Railroad Crossing Inventory Field Data Collection and Crossing Safety Evaluations for Wisconsin

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Submitted by:

Christopher M. Cunningham, Principal Investigator
Institute for Transportation Research & Education (ITRE)
North Carolina State University
909 Capability Drive, Suite 3600
Raleigh NC 27606
Phone Number: 919-515-8562
Email: cmcunnin@ncsu.edu

Authors:

Guangchuan Yang, John Shaw, Steve Bert, Jay Bowen, Colton Smith,
Christopher Vaughan, Hannah Smith, and Christopher Cunningham.

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Institute for Transportation Research & Education (ITRE)
North Carolina State University
909 Capability Drive, Suite 3600
Raleigh NC 27606

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16. **Abstract**
Highway-rail grade crossings remain a persistent safety concern, with collisions continuing to cause fatalities, injuries, and operational disruptions despite long-standing safety programs. Effective risk management relies on the U.S. DOT National Highway-Rail Crossing Inventory, supported by state databases and field data collection. Limitations in data completeness, update frequency, and system integration reduce data usability for crossing safety analysis, safety investment prioritization, and decision-making. In Wisconsin, staffing constraints and reliance on manual field data collection have further hindered the timely completion of the federally required triennial inventory, resulting in extended update cycles and uneven data quality.

This study develops an integrated framework to improve crossing inventory management and safety analysis in Wisconsin. A mixed-methods approach is used, including a review of federal requirements and best practices, a national practitioner survey, a cost analysis of alternative inventory field data collection strategies. This report also includes a combined safety assessment using FRA incident data and Wisconsin motor vehicle crash records.

The review and survey findings show widespread adoption of GIS and mobile data tools in the United States, but persistent challenges remain in data consistency, interoperability, and update efficiency. Emerging technologies such as LiDAR, UAVs, and AI-based data collection offer opportunities to improve efficiency and data quality, though their adoption is constrained by cost and implementation complexity.

The cost analysis indicates that labor is the primary driver of Wisconsin inventory expenses. A revised field data collection strategy and balanced clustered regional staffing approach were found to improve efficiency and reduce overall costs compared to the current allocation method.

The safety analysis shows that FRA data alone underrepresents crossing-related crashes. There are numerous crossing-related incidents that do not involve trains, including run-off-road, rear-end, and fixed-object collisions. These account for a substantial share of crossing-related crashes and exhibit clear spatial variation across the state.

Overall, the study demonstrates that integrating multi-source data, modernizing data collection methods, and optimizing staffing and workflows can improve data quality, reduce costs, and support more effective, data-driven prioritization of railroad crossing safety investments in Wisconsin.

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highway-rail grade crossings, railway crossings, level crossings, crossing inventory, inventory management, rail crossing safety, crash data integration, cost analysis

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EXECUTIVE SUMMARY

Highway-rail grade crossings are critical interfaces between Wisconsin's roadway and rail transportation systems. Although significant investments have been made in engineering improvements, enforcement, and public education, collisions at these locations continue to result in fatalities, injuries, property damage, and operational disruptions.

Effective management of these risks depends on accurate, current, and comprehensive railroad crossing inventory data. The Federal Railroad Administration's (FRA) National Highway-Rail Crossing Inventory provides the foundation for federal reporting, safety analysis, risk assessment, and funding decisions. However, incomplete inventories, delayed updates, and limited integration with other transportation data systems reduce its effectiveness for supporting modern, data-driven safety programs.

Federal regulations require states to update their railroad crossing inventories at least once every three years. In Wisconsin, staffing limitations and reliance on seasonal personnel have resulted in incomplete field inventories and delayed data entry, extending the effective inventory cycle to more than two decades in some areas. This has produced uneven data quality across WisDOT Regions and reduced the state's ability to identify and prioritize rapidly changing or high-risk crossings.

This study evaluated Wisconsin's current railroad crossing inventory program through a comprehensive review of federal requirements and state practices, a nationwide practitioner survey, a cost analysis of alternative implementation strategies, and an integrated safety analysis combining FRA incident data with Wisconsin motor vehicle crash records.

The literature review and practitioner survey indicate that transportation agencies are increasingly adopting GIS-based inventory management systems, mobile data collection technologies, and integrated databases to improve data quality and operational efficiency. Although these technologies have significantly modernized inventory management, challenges remain in maintaining current inventory information, integrating multiple data sources, and automating update processes. Emerging technologies—including LiDAR, mobile mapping, vehicle-mounted 360-degree cameras, unmanned aerial vehicles (UAVs), and artificial intelligence (AI)—offer significant opportunities to improve data collection efficiency and quality. However, no single technology can satisfy all inventory needs. Instead, the most effective approach combines traditional field inspections with emerging technologies through a hybrid inventory program.

The cost analysis found that labor is the largest component of Wisconsin's railroad crossing inventory program, followed by travel and field technology costs. Four implementation strategies were evaluated, including the current in-house approach, an optimized in-house approach, outsourcing to a specialty data collection vendor, and outsourcing to an engineering consultant. The optimized in-house approach, which reallocates field crews based on geographic efficiency rather than existing WisDOT Region boundaries, reduced estimated program costs substantially while maintaining full compliance with FRA inventory requirements.

Although outsourcing provides greater operational flexibility and scalability, the substantially higher labor, overhead, and profit costs associated with private-sector providers make outsourcing significantly more expensive than an optimized in-house program. Among the outsourcing alternatives, specialty data collection vendors offer a more cost-effective option than engineering consultants because of their lower indirect costs (overhead). Wisconsin's long history of intergovernmental partnerships suggests that local agencies may also provide opportunities to supplement future inventory efforts.

The safety analysis demonstrated that FRA incident data alone substantially underrepresent railroad crossing safety issues. Only 16 percent of crossing-related crashes reported by Wisconsin law enforcement involved a collision between a train and a highway user. The majority of crashes consisted of run-off-road, rear-end, and fixed-object collisions—including collisions with crossing signals and other rigid hazards. Many of these categories occurred more frequently than train-vehicle crashes. Significant geographic variation in crash frequency and crash type indicates that safety improvements should be tailored to regional conditions. Integrating FRA incident data with Wisconsin motor vehicle crash records provides a more comprehensive understanding of crossing safety and supports more effective identification of high-risk locations and prioritization of engineering improvements. The study also developed a set of engineering countermeasures to address common types of crossing-related crashes that do not involve trains.

Overall, the study concludes that Wisconsin can substantially improve the efficiency, quality, and long-term sustainability of its railroad crossing inventory program by adopting a more integrated, data-driven approach. Key recommendations include implementing the optimized in-house staffing model identified in this study, expanding the use of digital field data collection technologies, improving integration between the Rail Crossing Inventory System (RCIS) and other WisDOT databases, incorporating desk reviews into the inventory process, strengthening coordination with the Office of the Commissioner of Railroads and local agencies, and prioritizing inventories in rapidly changing and higher-risk locations. Collectively, these improvements will enhance inventory quality, support more effective safety analyses, reduce long-term program costs, and improve the prioritization of investments across Wisconsin's highway-rail crossing network.

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Chapter 1. Introduction

1.1 Background

According to the Association of American Railroads (AAR) (*AAR, 2026*), as of 2022 Wisconsin had more than 3,100 miles of freight railroad trackage (Figure 1). Wisconsin railroads directly employ nearly 2,700 people and play a vital role in supporting the state's agricultural and industrial economy. More than 300,000 carloads of freight originate in the state each year, while nearly 430,000 carloads are delivered to Wisconsin customers. Wisconsin is also served by three Amtrak passenger rail routes (Figure 2): the *Hiawatha*, which provides six daily round trips between Milwaukee and Chicago; the *Empire Builder*, which passes through the state daily on its route between Chicago and Portland and Seattle; and the *Borealis,* which operates daily between Chicago and the Twin Cities via Milwaukee (*WisDOT, 2026*).

Maintaining the safety of both roadway and rail users requires accurate and up-to-date information on the characteristics and condition of the state's highway-rail grade crossings (also referred to as railroad-highway crossings or level crossings). Like all states, Wisconsin is required to submit a comprehensive railroad crossing inventory to the Federal Railroad Administration (FRA) at least once every three years. In practice, most states divide this effort into three annual inventory cycles, updating approximately one-third of their crossings each year. To support these activities, federal law permits states to use up to eight percent of their FRA Section 130 funding for inventory-related data collection and management.

Over the past several years, Wisconsin has fallen well short of its inventory completion targets because of staffing limitations. The shortfalls vary considerably among WisDOT Regions and Offices. Most field data collection is currently performed by seasonal employees using paper forms. Although this approach has produced partial field inventories in some regions, only a small portion of the collected information has been entered into Wisconsin's Railroad Crossing Information System (RCIS). As a result, what should be a three-year inventory cycle has effectively stretched to a 20- to 25-year cycle for WisDOT and a 10-year inspection cycle for the Wisconsin Office of the Commissioner of Railroads (OCR).

The consequences of this extended update cycle are compounded by ongoing changes in Wisconsin's transportation network. While some areas experience little change over time, others continue to undergo rapid population growth and land development. Crossings located in these developing areas – particularly along the expanding edges of metropolitan regions – are often the most likely to require upgrades, modifications, or consolidation. However, the state's limited inventory efforts are not currently prioritized toward these higher-need locations.

The resulting data deficiencies affect the FRA, Amtrak, freight railroads, local governments, WisDOT, and the Wisconsin Office of the Commissioner of Railroads (OCR). OCR relies on accurate crossing inventories, together with its inspection activities to evaluate the need for warning device installations and upgrades and make recommendations for the removal or consolidation of unnecessary or unsafe crossings. The inventory process also provides opportunities to identify compliance issues problems (such as missing, faded, or damaged signs) for timely repair before they contribute to crashes.

Potential consequences of incomplete or outdated inventory data include:

- Less effective use of Section 130 railroad crossing safety improvement funding due to compromised project identification and prioritization resulting from incomplete or outdated inventory data.
- Increased planning and engineering costs for OCR investigations and highway improvement projects involving grade crossings.
- Higher crossing operation/maintenance costs resulting from delayed removal or consolidation.
- Increased risk of train-vehicle and train-pedestrian collisions because incomplete or outdated inventory data can hinder the identification of safety needs, delay implementation of appropriate countermeasures, and reduce the effectiveness of safety resource allocation.

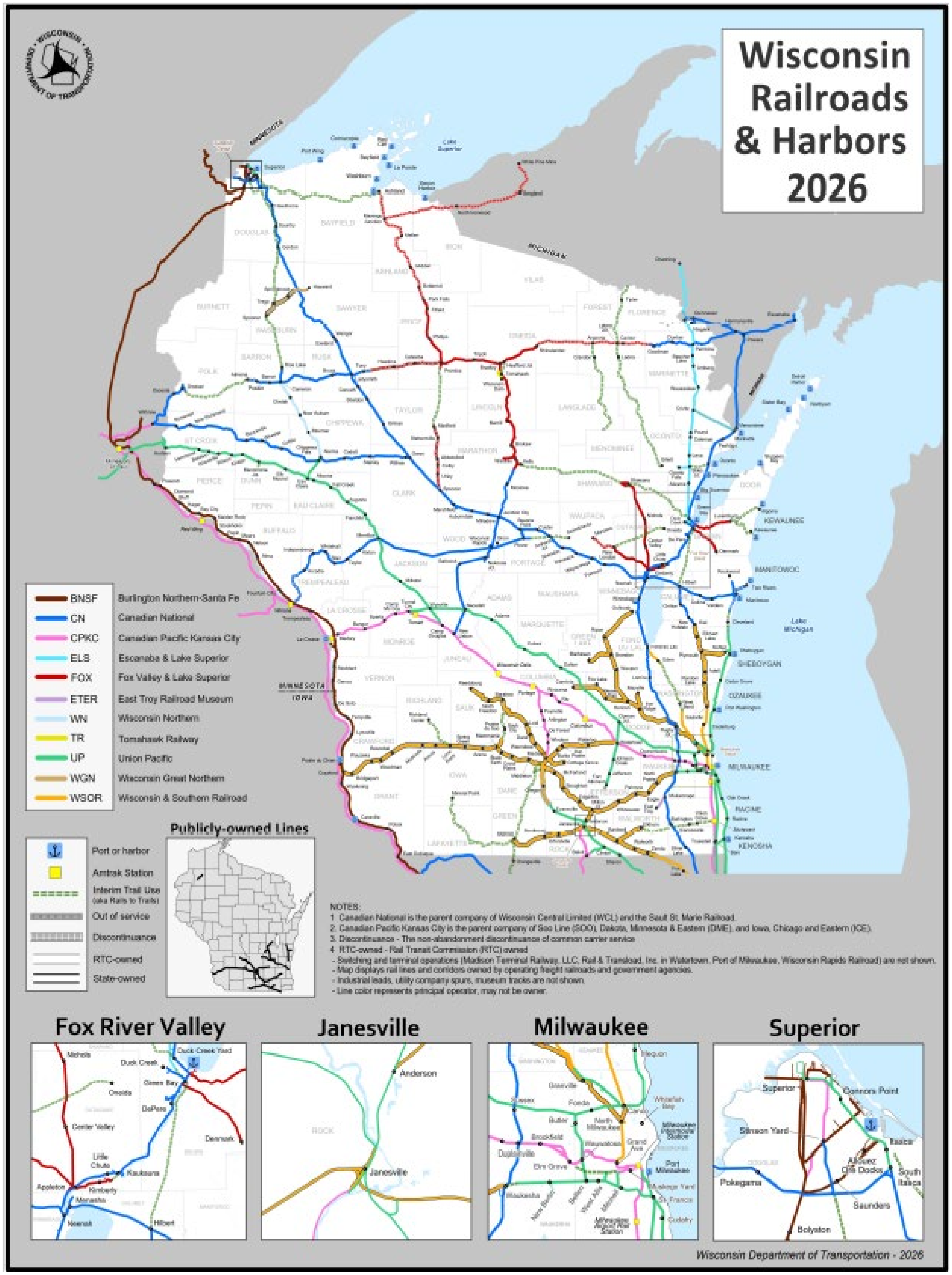

Figure 1. Wisconsin railroads.

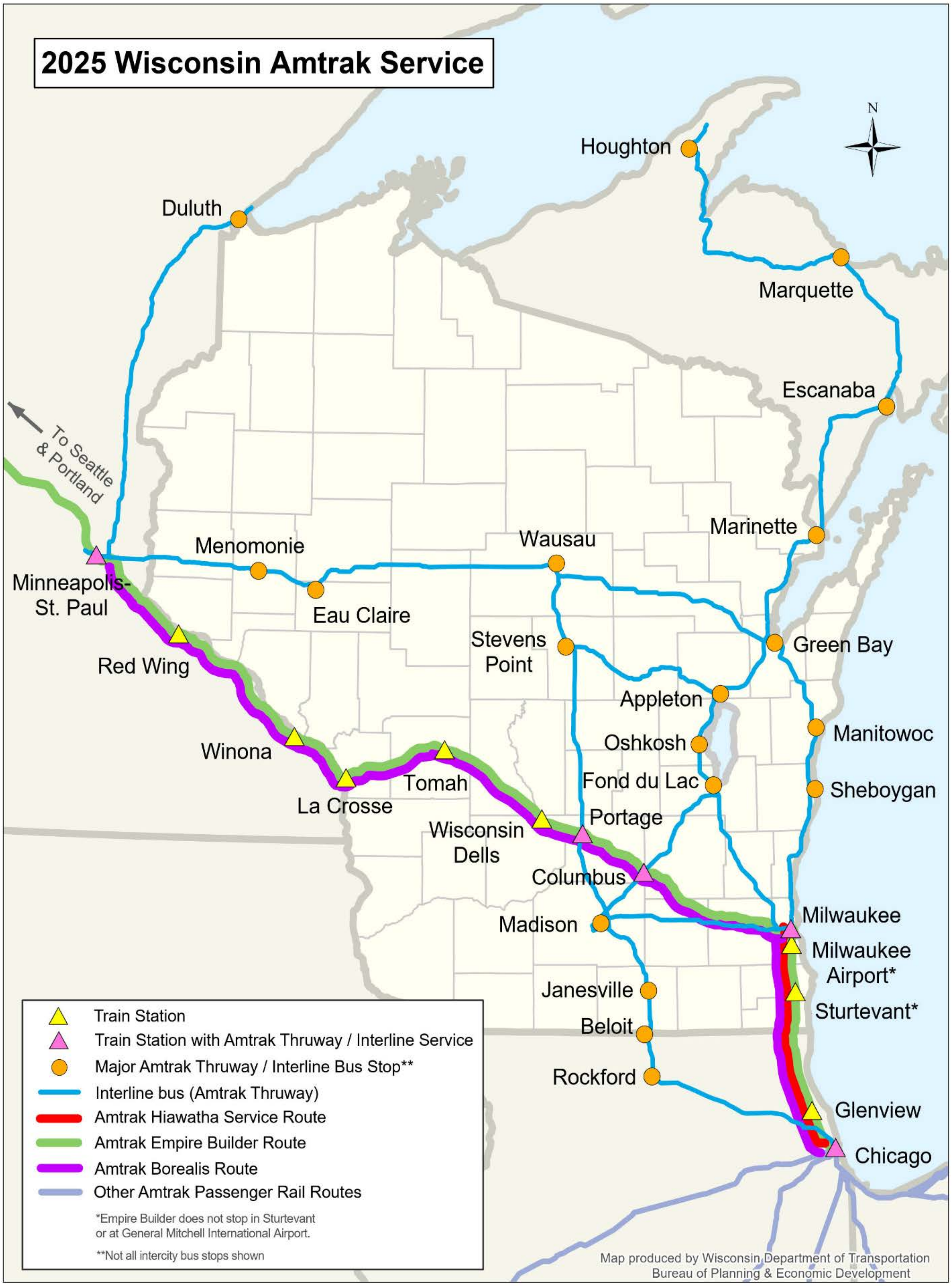

Figure 2. Wisconsin Amtrak services.

The costs associated with these deficiencies are distributed across numerous organizations. Some costs are incurred directly by WisDOT, while others are borne by OCR, local governments, and the railroads. More broadly, the costs associated with crossing-related crashes are ultimately absorbed by insurance providers, state and federally funded healthcare programs, employers, and individual road users.

As of May 2026, Wisconsin had 3,723 public at-grade railroad crossings. This total excludes private crossings, such as farm and driveway access crossings, but includes 223 crossings located on rail lines that are no longer in active service. As shown by the dashed lines in Figure 1, these corridors are classified as discontinued, out of service, or interim trail use (rails-to-trails). Because crossings on inactive rail lines require relatively little inventory effort, this report focuses primarily on the public crossings located on active rail lines, which number exactly 3,500 as of the time of this report.

Table 1 summarizes the distribution of public railroad crossings among WisDOT's five Regions and eight Offices. Crossing locations are not evenly distributed across the state. For example, the North Central Region's Rhinelander Office is responsible for only 133 crossings, while the Northeast Region's Green Bay Office is responsible for 856 crossings—more than six times as many. Crossings also tend to be concentrated in older, more heavily industrialized parts of the state that were largely developed before 1950. Together, the Northeast and Southwest Regions account for more than half of Wisconsin's public railroad crossings, and the addition of the Southeast Region increases that share to more than two-thirds of the statewide total. Despite these substantial differences in workload, staffing assigned to crossing inventory activities is generally similar across the eight WisDOT Offices, further exacerbating the resource limitations affecting the statewide inventory program.

Table 1. Distribution of public at-grade railroad crossings among WisDOT Regions and Offices as of May 2026.

Region	Office	Public Grade Crossings	In-Service Public Crossings for Office	In-Service Public Crossings for Region	Percent for Region
NC	Rhinelander	203	133	445	13%
	Wis. Rapids	325	312		
NE	Green Bay	879	856	856	24%
NW	Eau Claire	402	379	687	20%
	Superior	393	308		
SE	Waukesha	564	563	563	16%
SW	La Crosse	241	241	949	27%
	Madison	716	708		
Total	**Statewide**	**3723**	**3500**		**100%**

1.2 Research Objective and Scope

The objective of this research is to develop a comprehensive, efficient, and sustainable approach for collecting, updating, and managing safety-critical data at public at-grade railroad crossings throughout Wisconsin. In addition, the study includes an analysis of the characteristics of crossing-related motor vehicle crashes throughout the state based on a combination of FRA and law enforcement data.

The study identifies inventory data elements required under federal regulations (49 CFR Part 234 and 23 USC 130), evaluates current data collection practices, and examines emerging technologies—including mobile applications, LiDAR, drones, and GIS-based tools—to improve the accuracy, efficiency, and completeness of crossing inventory data. The research also addresses known gaps and inconsistencies in Wisconsin's crossing inventory, particularly those related to warning device attributes and pedestrian and bicyclist accommodations. Building upon the 2022 *Wisconsin Highway-Railway Grade Crossing Safety Action Plan*, the study supports WisDOT's goal of completing a comprehensive statewide crossing inventory every three years while enhancing data-driven decision-making for crossing safety improvements, project prioritization, and compliance with federal reporting requirements.

1.3 Research Approach

This research employs an integrated mixed-methods approach to evaluate and improve railroad crossing inventory management in Wisconsin. The study begins with a review of applicable federal requirements and a synthesis of best practices from peer states and industry sources, with emphasis on data collection methods, technologies, workflows, and organizational practices. A nationwide practitioner survey documents current state inventory management and FRA reporting practices while identifying common operational challenges and emerging approaches.

The research also includes a comprehensive cost analysis to estimate the resources required to complete and maintain Wisconsin's railroad crossing inventory on a triennial cycle. The analysis considers both direct and indirect costs, including labor, travel, equipment, administrative support, and quality assurance activities. In addition, the study evaluates the availability, quality, and consistency of railroad crossing crash data to identify limitations in existing reporting systems and opportunities to improve data integration and support more effective safety analysis and decision-making.

Finally, the study includes an analysis of the characteristics of crossing-related crashes in Wisconsin. This part of the study expands beyond the traditional focus on train-vehicle collisions to look at the situation more holistically. Using data from law enforcement reports, the crash analysis considers the frequency and severity of crashes resulting rear-end collisions at crossings, run-off-the road incidents, vehicles striking crossing signal masts, and related issues.

1.4 Report Organization

The remainder of this report is organized as follows.

- **Chapter 2** presents a review of federal requirements, current WisDOT practices, peer state approaches, and emerging technologies for railroad crossing inventory management.
- **Chapter 3** summarizes the results of the nationwide practitioner survey.
- **Chapter 4** presents the cost analysis of completing an FRA-compliant Wisconsin railroad crossing inventory using WisDOT’s traditional staffing and organization methods.
- **Chapter 5** evaluates opportunities to optimize the delivery of in-house data collection, as well as contractor, consultant, and intergovernmental options for conducting inventory activities.
- **Chapter 6** presents the safety analysis of railroad crossing crashes and associated countermeasures.
- **Chapter 7** summarizes the study findings and provides recommendations for improving Wisconsin's railroad crossing inventory program and supporting data-driven safety decision-making.

Chapter 2. State of Practice Review

2.1 Overview

Highway-rail grade crossings remain critical interfaces between roadway and rail transportation systems in the United States. Despite continued investments in engineering countermeasures, public education, and enforcement, collisions at grade crossings continue to result in fatalities, injuries, property damage, and operational disruptions. According to the Federal Railroad Administration (FRA), hundreds of incidents occur annually at public and private crossings, underscoring the continued need for data-driven safety improvements.

A cornerstone of national grade crossing safety efforts is the U.S. DOT National Highway-Rail Crossing Inventory, which is maintained by the FRA in partnership with state transportation agencies and railroads. The inventory provides detailed information on crossing characteristics including warning devices, roadway geometry, train volumes, traffic exposure, and operational attributes. These data support federal programs such as the Highway-Rail Grade Crossing Program (Section 130), state-level project prioritization, and analytical tools such as the FRA's Grade Crossing Accident Prediction System (GXAPS).

Although the crossing inventory is widely used for regulatory reporting, funding allocation, and risk assessment, concerns remain regarding data completeness, consistency, timeliness, and integration with emerging safety analytics. Advances in geospatial technologies, real-time traffic data, machine learning, and predictive risk modeling offer new opportunities to enhance the value of crossing inventory data. Nevertheless, inconsistent reporting practices and delays in updating crossing characteristics can reduce the reliability of safety analyses and investment decisions.

This chapter reviews the current state of practice for railroad crossing inventory management, including:

- Federal requirements and guidance.
- Current WisDOT inventory management practices.
- Inventory management approaches used by peer states.
- Emerging technologies for improving data collection and management.
- Opportunities to modernize crossing inventory programs and improve data quality.

The review provides the foundation for subsequent analyses by identifying current practices, challenges, and opportunities to improve the efficiency, accuracy, and long-term sustainability of Wisconsin's railroad crossing inventory program.

2.2 Federal Requirements

The federal government has provided funding for highway-rail grade crossing safety improvements since 1935. The current *Federal Highway Administration (FHWA) Highway-Rail Grade Crossing Action Plan and Project Prioritization Noteworthy Practices Guide* (Rutter et al., 2016) provides guidance for developing and refining State Action Plans (SAPs) through a systematic, data-driven, and collaborative approach to identifying safety risks, prioritizing projects, and allocating resources.

The guide identifies several key elements of an effective State Action Plan, including defining safety challenges, establishing measurable goals, engaging stakeholders, assigning responsibilities, and developing performance measures to monitor implementation. It also describes three general approaches to project prioritization:

- **Process-driven**, which relies primarily on stakeholder input and local knowledge.
- **Data-driven**, which emphasizes quantitative analyses of safety performance and exposure.

- **Hybrid**, which combines stakeholder expertise with quantitative analysis to support balanced decision-making.

The guide highlights five noteworthy practices observed among state programs:

- Adapting risk assessment methodologies to state-specific conditions.
- Incorporating benefit-cost analysis into project prioritization.
- Leveraging funding sources beyond Section 130.
- Improving the accuracy and completeness of crossing inventory data.
- Implementing innovative planning, project delivery, and performance monitoring practices.

Case studies from California, North Carolina, and Ohio demonstrate how customized prioritization methods, high-quality inventory data, and strong interagency coordination can improve both safety outcomes and funding effectiveness.

Overall, the FHWA guidance emphasizes that successful highway-rail grade crossing programs depend on accurate inventory data, systematic project prioritization, and continued coordination among transportation agencies, railroads, and other stakeholders. Regular updates to State Action Plans and ongoing performance monitoring help ensure that safety investments remain effective over time.

2.3 Current WisDOT RRX Inventory Staffing Practices

The WisDOT Railroad Crossing Information System (RCIS) provides tools for viewing, editing, and maintaining data for approximately 4,000 public highway-rail grade crossings throughout Wisconsin *(Van Schoick and Lodes, 2024).*

The RCIS consists of several integrated components, including an Oracle database, a web application, a Central Office Updater tool, an MS Access database, and ArcGIS Online web maps. Its primary purpose is to maintain Wisconsin's railroad crossing inventory for use by WisDOT Central Office staff and Regional Rail Coordinators. The system also integrates with several external resources, including the FRA Grade Crossing Inventory System (GCIS), Box.com for photo storage, and the WisDOT Safety Scan tool used to conduct benefit-cost analyses for potential crossing safety improvements. In addition, ArcGIS web maps allow WisDOT staff to visualize crossing information within a geographic context.

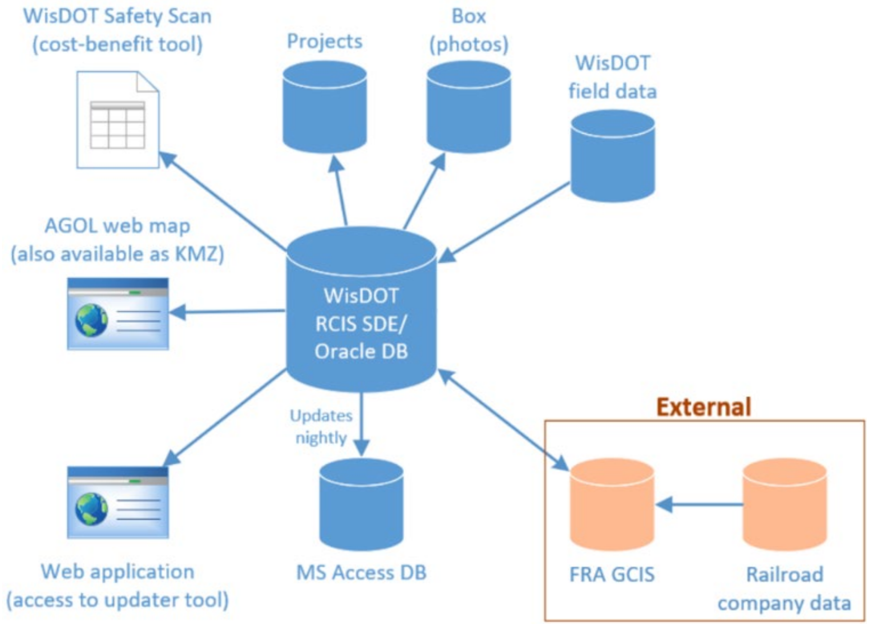

Figure 3. Existing WisDOT RCIS architecture

Although RCIS provides a centralized platform for inventory management, several limitations reduce its efficiency. Field data collection remains largely paper-based, increasing processing time and the potential for transcription errors. Record editing requires multiple manual steps, discouraging timely updates. Synchronization with the FRA GCIS remains a manual process, creating delays and opportunities for inconsistencies, while limited data validation between the two systems allows errors to persist. In addition, the system provides limited map-based editing capabilities and restricted access for external users, reducing opportunities for collaboration and requiring inefficient manual data-sharing processes.

Several enhancements are underway to address these limitations. Mobile data collection tools are replacing paper-based workflows, improving efficiency while reducing data entry errors. Planned synchronization with the FRA database will improve consistency between systems, while enhanced quality control procedures will strengthen data validation. Additional integration with WisDOT datasets and GIS layers will create a more comprehensive information environment, and expanded access through ArcGIS Enterprise and custom applications will improve usability for both internal and external users.

The *Wisconsin Highway-Railway Grade Crossing Safety Action Plan* (WisDOT, 2022) identifies the primary data sources used to maintain the statewide railroad crossing inventory. These sources were evaluated to assess their completeness, accuracy, and currency. The principal sources include:

- **FRA Highway-Rail Crossing Inventory:** Form FRA F 6180.71, including crossing location, classification, railroad characteristics, roadway information, traffic control devices, and physical characteristics.
- **FRA Highway-Rail Grade Crossing Accident/Incident Reports:** Form FRA F 6180.57, documenting crossing conditions, vehicle information, and incident characteristics.
- **FRA Rail Equipment Accident/Incident Reports:** Form FRA F 6180.54, documenting reportable railroad equipment accidents and incidents.
- **FRA Railroad Injury and Illness Summary:** Form FRA F 6180.55, including reported railroad casualties and trespassing incidents.
- **Rail Inventory Management System (RIMS):** A web-based platform for managing rail infrastructure assets, crossing characteristics, and operational information.
- **National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS):** A nationwide census of fatal motor vehicle crashes that provides complementary roadway safety information.
- **Wisconsin Rail Data Systems:** State-level databases containing railroad operational and safety information that supplement federal data sources.

The Action Plan also compared Wisconsin's highway-rail crossing inventory with national averages for the age of Average Annual Daily Traffic (AADT) and train count data. The analysis found that most Wisconsin crossings have AADT values that are 10 to 20 years old or older, with Wisconsin's average AADT age approximately 8 percent older than the national average. In contrast, most train count data are between one and three years old. Wisconsin also has a greater concentration of older train count records than the national average, potentially reflecting the larger number of short-line railroads operating within the state.

2.4 Current RRX Staffing Practices in Other States

2.4.1 North Carolina Rail System - Rail Lines, Facilities, and Crossings

The North Carolina Department of Transportation (NCDOT) maintains a GIS-based database of public railroad crossings that includes both active and inactive crossings; closed crossings are excluded. Each record includes the FRA crossing identification number, geographic coordinates, and other inventory attributes maintained in NCDOT's State Authoritative Rail and Highway (SARAH) database.

Crossing locations and operational status are verified by comparing the FRA Highway-Rail Crossing Inventory with the NCDOT Rail Division database, railroad track charts, and aerial imagery. When discrepancies are identified, crossing status is confirmed through coordination with the railroad, property owner, or local jurisdiction. This process improves the accuracy and reliability of the statewide inventory while providing a centralized, map-based interface for viewing crossing information.

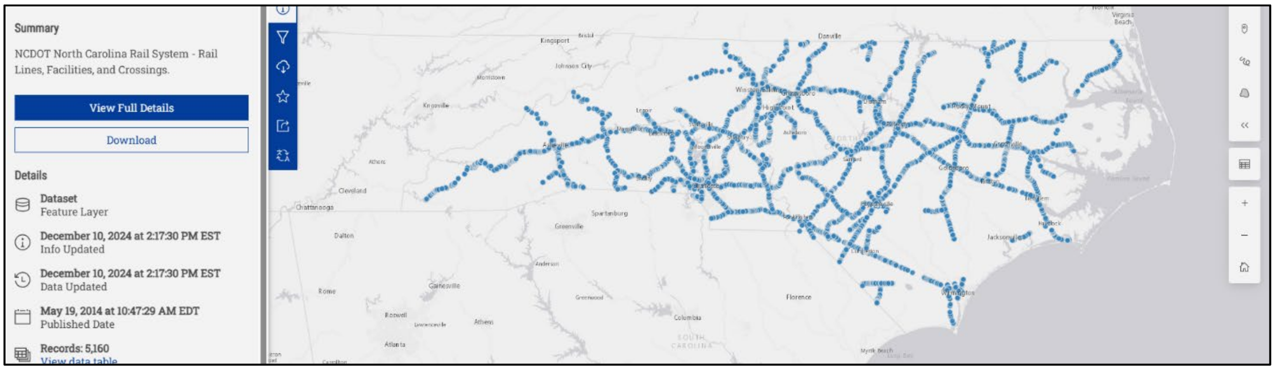

Figure 4. User interface of the North Carolina Railroad Crossing Inventory map.[1]

2.4.2 *Ohio Rail Crossing Inventory*

The Public Utilities Commission of Ohio (PUCO) maintains the Ohio Railroad Information System (ORIS), the official inventory of public highway-rail grade crossings in Ohio. ORIS includes crossing locations, physical characteristics, traffic volumes, warning devices, and crash history.

