
# A HAZARDOUS MATERIAL ROUTE REGISTRY STUDY AND REPORT FOR THE AMBASSADOR BRIDGE IN DETROIT, MI

DRAFT FINAL REPORT V1.3

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# 1 SUMMARY

This report contains the results of a hazardous materials route registry transportation study performed after the Detroit International Bridge Company proposed that MDOT allow Class 3 and Class 8 materials to be transported on the Ambassador Bridge, including transportation risk analysis on non-radioactive hazardous materials (NRHM) restricted route designations, for the Ambassador Bridge in Detroit, Michigan. This study was conducted to better understand and evaluate the risks associated with transportation of hazardous materials on the Ambassador Bridge from Porter Street to Canada should any of the existing restrictions be changed. Current NRHM route restrictions for the Ambassador Bridge include Class 1 (explosives), Class 3 (flammable liquids), Division 6.2 (infectious substances), Class 7 (radioactive materials), and Class 8 (corrosives).

Hazardous materials in transportation may pose risks to people, property, and the environment. In this report, these risks are quantified for highway transportation routes based on information obtained from stakeholders, industry, and public and private data sources. Population and environmental risks were independently estimated for each highway transportation route using various factors including crash rates, probabilities of release of the hazardous material in a crash, and potential consequences for each hazard class. Resultant risk values were analyzed, along with other information including special populations, services, and facilities counts, to compare alternate routes and patterns for hazardous materials transportation between various origin points in Michigan and international border crossings to Ontario, Canada.

As part of this restricted route study, considerations were presented based on an analysis of potential changes in commodity flow and quantified risk statewide and for local routes leading to the Ambassador Bridge. The study did include an assessment of potential impacts if additional mitigation strategies were applied and, of the strategies considered, all would provide a positive impact to transportation safety and security. However, mitigation strategies that are only applicable at the bridge itself would not be effective at reducing risk on routes throughout the state. To aid the Michigan Department of Transportation (MDOT) with decisions related to existing NRHM restricted route designations for the Ambassador Bridge the following observations have been made:

- The analysis results show a small difference in statewide risk if the existing Class 3 and 8 restrictions were lifted; however, the difference is not significant enough to make a compelling case for or against any changes.
- While not represented in the numerical risk analysis, the potential consequences of a Class 3 incident on the Ambassador Bridge are expected to be greater than those of a Class 8 incident.
- MDOT has many additional factors to consider in making their decision, including public input and consultation with Canadian authorities, per the FHWA routing guidelines.

# 2 INTRODUCTION

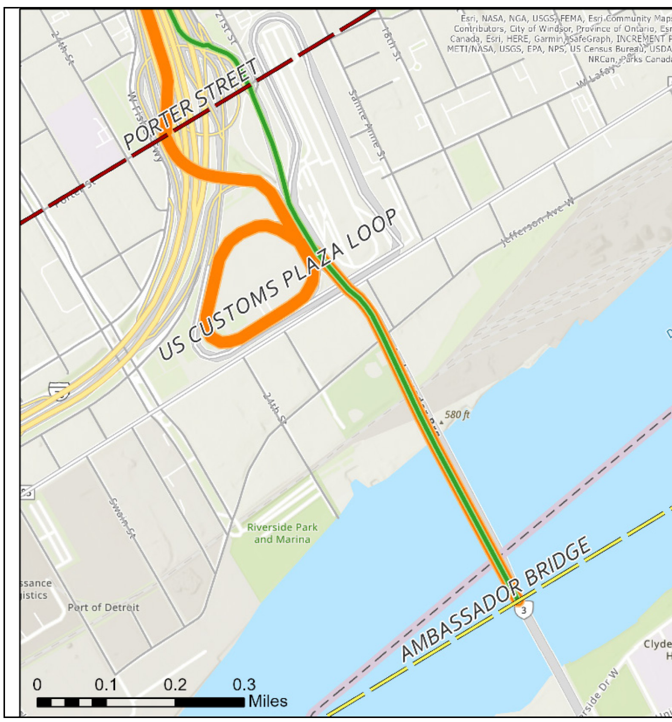
The primary focus of this study is the Ambassador Bridge which connects Detroit, Michigan and Windsor, Ontario. The Ambassador Bridge is a key international border crossing and critical transportation route that helps move millions of people and freight shipments every year. At the time of this study, only certain hazardous materials are permitted to be transported over the Ambassador Bridge. This study was conducted to better understand and evaluate the risks associated with transportation of hazardous materials on the Ambassador Bridge from Porter Street to Canada should any of the existing restrictions be changed.

## 2.1 Ambassador Bridge

The roadway analyzed that represents the Ambassador Bridge extends from Porter Street in Detroit, Michigan to the approximate centerline of the bridge span at the international border between U.S. and Canada.

Canada-bound traffic enters the U.S. Customs Plaza loop from I-75 and then proceeds to the bridge crossing. U.S.-bound traffic passes through Canadian Customs in Windsor, proceeds to the bridge crossing, and then exits via I-75 without stoppage as shown in Table 1 below:

*Table 1 – Ambassador Bridge Segment Map and Description*




| Description | |
|---|---|
| (orange) | Porter Street to Ambassador Bridge |
| (green) | Ambassador Bridge to Porter Street |
| **Length (miles) and Direction** | |
| (orange) | 1.76 – SE |
| (green) | 1.22 – NW |

## 2.2 Current Restrictions

Current MDOT NRHM route restrictions for the Ambassador Bridge include Class 1 (explosives), Class 3 (flammable liquids), Division 6.2 (infectious substances), Class 7 (radioactive materials), and Class 8 (corrosives). These current restrictions have been in place since April 2, 2014 and differ from those at the Blue Water Bridge where Class 1 (explosives), Class 5 (oxidizers and organic peroxides), Class 7 (radioactive materials), and Class 9 (miscellaneous) are restricted, but Class 3 (flammable liquids) and Class 8 (corrosive materials) are permitted (see Table 2). Trucks hauling hazardous materials to/from Canada that are not permitted on the Ambassador Bridge must use alternative routes that use crossings such as the Blue Water Bridge connecting Port Huron, Michigan with Sarnia, Ontario, or the Detroit-Windsor Truck Ferry.

*Table 2 – Current Hazardous Materials Restrictions*

| Hazard Class / Division | Ambassador Bridge | Blue Water Bridge |
|---|---|---|
| Class 1, Explosives | ✗ | ✗ |
| Class 2 | ✓ | ✓ |
| Division 2.1 Flammable gas | ✓ | ✓ |
| Division 2.2, Nonflammable, nonpoisonous compressed gas | ✓ | ✓ |
| Division 2.3, Gas poisonous by inhalation | ✓ | ✓ |
| Class 3, Flammable and combustible liquid | ✗ | ✓ |
| Class 4 | ✓ | ✓ |
| Division 4.1, Flammable solid | ✓ | ✓ |
| Division 4.2, Spontaneously combustible material | ✓ | ✓* |
| Division 4.3, Dangerous when wet material | ✓ | ✓ |
| Class 5, Oxidizers and organic peroxides | ✓ | ✗ |
| Class 6 | ✓ | ✓ |
| Division 6.1, Toxic (poisonous) materials | ✓ | ✓ |
| Division 6.2, Infectious substances | ✗ | ✓ |
| Class 7, Radioactive material | ✗ | ✗ |
| Class 8, Corrosive materials | ✗ | ✓ |
| Class 9, Miscellaneous hazardous material | ✓ | ✗ |

** Pyrophoric liquids are prohibited*

There are no designated hazardous materials routes in Ontario, Canada, and any changes in route restrictions will impact the movements of the associated commodities in Canada. Evaluating the effects of such changes is beyond the scope of this study.

## 2.3 Study Design

This study was conducted in accordance with FMCSA regulations published in 49 CFR 397.71(b) and other guidance published by the U.S. Department of Transportation (USDOT), including the FHWA Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous

Materials and TRB Hazardous Materials Cooperative Research Program (HMCRP) Report 3: Guidebook for Conducting Local Hazardous Materials Commodity Flow Studies.

The study included data collection (see Section3) and analysis (see Section 4) phases. Data collection included a literature review of prior reports, studies, and documents; obtaining relevant databases (crashes, truck traffic, population, environment, services, and facilities); and conducting interviews with numerous stakeholders. A description of the analysis methodology is presented in Section 2.4.

We used actual cross-border hazardous materials shipment data obtained from the Canada Border Services Agency to represent hazardous materials truck flows across the Ambassador Bridge. At the time of this report, border crossing data were not available from the U.S. Customs and Border Protection Agency. Additionally, we identified six representative shipment origins in Michigan. From each of these origins, we used truck flow data to identify the likely routes that shipments would take to cross into Canada (or the reverse) using the Ambassador Bridge, the Detroit-Windsor Truck Ferry, and the Blue Water Bridge. We established weights for each origin-destination pair based on shortest path analysis and border crossing data. We adjusted these weights based on shipment data (to establish the ratio of shipments between the Ports of Detroit and Port Huron) allowing the determination of the *per-hazard class* distribution of traffic among the different international crossings. We computed risk and other metrics for each alternative, so that we could compare the relative changes in risk within the State for any shipments that may shift from using the Blue Water Bridge or the Detroit-Windsor Truck Ferry to using the Ambassador Bridge if restrictions were removed for certain hazard classes.

