The Impacts of Heavier Trucks on Local Bridges

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Contributors

Rick Bailey
County Commissioner
Johnson County, Texas

Josh Harvill, P.E.
County Engineer
Chambers County, Alabama

Brian Keierleber, P.E.
County Engineer
Buchanan County, Iowa

Thomas Klasner, P.E.
County Engineer
Jersey County, Illinois

Roger D. Mingo, P.E.
Principal
R.D. Mingo and Associates

Matthew Muir
Director of Policy and Technology
Coalition Against Bigger Trucks

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Foreword

The impact of heavier and longer trucks on locally owned bridges is an important issue that needs to be explored nationally, including Congress. While we have long known that heavier trucks increase bridge damage, this study represents the first attempt to work directly with local officials to quantify the real world impacts. County officials, specifically county engineers, know their bridges better than anyone else.

Since Counties have few options for increasing revenue to cover the increased bridge damage that heavier trucks might be causing to county-owned infrastructure, knowing the full scale of the fiscal challenges that might arise is imperative.

The National Association of Counties (NACo) and the National Association of County Engineers (NACE) are interested in the outcomes of the *Impacts of Heavier Trucks on Local Bridges* study. Further, we view this research as an important source for policymakers to utilize when considering legislation in Congress and state legislatures to increase truck weight.

Using National Bridge Inventory data and the methodology developed with county officials, including engineers who have personally designed, maintained and inspected these bridges, this research fills a longstanding gap in knowledge on the subject and reveals massive financial costs that would burden counties across the country.

Sincerely,

Matthew D. Chase
CEO/Executive Director
National Association of Counties

Kevan P. Stone
CEO/Executive Director
National Association of County Engineers

Executive Summary

> For the purposes of this study, "local bridges" is used to describe bridges that are not on the National Highway System.

Research on the impact of weight increases for semi-trailer trucks on bridges has historically focused on structures located on interstates and other major highways, failing to examine the effects of the extra weight on local bridges (defined as bridges that are not a part of the National Highway System). This is despite the fact that three-quarters of all bridges are on local roads. What's more, the limited research that has been done on local bridges has not included input from those who know these bridges best: the county, city or township engineers who designed, built and regularly inspect them.

Because legislation to increase truck weights is proposed every year in state legislatures and in Congress, it is imperative to understand the full impact on local infrastructure and determine the associated costs. This research fills that knowledge gap by looking exclusively at local bridges and using data that is collected and analyzed by the local professional engineers who have intimate knowledge of each bridge.

There are 474,266 local bridges in the U.S. Our research found that **87,455 of those structures would be "at risk" of needing to be replaced or strengthened to accommodate heavier configurations, nearly 1 in 5.** Bridges defined as at risk would require posting, increased monitoring and inspection and ultimately would need to be replaced or strengthened to accommodate the configuration. A conservative estimate of the cost of replacing or strengthening those at-risk bridges would be as much as **$78.4 billion** depending on the weight of the truck.

This study was conducted by the Coalition Against Bigger Trucks (CABT) in conjunction with county road officials from four counties across the nation. The county officials who participated in this study personally oversaw the design and construction of many of their bridges. They are aware of any unique circumstances such as flooding, design specifications, the history of the bridge and the condition of each component. It is the combination of their familiarity with their local bridges and their professional engineering education and training that justifies reliance on this approach for evaluating the impact of heavier trucks on local infrastructure. The local officials are:

Josh Harvill
County Engineer
Chambers County, Alabama

Brian Keierleber
County Engineer
Buchanan County, Iowa

Thomas Klasner
County Engineer
Jersey County, Illinois

Rick Bailey
County Commissioner
Johnson County, Texas

They oversee a diverse set of bridges. From a total of 35 structures in Buchanan County, Iowa that predated the production of the Model T to bridges that face flooding 15 feet above the deck, there are variety of unique challenges these officials face in managing their local infrastructure. Their bridges are of varying quality, but like many county bridges across the country, age and condition are significant concerns.

The methodology we used for this study relies on data from the National Bridge Inventory (NBI), a compilation of detailed engineering information on each bridge in the nation based on inspections performed by infrastructure engineers. The data is maintained by the Federal Highway Administration (FHWA). Every bridge has an “operating rating” which is defined as the “maximum permissible load level to which the structure may be subjected to” based on a design vehicle. For each heavier truck configuration, it was determined if the operating rating would be exceeded at any point during passage based on the length of the structure. If the truck weight on the bridge exceeded the operating rating, the bridge was deemed as being at risk for needing replacement or strengthening.

The method was applied to the four counties and reviewed closely with the officials responsible for bridge maintenance, construction and inspection for those counties. The lists accurately reflected the bridges that could not handle heavier trucks. After confirming the accuracy of our approach, this analysis method was applied to non-NHS bridges nationwide.

According to each official, the associated cost, which was set by bridge replacement estimates reported to the FHWA by state departments of transportation, would be severely prohibitive and would ultimately result in significant bridge closures absent substantial increases in revenue.

The strength of our research lies not only in the data within the NBI, but more importantly, in the consultation with local officials. The specific insight provided can aid in identifying the scope of the damage caused by heavier trucks and the often impossible nature of coming up with additional funding.

The results of this study show a devastating financial cost associated with heavier trucks. This cost is not limited to the federal government, but would be inflicted upon nearly every township, city, county and state in the nation. Absent additional funding, failure to replace these bridges would result in a patchwork of closures, disrupting commerce and everyday lives. Ultimately, bridges can and will fail, resulting the loss of human life.