The system provides a web-based search interface that allows users to locate crossings using criteria such as county, railroad, or crossing type and to view detailed information for individual crossings. The centralized platform improves access to crossing data for both agency staff and the public while supporting inventory management and safety analysis.

Figure 5. User interface of the Ohio Rail Crossing Inventory map[2]

[1] https://www.nconemap.gov/datasets/NCDOT::railroad-crossings/about

[2] https://tims.dot.state.oh.us/portal/home/item.html?id=08390fbbf9514898863cfff4d71f05fe

2.4.3 Texas Railroad Information Management System

The Texas Railroad Information Management System (TRIMS) is a comprehensive statewide platform developed by the Texas Department of Transportation (TxDOT) to improve the management, accuracy, and accessibility of railroad crossing data *(TxDOT, 2023)*. The system serves as the statewide database for rail-highway crossings and integrates roadway maps, aerial imagery, and railroad information into a single geospatial platform that supports planning, project development, and safety analysis.

TRIMS includes a crossing inventory module containing detailed crossing information and photographs, as well as a project management module that links rail-highway improvement projects to individual crossings using FRA identification numbers. Authorized users can update inventory records, manage projects, and review a complete history of database edits. These capabilities improve data quality, facilitate coordination among agencies, and support data-driven decision-making.

Inventory data maintained within TRIMS support several statewide programs, including the Section 130 Highway-Rail Grade Crossing Program, the Rail Grade Separation (RGS) Program, and state and federal reporting requirements. Critical data elements include train volumes and speeds, average annual daily traffic (AADT), roadway speed limits, truck percentages, special vehicle movements, and FRA-reported crash history. Maintaining current information is seen as essential for effective project prioritization and resource allocation.

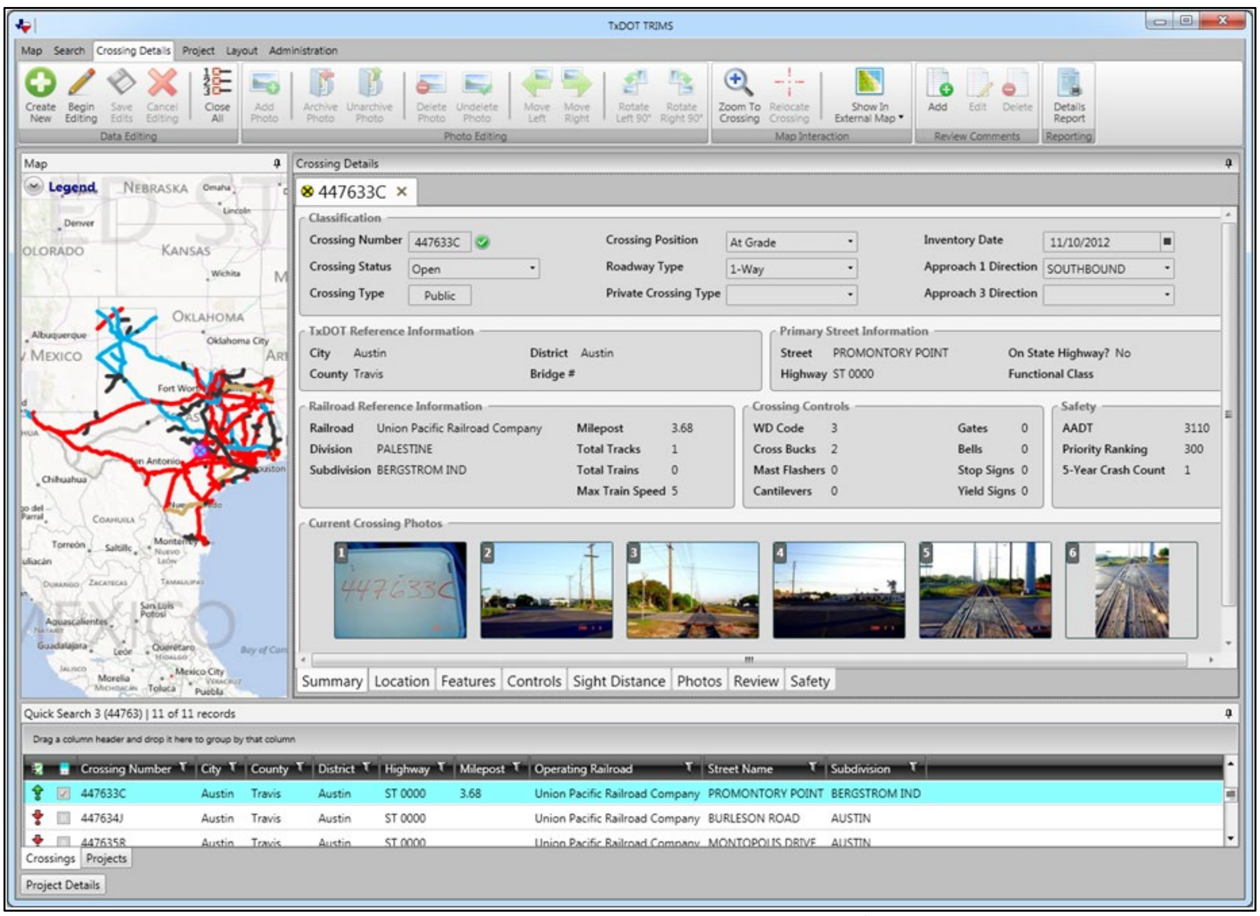

Figure 6. User interface of the Texas Railroad Information Management System[3]

[3] https://www.txdot.gov/business/resources/railroad-highway-crossing/railroad-information-management-system.html

2.4.4 Florida Rail-Highway Crossing Inventory (RHCI) - Data Collection Program

The Florida Department of Transportation (FDOT) maintains a GIS-based Railroad Highway Crossing Inventory (RHCI) containing public at-grade crossings located on roadways included in the state's Roadway Characteristics Inventory (RCI).

The RCI Handbook establishes statewide standards for data collection, asset location, data governance, and quality management. Supporting these standards is a web-based application that integrates field data collection, desktop review, quality assurance, quality control, data analysis, and database updates within a single platform. This integrated workflow improves data consistency, enhances quality control, and streamlines the management of statewide transportation asset information.

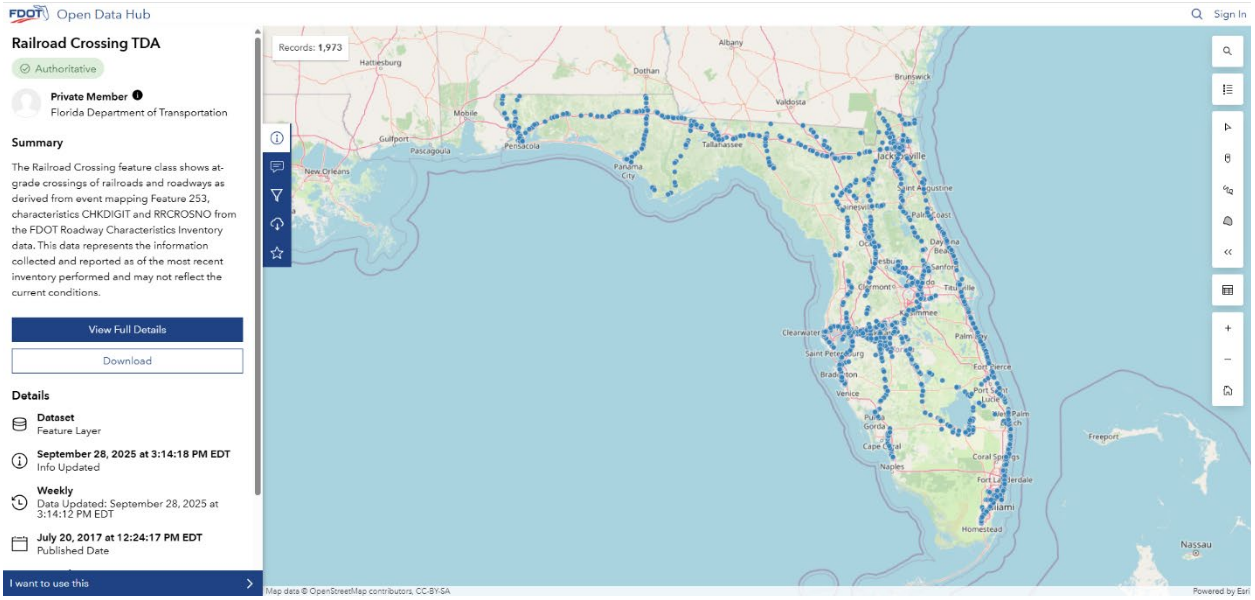

Figure 7. User Interface of the Florida Railroad Crossing Transportation Data and Analytics[4]

2.4.5 Iowa Highway-Rail Grade Crossing Safety Action Plan

The Iowa Department of Transportation (Iowa DOT) manages highway-rail crossing inventory data using Esri's ArcGIS Roads and Highways platform, which integrates with ArcGIS Pro, ArcGIS Online, and ArcGIS Field Maps (Iowa DOT, 2022).

Field inspections are conducted annually using the Fulcrum mobile application, which records crossing attributes, geotagged photographs, and metadata such as GPS coordinates and viewing direction. Inspectors receive crossing assignments from the statewide inventory database and can add new crossings during field inspections. Following data collection, information is reviewed through a structured quality control process before being incorporated into the ArcGIS database.

The system offers several advantages, including fully digital field inspections, version tracking, geotagged photographs to support data verification, integration with AADT and other DOT datasets, a user-friendly web interface, and comprehensive quality control procedures. Limitations include the need to reconcile field observations with the Rail Crossing Inventory System (RCIS), storage of photographs outside ArcGIS, duplication of crossing points associated with the linear referencing system, and reliance on additional software such as Feature Manipulation Engine (FME) for data processing.

[4] https://gis-fdot.opendata.arcgis.com/datasets/railroad-crossing-tda/about

2.4.6 Indiana DOT Rail-Highway Crossing Program

The Indiana Department of Transportation (INDOT) manages highway-rail crossing inventory data using the ArcGIS platform together with the FRA SecureAPI to exchange information with the Federal Railroad Administration's Grade Crossing Inventory System (GCIS) (Indiana DOT, 2026). Field data are collected using ArcGIS Field Maps on iOS and Android devices and stored within an ArcGIS Enterprise database. Updates are transferred through a staging database before synchronization with the production database.

Automated Python scripts perform nightly read and write operations between the INDOT database and the FRA GCIS, maintaining synchronization between the two systems. INDOT supports this process through separate production and staging databases that facilitate quality control and system reliability.

The system provides several advantages, including seamless integration with ArcGIS and other DOT datasets, fully digital field data collection, and automated synchronization with the FRA database without requiring manual uploads. Current limitations include the absence of a formal quality control process before field data enter the production database, limited flexibility in filtering FRA data, and occasional synchronization failures when the FRA application programming interface (API) is unavailable.

2.5 Opportunities for Improved Efficiency

Accurate, comprehensive, and current inventory data are essential for effective railroad crossing management and safety analysis, but traditional inventory methods often rely on labor-intensive field surveys, fragmented data management systems, and infrequent update cycles that limit efficiency, consistency, and scalability. As transportation agencies increasingly rely on data-driven decision-making and performance management, modernizing inventory data collection has become a growing priority.

Recent advances in mobile sensing, unmanned aerial systems (UAS), computer vision, and geospatial data integration provide opportunities to improve both the quality and timeliness of railroad crossing inventory data. This section reviews several technologies that can enhance data collection efficiency, improve data quality, reduce field effort, and support more informed safety and asset management decisions.

2.5.1 Light Detection and Ranging (LiDAR)

Light Detection and Ranging (LiDAR) is a remote sensing technology that uses laser pulses to create highly accurate three-dimensional (3D) representations of the surrounding environment. When integrated with Global Positioning System (GPS) receivers and inertial measurement units (IMUs), LiDAR produces georeferenced point clouds that accurately capture roadway, railway, and roadside infrastructure.

LiDAR systems can be deployed using several platforms:

- **Mobile LiDAR** – Vehicle- or rail-mounted systems used for continuous corridor-level data collection.
- **Terrestrial LiDAR** – Stationary or vehicle-mounted scanners used for detailed mapping of roads, railways, and adjacent infrastructure.
- **Airborne LiDAR** – Aircraft- or drone-mounted systems used to collect large-area topographic and infrastructure data.

LiDAR supports the inventory of numerous transportation assets, including pavement features, signs, poles, railroad tracks, crossings, and adjacent infrastructure. Key advantages include high positional accuracy, rapid data collection, and the ability to operate under a wide range of lighting conditions. Primary limitations include large data volumes, substantial processing requirements, and reduced performance at sites where dense vegetation or other obstructions limit visibility.

2.5.2 *Mobile GIS and Tablet-based Field Data Collection*

Mobile geographic information systems (GIS) enable field personnel to collect, view, and edit geospatial information using tablets, smartphones, or ruggedized field computers. GPS-enabled mobile applications allow inspectors to record crossing attributes, photographs, and geographic coordinates directly in the field while synchronizing information with centralized databases.

Compared with traditional paper-based methods, mobile GIS improves data quality by reducing transcription errors, providing immediate access to existing inventory information, and supporting real-time quality assurance. These systems also improve efficiency by eliminating duplicate data entry and enabling rapid updates to statewide inventory databases.

2.5.3 *Video Logging and AI-assisted Object Recognition*

Video logging systems collect continuous georeferenced imagery using vehicle-mounted cameras to document roadway and railway corridors. The resulting imagery provides detailed visual records of roadway geometry, traffic control devices, railroad crossings, roadside assets, and surrounding conditions. These records can support inventory management, inspections, and safety analyses.

WisDOT's Photolog is one such system. It provides high-resolution imagery along the State Trunk Network (STN). Images are collected by a specialty contractor in conjunction with pavement condition surveys and include left, center, and right forward-facing views at 0.01-mile intervals.

Google Street View provides a complementary resource by offering panoramic imagery for most public roadways, including county highways and local streets that are not covered by Photolog. Unlike Photolog, Street View provides 360-degree imagery and allows users to contribute additional images to supplement Google's data collection efforts.

Commercially available 360-degree camera systems provide another opportunity to improve inventory collection. Professional-grade systems currently cost approximately $5,000 to $15,000, while hobbyist-grade cameras are available for less than $300. These cameras can be mounted on passenger vehicles or used as handheld devices to efficiently collect many of the photographs currently obtained manually during field inspections. In addition to improving efficiency, they could enhance employee safety by reducing the need for personnel to stand in active travel lanes while photographing crossings. With railroad cooperation, similar camera systems could also be mounted on locomotives or maintenance vehicles to collect trackside imagery.

Figure 8. Camera mount for hobbyist-grade 360 degree camera.[5]

[5] Source: Insta360

2.5.4 *Drone Imagery and Photogrammetry*

Unmanned aerial vehicles (UAVs), commonly referred to as drones, can efficiently collect high-resolution aerial imagery of transportation infrastructure, particularly in locations that are difficult, hazardous, or time-consuming to inspect from the ground. When combined with photogrammetry, overlapping aerial images can be processed to generate accurate three-dimensional models, orthophotography, and other geospatial products suitable for integration into GIS and asset management systems.

Table 2. Comparison of existing highway inventory data collection methods (Jalayer et al., 2014)

Category	Description	Advantages	Disadvantages
Field Inventory	Uses GPS survey equipment and conventional optical to collect desired information in the field	Low initial cost, minimal data processing, and the ability to collect accurate, information-rich roadway inventory data.	Crew exposure to traffic and long field data collection time
Photo/Video Log	Driving a vehicle along the roadway while automatically recording photos/videos for data extraction	Less exposure to traffic and short field data collection time	Inability to measure feature dimensions and need for large data reduction efforts
Integrated GPS / GIS Mapping Systems	Using an integrated GPS/GIS field data logger to record and store inventory information	Low initial cost, low data reduction effort, and ability to transfer inventory data back to the home office through a wireless connection	Crew exposure to traffic, long field collection time, and GPS outage problems due to trees
Aerial / Satellite Photography	Analyzing high-resolution images taken from aircraft or satellite to identify and extract highway inventory information	Elimination of fieldwork and data collection time, no traffic exposure, no disruption to traffic, and compatibility of images with GPS	Difficulty identifying features, such as signs or traffic signals, from overhead imagery
Terrestrial Laser Scanning	Using direct 3D precision point information (3D point clouds) acquired from stationary 3D laser scanners to extract highway inventory data	Operating in daylight or darkness, high data accuracy, and extremely rich and accurate data collection valuable to multiple DOT programs	Long field data collection time, exposure to traffic, high initial cost, long data reduction time, and large dataset size
Mobile LiDAR	Collecting high-precision 3D point cloud data from a vehicle-mounted LiDAR or photogrammetry system.	Collecting huge amounts of data in a very short time; survey crew safety is superior compared to traditional survey methods	Need for expensive equipment, long data extraction time, and large dataset size
Airborne LiDAR	Using aircraft-mounted LiDAR to collect high-precision 3D point cloud data for deriving highway inventory information.	No exposure to traffic, short field data collection time, and collection of rich data in a short amount of time	High initial cost, large dataset size, and long data reduction time

Table 2 from Jalayer et al. (2014) summarizes existing highway inventory data collection methods based on equipment cost, data quality, worker safety, collection efficiency, processing requirements, and storage requirements. Their findings indicate that advanced technologies, particularly mobile mapping systems, substantially improve collection efficiency and worker safety by reducing field exposure while enabling rapid collection of multiple asset types from a single dataset. However, these technologies require greater initial investment, specialized expertise, and significant post-processing. Traditional manual methods remain more economical for small or specialized data collection efforts but generally provide lower productivity and are more susceptible to human error.

Overall, the study concludes that no single technology is appropriate for all applications. Instead, agencies should adopt a hybrid approach that combines complementary data collection methods to balance cost, efficiency, accuracy, and operational requirements.

Chapter 3. Practitioner Survey

3.1 Overview

To better understand current practices related to railroad crossing inventory management and Federal Railroad Administration (FRA) reporting requirements, an online survey was administered through the Qualtrics platform to representatives of state agencies responsible for managing railroad crossing inventories. The survey consisted of nine open-ended questions addressing inventory procedures, staffing approaches, data collection technologies, data management practices, compliance with FRA inventory requirements, and challenges associated with maintaining crossing inventory data. The complete questionnaire is provided in Appendix A. Survey findings were supplemented by a presentation delivered by the Florida Department of Transportation (FDOT) to WisDOT and the Office of the Commissioner of Railroads (OCR), which is summarized in Appendix C.

Survey responses were analyzed using qualitative synthesis techniques to identify common themes and trends across participating states. A total of 32 responses were received, of which 18 complete responses were considered suitable for analysis. Respondents represented 18 states distributed across the West, South, Midwest, and Northeast regions of the United States, as shown in Figure 9. Most respondents represented state departments of transportation, while a smaller number represented regulatory agencies or other organizations involved in railroad crossing management.

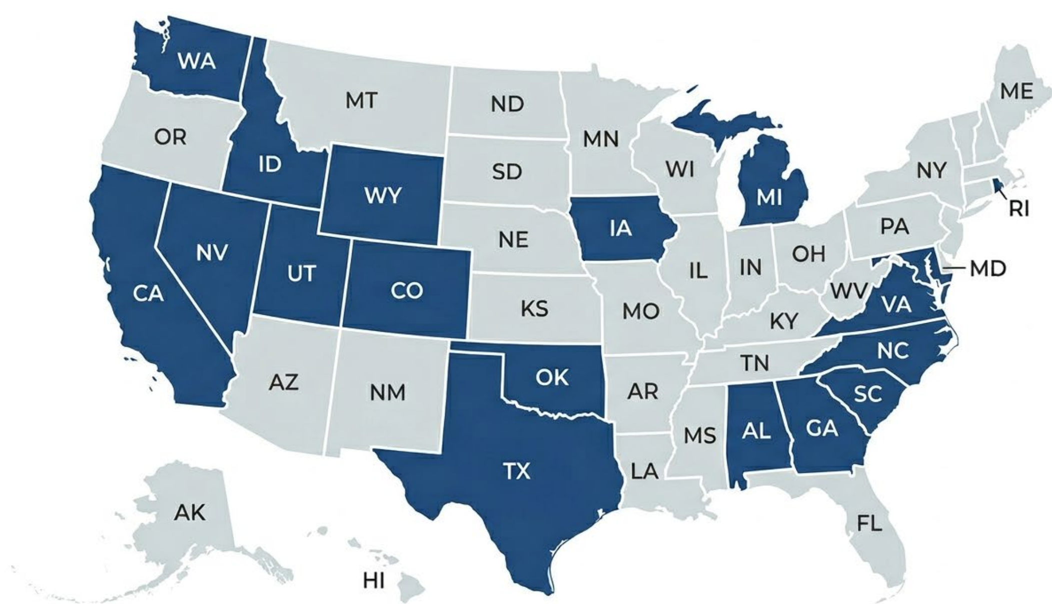

Figure 9. Overview of states that responded to the survey

3.2 Summary of Key Findings

Table 3 summarizes the responses by survey question and highlights common practices, emerging trends, innovative approaches, and recurring challenges identified across participating states. Organizing the results by topic facilitates cross-state comparisons and provides insight into the similarities and differences in railroad crossing inventory management practices.

Table 3. Summary of questionnaire survey feedback

Questions	Key Findings
1. FRA Crossing Inventories	Nearly all responding states conduct rail crossing inventories to comply with FRA requirements. Most use a continuous or cyclical update process rather than inventorying the entire state at once. Inventory cycles range from annual updates to multi-year rotational schedules.
2. Organization and Staffing	Inventory activities are typically carried out through a combination of state DOT staff, railroads, consultants, and contractors. Several states outsource field data collection while maintaining oversight internally.
3. Data Collection Technologies	Common technologies include GPS-enabled mobile devices, GIS applications, aerial imagery, Google Earth/Street View, and mobile inspection tools. Use of advanced technologies such as LiDAR and drones remains limited.
4. Data Management Technologies	Most states use GIS-based inventory systems, mobile applications, or asset management platforms to improve data quality and efficiency. ESRI-based systems are particularly common.
5. GIS Integration	Integration with other transportation databases is growing but remains inconsistent. Some states automatically update attributes such as traffic volumes and roadway characteristics, while many still rely on manual updates.
6. Most Challenging FRA Data Fields	Traffic volume (AADT), train traffic, crossing geometry, and warning device information are the most difficult fields to keep current due to frequent changes and data collection challenges.
7. Additional Data Collection	Many states collect data beyond FRA requirements, including equipment age, condition assessments, maintenance history, photographs, sight distance, pedestrian facilities, and signal preemption information.
8. Written Procedures and Guidance	Some states maintain formal inventory manuals, standard operating procedures, or FRA reporting guidance, while others rely on internal practices or consultant-developed procedures.
9. Pain Points	Common challenges include maintaining current and accurate data, coordinating among multiple stakeholders, integrating databases, resource constraints, and ensuring consistency in reporting and inventory updates. Some states collect data on school bus volumes, which can be particularly problematic to maintain.

Several consistent themes emerged from the survey. Nearly all participating states maintain active railroad crossing inventory programs to support compliance with FRA reporting requirements. Most agencies use GIS-based platforms as the foundation for inventory management, while mobile data collection applications, GPS technologies, and aerial imagery are widely used to improve the efficiency and accuracy of field inspections and inventory updates.

The survey also identified several common challenges. Dynamic inventory attributes—particularly roadway traffic volumes (AADT), train volumes, and other operational characteristics—were consistently identified as the most difficult data elements to maintain because they change frequently and often depend on information provided by multiple organizations. In addition, many states collect supplemental information beyond FRA reporting requirements, including infrastructure condition, equipment age, maintenance history, photographs, pedestrian facilities, sight distance, and signal preemption data to support broader safety, maintenance, and asset management objectives. Although significant progress has been made in inventory management technology, many agencies continue to face challenges integrating multiple databases and automating inventory update processes.

Table 4 provides a state-by-state summary of inventory management practices, staffing approaches, data collection technologies, data management systems, compliance procedures, and operational challenges. Together, Tables 3 and 4 provide both a national synthesis of current practices and a detailed comparison of individual state approaches. Complete survey responses are provided in Appendix B.

Table 4. Summary of feedback from States

State	Q1: Inventory Cycle	Q2: Staffing Approach	Q3: Data Collection Technologies	Q4: Data Management	Q5: GIS Integration	Q6: Most Challenging FRA Fields	Q7: Additional Data Collected	Q8: Written Procedures	Q9: Key Pain Points
AL	Ongoing updates	State staff	Google Earth, iPads	RIMS	No	School bus data, equipment service life	No	Not reported	Aging database and potentially unreliable AADT estimates
CA	Split cycle (1,000-2,000 crossings per cycle)	State staff + contractors	Google Maps	GIS	No	MUTCD sign, traffic counts, truck percent, school bus, emergency vehicle	Roadway geometry details, traffic control devices, pre-emption, ped and bike facilities	No	FRA inventory compatibility and database update limitations
CO	3-year cycle	Consultants	Google Street View	PointMan	No	Train traffic, AADT	No	No	Traffic volume updates
FL*	3-year cycle	Consultants + State staff	Desktop review and field review (Field Maps, Survey123)	ArcGIS	Yes	Adjust data collection timing for infrastructure projects	Linear referencing for both highway and rail, crossing surface condition	FRA-based procedures	Maintaining consistency between the FDOT and FRA databases
GA	Repeating cycle	Consultants + railroad	Drones (limited)	GRAILS	No	AADT, emergency routes	No	No	School bus counts
ID	Split cycle (3-year rotating cycle)	Consultants + State staff	No (GoogleEarth & Lidar are available)	GIS	No	AADT, crossing coordinates	No	No	None
IA	Split cycle (4-year rotating cycle)	Temporary state staff	No (Physical inventory)	GIS and FME	Yes	Data sharing between rail, FRA and state	Presence of sidewalks	FRA-based procedures	Interagency coordination and data standardization
MD	Continuous updates	State staff + Consultants	No	GIS	Yes	Train data, traffic volume	No	No	Not reported

MI	2-year cycle	State staff	Field inspections (Tech for office validation)	GIS, TAX, NFC	Yes	Train volume, traffic volume	Crossing surface and approach surface conditions	No	Data migration, system transition, and inventory correction
NV	Statewide inventory updated all at once	State staff	Google Earth, iPads	GIS	No	Geometry	No	No	Internal staff cost efficiency
NC	Split cycle (3-year rotating cycle)	State staff, interns, consultants	GIS, Mobile tools (Quick Capture, Field Maps, Survey123)	GIS integrated with highway linear reference system	No	Train volume, train speed	Sight distance, drag marks, pedestrian facilities, equipment condition, photos, preemption data, etc.	FRA-based procedures	Inconsistent railroad feedback and data overwrites
OK	Periodic inventory	Consultant	No	GIS	No	Traffic volume	Equipment installation dates	Not reported	Not reported
RI	Every 2–3 years	Consultant	Field visits, drones, Google Earth	GIS	Yes	Not reported	No	Consultant procedures	None
SC	Biannual cycle	Engineering consultants	Google Earth, ArcGIS, Survey123, Retro-reflectometer	ArcGIS + internal database	No	Roadway traffic/ADT updates	Hump crossing elevations	Yes	None
TX	Split cycle	Consultants + State staff	Google Earth	TRIMS	Yes	Warning devices, train traffic	No	FRA-based procedures	Getting base line and verifying GPS location
UT	Split cycle (3-year rotating cycle)	Consultant	Field inspection and photos	GIS	No	AADT	No	Consultant procedures	Not reported

VA	Split cycle (2-year rotating cycle)	State staff + consultant	GIS, field inspection	RIMS	Yes	Pavement markings, warning signs and devices	No	FRA-based procedures	Railroad updates overwriting state records
WA	18-month for crude oil routes; 3-year for other crossings	State staff	No	Internal API interface with FRA inventory	No	AADT, school bus counts, emergency route status	Sight distance, equipment/ signage direction	Not reported	Not reported
WY	Annual statewide inventory	State staff	Google Earth	No	No	Train traffic	Any data if available	No	None

Note: * Florida inputs were from an invited presentation delivered by FDOT staffs; summary of the presentation is documented in Appendix C.

3.3 Practitioner Survey Conclusions

The survey results demonstrate that state transportation agencies have made substantial progress in modernizing railroad crossing inventory management through the adoption of GIS-based platforms, mobile data collection technologies, and integrated database systems. These tools have improved the efficiency, accessibility, and accuracy of inventory data while supporting compliance with federal reporting requirements.

Despite these advances, considerable variation remains in inventory management practices, staffing models, technological capabilities, and update cycles across states. Maintaining accurate and current inventory information continues to be one of the greatest operational challenges, particularly for dynamic roadway and railroad attributes that require coordination among multiple agencies and data sources.

Future improvements will likely depend on greater integration of transportation, railroad, and inventory databases; increased automation of data collection and synchronization processes; stronger collaboration among transportation agencies and railroad operators; and broader implementation of enterprise GIS and asset management systems. Continued investment in these areas has the potential to improve data quality, reduce long-term maintenance effort, and support more effective railroad crossing safety and asset management programs.

Chapter 4. Cost Analysis for In-House Staffing

4.1 Overview

Compliance with Federal Railroad Administration (FRA) railroad crossing inventory requirements requires maintaining accurate, standardized, and continuously updated records of highway-rail grade crossings. This includes collecting and managing inventory data, coordinating with railroads and local agencies, and complying with evolving federal reporting requirements. Consequently, maintaining the statewide crossing inventory represents an ongoing programmatic responsibility rather than a one-time effort.

The project team developed two approaches to estimate the cost of achieving full compliance with FRA inventory requirements. The first approach, presented in this chapter, reflects WisDOT's current staffing structure and program management practices. The second approach, presented in Chapter 5, evaluates two progressively optimized alternatives designed to reduce costs. The first uses GIS-based route optimization and modifies the threshold for overnight travel, while retaining existing WisDOT Region office assignments. The second removes geographic staffing constraints, allowing personnel to be based at locations that are optimal with respect to the locations of the crossings and operate across region boundaries to maximize efficiency. Chapter 5 further extends this fully optimized approach to evaluate outsourcing field data collection to a specialty data collection vendor or engineering consultant.

For the in-house approach, cost estimates include labor, vehicle operations, field technology, training, quality assurance, and administrative coordination. Together, these components represent the total cost of maintaining a compliant statewide railroad crossing inventory. The outsourcing scenarios presented in Chapter 5 include additional costs associated with contractor overhead (indirect cost) rates, wage scales, and profit.

4.2 Labor Costs

Labor is the largest cost component associated with maintaining Wisconsin's railroad crossing inventory because the work is field intensive and requires extensive travel and recurring data collection and verification. WisDOT currently relies on a combination of full-time staff, Regional Rail Coordinators, limited-term employees (LTEs), and interns to complete these activities.

Labor costs include more than salaries and hourly wages. Fully burdened labor rates also account for fringe benefits—including health insurance, retirement contributions, payroll taxes, and other employee benefits—as well as indirect costs associated with administrative support, office space, information technology, and other agency overhead.

Several assumptions were used to estimate labor costs. Average annual salaries of $75,000 and $80,000 were assumed for WisDOT staff and Regional Rail Coordinators, respectively. Fringe benefits were estimated at 45 percent of salary and overhead at 30 percent of salary for both positions. LTEs were assumed to earn $22.00 per hour, while interns were assumed to earn $17.50 per hour. No fringe benefits or overhead were applied to LTEs or interns.

Because inventory activities are performed by a combination of these personnel, a blended labor rate was developed. The analysis assumes that field data collection is completed by LTEs (40 percent), interns (40 percent), WisDOT staff (10 percent), and Regional Rail Coordinators (10 percent). These assumptions produce the blended hourly rate shown in Table 5.

Table 5. Ongoing personnel costs

Staff Composition	Hourly Rate	Fully Burdened Rate*	Fully Burdened Rate per Minute	Estimated Share
Full Time WisDOT Staff	$36.06	$63.10	$1.05	10%
Regional Rail Coordinators	$38.46	$67.31	$1.12	10%
LTEs	$22.00	n/a	$0.37	40%
Interns	$17.50	n/a	$0.29	40%
Blended Hourly Rate	$23.25	$28.84	$0.48	100%

*Fully burdened rates include estimated fringe benefits (45%) and agency overhead (30%).

Contracted services typically include labor, employee benefits, firm overhead, liability insurance, and profit, resulting in higher billing rates than comparable in-house staff. Although outsourcing can provide additional flexibility and scalability, particularly during intensive field data collection efforts, it generally increases unit labor costs, as discussed in Chapter 5.

Labor costs are also influenced by travel requirements, site accessibility, railroad coordination, and safety procedures associated with field inventories. Consequently, labor represents both the largest cost component and one of the greatest sources of variability in the overall cost of maintaining a compliant railroad crossing inventory.

4.3 Travel and Vehicle Costs

Vehicle usage is a major component of FRA compliance because railroad crossing inventories require in-person field inspections. In a geographically large state such as Wisconsin, personnel often travel considerable distances to access dispersed crossing locations, particularly in rural areas. Direct vehicle costs include fuel, mileage reimbursement, maintenance, insurance, and depreciation. Additional travel-related expenses include employee travel time, meals, lodging, and other per diem costs.

Travel time represents a significant labor expense because employees are compensated at the same fully burdened rate while driving as they are while conducting field inspections. Consequently, longer travel distances increase both vehicle operating costs and labor costs. In remote areas or large geographic regions, travel can account for a substantial portion of total project hours.

Multi-day field efforts require overnight travel resulting in costs for lodging, meals, and incidental expenses. Mileage costs, meal allowances, and lodging rates used in this analysis were obtained from the January 2026 State of Wisconsin Pocket Travel Guide, as summarized in Table 6.

