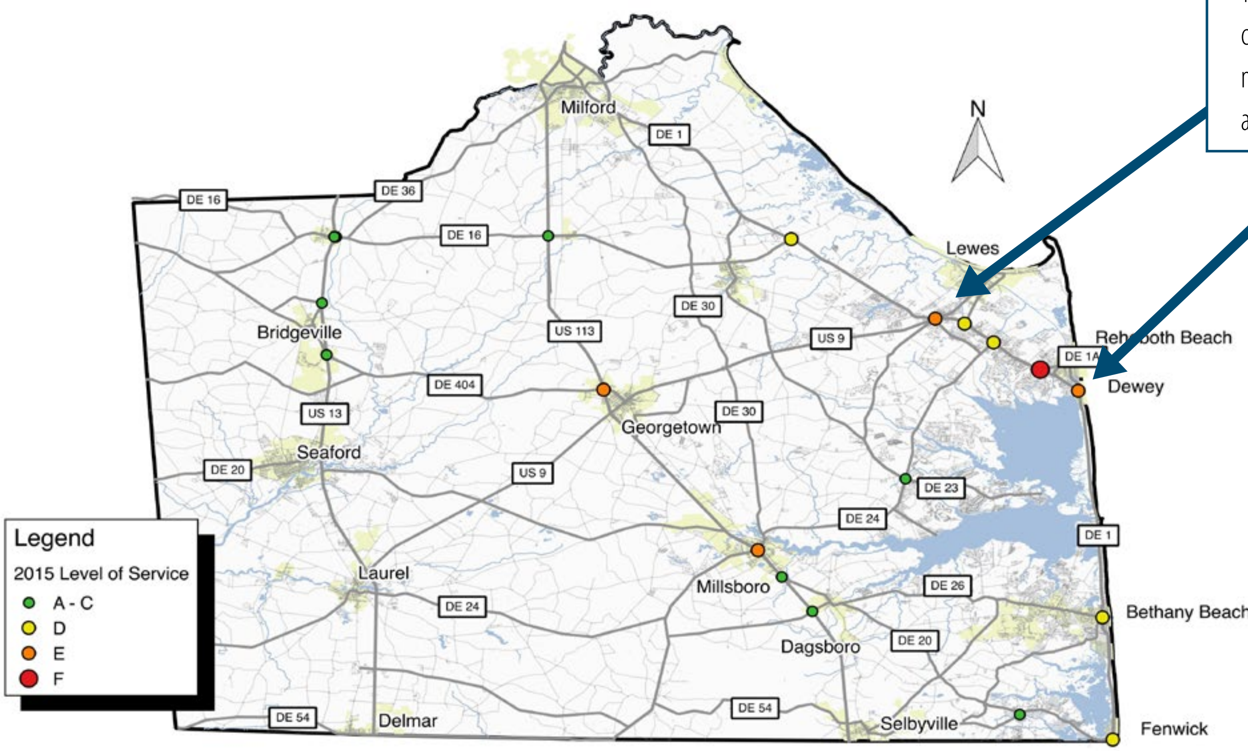
DelDOT has long used the critical movement summation method to assess the capacity of intersections. It is an old hand method that provides a tried-and-true quick check of an intersection's potential. Relating observed critical volumes to the intersection's capacity enables assignment of a letter score. As a rule of thumb, intersections scoring "D" or worse need more capacity (that is, additional lanes) to gain a better score. Intersections scoring "C" or better should experience relatively tolerable delay.

Based on the critical movement summation method, many of Sussex County's key intersections operate with little to no delay under the worst conditions, with notable exceptions along DE 1 and US 113.

A good level of service means the location should be able to handle the traffic, and a bad level of service (D or worse) means vehicles will wait more than one traffic signal cycle, even with improved signal timings. Traffic signal cycles typically range from 2 to 3 minutes. The results of this method should be paired with the results of the travel time analysis to provide a more complete understanding of where congestion occurs based on both volume and delay.

Impacts of pedestrian crossings have been taken into consideration where appropriate.

Worst Levels of Service Found at All Intersections Studied



Traffic signals at intersections can be used as real-time "gates" to control traffic entering a congested area. Delays at these locations may be necessary in order to optimize mobility on the corridor as a whole.