## 2.4 Methodology

The analysis used for this study incorporates widely accepted data and procedures that are available to address numerous components of route risk assessment. It relies on a geographic information system (GIS) that integrates analysis of transportation networks with associated attributes, such as crash likelihood, neighboring population, and environmental characteristics.

To facilitate decision-making based on the results of the analysis, each hazard class was separately analyzed using the same approach. For some classes, divisions within the hazard class were analyzed separately because the analysis parameters for each division were sufficiently different. Results were combined based on the weighted proportion of transport based on national data as Michigan-specific data are not available. The analysis included computing crash rates for different roadway types in Michigan, estimating release probabilities in the event of a crash for different types of cargo tank specifications, computing risk values for several consequence types, and computing other roadway and route-specific values.

We performed analyses on alternate routes from various locations to each of the three international crossings from southeast Michigan to Ontario. The analyses generated a variety of evaluation metrics including, but not limited to, estimated crash likelihood, estimated release probability, and estimated population within specified distances from the roadway that could potentially be impacted based on the characteristics of each hazard class. This analysis does not predict specific consequences to persons within those impact distances, such as injuries or fatalities, but rather provides as the consequence measure an estimate of persons within the various impact distances potentially at risk of effects such as sheltering in place; evacuation; road closure; exposure to released product, a resultant fire, and/or fire byproducts; etc. Detailed dispersion modeling and consequence modeling for specific substances was outside the scope of the study.

Additionally, a composite risk measure, defined as a combination of the *likelihood* of an event multiplied by the *consequences* of that event is generated. This risk value is computed separately for each hazard class for a route as follows:

$$RISK_{route} = \sum_{l=1}^{L} \left[ P(Crash)_l \times P(Release) \times Consequence_l \right]$$

where $L$ is the number of segments (or links) in the route, $P(Crash)_l$ is the crash likelihood along segment $l$, *P(Release)* is the probability that a crash will result in a release, and $Consequence_l$ is the expected consequences of a release along segment $l$. The route's risk value is computed by summing the individual segment risk values for each segment that comprises the route.

The resulting value is a relative risk measure (not an absolute risk measure) that is most meaningful when used to compare different restricted route alternatives. The route comparison is based on the concept of benchmarking where the current state of route restrictions serves as the *benchmark,* and they are compared to the future state of route restrictions that include the Ambassador Bridge as an authorized alternative. For the analysis, and consistent with the Guidelines, we emphasized population risk, but considered risk to the environment as well. We examined route delays and the lengths of different route alternatives. More details on the study implementation are presented in subsequent sections of this report.

# 3 DATA COLLECTION

This section contains a summary of the public and private data that were collected to obtain sufficient information on the USDOT-defined factors for evaluating NRHM routing designations and commodity flow in the Detroit-Windsor area. Interviews were conducted with key stakeholders to gather information on industries that use hazardous materials, hazardous materials transportation volumes and routing, and emergency and spill response capabilities.

## 3.1 Data Sources

Data were collected from various public and private sources to support analysis including from USDOT and MDOT. The highway transportation GIS network used for this study was obtained from the MDOT Linear Referencing System (LRS). Aggregate commodity flow data were obtained from the 2017 Commodity Flow Survey (CFS)[1] published by the U.S. Bureau of Transportation Statistics (BTS). International border crossing data were obtained from the Canada Border Service Agency. Crash data and commercial traffic data were obtained from MDOT and were used to calculate truck crash rates for network segments. Conditional probability of release estimates for each hazard class were calculated based on CPR values for highway container types. Consequence data were mainly sourced from public data sets (e.g., FEMA Hazus population data and Homeland Infrastructure Foundational-Level Data [HIFLD] Open Data).

## 3.2 Interviews

Numerous interviews were conducted to obtain or identify data to support analysis. Representatives from MDOT, the Detroit International Bridge Company (DIBC), the Federal Bridge Corporation, and the Detroit-Windsor Truck Ferry were interviewed to obtain information on congestion, commodity flow, operations, maintenance, and emergency response for key border crossings in the Detroit-Windsor area. Interviews with shippers and carriers were conducted to acquire information on commonly transported hazardous materials and their likely transportation routes. According to individuals we interviewed, in the Detroit-Windsor area hazardous materials transportation predominantly supports the automotive and energy distribution industries; **Class 3 (flammable liquids)**, **Class 8 (Corrosive liquids)**, and **Class 9 (Miscellaneous)** are the most common. This includes commodities such as gasoline, fuel oil, paint, coatings, batteries, and cleaning solutions. With existing hazardous materials route restrictions over the Ambassador Bridge, interviewees reported that international trade involving these commodities typically includes routing through Detroit using I-75 and I-94 to cross into Canada via the Blue Water Bridge in Port Huron/Sarnia. In some instances where the delivery destination is Windsor or other southwestern points in Ontario, the Detroit-Windsor truck ferry is generally used. Many interviewees expressed a lack of understanding on which hazardous material shipments were restricted from transportation over the Ambassador Bridge. Some reported rerouting non-bulk shipments (e.g., limited quantities) of restricted hazard classes even though it would be permissible to transport these shipments across the bridge because placarding is not required. Additional interviews with local emergency responders and recovery service providers were conducted to obtain information on response capability and experience with hazardous materials transportation incidents.

## 3.3 Crash Rates

Crash rates are generally estimated as the number of crashes for a given traffic exposure, which can be expressed in various measurement units. Developing commercial crash rates requires acquiring data related to the number of crashes, categorized by the transportation mode and segment type (e.g., roadway type and urban/rural location), among other factors. For road, the numerator is crashes and the denominator is generally miles (such as *x* crashes per *y* million

[1] Available at https://www.census.gov/data/tables/2017/econ/cfs/aff-2017.html.

miles of travel). Table 3 shows the commercial vehicle crash rates computed for this study using Michigan data for 2018-2019.

*Table 3 – Michigan Commercial Vehicle Crash Rates*

| Area Type | Roadway Type | *Commercial Vehicle Crash Rate (Crashes per mile traveled)* |
|---|---|---|
| Large Urban | 1: Interstates | *7.55E-07* |
| Large Urban | 2: Other Freeways | *7.47E-07* |
| Large Urban | 3: Other Principal Arterials | *4.50E-06* |
| Large Urban | 4: Minor Arterials | *3.76E-06* |
| Large Urban | 5: Major Collectors | *4.82E-06* |
| Large Urban | 6: Minor Collectors | *5.73E-06* |
| Large Urban | 7: Local | *3.28E-06* |
| Small/Med Urban | 1: Interstates | *4.74E-07* |
| Small/Med Urban | 2: Other Freeways | *4.96E-07* |
| Small/Med Urban | 3: Other Principal Arterials | *2.97E-06* |
| Small/Med Urban | 4: Minor Arterials | *3.00E-06* |
| Small/Med Urban | 5: Major Collectors | *2.93E-06* |
| Small/Med Urban | 6: Minor Collectors | *2.41E-06* |
| Small/Med Urban | 7: Local | *2.90E-06* |
| Rural | 1: Interstates | *3.54E-07* |
| Rural | 2: Other Freeways | *3.59E-07* |
| Rural | 3: Other Principal Arterials | *1.07E-06* |
| Rural | 4: Minor Arterials | *1.53E-06* |
| Rural | 5: Major Collectors | *1.86E-06* |
| Rural | 6: Minor Collectors | *2.10E-06* |
| Rural | 7: Local | *6.94E-07* |

In Michigan, a reportable crash is defined as an incident involving a motor vehicle that was in transport, and on the roadway, which resulted in death, injury, or property damage of $1,000 or more.[2] We obtained a State-wide dataset extract of commercial vehicle crashes for 2018 and 2019[3] that was referenced to individual segments the Michigan Linear Reference System (LRS) roadway network. We also obtained data on commercial annual average daily traffic for each segment in the LRS data for the same two-year period.[4] We then computed the crash rates by roadway type by dividing the total crashes by the total annual commercial miles traveled.

[2] UD-10 Traffic Crash Report Instruction Manual, Michigan Department of State Police (MSP), revised 2018.
[3] Extract from the Michigan Traffic Crash Reporting System (TCRS) maintained by MSP, downloaded on 8/6/2021.
[4] Commercial Annual Average Daily Traffic (CAADT) downloaded from https://gis-mdot.opendata.arcgis.com/datasets/2019-traffic-volumes and https://gis-mdot.opendata.arcgis.com/datasets/mdotaadtcaadt2018 on 5/24/2001.