Table 6. Travel, per diem, and lodging costs[6]

Item	Cost	Unit
Mileage	$0.51	per mile
Breakfast	$11.00	per day
Lunch	$13.00	per day
Dinner	$24.00	per day
Lodging - Milwaukee, Waukesha and Racine	$106.00	per day
Lodging - All Other Counties	$101.00	per day

The geographic distribution of railroad crossings is a primary driver of travel costs. Widely dispersed crossings increase driving distances, lengthen working days, and increase the likelihood of overnight travel. Conversely, efficient scheduling, route optimization, and coordination with other field activities

[6] State of Wisconsin Pocket Travel Guide, 2026.

can substantially reduce these costs. The methodologies used to estimate local and overnight travel costs are described in *Cost Analysis Methodology* of this report.

4.4 Field Technology Costs

Digital field technologies have become essential components of modern railroad crossing inventory programs by improving data collection efficiency, accuracy, and reporting. WisDOT's inventory program is transitioning toward GPS-enabled tablets and specialized software applications that support field data collection, GIS integration, and electronic reporting to the FRA.

Field technology costs include both one-time capital investments and recurring operational expenses (Table 7). Although hardware purchases represent the largest initial investment, recurring software licensing and mobile data service typically account for a greater share of long-term costs. Additional expenditures are associated with integrating field-collected data into centralized databases and maintaining compatibility with federal reporting systems. Ongoing software maintenance, periodic hardware replacement, and cybersecurity also contribute to lifecycle costs.

Table 7. Field technology costs[7]

Item	Unit Cost	Units	Total Cost
Tablets (one-time cost)	$1,300.00	18	$23,400.00
Mobile Data Plan ($20 per month)	$240.00	18	$4,320.00
ESRI Enterprise License (annual cost)	$1,400.00	18	$25,200.00
Microsoft Licensing (annual cost)	$55.00	18	$986.00
Total Cost			**$53,906.00**

4.5 Training and Quality Assurance / Quality Control

Training and quality assurance/quality control (QA/QC) are essential for maintaining the accuracy and consistency of railroad crossing inventory data required by the FRA. Initial training familiarizes personnel with federal reporting requirements, field procedures, occupational safety requirements, and data collection technologies. Because of employee turnover and evolving software and regulatory requirements, refresher training is also required periodically.

QA/QC activities include supervisory review of submitted data, automated validation checks, and targeted field re-inspections when data quality concerns are identified. Although these activities increase short-term program costs, they reduce the likelihood of data errors, rework, and noncompliance with federal requirements, thereby improving the overall reliability of the inventory.

For this analysis, annual training is assumed to consist of one eight-hour session for approximately 18 personnel using the blended labor rate presented in Table 5. QA/QC activities are assumed to require an average of 10 minutes per inventoried crossing.

4.6 Administrative Support and Coordination

Administrative support and coordination are required throughout the railroad crossing inventory program and represent an important component of overall compliance costs. Program management responsibilities include planning and scheduling field activities, tracking inventory progress, coordinating with railroads and local agencies, and ensuring compliance with FRA reporting deadlines.

Additional administrative activities include maintaining centralized databases, validating and submitting inventory updates, managing data quality, and administering contractor or consultant agreements when

[7] Online research was used to estimate costs for field technology. These costs are estimates and may be subject to change based on geographic boundaries and variable corporate cost structures.

applicable. Although these activities are less visible than field data collection, they are essential for maintaining a reliable, compliant, and sustainable inventory program.

For this analysis, administrative support and coordination are assumed to require approximately one month of personnel time during each three-year inventory cycle, equivalent to an average of five minutes per inventoried crossing.[8]

4.7 Cost Analysis Methodology

4.7.1 Data Collection – Labor Cost Methodology

Institute for Transportation Research and Education (ITRE) personnel participated in a field visit with Wisconsin Department of Transportation (WisDOT) staff to gain a clear understanding of the time and resources required to collect railroad crossing inventory data. Through these observations, the research team identified key cost elements associated with data collection.

Initial conversations focused on the possibility that active and passive railroad crossings require different levels of effort due to differences in site characteristics and required data elements. After further discussion with data collection personnel and the project advisory panel, it was agreed that while the technical requirements differ, the total data collection time per crossing is approximately 55 minutes for each member of a two-person crew, regardless of whether the crossing is active or passive. This assumption was used throughout the remainder of the Chapter 4 and Chapter 5 analyses. Table 8 summarizes the estimated labor costs by cost element.

Table 8. Labor costs for crossing data inventories

Cost Element	Minutes	No. of Personnel	Personnel Cost / Minute	Total Cost
Personnel Training (one time cost)	240	18	$0.48	$2,076.54
Administrative Support & Coordination	5	1	$1.12	$5.61
Field Planning	15	2	$0.48	$14.42
Equipment Setup & Takedown	30	2	$0.48	$28.84
Sight Distance	35	2	$0.48	$33.65
Other Data Collection	45	2	$0.48	$43.26
QAQC	10	1	$1.05	$10.52
Labor Cost Subtotals	***Labor per Crossing***			**$136.30**
	Labor for all 3500 Crossings			**$477,050**

4.7.2 Travel – Drive Distance and Time Methodology

Travel time and distance are important factors in estimating the overall cost of a statewide railroad crossing inventory program. Although field data collection represents the largest component of the effort, travel between employees' base locations and individual rail crossings contributes substantially to total program costs, particularly in regions with large geographic service areas or dispersed crossing locations. Accurately estimating travel requirements is essential for developing realistic cost and staffing estimates.

Travel distance and time were estimated using the ArcGIS Network Analyst extension. Driving distances and estimated travel times were calculated between each WisDOT Division of Transportation System Development (DTSD) office and the railroad crossings within its service area. This approach provides a consistent, data-driven basis for estimating travel-related labor and vehicle costs.

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[8] The cost analysis assumes the Regional Rail Coordinator rate for administrative support and coordination activities.

For this analysis, crossings located 90 minutes or more (one-way drive time) from the assigned DTSD office were assumed to require overnight travel. Overnight travel costs, including mileage reimbursement, lodging, and per diem expenses, were estimated using the rates presented in Table 6. Crossings located less than 90 minutes from the assigned office were assumed to be inventoried without an overnight stay.

To better represent anticipated field operations, nearby railroad crossings were grouped into efficient travel clusters. Under this approach, field crews complete up to five crossing inventories per day, reducing travel costs while maintaining a realistic daily workload.

Using these assumptions, travel costs were estimated for personnel assigned to each of the eight DTSD offices. Table 9 summarizes the labor costs associated with travel to crossings that do not require overnight stays, including the number of crossings, estimated drive time, labor rates, and total travel labor costs. Table 10 summarizes the corresponding vehicle mileage costs for non-overnight travel, including the estimated mileage required to complete the inventories and the associated reimbursement costs.

Table 9. Labor cost considerations for non-overnight crossing locations

DTSD Office	Non-Overnight Sites	Personnel	Non-Overnight Drive Time (Minutes)	Personnel Cost / Minute	Total Cost
Rhinelander	108	2	2,545	$0.48	$2,446.75
Wisconsin Rapids	311	2	6,315	$0.48	$6,070.56
Green Bay	840	2	18,776	$0.48	$18,050.68
Eau Claire	493	2	12,088	$0.48	$11,621.39
Superior	157	2	1,880	$0.48	$1,807.44
Waukesha	564	2	11,159	$0.48	$10,727.85
La Crosse	227	2	7,384	$0.48	$7,099.12
Madison	708	2	16,075	$0.48	$15,453.64
Labor Cost Subtotals	***Labor to Drive to Non-Overnight Crossings***				$46,709.44

Table 10. Equipment cost considerations for non-overnight crossing locations

DTSD Office	Non-Overnight Sites	Vehicles	Non-Overnight Drive Time (Miles)	Mileage Cost	Total Cost
Rhinelander	108	1	2,195	$0.51	$1,119.41
Wisconsin Rapids	311	1	5,446	$0.51	$2,777.32
Green Bay	840	1	16,193	$0.51	$8,258.32
Eau Claire	493	1	10,425	$0.51	$5,316.87
Superior	157	1	1,621	$0.51	$826.92
Waukesha	564	1	9,624	$0.51	$4,908.07
La Crosse	227	1	6,368	$0.51	$3,247.90
Madison	708	1	13,863	$0.51	$7,070.15
Mileage Cost Subtotals	***Mileage to Drive to Non-Overnight Crossings***				$21,369.92

Travel costs were also estimated for crossings requiring overnight stays. Table 11 summarizes the associated travel labor costs, including the number of overnight crossings, estimated drive time, and resulting labor costs.

Table 11. Labor cost considerations for overnight crossing locations

DTSD Office	Overnight Sites	Personnel	Overnight Drive Time (Mins)	Personnel Cost / Minute	Total Cost
Rhinelander	25	2	380	$0.48	$365.17
Wisconsin Rapids	0	2	0	$0.48	$0.00
Green Bay	15	2	292	$0.48	$280.41
Eau Claire	28	2	406	$0.48	$390.51
Superior	10	2	301	$0.48	$289.58
Waukesha	0	2	0	$0.48	$0.00
La Crosse	14	2	314	$0.48	$301.99
Madison	0	2	0	$0.48	$0.00
Labor Cost Subtotals	***Labor to Drive to Overnight Crossings***				$982.08

Table 12 summarizes the corresponding vehicle mileage costs for overnight travel.

Table 12. Equipment cost considerations for overnight crossing locations

DTSD Office	Overnight Sites	Vehicle	Overnight Drive Time (Miles)	Mileage Cost	Total Cost
Rhinelander	25	1	328	$0.51	$167.07
Wisconsin Rapids	0	1	0	$0.51	$0.00
Green Bay	15	1	252	$0.51	$128.29
Eau Claire	28	1	350	$0.51	$178.66
Superior	10	1	260	$0.51	$132.48
Waukesha	0	1	0	$0.51	$0.00
La Crosse	14	1	271	$0.51	$138.16
Madison	0	1	0	$0.51	$0.00
Mileage Cost Subtotals	***Mileage to Drive to Overnight Crossings***				$449.31

Table 13 summarizes the estimated lodging and per diem costs associated with overnight railroad crossing inventory activities. Cost estimates are based on the number of crossings requiring overnight travel, the corresponding number of overnight stays, and the applicable Wisconsin lodging and meal reimbursement rates presented in Table 6. As shown, the Wisconsin Rapids, Waukesha, and Madison DTSD offices do not require overnight travel under the assumptions used in this analysis and therefore incur no lodging or per diem costs.

Table 13. Lodging and meal considerations for overnight stays

DTSD Office	Overnight Sites	Personnel	Overnight Days	Hotel Cost	Food Costs (Breakfast, Lunch, Dinner)	Total Costs
Rhinelander	25	2	5	$101.00	$48.00	$1,490.00
Wisconsin Rapids	0	2	0	$101.00	$48.00	$0.00
Green Bay	15	2	3	$101.00	$48.00	$894.00
Eau Claire	28	2	6	$101.00	$48.00	$1,788.00
Superior	10	2	2	$101.00	$48.00	$596.00
Waukesha	0	2	0	$106.00	$48.00	$0.00
La Crosse	14	2	3	$101.00	$48.00	$894.00
Madison	0	2	0	$101.00	$48.00	$0.00
Overnight Cost Subtotals	***Lodging and Meals for Overnight Crossings***					$3,278.00

4.8 Cost Analysis Findings

The cost estimates include labor costs associated with conducting railroad crossing inventories, labor costs incurred while traveling to non-overnight sites, and mileage costs associated with those same trips. Additional costs include labor and mileage expenses associated with overnight travel, as well as lodging and per diem costs for personnel required to stay overnight while completing inventory activities. The analysis also incorporates field technology costs, including the equipment and technology resources necessary to support data collection efforts.

Labor costs for inventorying all 3500 public crossings on in-service rail lines are estimated at $477,050 over a three-year inventory cycle. When combined with travel, lodging, per diem, and field technology costs, the total estimated cost is $603,744, equivalent to an annual cost of approximately $201,248 (2026 dollars).

Overall, the analysis indicates that inventory labor represents the largest cost component in both scenarios, while travel, lodging, and field technology costs account for a smaller share of total expenditures. Table 14 summarizes these costs.

Table 14. Railroad crossing data collection and inventory cost summary – current management methods

Cost Element	Cost
Labor Costs	$477,050
Labor Costs to Drive to Non-Overnight Sites	$46,709
Mileage Costs to Drive to Non-Overnight Sites	$21,370
Labor Costs to Drive to Overnight Sites	$982
Mileage Costs to Drive to Overnight Sites	$449
Lodging & Per Diem Costs for Overnight Sites	$3,278
Field Technology	$53,906
Total Data and Inventory Costs (3-Year Cycle)	**$603,744**
Annual Data and Inventory Costs	**201,248**

4.9 Cost Analysis Conclusions

Maintaining compliance with FRA railroad crossing inventory requirements requires sustained effort including labor, travel, technology, training, quality assurance, and administrative support. Among these components, labor associated with field data collection represents the largest share of total program costs.

Overall program costs are influenced by the number and geographic distribution of crossings, the frequency of inventory updates, staffing strategies, and the technologies used to support field operations. Although labor and travel costs are inherently difficult to reduce, improvements in technology, route planning, and data collection procedures can increase operational efficiency and reduce long-term costs.

The estimates presented in this chapter establish a baseline for WisDOT's current in-house inventory program. Chapter 5 builds on this analysis by evaluating operational optimization strategies and outsourced data collection alternatives that modify—and in some cases reduce—costs while maintaining compliance with FRA inventory requirements, good data collection practices, and employee safety requirements.

Chapter 5. Contractor and Consultant Options

5.1 Overview

The previous chapter developed a cost estimate for an in-house data collection program that complies with FRA requirements and is consistent with WisDOT's current personnel and program management methods. Notable assumptions of that scenario were as follows:

- Data collection crews are based at each of the eight WisDOT DTSD Region offices.
- Site selection and vehicle routing are determined manually on a day-by-day basis.
- Overnight stays are minimized by allowing deadheading of up to 90 minutes in each direction to reach crossings distant from the office. Overnight stays are considered only when the travel time to a group of crossings exceeds 90 minutes. Thus, up to 3 hours of each 8-hour workday could be spent driving to/from data collection sites.

The resulting cost estimate was **$603,744** for the full three-year data collection program, an average of $201,248 per year (2026 dollars).

This chapter describes the results of geospatial optimization intended to improve labor utilization. Two levels of optimization were considered:

- **Partially optimized program.** This scenario uses GIS-based route planning to limit travel while basing field personnel at WisDOT Region offices. Deadheading is limited to 60 minutes per direction, except in sparsely populated areas where up to 80 minutes per direction is allowed. To collect data at crossings distant from a Region office, crews stay overnight for multiple consecutive nights, applying predefined work plans that cluster data collection around a hotel location.
- **Fully optimized program.** This scenario relaxes all constraints on the locations where personnel are based and freely allows data collection activities to cross WisDOT DTSD Region boundaries. As in the partially optimized scenario, crews avoid excessive deadheading and stay overnight at hotels multiple nights each week. Nevertheless, by modifying the locations where crews are based, predefining daily routes, and ignoring Region boundaries there were substantial reductions in overnight stays, mileage costs, and deadheading.

Both analyses were GIS-based. Additional goals intended to maximize efficiency included ensuring an even distribution of labor between data collection regions, locating labor bases and overnight lodging optimally relative to railroad crossing locations, and finding the minimum number of daily vehicle routes from these bases required to complete the crossing inventories. The crossing data collection program is organized into a series of pre-planned daily routes, with each route designed to collect crossing data in a concentrated geographical area.

The fully optimized approach is further developed in this chapter to estimate costs associated with outsourcing the services to:

- A specialty data collection vendor/contractor
- An engineering or planning consulting firm

Both outsourcing options were developed as extensions of the initial in-house estimate. We sought to combine mileage, vehicle usage, lodging, and per diem cost assumptions with overhead, benefit, and profit calculations for labor rates likely to be charged by contracting firms and consultants. The text below explains the approaches and techniques used and presents the costs likely to be incurred. Outsourcing strategies are presented first, followed by the in-house optimization options.

5.2 Outsourcing Options

The practitioner survey described in Chapter 3 found that several state transportation agencies outsource some or all of their railroad crossing inventory activities. In many cases, outsourcing appears to have been driven by staffing limitations and scheduling constraints rather than cost savings.

To evaluate the feasibility of outsourcing Wisconsin's railroad crossing inventory program, the project team estimated the total costs of contracting with two distinct types of service providers:

- Specialty data collection vendors
- Engineering consultants

Although both organization types are capable of performing railroad crossing inventories, they differ substantially in organizational structure, overhead, procurement requirements, and overall cost. These differences are described below and summarized in Table 15.

Table 15. Characteristics of specialty data collection vendors and engineering consultants

Characteristic	Specialty Data Collection Vendor	Engineering Consultant
Primary Role	Collect and deliver inventory data in accordance with established protocols	Provide professional engineering services, analysis, design services, and technical recommendations
Typical Staff	Field technicians, GIS technicians, data specialists	Engineers, project managers, technical specialists, field technicians
Engineering Judgment Required	Limited	Significant
Professional Licensure	Generally none	Licensed professional engineers required; sealed documents
Professional Liability Insurance	Typically not carried	Required; materially adds to overhead
FAR Part 31 Audit Required?	Rarely, unless direct federal prime	Yes — required for most DOT/federal A&E contracts
Key Overhead Cost Drivers	Field vehicles, GPS/GIS equipment, software licenses, field supplies	Office facilities, professional licensure, E&O insurance, business development, FAR-compliant accounting
Procurement	Wisconsin DOA rule PRO-304	Qualifications Based Selection (QBS)

5.2.1 Differences Between the Two Firm Types

Specialty data collection vendors/contractors (e.g., Quality Counts and Verdanterra) specialize in collecting, processing, and delivering field data. These firms typically employ field technicians, GIS specialists, and data management personnel responsible for documenting asset locations, physical characteristics, condition, and other predefined inventory attributes.

Their work is generally performed in accordance with agency-developed inventory protocols or detailed project specifications. It typically does *not* require engineering judgment, design services, or the preparation of sealed engineering documents. As a result, these firms generally have lower professional liability exposure, simpler accounting requirements, and leaner organizational structures, which contribute to relatively low overhead (indirect cost) rates.

Engineering consultants provide a broader range of professional services that extend beyond data collection. In addition to inventory activities, they typically perform engineering analyses, asset management planning, infrastructure design, and suggestions for operational or safety improvements.

Engineering consulting firms typically employ licensed professional engineers, project managers, and technical specialists. Their overhead includes professional liability insurance, continuing professional education, quality management systems, proposal development, and accounting systems that comply with Federal Acquisition Regulation (FAR) Part 31 requirements. These additional responsibilities result in substantially higher indirect cost rates than those of specialty data collection vendors.

5.2.2 Procurement Requirements

Procurement procedures differ substantially between specialty data collection vendors and engineering consultants.

- **Specialty data collection vendors.** Procurement typically follows Wisconsin Department of Administration administrative rule PRO-304. Services are generally obtained through a competitive request-for-proposals (RFP) process that defines the inventory locations, required data elements, deliverables, and performance expectations. Proposals may be evaluated based solely on cost or on a combination of cost and technical qualifications.
- **Engineering consultants.** Engineering consulting services are procured using the Qualifications-Based Selection (QBS) process required under the Brooks Act. Under this approach, firms are evaluated based on professional qualifications, relevant experience, and demonstrated competence. Scope, schedule, and fee negotiations occur only after the most qualified firm has been selected.

5.2.3 Cost Assumptions

Separate labor cost assumptions were developed for specialty data collection vendors and engineering consultants to reflect the different staffing compositions and business structures associated with each organization type. These assumptions are summarized in Table 16.

Table 16. Cost assumptions summary

Cost Element	Specialty Data Collection Vendor	Engineering Consultant
Staffing Composition	70% Surveying/Mapping Technicians 10% Civil Engineering Technicians 10% First-Line Supervisors of Construction Trades and Extraction Workers 10% Civil Engineers	70% Civil Engineering Technologists and Technicians 10% Civil Engineering Technicians 10% Architectural and Civil Drafters 10% Civil Engineers
Blended Hourly Rate (May 2025)	$34.12	$37.31
Adjusted Hourly Rate (June 2026)	$35.31	$38.62
Fringe Benefits	35.0%	45.0%
Administrative Overhead	90.0%	175.0%
Profit	15.0%	12.5%
Total Burden on Direct Costs	140.0%	232.5%
Loaded Hourly Rate	$84.76	$128.41

Direct labor rates were estimated using Wisconsin wage data from the Bureau of Labor Statistics (BLS) Occupational Employment and Wage Statistics database. For each occupation, the midpoint between the median and 75th percentile hourly wage was used to estimate a representative billing rate. Because the most recent wage data available at the time of the analysis were for May 2025, all labor rates were increased by 3.5 percent to estimate expected costs as of June 2026.

5.2.4 Intergovernmental Options

Wisconsin has a long history of intergovernmental cooperation in transportation. Since the establishment of the State Trunk Highway System in 1917, county governments have performed most routine highway maintenance on behalf of WisDOT, including snow and ice removal. Similarly, traffic counting activities in Madison and Milwaukee have long been conducted by local government personnel.

A similar approach could be considered for railroad crossing inventory activities. Potential partners include county highway departments, municipalities, regional planning commissions, metropolitan planning organizations, technical colleges, and universities. Distributing data collection responsibilities among organizations located throughout the state could reduce travel time and associated costs while providing additional staffing flexibility.

As with private-sector outsourcing, successful implementation would require clearly defined scopes of work, standardized data collection procedures, quality assurance requirements, and consistent deliverables to ensure statewide consistency and compliance with FRA reporting requirements.

5.3 Labor Costs

Labor is the largest cost component associated with outsourcing railroad crossing inventory activities. In addition to direct wages, contractor and consultant billing rates include fringe benefits, administrative overhead, liability insurance, and profit. Because specialty data collection vendors and engineering consultants differ substantially in staffing composition and business structure, separate labor rates were developed for each organization type.

Table 17 summarizes the labor rate assumptions used in this analysis. Direct labor rates were estimated using Wisconsin wage data from the Bureau of Labor Statistics (BLS) Occupational Employment and Wage Statistics database. For each occupation, the midpoint between the median and 75th percentile hourly wage was used to estimate a representative labor rate. These rates were then adjusted by 3.5 percent to estimate expected June 2026 labor costs.

Table 17. Labor costs by occupation, considering contractor and consultant rates

Occupation	Hourly Rate	Contractor Share	Consultant Share	Contractor Blended Rate	Consultant Blended Rate
Civil Engineering Technologists & Technicians (17-3022)	$37.10	10%	70%	$3.71	$25.97
Civil Engineers (17-2051)	$49.52	10%	10%	$4.95	$4.95
Architectural & Civil Drafters (17-3011)	$34.03	0%	10%	$0.00	$3.40
Surveying and Mapping Technicians (17-3031)	$29.94	70%	10%	$20.95	$2.99
First-Line Supervisors of Construction Trades and Extraction Workers (47-1011)	$45.05	10%	0%	$4.50	$0.00
Raw Blended Hourly Rate				$34.12	$37.31
Inflation Adjustment (2025 - 2026)				3.5%	3.5%
Inflation-Adjusted Raw Blended Hourly Rate				$35.31	$38.62
Fringe				35%	45%
Overhead				90%	175%

Occupation	Hourly Rate	Contractor Share	Consultant Share	Contractor Blended Rate	Consultant Blended Rate
Profit				15%	12.5%
Loaded Hourly Rate				$84.76	$128.41
Loaded Per-Minute Rate				$1.41	$2.14

Separate blended labor rates were developed for specialty data collection vendors and engineering consultants based on the anticipated mix of personnel used to perform statewide railroad crossing inventories. These blended rates were then adjusted to account for fringe benefits, administrative overhead, and profit using the assumptions presented in Table 18. The resulting fully loaded labor rates are estimated at $84.76 per hour ($1.41 per minute) for specialty data collection vendors and $128.41 per hour ($2.14 per minute) for engineering consultants. For comparison, the corresponding blended in-house labor rate developed in Chapter 4 is $28.84 per hour ($0.48 per minute). The assumed profit margins are 15% for specialty data collection vendors/contractors and 12.5% for consultants.

Table 18. Fully loaded per-minute blended rates for different options

In-House Rate	Contractor Rate	Consultant Rate
$0.48	$1.41	$2.14

Although outsourced labor rates are substantially higher than in-house labor rates, outsourcing provides greater operational flexibility and allows staffing resources to be distributed more efficiently across the state. Rather than assigning personnel to fixed WisDOT Regions, contractors can allocate field crews according to workload, seasonal schedules, and geographic efficiency.

The Green Bay area illustrates this advantage. Under the current in-house approach, approximately 855 crossings are assigned to a single WisDOT office, requiring an estimated 141 workdays for a two-person crew to complete the inventory. In contrast, the optimized contractor approach distributes approximately 1,167 crossings among each of three balanced operating regions, with annual targets of approximately 389 crossings per subregion. This more equitable distribution of work improves scheduling flexibility, reduces the risk of falling behind the three-year inventory cycle, and allows resources to be shifted more easily as project needs change.

While outsourcing provides these operational advantages, labor remains the dominant driver of overall program costs because contractor and consultant billing rates include substantially higher indirect costs than comparable in-house labor. Consequently, the primary benefit of outsourcing lies in increased flexibility, scalability, and schedule reliability rather than lower costs.

5.4 Vehicle Usage and Travel Costs

To estimate travel costs under outsourced data collection scenarios, the project team applied a series of GIS-based optimization techniques to identify efficient labor regions, locate optimal operating bases, minimize travel distances, and determine efficient daily inventory routes. The same methodology was then applied to optimize the in-house approaches and provide a consistent basis for comparison.

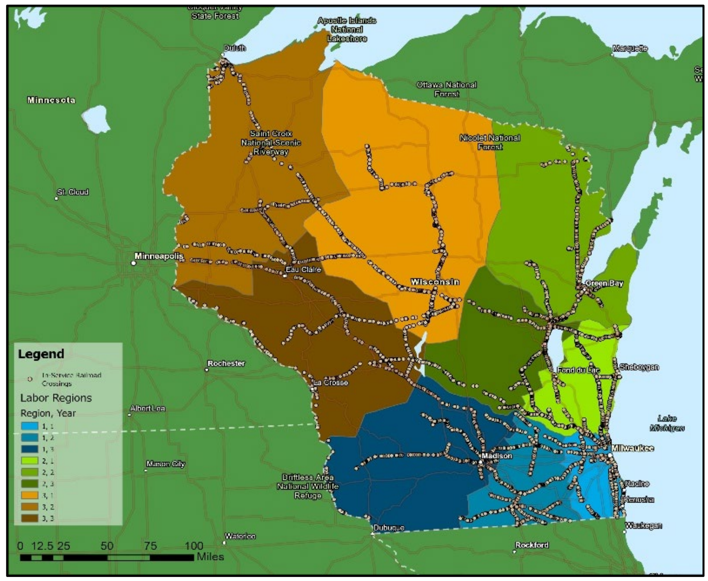
The analysis consisted of three sequential steps:

1. Development of balanced labor regions.
2. Selection of optimal labor bases and overnight lodging locations.
3. Optimization of daily vehicle routing.

5.4.1 Balanced Regionalization

A balanced k-means clustering methodology was used to divide Wisconsin's 3,500 in-service public railroad crossings into geographically compact regions with similar workloads. Unlike traditional k-means clustering, which minimizes only the distance between crossings and cluster centers, the balanced approach also constrained each region to contain approximately the same number of crossings.

The statewide inventory was divided into three primary operating regions containing approximately 1,167 crossings each (3,500 ÷ 3), with each region further divided into three annual work areas containing approximately 389 crossings each. As shown in Figure 10, the shapes of these regions and work areas reflect the radial pattern of the rail network and are very different from the shapes of WisDOT Regions.



An automated Python workflow generated the balanced regions by iteratively assigning crossings to cluster centers while maintaining the target workload for each region. When a cluster reached its capacity, crossings were reassigned to neighboring clusters while minimizing the additional travel cost using the Hungarian (Munkres) assignment algorithm. The resulting clusters were converted into operational regions by creating Thiessen (Voronoi) polygons around each crossing and dissolving the polygons by cluster assignment. Minor manual adjustments were then made to keep individual railroad corridors within a single operational region where practical. The resulting regional distribution is shown in Figure 10.

5.4.2 Labor Base and Overnight Stay Selection

Following development of the balanced labor regions, the project team identified the optimal operating base for each annual work area using a GIS location-allocation analysis. Candidate operating bases included all Wisconsin communities with populations greater than 10,000.

Travel times between each candidate location and assigned railroad crossings were calculated using Wisconsin's WISLR roadway network. The location-allocation model identified the operating base that maximized the number of crossings within a target travel time of approximately 60 to 80 minutes, with the longer thresholds permitted in sparsely populated areas.

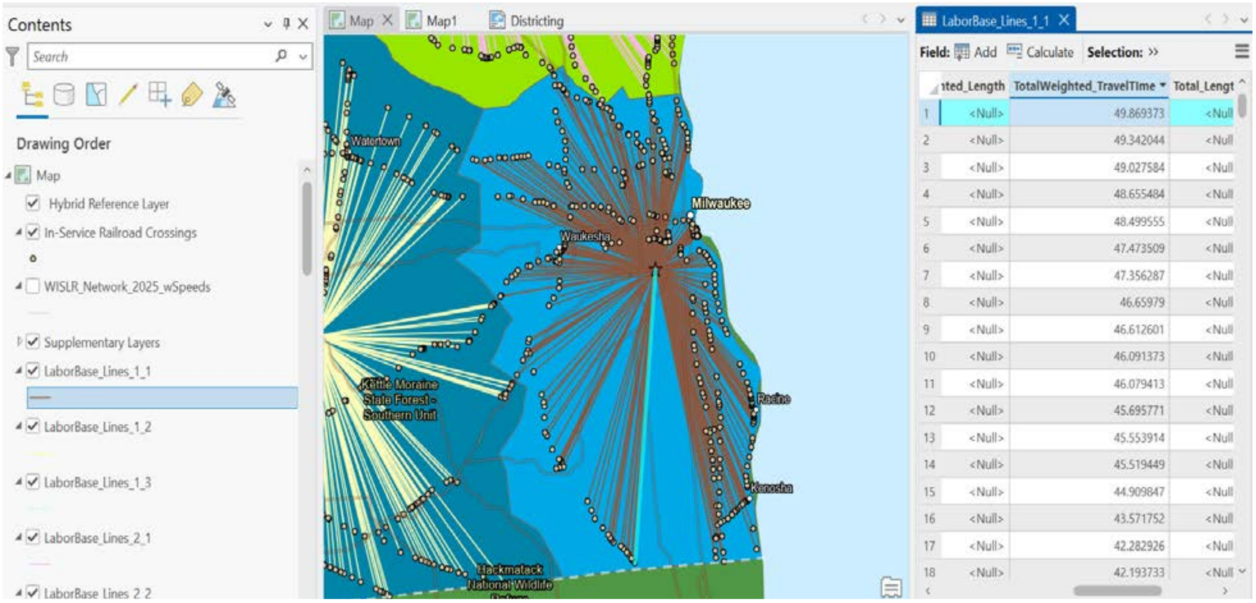


Figure 11. Locating labor bases by minimizing Travel times to crossings

For crossings located beyond the maximum travel time threshold, a second location-allocation analysis was performed using hotels as candidate facilities and a travel time threshold of 30 minutes. This approach minimized overnight travel while maintaining efficient access to remote crossing locations. The methodology used to identify operating bases is illustrated in Figure 11.

Table 19. Optimized crew base locations

Region	Year	Operating Base	Examples of Potential In-House Crew Base Locations
1 (Blue)	1	Greenfield	Loomis Road Park & Ride Lot, Greenfield City Hall
	2	Fort Atkinson	Fort Atkinson Municipal Airport
	3	Deforest	Wisconsin State Patrol SW Region Office
2 (Green)	1	Fond du Lac	Fond du Lac County Highway Department
	2	Suamico	Village of Suamico Fire Station No. 1
	3	Oshkosh	Ken Robl Conservation Park, Oshkosh Correctional Inst.
3 (Brown)	1	Wausau	Wausau DMV Office, Rib Mountain Town Garage
	2	Rice Lake	Rice Lake DMV Office, Rice Lake Regional Airport
	2	Superior (Supplemental)	NW Region Superior Office, Bong Memorial Airport
	3	Sparta	WisDOT Safety & Weight Enforcement Facility #54, WisDOT Rest Area #16
	1-3	Eau Claire (Supplemental)	Wisconsin State Patrol NW Region Office

Table 19 identifies the locations of the crew basing locations obtained from this analysis. The table also includes examples of public facilities that in-house crews could potentially use as gathering points prior to beginning their daily field work. The gathering points are suggested based on proximity to major highways and parking availability, and will require coordination with the applicable agencies.

Application of this methodology indicates that both the optimized contractor/consultant approach and the current in-house approach are expected to require approximately 40 overnight stays to complete the statewide inventory. Although the optimized approach uses shorter daily travel thresholds, improved workload balancing and more efficient routing offset the additional overnight travel that might otherwise be expected. Estimated lodging and per diem costs for both approaches are summarized in Table 20 and Table 21.