Study Hours: Multiple Fridays, Saturdays, and Sundays during Summer 2015

Moving Forward

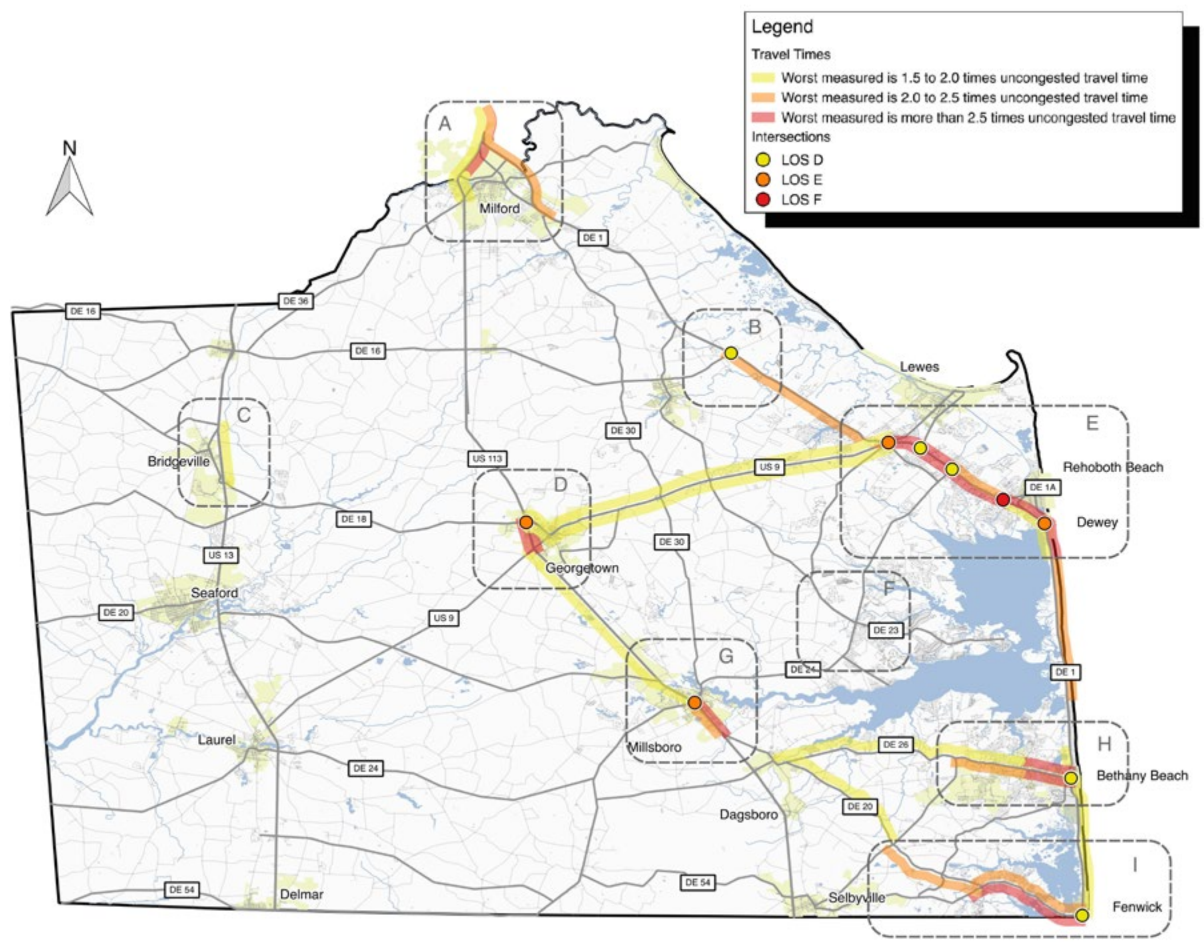
A variety of traditional and innovative solutions can be implemented to optimize mobility in Sussex County. Some solutions are location-specific, while others are countywide. The Integration of Operations and Planning Advisory Committee should discuss the progress of TOMP at least twice a year to ensure progress. Active now for 10 years, this committee includes the Federal Highway Administration (FHWA), Wilmington Area Planning Council (WILMAPCO), Dover/Kent Metropolitan Planning Organization (Dover/Kent MPO), City of Wilmington, University of Delaware, DelDOT, and others.

Improving mobility in Sussex County depends on further investment in locations that either are currently experiencing issues or are likely to experience issues in coming years as growth continues.

