



THE UNIVERSITY OF TEXAS AT AUSTIN
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SB 1524 Study

Impact on Pavements and Bridges by vehicles operating with an Intermodal Containers Permit from or to a Port Authority located contiguous to the Gulf of Mexico (or inlet opening into the gulf) within a 30-mile radius

This report was prepared in collaboration with the Texas Department of Transportation (TxDOT), the Texas Department of Motor Vehicles (TxDMV), The University of Texas at Austin (UT Austin), and The University of Texas at San Antonio (UTSA), in response to Senate Bill 1524 of the 85th Texas Legislative Session.

1 INTRODUCTION

Texas serves as one of the nation's largest freight transportation hubs with an extensive network of highways, ports, rail terminals, and distribution centers supporting domestic and international commerce. As freight demand continues to increase, the efficient movement of intermodal shipping containers has become increasingly important for maintaining supply chain performance and supporting the state's economic growth. To facilitate these operations while accommodating heavier freight movements, the Texas Legislature enacted Senate Bill 1524 (SB 1524), establishing a permitting framework for specific overweight vehicles transporting intermodal shipping containers. Although these permits improve freight mobility and operational efficiency by allowing heavier movements per trip, they also increase the loads imposed on the state's pavement and bridge infrastructure, accelerating infrastructure deterioration and increasing maintenance costs.

This study evaluates the impacts of vehicles operating under permits issued pursuant to Senate Bill 1524 (SB 1524) of the 85th Texas Legislative Session, codified in the 2023 Texas Transportation Code, Title 7 (Vehicles and Traffic), Subtitle E (Vehicle Size and Weight), Chapter 623 (Permits for Oversize or Overweight Vehicles), Subchapter U (Intermodal Shipping Containers), Sections 623.401 through 623.411. This legislation applies to vehicles transporting intermodal shipping containers, defined as enclosed, standardized, reusable containers that (i) are used to pack, ship, move, or transport cargo; (ii) are designed to be carried on a semitrailer and transferred to or from a ship engaged in international transportation or a rail system supporting international transportation; and (iii) when transported in combination with a vehicle, exceed the statutory gross vehicle weight or axle weight limits established for operation on state highways or county and municipal roads.

The objective of this report is to quantify the pavement and bridge impacts of vehicles with an Intermodal Shipping Container (ISC) permit by estimating the infrastructure structural consumption and associated costs, while evaluating whether the current permit fee structure adequately recovers the additional costs imposed to the Texas highway network. The findings provide a technical basis to support future biennial reassessments of the ISC permit fee, as required by SB 1524, and to assist the Texas Department of Motor Vehicle (TxDMV) and the Texas Department of Transportation (TxDOT) in balancing freight mobility with long-term infrastructure preservation.

2 ROADWAY NETWORK OF INTEREST

Under the provisions of SB 1524, motor carriers moving an ISC must either originate from or terminate at a port authority or port of entry located along the Gulf of Mexico or a bay or inlet connected to the Gulf. In addition, permitted trucks are restricted to operating within a 30-mile

radius of the associated port authority or port of entry, as illustrated in **Figure 1**.

The ISC permit does not authorize operation on the National System of Interstate and Defense Highways (Interstate Highways, IH) or on roadways and bridges subject to posted weight restrictions. This includes any roads or bridges for which TxDOT has established and posted maximum weight limits. The highway network eligible for operation under SB 1524 comprises approximately 5,671 centerline miles, including 1,797 on-system miles and 3,874 off-system miles, with 3,365 bridges (1,044 on-system and 2,321 off-system).