Table 20. Contractor/consultant lodging and per diem costs for overnight sites

Cost Element	Overnight Sites	Personnel	Overnight Days	Hotel Cost	Food Costs (Breakfast, Lunch, Dinner)	Total Costs
Lodging & Per Diem Costs for Overnight Sites						
1_1 (Greenfield)	0	2	0	$106.00	$48.00	$0
1_2 (Fort Atkinson)	0	2	0	$101.00	$48.00	$0
1_3 (Deforest)	76	2	14	$101.00	$48.00	$4,172
2_1 (Fond du Lac)	0	2	0	$101.00	$48.00	$0
2_2 (Suamico)	30	2	5	$101.00	$48.00	$1,490
2_3 (Oshkosh)	26	2	5	$101.00	$48.00	$1,490
3_1 (Wausau)	34	2	6	$101.00	$48.00	$1,788
3_2 (Rice Lake & Superior)	24	2	4	$101.00	$48.00	$1,192
3_3 (Sparta)	28	2	6	$101.00	$48.00	$1,788
Suplemental Base (Eau Claire)	0	2	0	$101.00	$48.00	$0
Lodging & Meals Cost Subtotals	***Lodging & Meals for Overnight Crossings***					**$11,920.00**

Table 21. In-house lodging and per diem costs for overnight sites

Cost Element	Overnight Sites	Personnel	Overnight Days	Hotel Cost	Food Costs (Breakfast, Lunch, Dinner)	Total Costs
Lodging & Per Diem Costs for Overnight Sites						
Rhinelander	25	2	4	$101.00	$48.00	$1,192
Wisconsin Rapids	5	2	1	$101.00	$48.00	$298
Green Bay	34	2	5	$101.00	$48.00	$1,490
Eau Claire	0	2	0	$101.00	$48.00	$0
Superior	155	2	26	$101.00	$48.00	$7,748
Waukesha	0	2	0	$106.00	$48.00	$0
La Crosse	14	2	4	$101.00	$48.00	$1,192
Madison	0	2	0	$101.00	$48.00	$0
Lodging & Meals Cost Subtotals	***Lodging & Meals for Overnight Crossings***					**$11,920.00**

5.4.3 Vehicle Routing

After operating bases and overnight lodging locations were established, vehicle routing analyses were performed to determine the most efficient daily inventory routes. The routing analysis estimated the minimum number of crew workdays required to inventory all crossings while providing detailed estimates of travel distance and travel time for each route.

Vehicle routing was performed using the ArcGIS Pro Vehicle Routing Problem (VRP) solver (Figure 12). Operating bases and hotels served as depots, while assigned railroad crossings served as inventory locations. Routing was based on the WISLR roadway network using estimated travel times derived from roadway classifications.

The analysis assumed an average inspection time of 55 minutes per crossing and a standard 8-hour workday, including a 30-minute lunch break, resulting in a maximum available field time of 450 minutes per day. The VRP solver optimized each route by minimizing overall travel time while satisfying these operational constraints.

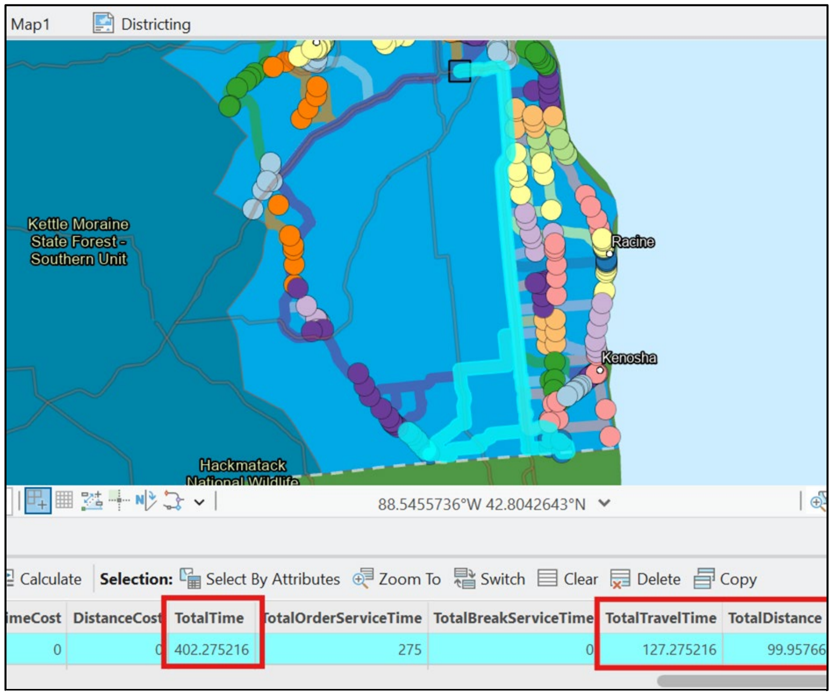


Figure 12. Modeling crossing inventory routing in ArcGIS Pro

The routing analysis confirmed that the optimized labor allocation strategy is more efficient than the current in-house regional structure. Compared with the existing WisDOT Regions, the balanced regional approach reduces the total number of crew workdays by 15 days, decreases total travel by approximately 10,600 miles, and reduces driving time by more than 10,000 minutes over the three-year inventory cycle. These differences are summarized in Table 22 to Table 24.

Table 22. Workdays compared – in-house vs. contractor/consultant

Labor Allocation Strategy	Total Non-Overnight Days	Total Overnight Days	Total Workdays
In-House	554	40	594
Contractor/Consultant	539	40	579

Table 23. Miles traveled compared – in-house vs. contractor/consultant

Labor Allocation Strategy	Total Non-Overnight Miles	Total Overnight Miles	Total Miles
In-House	44,776	1,130	45,906
Contractor/Consultant	33,973	1,289	35,261

Table 24. Travel time compared – in-house vs. contractor/consultant

Labor Allocation Strategy	Total Non-Overnight Mins	Total Overnight Mins	Total Mins
In-House	52,542	1,390	53,931
Contractor/Consultant	42,076	1,661	43,736

5.5 Comparing Overall Costs for In-House, Contractor, and Consultant Options

Using the methodologies described in Chapters 4 and 5, the project team evaluated five approaches for completing Wisconsin's statewide railroad crossing inventory:

1. **In-House - Existing Process:** FRA compliant data collection cycle with crews based at WisDOT Region offices, ad-hoc determination of daily work plans, and minimal overnight travel.
2. **In-House - Partially Optimized**: In-house staffing with crews based at WisDOT Region offices, predetermined daily work plans with optimized routing, and optimal use of overnight travel including overnight stays that could include multiple consecutive nights.
3. **In-House - Fully Optimized:** In-house staffing with optimized crew base locations, predetermined daily work plans with optimized routing, and optimal use of overnight travel including overnight stays that could include multiple consecutive nights.
4. **Specialty Data Collection Vendor/Contractor:** Same as #3 but using vendor/contractor labor rates and 15% profit margin.
5. **Engineering Consultant:** Same as #3 but using consultant labor rates and 12.5% profit margin.

The primary difference among the last three alternatives is labor cost. Although the optimized in-house, contractor, and consultant approaches all use the same GIS-based labor allocation strategy, the vendor/contractor and consultant billing rates include substantially higher fringe benefits, overhead, liability costs, and profit than the corresponding in-house labor rates.

Table 25. Total all crossing labor costs – partially optimized in-house approach

Cost Element	Mins.	Personnel Cost	No. of Personnel	Total Cost	No. of Personnel	Total Cost	No. of Personnel	Total Cost
Personnel Training (once)	240	$0.48	18	$2,076.54	20	$2,307.27	22	$2,538.00
Admin Support	5	$1.12	1	$5.61	1	$5.61	1	$5.61
Avg Mins Per Xing	55	$0.48	2	$52.87	2	$52.87	2	$52.87
QA / QC	10	$1.05	1	$10.52	1	$10.52	1	$10.52
Labor Cost Subtotals			**Per Crossing**	$69.00	**Per Crossing**	$69.00	**Per Crossing**	$69.00
			All Crossings	$243,579	**All Crossings**	$243,810	**All Crossings**	$244,041

5.5.1 Partially Optimized In-House Approach

Table 25 summarizes labor costs using WisDOT's current regional labor allocation. Under this approach, approximately 18 personnel are required to staff two-person field crews in each of the eight WisDOT Regions, with an additional crew assigned to the Green Bay Region because of its substantially larger inventory workload.

The analysis indicates that additional personnel may ultimately be required in the Madison and Waukesha Regions because of their relatively large numbers of crossings. Depending on staffing levels, estimated labor costs for statewide inventory collection range from $243,579 to $244,041 over the three-year inventory cycle.

5.5.2 *Fully Optimized In-House, Specialty Vendor, and Consultant Approaches*

Applying the balanced regional labor allocation strategy produces similar in-house labor costs while substantially improving operational efficiency by distributing workloads more evenly across the state. Using this approach, total labor costs are estimated at **$244,041** for the in-house option, **$625,466** for the specialty data collection contractor option, and **$947,647** for the engineering consultant option.

These differences reflect the substantially higher loaded labor rates associated with private-sector organizations rather than differences in the amount of work performed.

Table 26. Total all crossing labor costs – balanced clustered regional division of labor

Cost Element	Mins.	No. of Personnel	In-House Personnel Cost	In-House Total Cost	Contractor Personnel Cost	Contractor Total Cost	Consultant Personnel Cost	Consultant Total Cost
Personnel Training (once)	240	22	$0.48	$2,538.00	$1.41	$7,458.47	$2.14	$11,300.36
Admin Support	5	1	$1.12	$5.61	$1.41	$7.06	$2.14	$10.70
Avg Mins Per Crossing	55	2	$0.48	$52.87	$1.41	$155.38	$2.14	$235.42
QA / QC	10	1	$1.05	$10.52	$1.41	$14.13	$2.14	$21.40
Labor Cost Subtotals			**Per Xing**	$69.00	**Per Xing**	$176.57	**Per Xing**	$267.53
			All Xings	$244,041	**All Xings**	$625,466	**All Xings**	$947,647

Table 27 through Table 30 summarize the total costs associated with each of these alternatives, including labor, travel, mileage, lodging, per diem, and field technology.

Table 27. Itemization of total costs – partially optimized in-house approach

Summary	Totals
Labor Costs for Crossings	$243,579
Labor Costs to Drive to Non-Overnight Sites	$50,512
Mileage Costs to Drive to Non-Overnight Sites	$22,836
Labor Costs to Drive to Overnight Sites	$3,743
Mileage Costs to Drive to Overnight Sites	$1,720
Lodging & Per Diem Costs for Overnight Sites	$11,920
Field Technology	$53,906
Total Data and Inventory Costs (3-Year Cycle)	**$388,215**
Annual Data and Inventory Costs (Average)	$129,405

Table 28. Itemization of total costs – fully optimized in-house approach

Summary (In-House)	Totals	Year 1	Year 2	Year 3
Labor Costs for Crossings	$244,041	$84,129.87	$83,577.86	$76,332.79
Labor Costs to Drive to Non-Overnight Sites	$40,450	$15,365.77	$13,648.01	$11,436.13
Mileage Costs to Drive to Non-Overnight Sites	$17,326	$6,696.76	$5,673.44	$4,955.85
Labor Costs to Drive to Overnight Sites	$3,287	$363.79	$779.35	$2,143.44
Mileage Costs to Drive to Overnight Sites	$1,485	$162.87	$345.72	$976.80
Lodging & Per Diem Costs for Overnight Sites	$11,920	$1,788.00	$2,682.00	$7,450.00
Field Technology	$0	$0.00	$0.00	$0.00
Total Data and Inventory Costs (3-Year Cycle)	**$318,508**	**$108,507.05**	**$106,706.38**	**$103,295.01**
Annual Data and Inventory Costs (Average)	$106,169			

Table 29. Itemization of total costs – contractor with balanced clustered regions

Summary (Contractor)	Totals	Year 1	Year 2	Year 3
Labor Costs for Crossings	$625,466	$215,610.48	$214,197.89	$195,657.66
Labor Costs to Drive to Non-Overnight Sites	$118,871	$45,155.75	$40,107.72	$33,607.62
Mileage Costs to Drive to Non-Overnight Sites	$17,326	$6,696.76	$5,673.44	$4,955.85
Labor Costs to Drive to Overnight Sites	$9,658	$1,069.07	$2,290.29	$6,298.98
Mileage Costs to Drive to Overnight Sites	$1,485	$162.87	$345.72	$976.80
Lodging & Per Diem Costs for Overnight Sites	$11,920	$1,788.00	$2,682.00	$7,450.00
Field Technology	$0	$0.00	$0.00	$0.00
Total Data and Inventory Costs (3-Year Cycle)	**$784,727**	**$270,482.93**	**$265,297.06**	**$248,946.91**
Annual Data and Inventory Costs (Average)	$261,576			

Table 30. Itemization of total costs – consultant with balanced clustered regions

Summary (Consultant)	Totals	Year 1	Year 2	Year 3
Labor Costs for Crossings	$947,647	$326,672.45	$324,532.23	$296,441.84
Labor Costs to Drive to Non-Overnight Sites	$180,102	$68,415.69	$60,767.40	$50,919.06
Mileage Costs to Drive to Non-Overnight Sites	$17,326	$6,696.76	$5,673.44	$4,955.85
Labor Costs to Drive to Overnight Sites	$14,633	$1,619.76	$3,470.03	$9,543.62
Mileage Costs to Drive to Overnight Sites	$1,485	$162.87	$345.72	$976.80
Lodging & Per Diem Costs for Overnight Sites	$11,920	$1,788.00	$2,682.00	$7,450.00
Field Technology	$0	$0.00	$0.00	$0.00
Total Data and Inventory Costs (3-Year Cycle)	**$1,173,114**	**$405,355.52**	**$397,470.82**	**$370,287.17**
Annual Data and Inventory Costs (Average)	$391,038			

The updated travel modeling indicates that simply adopting the optimized regional labor allocation strategy reduces the estimated cost of the in-house program by approximately **$70,000** over the three-year inventory cycle. This reduction is achieved primarily through shorter travel distances, fewer workdays, and lower travel-related labor costs.

Field technology costs are included only in the in-house alternatives because contractors and consultants are assumed to include the costs of the necessary equipment in their overhead (indirect cost) charges.

5.6 Conclusion

As shown in Table 31, the estimated total program costs over a three-year inventory cycle range from **$318,508** with the fully optimized in-house approach **to $1,173,114** with the Consultant approach. The differences among the three in-house options are driven by changes in the extent of overnight travel to reach crossings distant from crew bases, routing efficiencies associated with pre-planning the entire inventory cycle, and potential changes in crew base locations. The contractor/vendor and consultant approaches incorporate the same efficiencies as the fully-optimized in-house approach, but reflect higher wage and overhead costs as well as the profit margins for private firms.

Table 31. Comparison of total program costs for each staffing scenario (2026 dollars)

Staffing Scenario	Report Chapter	Three-Year Total	Average Annual Cost	Ratio to Existing Process
In-House - Existing Process	4	$603,744	$201,248	1.00
In-House - Partially Optimized	5	$388,215	$129,405	0.64
In-House - Fully Optimized	5	$318,508	$106,169	0.53
Specialty Data Collection Vendor/Contractor	5	$784,727	$261,576	1.30
Engineering/Planning Consultant	5	$1,173,114	$391,038	1.94

The analysis demonstrates that optimizing the geographic distribution of field crews can substantially improve the efficiency of Wisconsin's statewide railroad crossing inventory program. Compared with the current WisDOT regional labor allocation, the fully optimized approach reduces travel time, vehicle mileage, and total workdays while maintaining equivalent inventory coverage. These efficiencies are achieved primarily through improved placement of operating bases. For example, the base of operations for the southeastern part of the state would move from Waukesha in the western Milwaukee suburbs to Greenfield in the southern suburbs, reducing round-trip travel time to the dense cluster of crossings in Racine and Kenosha Counties by about 40 minutes each day. In addition, the optimization process results in more uniform distribution of workloads among field crews, for example eliminating the large existing workload differences between the Rhinelander and Green Bay crews (Table 1 on Page).

Compared to the partially-optimized scenario, the fully-optimized labor allocation strategy reduces the estimated cost of the statewide inventory program by approximately $70,000 over each three-year inventory cycle. This finding indicates that meaningful cost savings can be achieved through operational improvements alone, without changing staffing levels or outsourcing data collection activities.

Although outsourcing to a specialty data collection vendor/contractor or engineering consultant provides greater operational flexibility, scalability, and scheduling certainty, labor costs remain the dominant driver of total program cost. Because contractor and consultant billing rates include substantially higher fringe benefits, overhead, liability costs, and profit, both outsourcing alternatives are considerably more expensive than any of the in-house options.

Based on the analyses presented in Chapters 4 and 5, the optimized in-house approach provides the lowest overall cost while maintaining the operational efficiencies necessary to complete a statewide railroad crossing inventory within the required three-year cycle. Outsourcing should be considered if staffing limitations, schedule constraints, or the need for specialized expertise outweigh the additional costs associated with private-sector service providers.

Chapter 6. Safety Analysis

6.1 Overview

To develop a more comprehensive understanding of railroad crossing safety in Wisconsin, the project team analyzed two complementary data sources:

- **FRA Highway-Rail Crossing Incident Database:** A rail industry-focused database of train-involved collisions.
- **Wisconsin Motor Vehicle Crash Reports:** A database of all motor vehicle crashes on public roadways reported to law enforcement agencies.

Comparison of these datasets (Figure 13), revealed underreporting of crossing-related crashes in both sources. Some differences are structural. For example, pedestrian-train collisions are not included in motor vehicle crash records if no roadway vehicle is involved. Similarly, a vehicle that runs off the roadway at a railroad crossing is generally not reported to the FRA unless a train is involved. Although train-vehicle collisions should in principle appear in both databases, the analysis found that this is not always the case.

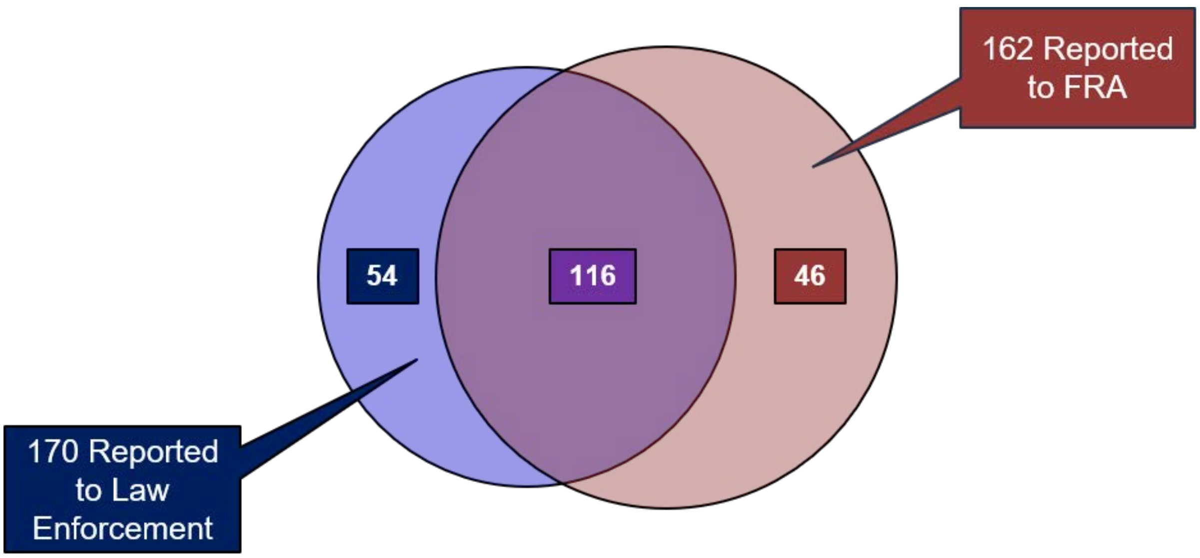


Figure 13. Comparison of FRA-reported crashes and total police-reported crashes (all consequences) at FRA crossings (2021-2025 [60 months]).

The analysis also indicates that train-vehicle collisions account for only a small portion of all crossing-related crashes. Based on Wisconsin motor vehicle crash records, only **16 percent** of crossing-related crashes involve a train. The remaining crashes generally fall into the following categories:

- **Single-vehicle run-off-the-road crashes.** As shown in Figure 14, many railroad crossings have unprotected edge drop-offs created by the elevation difference between the crossing surface and the adjacent crosstie and ballast structure. Vehicles that leave the roadway at these locations can become lodged on the track structure or railroad embankment, creating both roadway and rail operational hazards. These crashes are often associated with slippery pavement, narrow or nonexistent shoulders, or steering errors at crossings located near intersections.
- **Rear-end collisions involving stopped vehicles.** These crashes typically occur when drivers fail to recognize a queue of vehicles stopped at a railroad crossing. Limited sight distance, driver inattention, and slippery pavement can contribute to these collisions. In severe cases, the lead vehicle may be pushed onto the tracks.

- **Collisions with crossing signal equipment.** Errant vehicles sometimes strike signal masts, signal controller bungalows, or other railroad warning equipment. Because this equipment is not designed to be crashworthy, these collisions can result in significant vehicle occupant injury.
- **Collisions with fixed roadside objects.** Vehicles also strike utility poles, light poles, or other fixed objects located near railroad crossings.

Potential engineering countermeasures to address these crash types are discussed later in this chapter.

Figure 14. An example of a Wisconsin railroad crossing that lacks safety shoulders.
Note: This example is on Town Hall Drive at the Wisconsin & Southern Railroad in Sun Prairie.[9]

6.2 FRA Crossing Incident Database

The FRA Highway-Rail Crossing Incident Database provides a railroad-focused perspective on crossing safety by documenting collisions between railroad equipment and highway users, including motorists, pedestrians, bicyclists, and motorcyclists. Railroad equipment involved in these incidents may include moving trains, stationary trains, light locomotives, individual railcars, and track maintenance equipment (a “light” locomotive is one with no railcars attached). Reported incidents range from high-severity collisions involving passenger or freight trains to relatively minor events, such as a semi striking a stationary railcar while turning into an industrial facility.

Between 2021 and 2025, the FRA database recorded 162 incidents at public railroad crossings in Wisconsin, resulting in 13 fatalities and 40 injuries. As shown in Figure 15, the greatest number of incidents occurred in Brown County (15), followed by Milwaukee (10), Waukesha (9), Winnebago (8), Outagamie (7), Chippewa (6), Clark (6), and Rusk (6). During the same period, an additional 23 incidents occurred at private crossings, resulting in five fatalities and five injuries.

Although the FRA database has traditionally served as the primary source of information for prioritizing railroad crossing safety improvements, its focus on train-involved collisions provides only a partial view

[9] Google StreetView (August 2025 image).

of crossing safety. Integrating FRA incident data with Wisconsin motor vehicle crash records provides a more complete understanding of the full range of crashes that occur at railroad crossings and supports more comprehensive safety analyses and investment decisions.

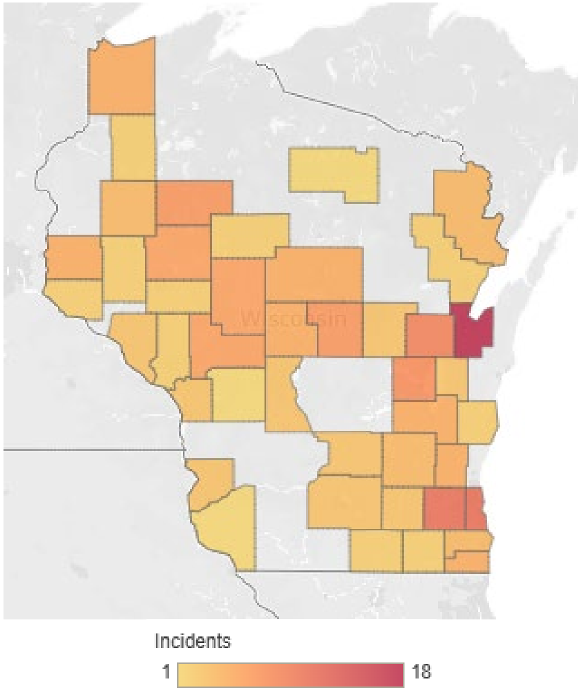


Figure 15. FRA-reported crossing incidents in Wisconsin, 2021-2025

6.3 Wisconsin Motor Vehicle Crash Records

Under Wisconsin Statute 346.70(1), motor vehicle crashes occurring on public streets or highways must be reported if they result in:

- Injury to any person.
- Property damage of $1,000 or more to any person's vehicle or other property.
- Damage of $200 or more to state or other government-owned property (excluding vehicles).

The project team identified railroad crossing-related crashes using a combination of geospatial analysis, keyword searches, and manual review of crash narratives. The analysis began with a geocoded database of Wisconsin motor vehicle crash records provided by WisDOT, containing crash identification numbers and GPS coordinates for crashes occurring between January 1, 2021, and February 16, 2026 (61½ months). A geospatial search identified all crashes occurring within 150 feet of a railroad crossing for further review. The Wisconsin State Patrol then provided the corresponding crash reports, including narratives and diagrams, for detailed evaluation.

The following inclusion and exclusion criteria were applied:

- Crossings on active freight, Amtrak, and Metra commuter rail lines were included.
- Crossings on railroad museum trackage, such as the East Troy Electric Railroad and the Mid-Continent Railway Museum, were included.
- Milwaukee and Kenosha streetcar crossings were excluded.
- Out-of-service rail lines (including rails-to-trails corridors) were shown on the crash maps for reference but were excluded from the analysis.

Because many railroad crossings are located near roadway intersections, crash narratives and diagrams were reviewed to distinguish crossing-related crashes from unrelated intersection crashes. Crashes were classified as crossing-related if they involved a train, railroad track structure, embankments, crossing signal equipment, or other railroad-related features. Rear-end collisions involving vehicles stopped at railroad crossings were also included.

Using these criteria, the project team identified **838 crossing-related crashes** during the five-year study period (Table 32). Each crash was classified into one of the following consequence categories (Table 33):

- **Train Involved:** Train-vehicle collisions.
- **Rear-End at Crossing:** Rear-end crashes involving vehicles stopped at a crossing.
- **Struck Crossing Equipment:** Collisions involving crossing signal masts, gate arms, controller bungalows, or other railroad warning equipment.
- **Struck Fixed Object:** Collisions involving fixed roadside objects near crossings, excluding railroad warning equipment. Common examples include utility poles and lighting poles.
- **Struck Track-Related Item:** Vehicles striking railroad tracks or embankments, including run-off-road crashes and tractor-trailers becoming lodged at humpback crossings.
- **Other Single-Vehicle:** Miscellaneous single-vehicle crashes not included in the preceding categories.
- **Pedestrian Involved:** A single case of a train-pedestrian collision identified in the motor vehicle crash records.
- **Other Multi-Vehicle/Unusual:** Miscellaneous crossing-related events, such as vehicles entering crossing reconstruction work zones.

Table 32. Law enforcement reported crossing-related crashes by WisDOT Region, office, and severity.

Region	NC		NE	NW		SE	SW		Statewide Total	Percent
Office	Rhine-lander	Wisconsin Rapids	Green Bay	Eau Claire	Superior	Waukesha	La Crosse	Madison		
Fatal (K)	0	0	2	4	0	2	0	1	9	1.1%
Incapacitating Injury (A)	0	3	2	5	4	8	2	2	26	3.1%
Non-Incapacitating Injury (B)	0	10	12	7	2	11	1	13	56	6.7%
Possible Injury (C)	0	6	38	5	4	27	8	13	101	12%
No Apparent Injury (O)	13	58	163	72	32	172	40	96	646	77%
Total	13	77	217	93	42	220	51	125	838	100%
	90			135			176			
Percent	2%	9%	26%	11%	5%	26%	6%	15%	100%	
	11%			16%			21%			

Table 33. Law enforcement reported crossing-related crashes by WisDOT Region, office, and consequence.

Region	NC		NE	NW		SE	SW		Statewide Total	Percent
Office	Rhine-lander	Wisconsin Rapids	Green Bay	Eau Claire	Superior	Waukesha	La Crosse	Madison		
Struck Fixed Object	3	5	22	3	2	21	5	18	79	9%
Struck Crossing Equipment	3	15	36	31	2	45	6	25	163	19%
Train Involved	1	16	39	22	16	24	7	12	137	16%
Other Single Vehicle	0	2	9	1	3	10	1	7	33	3.9%
Pedestrian Involved	0	1	0	0	0	0	0	0	1	0.1%
Struck Track Related Item	1	10	25	23	5	31	8	18	121	14%
Other Multi-Vehicle/Unusual	1	15	31	4	3	23	10	22	109	13%
Rear-End at Crossing	4	13	55	9	11	66	14	23	195	23%
Total	13	77	217	93	42	220	51	125	838	100%
	90			135			176			
Percent	2%	9%	26%	11%	5%	26%	6%	15%	100%	
	11%			16%			21%			

The crash database is available through an interactive web map http://go.ncsu.edu/wi-rrx. As shown in Figure 18, users can zoom to individual locations, identify crossings with multiple crashes, and filter crashes by consequence and severity. Additional information for individual crossings and crashes is available by right-clicking the corresponding map features (Figure 19).

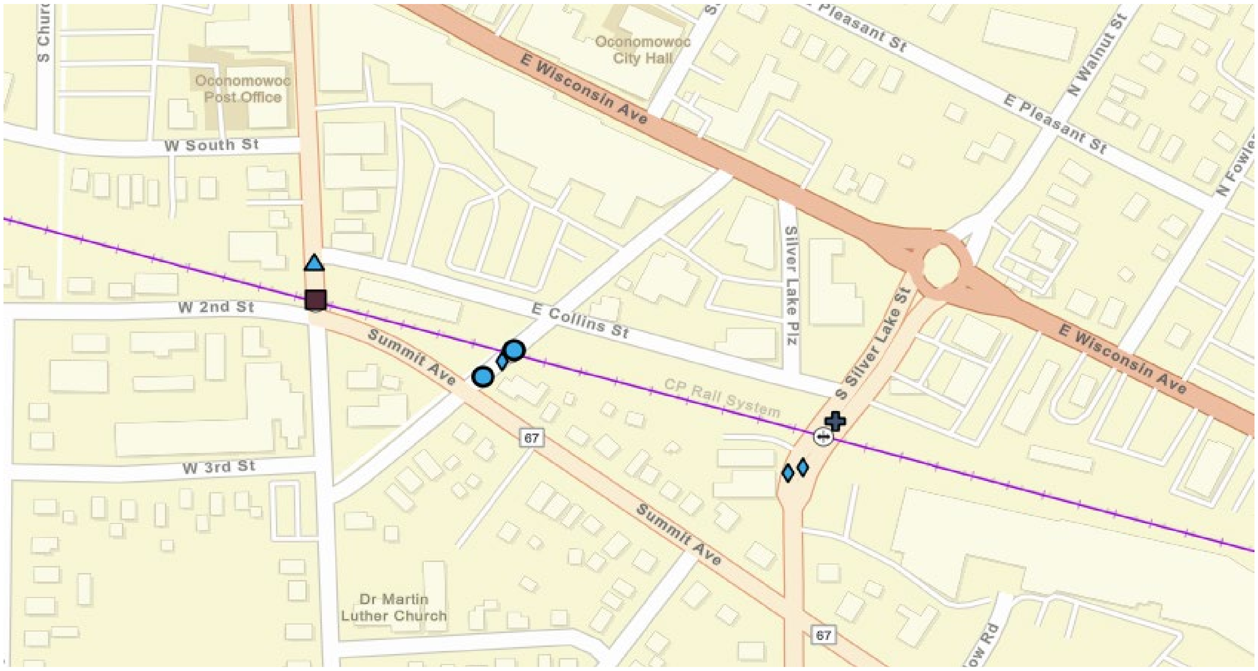


Figure 16. Crossings with multiple crashes – Oconomowoc

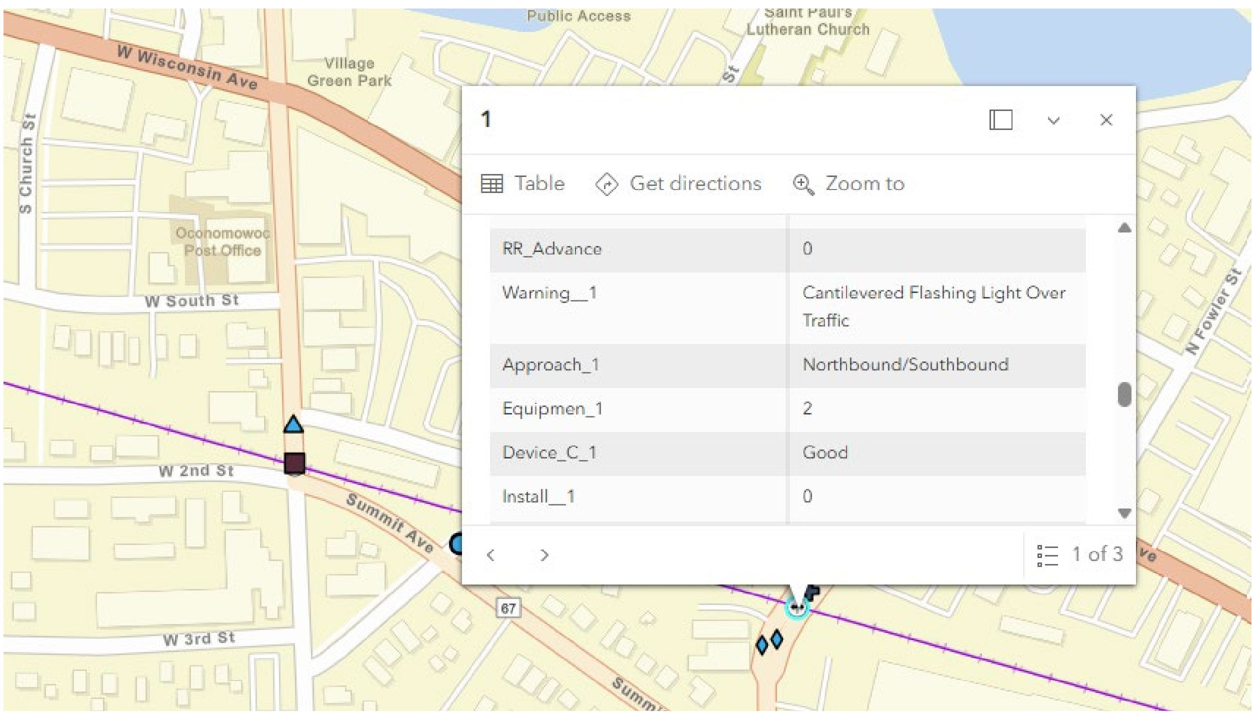


Figure 17. Additional details available by right-clicking a crossing marker.