As this report has shown, the county's transportation problems are concentrated along routes in and out of the beaches in Rehoboth, Dewey, Bethany, and Fenwick. Additional issues have been identified in the areas of Georgetown and Millsboro. The borderline problem areas, shown in yellow on the map, must not be ignored; they may become particularly problematic as growth continues.

Sussex County's active and planned projects are remarkably diverse, benefiting bicyclists, pedestrians, transit riders, and motor vehicle drivers. The following pages outline countywide recommendations and location-specific projects for each congested area. Sections for each congested area include a summary of recently implemented projects, upcoming planned projects (including projects outlined in DelDOT's Capital Transportation Program), and new recommendations to address operational issues for which no improvements are currently planned. It should be noted that other ongoing safety programs and local studies may generate additional recommendations and projects in the future.

Sussex County Congested Areas



Countywide solutions take advantage of DelDOT's monitoring and management capabilities.

REAL-TIME TRAVELER INFORMATION

Travelers could avoid traffic by following realtime traveler information from the Transportation Management Center, which is already available through the DelDOT website and mobile app. Traveler information can be an effective solution to to enable educated mode, route, and time-of-day choices. By continuing to expand and enhance this system, we hope to spread out demand throughout the county to lessen congestion in already crowded areas. Enhancements include expanding and promoting the use of DelDOT's traffic advisory radio station (WTMC) and installing additional ITMS devices such as variable message signs to help inform drivers who may not be connected via the mobile app or radio.

BEACH RENTAL COORDINATION

Hotels and rental locations in the beach areas should be encouraged to continue to work with one another to stagger check-in and check-out to help spread out demand.

DELAWARE TRANSIT

DelDOT's Delaware Transit Corporation (DTC) provides service to, from, and within Sussex County, with special routes and services designed to handle peak season travel demand. Continued investments in real-time transit information and management tools make transit more accessible and reliable for travelers.

INCIDENT AND EVENT MANAGEMENT

Timely and effective incident and event management is critical to mitigating nonrecurring traffic congestion. DelDOT has the ability to identify issues, respond, and return the transportation system to normal conditions. Strategies can be applied to all stages of incident management: detection, verification, response, and clearance.

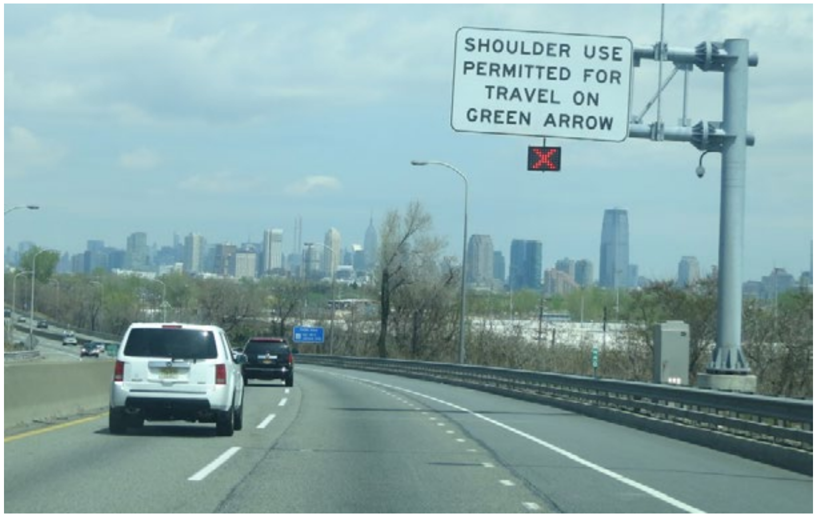
The DelDOT mobile app incorporates many of these transportation management solutions and is currently available to the public.

Real-time transit information and management tools could improve ridership.

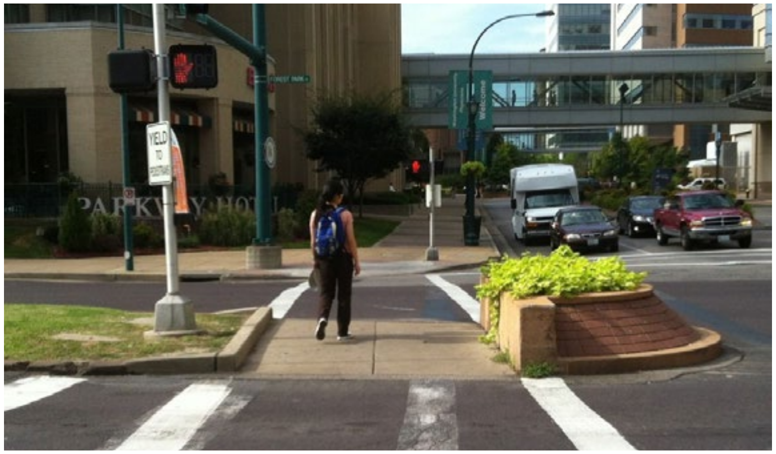
Additional solutions are targeted at locations that are known to have inadequate capacity on a regular basis.

