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How Toll Facility Operators Are

ADVANCING ROADWAY SAFETY

SIX CASE STUDIES

JUNE 2024

ASFINAG
ATTIKES DIADROMES
elizabeth river crossings
an Abertis company
NTTA
NORTH TEXAS TOLLWAY AUTHORITY
PENNA TURN PIKE
TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY

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This paper documents six case studies of effective safety practices employed by toll facility operators who are members of the International Bridge, Tunnel and Turnpike Association (IBTTA) in both the United States and Europe. These case studies provide an in-depth look at the innovative and successful strategies that have been implemented to enhance road safety across various toll facilities.

Ginger Goodin, a principal in the firm Blue Door Strategy and Research, and her dedicated team conducted the interviews forming the basis of these case studies. Through their meticulous research and insightful conversations with industry experts, the Blue Door team has revealed valuable lessons and practical solutions that can be adopted and adapted by toll facility operators worldwide.

The release of these case studies is a highlight of IBTTA's Global Road Safety Week, which this year emphasizes the theme "Be Safe Together." By presenting these real-world examples of safety excellence, we hope to inspire and guide others in the ongoing quest to create safer roadways for all users. We call on all of our members and those across the transportation industry to join us by getting involved at www.besafetogether.org and help us create safer roads and save lives.

Bill M. Halkias, PE, F.ASCE, F.ITE
President, IBTTA
President Emeritus, HELLASTRON

Patrick D. Jones
Executive Director and CEO
IBTTA

CASE STUDY ASFINAG

KEY TAKEAWAY: DRIVEN BY A SAFE SYSTEM STRATEGY

ASFINAG, founded in 1982, is an Austrian federal agency responsible for managing the entire Austrian motorway network. The organization has a deep-seated commitment to both customers and employees and is driven by its vision, mission and set of nine core values, including road safety. As one of the leading road operators in Europe, the organization has an ambitious standard to build and operate the safest motorways and expressways. It also has an equally ambitious goal to become a "Safe System."

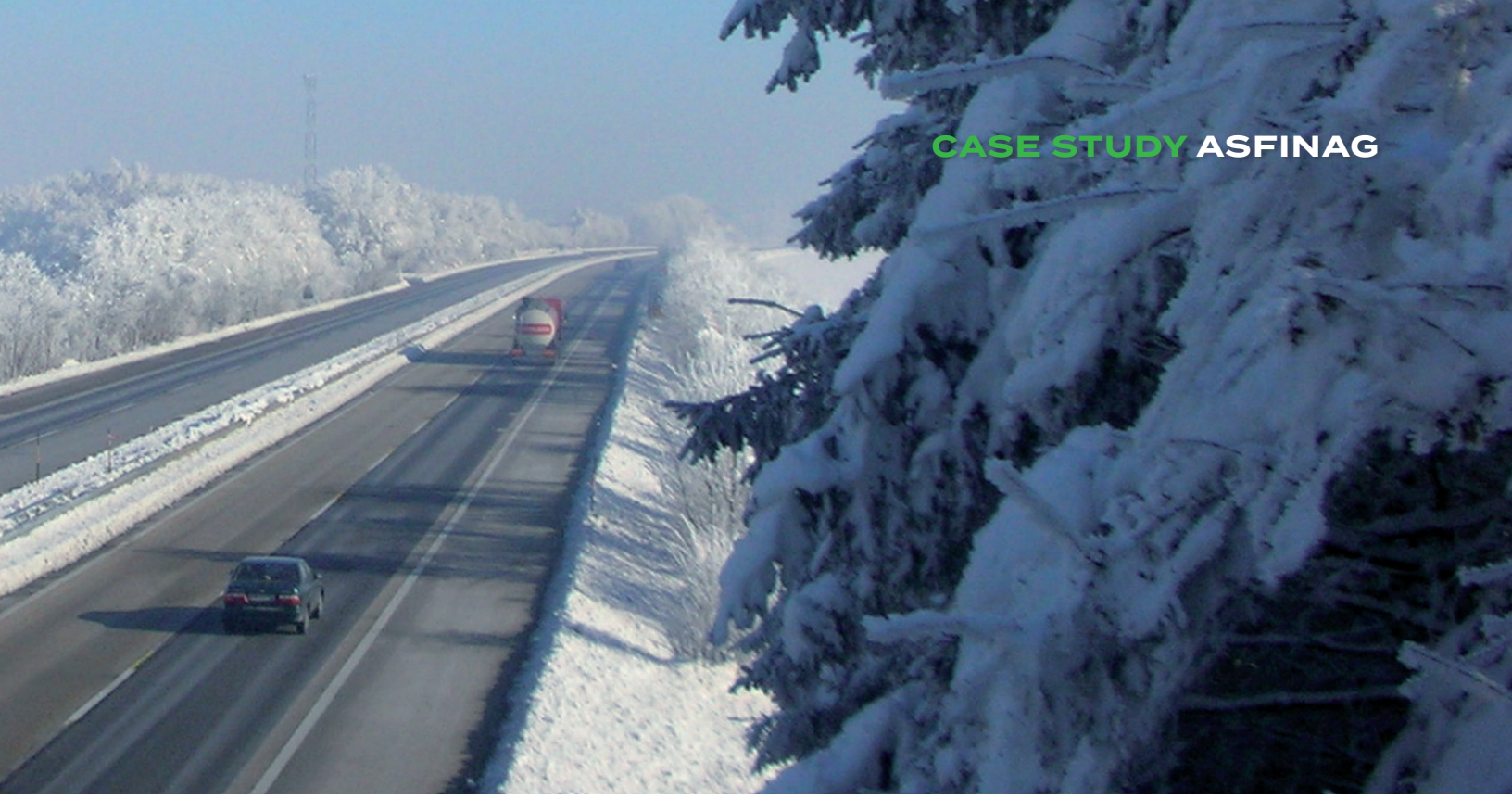
ASFINAG

FACILITY OVERVIEW

With sole focus on the Austrian motorway network, ASFINAG's team of 3,000+ employees is responsible for highway operation, maintenance, construction management and toll collection, as well as traffic management. The ASFINAG network consists of 2,200 km (1,400 miles) of highways, 165 tunnels and more than 5,700 bridges. The organization is user-financed, and its primary source of revenue is tolls, which are time-based for light vehicles and distance-based for heavy vehicles.