Static crash maps are presented in Figure 18. Geographical distribution of crossing-involved crashes of all severities. See Figure 23 through Figure 26 for urban area details.Figure 18 through Figure 21. The series begins with a statewide map of all crossing-related crashes (Figure 18), followed by maps showing fatal and incapacitating injury crashes (Figure 19), non-incapacitating and possible injury crashes (Figure 20), and property-damage-only crashes (Figure 21).

Figure 22 presents two complementary summaries of the statewide crash distribution. The heat map (left) illustrates the severity-weighted spatial distribution of crashes, highlighting concentrations in the Fox Valley, Green Bay, the western Milwaukee suburbs, the Kenosha-Racine corridor, Madison, Wausau, and Hudson. The accompanying cartogram (right) summarizes both the number and severity of crashes within the counties served by each WisDOT Region Office. Pie chart size is proportional to the number of crashes, while slice colors indicate crash severity.

Figure 23 through Figure 26 provide enlarged views of metropolitan areas where the statewide maps become difficult to interpret, including Milwaukee, Madison, the Fox River Valley, Green Bay, Eau Claire, La Crosse, the Wisconsin River Valley, and Superior.

Additional information on the geographic distribution of crash types is presented in Figure 27 through Figure 44. Figure 27 summarizes crash severity by consequence category statewide, while Figure 28 illustrates the statewide distribution of crash consequence categories. Figure 29 though Figure 44 present the same information for each of the eight WisDOT Region offices.

The results demonstrate that railroad crossing safety concerns are not uniformly distributed throughout Wisconsin. The Northeast Region (Green Bay) accounts for more than one-quarter of all crossing-related crashes, followed closely by the Southeast Region (Waukesha). More than one-fifth of the crashes occur within the Southwest Region, while approximately 16 percent occur in the Northwest Region, primarily near Eau Claire and the Port of Superior. Consistent with its relatively small number of railroad crossings, the North Central Region experiences the fewest crossing-related crashes, although notable concentrations are present near Stevens Point, Wausau, and Wisconsin Rapids.

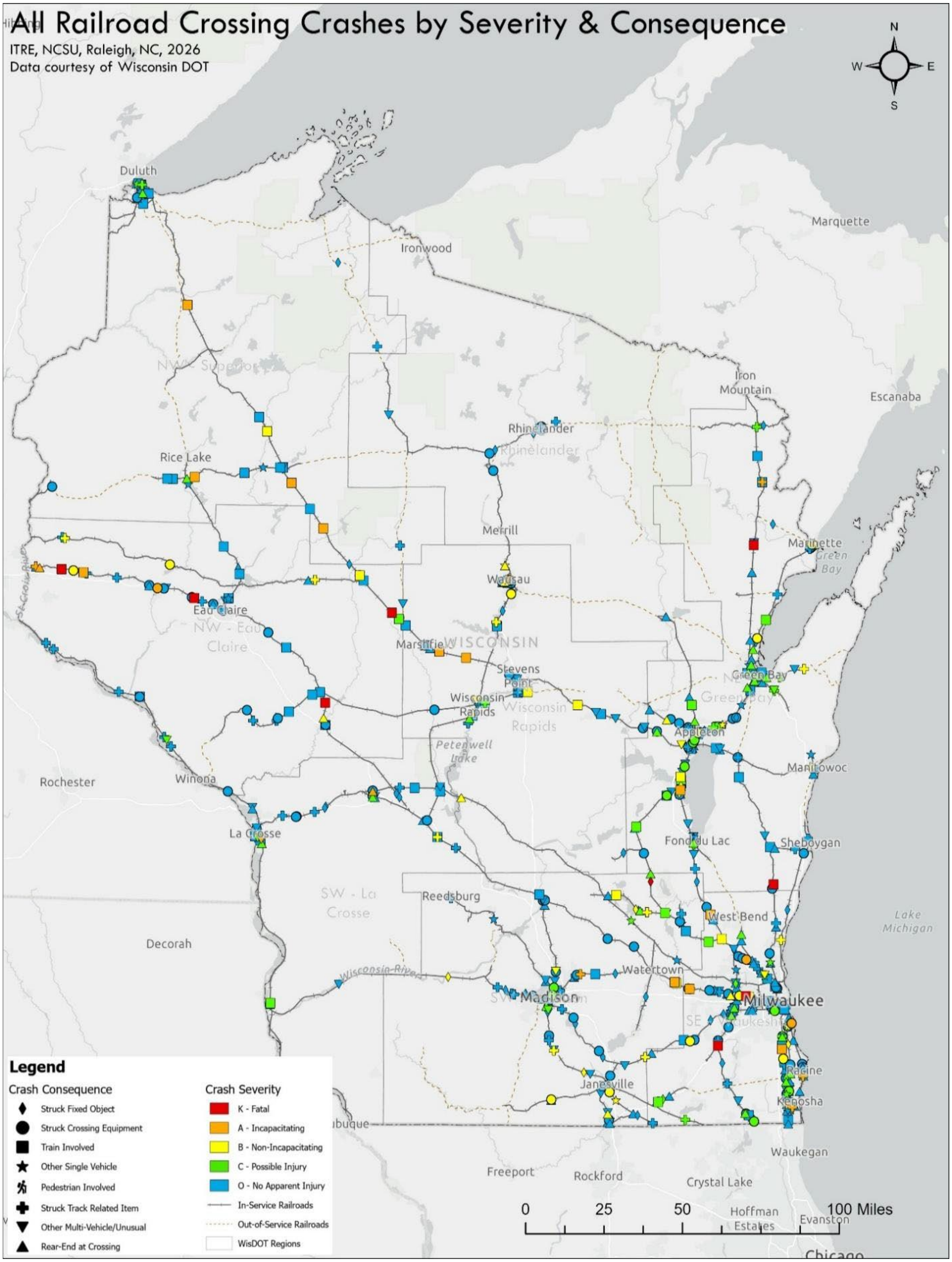


Figure 18. Geographical distribution of crossing-involved crashes of all severities. See Figure 23 through Figure 26 for urban area details.

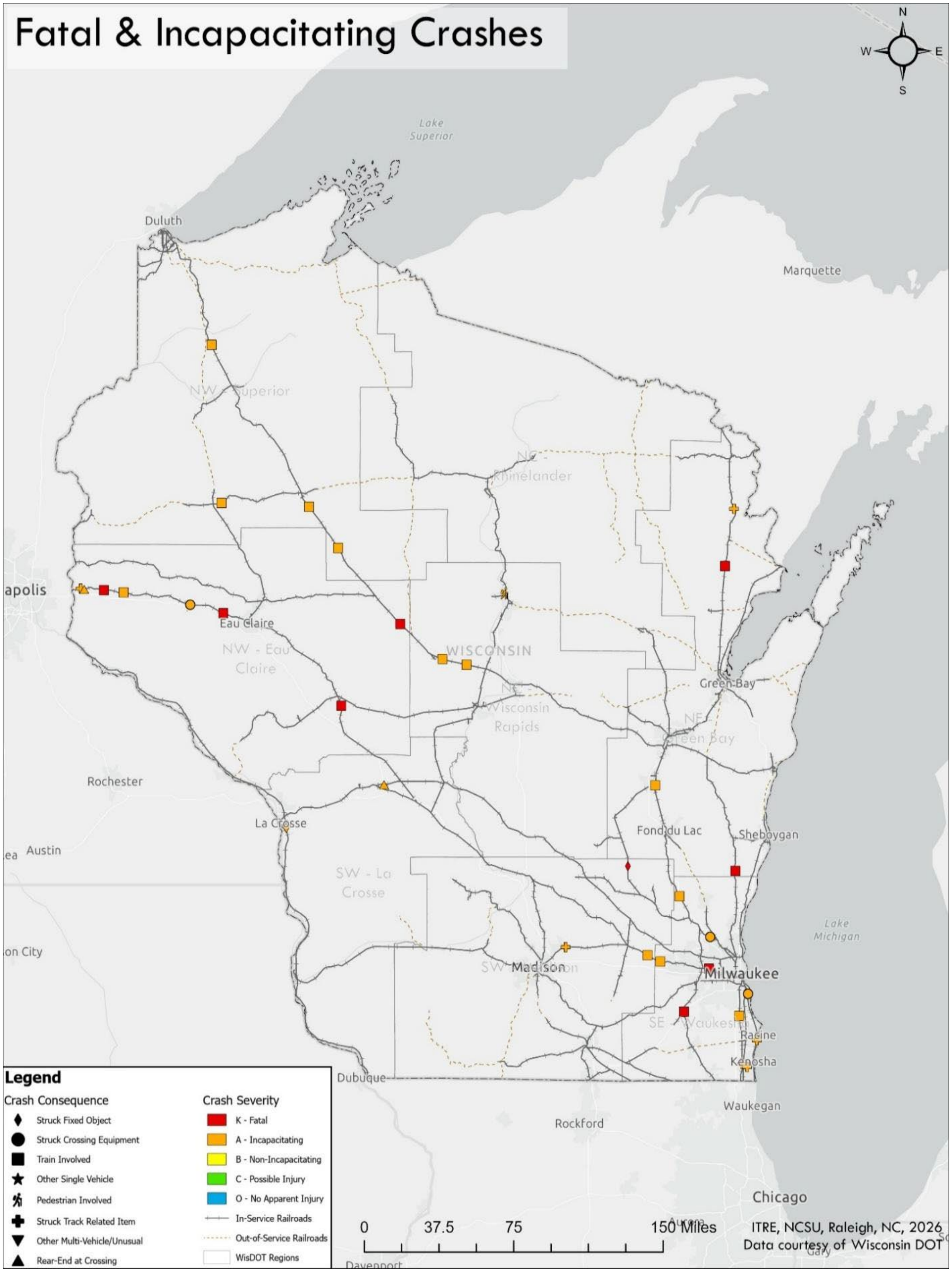


Figure 19. Geographical distribution of crossing-involved fatal (K) and incapacitating injury (A) crashes.

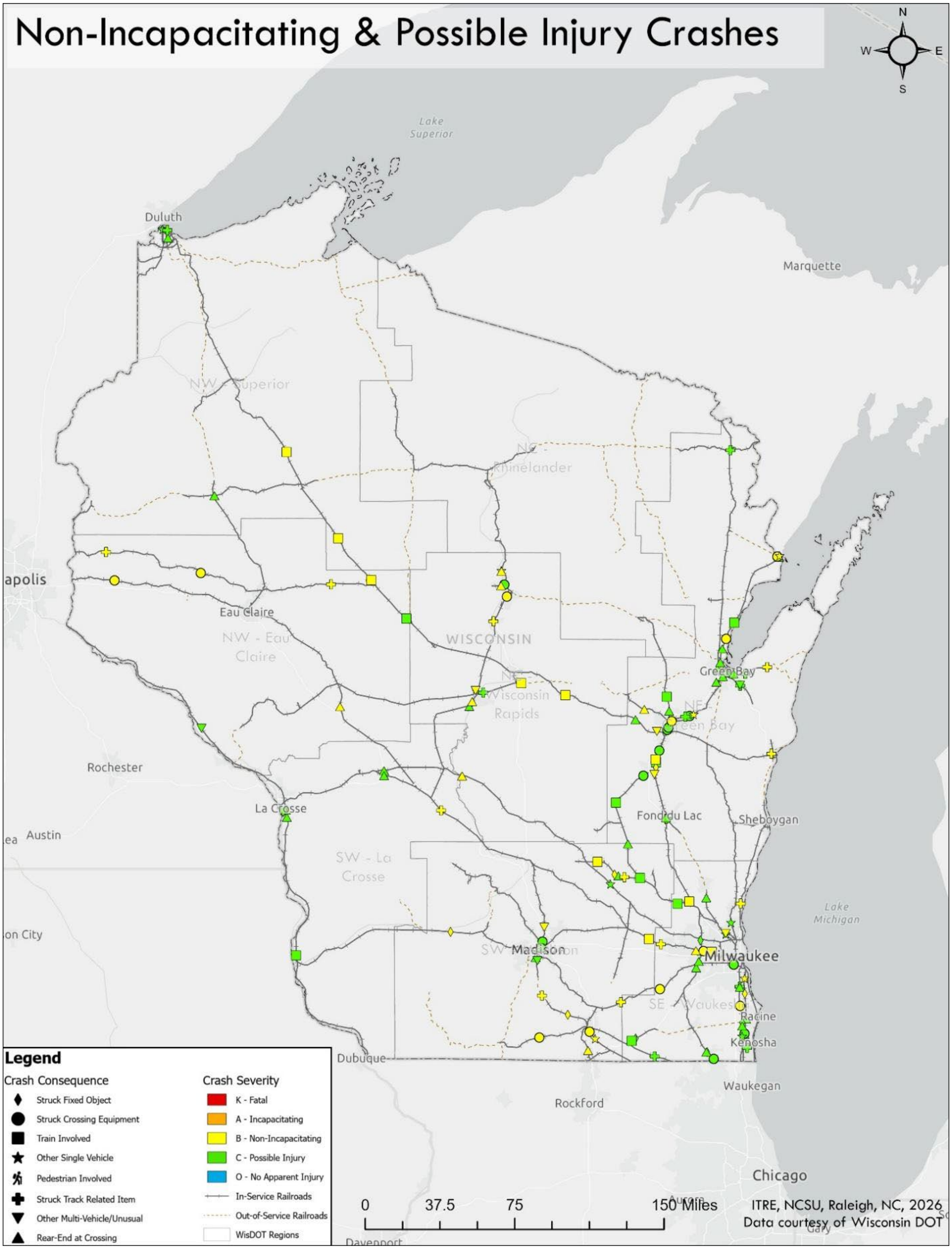


Figure 20. Geographical distribution of crossing-involved non-incapacitating injury (B) and possible injury (C) crashes

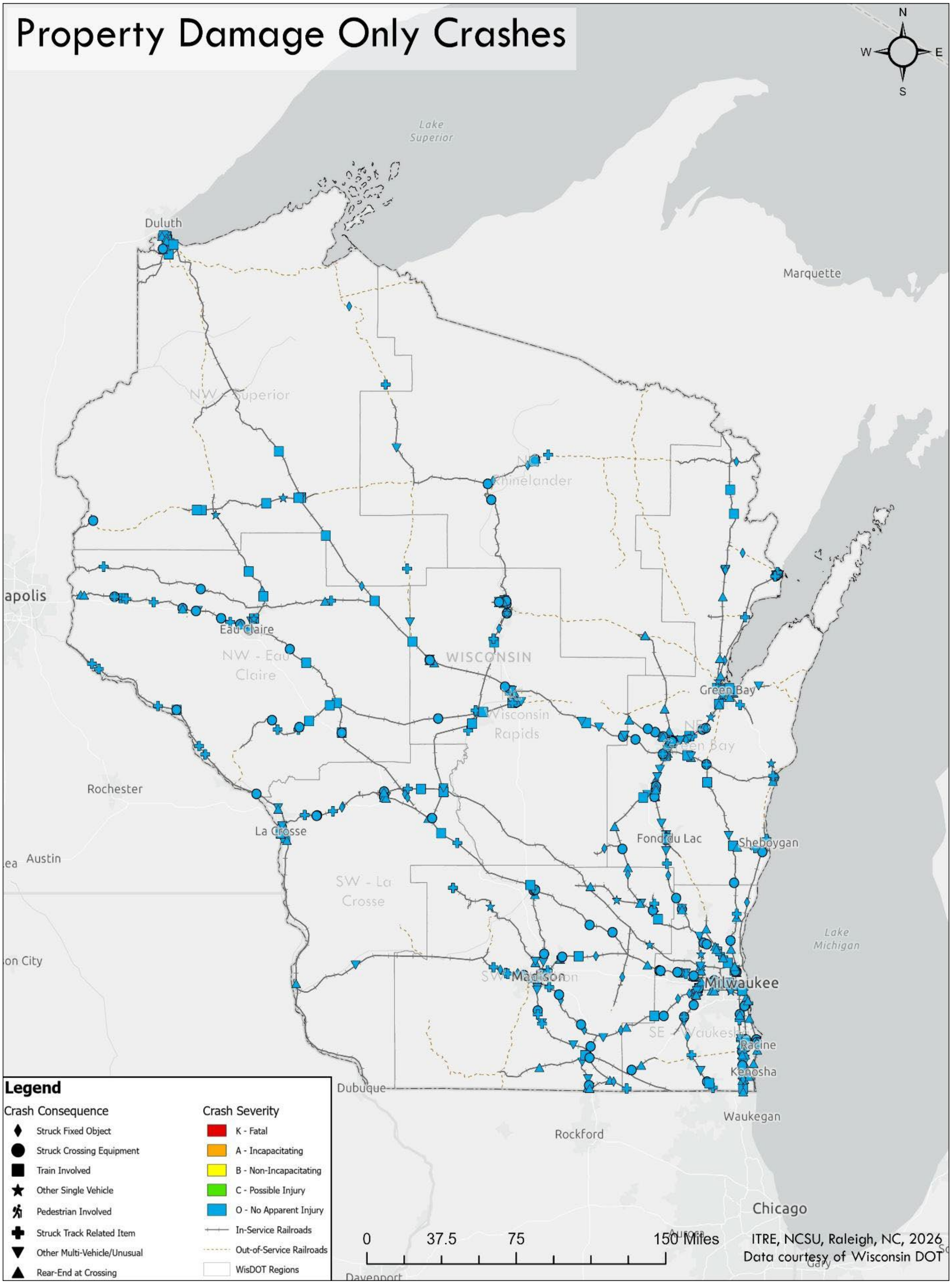


Figure 21. Geographical distribution of crossing-involved property-damage-only (O) crashes.

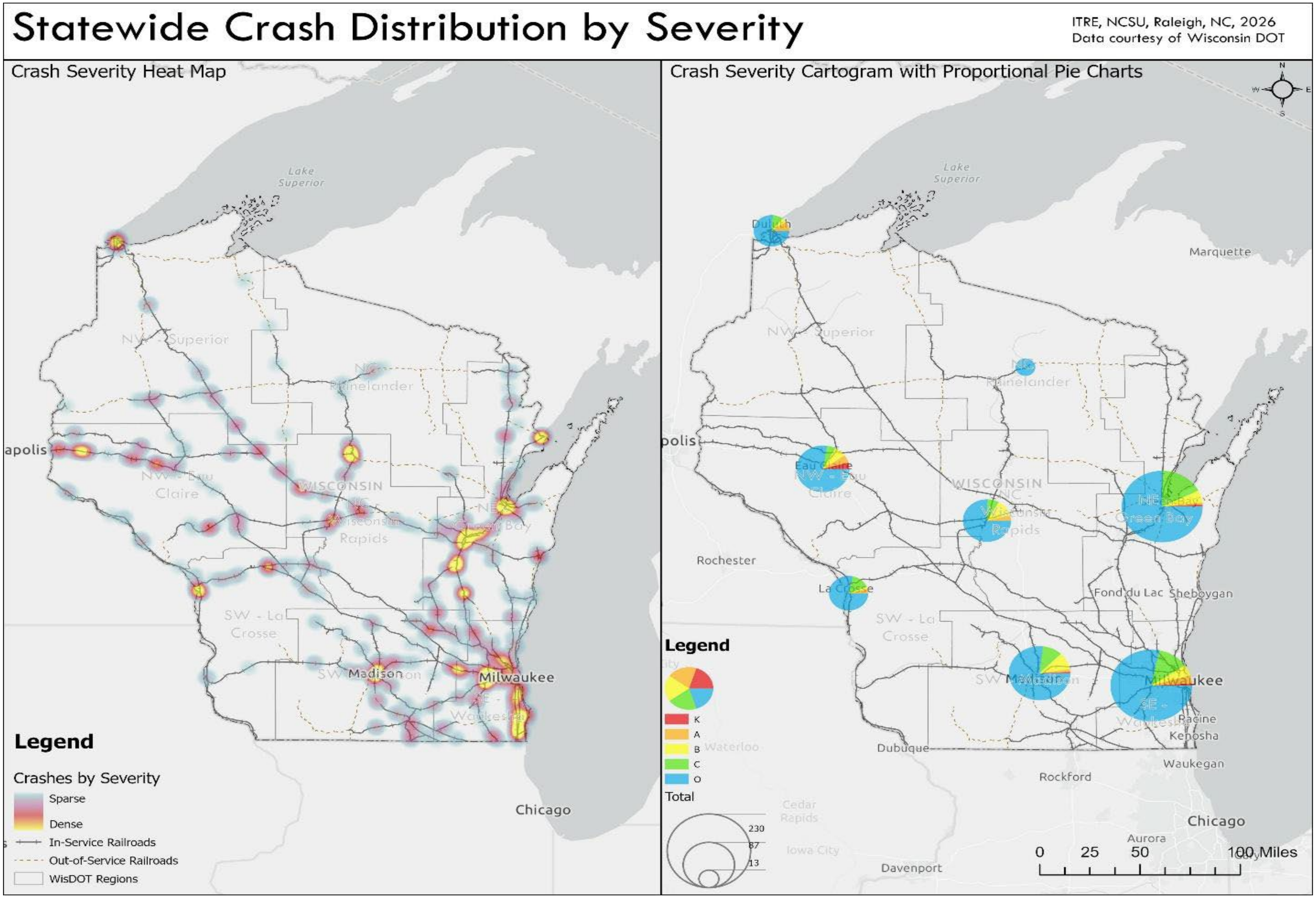


Figure 22. Heat map of severity-weighted crossing-involved crashes (left) and cartogram indicating relative number and severity of crossing-involved crashes in the counties associated with each WisDOT region office.

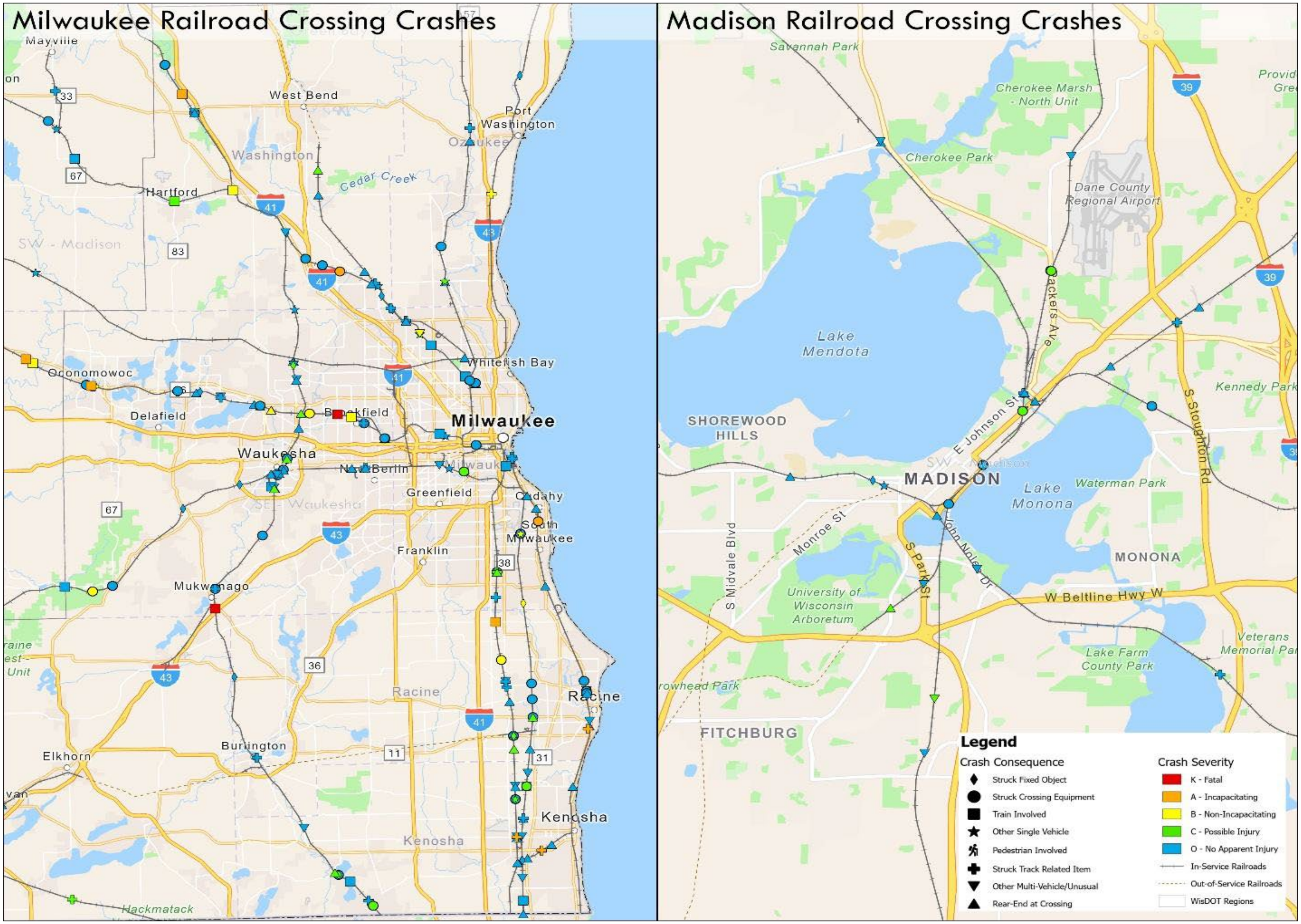


Figure 23. Geographical distribution of crossing-involved crashes of all severities for the Milwaukee (left) and Madison (right) areas.

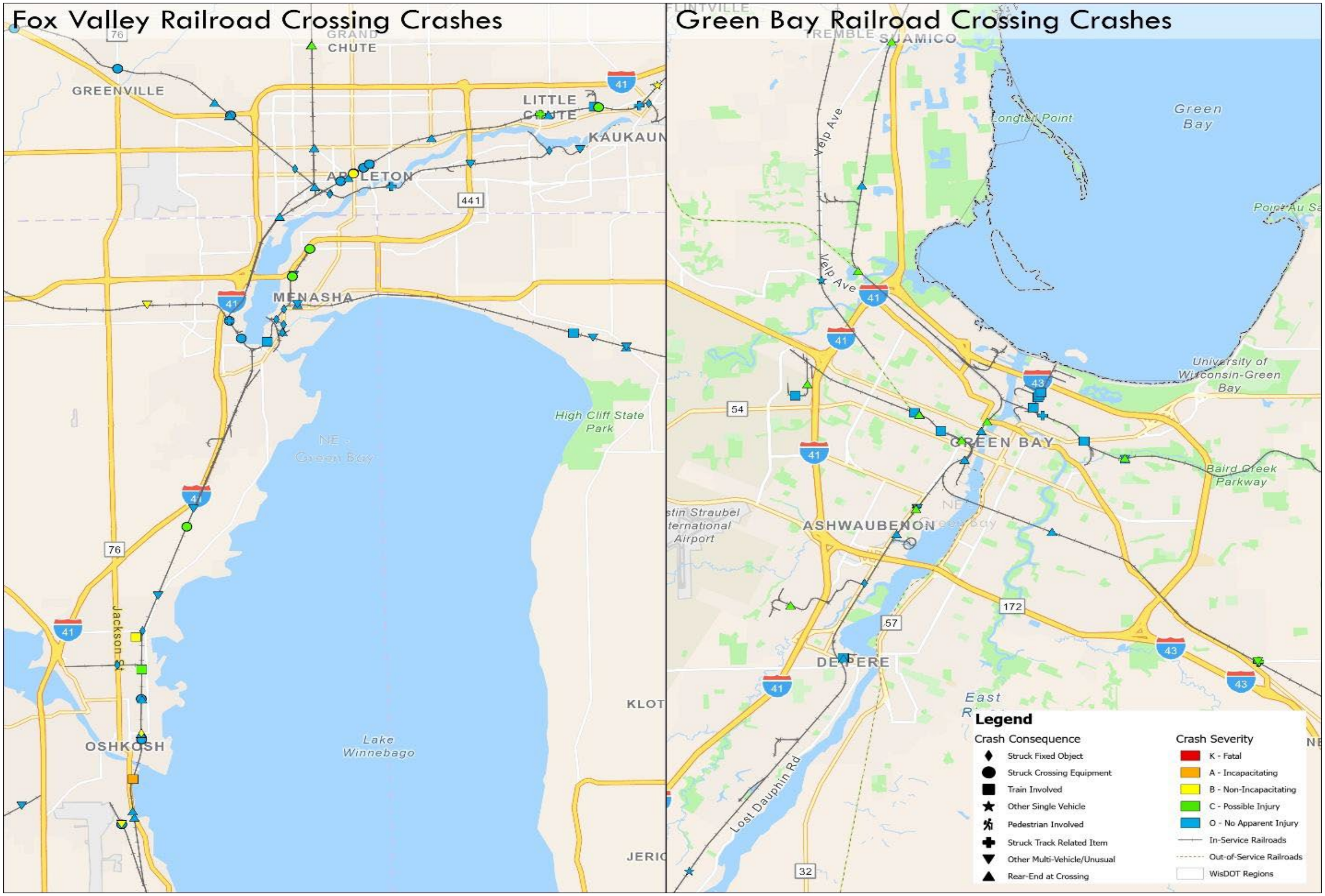


Figure 24. Geographical distribution of crossing-involved crashes of all severities for the Fox River Valley (left) and Green Bay area (right).

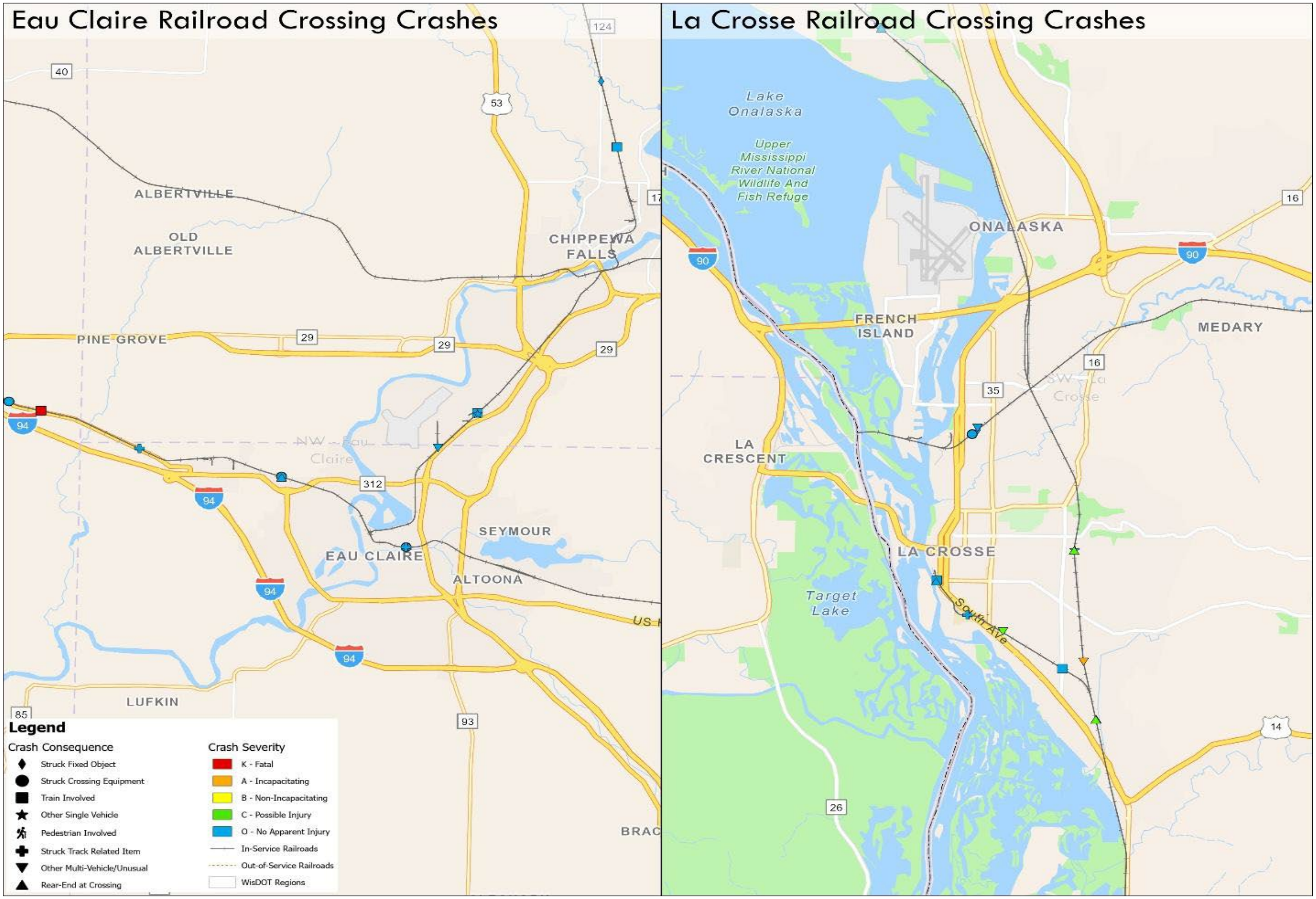


Figure 25. Geographical distribution of crossing-involved crashes of all severities for the Eau Claire (left) and La Crosse (right) areas.