Monetary Impact of Heavier Configurations by State

State	88,000 lb. at-risk bridges	88,000 lb. replacement cost	91,000 lb. at-risk bridges	91,000 lb. replacement cost	97,000 lb. at-risk bridges	97,000 lb. replacement cost
Alabama	2,161	$1,098,011,395	2,331	$1,295,160,672	2,790	$1,773,045,235
Alaska	236	$179,973,972	242	$193,489,513	289	$220,565,942
Arizona	304	$391,780,538	321	$464,844,816	392	$561,117,796
Arkansas	2,028	$1,120,532,017	2,245	$1,325,044,027	2,746	$1,721,958,287
California	2,829	$6,019,277,295	3,089	$6,974,048,612	3,456	$7,983,267,237
Colorado	837	$879,295,153	861	$954,550,989	1,092	$1,192,072,938
Connecticut	179	$689,867,604	199	$796,692,240	274	$1,055,768,742
Delaware	51	$364,659,750	54	$378,662,785	65	$425,411,942
District of Columbia	8	$140,699,873	9	$144,791,482	12	$177,178,939
Florida	909	$1,359,214,102	992	$1,620,356,800	1,297	$2,445,287,859
Georgia	2,280	$2,028,937,750	2,443	$2,237,144,913	2,703	$2,465,316,745
Hawaii	224	$1,137,718,388	226	$1,218,791,358	260	$1,394,046,542
Idaho	616	$415,158,769	623	$450,758,731	728	$565,971,810
Illinois	1,067	$832,059,855	1,252	$1,067,271,845	1,614	$1,395,732,907
Indiana	1,658	$1,340,559,246	1,922	$1,631,216,083	2,415	$2,133,059,262
Iowa	5,011	$1,377,791,782	5,061	$1,451,707,675	5,565	$1,656,254,553
Kansas	5,787	$2,221,720,551	5,658	$2,354,015,585	6,613	$2,785,517,207
Kentucky	1,706	$1,141,308,750	1,695	$1,296,872,679	1,943	$1,608,810,055
Louisiana	3,182	$2,579,970,855	3,245	$2,702,833,667	3,665	$3,052,159,985
Maine	363	$656,112,937	376	$694,005,285	480	$905,896,011
Maryland	181	$363,228,317	200	$466,765,773	254	$732,087,678
Massachusetts	254	$1,833,913,937	281	$1,953,339,478	359	$2,213,377,591
Michigan	582	$488,314,885	589	$582,546,421	727	$716,514,552
Minnesota	707	$521,068,232	764	$622,589,202	987	$860,460,545
Mississippi	2,538	$989,552,152	2,660	$1,078,283,747	3,376	$1,539,589,767
Missouri	4,134	$1,582,715,821	4,128	$1,666,735,074	4,544	$1,846,508,918
Montana	876	$613,891,368	932	$716,792,435	1,097	$847,825,519
Nebraska	3,405	$1,296,185,035	3,499	$1,417,253,654	3,871	$1,651,032,072
Nevada	56	$121,865,009	61	$132,107,656	82	$225,992,899
New Hampshire	251	$451,771,953	254	$487,828,622	323	$633,940,538
New Jersey	323	$1,243,744,512	355	$1,404,157,127	424	$1,646,463,043
New Mexico	271	$205,270,742	287	$228,195,344	343	$293,239,443
New York	891	$1,243,883,442	945	$1,387,888,250	1,117	$1,706,771,065
North Carolina	1,479	$604,244,866	1,482	$657,488,246	1,813	$871,212,902
North Dakota	604	$180,359,035	592	$189,594,319	698	$295,218,804
Ohio	2,203	$2,092,492,730	2,214	$2,169,111,109	5,394	$6,909,092,332

State	88,000 lb. at-risk bridges	88,000 lb. replacement cost	91,000 lb. at-risk bridges	91,000 lb. replacement cost	97,000 lb. at-risk bridges	97,000 lb. replacement cost
Oklahoma	2,854	$1,017,901,368	2,961	$1,130,386,195	3,482	$1,443,786,279
Oregon	1,938	$3,254,064,076	2,012	$3,418,767,891	2,273	$3,758,306,874
Pennsylvania	1,065	$837,827,796	1,058	$926,294,010	1,244	$1,205,999,130
Puerto Rico	387	$490,338,233	383	$490,338,233	427	$528,800,392
Rhode Island	79	$443,906,918	88	$494,251,178	102	$574,628,586
South Carolina	3,861	$1,946,337,233	3,774	$2,079,690,581	4,187	$2,346,941,205
South Dakota	1,088	$535,647,920	1,081	$564,476,040	1,249	$694,049,180
Tennessee	1,862	$1,170,937,719	1,914	$1,262,351,639	2,391	$1,530,324,319
Texas	1,460	$626,790,730	2,184	$1,034,594,960	2,692	$1,461,447,430
Utah	378	$381,755,158	400	$419,101,175	466	$503,921,037
Vermont	375	$252,277,174	388	$283,009,596	453	$340,954,186
Virginia	893	$1,118,464,622	932	$1,277,405,758	1,141	$1,822,542,816
Washington	1,393	$1,918,234,429	1,459	$2,103,683,572	1,695	$2,456,327,987
West Virginia	397	$336,677,170	422	$385,143,200	531	$498,825,149
Wisconsin	747	$352,120,375	809	$433,979,634	979	$568,926,376
Wyoming	263	$109,063,472	288	$128,346,448	335	$154,938,698

Introduction

Research conducted on the impacts of increases in the weight or length of semi-trailer trucks has historically failed to evaluate the implications for local bridges. Published studies have primarily focused on the impacts of bigger trucks on interstates and other major highways. This is despite the fact that three-quarters of all bridges are on local roads[1]. This represents a serious gap in knowledge that must be addressed prior to any meaningful discussion on changing truck size and weight limits.

In addition, the limited research that has been done on local roads has not included input from those who know local roads and bridges best: the county, city or township engineers that designed, built, and regularly inspect them.

This study addresses these two fundamental shortcomings. The methodology used to examine the impact of heavier configurations on local bridges is supported by data reported to the National Bridge Inventory (NBI) that is collected and analyzed by the local professional engineers who have detailed knowledge of each bridge.