KEY SAFETY INITIATIVES

ASFINAG's Road Safety Program takes a systemic, interdisciplinary approach to safety and forms the framework for the organization's safety initiatives. The program consists of thirteen ambitious fields of action, representing ASFINAG's entire road safety responsibility



and a set of clear and bold measures that are continuously being enhanced and evaluated. The thirteen safety strategies are grouped into three categories:

1. Vehicle (Motorbike Safety, Truck Safety)
2. Infrastructure (Innovation, Safety Standards, Network Expansion and Improvement, Traffic Management and Telematics, Tunnel Safety, and Construction Sites)
3. Driver/human (Communication and Raising Awareness, Employee Safety, Inspection, Wrong-Way Drivers, and Accidents caused by Fog)

These strategies form the core focus of ASFINAG's Road Safety Program with a goal to avoid serious accidents and reduce accident consequences. The organization has numerous safety initiatives that resulted in a significant reduction in crashes over the past decade. The following highlights a few of their many initiatives.

STAKEHOLDER ENGAGEMENT FOR SAFETY

Achieving ASFINAG's "Safe System" goal requires teamwork beyond its 3000+ employees. Success hinges upon collaboration with all participants in the traffic network, including emergency response organizations, policymakers, technology providers, vehicle manufacturers, and road users. ASFINAG's traffic safety experts use every tool, data source, and technology available to them, but a holistic approach requires actions in areas beyond their direct purview and legal jurisdiction. Partnerships with police, emergency services, and

customs authorities are essential to address safety concerns in a holistic way. ASFINAG supports its partners through cross-training on safety and emergency exercises and by providing law enforcement with technologies that enable more effective speed management.

One example of the value of this engagement and coordination is ASFINAG's sponsorship of emergency support and rescue exercises in all tunnels that are longer than 500 meters. Despite proactive strategies to prevent accidents, unpredictable events do occur. To ensure readiness in the event of an accident across all emergency services, large scale exercises are undertaken every four years and routine exercises are conducted before the commissioning of new tunnel facilities or after the renovation of existing tunnels. This level of readiness ensures effective coordination between emergency services and ASFINAG's tunnel management team with the goal of saving lives and limiting damage.

TUNNEL SAFETY PROGRAM

ASFINAG's motorway system consists of 155 tunnels and the organization takes great pride in the tunnel management team and emergency services' efforts to ensure the tunnels are among the safest in Europe. Safety initiatives span educating tunnel customers about safe tunnel driving behaviors to maintaining and safeguarding the tunnel network 24/7 through traffic management centers.

Another initiative is to ensure maintenance and continual updates of the tunnel's state-of-the-art technologies to ensure greater safety in tunnels, such as video image evaluation, fire alarm systems, thermal scanners, and LED lighting. The recent deployment of an Acoustic Tunnel Monitoring system detects noises such as emergency braking (screeching tires) and immediately sounds an alarm to roadway operations staff. The system is now in use by 26 tunnels and is being expanded to other tunnels. These initiatives contribute to ASFINAG tunnels continuously exceeding the European Union's safety requirements.

SYSTEMATIC SAFETY EVALUATION AND AMBITIOUS TARGETS

Since 2007, ASFINAG's leadership has been intentional in prioritizing its road safety efforts with a comprehensive set of road safety metrics

and performance targets. Performance targets address system components of infrastructure, vehicle, and driver behavior and are grouped according to actions that prevent accidents or reduce accident severity. With continuous, systematic evaluation as the foundation for action, they have reduced fatalities by 50% from 2010 to 2020. This proactive approach continues into this decade with ASFINAG's new road safety standard targets[1]. Examples include:

- Reduce the traffic fatality rate per billion kilometers driven below 1, continuing the 65% reduction achieved from the levels experienced in 2006-2008.
- Achieve fewer than 70 accidents with personal injuries per billion kilometers driven.
- Reduce the number of accident hot spots ("black spots") to 30, continuing the 50% reduction since 2010.

In support of these standards, the organization deploys forty-two "traffic managers" who work around the clock on their expansive urban area network of motorways and expressways, assisting motorists with breakdowns and ensuring rapid medical response services.

PUBLIC OUTREACH CAMPAIGN: "THE STREET IS MY WORKPLACE. THANK YOU FOR PAYING ATTENTION."

A top priority of ASFINAG is the occupational health and safety of all workers regardless of their physical workplace location. For about one-third of the company's employees, the highway is their workplace. These employees ensure everything runs smoothly along the system of motorways and expressways from roadside vegetation management, mowing and landscaping, to technical maintenance and construction to toll and inspection checks and accident protection.

ASFINAG's public-facing campaign, "The street is my workplace. Thank you for paying attention," raises customer awareness about the highway as a workplace with the aim of heightening attention to roadway workers while driving. The campaign makes an emotional connection between ASFINAG employees being partners, parents, sons, and daughters, each with a family waiting for them to return home safely. The campaign is comprised of four testimonial videos in which employees describe their roadway safety role with the help of their young son or daughter, who each end the video by saying "Thank you for watching out for my [mom] [dad]."

[1] Additional targets at https://verkehrssicherheit.asfinag.at/ziele/

CASE STUDY ATTIKES DIADROMES SA

KEY TAKEAWAY: CUSTOMERS FEEL SAFE ON THE ROAD

ATTIKES DIADROMES SA operates and manages the Attica Tollway (Attiki Odos), an Important toll motorway in Greece serving as the major ring road around the greater Athens area and providing connection to the Athens airport and the city center. The project was constructed with a concession agreement and began in the 1990s as part of a national effort to improve transportation infrastructure in Athens ahead of the 2004 Olympic Games. The tollway belongs to the first generation of co-financed projects awarded in Greece during the '90s, serving as a model for concession projects and a prototype for other concessionaire contracts in Europe awarded after 2008.

ATTIKES DIADROMES

FACILITY OVERVIEW

The Attica Tollway is 70 km (43 miles) in length with three lanes in each direction (some sections have four and two lanes, but most of the sections are three-directional lanes) with traditional toll plazas that offer cash, credit card, and electronic payment. Drivers are charged a flat toll of €2.80 ($3.00) when entering the roadway, irrespective of distance.