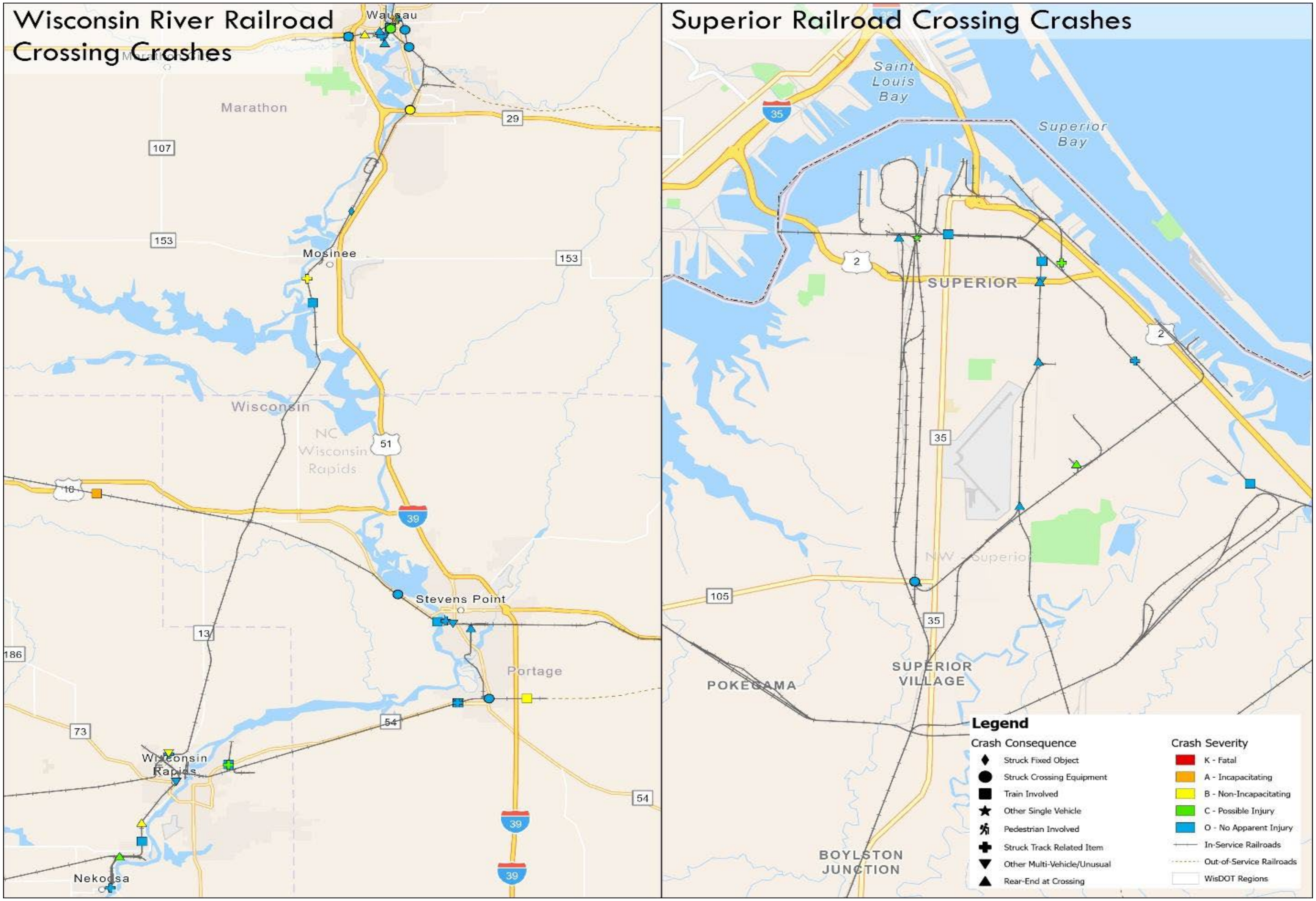


Figure 26. Geographical distribution of crossing-involved crashes of all severities for the Wisconsin River Valley (left) and Superior area (right).

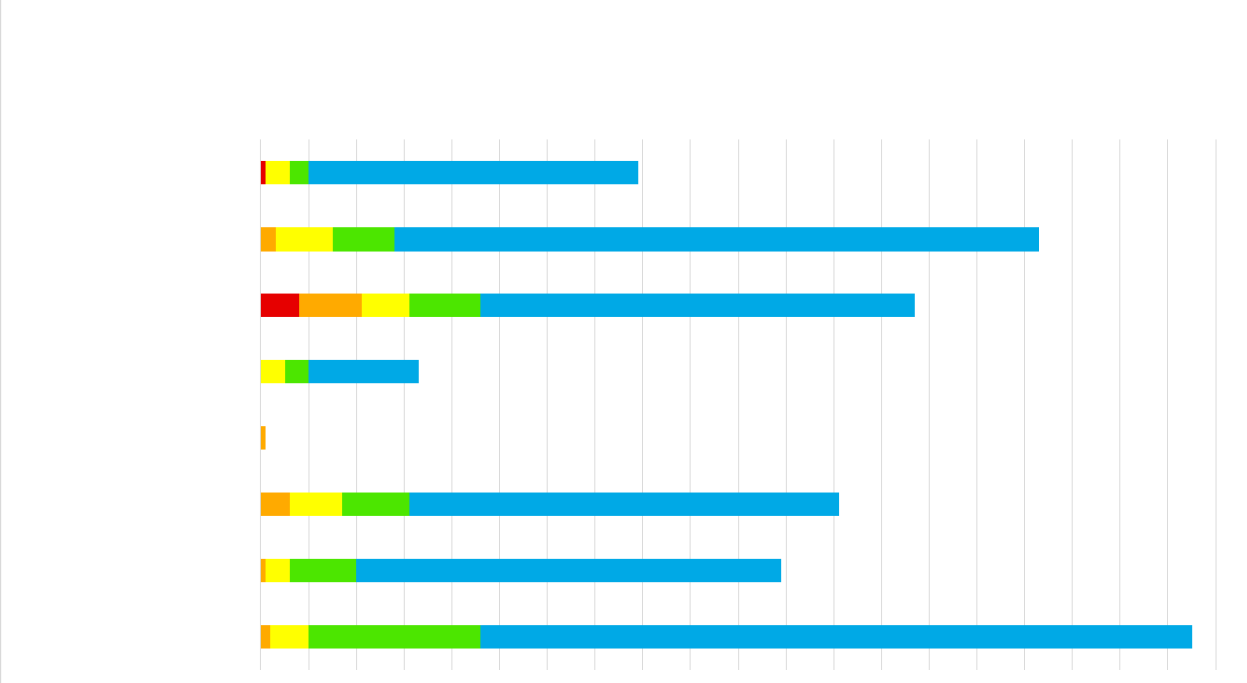


Figure 27. Crossing-involved crashes by severity and consequence – Statewide

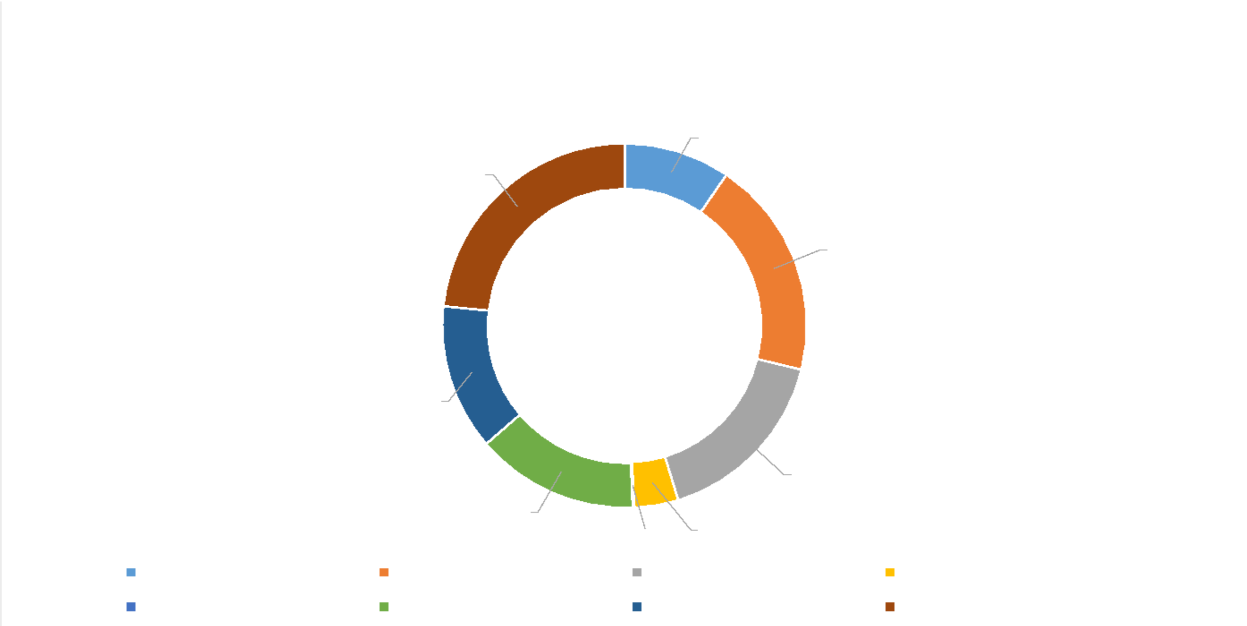


Figure 28. Allocation of crossing-related crashes by consequence – Statewide

Figure 29. Crossing-involved crashes by severity and consequence – North Central Region – Rhinelander

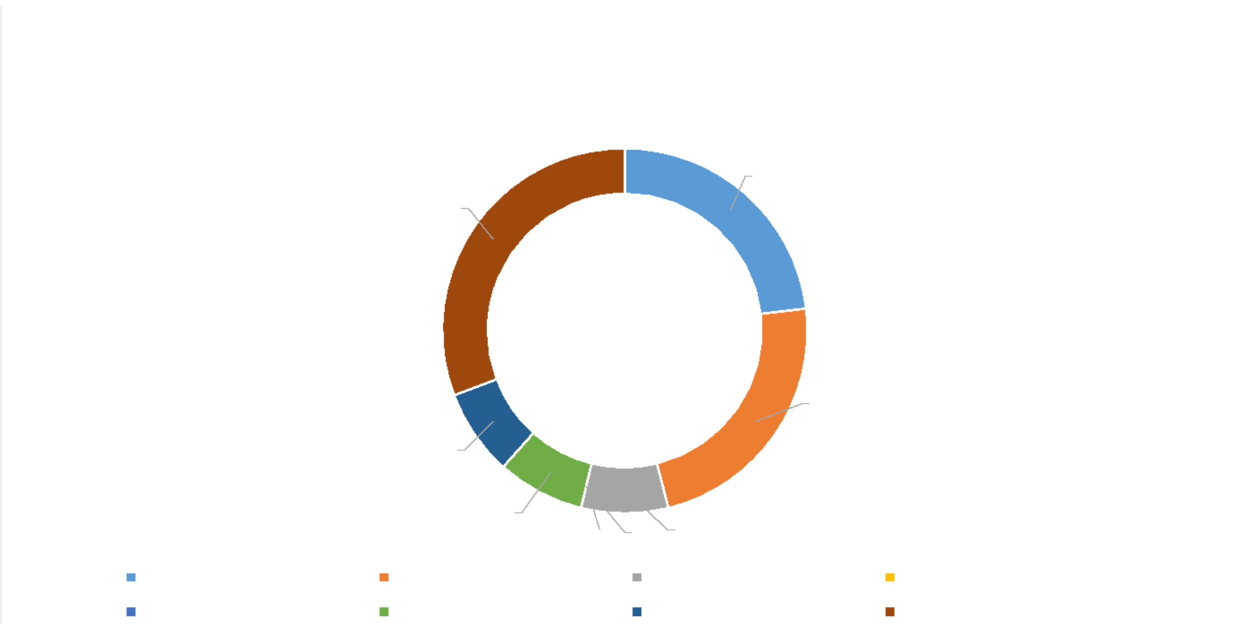


Figure 30. Allocation of crossing-related crashes by consequence – North Central Region - Rhinelander

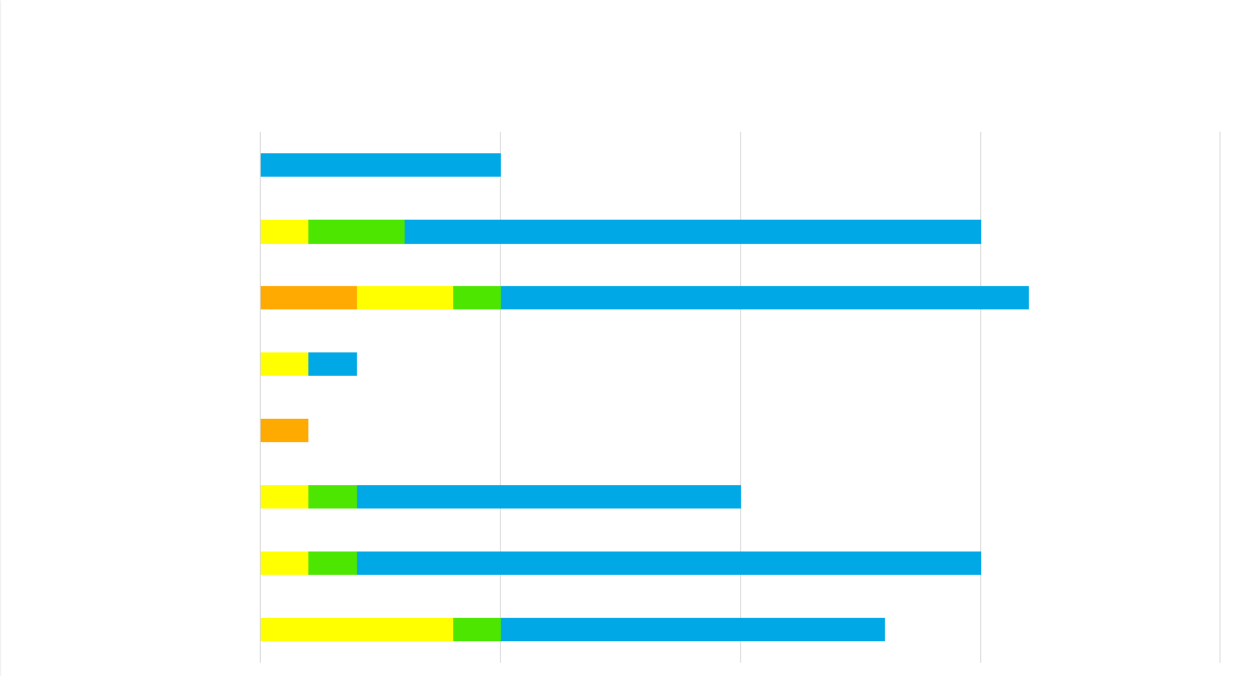


Figure 31. Crossing-involved crashes by severity and consequence – North Central Region - Wisconsin Rapids

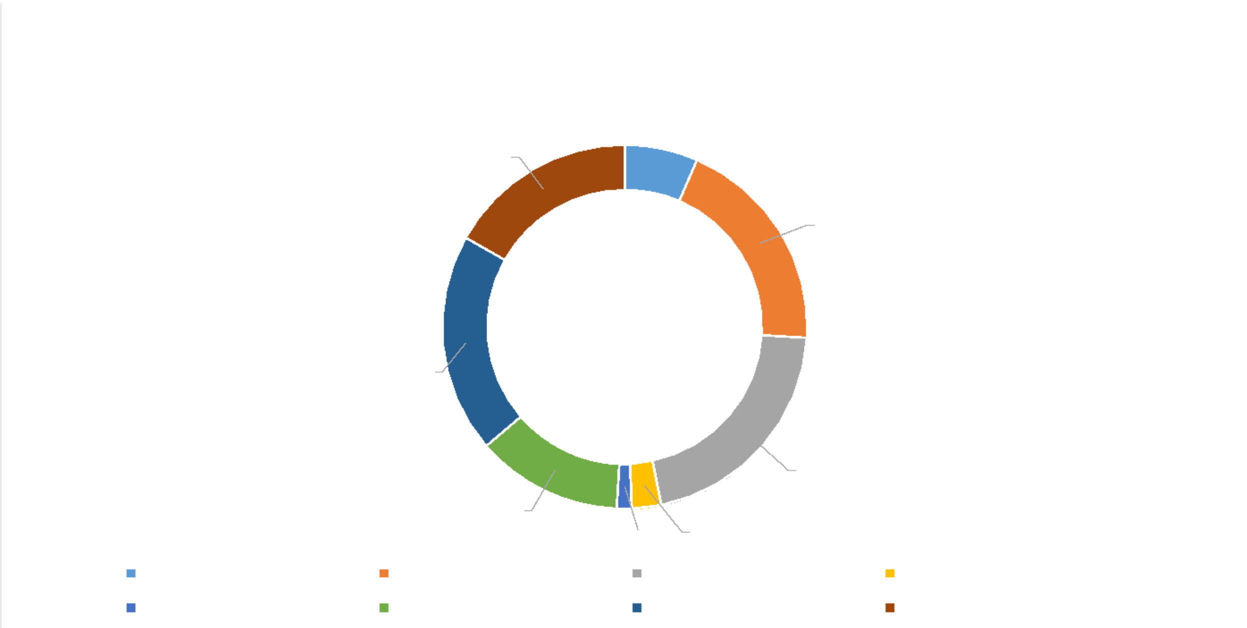


Figure 32. Allocation of crossing-related crashes by consequence – North Central Region – Wisconsin Rapids

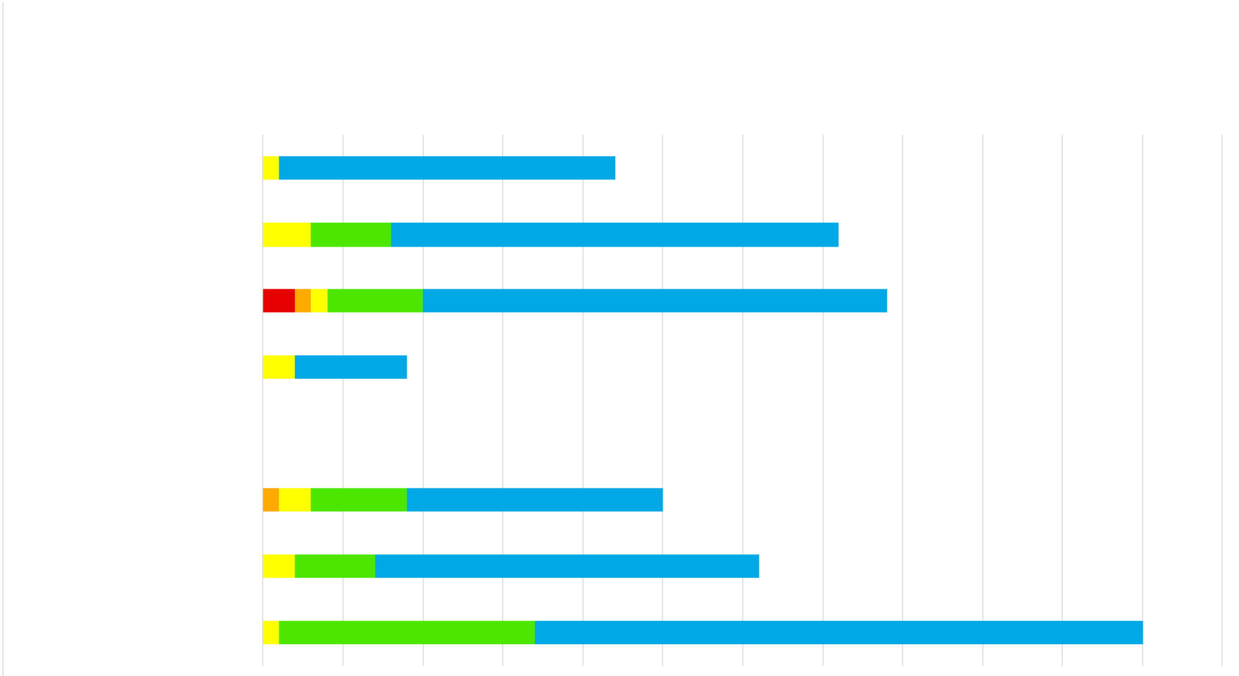


Figure 33. Crossing-involved crashes by severity and consequence – Northeast Region - Green Bay

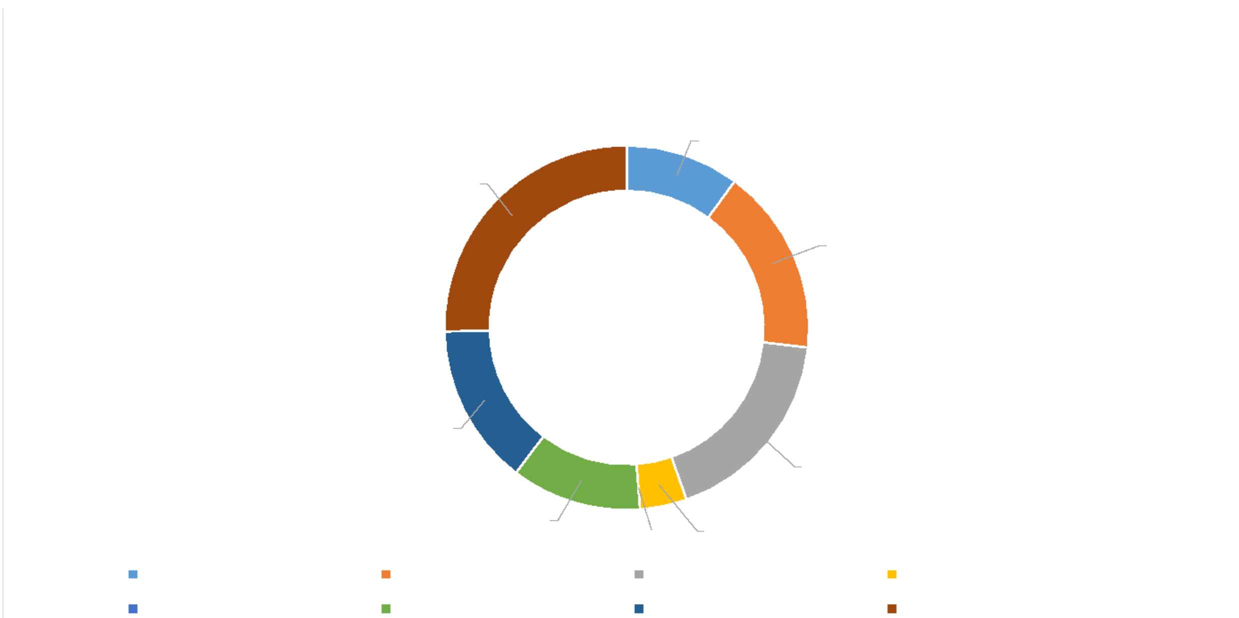


Figure 34. Allocation of crossing-related crashes by consequence – Northeast Region - Green Bay

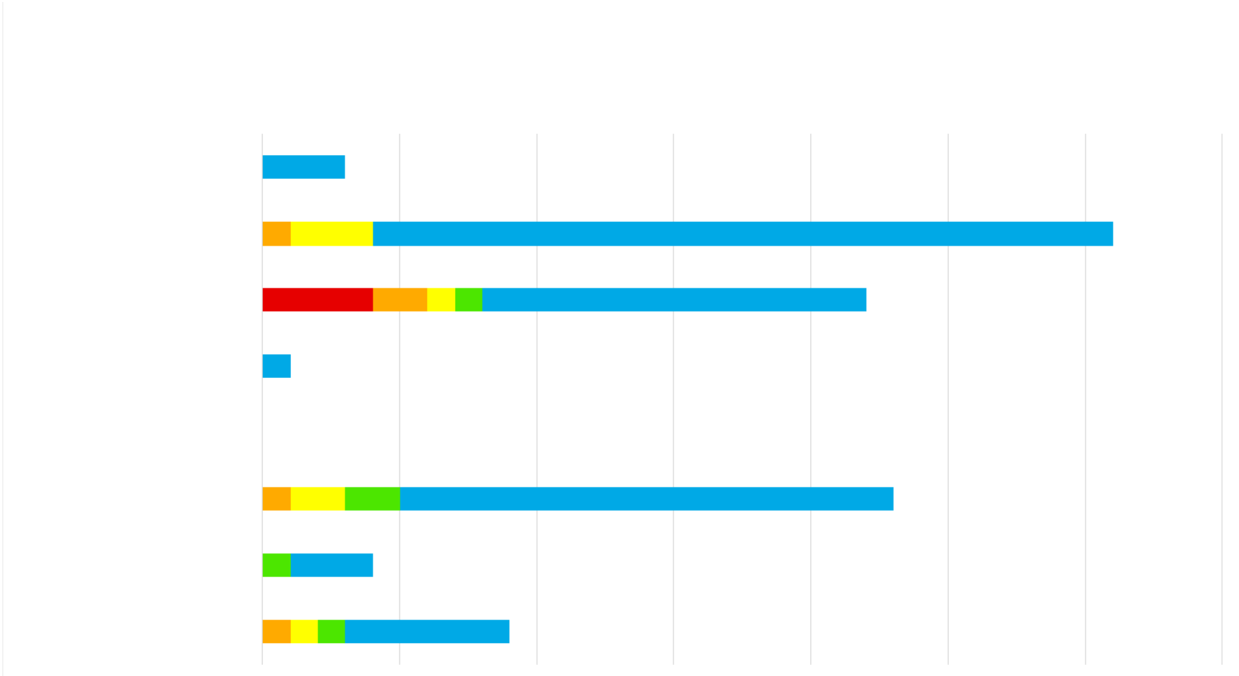


Figure 35. Crossing-involved crashes by severity and consequence – Northwest Region - Eau Claire

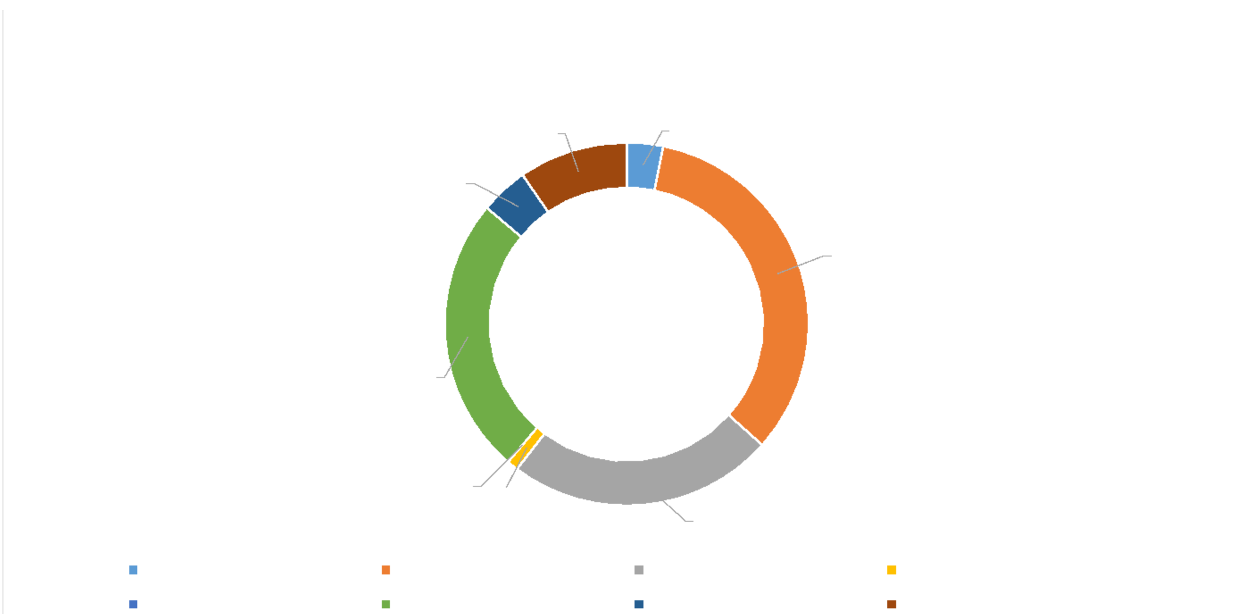


Figure 36. Allocation of crossing-related crashes by consequence – Northwest Region - Eau Claire

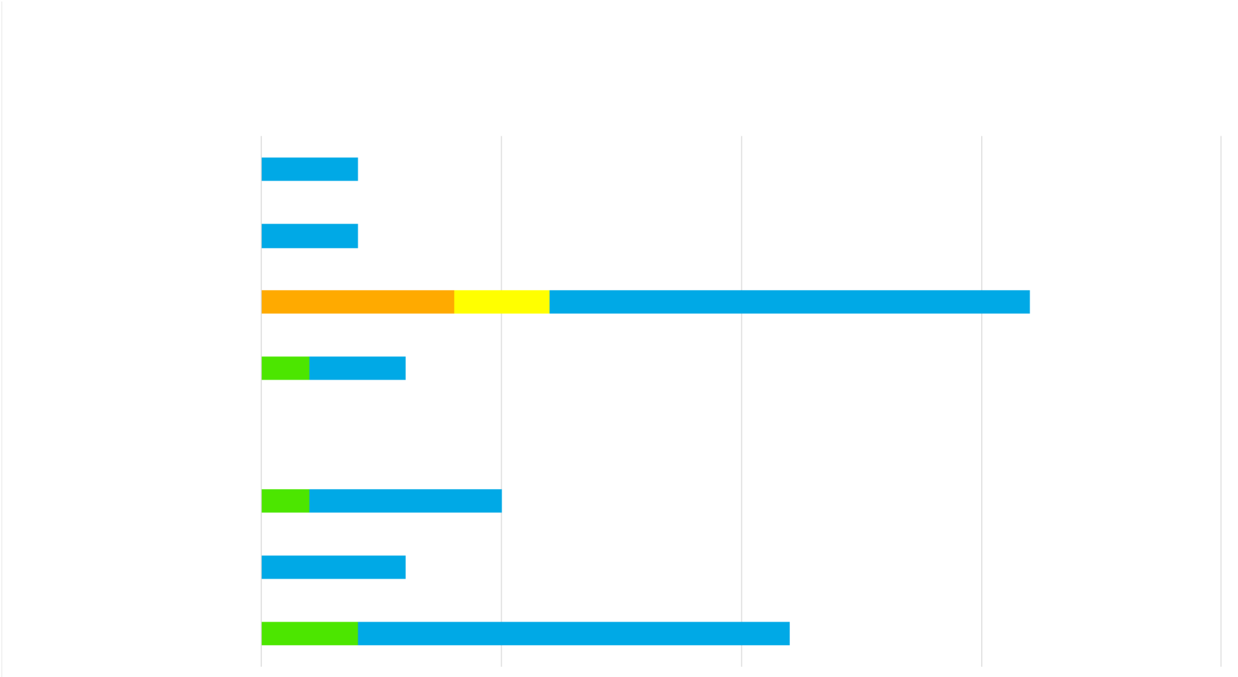


Figure 37. Crossing-involved crashes by severity and consequence – Northwest Region – Superior

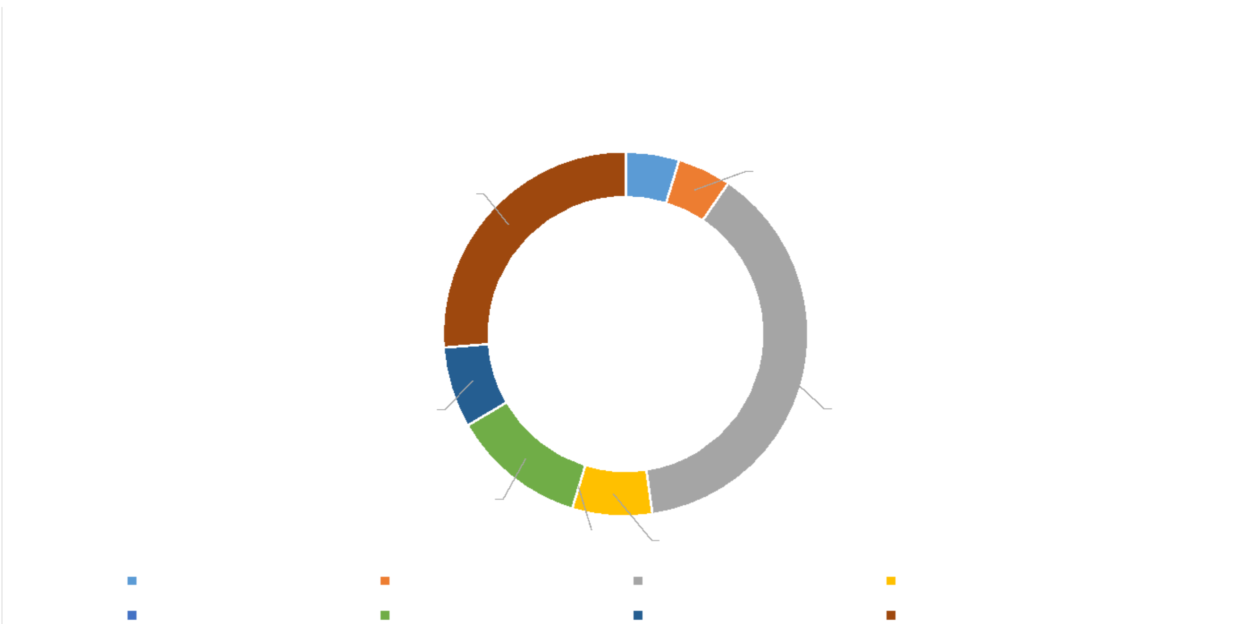


Figure 38. Allocation of crossing-related crashes by consequence – Northwest Region - Superior