## 3.4 Conditional Release Probabilities

The conditional probability of release (CPR) for a shipment refers to the probability that the hazardous material being transported will actually be released from the packaging/container in the event of a crash. Many crashes involving hazardous materials do not result in a spill because packaging integrity is often maintained in less severe crashes. For road transport, container characteristics that may affect the CPR include DOT Specification, material of construction, shell and head thicknesses, design pressure, insulation, external jacketing, and fittings design and protection. Shippers select the appropriate packaging/container based on the material being transported and the minimum regulatory requirements for that material.

### 3.4.1 Highway Container Types

Data on conditional release probabilities for tank trucks are very limited. In the early 1990s, Arthur D. Little Consulting developed representative release probabilities for several general types of tank trucks.[5] Because this study is focused at the hazard class level, the AD Little data is mapped to identify the tank design most likely associated with the typical commodities in each hazard class and division. This allowed CPRs to be estimated for each hazard class.

CPRs for other highway containers, such as van trailers, intermodal trailers, and shipping containers are not available, therefore, the analysis is restricted to regulated hazardous materials shipped in DOT Specification cargo tank motor vehicles ("tank trucks") and possibly portable tanks shipped on truck chassis or flatbed. From a risk perspective, regulated hazardous materials shipped in bulk are generally of the greater concern (due to the volume of material that can potentially be released), so focusing the analysis on this subset of the commodity flow is reasonable given the data limitations. Table 4 contains the CPRs by container type from the Arthur D. Little study.

*Table 4 – CPRs by Highway Container Type*

| Container Type | *Conditional Probability of Release* |
|---|---|
| Non-pressure, General Purpose MC 306/312 | *0.06* |
| Stainless Steel, Pressurized, MC 307 | *0.04* |
| Compressed Gas, MC 331 | *0.03* |
| Vacuum Insulated Cryogenic MC 338 | *0.02* |
| ISO Insulated Pressurized Containers | *0.01* |

Source: "Representative Transportation Accident Rates and Large Spill Probabilities", Arthur D. Little, Inc., Cambridge, MA. 1992

[5] "Representative Transportation Accident Rates and Large Spill Probabilities", Arthur D. Little, Inc., Cambridge, MA. Unpublished, 1992.

### 3.4.2 Hazard Class Determination

To determine an appropriate CPR value for each hazard class, the packaging instructions in the Hazardous Materials Table (HMT; 49 CFR 172.101) are used to assign authorized packaging types to material Proper Shipping Names (PSN). We then developed a relationship between each hazard class and authorized container types. Where a single CPR value is dominant for a hazard class, that CPR value is used to represent the hazard class. For hazard classes that have more than one division with different material characteristics, such as Classes 2 and 4, a single CPR value is calculated. 2017 Commodity Flow Survey (CFS) data are used to determine the relative proportion of packaging types across the divisions within these classes. Risk values are computed for each of these divisions using the appropriate CPR and the results were combined using the divisions' relative proportions. Table 5 on the right contains the calculated CPR values by hazard class.

*Table 5 – CPR Values by Hazard Class*

| Hazard Class | Conditional Probability of Release |
|---|---|
| 1 | 0.060 |
| 2 | 0.020 |
| 3 | 0.060 |
| 4 | 0.060 |
| 5 | 0.060 |
| 6 | 0.060 |
| 7 | 0.001 |
| 8 | 0.060 |
| 9 | 0.060 |

## 3.5 Consequences

Potential consequences from a hazardous materials transportation incident are evaluated in terms of exposure to human health and the environment as well to services and facilities. For all consequence types, the consequences are estimated based on determining the population, sensitive environmental areas, or counts of special populations, services, and facilities (described later in this section) within an appropriate distance from the transportation network that could potentially be exposed should hazardous material be released in an accident. This is done at the roadway network segment level and aggregated for each alternate route we analyzed. Roadway network segments are represented as unique elements within the Michigan LRS dataset that have homogenous attributes (such as roadway type, number of lanes, etc.).

The proxy measure for human health consequence is population exposure, i.e., the expected number of people impacted (potential evacuated population) in case of a release. The distances of concern are an average evacuation or protective action distance for each hazard class based on information provided in the North American Emergency Response Guidebook (ERG).

For environmental consequences, both land and water exposure are combined. Land exposure is measured by determining the total square miles of any area included in the USGS Protected Areas Dataset (PAD) that falls within the impact distances used for population exposure. The primary source for water-based areas is the USGS National Hydrography Dataset (NHD), which includes lakes, rivers, and streams. For consequence exposure, we determine the square miles of NHD areas within 0.1 miles from the transportation network.

Special population, service, and facility counts are estimated by determining how many such locations fall within the same hazard class-specific impact distance of the roadway that was used for population exposure. The locations are determined from the DHS Homeland Infrastructure Foundation-Level Data (HIFLD) dataset. Each of these items is discussed in more detail in the following sections.

### 3.5.1 Impact Distances

The area affected by the release of a hazardous material is dependent upon the properties of the specific commodity being released. The ERG is used to determine the suggested evacuation or protective action distances (and thus impact area) associated with each commodity. 2017 CFS data are used to determine appropriate weighting of impact distances within hazard classes that have more than one hazard class or division (e.g., Classes 1, 2, 4, 5, 6) based on the ton-miles shipped nationwide by hazard class and division. Subsequent analysis is done at the division level and aggregated to compute a hazard class-specific value. By relating the HMT to the ERG lists, predominant impact distances by hazard class are derived as shown in Table 6.

*Table 6 – Impact Distances by Hazard Class*

| Hazard Class | Sub Class or Division | Impact Distance (miles) | Weight |
|---|---|---|---|
| 1 | - | 1.0 | 1.000 |
| 2 | 2.1 | 1.0 | 0.517 |
| | 2.2 | 0.5 | 0.397 |
| | 2.3 | 7.0 | 0.086 |
| 3 | - | 0.5 | 1.000 |
| 4 | 4.1 | 1.0 | 0.573 |
| | 4.2/4.3 | 4.4 | 0.427 |
| 5 | - | 0.5 | 1.000 |
| 6 | - | 6.8 | 1.000 |
| 7 | - | 0.2 | 1.000 |
| 8 | - | 0.5 | 1.000 |
| 9 | - | 0.5 | 1.000 |

### 3.5.2 Population

The primary consequence measure for population exposure, as mentioned above, is the population data in FEMA's Hazus system for natural disaster impact modeling. The data are based on the 2010 decennial census but are periodically updated with interim population estimates and other methodological improvements. The most recent Hazus population data update was done in 2016. Hazus-based population data at the Census Block level are overlayed on the roadway network, buffered by the hazard-class-specific impact distances described above, to compute population-based risk values.

The HIFLD dataset contains data on special populations that may be of concern during a hazardous materials incident (see Table 7). These data are used to determine how many of each type of special population are within the hazard-class-specific impact distance around each roadway segment to provide additional context for emergency planners, but they are not directly used to compute risk.

*Table 7 – Special Populations & Examples*

| Special Populations | *Examples* |
|---|---|
| Communities | *Mobile Home Parks*<br>*Nursing Homes*<br>*Prisons* |
| Gathering Places | *Convention centers and fairgrounds*<br>*Government buildings (Governors' Mansions, Major State Government & Capitol Buildings)*<br>*Places of worship (churches & synagogues)*<br>*Sports venues (stadiums, arena, racetracks, golf courses)* |
| Healthcare Facilities | *Urgent Care Facilities*<br>*Hospitals*<br>*Veterans' Health Administration Medical Facilities* |
| Schools | *Childcare facilities*<br>*Colleges and Universities,*<br>*Public and private schools (K-12)*<br>*Trade schools & supplemental colleges* |

### 3.5.3 Environmentally Sensitive Areas

Environmental consequences are determined separately for land- and water-based receptors, due to the differing types of impacts that each may experience.

*Land-based Areas*

The USGS Protected Areas Dataset (PAD) contains most of the land-based areas of concern for the State. Rather than impute the relative importance of each type of designation for this analysis, we determined it appropriate to use all PAD layers, realizing that some of them will not have any features within Michigan.

*Water-based Areas*

The primary source for water-based areas is the USGS National Hydrography Dataset, which includes lakes, rivers, and streams. Not all materials are water-sensitive, but our analysis includes exposure to water as a component. This metric assesses a combination of direct contact with and close proximity to water bodies. This metric also provides segment-level reporting of the magnitude and percent of network miles with water exposure. The number of miles along each network segment that has exposure to water bodies is compared to the overall segment distance to compute a percentage.

### 3.5.4 Services and Facilities

*Table 8 – Services and Facilities with Examples*

| Services & Facilities | *Examples* |
|---|---|
| Emergency Services | *EMS Stations*<br>*Fire Stations*<br>*Local & State EOCs*<br>*National Shelter System Facilities*<br>*Police Departments* |
| Infrastructure | *Dam Areas*<br>*Power Plants*<br>*Substations* |
| Transportation | *Aircraft Landing Facilities*<br>*Amtrak Stations*<br>*Intermodal Terminal Facilities*<br>*Railroad Bridges*<br>*Road and Railroad Tunnels* |

The Homeland Infrastructure Foundational-Level Data (HIFLD) are used for analysis and includes services and facilities as shown in Table 8.