This study is being conducted by the Coalition Against Bigger Trucks (CABT) in conjunction with county road officials from four counties. They are:

Josh Harvill
County Engineer
Chambers County, Alabama

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Buchanan County, Iowa

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Rick Bailey
County Commissioner
Johnson County, Texas

Each of the county engineers have inspected the bridges in their counties and, in some cases, have personally overseen their design and construction. They are aware of any unique circumstances involving weather, flooding, periods of high truck traffic, the history of the bridge and the condition of each specific bridge component. The high level of familiarity with their infrastructure gives these local experts insight into how each bridge would respond to repeated loads over time, which components are closest to critical failure, and which are most susceptible to damage under load.

It is the combination of this familiarity with their local bridges, their professional engineering educational background of the official and their use of guidelines from publications like the

[1] Federal Highway Administration. (2022). *LTBP InfoBridge Data: 2022 National Bridge Inventory.* Retrieved February 2, 2022

AASHTO *Manual for Bridge Evaluation* that allow for NBI data to be thorough, precise and very appropriate for our research purposes.

Research Objectives

The objectives of this research include:

1) Conduct a study to assess the impact of increased loads on local bridges in four county case studies, identifying the cost of retrofitting or replacing structures that are unable to accommodate each configuration.
2) If the methodology is confirmed accurate in each county case study, apply it to the entire network of local bridges nationwide, identifying a total cost estimate associated for each proposed configuration.
3) Achieve a level of accuracy appropriate for use by policymakers at the state and federal level.

Background

There have been several studies conducted on the implications of heavier trucks on infrastructure. While these studies utilized a variety of approaches, they did not work closely with local officials to review their findings, and in some cases neglected to examine local bridges. The following is a summary of some of the applicable modern research on the subject.

USDOT Comprehensive Truck Size and Weight Limits Study, 2016

The most recent and highest profile research on the infrastructure impacts of longer and heavier trucks is the 2016 USDOT Comprehensive Truck Size and Weight Limits Study which sought to "assess the impacts that vehicles would have on bridges" as per Subsection 32801 (a)(4) of the Moving Ahead for Progress in the 21st Century Act (P.L. 112-141).

The methodology utilized involved an examination of 490 bridges using *AASHTOWare Bridge Rating* software, utilizing the load resistance factor rating method of analysis to identify maximum moment, shear and the relevant rating factors when compared to control vehicles. The results were then extrapolated to draw national conclusions on 88,945 bridges on the National Highway System, including interstates.

This research identified $400 million to $5.4 billion in costs associated with the various truck configurations. There were significant shortcomings in this research that we seek to overcome:

- **Failure to examine local bridges**

  This research only examined interstate and US highway bridges, accounting for less than 20% of bridges.

  The study provided the reasoning for not examining local bridges, stating that:

  > Local bridges were not considered as the design, construction, and management of local bridges vary greatly given that there are thousands of independent local owners across the Nation with differing practices. Consequently, it is difficult to draw detailed conclusions about the impacts of truck size and weight increases on these facilities.[2]

  While the study goes on to predict that inclusion of local bridges would "not differ" from their examination[3], no conclusive finding is discussed, including the number of local bridges

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[2] U.S. Department of Transportation, Federal Highway Administration. (2016). *Comprehensive Truck Size and Weight Limits Study: Final Report to Congress,* p.19

[3] Ibid, p.24

that could not accommodate each configuration or the associated financial burden of replacement/strengthening placed on units of local government.

They concluded the subject by stating that "Development of methodology and an analysis of the impacts that changes in Federal truck size and weight limits would have on local bridges are needed."[4]

- **Use of extrapolation to draw conclusions**

The conclusions about the 88,945 bridges examined were drawn from an examination of a subset of only 490 bridges. Efforts were made to select bridges for this subset that accurately reflected the larger group based on bridge type[5], span length[6] and age[7].

While proper precautions were utilized, there are inherent shortcomings when drawing conclusions from a small sample.

By using data from each individual bridge in the system, our research eliminated the need for extrapolation, working directly with the data collected by the local officials responsible for the maintenance and construction of the bridges under their purview.

- **Lack of specific, localized knowledge**

There are inherent limitations with an analysis of bridges that does not include input and consultation from local engineering officials. Data on a spreadsheet only provides a partial picture of each bridge and the ability to handle longer and heavier configurations.

While the USDOT study was limited to NHS infrastructure, they recognize the limitations of a national approach that ignored differences between even state practices that can come from consultation with local officials:

> the methodology does not take into account any cost- or budget-driven decisions that may be made by the State DOTs and does not address State DOT policy alternatives that may initiate more refined analysis or load testing options to improve load ratings.[8]

This is further demonstrated in the use of a single, nationwide cost estimate for rehabilitation/repair on a national level of $235 per square foot. Utilization of state specific numbers gathered from actual reported costs would provide a more accurate number, which is the approach utilized in our study.

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[4] U.S. Department of Transportation, Federal Highway Administration. (2016). *Comprehensive Truck Size and Weight Limits Study: Final Report to Congress,* p.24
[5] U.S. Department of Transportation, Federal Highway Administration. (2016). *Comprehensive Truck Size and Weight Limits Study: Bridge Structure Comparative Analysis Technical Report,* p.19
[6] Ibid, p.19
[7] Ibid, p.21
[8] Ibid, p.58

This research should be viewed as a supplement and extension of the USDOT study, working to overcome the shortfalls by examining the effect of each configuration on case studies that include the local bridges in specific counties, and expanding that research to all local bridges.

Transportation Research Board Recommendations for Further Research, 2019

At the request of USDOT, the Transportation Research Board (TRB) convened a working group that spent a year developing a detailed research plan of 27 projects that would address gaps in research on truck size and weight. The TRB research projects have been before USDOT for more than three years now and have not been undertaken.