The facility operates under a concession contract through the end of 2024 and is undergoing the final steps to prepare the facility for transfer to a new concessionaire. Transfer preparations include heavy maintenance activities and replacement of equipment by the concessionaire (Attiki Odos SA), after inspections and proposal from the Operator (Attikes Diadromes SA). Activities for the new concessionaire include traffic management, patrolling, inspections, routine maintenance, pavement resurfacing, and pavement monitoring.

Regarding the toll regime in the new concession period 2025-2050, it is not foreseen that the project will ever run as free-flow tolling, as in the new contract, there must be at least one manual payment lane on each toll road plaza through 2050.

KEY SAFETY INITIATIVES

During more than two decades of operation, the Attica Tollway has been recognized for raising the standards in the field of safety. Beginning with its first award for the operator's contribution to road safety in 2005 from the International Road Federation, the organization has been recognized by multiple entities for its road safety campaigns and low crash rates.

HIGH CUSTOMER SATISFACTION

Surveys have documented that tollway customers feel safe on the Attica Tollway. The operator conducts regular customer surveys every few years and has seen over 80% satisfaction from users on the value they receive from the quality of the services they provide for roadway operations.

The high approval ratings can be attributed in part to the rapid response by their safety patrols, which run 15 to 16 units per shift (customers can dial #1024 at any time to receive assistance). For example, if a driver experiences a flat tire, the safety patrols will reach the vehicle within 10 minutes to change the tire, or if the situation is more serious, will remove the vehicle from the motorway free of charge. If the vehicle is out of fuel, the patrol will take the driver to the closest station free of charge. And if there is an accident, they protect the scene with cones and provide guidance or support if medical assistance is required.

Attica Tollway was the first road operation concessionaire contract in Greece, so few, if any, performance criteria were included in the original contract. The main requirements were to maintain smooth traffic flow and to respond to accidents within 10 minutes (the average is now 6 minutes). The operator's response time has been historically between five and six minutes. They have been able to maintain this response in periods of high and increasing volumes of traffic. This consistency in quickly responding to motorists' needs in high-risk situations has contributed to customer satisfaction and a solid safety record by reducing risks of secondary crashes..

The new concession contract will have more and stricter KPIs for operations, including response times, clearance times, operational

performance during adverse weather conditions, response time to pavement damage and other maintenance incidents, and will include penalties for each incident that does not meet requirements. The new contract also envisions continuation of funding for police enforcement and adds resources for fire brigade services.

INDEPENDENT ROAD SAFETY AUDIT

The operator had an independent auditor perform a road safety audit 15 years ago, and as a result, applied improved lighting, more detailed signage, guard rail extensions, and increased pavement roughness on curves to reduce skidding. In one section where there were skidding issues, the operator performed shot blasting to make the pavement surface rougher. A two-lane section with sharp curves and a speed limit of 70 kph (43 mph), experienced average speeds of 90 kph (56 mph); the pavement friction treatments realized a drop of 85% in skidding incidents.

Through their intentional safety efforts, Attikes Diadromes has seen a reduction in fatality rate on the tollway. The facility usually has five to six fatalities per year, which at one point had been as high as ten per year. Last year, there was only one fatality. The 2023 fatality rate was only 0.7 fatalities per billion vehicle-kms compared to an average of 2.5 in Europe. A priority focus in addressing work zone incidents highlights a responsibility for their own personnel. For every one to two personnel working on the road, five to six others are protecting them with traffic control devices, vehicles, dynamic message signs, and staff in their traffic management center. There was one work zone fatality in 2010, when a drunk driver entered the work zone at 100 kph (62 mph) but there has not been any worker fatalities since. The last incident involving a worker was a non-serious injury in 2016. This record of achievement has been sustained through a period of intense nighttime maintenance – with ten work zones every night – to prepare for transition to the new concessionaire.

AUTOMATED ENFORCEMENT TO ADDRESS SPEEDING

Aggressive driving behavior and excessive speeds are the primary driver behaviors measured on the tollway. The speed limits on the tollway range from 130 kph (80 mph) on the east and west sections outside of the urban area, 110 kph (68 mph) on the central sections in urban areas, and 70 kph (43 mph) in the two-lane sections. Most

violations occur on the two-lane sections, where the roadway curvatures warrant a speed limit of 70 kph (43 mph) but the average speed is 90 kph (56 mph).

The operator installed speed enforcement cameras – that are operated by the Traffic Police. Before the camera installation, 27% of drivers complied with the speed limit, with 62% traveling within 20 kph (12 mph) above the speed limit. After installation, compliance with the speed limit rose to 40% and overall, the average speed dropped by 8% from 115 kph (71 mph) to 105 kph (65 mph). The Greek police issue approximately 3,000 penalties per month, with an escalating fine based on the amount that the driver exceeds the speed limit. The fine is escalated according to the speed, e.g., the maximum for driving above 150 kph (94 mph) is €350 ($400) and is coupled with a loss of driver's license for two months. The concession contract funds enforcement personnel and vehicles: 70 police are to be assigned by contract, but with a lack of officers, only about 65% of the enforcement resources are fulfilled.

YOUTH-FOCUSED DRIVER AWARENESS CAMPAIGNS

The operator has two awareness campaigns to reach students to provide early influence safe driving behaviors. For high school students, they provide an online educational module that gives students information about the Greek traffic code and signage, and informs them of a probability of driving at higher speeds and not wearing seatbelts, etc. It began as a live program that was approved by the Ministry of Education, and in 2018 it was developed into an online platform, allowing any school to apply and deliver the program to the students. Since 2015, approximately 15,000 students have gone through the program. The program received an award from the European Commission.

The second youth safe driving program is designed for younger students (kindergarten and elementary age) that is a small-scale simulated road network set up in a children's museum. It uses small cars that the children can push and follow the traffic regulations, including speed limits, use direction signals for turning left and right, among other rules of the road.

CASE STUDY ELIZABETH RIVER CROSSINGS

KEY TAKEAWAY: GLOBAL ROAD SAFETY IN OUR DNA

Elizabeth River Crossings (An Abertis Company), officially Elizabeth River Crossings OpCo, LLC, is a limited liability company owned by Abertis and Manulife Investment Management. ERC's sole purpose is to finance, deliver, operate, and maintain the Elizabeth River Crossings facilities, which include the Downtown and Midtown Tunnels and the MLK Freeway extension, as part of a 58-year public-private partnership with the Virginia Department of Transportation (VDOT).