## 3.6 Other Considerations

In addition to the information described above that are used in the formal risk analysis, we also considered emergency and spill response, security, congestion, and through routing as part of this study as noted below.

### 3.6.1 Emergency and Spill Response

The Ambassador Bridge Authority maintains comprehensive emergency response, spill prevention, and contingency plans. These plans include detailed instruction on communications, notifications, resources, and procedures to help minimize the impact of incidents to people, property, and environment. All incidents are coordinated by the bridge's Command Center to facilitate containment and traffic control.

The bridge itself has a “dry line” fire suppression system that can be connected to water supplies to help suppress or extinguish a fire event. The system is compliant and periodically tested in accordance with NFPA 502. A local response (e.g., Police, Fire, Medical) will originate from Detroit or Windsor depending on the location of the incident on the bridge. The Detroit

Fire Department has a hazardous materials incident response vehicle that is equipped to handle most hazardous materials incidents, including chemical fires that require an aqueous (alcohol-resistant) foam for suppression.

Liquid pooling devices are available on escort and supervisor vehicles as well as on either side of the bridge. They can hold approximately 100 gallons of liquid and are designed to be placed under a vehicle to contain a spill. If there is a release of chemical into the Detroit River, the U.S. Coast Guard and the Ministry of the Environment Spills Action Centre are notified to help facilitate containment and clean-up. The bridge authority maintains an active contract for on-call environment recovery services. Both the Detroit and Windsor Fire Departments conduct training exercises, including pressurizing the standpipes to bring water to points on their respective sides of the bridge. The most recent such exercises occurred in July 2020 (Windsor) and August 2020 (Detroit).

### 3.6.2 Security

This quantitative risk analysis did not specifically consider release probabilities as they may relate to potential security threats and vulnerabilities; however, the consequences for security related events are roughly equivalent to what has been presented. It is recognized that certain hazardous materials are of a greater security concern (e.g., explosives, radioactive materials, toxic materials) and other regulatory requirements that apply will influence, to a certain extent, NRHM route designation decisions.

### 3.6.3 Congestion

The quantitative risk analysis considers trip length (i.e., distance) but does not consider trip times or congestion and the potential for dwell time during transit as such data were not available from U.S. or Canadian border officials as of the writing of this report. Risk exposure may increase with an increase in transit time. However, slower traffic speeds may also reduce overall crash severity and release probabilities. Additionally, carriers and drivers may select routes that experience shorter expected wait times. A review of historical inbound wait times[6] at the Ambassador Bridge the average truck wait time is 33 minutes with a maximum of 38 minutes. At the Blue Water Bridge, the average truck wait time is 15 minutes with a maximum of 78 minutes. The Detroit-Windsor Ferry makes five crossings each day, departing Detroit every two hours during operating hours. Without specific cross-border shipment counts from the U.S. to Canada, we were unable to perform a more detailed congestion analysis.

### 3.6.4 Through Routing

Per the FHWA guidelines, through-routing criteria were considered for this study. However, only adding *additional* restrictions would potentially impact through routing of hazardous materials. Maintaining or removing existing restrictions would not impact through routing as all

[6] Border Wait Times (cbp.gov): https://bwt.cbp.gov/historical

traffic could continue to cross the border using the current routes or they could use the newly available routes.

# 4 ANALYSIS

This section includes the analysis results and a summary of other considerations. In this analysis, thirty-two routes were analyzed. Details on these routes and how they were selected appear in Section 4.2. For specific U.S. and Canadian origins and destinations, different routes and border crossings are typically chosen by transporters based on relevant hazardous materials restrictions and on the shortest mileage (or travel time) to the destination. In order to accurately reflect these preferences, route weights were developed using a shortest path analysis. The routes selected for this study (six representative origins in Michigan to each of three border crossings) were paired with four destination points in Canada[7] to calculate the total distance. The routes with the shortest path to the destination were selected as the preferred route and used to identify the preferred border crossing. A border crossing preference ratio was then determined by comparing all the shortest-path routes for a given U.S. origin/destination. Then for each hazard class where removal of a restriction is considered, weight-adjusted risk values and counts were compared with the benchmark in terms percent change for all routes analyzed in Michigan and for localized routes in the Detroit area.

## 4.1 Border Crossings

Through data collection and interviews, it was determined that changes to the NRHM restricted route designations for the Ambassador Bridge would mainly impact cross border shipments of hazardous materials between southeastern Michigan and Ontario, Canada. Hazardous material truck shipments not permitted to cross at the Ambassador Bridge have two alternate routes: the Blue Water Bridge near Port Huron, Michigan and the Detroit-Windsor Truck Ferry in Detroit, Michigan[8]. If the hazardous material is also restricted on Blue Water Bridge, then the Detroit-Windsor Truck Ferry may be used (e.g., Class 1 explosives).

Based on an assessment of international border crossing data, a change to the NRHM restricted route designations for the Ambassador Bridge could cause approximately 15 percent of certain hazardous material shipments to be rerouted to the Ambassador Bridge from the Blue Water Bridge and 100 percent rerouted to the Ambassador Bridge from the Detroit-Windsor Truck Ferry. To estimate the impact of this potential hazardous materials commodity flow shift, various routes were analyzed considering various factors including population exposure, crash rates, infrastructure, and the environment.

## 4.2 State Routes

The FACTOR team determined that there was no appropriate public dataset that provided information on Class 3 or Class 8 movements to or from locations in (or beyond) Michigan to the Ontario border. Note that we assumed that some shipments from outside Michigan would

[7] These locations in Ontario are Windsor, Tilbury, London, and Forest.

[8] The International Bridge, which connects Sault St. Marie, MI and Sault St. Marie, ON was not considered in this study as a viable alternative route, due to its considerably more northern location in Michigan.

travel through Michigan to reach the most direct permissible crossing into Canada. The scope and timeframe for this analysis did not support field data collection to determine actual origins and destinations for cross-border Class 3 and 8 shipments as well as the border crossing that the carrier would prefer in the absence of hazmat restrictions. Instead, we had to develop an approach to model representative movements from locations throughout Michigan into Canada. This approach had to consider possible destinations within Canada—not just the closest border crossing—to adequately represent actual routing decisions that a carrier would make.

The team needed to account for shipments from different parts of the state from a geographical perspective, but also needed to account for likely traffic patterns based on the locations of industry and potential shippers of Class 3 and Class 8 commodities. We reviewed many data sources and determined that the best sources of the information needed to inform the selection of origins and destinations in Michigan were: (a) the MDOT 2040 Freight Plan;[9] (b) MDOT published traffic volumes for the two years pre-COVID; (c) the industry contacts that provided information; (d) employment data for manufacturing, transportation, and warehousing establishments; (e) the location of automotive facilities; (f) Michigan business searches for relevant industries; and (g) Census Bureau data on the industries in which residents work. Our team reviewed these sources and made a determination about the general locations appropriate for our analysis, accounting also for shipments from outside Michigan that would likely travel through Michigan on their way to Canadian destinations. Six locations in Michigan and Ohio were selected as origins/destinations:

- Lansing (west from both the Ambassador Bridge (AB) and Blue Water Bridge (BWB), but between them both),
- Flint (due west from the BWB),
- Sterling Heights (north of the AB),
- East Toledo (southwest from the AB),
- West Toledo (southwest from the AB, but closer to other routes north), and
- Battle Creek (west of the AB).

Based on our review of the Freight Plan and other data,[10] these six origins are representative of locations that are either a potential source, destination, or waypoint for international hazardous materials shipments. Some represent specific areas of manufacture and industry (Sterling Heights) while others were chosen to represent shipments whose origins or destinations are beyond these locations but that would likely travel through them (East Toledo).

[9] https://www.michigan.gov/documents/mdot/MDOT_DRAFT_StateFreightPlan2017_599148_7.pdf; the 2040 Freight Plan contains a list of top road corridors by commercial traffic volume.

[10] Including stakeholder interviews, traffic volume data, employment concentration in transportation and warehousing industries based on American Community Survey data.

To be able to properly determine the percentage of freight crossing at each border that should be assigned to each route (and origin), we had to model the movement of freight from locations in Michigan to locations in Ontario and beyond. We identified four locations in Ontario to represent a variety of destinations that would capture routing decisions for shipments traveling to these locations (even if the shipments we destined for more distant locations). These were:

- Windsor (to capture local Ambassador Bridge destinations),
- Tilbury (farther east, but not too far, from Windsor),
- London (due east of the BWB, but also with a direct path from the AB), and
- Forest (to capture traffic headed to Northern Ontario).