The TRB recognized the important need to examine local infrastructure, including multiple recommendations that encouraged further research into the impacts on local bridges. Project B1 asks USDOT to "Compile information from state and local highway agencies on costs and treatment selection criteria for bridge deck repair, rehabilitation, and replacement and for bridge span strengthening and replacement."[9]

In particular, the TRB research recommendations recognize the difficulty in national examinations of local bridges, citing the varied decision-making and different levels of capability in local highway departments. They ultimately urge an examination of states or counties that are representative of the national inventory of bridges.[10]

Wassef Local Infrastructure Study, 2017

In 2017, a national examination of the impacts of longer and heavier configurations on local bridges was conducted by Wagdy Wassef for the AASHTO Subcommittee on Bridges and Structures. The purpose of the study was to examine all local bridges to determine their ability to adequately handle longer and heavier configurations, and to identify a cost associated with their replacement or strengthening.

This study used a thorough examination of National Bridge Inventory data, developing a formulaic approach to all local bridges based on load effects and load ratios. This research resulted in two sets of findings. The first was a set of results that excluded currently posted bridges, finding a range of 740 to 6,909 bridges that would have to be replaced, depending on the heavier configuration, with a cost as high as $41 billion. The latter paradigm which ignored existing posting status, an assumption we adopt in our research, found a range of 37,244 to

[9] National Academy of Sciences, Engineering, and Medicine. (2019). *Research to Support Evaluation of Truck Size and Weight Regulations,* p.63
[10] Ibid, p.65

75,683 bridges needing replacement depending on configuration with a cost as high as $87.2 billion.

The Wassef study was unique in that it developed a methodology to examine the nationwide impact on local bridges and did not rely on extrapolation to reach the results. He utilized a state-specific average for per square foot costs of replacement/strengthening, a more accurate approach than a singular nationwide estimate.

Our research utilizes a similar approach through the use of NBI data and weight capacity information determined by local officials. We seek to expand on Wassef's work by confirming and reviewing our methodology and findings directly with impacted local officials, as well as updating it with more recent bridge information.

The Importance of Studying Local Bridges

While the importance of studying truck traffic on local bridges is readily apparent to those who live and work near these roads, some have claimed proposed configurations will not operate on local roads.[11] Other research has found that examining local infrastructure presents too large a challenge or is outside the scope of study. Local bridges represent 76% of the nation's bridge stock.[12] When policymakers are tasked with evaluating truck weight increase proposals, it is critical that they know the full fiscal impact of their decisions, and garnering data on local infrastructure is of the utmost importance.

Truck Travel

No truck trip begins and ends on the Interstate system, and local roads are utilized extensively for truck travel.

Average daily truck trip data within the National Bridge Inventory is calculated using a variety of means depending on the state and local government computing the total. This makes it hard to draw national conclusions with a high degree of precision, but the data do allow broad conclusions to be drawn about where trucks travel. This data in the NBI states that 13.5% of daily truck trips over bridges take place off the NHS.[13]

> "With the housing boom, we have seen increased volume of trucks carrying cement, lumber, sand and gravel on our county roads and have to adjust our work accordingly."
>
> Rick Bailey
> Commissioner
> Johnson County, TX

Condition

Local bridges are more often in poor condition.[14]

Bridge Type	Percentage of all bridges	Percentage of Poor bridges
Non-NHS	76.4%	89.6%
County Owned	36.5%	51%
City/Municipal Owned	7.8%	7.4%
Town/Township Owned	5.0%	7.1%
NHS	23.6%	10.4%

[11] Americans for Modern Transportation. (2022). *Safer, Green Transportation Infrastructure Improvements to Support Domestic Jobs,* p.1

[12] Federal Highway Administration. (2022). *Bridge Condition by Highway System 2022*

[13] Federal Highway Administration. (2022). *LTBP InfoBridge Data: 2022 National Bridge Inventory.* Retrieved February 2, 2022

[14] Ibid

County bridges that are not on the NHS represent 36.5% of the national bridge stock, but 51% of all poor bridges. Overall, local bridges represent 76.4% of all bridges, but 89.6% of poor bridges.

This has significant implications for evaluating whether these bridges can handle heavier truck configurations. Local bridges, being in worse condition overall, are more vulnerable to the potential damage caused by heavier trucks.

The Transportation Research Board supported this claim in 2019 by stating:

> Bridges and pavements on local roads typically are of lighter construction than those on major roads, and local governments often have fewer resources for maintenance and enforcement than state governments. Therefore, many local roads are more susceptible than major roads to effects of changes in truck sizes and weight.[15]

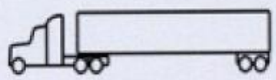
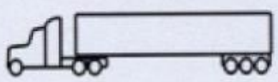
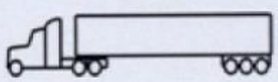
[15] National Academy of Sciences, Engineering, and Medicine. (2019). *Research to Support Evaluation of Truck Size and Weight Regulations,* p.33

Assumptions

An examination of hundreds of thousands of bridges owned by a variety of governmental entities requires assumptions to be made that streamline the ability to examine the issue while simultaneously representing the real world changes these policies would have. This includes identification of the configurations being examined, the characteristics of truck operation, bridge selection and proposed alternatives to replacement.

Truck configurations

The truck configurations examined mirror the single trailer configurations used in the 2016 USDOT study that exceed the national weight limit of 80,000 pounds. The specifications utilized include gross vehicle weight, axle weight, and axle spacing. The following table is from the USDOT analysis in 2016, modified to show the configurations evaluated.