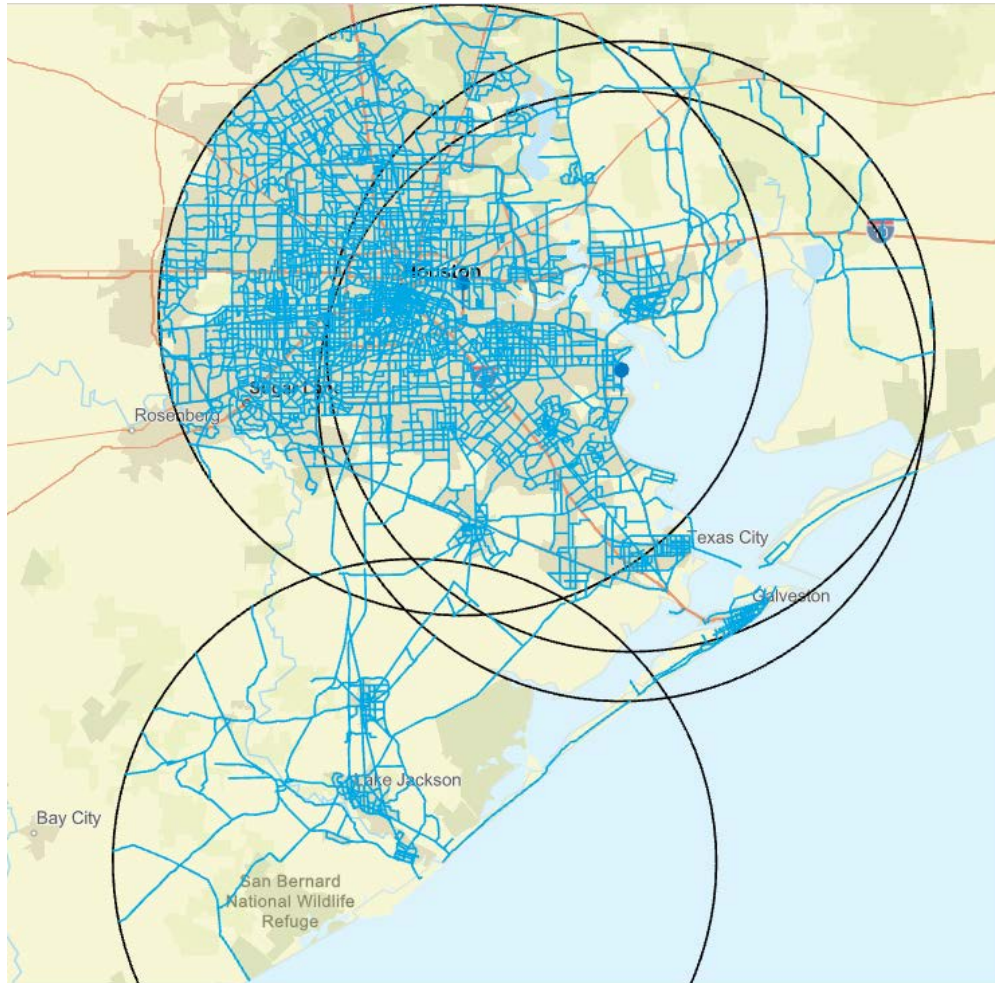


Figure 1: Roadway network under the provision of SB 1524.

It is important to note that an applicant for an ISC permit must designate each county and municipality she/he will move through; otherwise, the permit is not valid for that jurisdiction. If the carrier selects all cities during permit issuance to maximize the permitted transit range, the revenue collected is distributed equally across all counties and municipalities, even if the carrier only travels through a few of them. Consequently, the greater the number of counties selected, the smaller the share allocated to each jurisdiction, regardless of the miles actually traveled within it.

3 TRAFFIC CHARACTERISTICS

SB 1524 authorizes the TxDMV to issue an annual ISC permit for truck-tractor and semitrailer combinations equipped with either six- or seven-axles. Vehicles operating under this permit must comply with axle-weight and axle-spacing envelope, summarized in **Table 1** and illustrated in **Figure 2**.

Table 1: Vehicle configuration envelope under the provision of SB 1524.