All traffic headed to cities such as Hamilton, Toronto, and beyond would pass through London. As briefly stated in the introductory text in section 4, each of the six Michigan locations were paired with the four locations in Canada to generate 24 origin-destination pairs. The shortest-path analysis for each pair was used to determine the preferred border crossing for that pair.

Tables 9, 10, and 11 below show the origin and destination pairs and routes selected for analysis. Each table shows the possible routes from the origins to either the Ambassador Bridge or the Blue Water Bridge. At this scale, the deviations in routes that use the Detroit-Windsor Truck Ferry are not visible and are examined in Section 4.4. Routes are color-coded on the maps and in the small table beneath each one showing the route name used in the analysis, the major roadways used and the route distance for reference.

*Table 9 – Key Routes by Origin and Destination Pairs (1 of 3)*

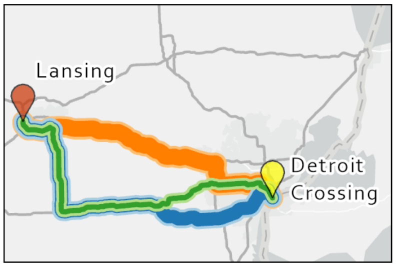
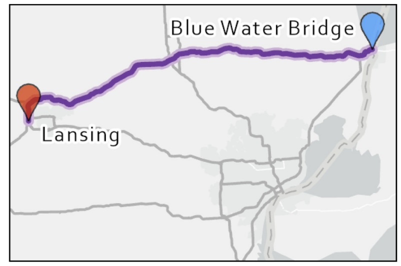
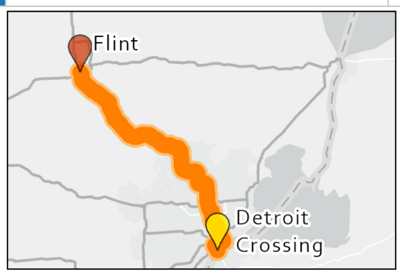
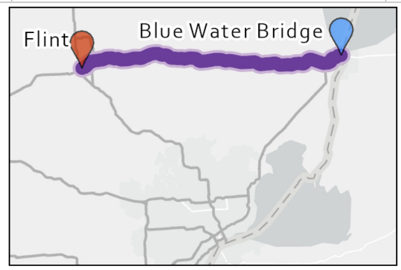
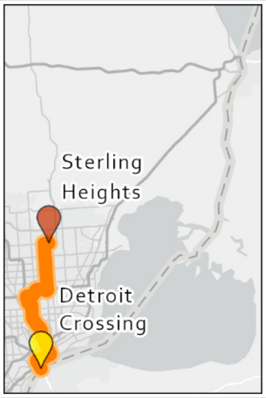
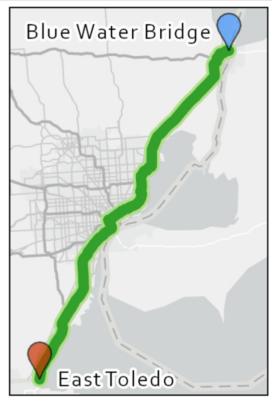
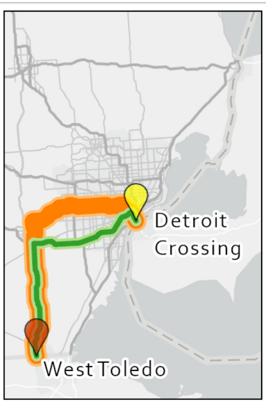
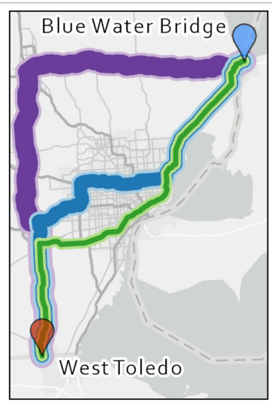
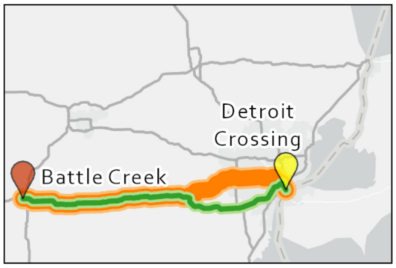
| | Ambassador Bridge (A) | | | Blue Water Bridge (B) | | |
|---|---|---|---|---|---|---|
| **Lansing (1)** |  | | |  | | |
| | 1A.1) | I-96 | 98 mi | 1B.1) | I-69 | 129 mi |
| | 1A.2) | Through Livonia to US-27, to I-96 | 117 mi | | | |
| | 1A.4) | Through Romulus to US-27, to I-96 | 118 mi | | | |
| **Flint (2)** |  | | |  | | |
| | 2A.1) | I-75 | 69 mi | 2B.1) | I-69 | 70 mi |

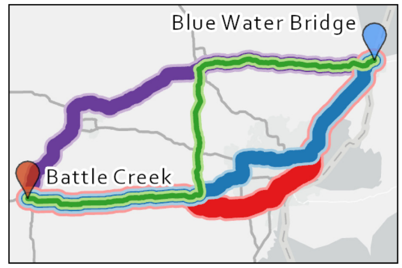
*Table 10 – Key Routes by Origin and Destination Pairs (2 of 3)*

<table>
<tr><th></th><th colspan="3">Ambassador Bridge (A)</th><th colspan="3">Blue Water Bridge (B)</th></tr>
<tr><td rowspan="3">Sterling Heights (3)</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td rowspan="2">3A.1)</td><td rowspan="2">I-75, I-696/Walter P. Reuther Fwy, Mound Road</td><td rowspan="2">26 mi</td><td>3B.1)</td><td>I-94, M-59</td><td>47 mi</td></tr>
<tr><td>3B.2)</td><td>I-69 to Flint, M-53</td><td>65 mi</td></tr>
<tr><td rowspan="2">East Toledo (4)</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>4A.1)</td><td>I-75</td><td>49 mi</td><td>4B.1)</td><td>I-94, I-75</td><td>112 mi</td></tr>
<tr><td rowspan="2">West Toledo (5)</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>5A.1)</td><td>Through Livonia, US-23</td><td>79 mi</td><td>5B.1)</td><td>I-94 to Romulus, US-23</td><td>132 mi</td></tr>
<tr><td></td><td>5A.2)</td><td>Through Romulus, US-23</td><td>73 mi</td><td>5B.2)*</td><td>I-94 to I-696/Walter P. Reuther Fwy, through Ann Arbor, US-23</td><td>138 mi</td></tr>
<tr><td></td><td></td><td></td><td></td><td>5B.3)</td><td>I-69 to Flint, US-23</td><td>163 mi</td></tr>
</table>

*Hazmat restricted route: Classes 1 & 3 restricted on I-696

*Table 11 – Key Routes by Origin and Destination Pairs (3 of 3)*




| | Ambassador Bridge (A) | | | Blue Water Bridge (B) | | |
|---|---|---|---|---|---|---|
| Battle Creek (6) | 6A.1) | Through Livonia | 107 mi | 6B.1) | Through Flint, US-23 | 186 mi |
| | 6A.2) | Through Romulus | 109 mi | 6B.3)* | Through Detroit on I-696/Walter P. Reuther Fwy | 167 mi |
| | | | | 6B.4) | Through Romulus | 168 mi |
| | | | | 6B.5) | Through Flint and Lansing (on I-69) | 165 mi |

*Hazmat restricted route: Classes 1 & 3 restricted on I-696

## 4.3 Local Detroit Routes

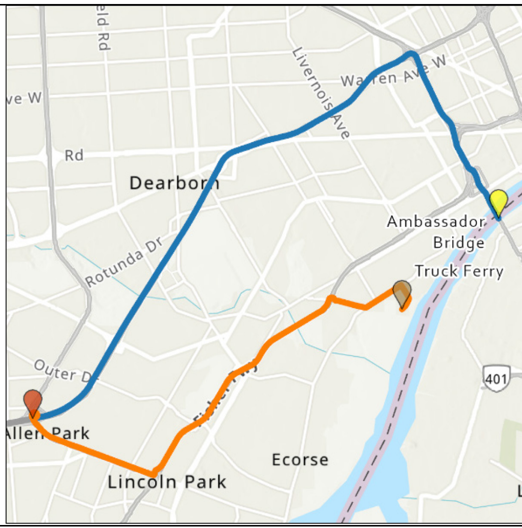
Routes from each origin to the Detroit-Windsor Truck Ferry and the Ambassador Bridge follow the same paths until they reach the vicinity of the river crossings and the analysis for these alternatives focuses on the localized differences. Table 12 shows the mileage by road type for local Detroit routes. Table 13 shows these route differences, as well as the mileage and estimated rush-hour travel times. In both tables, AB refers to the Ambassador Bridge and TF refers to the Detroit-Windsor Truck Ferry.