Truck 1 CS5 (3S2) ATC 1	5-axle vehicle (GVW = 88)	Axle Data							
		Axle Locations	0	197	247	739	789		
		Allowed Max Loads (kips)	12.0	19.0	19.0	19.0	19.0		
Truck 2 CS6 (3S3) ATC 2	6-axle vehicle (GVW = 91)	Axle Data							
		Axle Locations	0	197	247	688	739	789	
		Allowed Max Loads (kips)	12.0	15.8	15.8	15.8	15.8	15.8	
Truck 3 CS6 (3S3) ATC 3	6-axle vehicle (GVW = 97)	Axle Data							
		Axle Locations	0	197	247	688	739	789	
		Allowed Max Loads (kips)	12.0	17.0	17.0	17.0	17.0	17.0	

Truck Operation

This research operates under the assumption that a substantial number of trucks will transition to the higher weight if allowed under each scenario, and that each truck configuration will operate at the maximum legal weight. This has historical precedent: when trailer length was extended from 48’ to 53’, it became predominately utilized nationwide. This approach was adopted by the USDOT in their study on the issue as well.[16]

[16] U.S. Department of Transportation, Federal Highway Administration. (2016). *Comprehensive Truck Size and Weight Limits Study: Bridge Structure Comparative Analysis Technical Report*, p. ES-7

Bridge Selection

This paper examined only bridges that are defined as not being on the NHS (item 104 in the National Bridge Inventory). This dataset includes state, county, municipal and town/township owned bridges.

Assigned Ratings and Excluded Bridges

Depending on a variety of factors, a bridge may have an operating rating assigned to it based on the design, rather than basing it off of inspection data. There are five requirements involving the design specifications, existing condition and a force effect analysis.

Because the methodology relies upon an analysis of the operating rating, it requires an accurate number that reflects the bridge's current condition and bridges with an assigned operating rating often understated the weight they were able to carry. Additionally, a handful of bridges were identified as having "no rating analysis performed" and were excluded. Due to these factors, 37,897 local bridges have been excluded from the study.

An additional 14,762 bridges had a code indicating the operating rating was determined through "field evaluation and documented engineering analysis" but were all given an assigned rating of 36 tons. These bridges were also removed due to an inability to accurately use the operating rating to determine load carrying capacity. Since some of these bridges may be incapable of handling heavier loads, this research ultimately undercounts the total number of at-risk bridges.

In the county-specific analysis, 10 bridges with assigned ratings were found to be at risk for requiring replacement or strengthening through the review by the respective county officials. These structures were added to the total number of at-risk bridges.

Existing Overweight Exemptions

States have a variety of existing overweight trucks operating today, ranging from permitted overweight loads to higher weight limits on state and local roads. This research worked under the assumption that existing overweight traffic is limited in nature due to a variety of factors that often apply: inability to utilize the Interstate system, inability to carry the load across state lines, requirements for additional axles, additional permit costs and restrictions on commodities, routes and hours of operation. This examination looks at a change to the

> "Our bridges that see overweight log truck traffic are facing dramatic decreases in their lifespans upon inspection."
>
> Josh Harvill
> County Engineer
> Chambers County, AL

national weight limit, which would allow heavier trucks to operate with no additional restrictions.

Existing overweight traffic is rare and the majority of trucks operate under the national weight limit of 80,000 pounds. This is reflected in available data in states like Michigan. While weights up to 164,000 pounds are allowed to operate on local, state and interstate routes, only 8% of trucks exceed 80,000 pounds.[17] The state of Pennsylvania offers dozens of permits to exceed a gross vehicle weight of 80,000 pounds, most of which require an additional axle. Despite these broad permits, six and seven axle trucks made up less than 4% of total semi-truck daily vehicle miles traveled.[18]

With these facts in mind, this study assumed that a change in weight limits would lead to significant adoption and a dramatic increase of truck weight in general operations, regardless of existing permits and exemptions.

In the case study counties, local officials have seen firsthand the impact of even the limited operation of these permitted vehicles. Structures that see significant overweight traffic are often the first to need replacement and have to be built using far more expensive techniques and materials. Whether it's log trucks in Chambers County or agricultural trucks in Buchanan County, the operation of these vehicles dramatically changes the approach each office has to take when evaluating, maintaining and replacing bridges. A national increase would change this burden from a few select routes to our entire transportation system, dramatically increasing the impact.

Bridge Posting

A bridge that is weight restricted is a bridge that needs repair or replacement. The role of government when it comes to infrastructure is to create and maintain roads and bridges that can safely and economically accommodate traffic necessary for personal and commercial purposes. A bridge that is load restricted has failed to meet that goal, with limits put into place to preserve structural integrity until the bridge is repaired or replaced.

Enforcement of bridge weight limitations poses unique difficulties for law enforcement, who are often unable to sufficiently monitor each bridge and may not have the necessary equipment to determine if a violation has taken place. In addition to monitoring traffic on the bridge, officers must be trained and equipped for roadside weighing of commercial vehicles.

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[17] Michigan Department of Transportation. (2017). *Truck Weights in Michigan*, p. 2

[18] Pennsylvania Department of Transportation. (2021). *Pennsylvania Highway Statistics 2021 Highway Data,* p.7

It's difficult to quantify the violation percentage without constant monitoring, but spot checks and enforcement, when possible, show significant non-compliance. Violations are particularly common in cases where there are no ideal alternative routes, which is often the case considering bridges are generally built in convenient locations.

> "The only time posting a bridge works is if I am standing on it."
>
> Brian Keierleber
> County Engineer
> Buchanan County, IA

In Buchanan County, load postings cost more than $1,000 per bridge. This is an expensive venture that adds up quickly, particularly for counties with tighter budgets and a high number of affected bridges.

Even the slightest violation rate dramatically reduces the effectiveness of load posting, as described in research published in the Journal of Bridge Engineering:

> Under imperfect compliance, however, a violation rate as low as 2.5% (i.e., one illegal truck in 40 ignores the posting) causes the mean value and variability of the annual maximum live load effect distribution to increase significantly, resulting in a significant loss in reliability. Thus, unless posted loads are strictly enforced, the effectiveness of enhancing existing bridge reliability with a posted load restriction is questionable.[19]

When numerous bridges must be posted, it creates significant route disruptions for commercial vehicles, where the most straightforward route is not always legal and GPS technology may not be updated with the latest postings. This can create exorbitant costs associated with high detour distances depending on the location of the posted bridge and alternative paths. When bridges are restricted, truck traffic becomes more consolidated as the number of viable routes decreases, often placing this heightened traffic into high density populated areas as route lengths increase. Ultimately, the higher the cost of compliance, the higher the likelihood of a violation.