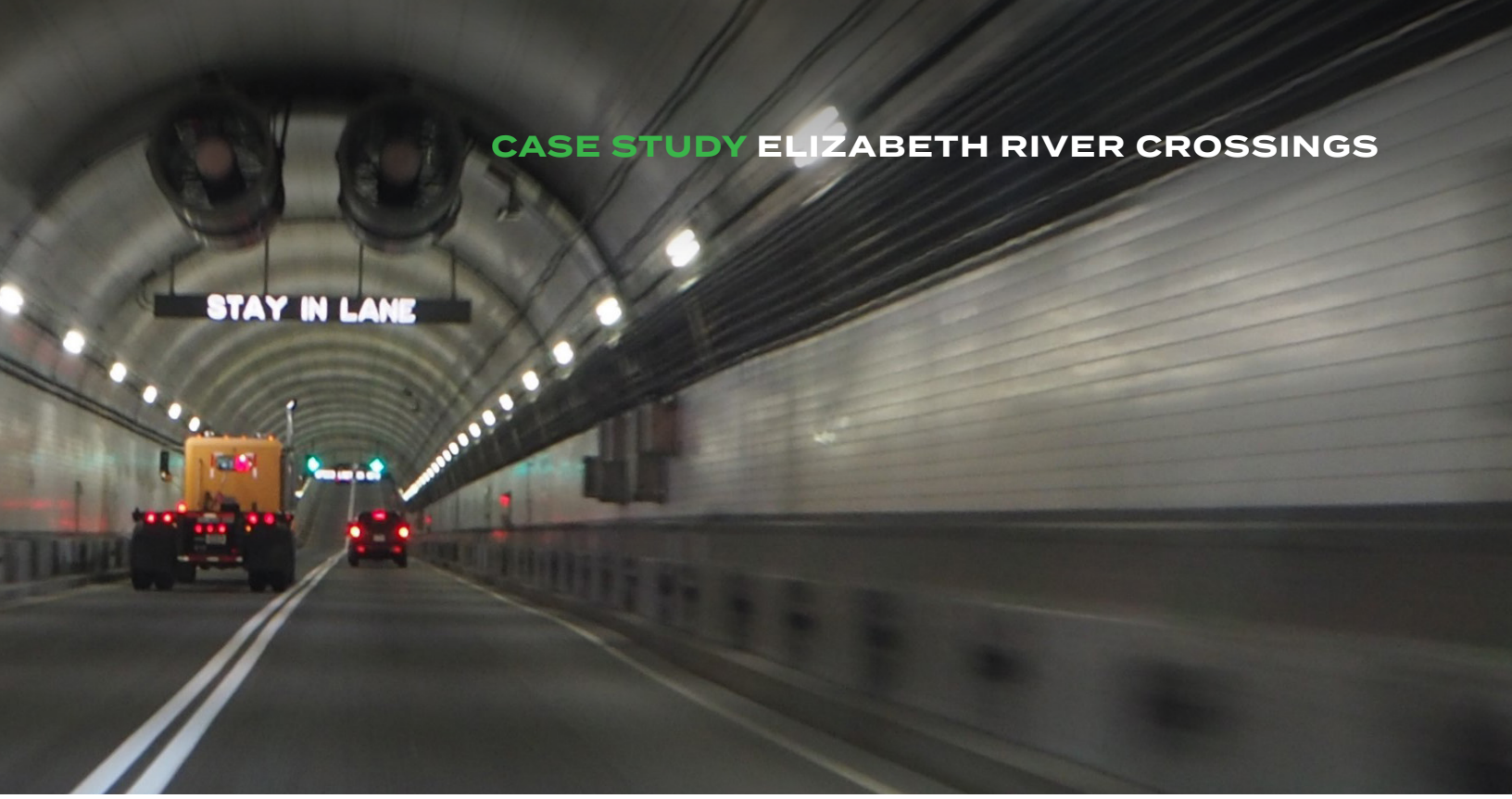
elizabeth river crossings
an Abertis company

FACILITY OVERVIEW

The Elizabeth River Crossings facilities primarily consist of tunnels and bridges spanning the Elizabeth River in Virginia. The total length of the network is 7.5 miles and 51 lane miles.

The major components of these facilities include:

- The Downtown Tunnel: This tunnel connects the cities of Portsmouth and Norfolk under the Elizabeth River. It forms a vital transportation link for commuters and travelers in the Hampton Roads region.
- The Midtown Tunnel: Another tunnel connecting Portsmouth and Norfolk, the Midtown Tunnel provides an alternative route for traffic traveling between these two cities.
- The MLK Freeway Extension: This extension provides a direct connection to the Midtown Tunnel from the Martin Luther King Jr. Expressway, facilitating smoother traffic flow.



CASE STUDY ELIZABETH RIVER CROSSINGS

There are two lanes per direction in tunnels, with three lanes per direction outside the tunnels. The speed limit is 35 mph in the Tunnels, 45 mph at the MLK, and 55 mph at the I-264.

ERC also provides incident response for the West Norfolk and Berkley Bridges, although VDOT still operates these bridges.

KEY SAFETY INITIATIVES

Abertis, a global toll road management operator, leads the ERC consortium and is the majority owner. Abertis operates over 5,400 miles of roadway in 16 countries in Europe, the Americas and Asia. The corporation has a sustainability strategy for 2022-2030 that lays out principles for corporate responsibility, including the reduction of traffic accidents and fatalities in accordance with the United Nations Decade for Road Safety and with an ambition of zero victims, including employees and workers[2].

COMPANY-WIDE GLOBAL APPROACH TO ROAD SAFETY

As a subsidiary of a larger corporation, ERC operates like each of Abertis' business units, with KPIs for safety performance that are unique to their operation. Their indicators relate to the number of accidents and fatalities, follow European standard KPIs, and the goal is continuous improvement. If they achieve their annual safety KPI targets, they receive a financial bonus.