Axle configuration limits	Six-axle	Seven-axle
Max. Gross vehicle weight:	93,000 lbs.	100,000 lbs.
Max dist. between 1 st and last axle:	647 to 744 in.	612 to 703.8 in.
<i>Truck-tractor</i>		
Max. load for single axle:	13,000 lbs.	15,000 lbs.
Max. load for 2-axle group:	37,000 lbs.	n/a
Max. load per axle:	18,500 lbs.	n/a
Max. distance between axles ¹ :	51–52 in.	n/a
Max. load for 3-axle group:	n/a	44,500 lbs.
Max. load per axle:	n/a	14,900 lbs.
Max. distance between axles ¹ :	n/a	60 in.
<i>Semi-trailer</i>		
Max. load for 3-axle group:	49,195 lbs.	46,200 lbs.
Max. load per axle:	16,400 lbs.	15,400 lbs.
Max. distance between axles ¹ :	60 in.	60 in.

¹ Distance between axles of the same axle-group.

When each axle group is loaded to its maximum allowable axle weight, the resulting GVW exceeds the 93,000 lbs. and 100,000 lbs. limits for the six- and seven-axles, respectively, as established by SB 1524. Therefore, multiple loading scenarios were required to assess the critical axle-load combination and estimate the corresponding structural consumption rates, as presented in **Table 2**. This approach ensures that the analysis captures the full range of feasible loading conditions while accounting for the worst-case structural impact.

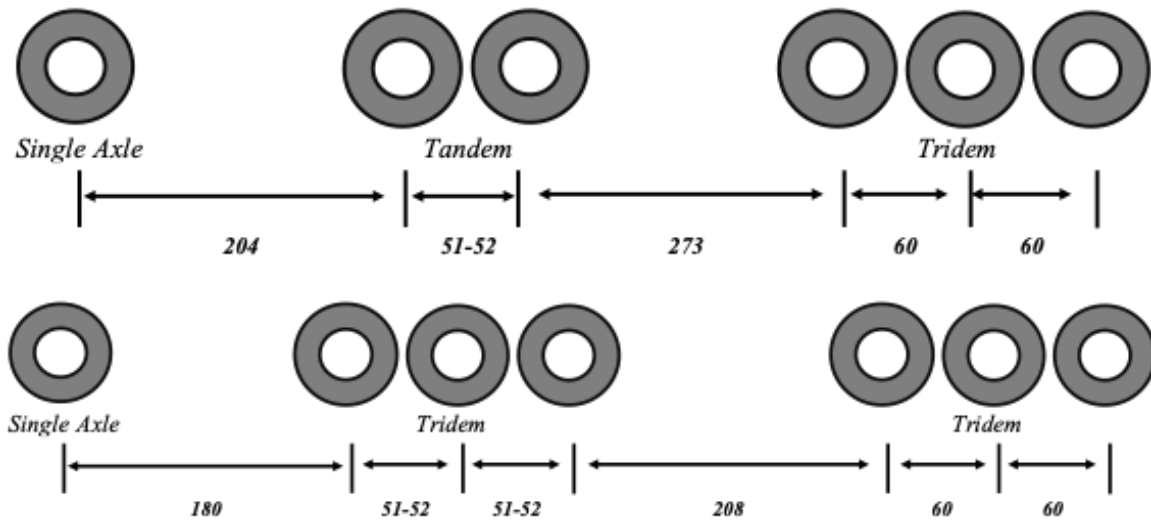


Figure 2: Axle configuration scheme: (top) six axles, and (bottom) seven axles.

Table 2: Proposed loading scenarios for the six- and seven-axle configurations.

Vehicle Configuration	Axle weight (lbs.)		
	Single	Tandem or Tridem	Tridem
1-2-3 (93,000 lbs.)	11,000	32,805	49,195
	11,000	35,000	47,000
	11,000	37,000	45,000
	12,000	31,805	49,195
	12,000	35,000	46,000
	12,000	37,000	44,000
	13,000	30,805	49,195
	13,000	35,000	45,000
	13,000	37,000	43,000
1-3-3 (100,000 lbs.)	11,000	42,800	46,200
	11,000	44,500	44,500
	11,000	46,200	42,800
	13,000	40,800	46,200
	13,000	43,500	43,500
	13,000	46,200	40,800
	15,000	38,800	46,200
	15,000	42,500	42,500
	15,000	46,200	38,800

4 INTERMODAL SHIPPING CONTAINER PERMIT DATA

This study was based on the data provided by TxDMV through the Texas Permitting & Routing Optimization System (TxPROS). TxPROS is a web-based integrated GIS-based mapping system with real time restriction management that provides automated routing for the transportation of oversized and overweight loads on the TxDOT maintained infrastructure network. The real-time restriction management provides a specific route based on vehicle information and infrastructure constraints, such as vertical clearance, lane width, load ratings, scheduled construction, and maintenance activities. The database of the system is synchronized with reports from district officials, resulting in a reliable mapping of possible routes, reducing possible congestion or misleading paths.