It is an inevitability that a posted bridge will face a load above the legal limit, either through intentional or inadvertent violation. Weight restricting a bridge is an emergency action that does not eliminate the need to retrofit or replace the bridge.

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[19] Journal of Bridge Engineering, Solomon Asantey and F. M. Bartlett. (2005) *Impact of Posted Load Limits on Highway Bridge Reliability*.

Methodology

The method of examining bridges and their ability to handle heavier configurations was formulated in close consultation with all four local engineering experts. The methodology used to conduct the analysis utilized data from the National Bridge Inventory (NBI), a compilation of information on each bridge in the nation based on reports from individual State transportation departments, federal agencies and Tribal governments. The information reported is outlined in a document titled *Specifications for the National Bridge Inventory* created by the USDOT and is supplemented by the AASHTO *Manual for Bridge Evaluation* and the *Manual for Bridge Element Inspection*, along with the FHWA's *Bridge Inspector's Reference Manual*. The individual points in the dataset are collected by the relevant agencies responsible for bridge inspection, ranging from local governments to federal entities. The information for each bridge is updated during biannual inspections.

Through an analysis of each configuration, axle spacing and weights, the maximum weight a configuration will place onto a structure while it is crossing was determined. If that weight exceeds the operating rating, the bridge was deemed at risk for needing replacement or strengthening.

Bridge Load Ratings

Within the NBI, there is a datapoint titled "operating rating" (item 64), defined as "the absolute maximum permissible load level to which the structure may be subjected for the vehicle type used in the rating". This is the maximum weight a bridge should be subjected to for even a single pass of a design truck that varies depending on the design specifications of the bridge.

Item 63 of each bridge's report designates the method used to come to that rating. The various methods (load factor, allowable stress, load and resistance factor, etc.) are well established engineering calculations designed to analyze the weight capacity of a bridge.

These analysis methods reflect numerous aspects of a bridge that can affect load capacity, including:

Bridge age	Structural layout	Bridge material
Structural condition	Redundancy	Bridge design
Traffic volume	Field trials	Bridge strength
Past performance	Site specific factors	Span length

A filter was applied to take the length of bridges into account. A shorter bridge may not bear the entire weight of a truck at a given time, meaning it may be capable of handling a heavier configuration. Therefore, it was necessary to apply a formula that accounts for the length of the bridge. Using the position and weight of the axles to determine the maximum weight that would be on the bridge during a pass, this calculation determined whether that weight exceeded the operating rating. If exceeded, the bridge was deemed insufficient to accommodate the configuration and would be at risk of failing and needing repair or replacement.

In addition to this technical analysis, the relevant local official in each case study county closely examined their bridges to evaluate and expand the findings based on characteristics that may not be evident in the National Bridge Inventory Data. This could include changes in the status of the bridge since the last inspection, unique local circumstances, periods of accentuated truck travel and outdated design loads that overstate the operating rating and do not account for modern day vehicles. This more thorough examination both added and removed bridges from the list of those incapable of handling heavier loads. These changes were minimal, reflecting recently reconstructed bridges, temporary structures and recently inspected bridges with updated operating ratings.

Bridges Identified as At Risk

When a bridge fails the test for a configuration, it is defined as being at risk. These are bridges that, based on the identified operating rating, would have to be replaced to safely accommodate the configuration for any significant period of time.

There is a process that would apply in different ways to all bridges identified as at risk. Some bridges could be load restricted but would face increased wear and tear and risk significant damage in the likely scenario that enforcement is not perfect. In the most extreme scenario, the oldest and poorest condition structures would be immediately at risk of collapse and would require closure.

Most bridges identified would have to be load restricted, due to both safety concerns and legal requirements. As pointed out in the previous section, posting a bridge is an ineffective strategy that creates significant issues with enforcement and detours. Ultimately, it is a bridge that has failed to meet the needs of legal vehicle traffic.

If a bridge is not posted or there are violations, there would be a need for increased monitoring, inspections and repairs as the weight limit of the bridge is being exceeded, creating a risk of severe structural damage. The lifespan of the bridge would be significantly shortened and each passage of the heavier configuration risks damage to critical structural components. This increased inspection and repair cycle would come at a substantial cost to the responsible governmental entity, many of which have already limited budgets. Additionally, it could complicate efforts to preserve funding necessary for replacement.

When a bridge significantly deteriorates or has severe damage to a critical component, it would be closed. There are currently 3,301 bridges nationwide that are either fully closed due to construction or have reached a level of damage that requires closure due to safety concerns. Unfortunately, not all significant structural issues are identified in time, resulting in catastrophic consequences, like what happened on I-35 in Minnesota and the Fern Hollow bridge in Pennsylvania.

Replacement or strengthening can prevent the progress of a bridge through this continuum towards closure or collapse. When structural evaluation of a bridge by engineering experts has determined the operating rating to be insufficient to accommodate a configuration, it must be replaced or strengthened with a design that has been evaluated to adequately bear the weight.

Cost of Replacement and Strengthening

The costs associated with replacing or strengthening a bridge that is deemed incapable of handling a configuration were determined by using statewide averages from the FHWA annual report titled "Bridge Replacement Unit Costs 2020". In particular, the 3-year average for replacement of local bridges that is used for estimates in 2020 were utilized on a per-state basis, applied to the total square footage of each bridge.

Replacement and strengthening were treated as having the same cost per square foot, which was the practice adopted by the USDOT in their 2016 report.[20] This reflects the significant shared costs between both. Given the materials of most bridges examined, replacement would generally be the more economical and realistic option.

These cost estimates did not account for both monetary inflation and increases in specific commodities like concrete and steel that tend to fluctuate, particularly in recent years.