At the global level, Abertis supports a foundation that has been proactive in reducing international road deaths and has been a strategic ally of UNICEF to reduce traffic deaths among school children[3]. Their work has involved working with local agencies to implement safer infrastructure in school zones, promote safe driving and sustainable mobility, and support legislation. Their documented success has led to UNICEF defining their safety program as a work priority in its 2022-2025 strategic plan.

As a smaller operation, ERC has undertaken driver awareness campaigns scaled for their resources. For example, they use variable message signs to introduce messages oriented to drivers, such as avoiding the use of cell phones and driving safely over long holiday weekends.

IDENTIFICATION OF CRASH HOT-SPOTS AND INITIATION OF SAFETY COUNTERMEASURES

ERC uses a systematic process to identify and treat safety at two levels: road safety (infrastructure and behavioral-oriented), and health and safety of workers. For the safety of their employees, they have established a process when an incident involving a worker or employee occurs. A review by a safety team is undertaken. The post-incident review identifies the root cause (environment, human behavior/distraction), and produces a report with a defined action plan that outlines the mitigation steps to be taken.

There is also a 10-person employee-based Safety Committee, which meets monthly, analyzes the information from all accidents during the previous month, and identifies what occurred with as much detail as is available. If police report information is not readily available, they use camera footage, incident reports, and environmental conditions (weather) to provide as many specifics as possible about the accident. ERC leadership meets quarterly to conduct a deep-dive review of the accidents, fatality data and identified hot spots to determine mitigation actions. However, if an immediate need arises, they will take corrective action more quickly.

One example of ERC's safety review process and hot spot identification involved accidents occurring at the approach to the Midtown Tunnel, where drivers had a decision point to either take the tunnel or use another route. In addition to documented

incidents, delineators separating the lanes were confusing, and it was determined that the signage was not clear. The mitigation action involved removing the delineators and placing upstream striping on the road to give the drivers better information to make a timely decision before reaching the diverge point. Accidents have gone down significantly after implementing the mitigation actions, from a baseline of 16 accidents in 2019, to seven accidents in 2023 (changes were implemented in Q2), to one accident as of April 2024.

PROACTIVE SAFETY REVIEW WITH CONTINUOUS IMPROVEMENT

ERC is a smaller toll operation, but that does not limit the priority they place on safety improvement. They believe that every opportunity they have to improve safety is meaningful. They have designated June as "safety month," during which they deploy different training initiatives with staff and focus on different topics to increase awareness. With their hot spot analysis and structured process for reviewing incidents and accidents, ERC is systematically focused on continuously improving the safety performance of their facilities and protecting employees.

[2] Abertis Sustainability Plan. https://www.abertis.com/sostenibilidad/

[3] Abertis Foundation, Road Safety Program. https://www.abertis.com/fundacion-abertis/

CASE STUDY NORTH TEXAS TOLLWAY AUTHORITY

KEY TAKEAWAY: ORGANIZED FOR ACTION

The North Texas Tollway Authority (NTTA) has been connecting North Texas for more than 25 years. Headquartered in Plano, Texas, NTTA acquires, constructs, maintains, repairs, and operates turnpike projects in the North Texas region, including the metropolitan centers of Dallas and Fort Worth. At the organization's core is the focus on serving its 7.4 million customers with safe, well-maintained, and efficient roadways.

NTTA®
NORTH TEXAS TOLLWAY AUTHORITY

FACILITY OVERVIEW

NTTA operates as an enterprise system of tollways and is responsible for 1200 lane miles of limited access North Texas tolled facilities. The system is comprised of:

- Five toll roads (360 Tollway, Chisholm Trail Parkway, Dallas North Tollway, President George Bush Turnpike, and Sam Rayburn Tollway),
- Two bridges (Lewisville Lake Toll Bridge and Mountain Creek Lake Bridge), and
- One tunnel (Addison Airport Toll Tunnel).

While NTTA maintains frontage roads adjoining some of these facilities, the cities manage frontage road operations. The agency is also the tolling services provider on toll projects in the region that are owned and operated by other entities.

CASE STUDY NORTH TEXAS TOLLWAY AUTHORITY

KEY SAFETY INITIATIVES

NTTA supports the demands for transportation in the North Texas region, which ranks as the fourth largest metropolitan area in the United States. NTTA has been at the forefront of tolling technology and industry leadership. It was the first tolling agency in the United States to employ an electronic toll collection system (ETC) and one of the first to convert an entire toll road system to cashless tolling in 2010, in part to improve driver safety. Today, that leadership continues with NTTA's comprehensive approach to safety.

CENTRALIZED STRUCTURE SUPPORTS COMPREHENSIVE SAFETY APPROACH

In 2014, NTTA took an extra step toward prioritizing safety by establishing a Traffic and Incident Management (TIM) Department, which elevated the agency's ability to quickly identify and effectively address safety issues across all business units and assets. Prior to this, addressing safety was a shared responsibility across departments and business units.

The new department consolidates traffic management and operations functions, including responsibility for the Safety Operations Center (SOC), the agency's 24/7/365 central "control room" for the full NTTA system. The SOC is also the focal point for data analysis and risk management, safety service patrols, state troopers, and dispatch services. The Department has a dedicated line-item budget for systemwide traffic safety improvements, which can be used to help address safety issues that "pop up," and a team of three Professional Engineers and an Engineer-in-Training. In addition, the Engineering/Project Delivery Department,

Maintenance Department, and TIM Department all report to the same Assistant Executive Director, creating a collaborative safety culture.

The team has adopted a proactive and integrated process to collect and analyze incident and crash data, identify, and resolve safety issues, take immediate action to resolve the small issues as soon as possible, and work the larger issues into the agency's planning processes. Their process ensures cross-departmental collaborations in providing input on plan reviews, engineering, and roadway facility design. The department also identifies safety improvements for scheduled projects through the agency's 5-year and 10-year plans.

This process results in the early and quick identification of safety-related trends and issues, along with countermeasures and improvements. As a result, the department serves as an effective check on safety practices to avoid variations in standards while promoting a collective safety mindfulness within the organization.

The following highlights a few of NTTA's safety-related activities, many of which were initially deployed to address a particular and immediate safety issue and have now been adopted as standard practice.