*Table 12 – Detroit Area Routes – Mileage by Road Type*

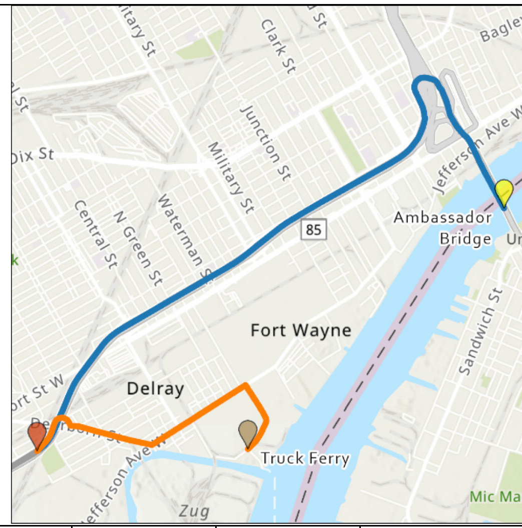
| | D1: To/From Battle Creek, Lansing & West Toledo via Romulus | | D2: To/From East Toledo | | D3: To/From Battle Creek, Lansing & West Toledo via Livonia, Sterling Heights, Flint | |
|---|---|---|---|---|---|---|
| **Road Type** | AB | TF | AB | TF | AB | TF |
| Interstate | 11.25 | 4.69 | 3.68 | 0.34 | 0.31 | 1.02 |
| Other Freeways | | 0.19 | | | | |
| Other Principal Arterial | 0.83 | 2.63 | 0.83 | 0.68 | 0.85 | 0.88 |
| Minor Arterials | | | | | | 0.43 |
| Major Collector | | 0.98 | | 0.98 | | 0.98 |
| **TOTAL** | 12.08 | 8.49 | 4.51 | 2.01 | 1.16 | 3.32 |

*Table 13 – Detroit Area Route Differences*

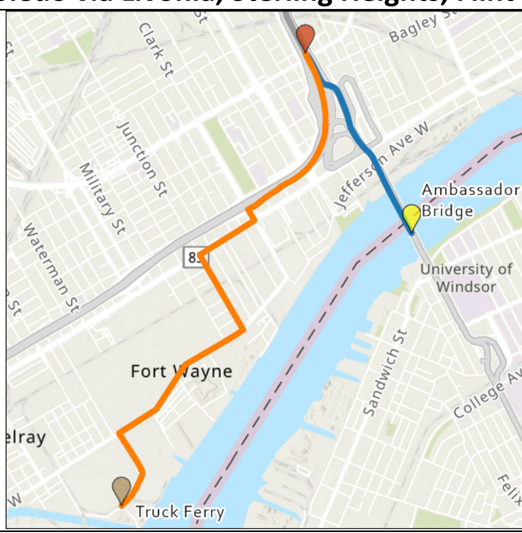
**D1: To/From Battle Creek, Lansing & West Toledo via Romulus**




**D2: To/From East Toledo**




**D3: To/From Battle Creek, Lansing & West Toledo via Livonia, Sterling Heights, Flint**




| Route | Crossing | Length | Travel Time* |
|---|---|---|---|
| D1 | AB | 12.08 mi. | 12-14 min. |
| | TF | 8.49 mi. | 12-18 min. |
| D2 | AB | 4.51 mi. | 8 min. |
| | TF | 2.01 mi. | 6-7 min. |
| D3 | AB | 1.16 mi. | 4 min. |
| | TF | 3.32 mi. | 7-10 min. |

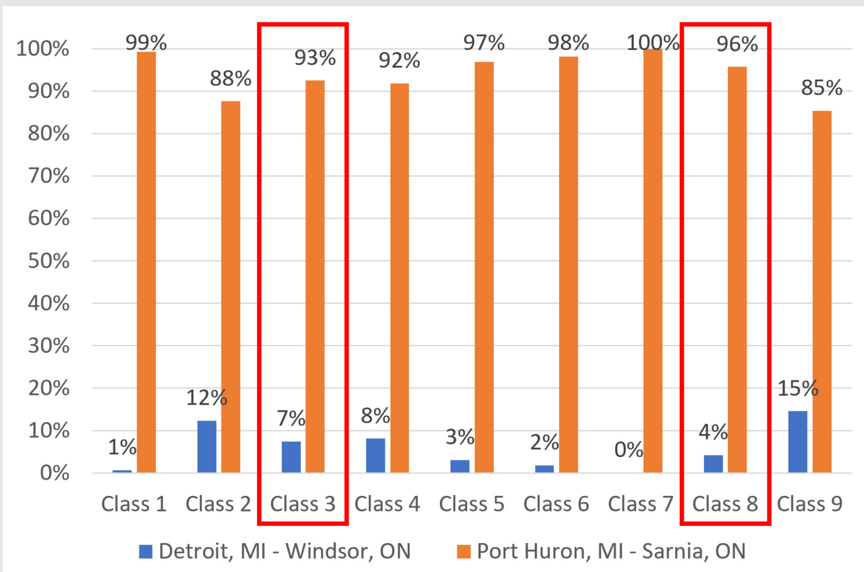
** Travel times are based on typical passenger vehicle speeds and will be longer for heavy trucks.*

## 4.4 Weighting

Route weights derived from the shortest-path analysis described above are then applied to the calculated risk values and other metrics, as appropriate, for each hazard class. Benchmark routes for each origin/destination are determined considering existing route restrictions. Route weights are also applied to calculated risk values and counts, as appropriate, for each hazard class that considered potential removal of route restrictions at the Ambassador Bridge.

Hazardous materials shipments to Canada typically cross the border in Detroit, MI or Port Huron, MI. For Detroit, some shipments of hazard classes that are currently restricted at the Ambassador Bridge will cross the border on the Detroit-Windsor Truck Ferry. Due to the close proximity of the Detroit-Windsor Truck Ferry, we estimate that 100 percent of the shipments utilizing the Truck Ferry would shift to the Ambassador Bridge if restrictions were lifted. Figure 1 shows the percentages of total shipments of each hazard class that cross into Canada at Detroit or Port Huron based on border crossing data obtained from the Canada Border Services Agency. For shipments of Classes 3 and 8, approximately 93 percent and 96 percent, respectively, use the Blue Water Bridge in Port Huron to cross in and out of Canada. If hazardous materials restrictions for Classes 3 and 8 were lifted at the Ambassador Bridge, it is estimated that approximately 15 percent of these shipments would shift to using the Ambassador Bridge. This estimation is based on the ratio of shipments for a currently unrestricted hazard class (Class 2). Through the stakeholder interview process, we also learned that industry is more developed in locations where unrestricted routes are more accessible and, therefore, we believe the shift for Classes 3 and 8 will be modest.

*Figure 1 – CBSA Shipment Data – Distribution by Hazard Class and Port*




*Note: percentages are based on total number of shipments*

## 4.5 Results

The population risk values, environmental risk values, special population counts, and service and facility counts have been computed for each hazard class for each of the thirty-two key routes plus the six localized Detroit-area routes analyzed. Risk values and counts were only computed for the outbound trip to key border crossings; however, these values and counts are representative of the general flow pattern of hazardous materials in either direction with only minor deviations in routing. The calculated values and counts for population, environmental, special populations, and services and facilities are independent of each other.

Class 2 (gases), Class 4 (flammable solids, substances liable to spontaneous combustion, and substances which, in contact with water, emit flammable gases), Class 5 (oxidizing substances and organic peroxides), Division 6.1 (toxic substances), and Class 9 (miscellaneous) are currently authorized for transportation over the Ambassador Bridge. It would be possible to analyze these hazard classes in the context of new restrictions, but it should be noted that in all cases, the introduction of new restrictions would likely have a significant negative impact on commerce and facilitation of trade, especially if certain hazard classes are also restricted on the Blue Water Bridge. A review of crash data for the Ambassador Bridge does not suggest that there is a need to introduce new restrictions. On this basis, detailed analyses for these hazard classes are not included and detailed analysis or discussion is only presented for Class 1 (explosives), Class 3 (flammable liquids), Division 6.2 (infectious substances), Class 7 (radioactive materials), and Class 8 (corrosive substances).

### 4.5.1 Restricted Material Properties

The properties of the currently restricted hazardous materials are discussed below.

***Class 1 – Explosives:*** Class 1 (explosives) are liquids, solids, or mixtures of liquids or solids that are capable by chemical reaction of producing gas at such a temperature and pressure and such a speed as to cause damage to its surroundings. Pyrotechnic substances are included in this Class even when they do not evolve gases. Explosives can easily ignite and cause projection and mass explosion hazards. If a fire or heat is present, the cargo may explode. It is recommended to flood the cargo with water (or $CO_2$, dry chemical, or dirt) from a safe distance, stop all traffic, and evacuate the area.