Capacity solutions include adding travel lanes, changing intersection designs and associated signal phasing, or grade-separating lanes so they pass over other traffic without stopping.

Managed lanes take advantage of directional peaks. In the times of greatest demand, traffic lanes can be managed for efficient use of existing roadways. For example, an outer lane that is marked to serve buses, bicycles, and right-turning vehicles could be used to serve all kinds of vehicles during peak times. Striping and dynamic overhead signage would be needed to control the use of managed lanes.



Source: FHWA



Source: NATO

Pedestrian refuges can be built into available roadway space in the median of an intersection, adding an element of safety for people crossing multiple lanes, a common situation near the beaches in Sussex County. Providing a safe space in the roadway means pedestrians can take two signal cycles to cross rather than one. This practice in turn provides an opportunity to change the signal cycle length and push more vehicles through the intersection.

CONGESTED AREA A: MILFORD

Congested Area A in Milford was under construction during the time of data collection, and improvements have been completed since that time. Continued monitoring can help to determine the impacts of those improvements.

CHANGES SINCE 2000	PLANNED PROJECTS*	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system Signage added to direct motorists to take DE 1 or US 113 depending on their destination Signal at Thompsonville Rd (Kent County) removed; intersection improvements made	DE 1 in Little Heaven (Kent County) grade-separated intersection (not pictured) US 113 at DE 16 grade-separated intersection	Further improvements may be needed at the DE 1-US 113 merge in the future Install variable message signs approaching Milford to display travel time information to encourage more informed travel decisions

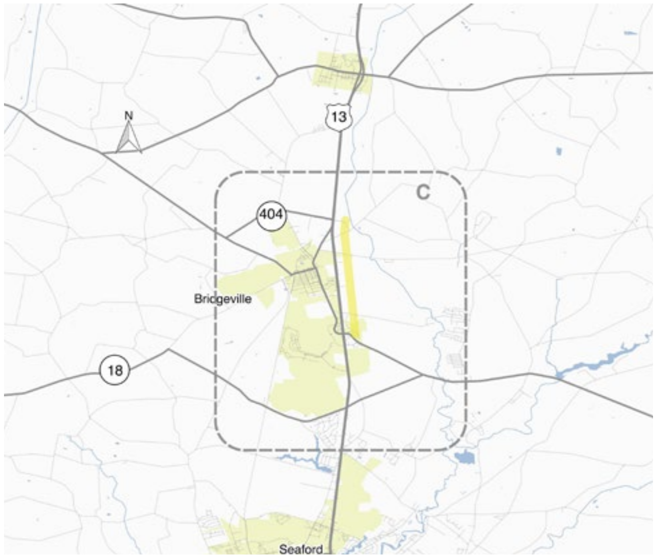
CONGESTED AREA B: DE 1 AT DE 16

Congested Area B, DE 1 at DE 16, is currently over capacity on summer weekends, so levels of service are poor. Additionally, travel times south of the intersection, toward the beach, are unreliable.

CHANGES SINCE 2000	PLANNED PROJECTS	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system	DE 1 at DE 16 grade-separated intersection	No additional recommendations at this time

* More information on these planned projects can be found in DelDOT's Capital Transportation Program.

CONGESTED AREA C: BRIDGEVILLE



Congested Area C in Bridgeville currently experiences unreliable travel times and is a borderline congested location. Because Bridgeville is a developing area, traffic growth should be monitored in the future.

CHANGES SINCE 2000	PLANNED PROJECTS	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system US 13 at DE 404 intersection realigned and turn lanes added	No planned projects at this time	No additional recommendations at this time

CONGESTED AREA D: US 113 AT DE 404-DE 18

Congested Area D in Georgetown currently experiences high levels of delay, partially because of poor levels of service at the intersection of US 113 with DE 404-DE 18. Georgetown has experienced a great deal of growth in both commuter and resort traffic.