- Noting an uptick in incidents including fatalities in which light poles located in the facility median were hit, with fallen poles causing secondary incidents, the team conducted an evaluation to determine an appropriate countermeasure. On a future roadway widening project, the team worked with the construction group to include outside shoulders as a buffer to the light poles, as well as to enable space for safely pulling over disabled vehicles.

- Incorporating safety improvements into roadway projects has become standard practice. This includes, for example, moving light fixtures, adding shoulders, or adjusting sign structures as part of a widening project. It also includes replacing guard rail, adjusting slopes on clear zones, and modifying striping during a pavement rehabilitation project.
- To protect construction and maintenance workers in work zones, NTTA was among the first agencies in the US to deploy a mobile barrier trailer to quickly set up a protected temporary work zone. The agency now has four of them. In longer-term construction zones, a moveable concrete barrier is used to provide protection for construction workers.
- Continuous lighting projects are implemented along older corridors. The agency has also established programs for monitoring and replacing roadway signage and pavement markings.
- Wrong-way driver countermeasures are installed on new ramps as a standard practice. The ramps have reflective raised pavement marking arrows, reflective red tape on the sign poles, and two "Do Not Enter" and two "Wrong Way" signs. Additional measures such as geometric ramp improvements, do not enter/wrong way signing with LED border lights or thermal imaging flashing lights are installed based upon analyses of wrong-way driver data.
- TIM analyzes crash data to determine where pavement treatments are needed to reduce wet weather crashes. The pavement treatments have included grinding and grooving, as well as the installation of high-friction treatments.

SPEED LIMIT COMPLIANCE WITH STATE TROOPERS

NTTA's safety strategy includes a unique collaboration with the Texas Department of Public Safety (DPS) State Trooper Patrols, which enables them to seamlessly integrate their safety-focused services. Through an arrangement between NTTA and DPS, just over 80 State troopers are assigned to work on NTTA's system and co-work in NTTA offices.

Operationally integrating with the troopers makes speed compliance on NTTA facilities simpler to coordinate speed and safety campaigns. For example, the state troopers partner with NTTA's safety service patrol on enforcement of the "Move Over or Slow Down" law, which requires drivers to move over a lane or slow down when they see any NTTA vehicle with its lights activated. Troopers are paired with the safety

service patrol to pursue drivers who fail to slow down or move over. Another example of the value of this integrated working arrangement is the ability to work closer and share resources. Using data from microwave sensors installed along the roadway, NTTA routinely analyzes speed data patterns and can identify the days and times when higher average speeds are more likely. Equipped with this insight, NTTA-assigned troopers are directed to those locations and times as a speeding deterrent. NTTA and troopers have also partnered to move around unoccupied trooper vehicles to serve as visual deterrents for speeders, with actual enforcement as a follow. In addition, NTTA and state troopers partner with local cities to create enforcement task forces, flooding the system with patrol vehicles on certain days. NTTA speed data analytics has proven this practice is effective in reducing driving speeds.

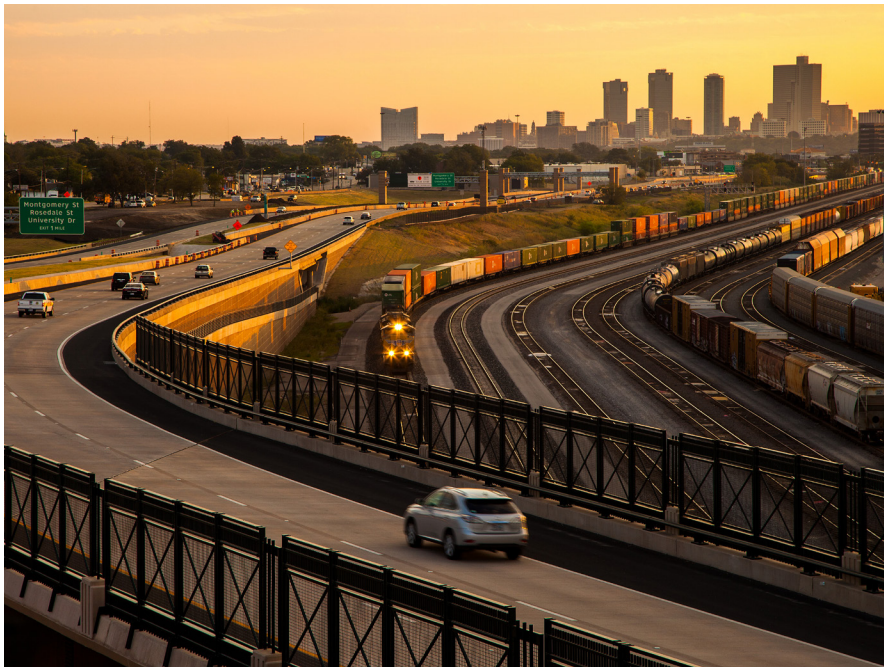
Collaboration with law enforcement collaboration has improved NTTA's timely collection of crash and incident data from state troopers assigned to their facilities. The agency maintains a "quick database" of incidents and crashes that is obtained from various sources, including NTTA's safety service and maintenance team incident reports and state troopers' crash reports. The state's crash database is the final source, but since there is typically a lag in the availability of that data, the state trooper relationship offers direct and early insight to analysts.

RED THUMB MOVEMENT AND ROAD SAFETY SERVICES CAMPAIGNS

Since 2015, NTTA has led the Red Thumb Campaign to combat distracted driving in North Texas. The campaign encourages drivers to wear and share a red thumb band ("W8 2 TXT") or creatively make some part of their thumb red to remind them to keep their hands on the wheel and eyes on the road. Over 50 community cities, companies, schools, and organizations, have signed on as campaign partners to help promote the campaign and encourage others to join the movement. For the past two years, NTTA has engaged students grades 2 through 12 and their teachers in a contest to create a design or video promoting the Red Thumb Movement and the dangers of distracted driving (Link to 2024 winners). In 2017, NTTA received a toll excellence award for social responsibility from IBTTA for its Red Thumb anti-texting-and-driving efforts.