In addition to the costs associated with materials and construction, these averages are not inclusive of numerous costs that a bridge replacement or strengthening project may incur. These cost estimates do not include[21]:

- Mobilization
- Demolition of Existing Bridges
- Approach Slabs
- Stream Channel Work
- Riprap
- Slope Paving

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[20] U.S. Department of Transportation, Federal Highway Administration. (2016). *Comprehensive Truck Size and Weight Limits Study: Bridge Structure Comparative Analysis Technical Report*, p.58-59

[21] Federal Highway Administration. (2017). *Bridge Replacement Cost Submittal Criteria*

- Earthwork (exclusive of structural excavation, structural backfill, and earthwork associated with Geosynthetic Reinforced Soil Integrated Bridge Systems)
- Clearing and Grubbing
- Retaining Walls not attached to the Abutment
- Guardrail Transitions to Bridges
- Maintenance and Protection of Traffic
- Detour Costs
- Signing and Marking
- Lighting
- Electrical Conduit
- Inlet Frames and Grates
- Field Office
- Construction Engineering Items
- Training
- Right-of-Way
- Utility Relocation
- Contingencies

County Case Studies

An in-depth review of the findings was conducted in the following four counties, as well as discussion of the ability to make the necessary bridge replacements and strengthening. This process involved sharing the data and conducting a bridge-by-bridge review to both confirm, and where necessary, modify the results while identifying the reasoning for any changes.

Chambers County, Alabama

The examination of bridges in Chambers County, Alabama included 144 total county structures. The analysis method found 26-31 bridges that could not accommodate heavier truck configurations, with a cost of $4.1 million to $8.6 million.

The following is a report by Josh Harvill, Chambers County Engineer, on the results for his county.

> I have served as the county engineer in Chambers County since March 2012. I received my BS in Civil Engineering from Auburn University and have worked in county government for over 20 years, serving as the assistant county engineer in Russell and Chambers counties. I am responsible for managing the operation of the highway department, which includes the construction and maintenance of the county's 784 miles of roadway and 144 bridge structures. In addition to my work in the county, I serve as the Vice President representing the Southeast region for the National Association of County Engineers.
>
> Having spent decades working on the bridges in Chambers County, I have overseen the inspection and maintenance of our entire bridge inventory, as well as the design and construction of many of our bridges.
>
> We face many challenges in Chambers County, even with existing truck traffic. We have 50 bridges that are over 50 years in age, which is the industry standard cycle. In 2018, we worked with our state association to analyze our budget and determine the appropriate pace of maintenance spending to prevent degradation to our roads and bridges. The analysis found that Chambers County should be spending $5.8 million per year to resurface 29 miles of our paved network, and $2.1 million per year annually to replace 2-3 bridges.
>
> In reality, we average 11.2 miles of repaving per year, and are not even able to average one bridge replacement per year. Our current operating budget is $3.05 million short of what is needed to maintain and improve our infrastructure.

Chambers County sees significant heavy truck traffic now and have had to post 28 bridges. Load posting a bridge is ineffective as enforcement is difficult due to the size of our county and the specialized training needed to weigh trucks on the roadside. Our posted bridges create more detours for businesses and our residents, and when we ultimately have to close a bridge it affects all motorists.

Our last analysis of our current bridge backlog found 27 structures needing replacement, representing 1,577 feet in deck length with a total cost of $10.9 million. Since 2005, we have only replaced 13 bridges, meaning with current funding levels it will be decades before we clear our existing backlog, and that does not account for future degradation of other structures that will necessitate replacement.

We have seen the effects of trucks weighing over 80,000 pounds on our structures already. In particular, we have utilized pre-cast concrete bridges to replace many of the structures. Compared to bridges that don't see high levels of overweight traffic, these structures have higher rates of wear and tear on keyway and precast unit components. **Ultimately, the lifespans of these bridges are shortening, and the exposure to heavier trucks is one of the most likely causes.**

After reviewing our bridges with my staff, there are 31 total structures that would not be able to safely accommodate 97,000 pound trucks, as well as 26 that would need to be replaced to accommodate 88,000 and 91,000 pound trucks. This would be devastating to our county and would dig our budgetary hole even deeper. I have reviewed the cost estimates of $3.1-$5.7 million, depending on configuration, and view them as a low-end cost estimate. Since our staff is small, we often have to contract out aspects of bridge replacement, which increases costs. And since the FHWA state cost numbers are older, they do not account for the inflation of various materials which has been as high as 20% or more in recent years.

Overall, the method used to analyze the bridges in this study was very accurate and was even conservative in that it did not identify all the bridges that are concerning. Specifically, upon further review, I identified seven additional structures that passed the operating rating test but would need to be replaced if the standard truck weight was changed. These are older structures that utilized either the H 15 design load or lacked a standardized design load. Examples include the County Road 98 bridge over Chatahospee Creek, rated with the H15 design load with timber components. In the cases of these bridges, the operating rating was artificially higher. Two structures identified as at risk are currently in the process of being rebuilt and were removed from the list.

In some cases, more recent information is available. An example is a bridge on County Road 224, where recent inspection found scour/abutment damage that necessitated load posting. While this bridge passed the initial review, this more recent information shows it would not be able to handle heavier trucks.

These structures that would be subjected to heavier trucks would have to be posted and the inevitably high violation rates would lead to closures. Absent an increase in revenue, our closed structures would slowly increase, creating major inconveniences for residents and businesses throughout the county. With a population of just over 35,000, we have a limited tax base and generating the additional revenue would be difficult. Our existing backlog is big enough, but our issues would become insurmountable with even heavier trucks.