CHANGES SINCE 2000	PLANNED PROJECTS	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system One westbound through lane added to the intersection of US 113 at DE 404-DE 18	US 113 at DE 404-DE 18 intersection improvements	A grade-separated intersection is being considered for this location

CONGESTED AREA E: REHOBOTH AND DEWEY

Congested Area E in Rehoboth and Dewey is currently one of the most congested in Sussex County due to its proximity to the beaches and shopping outlets. Large numbers of travelers, especially during the peak season, produce capacity issues and congestion in this area.

Planned projects will address some of the current issues. However, many of these projects are focused on pedestrians and may impact vehicular mobility because providing pedestrian crossing time at a traffic signal reduces green time for vehicles traveling the corridor. Additionally, a grade-separated intersection has been considered at DE 1 at US 9 (Five Points), but there is no project currently planned.

CHANGES SINCE 2000

- All signals added to statewide computerized signal system
- Westbound left turns no longer permitted at the intersection of DE 1 at US 9. A additional southbound through lane added
- At DE 1 at Dartmouth Drive, separate turn lanes and an additional through lane added
- At DE 1 at DE 24, traffic signal phasing adjusted
- At DE 1 at DE 1A (Rehoboth), double southbound left-turn lanes added and traffic signal phasing adjusted
- DE 1 at US 9 (Five Points) pedestrian improvements
- DE 1 at Dartmouth Drive pedestrian improvements
- DE 1 pedestrian improvements
- At DE 1 at DE 24, third eastbound left-turn lane added

PLANNED PROJECTS

- DE 1 Dewey Beach pedestrian and bicycle improvements
- DE 1A Dewey Beach pedestrian and bicycle improvements
- Widening of DE 24 at DE 1
- New DelDOT Lewes Transit Center

ADDITIONAL RECOMMENDATIONS

- DE 1 from US 9 (Five Points) to Rehoboth Corridor: Consider improvements such as using the bus lane as a travel lane (possibly only during peak periods), adding a lane in the median, incorporating dynamic lane use, or narrowing travel lanes

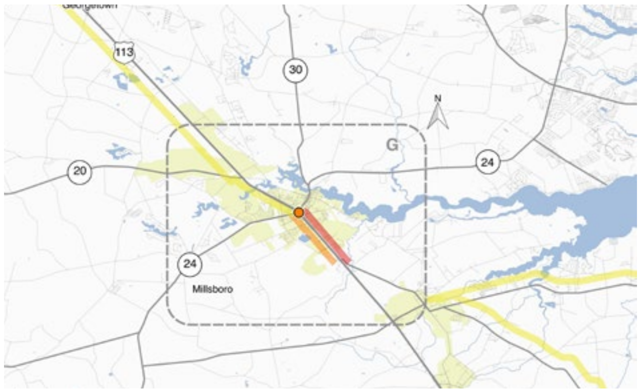
CONGESTED AREA F: DE 24

Congested Area F covers the east-west route DE 24 between Millsboro and DE 1. Integrated management system device coverage was sparse during the 2015 analysis. However, the TMC's experience indicates that this corridor is currently experiencing issues and should be monitored more closely.

CHANGES SINCE 2000	PLANNED PROJECTS	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system	DE 24 at Mount Joy Road and DE 24 at Bay Farm Road intersection improvements DE 24 at Camp Arrow Head Road and DE 24 at Robinsonville Road-Angola Road intersection improvements Traffic data collection from monitoring devices to assess traffic volumes and growth Expansion of system detector loop coverage	Install additional monitoring devices

DelDOT is installing monitoring devices along DE 24 to provide valuable data for planning, design, and operations. Operational experience has shown that traffic demand spikes on DE 24 when sections of DE 1 are flooded. DE 24 is also a connection from the suburbs to beach area resorts.

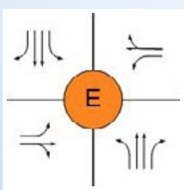
CONGESTED AREA G: MILLSBORO



Congested Area G in Millsboro is similar to Congested Area D in Georgetown in that it sees a variety of travelers, both commuters and people heading to the resort areas. Notably, mobility issues occur throughout the year, not just in peak season. This area has previously been a part of many US 113 North-South studies.