The TxPROS allows the user to select the origin and destination, and by checking the respective vehicle configuration with the system infrastructure, returns a specified route in compliance with the state restrictions (1). In addition to mapping and managing restrictions for OS/OW routes, TxPROS also generates an inventory of permits issued through 13 different reports regarding routes used by OS/OW vehicles, axle configuration, and administrative status of the permitting processes. It should be noted, however, the permits specified by SB 1524 are annual permits and do not require the user to provide specific routing information.

As part of the present study, data from calendar years 2018 through 2025 were analyzed. Calendar years were used because data from fiscal-year 2026 were not available at the time of preparing this report; this is also consistent with previous similar studies (2, 3). During 2024 and 2025, 515 and 526 ISC permits were issued, respectively, representing a total of 1,041 permits, following the upward trend in permit issuance observed since 2018, as shown in **Figure 3**.

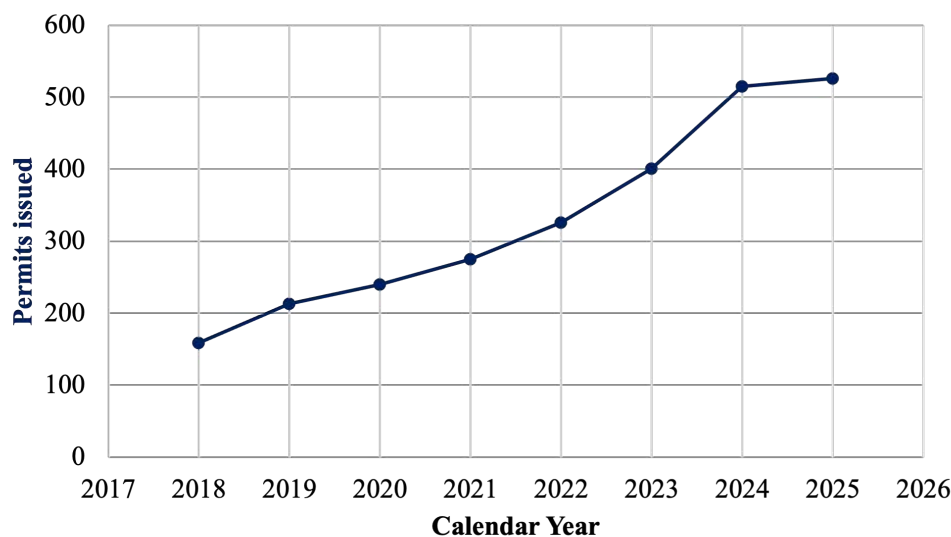


Figure 3: Temporal ISC permits issuance.

5 PAVEMENT ANALYSIS

The pavement analysis was based on the structural consumption methodology developed in previous studies (4–6) to quantify the effects of overweight vehicles using the equivalent consumption factor (ECF). The ECF represents the relative amount of pavement life consumed by a given axle configuration compared with the equivalent single axle load (ESAL), which consists of a dual-wheel single-axle loaded to 18,000 lbs.

The pavement network within the 30-mile operating radius of the four Gulf ports considered in this study includes: asphalt concrete pavements (ACP), surface-treated pavements (STP), jointed concrete pavements (JCP), and continuously reinforced concrete pavements (CRCP). To account for the distinct deterioration mechanisms of each pavement type, the structural consumption analysis employed pavement-specific terminal failure criteria. The distress thresholds adopted by pavement type are summarized in **Table 3**.