Keeping drivers safe in the case of disabled vehicles is a priority of NTTA's Safety Operations Center (SOC). Calling for help on an NTTA road got easier with the 2017 rollout of the agency's easy-to-remember #9-9-9

number to call for roadside assistance. Drivers who dial #9-9-9 are connected directly to the SOC 24/7/365 emergency dispatch facility. The service is highlighted on variable message signs on NTTA's facilities and is regularly promoted through media channels and social media throughout the year, particularly during holiday seasons. During #9-9-9 promotions, the number of abandoned vehicles per day dropped significantly; during one campaign, the number dropped from an average of 12 abandoned vehicles per day to zero.



CASE STUDY PENNSYLVANIA TURNPIKE COMMISSION

KEY TAKEAWAY: TACKLING WORK ZONE CRASHES

The Pennsylvania Turnpike Commission (PTC) was created in 1937 to construct, operate, and maintain the state's turnpike system. Known as "America's First Superhighway," the Pennsylvania Turnpike represents a key transportation route within the state and a vital link in the network of the eastern United States. Since its inception, the Commission has built a legacy as a leader and trailblazer in the transportation industry by consistently demonstrating a commitment to safety, innovation, and customer service.

FACILITY OVERVIEW

The PTC manages roughly 565 miles of limited access roadway that is comprised of the 359-mile Turnpike Mainline covering the southern portion of Pennsylvania from east to west, along with several extensions and bypasses, five tunnels, 73 toll interchanges, 17 service plazas, maintenance sheds, and towing facilities. On March 16, 2020, in response to the public health concerns resulting from the COVID-19 pandemic, the Commission moved to all-electric toll collection, removed toll collectors from toll plazas and transitioned exclusively to license plate capture and E-ZPass transponder-based toll collection across the Turnpike System.

KEY SAFETY INITIATIVES

The organization's strategic plan framework (2019-2024) lays out a clear vision for its operations: "Safety Focused. Customer Driven." The Commission prioritizes safety with a commitment to, "improved safety: zero fatalities, no work zone injuries, reduced incidents." The plan's

mission, goals, objectives, and values serve as the guiding framework for everything that PTC does. While responsibility for safety is shared across agency departments, oversight for the Commission's safety-related programs, services, and initiatives resides within the Traffic Engineering and Operations Department.

REDUCING WORK ZONE EXPOSURE

The Commission formed a Work Zone Safety Subcommittee to review work zone crash statistics, assess problem areas, and determine potential improvements, backing its commitment priority on work zone safety with tangible actions. The Subcommittee is comprised of cross departmental representatives (Traffic Engineering and Operations, Engineering - Design and Construction, Maintenance, and Public Relations and Marketing) and representatives external to the agency (Pennsylvania State Police, Federal Highway Administration, Pennsylvania Department of Transportation, and a General Consultant Engineer). Work zone safety improvement initiatives fall into one of three categories: (1) outreach and education, (2) local treatments and (3) programmatic changes. Since the Subcommittee began meeting in 2015, over 50 separate innovations and initiatives have been introduced to varying levels of success. The following highlights several of the more impactful initiatives:

- Work Zone Safety Awareness Campaign. The PTC Public Relations and Marketing Team worked closely with the Subcommittee to extend the reach of their Go Orange safety campaign to raise awareness about driver behavior particularly in work zones. Actions

included messaging on avoiding distractions and slowing speeds when driving through work zones, and the opportunity for drivers to sign an online "Go Orange" pledge to commit to safe driving. The team created a hashtag (#GoOrangePA), billboards, media buys and social media. The team also recognizes the employees who lost their lives while performing their duties through a Lost Worker Memorial in which traffic cones, representing each PTC Lost Worker, are lined up to create a visually impactful and emotional memorial.

- Removal of Median Signs. The Manual on Uniform Traffic Control Devices (MUTCD) provides an option for placing signs on both the left and right sides of a multi-lane freeway or expressway where special emphasis is needed. The Subcommittee noted a significant proportion of Truck Mounted Attenuator (TMA) hits occurred during mobile operations for median sign installation and removal. To resolve this, in 2016, the PTC successfully piloted the elimination of median signs in narrow median areas and countered the sign removal with additional portable changeable message signs in advance of the signing area. In 2017, the PTC removed median signs for areas with median widths less than 15 feet for temporary traffic control which resulted in significantly reducing TMA hits in 2018 and 2019.
- New Technologies. The Subcommittee piloted new technology to provide drivers with additional visual notification of work zones and workers present during nighttime operations. These include the implementation of sequential lights during nighttime hours and LED hard hat lights.

As a result of their efforts, PTC has seen a steady decline of more than 30% in work zone crashes since 2016.

INTERCHANGE SIGNING STANDARDS

Despite roadway improvements and traffic control devices deployed to slow and positively direct traffic, crashes in Pennsylvania Turnpike interchanges and service plazas present safety and incident management challenges. To address this, an Interchange Signing Plan (ISP) was developed to provide supplemental guidance based on best practice for placing warning signs, plaques, and markers. The plan's goal is to provide clear and consistent messages to help motorists react positively to the conditions they encounter at interchanges and service plazas.

The plan is now being implemented on scheduled rehabilitation projects, such as roadway resurfacing or interchange projects. The move to open road tolling offered critical opportunities for implementing the ISP with the construction of overhead cashless tolling gantries, removal of existing toll plazas, and upgrading ramps and roadways close to these areas. Installing appropriate, new signage to support cashless tolling and motorist communications will be incorporated into the contracts for this work.

ROUTINE ROADWAY CRASH SEGMENT ANALYTICS

With the Commission's commitment to work toward zero fatalities on the Turnpike System comes the expectation for monitoring and reporting on safety performance. The agency monitors their annual average crash rate and crash severity rate, work zone crashes, and fatalities, benchmarking their performance against similar roadways on a statewide and national basis.

As part of safety performance monitoring, the agency completes a crash segment analysis every two years to review potential problem areas and consider remediations. During each review, crash data for the previous three years is compiled and reviewed to identify crash cluster locations. The crash clusters are then reviewed by a working group of design engineers, traffic engineering and operations staff, and construction and maintenance personnel, who determine the appropriate mitigation strategies and assign responsibility to the relevant department to lead the project. During the last crash segment analysis cycle, just under 20 different segments were identified.