***Class 3 – Flammable Liquids:*** Class 3 (flammable liquids) are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (e.g., paints, varnishes, lacquers, etc.) that give off flammable vapors at or below 60$^{o}$C (flashpoint). Included in Class 3 are also liquids offered for transport above their flashpoint temperature and substances offered for transport at an elevated temperature in a liquid state. Flammable liquids can easily ignite by heat, spark, or flames. Flammable liquids may also be toxic if inhaled, ingested, or absorbed through skin. If involved in a fire, flammable liquids can be extinguished with a water spray (small fires only), a dry chemical, $CO_2$, or an alcohol-resistant foam. For larger fires, a water spray may be ineffective.

***Division 6.2 – Infectious Substances:*** Division 6.2 (infectious substances) are substances that are known or reasonably expected to contain pathogens. Pathogens are defined as microorganisms (including bacteria, viruses, rickettsiae, parasites, fungi) and other agents such as prions, which can cause disease in humans or animals. Infectious substances may cause infection, disease, or death and spills or leaks must be cleaned-up or disposed of by qualified personnel with appropriate personal protective equipment.

***Class 7 – Radioactive Materials:*** Class 7 (radioactive materials) contain radionuclides where both the activity concentration and total activity in the consignment exceed defined values for exemption. Radioactive materials may emit alpha, beta, or gamma particles which can cause burns to skin, eyes, and respiratory tract. If involved in a fire, spill, or leak, the area should be isolated and be cleaned-up or disposed of by qualified personnel with appropriate personal protective equipment. All exposed persons, clothing, equipment, and surfaces must be decontaminated.

***Class 8 – Corrosive Substances:*** Class 8 (corrosive substances) are substances which, by chemical action, will cause severe damage when in contact with living tissue or, in the case of leakage, will materially damage, or even destroy other goods or means of transport. Included in Class 8 are substances that can cause full thickness skin destruction of intact skin tissue within an observation period of up to 14 days after an initial exposure time of as little as 3 minutes or less and substances that have a corrosion rate on either steel or aluminum surfaces that exceeds 6.25 mm a year at test temperature of 55$^{o}$C. Strong acids and alkalis are often classified as corrosive. Many Class 8 substances also have other subsidiary hazardous properties including toxicity, water-reactivity, and flammability. Corrosive liquids may also be toxic if inhaled, ingested, or absorbed through skin. If involved in a fire, corrosive liquids can be extinguished with a water spray, a dry chemical, $CO_2$, or an alcohol-resistant foam.

### 4.5.2 Hazard Analysis

Currently, placarded Class 1 (explosives), Class 3 (flammable liquids), Division 6.2 (infectious substances), Class 7 (radioactive materials), and Class 8 (corrosive substances) are restricted from transport over the Ambassador Bridge and, therefore, the risk of a crash involving a placarded load of these hazardous materials directly on the bridge is assumed zero. If Class 1 restrictions were lifted, trucks that regularly use the Detroit-Windsor Truck Ferry for explosive shipments would shift to using the Ambassador Bridge. While this could reduce transit times and local exposure, **the Ambassador Bridge itself is considered critical infrastructure** and an explosion could damage the bridge, cause injuries or death, and cause significant economic disruption and loss. Some bridges across the U.S. do allow explosives to be transported across provided escorts are used. This mitigation strategy may help reduce the probability of an explosion but would not change the consequences to the bridge and public if an explosion did occur. On this basis, Class 1 was not considered for detailed routing analysis.

The Division 6.2 restriction aims to prevent unauthorized importation of mixed municipal solid waste (MSW) containing medical waste from Canada into Michigan. Transport of Division 6.2 across the Ambassador Bridge is possible provided that an appropriate permit[11] is obtained.

Class 7 shipments are subject to 49 CFR 397 Subpart D – Routing of Class (Radioactive) Materials[12] for determining route restrictions and selecting a “preferred route” for transport. Motor carriers and drivers must analyze and select a route that reduces radiological risk or use a preferred route. Any highway route-controlled quantity of Class 7 requires preparation of a

[11] Michigan Department of Environment, Great Lakes, and Energy (EGLE) Medical Waste Regulatory Program applies and many activities under the program require a permit.
[12] 49 CFR 397.101 and 49 CFR 397.103

specific route plan. Because this study was conducted in accordance with 49 CFR 397.71, detailed analysis on preferred routes is not included.

### 4.5.3 Route Risk Assessment for Class 3 and 8

The current routes (benchmarks) for Classes 3 and 8 include routes to the Blue Water Bridge and Detroit-Windsor Truck Ferry. The potential future scenario includes routes across the Ambassador Bridge, should those restrictions be lifted. The population risk, environmental risk, counts of special populations, counts of services and facilities, and the percentage change in Michigan for benchmark and considered routes are shown in Table 14. Table 15 shows the current and future shipment counts and cumulative population risk values for Class 3 and 8.

*Table 14 – Class 3 (Flammable Liquids) and Class 8 (Corrosive Substances) Risk, Counts, and Percent Change*

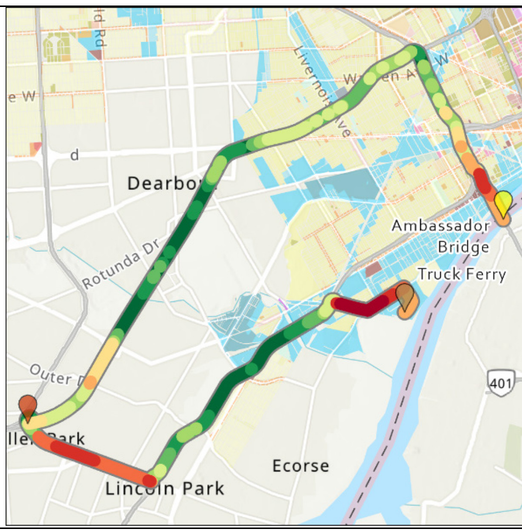
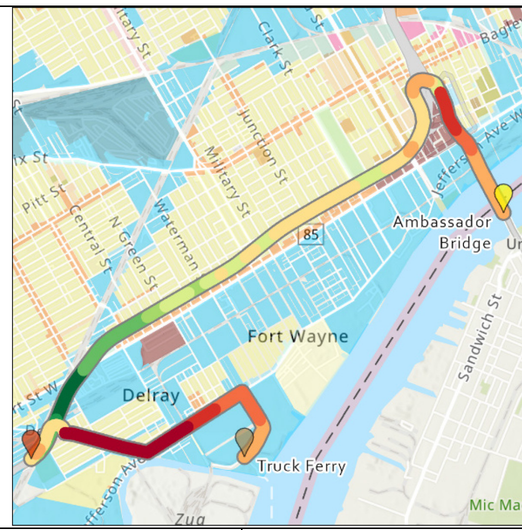
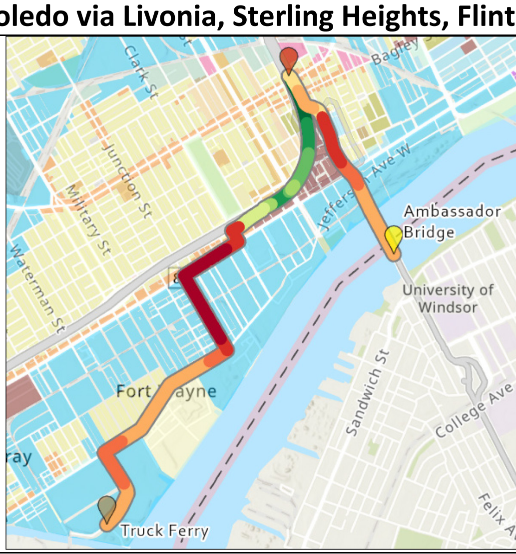

| | Benchmark | Class 3 & 8 Restrictions Removed at Ambassador Bridge | |
|---|---|---|---|
| | Current State | Potential Future Scenario | Percent Change |
| **Weighting based on shipment data (CBSA) – Class 3** | | | |
| Population Risk | 1.03E-01 | 9.85E-02 | -4.0% |
| Environmental Risk | 1.30E-07 | 1.31E-07 | 0.7% |
| Special Population Counts | 343.82 | 349.66 | 1.7% |
| Services and Facilities Counts | 166.39 | 176.07 | 5.8% |
| **Weighting based on shipment data (CBSA) – Class 8** | | | |
| Population Risk | 1.03E-01 | 9.83E-02 | -4.5% |
| Environmental Risk | 1.30E-07 | 1.30E-07 | -0.3% |
| Special Population Counts | 343.51 | 345.55 | 0.6% |
| Services and Facilities Counts | 164.67 | 172.12 | 4.5% |

*Table 15 – Comparison of Class 3 and Class 8 on Shipment Counts and Cumulative Risk*

| | Ambassador Bridge | | Truck Ferry | | Blue Water Bridge | |
|---|---|---|---|---|---|---|
| | Shipment Count | Population Risk | Shipment Count | Population Risk | Shipment Count | Population Risk |
| **Current State** | | | | | | |
| Class 3 | 0 | 0 | 2,416 | 1.27E+02 | 30,152 | 1.64E+03 |
| Class 8 | 0 | 0 | 706 | 3.71E+01 | 16,130 | 8.79E+02 |
| **Potential Future Scenario** | | | | | | |
| Class 3 | 6,939 | 3.22E+02 | 0 | 0 | 25,629 | 1.42E+03 |
| Class 8 | 3,126 | 1.45E+02 | 0 | 0 | 13,711 | 7.58E+02 |

The maps in Table 16 depict the population risk per mile along each of the six localized Detroit-area routes (Table 13) analyzed for Class 3 and Class 8 materials. This measure takes into consideration the maximum population within one mile of the traversed route as well as the accident rate, highlighting the differences in risk associated with transporting hazardous materials on local roads versus interstates (Table 12). The reduction in population risk shown in Table 15 is due to shipments moving from the higher risk links that go to the Truck Ferry to the lower risk links that go to the Ambassador Bridge.  Risk is driven by the higher crash rates on local roads as well as increased population along the route to the Truck Ferry.