Table 3: Failure criteria and respective threshold adopted by pavement type

Failure Criteria	Pavement Type			
	ACP	STP	JCP	CRCP
Rutting	0.5 in	0.5 in		
Fatigue Cracking	25% area	25% area		
Roughness	172 in/mi	172 in/mi	172 in/mi	172 in/mi
Transverse Cracking			14% area	
Faulting			0.12 in	
Punchout				10 units/mi

Because pavement distresses develop through different deterioration mechanisms, the corresponding terminal thresholds are generally not reached simultaneously at the end of the 20-year design period. Consequently, an individual ECF was first calculated for each pavement distress. However, for practical applications, each axle configuration should be represented by a single ECF. Therefore, a distress-based weighted average was employed, with the weights reflecting the relative importance of each distress mechanism according to the pavement type.

By definition, an axle configuration with an ECF less than 1.0 consumes pavement life at a slower rate than the standard 18,000-lb single axle and, therefore, it would require more than the 20-year design period to reach the terminal failure criteria. Conversely, an ECF greater than 1.0 indicates accelerated pavement deterioration, resulting in the terminal condition being reached in less than the design period. The inherent variability associated with each distress-specific ECF was also considered in the analysis. For example, the ECF derived from the rutting criterion exhibited lower uncertainty (i.e., a smaller standard error) than the ECFs based on fatigue cracking or pavement

roughness, which showed greater variability. Consequently, distress measures with lower uncertainty were assigned relatively greater weight in the calculation of the overall ECF.

To provide an estimate of pavement consumption under this permit, the design ECF is defined as the average of the three most critical loading scenarios. This approach yielded design ECFs of 3.66 and 3.07 for the six-axle and seven-axle configurations, respectively. Based on these values, the corresponding average pavement consumption costs were estimated at 24.3 cents per mile for the six-axle vehicle and 20.4 cents per mile for the seven-axle configurations. The costs are expressed in December 2025 dollars to align with the period covered by the database and to avoid distortions associated with construction cost fluctuations during recent years.

6 BRIDGE ANALYSIS

Bridge consumption can be understood as a fatigue process in which each truck passage consumes a portion of a bridge's structural life. Within this framework, bridge deterioration is characterized by fatigue curves that relate the stress range induced by a load to the number of load cycles required to reach the end of the bridge's fatigue life. In general, higher stress ranges reduce the allowable number of load cycles, resulting in greater structural consumption with each vehicle passage. The proportional structural consumption was obtained using the moment ratio concept, which is extensively documented on similar and previous bridge consumption studies (5,6).

The bridge consumption analysis was divided between state-managed bridges (on-system) and local-managed bridges (off-system), due to the requirements of the analytical procedures and data availability. The value for the bridge consumption analysis was updated using the same asset cost updating procedures used by the pavement analysis (through the same highway construction cost indices).

In addition, the load rating value, a key input for the bridge consumption analysis, was updated using the most current version of the bridge inspection database. The consumption per mile for off-system bridges was found to be higher than that for on-system bridges as expected and due to their lower average load ratings. By combining both on- and off-system bridge results, the total average bridge consumption costs were 22 cents per mile and 31 cents per mile, for the 6-axle and 7-axle vehicles, respectively, expressed in December 2025 dollars.

7 CONSUMPTION ANALYSIS

Because ISC permit holders are not required to report their travel routes, no information is available on the corresponding vehicle miles traveled (VMT). Therefore, a sensitivity analysis was conducted to estimate the mileage at which the total infrastructure consumption cost would equal the permit fee

collected. Transportation Code, on Section 623.404, Permit Fee, states that: “An application for a permit under Section 623.402(a) or (b) must be accompanied by a permit fee of \$6,000, of which:

- i. 50% shall be deposited to the credit of the State Highway Fund;
- ii. 30% shall be equally divided among and distributed to each county designated in the permit application;
- iii. 16% shall be equally divided among and distributed to each municipality designated in the permit application; and
- iv. 4% shall be deposited to the credit of the Texas Department of Motor Vehicles fund.”