CASE STUDY TAMPA-HILLSBOROUGH EXPRESSWAY AUTHORITY

KEY TAKEAWAY: SAFETY AT COMMUNITY CONNECTIONS

The Tampa-Hillsborough Expressway Authority (THEA) is guided by a strategic blueprint with the "mission to provide safe, reliable, and financially sustainable transportation services to the Tampa Bay region while reinvesting customer-based revenues back into the community." [4]
Since THEA's main system was initially built, safer roadway design criteria have replaced the old standards and new mobility trends associated with a fast-growing urban core have been recognized (walkable and connected communities, land use, growth and equity). In recent years, the organization has pivoted to meet those evolving needs as a collaborative partner and provider of safe, reliable, and financially sustainable transportation services to customers and the Tampa Bay region.

TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY

FACILITY OVERVIEW

THEA was established by the Florida legislature in 1963 as an independent agency of the State of Florida to bring roadway infrastructure projects online more quickly using tolling. Subsequent legislation passed in 2014 provided THEA the ability to offer services beyond Hillsborough County to surrounding counties, including Hardee, Manatee, Pasco, Pinellas, and Polk.

THEA currently owns, maintains, and operates four facilities:

- The Lee Roy Selmon Expressway (Selmon Expressway), a 17-mile tolled roadway featuring a segment with Reversible Express Lanes (RELs);
- The Brandon Parkway, a non-tolled facility that provides access to the RELs;

CASE STUDY TAMPA-HILLSBOROUGH EXPRESSWAY AUTHORITY

- Meridian Avenue, a road without tolls that provides access to the RELs;
- The Selmon Greenway, a 1.7-mile multi-use trail that travels below the elevated Selmon Expressway through Downtown Tampa.

SAFETY INITIATIVES

The agency plays a vital role in the Tampa Bay region's transportation infrastructure ecosystem, mindful of enhancing the quality of life for those who live, work, and visit Tampa Bay. With a commitment to Vision Zero, the agency embraces safety in their customer-centric operations and in providing mobility access throughout Tampa Bay's urban core.

FORMAL SYSTEMATIC APPROACH TO FULL-SYSTEM SAFETY ASSESSMENT

The organization takes a formal, systematic approach to safety that continues to evolve. A central component of THEA's approach is a full safety assessment conducted every two years, which involves a system-wide review of crashes to identify unique characteristics and circumstances. Deficiencies are flagged to pinpoint mitigation measures that will prevent future crashes. For all fatal or serious injury crashes, there is an immediate deep dive to identify corrections that should be activated.

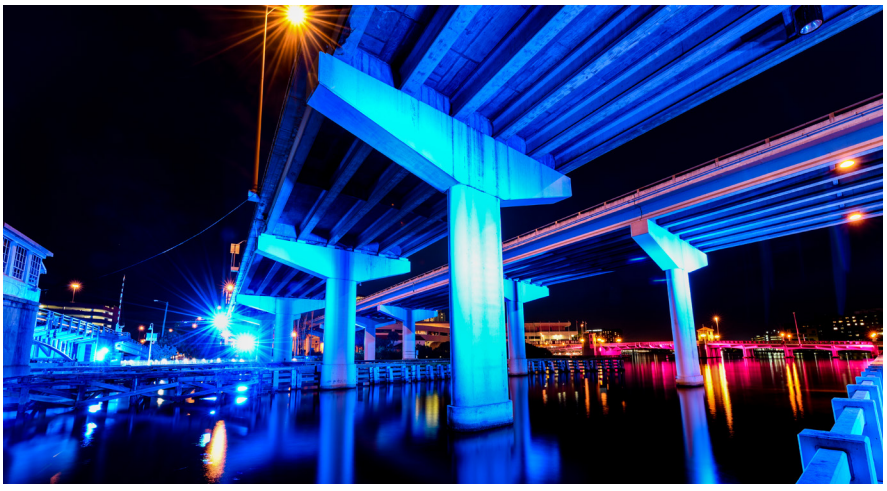
Their analysis has shown that most crashes are congestion or speed-related. Of particular focus is the speed differential at congested

locations where vehicles are approaching at a high rate of speed. Daily transaction reports quantify speed by the hour, which enables analysts to detect a speeding pattern that warrants action in a certain roadway section. Over the past two years they have also noted two emerging issues: (1) pedestrians conflicting with expressway access at the downtown terminus, and (2) wrong-way driving incidents associated with their reversible expressway.

The organization is evolving its systematic approach by developing a safety culture that makes safety everyone's responsibility, from employees to customers. Part of this evolution is a growing reliance on data analytics and integrating different data types with crashes to gain a better understanding of the relationship between their assets and the performance of their assets. To allow for proactive mitigation strategies, THEA's current budget includes a work program for safety that will facilitate quick actions, such as improvements in striping, signing, lighting or visibility.

IMPROVING PEDESTRIAN SAFETY

Over the last ten years, the urban core of Tampa has become more densely populated around the toll system, providing walkable and bikeable communities that are converging with high-speed expressway ramps. To address pedestrian safety concerns, THEA is installing infrared technology at crosswalks, which detects the presence of pedestrians and supports messages on expressway signs that inform drivers of pedestrians in the crosswalk. This demonstrates a safe system, a comprehensive approach to safety that seeks to ensure the safety of those in the community who are not necessarily users of the toll system.



CASE STUDY TAMPA-HILLSBOROUGH EXPRESSWAY AUTHORITY

ADDRESSING LONG-TERM DESIGN DEFICIENCIES

Since the initial THEA system was built in the 1960s and 1970s, standards have evolved to provide safer driving conditions. A number of locations have short merge and weave areas and sections without emergency shoulders. The organization is undertaking a large construction program over the next ten years to expand and rebuild the entire system, bringing outdated facilities up to current standards. For example, THEA recently completed a four-mile extension of the expressway as an elevated structure over an arterial roadway. The extended facility eliminated 40% of the crashes in the corridor.

To address wrong-way cross-median driving crashes, THEA uses a three-step approach with deployment of ITS technologies with a series of gates and lights. THEA has installed wider shoulders and closed median gaps with installation of new median barriers. Other proactive actions include the addition of rumble strips where they do not currently exist and removing protrusions on retaining and barrier walls that are problematic.

[4] www.tampa-xway.com/wp-content/uploads/2023/05/THEA_Strategic-Blueprint_2023FINAL-1.pdf

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