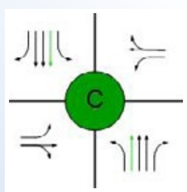
US 113 at DE 24 Consideration
ADDITIONAL THRU LANES

Current LOS



DELAY

Proposed LOS

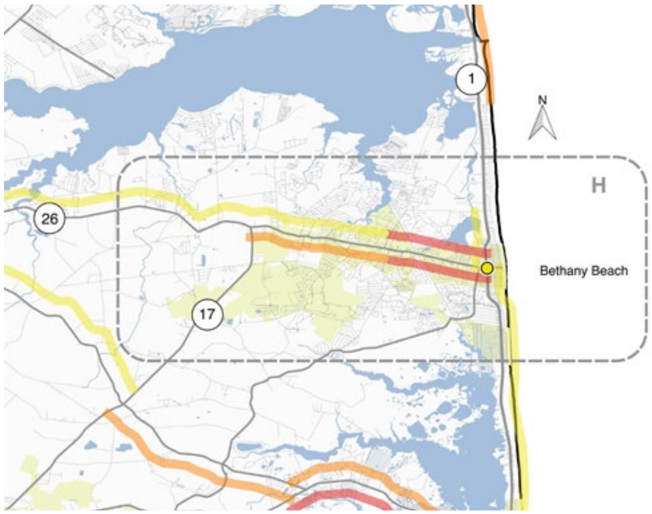


NO DELAY

Interim solutions can be implemented quickly while larger studies continue.

CHANGES SINCE 2000	PLANNED PROJECTS	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system Traffic signal phasing adjusted at the intersection of US 113 at DE 24	US 113 in Millsboro intersection improvements US 113 North-South study	Restripe and implement minor widening as necessary to add a third through lane both northbound and southbound

CONGESTED AREA H: DE 26



Congested Area H along DE 26 experiences unreliable travel times during summer hours due to beach traffic. The center turn lane improves operations, but does not add capacity for through vehicles, which still experience delays approaching Bethany.

CHANGES SINCE 2000	PLANNED PROJECTS	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system DE 26 center turn lane	No planned projects at this time	Complete an after study of the effect of the center turn lane Consider increasing roadway capacity or spreading out demand by encouraging travel at other times or by other modes

CONGESTED AREA I: DE 54

Congested Area I along DE 54 acts similarly to Congested Area H with high volumes of vehicles traveling to beaches during summer months.

CHANGES SINCE 2000	PLANNED PROJECTS	ADDITIONAL RECOMMENDATIONS
All signals added to statewide computerized signal system DE 54 center turn lane and bike lanes	No planned projects at this time	Consider increasing roadway capacity or spreading out demand by encouraging travel at other times or by other modes

This TOMP outlines an action plan for DelDOT divisions. The next Sussex County TOMP will evaluate the progress on each of these actions.

Traffic/TMC

- ✓ Track progress of TOMP recommendations
- ✓ Promote usage of traveler information
- ✓ Expand integrated transportation management system coverage
- ✓ Optimize traffic signal performance

Planning

- ✓ Incorporate TOMP methods to prioritize projects
- ✓ Apply expansive data to before-and-after studies
- ✓ Incorporate TOMP recommendations into capital program
- ✓ Coordinate area-specific TOMP strategies with local comprehensive plans

Project Development

- ✓ Use integrated traffic management system devices to collect study and design data for projects
- ✓ Assess the impact of projects on surrounding roadways and modes
- ✓ Refer to expansive data to make construction phasing decisions

Community Relations

- ✓ Promote mobile app and notifications to public
- ✓ Market Sussex County mobility choices

The TOMP process will continue to evolve as new technology emerges, changing the way we analyze the transportation network.

For example, future TOMPs may include a more comprehensive look at the frequency and causes of nonrecurring congestion. Future TOMPs may generate specific outputs, such as data on reliability and emissions, to feed the project prioritization process. While this 2017 Sussex County TOMP did involve coordination with the statewide congestion management planning effort and other concurrent projects, future projects may evolve to include even further collaboration and layering of data.

This TOMP focuses on key locations, but there is much more data available that could be used to investigate other intersections, segments, and time periods. We hope that sharing this information has highlighted the advantage of using operations resources whenever possible to enhance work.

To gain further understanding of operations across the entire state, we plan to prepare a TOMP for each county every three years on a rotating basis. Updates will be prepared as appropriate to study big changes such as land use or newly implemented projects.