*Table 16 – Population Risk per Mile on Detroit Area Routes*

<table>
<tr><td>D1: To/From Battle Creek, Lansing & West Toledo via Romulus</td><td colspan="2">D2: To/From East Toledo</td></tr>
<tr><td>
</td><td colspan="2">
</td></tr>
<tr><td>D3: To/From Battle Creek, Lansing & West Toledo via Livonia, Sterling Heights, Flint</td><td>Population Risk per Mile</td><td>Zoning[13]</td></tr>
<tr><td>
</td><td><= 0.00068<br><= 0.000784<br><= 0.000868<br><= 0.000966<br><= 0.001131<br><= 0.001365<br><= 0.004184<br><= 0.005739<br><= 0.007530<br><= 0.009290</td><td>Industrial Areas<br>Residential Areas<br>Services & Business<br><br>*Partial coverage of study area</td></tr>
</table>

[13] City of Detroit Zoning Map Index (April 2021)
https://www.arcgis.com/apps/webappviewer/index.html?id=ffcc6bfefed04673b6195fde9e5ca101

# 5 CONSIDERATIONS

This section contains further discussion of the analysis presented in Section 4 on the NRHM restricted route designations for the Ambassador Bridge. The considerations presented are based on information obtained through interviews and public data sources and a quantitative analysis of population risk, environmental risk, special population counts, and services and facilities counts on key routes leading to the Ambassador Bridge and other key border crossings for comparison purposes.

## 5.1 Discussion

Current NRHM restricted route designations for the Ambassador Bridge include Class 1 (explosives), Class 3 (flammable liquids), Division 6.2 (infectious substances), Class 7 (radioactive materials), and Class 8 (corrosive substances). These current designations have been in place since April 2, 2014.

The Ambassador Bridge is a key international border crossing and critical transportation route that helps move millions of people and freight shipments every year. While removing hazardous materials restrictions on the bridge could reduce transit times and population exposure, the Ambassador Bridge itself is considered critical infrastructure and an explosion or fire could damage the bridge, cause injuries or death, and cause significant economic disruption and loss. On this basis, Class 1 was not considered for detailed routing analysis.

The Division 6.2 restriction aims to prevent unauthorized importation of mixed municipal solid waste (MSW) containing medical waste from Canada into Michigan. Transport of Division 6.2 across the Ambassador Bridge is possible provided that an appropriate permit is obtained. Class 7 shipments are subject to 49 CFR 397 Subpart D – Routing of Class (Radioactive) Materials for determining route restrictions and selecting a "preferred route" for transport. Because these other regulations apply, detailed analysis on Class 6.2 and Class 7 was not conducted.

Analysis for Classes 3 and 8 show that if restrictions were removed at the Ambassador Bridge, there would be a small statewide reduction (4%) in population risk overall. Environmental risk for both Classes 3 and 8 would remain virtually unchanged but there would be slight increases (1-6%) in exposure to special populations, services, and facilities for both Classes 3 and 8 across all routes analyzed Michigan. While new hazardous materials transportation activity on or near the bridge would impact the local area, it only represents a small portion of all routes analyzed.

According to Canada Border Services Agency data, over 90% of trucks hauling Classes 3 and 8 hazardous materials use the Blue Water Bridge to cross in and out of Canada. If hazardous materials restrictions for Classes 3 and 8 were lifted at the Ambassador Bridge, it is estimated that approximately 15% of these shipments would shift to using the Ambassador Bridge, and this will increase hazardous materials truck volume on routes leading to and from the bridge and on the bridge itself. There are approximately 32,500 and 17,000 outbound shipments of Classes 3 and 8 hazardous materials to Canada every year, respectively. It is estimated that roughly 7,000 of Class 3 and 3,000 of Class 8 shipments outbound for Canada would shift to using the Ambassador Bridge.

While there would be new localized risks to the population, bridge, traffic, and commerce, the analysis results do not themselves provide a compelling case for or against changes to the current Ambassador Bridge restrictions for Class 3. However, the consequences from a crash involving Class 3 could result in fire and, like Class 1, could also cause significant damage to the bridge, economic disruption, and loss. Although the Ambassador Bridge has a “dry line” fire suppression system, it runs parallel to the roadway surface, and it is exposed to potential damage in the event of a highway vehicle crash. Additionally, many fires involving Class 3 require aqueous foam solution to properly extinguish. Fire stations and other locally available foam supplies would be the primary source for an extinguishing agent. Congestion may cause delays in response where prompt containment and recovery are essential for minimizing bridge damage and continuing traffic flow and commerce.

Similarly for Class 8, although there are potential reductions in statewide risk and the cumulative risk for Class 8 is lower than for Class 3, the analysis results also do not themselves provide a compelling case for or against changes to the restrictions on placarded loads of Class 8 being transported over the Ambassador Bridge.

## 5.2 Mitigation

There are mitigation strategies that could be applied to help reduce the inherent risks that hazardous materials present during transportation. For example, escorts are often used on bridges to provide additional crash protection and distancing from traffic. While this practice is generally understood to offer increased safety and security during transportation, no clear data sources exist to quantify this benefit. On this basis, we considered and estimated the potential local and state route impacts of various mitigation strategies on transportation safety and security for hazardous materials using a 3-point rating scale (Low, Medium, High). The results of these impact estimations are shown in Table 17. The mitigation strategies considered in Table 17 may provide a positive impact to transportation safety and security. However, mitigation strategies that are only applicable at the bridge itself would not be effective at reducing risk on routes throughout the state. For example, escorts provide on-bridge crash protection, but they provide no crash protection or benefit on routes leading to the bridge.

Some of the mitigation strategies, such as use of escorts or allowing travel of hazardous materials on the bridge only at certain times, may have associated consequences, such as a long queue of trucks waiting to be escorted. The adequacy of safe and secure parking for the anticipated number of trucks would need to be considered.

*Table 17 – Potential Risk Mitigation Strategies and Estimated Impacts on Local and State Routes Leading to the Ambassador Bridge*

| Mitigation Strategy | Description | Local Route Impact (near or on bridge) | State Route Impact (routes to bridge) |
|---|---|---|---|
| Vehicle escorts *(front and rear)* | Use front and rear escort vehicles for crossing the bridge with designated hazardous materials to reduce front and rear crashes. | **High** | **Low** |
| Vehicle escorts *(rear)* | Use rear escort vehicles for crossing the bridge with designated hazardous materials to reduce rear crashes. | **Medium** | **Low** |
| Daytime bridge crossing restriction *(6:00am- 7:00pm)* | Permit designated hazardous materials to cross bridge during off-hours to limit exposure to daytime traffic and population. | **Medium** | **Low** |
| Congested time bridge crossing restriction *(6:00-9:00am, 4:00-7:00pm)* | Permit designated hazardous materials to cross bridge during hours of lower congestion to limit exposure to heavier traffic. | **Medium** | **Low** |
| Bridge Crossing Notification | Permit designated hazardous materials to cross bridge if notification is given to bridge authority and/or emergency personnel prior to crossing. | **Low** | **Low** |
| Response Resource Prepositioning *(near bridge)* | Class 3 fires may require aqueous foam to properly extinguish. Prepositioning these (and other) resources near the bridge would help reduce the time needed to mitigate the consequences of a Class 3 fire. | **High** | **Low** |

## 5.3 Summary

In summary, to aid the Michigan Department of Transportation (MDOT) with decisions related to existing NRHM restricted route designations for the Ambassador Bridge, the following observations have been made:

- The analysis results show a small difference in statewide risk if the existing Class 3 and 8 restrictions were lifted; however, the difference is not significant enough to make a compelling case for or against any changes.
- While not represented in the numerical risk analysis, the potential consequences of a Class 3 incident on the Ambassador Bridge are expected to be greater than those of a Class 8 incident.
- MDOT has many additional factors to consider in making their decision, including public input and consultation with Canadian authorities, per the FHWA routing guidelines.