After accounting for the administrative fee retained by TxDMV, the net permit revenue available for maintenance and rehabilitation is 96% of the permit fee, or \$5,760. The estimated infrastructure consumption costs were therefore compared with this net revenue to determine the annual mileage that could be supported by the funds collected under the permit. The results are presented in **Table 4** and **Table 5** for the six-axle and seven-axle configurations, respectively.

Table 4: Sensitivity analysis for six-axle truck.

Annual VMT	Pavement Cost	Bridge Cost	Total Cost
2,000	\$487	\$433	\$920
5,000	\$1,216	\$1,083	\$2,299
7,500	\$1,825	\$1,624	\$3,449
10,000	\$2,433	\$2,165	\$4,598
12,527	\$3,048	\$2,712	\$5,760
20,000	\$4,866	\$4,330	\$9,196
50,000	\$12,165	\$10,826	\$22,991
100,000	\$24,330	\$21,652	\$45,981
150,000	\$36,494	\$32,478	\$68,972

Based on the estimated total infrastructure consumption, the ISC permit would recover the portion of the permit fee allocated to maintenance and rehabilitation up to 12,527 annual miles traveled, for the six-axle truck. Out of the total road infrastructure cost, 53% is attributable to pavement maintenance, while the remaining 47% is associated with bridge maintenance.

Table 5: Sensitivity analysis for seven-axle truck.

Annual VMT	Pavement Cost	Bridge Cost	Total Cost
2,000	\$408	\$620	\$1,028
5,000	\$1,021	\$1,550	\$2,570
7,500	\$1,531	\$2,325	\$3,856
10,000	\$2,041	\$3,099	\$5,141
11,205	\$2,287	\$3,473	\$5,760
20,000	\$4,083	\$6,199	\$10,281
50,000	\$10,207	\$15,497	\$25,703
100,000	\$20,413	\$30,994	\$51,407
150,000	\$30,620	\$46,491	\$77,110

For the seven-axle configuration, the current permit fee would recover up to 11,205 annual miles traveled by a seven-axle truck. Of the total estimated infrastructure deterioration cost, 40% was attributable to pavements and 60% to bridges. Compared with the six-axle configuration, this shift in road infrastructure consumption towards bridge is primarily explained by two factors. First, the higher GVW of the seven-axle permit trucks increases bridge load effects for the same set of bridges encompassed by the SB 1524 permits, an effect that is particularly critical for off-system bridges, which generally have lower load ratings. Second, pavement deterioration is governed primarily by axle loads rather than GVW. Thus, the addition of a seventh axle distributes the incremental 7,000-lbs. increase in GVW better over more axles, potentially reducing the pavement damage relative to the six-axle configuration.

8 CRASH ANALYSIS

The crash data was obtained by the Texas Peace Officer's Crash Reports processed by TxDOT. A reportable motor vehicle traffic crash is defined as: "... any crash involving a motor vehicle in transport that occurs or originates on a traffic way, results in injury to or death of any person, or damage to the property of any one person to the apparent extent of \$1,000 ..."

During the period of analysis (January 2024 to December 2025), 110 crashes were reported involving vehicles that have applied for an ISC permit. Eighty-three of those crashes happened within the area of interest (seven of which were flagged), 20 were outside the area (one of which was flagged) and seven could not be located. Of the seven crashes flagged with an ISC permit within the area of interest, three reported with possible-injured, and four were reported with no one injured (Table 6). The only crash that was flagged with an ISC permit but outside the area of interest was reported as no one injured.

Table 6: Motor vehicle traffic crashes involving ISC permits and flagged.

Crash Year	Fatal Crashes	Suspected Serious Injury	Suspected Minor Injury	Possible Injury	Non-Injury	Unknown Injury
2024	0	0	0	1	2	0
2025	0	0	0	2	2	0

9 SURVEY-BASED VALIDATION OF ANNUAL VMT

As noted previously, ISC permits do not required the applicant to provide route information, preventing direct quantification of network usage in terms of VMT. To address this limitation, the study team interviewed some of the most frequent ISC permit holders (operating under the provisions of SB 1524) to obtain representative travel patterns.