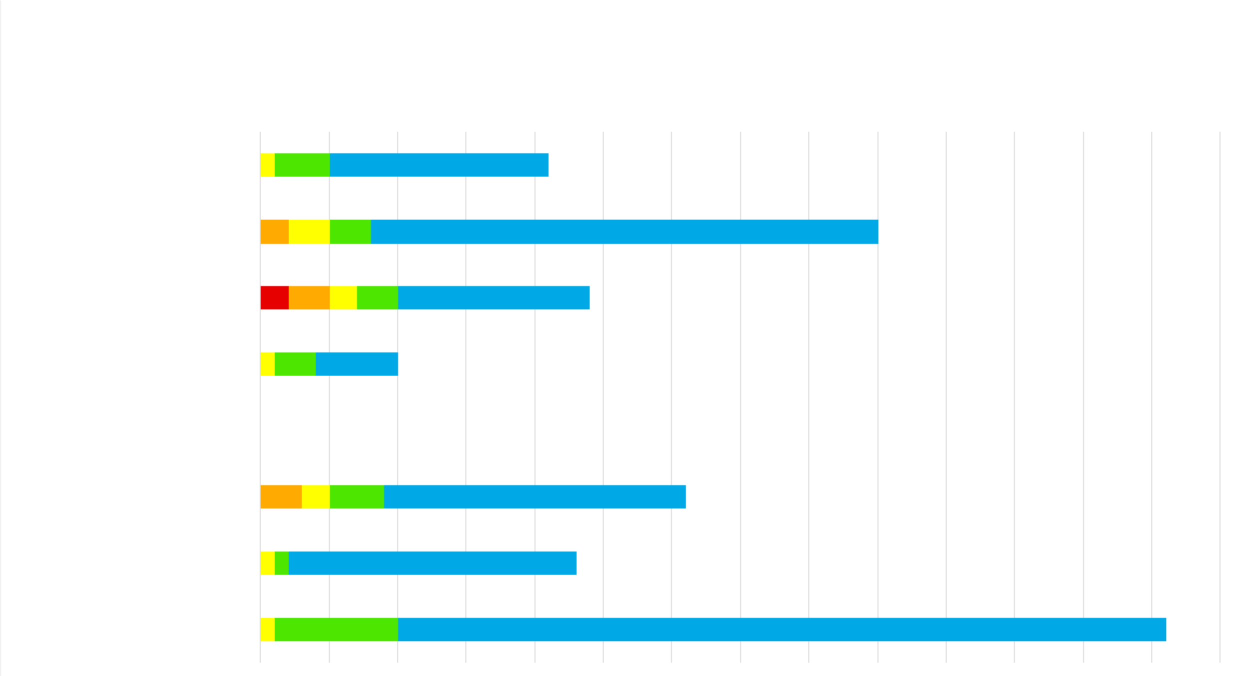


Figure 39. Crossing-involved crashes by severity and consequence – Southeast Region – Waukesha

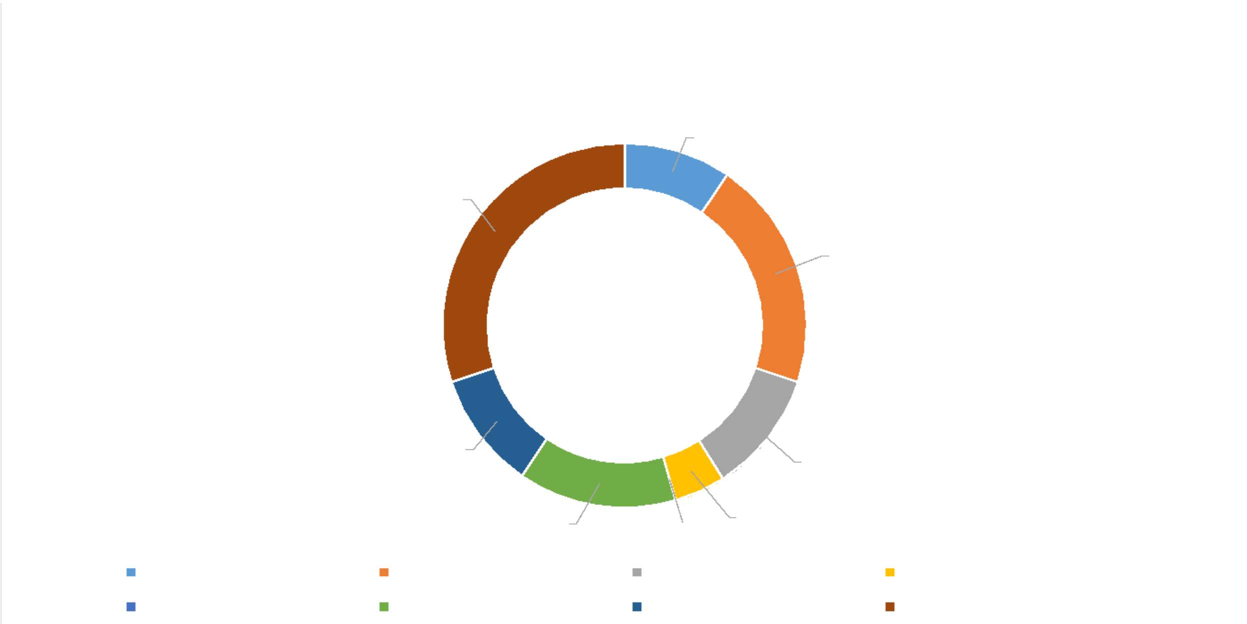


Figure 40. Allocation of crossing-related crashes by consequence – Southeast Region – Waukesha

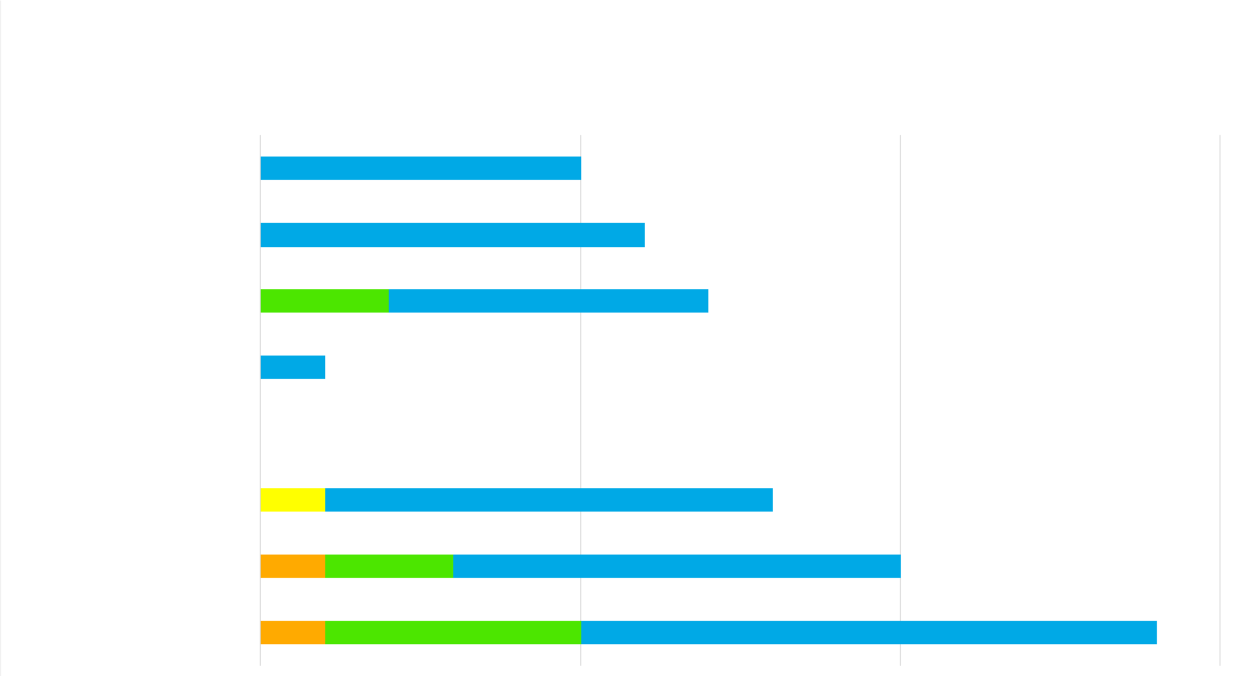


Figure 41. Crossing-involved crashes by severity and consequence – Southwest Region - La Crosse

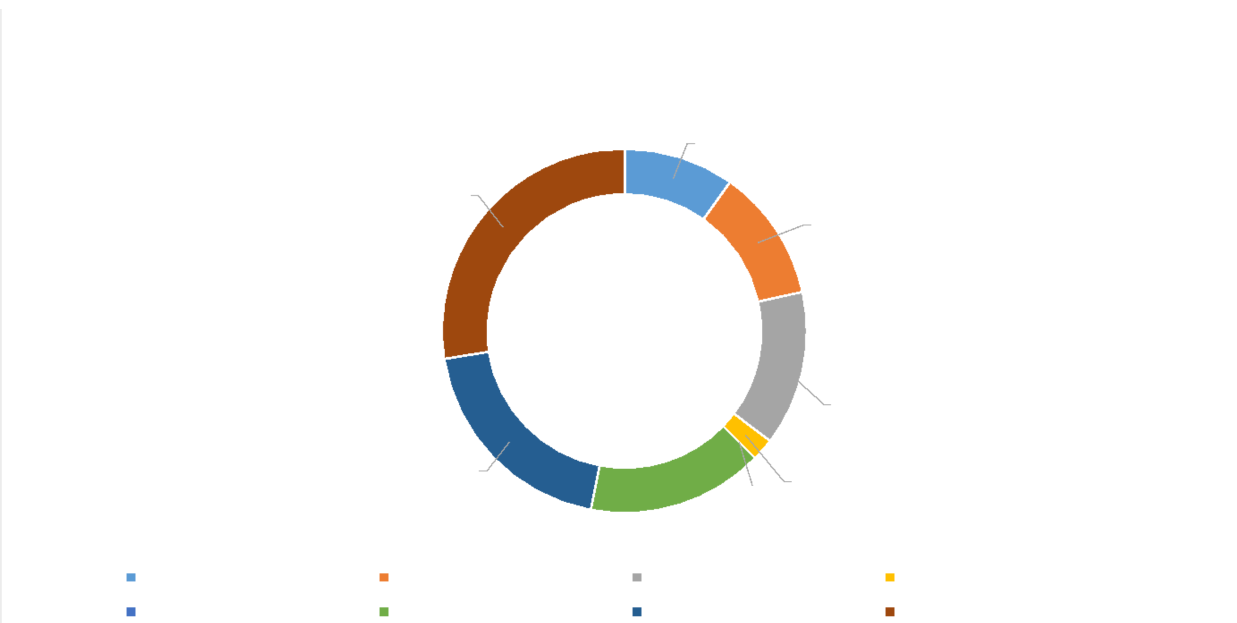


Figure 42. Allocation of crossing-related crashes by consequence – Southwest Region - La Crosse

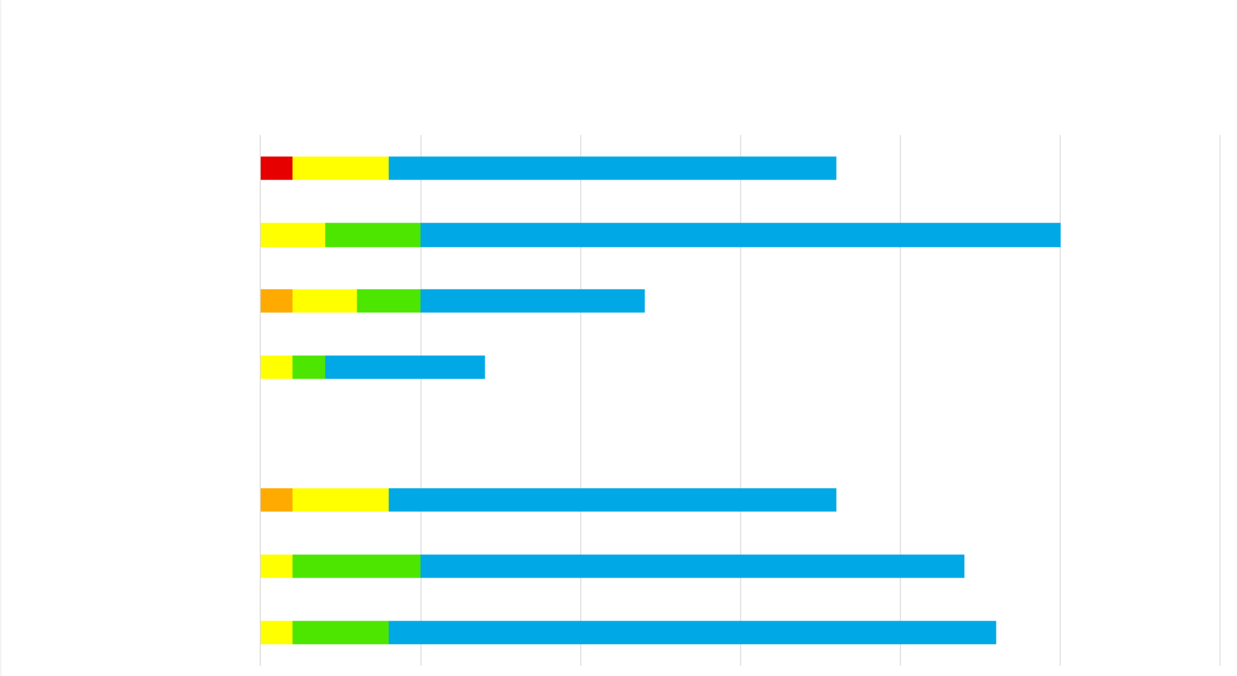


Figure 43. Crossing-involved crashes by severity and consequence – Southwest Region – Madison

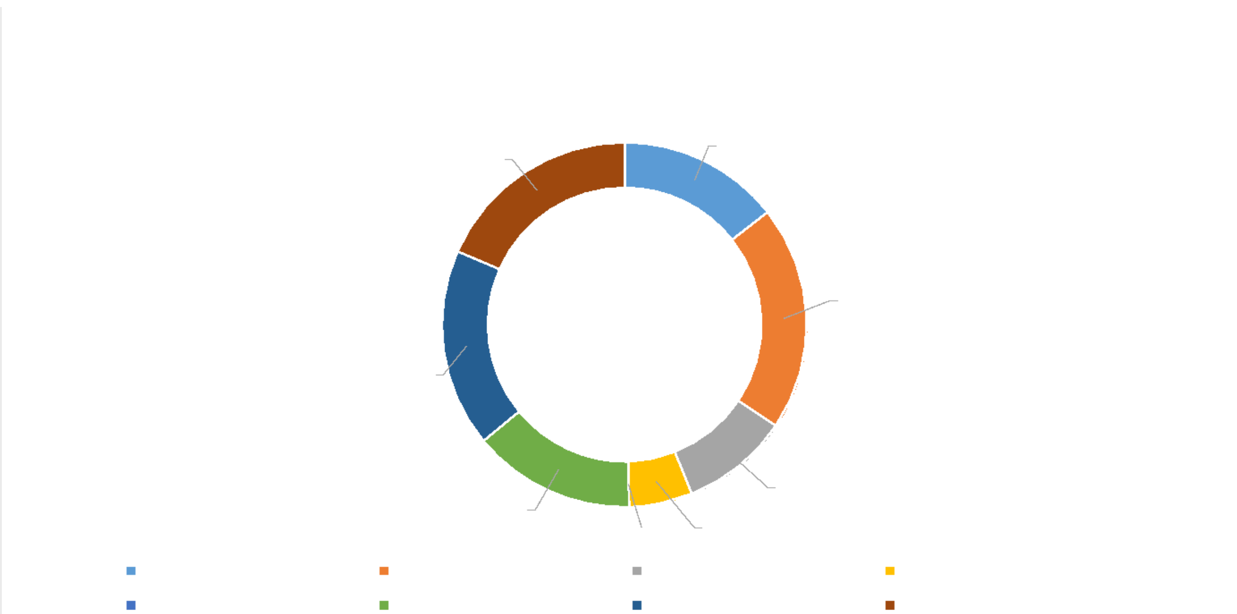


Figure 44. Allocation of crossing-related crashes by consequence – Southwest Region – Madison

6.4 Engineering Countermeasures for Crossing-Related Crashes

Although vehicle-train collisions have historically been the primary focus of railroad crossing safety programs, this analysis demonstrates that many other crash types require consideration. Fixed-object crashes occur more frequently than vehicle-train collisions statewide and in nearly every WisDOT Region, reinforcing findings from previous research *(Cyr et al., 2019)*. Run-off-road crashes and rear-end collisions involving vehicles stopped at crossings are also common. Table 34 summarizes potential engineering countermeasures for addressing these crash types. Many of these improvements could be incorporated into routine crossing maintenance, signal upgrades, and crossing surface rehabilitation projects through revisions to design standards and operating procedures. Consistent with the Safe System Approach, the objective is to prevent deaths and serious injuries for all users of the transportation system, as well as preventing disruptions to road and rail operations.

Table 34. Safety improvement strategies for non-train-involved crossing-related crashes

Situation	Potential Countermeasures
Rear-end collisions involving vehicles stopped at crossing	• Improve visibility upstream of crossing • Install high-friction surface treatments at crossing approaches • Provide radar-activated dynamic queue warning • Provide lateral rumble strips upstream of crossings with high train volumes
Crossing Signal Mast, Gate, and Bungalow Strikes	• Redesign flashing-lights-only signals to include breakaway bases • Increase lateral clearance between cantilever and gate support masts and travelled way • Locate signal bungalows beyond clear zone • Install high-friction surface treatments at crossing approaches
Other fixed-object collisions	• Ensure utility poles (including those providing power to crossing signals) are located beyond the clear zone • Remove unnecessary/obsolete roadside objects from crossing areas
Run-off-road crashes at crossings; track and embankment strikes	• Provide edge line rumble strips in advance of crossing • Provide full-width shoulders throughout crossing area. • Widen crossing surface to provide continuous shoulder • Provide turning path markings for crossings in/ near intersections • Improve vertical and horizontal geometry to provide recovery areas for errant vehicles • Install high-friction surface treatments at crossing approaches
Truck hang-ups at humpback crossings	• Provide proactive signing to prevent turns onto low-clearance roadways. • Provide active warning devices to alert trucks that lack adequate ground clearance • Improve vertical roadway profile to increase truck ground clearance

One particularly important finding is that railroad warning devices—including signal masts, cantilevers, gates, and controller bungalows—can themselves become roadside hazards. While these devices are intended to reduce train-vehicle collisions, they are large, rigid structures that are not crashworthy and are located close to the travelway. Unlike trains, which occupy crossings only briefly, this equipment presents a permanent roadside hazard. Potential improvements include:

- Redesigning flashing-light signal masts to incorporate breakaway bases similar to those used for traffic signals, pedestrian signals, and lighting poles. Breakaway supports are designed to fracture predictably upon impact, reducing crash severity while allowing relatively fast and inexpensive replacement. Additional guidance is available in the *AASHTO Roadside Design Guide* and the *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.
- Increasing the lateral offset between cantilever or gate support masts and the traveled way.

- Relocating signal controller bungalows and associated utility poles beyond the roadway clear zone.

Another significant concern identified during this study is the absence of safety shoulders at many railroad crossings. As shown previously in Figure 14, roadway shoulders frequently narrow or disappear at crossing approaches. This increases the likelihood that minor steering errors or loss of vehicle control will result in vehicles striking the railroad embankment or becoming lodged on the tracks. Potential countermeasures include installing edge-line rumble strips in advance of crossings, providing full-width shoulders through the crossing area, and widening crossing surfaces to maintain shoulder continuity.

Rear-end collisions involving vehicles stopped at crossings can be addressed by improving visibility upstream of the crossing. At locations with recurring queues, radar-activated dynamic queue warning systems similar to those used in work zones could be used. Lateral rumble strips can also be provided upstream of crossings with high train volumes, perhaps near the crossing's advance warning sign.

Chapter 7. Conclusions and Recommendations

7.1 Summary of Findings from State of Practice Review

The state of practice review highlights the critical role of railroad crossing inventory data in supporting data-driven safety analysis, planning, and decision-making. Across federal guidance, state practices, and recent research, a consistent finding is that the effectiveness of railroad crossing safety programs depends on the quality, completeness, timeliness, and integration of inventory data.

At the national level, the Federal Railroad Administration's (FRA) Grade Crossing Inventory System (GCIS) provides the standard framework for collecting and maintaining railroad crossing inventory data. The system supports consistent reporting, data sharing, and safety analysis nationwide. However, common challenges remain, including inconsistent reporting practices, delays in updating inventory information, and difficulties integrating data from multiple sources.

State transportation agencies are increasingly adopting GIS-based inventory management systems, mobile data collection applications, and data-driven approaches to improve inventory quality and support project prioritization. These technologies have improved data accessibility, quality control, and operational efficiency. Continued improvements in system interoperability, automated data updates, and quality assurance remain important needs.

Emerging technologies – including LiDAR, mobile mapping systems, video logging, artificial intelligence (AI)-based object recognition, and unmanned aerial vehicle (UAV) photogrammetry – offer significant opportunities to modernize railroad crossing inventories. These technologies can improve data quality, reduce field labor, and support more frequent inventory updates. For example, WisDOT's Photolog and Google Street View can supplement field inspections through desk reviews, while vehicle-mounted 360-degree cameras can improve both the efficiency and safety of field data collection. Although AI-based methods show considerable promise for automated asset identification and real-time safety monitoring, widespread implementation will require continued improvements in accuracy, standardized workflows, and cost-effective data processing.

Overall, the literature indicates that no single technology can satisfy all railroad crossing inventory needs. Instead, the most effective approach combines traditional field inspections with emerging technologies. Mobile mapping and video-based systems can efficiently collect large amounts of inventory data, while targeted field inspections remain necessary to verify conditions and document features that cannot be reliably identified remotely. Continued investment in modern data collection technologies, improved data integration, and streamlined inventory management practices will strengthen railroad crossing safety programs and support more effective, data-driven investment decisions.

7.2 Summary of Findings from Practitioner Survey

The practitioner survey identified common practices, emerging trends, innovative approaches, and recurring challenges associated with railroad crossing inventory management across participating states. Overall, the survey indicates that state transportation agencies have made significant progress by adopting GIS-based inventory management systems, mobile data collection technologies, and integrated databases. These advancements have improved the efficiency, accessibility, and accuracy of inventory data while supporting compliance with Federal Railroad Administration (FRA) reporting requirements.

Despite these advances, substantial variation remains in inventory management practices, staffing models, technological capabilities, and data update procedures. Maintaining accurate and current inventory information continues to be a significant operational challenge, particularly for dynamic data elements such as traffic volumes, train volumes, and other roadway and railroad characteristics that require coordination among multiple agencies and stakeholders.

The survey also identified several opportunities to improve railroad crossing inventory programs. These include greater integration of transportation, railroad, and inventory databases; increased automation of data collection and synchronization processes; enhanced collaboration among transportation agencies, railroads, and local governments; and broader implementation of enterprise GIS and asset management systems. Collectively, these improvements can enhance data quality, reduce long-term data management effort, and support more effective railroad crossing safety and asset management programs.

7.3 Cost Analysis Findings and Recommendations

The cost analysis demonstrates that maintaining compliance with Federal Railroad Administration (FRA) railroad crossing inventory requirements requires sustained investment in labor, travel, field technology, training, quality assurance, and administrative support. Labor associated with field data collection represents the largest cost component. Travel-related expenses are strongly influenced by the geographic distribution of crossings and basing locations for field crews.

Table 35 presents the project team's cost estimates for five different approaches for completing Wisconsin's statewide railroad crossing inventory. Briefly, they are as follows:

1. **In-House - Existing Process:** FRA compliant data collection cycle with crews based at WisDOT Region offices, ad-hoc determination of daily work plans, and minimal overnight travel.
2. **In-House - Partially Optimized:** In-house staffing with crews based at WisDOT Region offices, predetermined daily work plans with optimized routing, and optimal use of overnight travel including overnight stays for multiple consecutive nights.
3. **In-House - Fully Optimized**: In-house staffing with optimized crew base locations, predetermined daily work plans with optimized routing, and optimal use of overnight travel including overnight stays for multiple consecutive nights.
4. **Specialty Data Collection Vendor/Contractor**: Same as #3 but using vendor/contractor labor rates and 15% profit margin.
5. **Engineering Consultant:** Same as #3 but using consultant labor rates and 12.5% profit margin.

Table 35. Comparison of railroad crossing inventory costs under five staffing approaches.

Staffing Scenario	Report Chapter	Three-Year Total	Average Annual Cost	Ratio to Existing Process
In-House - Existing Process	4	$603,744	$201,248	1.00
In-House - Partially Optimized	5	$388,215	$129,405	0.64
In-House - Fully Optimized	5	$318,508	$106,169	0.53
Specialty Data Collection Vendor/Contractor	5	$784,727	$261,576	1.30
Engineering/Planning Consultant	5	$1,173,114	$391,038	1.94

In most cases, the current practice of basing crews at DTSD Region offices increases travel time to crossings and reduces productivity. To address this, Figure 45 illustrates a fully optimized approach which reorganizes field data collection crew base locations to match the radial pattern of the Wisconsin railroad network. Table 36 identifies the optimal locations of these operating bases and provides examples of public facilities where in-house data collection crews might gather at the start of each workday.

Among all alternatives, this optimized in-house approach provides the lowest overall cost while maintaining the operational capacity needed to complete Wisconsin's statewide railroad crossing inventory within the required three-year cycle. Compared with the current approach, the fully optimized strategy reduces total program costs through more efficient placement of operating bases, improved routing, and a balanced distribution of workloads across field crews. These efficiencies are achieved without reducing inventory coverage or data quality.

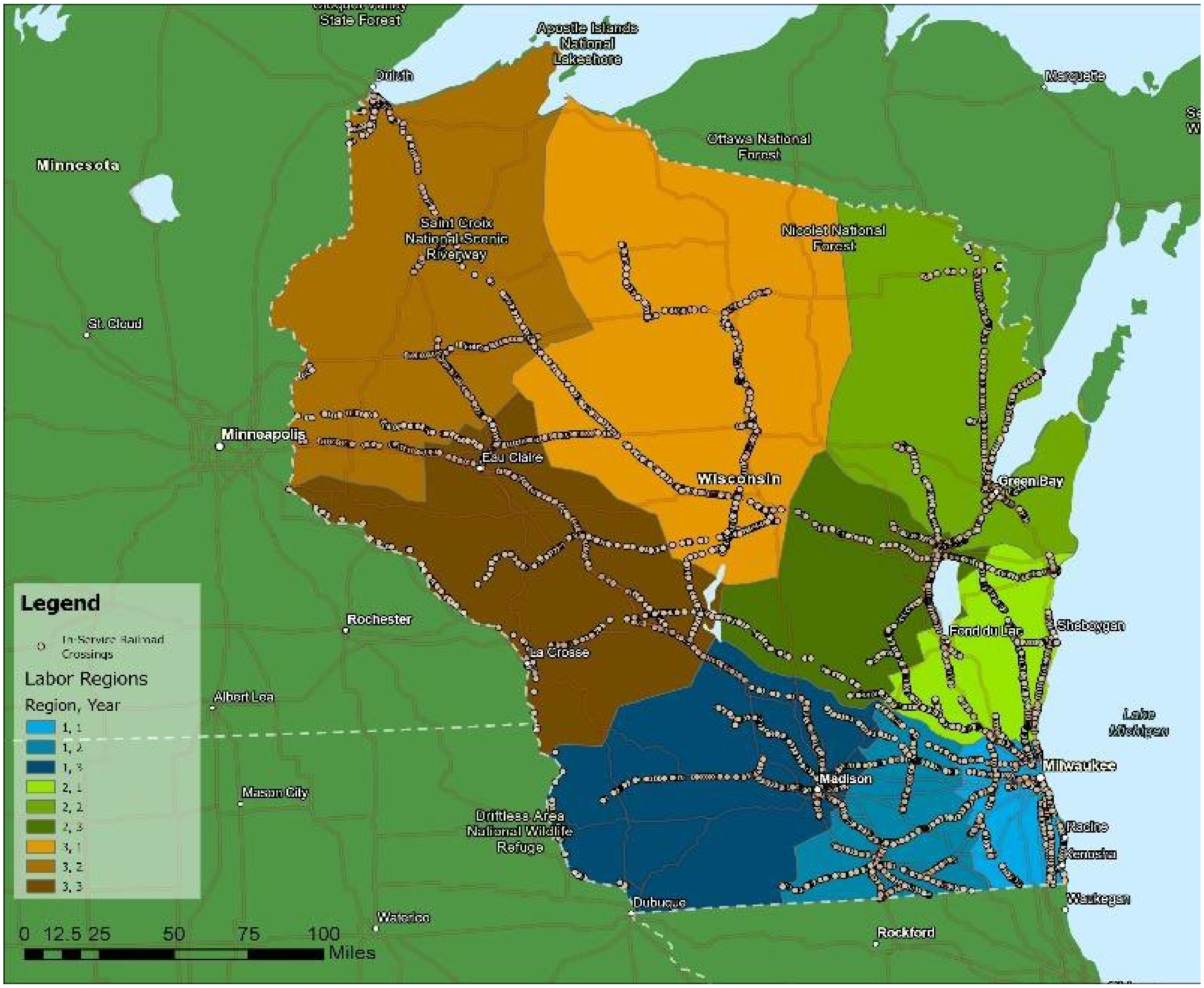


Figure 45. Geospatially optimized crossing data collection program.

The analysis also demonstrates that in-house data collection provides substantial cost savings compared to outsourcing. Although specialty data collection vendors and engineering consultants offer increased flexibility, scalability, and reduced demands on WisDOT staff, their higher labor rates, overhead, and profit margins result in substantially higher overall program costs. Consequently, outsourcing should be considered primarily if staffing limitations, schedule constraints, or the need for specialized services outweigh the additional costs.

Beyond staffing strategies, opportunities remain to further improve efficiency through expanded use of digital field technologies, improved integration between RCIS and other WisDOT databases, greater process automation, and continued investment in workforce training. Collectively, these improvements can reduce long-term maintenance costs while enhancing the accuracy, consistency, and sustainability of Wisconsin's railroad crossing inventory program.

Table 36. Fully optimized operating base locations and potential gathering points for in-house crews.

Region	Year	Operating Base	Examples of Potential In-House Crew Base Locations
1 (Blue)	1	Greenfield	Loomis Road Park & Ride Lot, Greenfield City Hall
	2	Fort Atkinson	Fort Atkinson Municipal Airport
	3	Deforest	Wisconsin State Patrol SW Region Office
2 (Green)	1	Fond du Lac	Fond du Lac County Highway Department
	2	Suamico	Village of Suamico Fire Station No. 1
	3	Oshkosh	Ken Robl Conservation Park, Oshkosh Correctional Inst.
3 (Brown)	1	Wausau	Wausau DMV Office, Rib Mountain Town Garage
	2	Rice Lake	Rice Lake DMV Office, Rice Lake Regional Airport
	2	Superior (Supplemental)	NW Region Superior Office, Bong Memorial Airport
	3	Sparta	WisDOT Safety & Weight Enforcement Facility #54, WisDOT Rest Area #16
	1-3	Eau Claire (Supplemental)	Wisconsin State Patrol NW Region Office

7.4 Recommendations for Interim Solutions

As discussed in Chapter 1, federal regulations require each state to complete a comprehensive railroad crossing inventory at least once every three years. States may use up to 8 percent of their Section 130 funding to support these inventory activities.

The practitioner survey found that most state DOTs achieve compliance by inventorying approximately one-third of their crossings each year using a combination of in-house staff, specialty data collection vendors, and engineering consultants. As demonstrated in Chapters 4 and 5, Wisconsin's current staffing levels are insufficient to maintain this schedule consistently. Until additional staffing or contracted support becomes available, several interim strategies can improve efficiency and help reduce the current inventory backlog.

7.4.1 WisDOT-OCR Coordination

The Wisconsin Office of the Commissioner of Railroads (OCR) conducts field investigations to evaluate crossings for grade separations, warning device upgrades, consolidations, and closures. Similarly, WisDOT Region offices and local governments routinely perform field reviews during highway improvement projects. Improved coordination among these organizations could reduce duplicate field visits and improve the efficiency of statewide inventory activities.

A shared inventory status dashboard could support this coordination by identifying recently completed field visits and planned inventory activities. Such a tool could range from a simple shared spreadsheet to an enhancement of the existing Rail Crossing Inventory System (RCIS).

7.4.2 Tiered Inventory Process: Desk and Field Reviews

Many railroad crossing attributes can be evaluated remotely using resources such as Google Street View and the WisDOT Photolog. Incorporating periodic desk reviews into the inventory program would allow many crossing attributes to be updated between comprehensive field inspections.

Examples include:

- Vegetation, damaged or missing signs, pavement markings, and crossing surface condition.
- Preliminary sight distance assessments using roadway imagery and aerial photography.
- Administrative updates such as traffic volumes, municipal boundaries, and roadway characteristics.

Google Street View is typically updated every one to five years, depending on location, while WisDOT State Trunk Network Photolog imagery is updated approximately every five years. Expanding Photolog access to OCR personnel could further reduce the need for field visits.

To support this approach, RCIS could maintain separate records for desk reviews and field inspections, including the review type, date, reviewer, agency, and purpose. Suggested review classifications include:

- Desk Review
- Partial Field Inventory
- Full Field Inventory
- OCR Docket Investigation
- Engineering Field Study
- Post-Construction Inspection

7.4.3 Crossing Inventory Prioritization

Inventory data are most valuable where roadway and railroad conditions are changing rapidly. Discussions with WisDOT and OCR personnel indicate that crossings located near expanding urban areas should receive the highest priority because new development (or redevelopment) frequently changes traffic volumes, roadway geometry, and crossing operations. Building permit data from the Wisconsin Department of Safety and Professional Services (DSPS) and local governments could help identify these areas.

Other potential prioritization criteria include:

- Crossings with recent crashes, including non-train-involved crashes.
- Crossings with deficiencies identified through desk reviews, drive-by inspections, or public complaints.
- Crossings with missing or outdated inventory information.
- Crossings where inventory data are more than six years old.
- Crossings near newly constructed or expanded emergency service facilities such as police and fire stations, ambulance depots, and hospitals.
- Crossings affected by recent roadway construction or reconfiguration, including state/federally funded projects and those completed at local/private expense.
- Crossings where railroads have recently modified warning devices or crossing surfaces.

7.4.4 Traffic Volumes and Other Data Integrations

Obtaining and manually entering traffic volume data was consistently identified by field personnel as one of the most time-consuming and error-prone components of the inventory process. Because Wisconsin traffic count locations are georeferenced, automated integration between the statewide traffic count database and RCIS appears technically feasible.

Such an approach would associate each crossing with the nearest representative traffic count location. A few special cases would need to be addressed:

- If a crossing is located a considerable distance between two traffic count locations, a weighted average of the two nearest counts might be used.
- A handful of Wisconsin grade crossings—notably in downtown La Crosse—run diagonally across intersections. In these instances, the applicable traffic volume is the sum of the counts for the two intersecting roadways.