The survey identified eight representative routes operated by 100 loaded ISC-permitted trucks, primarily six-axle trucks, representing a total average annual VMT of 1,271,356, as presented in **Table 7**. The unloaded mileage of these permitted vehicles was not considered because they operate within the state’s legal weight limits when empty.

Table 7: Survey-based VMT for 100 six-axle trucks loaded with 93,000 lbs.

Route	On-system (mi.)	Off-system (mi.)	VMT on-system	VMT off-system	Annual VMT
1	18.6	4.2	423,667	95,667	519,333
2	24.0	2.6	546,667	59,222	605,889
3	18.6	5.1	28,933	7,933	36,867
4	24.0	3.5	37,333	5,444	42,778
5	9.9	2.7	17,600	4,800	22,400
6	15.3	1.1	27,200	1,956	29,156
7	11.5	3.4	5,111	1,511	6,622
8	16.9	1.8	7,511	800	8,311
Totals:			1,094,022	177,333	1,271,356

The state-maintained portions of the representative routes were identified, allowing the annual VMT to be estimated separately for the on-system and off-system networks based on a 260-day annual operating schedule. The estimated annual VMT were 1,094,022 miles on the on-system network and 177,333 miles on the off-system network, corresponding to 86% and 14% of the total mileage travel, respectively. Based on the survey data of 100 trucks, the average annual VMT per permit was 12,714 miles.

The analysis of the survey data closely matches the 12,527-mile break-even threshold obtained from the sensitivity analysis (**Table 4**), differing by only 187 miles (1.5%). This difference

in VMT would cost an additional \$86 for the six-axle configuration. Although both estimates are subject to uncertainty, this close agreement suggests that the current permit fee of \$6,000 (of which \$5,760 is available for roadway maintenance, after administrative costs) is generally appropriate to recover the average annual infrastructure consumption costs associated with six-axle ISC-permitted vehicle. The close correspondence between the survey-based mileage and the break-even threshold also provides validation of the proposed methodology. It should be noted, however, that the analysis in this report considers only pavement and bridge deterioration costs and does not account for user delay costs associated with the routine maintenance (i.e., work zones) generated by the anticipated maintenance due to ISC-permitted operations.

10 CONCLUSIONS AND RECOMMENDATIONS

In response to the Senate Bill 1524 (SB 1524), this study evaluated the impacts of vehicles operating under the Intermodal Shipping Container (ISC) permits by quantifying their pavement and bridge consumption, estimating the associated maintenance and rehabilitation costs, and assessing whether the current permit fee adequately recovers those costs. Based on the analyses performed, the following conclusions are drawn:

- The corresponding average pavement consumption costs were estimated at 23.4 and 19.7 cents per mile, for the six-axle and seven-axle configuration, respectively.
- Average bridge consumption costs were estimated at 46.2 cents per mile for the 6-axle configuration and 51.7 cents per mile for the 7-axle configuration. Although the additional axle reduces pavement consumption by distributing the increased gross vehicle weight over more axles, the higher gross vehicle weight increases bridge consumption, particularly on off-system bridges with lower load ratings.
- The sensitivity analysis indicated that the current permit fee allocated to maintenance and rehabilitation (\$5,760) would recover the estimated infrastructure consumption costs up to approximately 12,527 miles for the six-axle configuration and 11,205 miles for the seven-axle configuration.
- A survey of representative ISC permit holders estimated an average annual travel of 12,714 miles per truck, only 187 miles (1.5%) greater than the break-even mileage estimated for the six-axle configuration. This close agreement provides an independent validation of the proposed infrastructure consumption methodology and suggests that the current permit fee generally recovers the average annual pavement and bridge deterioration costs associated with the six-axle truck.

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- Based on the sample reported in Section 9, 86% of the VMT takes place on the TxDOT-maintained network while only 50% of the permit fee is deposited to the credit of the State Highway Fund.
 - Review of crash records identified seven crashes involving ISC-permitted trucks within the study area during the analysis period, none of which resulted in fatalities.

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