Additional opportunities exist to integrate RCIS with other statewide databases, including the State Trunk Network (STN) Inventory, the Wisconsin Information System for Local Roads (WisLR), and other geospatial transportation databases. Potential data elements include posted speed limits, functional classification, number of lanes, lane widths, and other roadway characteristics. Additional information may also be available through OpenStreetMap and commercial mapping services such as Garmin, Here, or TomTom. Geocoded data indicative of school bus and transit bus volumes is potentially available from some school systems and public transit agencies, with the Google Transit Feed Specification (GTFS) potentially serving as a mechanism for linking data sets. In each of these cases, the value of data integration will depend on the reliability of the source data and the level of effort required to implement data exchange.

7.4.5 Other Data Collection Efficiency Opportunities

Several technologies evaluated in this study have the potential to improve both the efficiency and safety of railroad crossing inventories.

- GPS-enabled tablet computers can reduce or eliminate the need to re-enter paper field forms, reducing transcription errors. They also enable real-time validation of inventory data to catch errors and omissions and improve overall data quality.
- Vehicle-mounted 360-degree cameras provide another significant opportunity by allowing personnel to collect comprehensive photographic documentation without standing in active traffic lanes. These systems improve both efficiency and worker safety while capturing nearly all views required for inventory purposes.

Additional operational improvements include:

- Grouping nearby crossings to minimize travel time.
- Coordinating railroad crossing inventories with other field activities, such as traffic counts, local road inventories, culvert inspections, or roadway design surveys.

Collectively, these strategies can substantially improve inventory efficiency while reducing travel costs, improving data quality, and enhancing worker safety.

7.5 Safety Analysis Results

The safety analysis demonstrates that integrating Federal Railroad Administration (FRA) incident data with Wisconsin motor vehicle crash records provides a more comprehensive understanding of railroad crossing safety than either data source alone. The results show that FRA data alone significantly underrepresent crossing-related safety issues, as train-vehicle collisions account for only about one-sixth of all reported crossing-related crashes (Table 37). Other crash types include run-off-road, rear-end, and fixed-object collisions.

Consistent with the Safe System Approach, the findings support a more holistic approach to railroad crossing safety that addresses both train-involved and non-train-involved crashes. As summarized in Table 38, effective countermeasures include improving roadside recovery areas, enhancing driver warning and visibility, and redesigning or relocating crossing signal masts, controller bungalows, and other roadside infrastructure to reduce crash severity. Many of these improvements can be accomplished in conjunction with ongoing crossing maintenance and renewal activities.

Overall, the results demonstrate that improving the quality, completeness, and integration of railroad crossing inventory and crash data supports not only FRA compliance but also more comprehensive safety analyses and more effective prioritization of engineering improvements. By adopting an integrated, data-driven approach, WisDOT can better identify high-risk crossings, target investments where they will have the greatest safety benefit, and improve the long-term safety and resilience of Wisconsin's highway-rail crossing network.

Table 37. Crossing-related crashes consequence and WisDOT region, based on 2021-2025 law enforcement data.

Region	NC		NE	NW		SE	SW		Statewide Total	Percent
Office	**Rhine-lander**	**Wisconsin Rapids**	**Green Bay**	**Eau Claire**	**Superior**	**Waukesha**	**La Crosse**	**Madison**		
Struck Fixed Object	3	5	22	3	2	21	5	18	79	9.4%
Struck Crossing Equipment	3	15	36	31	2	45	6	25	163	19%
Train Involved	1	16	39	22	16	24	7	12	137	16%
Other Single Vehicle	0	2	9	1	3	10	1	7	33	3.9%
Pedestrian Involved	0	1	0	0	0	0	0	0	1	0.1%
Struck Track Related Item	1	10	25	23	5	31	8	18	121	14%
Other Multi-Vehicle/Unusual	1	15	31	4	3	23	10	22	109	13%
Rear-End at Crossing	4	13	55	9	11	66	14	23	195	23%
Total	**13**	**77**	**217**	**93**	**42**	**220**	**51**	**125**	**838**	100%
	90			**135**			**176**			
Percent	2%	9%	26%	11%	5%	26%	6%	15%	100%	
	11%			16%			21%			

Table 38. Potential countermeasures for non-train-involved crossing-related crashes.

Situation	Potential Countermeasures
Rear-end collisions involving vehicles stopped at crossing	• Improve visibility upstream of crossing • Install high-friction surface treatments at crossing approaches • Provide radar-activated dynamic queue warning • Provide lateral rumble strips upstream of crossings with high train volumes
Crossing Signal Mast, Gate, and Bungalow Strikes	• Redesign flashing-lights-only signals to include breakaway bases • Increase lateral clearance between cantilever and gate support masts and travelled way • Locate signal bungalows beyond clear zone • Install high-friction surface treatments at crossing approaches
Other fixed-object collisions	• Ensure utility poles (including those providing power to crossing signals) are located beyond the clear zone • Remove unnecessary/obsolete roadside objects from crossing areas • Install high-friction surface treatments at crossing approaches
Run-off-road crashes at crossings; track and embankment strikes	• Provide edge line rumble strips in advance of crossing • Provide full-width shoulders throughout crossing area. • Widen crossing surface to provide continuous shoulder • Provide turning path markings for crossings in/ near intersections • Improve vertical and horizontal geometry to provide recovery areas for errant vehicles • Install high-friction surface treatments at crossing approaches
Truck hang-ups at humpback crossings	• Provide active warning devices to alert trucks that lack adequate ground clearance • Improve vertical roadway profile to increase truck ground clearance

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Appendix A. State Survey Questions

A Few Questions About Rail Crossing Inventories

Thank you for taking a few minutes to share some information about your state's railroad crossing inventory process with our team at the Institute for Transportation Research and Education at NC State University.

Your input will be used to inform two studies, one for North Carolina DOT and another for Wisconsin DOT, regarding at-grade rail crossing inventory processes. Any information you can provide will be a great service.

Your participation is completely voluntary. If responses are not readily available or do not apply to your state, please feel free to partially answer or skip those questions. Also, if there is a better point of contact to address these questions, please provide us with that information or forward the link.

The questions should take just a few minutes to complete, and any responses you can provide are greatly appreciated.

If you have any questions, please contact John Shaw (jwshaw@ncsu.edu) or Steve Bert (sabert@ncsu.edu).

Do you agree to participate?

- ◯ Yes
- ◯ No

1. Does your state perform rail crossing inventories to meet FRA guidelines? If not, can you explain why not?

If yes, how is the crossing inventory conducted (for example, do you inventory the entire state at once, or is it a split cycle)?

2. How is the inventory process organized and staffed? (For example, is the process conducted by permanent state employees, temporary employees, outsourced to a data collection contractor, etc.)

3. Is your state using technologies to assist with crossing inventory data collection? (For example, lidar, drones, Google Earth, etc.)

4. Is your state using technologies to assist with inventory data management (GIS integration, mobile apps, asset management systems) to improve crossing inventory accuracy or reduce costs? Could you provide an explanation or any documentation.

4b. Please upload any supporting documentation

Drop files or click here to upload

5. Has your state integrated the inventory with other GIS databases to update elements such as traffic volume automatically? If so, please elaborate.

6. Which data fields required by FRA crossing inventory (e.g., warning devices, train traffic, roadway traffic, geometry) does your state find to be the most challenging to keep current?

7. Does your state collect additional data points beyond FRA requirements (such as equipment age, condition ratings, or maintenance history)?

8. Does your state have written procedures or guidance documents for complying with FRA's crossing inventory reporting requirements? (could you provide a link or attach any related documentation)

8b. Please upload any supporting documentation.

Drop files or click here to upload

9. Are there any other important features or "pain points" related to your state's crossing inventory data that we should be aware of?

For which state are you responding?

10. If you would be willing for our team to schedule a half hour with you to further discuss your state's approach to inventories, please provide your contact details below.

First and Last Name

Email Address

Phone Number

Appendix B. Feedback from States

Q1. Does your state perform rail crossing inventories to meet FRA guidelines? If not, can you explain why not?

If yes, how is the crossing inventory conducted (for example, do you inventory the entire state at once, or is it a split cycle)?

Alabama

We conduct RR crossing inventory updates by way of construction and section 130 safety improvement projects throughout the state. Upon completion of a project, the Rail Section will meet with local region railroad coordinators on site to conduct an inventory survey. Crossing inventory updates are added to the FRA GCIS and pictures are kept for records at ALDOT.

California

Yes the State of California performs rail crossing inventory to update the state portions of rail crossing inventory. We do not do the entire state at once due to the high number of at-grade crossings within California. We split up the crossings to be inventoried to a manageable amount, typically around 1000-2000 crossings.

Colorado

Yes, Colorado is on a three year cycle.

Georgia

Yes, typically through a repeating cycle.

Idaho

For the State of Idaho, the inventory was intended to be split into a 3 year cycle. With 1/3 of the state being inventoried. Idaho is broke out into six different district areas, so for each year two of the districts would be inventoried. Since this was originally began the person implementing the inventory has left and the inventory has been stagnated and not continued.

Iowa

We inventory a quadrant of the state on a 4 year cycle.

Maryland

Unfortunately, there is no schedule and crossings are updated as they are visited in the field or situations may arise. No formal inventory is conducted at this time. Mainly this is due to lack of resources within the Office.

Michigan

Public crossing inventory data is collected and updated by a repetitive ongoing 2-year cycle.

Nevada

We inventory everything all at once.

North Carolina

Yes, We have approximately 3700 at Grade Public crossings we assess across the state. This is separated into 3 cycles. This has been setup to take 3 years to complete the state inventory.

Oklahoma

Inventory updates are conducted periodically. The crossings update maybe be the all crossings entire state, it maybe only open public crossings, or other criteria. The inventory is not necessarily conducted the same way every time.

Rhode Island

A consultant provides this service for RIDOT. The inventory is conducted every two to three years.

South Carolina

Yes, we have a biannual cycle

Texas

Split cycle

Utah

Yes. We conduct the inventory over of 3-year period. Basically, 1/3 per year.

Virginia

Yes, we inventory all public at grade locations statewide. It is performed on a split cycle over 2 years.

Washington

Yes. Crossings are not inventoried all at once but are on a routine schedule. Crossings that have crude oil transported over them are inventoried every 18 months. All other crossings are inventoried every 3 years.

Wyoming

All public at-grade crossings are inventoried annually, in person.

Q2. How is the inventory process organized and staffed? (For example, is the process conducted by permanent state employees, temporary employees, outsourced to a data collection contractor, etc.)

Alabama

Permanent state employees utilize RIMS (Rail Inventory Management System) by TavlaSolutions to record crossing inventory data, which is then uploaded to the FRA GCIS.

ALDOT also keeps a rail inventory Microsoft Access database that attempts to mirror the FRA GCIS.

California

California assigns 3 permanent state employees to manage contractors who perform the on-site field inventory, update California's rail crossing inventory database, and update the FRA crossing inventory database. California staff handle the bid process for selecting and hiring the contractor, train the contractor, and oversees data collection and rail crossing inventory database updates.

Colorado

The data is collected by consultant.

Georgia

consultant contracts, organized by railroad (CSX, Norfolk Southern, Short Lines)

Idaho

At the this time the intention is to have a consultant firm collect the data. This will then be QC'd by the State. The hope is to have a consultant that is knowledgeable in the FRA system to be able to submit the inventory data directly, otherwise this will be a task for the State to complete.

Iowa

Temporary summer staff (usually May - August)

Maryland

When data is collected, it is typically done by a permanent state employee. Desktop reviews are a mix between permanent employees and consultants.

Michigan

Permanent state employees. Four field inspectors, each with approximately 1100 crossings in four unique territories. Field efforts and data management are supplemented with supervisory and support staff in main office.

Nevada

The current cycle is being outsourced with training material being developed to allow permanent state employees to conduct the inventory.

North Carolina

Predominantly our inventory process is conducted by in house state employees and interns when available. We do augment the inventory team with embedded consultants that support inventory or manage GIS resources. We also have a development team that manages and supports updates to our SARAH application that houses our crossing inventory data.

Oklahoma

A company is hired to conduct the inventory.

Rhode Island

The inventory process is organized and staffed by a Consulting Firm.

South Carolina

We have two engineering consultant firms that complete our inventory and inspections

Texas

Out sourced to consultant and spot desktop and spot field reviewed by staff for accuracy check

Utah

We outsource to a hired consultant.

Virginia

Internal and external. permanent state employees conduct a portion and data collection consultant performs the remainder.

Washington

Permanent state employees.

Wyoming

Staffed and conducted by one permanent state employee.

Q3. Is your state using technologies to assist with crossing inventory data collection? (For example, lidar, drones, Google Earth, etc.)

Alabama

Google Earth, Apple iPads

California

We use Google maps to allow contractors to locate crossings. The technology used is dependent on the contractors. We have not used lidar or drones in the past.

Colorado

Yes, Google street view is used initially and then field verified for efficiency.

Georgia

Some teams are using drones. I am not sure if other technology is being used.

Idaho

Currently the State is not utilizing any technologies. Although the use of GoogleEarth and Lidar are available options, it is felt that these may not have current data as some areas are not updated on an annual bases in Idaho. The consideration for use of these would be determined on the bases of the date the data was collected.

Iowa

We are doing a physical inventory of every crossing and taking photos.

Maryland

No, not at this time.

Michigan

Technology is used as supplemental tools for office validation. All inspections are performed live in the field by state employees.

Nevada

Google Earth and ipads

North Carolina

Yes, we use GIS Online experiences (ArcGIS Online, ArcGIS Pro) and mobile tools (Quick Capture, Field Maps, Survey123) to complete inventory. We also use our authoritative data application (SARAH) that allows us to print inventory forms to markup and complete data entry in the office. In addition, we use Power Automate and Microsoft Teams to process workflows of photos and notify the team of completed inventory.

Oklahoma

We have not used technologies in the past but might in the future.

Rhode Island

Data collection was in person, with drones and Google Earth.

South Carolina

Google Earth, ArcGIS, Survey 123, Retroreflectometer,

Texas

Google Earth for desktop review and verifcations

Utah

We use visual inspections and photos.

Virginia

In house GIS for locating the crossings. Each location is visited by internal and external staff.

Washington

No.

Wyoming

Google Earth.

Q4. Is your state using technologies to assist with inventory data management (GIS integration, mobile apps, asset management systems) to improve crossing inventory accuracy or reduce costs? Could you provide an explanation or any documentation.

Alabama

We used to use ArcGIS with a custom form created for inventory surveys, but now we use RIMS by TavlaSolutions and have phased out ArcGIS.

California

We currently have a GIS map of California crossings for internal use. We have released an updated California rail crossing inventory database which contains additional data not captured by the FRA crossing inventory. This database also captures California processes beyond rail crossing inventory. There is a GIS component which is currently under development which will integrate GIS functions with the database.

Colorado

Colorado uses PointMan, which is a data repository. www.pointman.com

Georgia

We use a program called GRAILS; however, it is in the process of being upgraded and is not functioning currently. We are uploading data directly to FRA presently.

Idaho

Idaho has in the past attempted to create a GIS mapping of all rail crossing within the State to include crossing inventory data. This has not been maintained and is out dated. Currently the State is working to reimplement this for use i the future.

Iowa

Our staff uses an iPad with an inhouse developed Fulcrum mobile app which is using our state's GIS data to locate the crossings. I QC the data as it is collected by reviewing each crossing. We use FME to process the data into our enterprise system.

Maryland

Yes, GIS is used with a mobile app to collect data on site.

Michigan

Yes. We have developed a proprietary crossing inventory data program. It is a web-based application allowing multiple authorized users. Field inspectors can use iPhones, iPads, or laptops to capture and upload real-time crossing data. Office staff can access live data from any desktop. The system integrates with several other MDOT platforms to cross-share data points for GIS, tax, NFC, and other information pertinent to public grade crossings. System allows for compilation of inspection photos, deficiency notices, correspondence, legal Orders. System also generates and tracks Diagnostic Study Team meetings and results; dispatching and tracking of weekly deficiency notices and compliance efforts for deficiencies; generation or Orders and compliance efforts for regulatory Orders; system is also integrated with Section 130 development and state-sponsored grade crossing surface program development.

Nevada

GIS integration is used and a new rail inventory management system is being developed.

North Carolina

Yes, we use ArcGIS Online experiences to manage content for rail crossings, rail lines and facilities. We also integrate with the department Highway linear reference system (LRS), request spreadsheet updates from short line railroads and ingest school bus data from Local Education Agencies (LEA) from across the state. Developed a discrepancy identification tool in ArcGIS against the Federal Rail Administrations (FRA) national rail crossing database. Also use Streetlight to collect traffic counts.

Oklahoma

Our crossing inventory is maintained by a company that created and maintains the program. I am not sure to what level they use technologies to assist with inventory data. However, they also work with the states GIS department to increase location accuracy.

Rhode Island

The data is incorporated into RIDOT's GIS System.

South Carolina

ArcGIS and internal built database

Texas

vendor provided field version of TRIMS for direct entry and GPS verification of location and taking and uploading pictures

Utah

We use a custom mobile app and GIS. The app has pre loaded questions for the inspectors to answer along with examples of MUTCD signs, previous inventory info, a place to upload photos, etc.

Virginia

VDOT uses a data management application RIMS (Rail Inventory Management System) created by Tavla Solutions in Raliegh. It is also used by other states. Tavla Solutions can provide documentation.

Washington

Data is collected on paper and then entered into an internal application. That application has an API interface with the FRA inventory that we are able to make most updates with.

Wyoming

No

Q5. Has your state integrated the inventory with other GIS databases to update elements such as traffic volume automatically? If so, please elaborate.

Alabama

No, we have not to my knowledge.

California

No.

Colorado

No.

Georgia

No.

Idaho

Idaho has not implemented this type of element updates.

Iowa

Yes, our railroad crossing data is stored in our ESRI Roads and Highways System which also stores our traffic and other roadway and structure asset data. We run batch updates to update fields that are needed for the crossings throughout the year.

Maryland

We are currently working on that integration now.

Michigan

Yes to NFC data and GIS mapping and certification processes. No to the ADT elements, as those come independently from road agencies.

Nevada

No

North Carolina

No, we have integrated with the highway LRS system to identify discrepancies between crossing record highway information and the LRS. We review these discrepancies prior to updating our crossing record data. We do the same with FRA crossing data (manual downloads weekly) to validate railroad updates in the national database.

Oklahoma

Currently, there is no autofill as the state does not allow our inventory company to link to the state system. The company that we use for our inventory and our GIS department have coordinated data such as Lat and Long data. The data is uploaded as needed.

Rhode Island

The data is incorporated into RIDOT's GIS Data Base

South Carolina

No

Texas

Our data base is updated yearly with AADT data from our planning division

Utah

AADT info in collected and updated but not through GIS databases.

Virginia

Yes, RIMS is integrated with VDOT's Traffic Management System to acquire traffic volume data.

Washington

No, but that is a great idea.

Wyoming

No

Q6. Which data fields required by FRA crossing inventory (e.g., warning devices, train traffic, roadway traffic, geometry) does your state find to be the most challenging to keep current?

Alabama

Regularly Used by Schoolbuses (Count)
Installation Date of Crossing Safety Equipment (Masts, Cantilever, Gates, RR Property)

California

Other MUTCD Signs (there is an issue with updates by API. There is not a comprehensive list of signs, signs change, etc). Traffic count (local roadway authorities often do not have recent traffic counts). Estimated Percent Trucks, Regularly used by School Buses, and Emergency Vehicle Services (very inaccurate. States basically guess). Any field in Part 1 or 3 for Union Pacific Railroad (UP is automatically notified of any changes to their crossings and their system automatically overwrites any Part 1 or 3 fields the States make).

Colorado

Train traffic and roadway traffic. Train traffic can be hard to get because the railroads say that information if proprietary. CDOT can get roadway traffic for Interstates and State Highways, CDOT struggles getting roadway traffic from cities, towns, and counties.

Georgia

ADT, emergency routes

Idaho

Most notably is the roadway traffic volumes (AADT). Obtaining this data from the local roadway jurisdictions has been a difficult process. The State is finding a challenge to have corrected or correct Latitude and Longitude coordinates for crossing locations.

Iowa

Any data that is supplied by the railroads is difficult to obtain and keep current. I download the data from the FRA website semiannually and update our crossing data with the railroad "required" fields. The traffic control data that is inventoried by the summer staff is updated in our database and we do not ingest what the railroad has provided to the FRA as we have found many instances of incorrect data, old data, or overwritten data.

The most challenging part of trying to keep the data current is the lack of communication and data sharing between the railroads, FRA and the state.

Maryland

Train data, which is why we don't collect and attempt to maintain the data. Traffic numbers are challenging to get and/or update as a lot of local jurisdictions have dropped traffic counts from their programs to save money.

Michigan

Train volume and traffic volume. Lack of responsiveness and accuracy from railroads and road agencies.

Nevada

Geometry due to rural areas in Nevada

North Carolina

Train volumes, and train speeds. It is also challenging on the FRA record to maintain corrective updates as the railroads may not verify updates made by the state with their databases. Thereby, overwriting our updates.

Oklahoma

The company that maintains our data has a program that links with the FRA data and uploads data. I am not sure at this time which data is uploaded. The incidents, accident, etc. data as a minimum.

Rhode Island

South Carolina

Not really challenging to update the FRA data fields just time consuming due to it being a manual process. Roadway traffic/ADT is challenging due to cost of getting tube counts at crossings.

Texas

warning devices, train traffic

Utah

AADT

Virginia

Pavement markings, warning signs and warning devices.

Washington

AADT, school bus counts, and emergency route status.

Wyoming

Train traffic

Q7. Does your state collect additional data points beyond FRA requirements (such as equipment age, condition ratings, or maintenance history)?

Alabama

No

California

Yes. California's rail crossing database has approximately 300 data fields. A small sample of data fields we collect which are not part of the FRA inventory are sightline distances, preemption equipment, preemption timing, type of stop/yield control, a much more comprehensive list of signs, allows multiple rail lines at a crossing, a breakdown # of traffic lanes at a crossing including turn lanes, # of bike lanes, # of sidewalks, Type of median, median length, pedestrian warning devices, etc. California's rail crossing database also documents light rail transit crossings.

Colorado

No.

Georgia

No.

Idaho

At this time the State does not collect additional data.
This may be good for implementation for future information and inclusion within a GIS data set.

Iowa

We inventory the presence of sidewalks and if there is "hump" or "dip" created with the roadway.

Maryland

No

Michigan

Yes. The system keeps a complete regulatory history dating back into the 1800s, showing the legal authority (where available) for creation of crossings and all subsequent warning device installations. Ratings and records are kept for crossing surface and approach surface conditions (retention schedule applies. Records include maintenance deficiencies, repair actions, photos, correspondence (retention schedule applies)

Nevada

No

North Carolina

Yes, Site distance, drag marks, pedestrian condition, equipment classification, crossbuck condition, 8-inch flasher lens count, preemption inspection dates, photographs at crossing, highway signal #'s, # school bus occupants and other dates to support internal information.

Oklahoma

We do update installation dates on some equipment after a project has been completed and it has passed final inspection.

Rhode Island

Not at this time.

South Carolina

hump crossing elevations

Texas

No

Utah

No

Virginia

No

Washington

We collect sight distance and directional information about what side of the crossing equipment/signage is located on.

Wyoming

Additional data is collected if known.

Q8. Does your state have written procedures or guidance documents for complying with FRA's crossing inventory reporting requirements? (could you provide a link or attach any related documentation)

Alabama

California

No

Colorado

No

Georgia

Not that I am aware of.

Idaho

At this time the State does not have written procedures or guidance. The State is in the process of updating Rail Manuals and this will be considered for inclusion.

Iowa

Field Guide for inventory already attached (which is based on FRA's guide). I will attach our Fulcrum guide below as well.

Maryland

No

Michigan

Not at this time. Our system was designed to compile all required FRA information, but during design there were incompatibilities with the FRA architecture for data transfer. It was also noted that significant portions of the current FRA database were inaccurate due to upload errors from railroads, and we wanted to maintain the integrity of the internal data we knew to be accurate before developing a new process for compliance with FRA reporting.

Nevada

No

North Carolina

Yes, we have an inventory manual to document to guide inventory assessments.
FRA Inventory Guide:
https://railroads.fra.dot.gov/sites/fra.dot.gov/files/fra_net/18855/Crossing_Inventory_Guide_01916.pdf

Oklahoma

I am not sure as I, personally, am not responsible for or assigned the tasks of working with the FRA data.

Rhode Island

The reporting, and updates, are done through RIDOT's consultant

South Carolina

Yes

Texas

existing FRA inventory guidelines

Utah

Just our specific contract requirements used to hirer a consultant.

Virginia

VDOT uses the current FRA data structure and definitions for conducting our inventory. The procedures follow these guidelines.

Washington

Wyoming

No

Q9. Are there any other important features or "pain points" related to your state's crossing inventory data that we should be aware of?

Alabama

Our Access Database's information is admittedly very outdated, especially in terms of traffic counts. We have had a few counties AADT counts done by consultants, but I personally think the data is a little dubious. The consultant used an automatic smart traffic counting device, and they were able to deliver a lot of data very quickly, which left some of us skeptical.

California

California has data fields, such as warning devices and crossing angle, which are documented in a different manner than the FRA inventory, requiring a translation to FRA inventory. Our new database exports a report with the goal of being able to update the FRA inventory in bulk. However, it is not currently functioning and requires troubleshooting. Inability to update latitude/longitude for private crossings is a huge pain point. Another pain point is inability to update crossing status of crossing inventory for defunct railroads. California has been part of the FRA crossing inventory working group and these issues are hopefully in the process of being addressed.

Colorado

The biggest pain point is traffic volumes from other municipalities.

Georgia

We collect and update school bus counts annually as required by GA state code.

Idaho

Nothing more identifiable currently.

Iowa

Just the frustration of 3 entities not working well together to share processes and data. The lack of data standards/governance set forth by the FRA as almost every time I download data something in the data format has been changed and we need to keep tweaking our processes to handle them.

Maryland

Michigan

Our new system was in design from 2017-2023. Implementation in early 2023. It replaced a system that had been designed in the 1990s. There were billions of lines of code and millions of documents to be preserved and digitized and linked to the new system. In our first statewide cycle (completed in mid 2025) we discovered and corrected a huge volume of erroneous crossing data. In our second statewide cycle, we are continuing the clean-up and fine-tuning our processes. The pain points involved continuing to operate an old system while developing the new system; ensuring all the data was migrated properly; preserving accurate data and cleaning bad data; and simultaneously operating a full-service statewide rail safety program of ongoing inspections, diagnostic meetings, and legal actions related to crossing regulation.

Nevada

Having trained staff to perform inventory much cheaper than having to bring in a consultant.

North Carolina

Getting responses from railroads regarding crossing inventory records. Again, the challenge on the FRA record to maintain corrective updates as the railroads may not verify updates made by the state with their databases. Thereby, overwriting our updates.

Oklahoma

Rhode Island

Not at this time.

South Carolina

No

Texas

getting base line and verifying GPS location

Utah

Virginia

Only that the railroad companies upload to the FRA database overwrite data we enter.

Washington

Wyoming

No

Appendix C. Florida DOT Railroad Highway Crossing Inventory Presentation

The project team invited representatives from Florida DOT (FDOT) to present their agency's railroad crossing inventory processes and procedures. The virtual presentation was conducted on November 5, 2025, providing an opportunity to compare and contrast Florida and Wisconsin practices. Attendance included Wisconsin DOT Rails and Harbors Section management and staff, representatives of the Wisconsin Office of the Commissioner of Railroads (OCR), and members of the project team. FDOT presenters were Holly Cohen (Freight & Rail Planning Administrator) and Khaleda Hatim (Freight & Rail Analyst).

Florida Rail System

As shown in Figure 46, Florida's freight rail system is operated by two Class I railroads (CSX and Norfolk Southern), one Class II railroad (Florida East Coast Railway [FEC]), and multiple Class III short line railroads. The state's passenger rail system includes intercity (Amtrak & Brightline), commuter rail (SunRail & Tri-Rail), and various rail transit and tourist railroad operations.

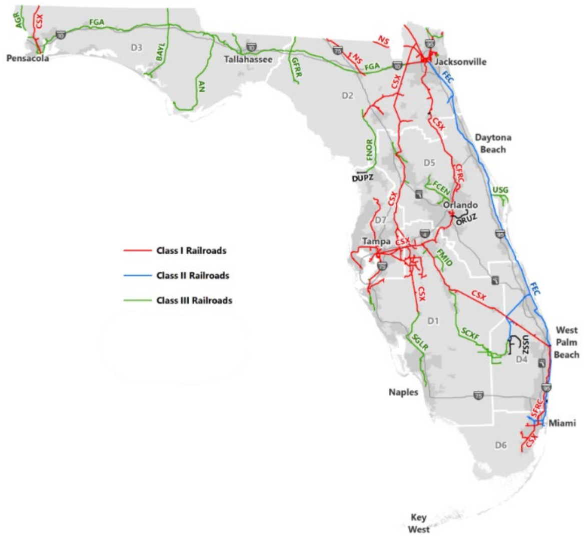

Figure 46. Florida rail system. Source: FDOT.

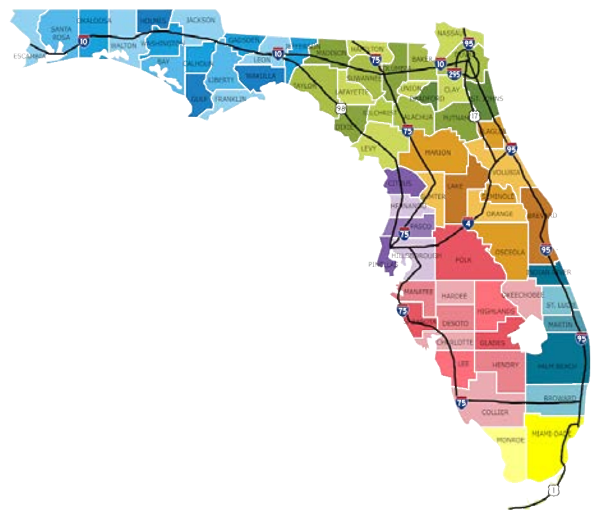

Figure 47. Florida DOT Districts. Source: FDOT.

The Florida and Wisconsin railroad crossing inventories are similar in scale. Florida has nearly 5,000 public and private at-grade crossings, composed of about 3,600 public crossings and about 1,300 private crossings. In addition, there are nearly 500 grade-separated crossings in Florida.

Administration

The Florida Department of Transportation (FDOT) is a decentralized agency. The Central Office in Tallahassee focuses primarily on development of policies, procedures, and plans; safety inspection/compliance; and technical assistance. FDOT District Offices (Figure 47) handle day-to-day operations.

The Freight & Rail Office (FRO) is responsible for assisting in the development of Florida's rail system, both passenger and freight. In addition, FRO champions Florida's multimodal freight programs.

Accurate inventory of crossing characteristics is a critical element of FDOT's safety programs. The railroad highway crossing inventory (RHCI) serves as FDOT's repository for crossing data, including fields not required by the Federal Railroad Administration (FRA).

Data Collection

Due to internal staffing constraints, Florida's rail crossing inventory data collection has been outsourced to consultants for about 15 years. The FDOT Central Office manages the contracting process, while FDOT District staff are responsible for quality/accuracy reviews, typically through spot checks of the data. This enables FDOT to perform a field inventory at each crossing at least once every 3 years in accordance with FRA requirements. Contracts are re-bid every five years.

As in Wisconsin, the geographical extent of Florida's rail crossing inventory is substantial. Although Wisconsin's overall land area is about 18% larger (65,500 vs 53,625 square miles), Florida's land mass is spread across the Panhandle and Peninsula regions, giving the state essentially the shape of an inverted letter L. In Wisconsin, the driving distance from Kenosha in the southeast to Superior in the northwest is approximately 430 miles. In Florida, the driving distance from Miami in the southeast to Pensacola in the northwest stretches to about 680 miles. To address this lack of compactness, FDOT divided the crossing inventory into regional contracts. Multiple consultants have been selected and perform their work concurrently.

Data Elements

Florida's crossing inventory updates combine the results of an annual desktop review with a triennial cycle of field reviews, which cover approximately one-third of the state each year. The scope of these efforts includes the following:

Annual Desktop Review

- Vehicular AADT
- School bus counts
- FRA incident data
- Number of lanes
- Street name
- Posted speed
- Jurisdictional boundary changes affecting administrative or maintenance responsibilities
- Updates arising from recent road/rail construction projects, new real estate developments, etc.

Field Review

- Validate "desktop" data elements
- Validate railroad responsibility fields
- Update crossing latitude/longitude to ensure accurate mapping
- Crossing surface type and condition
- Warning devices
- Humped crossings: update geometric data to reflect rail maintenance activities and help ensure accurate routing of trucks with low ground clearance
- Photos

Unique Florida fields include linear referencing for both highway and rail, crossing surface condition, etc.

Pain Points

- The timing of data collection at each site needs to be adjusted to reflect road and rail improvement projects. This is fairly straightforward for Section 130 crossing upgrades and FDOT projects, but difficult to monitor for projects undertaken by local governments.
- Centralization of inventory administration has made it easier to ensure statewide consistency, but the consultants performing the work do not always have local staff in each district. This has made it more important for FDOT to provide training and guidance to the data collection consultants.
- Differences between the administrative boundaries for the consultant contracts and the FDOT District boundaries sometimes hamper QA/QC reviews.
- Maintaining consistency between the FDOT and FRA databases is sometimes difficult. Railroads have the ability to overwrite data entered by FDOT, increasing the potential for spurious or erroneous entries.
- The cost of the inventory has grown to approximately $750,000 per year. This includes all public crossings and some private crossings.

Future Upgrades for Efficiency

The Florida RHCI has existing tools for comparing field characteristics with existing data. New tools will support immediate updates and faster validation. These include:

- ArcGIS Field Maps is an all-in-one app that uses data-driven maps and mobile forms to help workers perform data capture and editing. This tool will be used to locate assets and information and report real-time conditions.
- ArcGIS Survey123 supports data collection, editing, and viewing. This will allow users in the field to compare the existing data with actual characteristics on site.