Chambers County Bridges At Risk with Heavier Truck Configurations

Route Carried	Feature Intersected	Operating Rating (US tons)	Structure Length (ft.)	Bridge Condition	Bridge Age (yr)
CO. 244	DAVIS CREEK	30.3	58.1	Good	73
CO. 1053	PIGEON ROOST CREEK	32.6	78.1	Fair	102
CO. 150	SANDY CREEK	6	38.1	Fair	102
CO. 150	SANDY CREEK	9	23	Fair	102
CO. 174	SNAPPER CREEK	0	58.7	Fair	92
CO. 156	CHIKASANOXEE CREEK	16.4	142.1	Fair	93
CO. 244	LEE CREEK	19.3	24	Fair	56
CO RD 1021	NF SOUTHERN RAILROAD	12	106	Good	1
CO. 2	SOUTH SANDY CREEK	9	99.4	Poor	102
CO. 150	SANDY CREEK	6	22.3	Poor	102
CO. 174	SNAPPER CREEK	0	61	Poor	92
CO. 92	ALLEN CREEK	6	29.9	Poor	72
CO. 179	WELLS CREEK	6	63	Poor	87
CO. 55	CHATAHOSPEE CREEK	0	178.1	Poor	102
CO. 65	BRANCH	19.4	29.9	Poor	51
CO. 2	LITTLE SANDY CREEK	0	60	Poor	50
CO. 98	CHATAHOSPEE CREEK	38.9	38.1	Fair	57
CO. 160	CARLISLE CREEK	36.3	39.4	Fair	54
CO. 62	CREEK	33.4	38.1	Fair	66
CO. 133	BRANCH	26.2	40	Fair	30
CO. 53	CATY CREEK	30.8	39.7	Fair	82
CO. 131	BRANCH	34.8	27.9	Fair	65
CO. 224	UNNAMED BRANCH	55.8	24.9	Poor	53
CO. 297	STROUD CREEK	36.9	51.8	Fair	71

CO. 260	GAY CREEK	35.1	57.4	Fair	72
CO 28	LITTLE CHATAHOSPEE CREEK	41.3	53.8	Good	28
CO. 1266	WEST POINT RESERVOIR	48	207	Fair	49
CO. 66	LITTLE CHATAHOSPEE CREEK	42.2	60	Fair	72
CO. 1266	WEST POINT RESERVOIR	48	186	Good	49
CO. 1268	WEST POINT RESERVOIR	48	169.9	Good	49
CO. 1268	COUNTY LINE CREEK	0	20	Poor	67

Jersey County, Illinois

The examination of bridges in Jersey County, Illinois included 41 total local structures. The analysis method found seven bridges that could not accommodate heavier trucks, with a cost of $1.6 million.

The following is a report by Thomas Klasner, Jersey County Engineer, on the results for his county.

> I graduated from SIU-Edwardsville with a BS in Civil Engineering and worked in private sector engineering for 14 years where I assisted township, municipal and county governments on construction planning. I was appointed County Engineer of Jersey County in 2003 and hit the ground running on improving our bridge stock. I was awarded “Rural County Engineer of the Year” in 2018 by the National Association of County Engineers largely for my work with our county bridges.
>
> Overall, our bridges are in generally great shape. We have worked hard to balance limited funding and have been able to achieve a high level of quality in terms of ratings of our infrastructure. Decades of dedicated work has been made easier by the fact that the State of Illinois does not allow many exemptions to the 80,000-pound weight limit.
>
> This is a delicate balance. Our funding is limited and largely fixed due to the size of our county which has a population of 23,000. We currently have only a single problem bridge that was recently closed due to scour issues.
>
> I manage 120 miles of county roadway and 29 bridges on the county system, but also work closely with our townships and assist with 379 miles of roadway and 56 bridges under their purview. Many of the townships I work with are in more difficult circumstances with maintenance budgets.
>
> The increased cost of raw materials over the past several years has been an incredible challenge, with prices outpacing inflation and revenue growth. I recently bid out a bridge for $330,000 that would have cost $150,000 just ten years ago. The price of steel, concrete, rock and asphalt have dramatically increased. Based on recent construction projects, $1.5 million represents a low end estimate of the total cost.
>
> With these challenges, we have been able to replace one bridge a year at best, and many years none get replaced. We also chip and seal around 25 miles of roadway a year.
>
> **While our bridges are in good shape, our staff of myself, an office manager and only 4 maintenance workers have been able to keep up and maintain our bridges. Any significant changes could disrupt that balance.**

At first glance, the amount to replace the seven bridges that would not be able to accommodate heavier trucks may seem small at only a little over $1.5 million. But the scope of the problem becomes clearer when we can only afford to replace a single bridge a year at best. The cost of replacing these bridges would be a massive budgetary burden not only to our county, but especially to the township governments we work closely with on bridge replacement.

Funding is so tight that in a recent meeting of district-wide county engineers, we discussed issues with matching funds. **Often there will be substantial federal funds available for bridge construction, but the small portion that must be matched by a local government is too much to afford, and that money is often left on the table.**

Not every bridge qualifies for these matching funds, and the inability to take advantage of them when they do is indicative of the dire financial situation in many local governments across our state.

In addition to the immediate concerns about bridges, heavier trucks would dramatically change the lifespan of the structures I am responsible for. Our replacement efforts have been able to keep up with existing lifespan of bridges, but heavier trucks would add to our backlog as we would be unable to replace them quickly enough.

The only alternative when a bridge becomes dangerously damaged and the funding isn't there is to close the bridge. I recently had to close a bridge that saw only 250 vehicles per day, and it has created significant inconveniences for our residents, creating a nearly 10-mile detour in the commutes of many.

My top priority is protecting the traveling public, and when a structure has to be closed to prevent collapse, our transportation network is significantly damaged. Both businesses and residents face delays and detours as entire communities can be cut off.

Jersey County Bridges At Risk with Heavier Truck Configurations

Route Carried	Feature Intersected	Operating Rating (US tons)	Structure Length (ft.)	Bridge Condition	Bridge Age (yr)
FAS 749	OTTER CREEK	38.6	115.2	Fair	59
ILL 100 (FAP-304)	Trib to Otter Creek	45.3	26.2	Fair	97
ILL 100	DRAINS TO EAGLE LAKE	33.2	33.8	Fair	84
TR 187	LITTLE PIASA CK	50.7	81.7	Poor	50
TR 77	STREAM	35.7	25.9	Fair	98
TR 150C	BRANCH LITTLE PIASA	38.3	25.9	Fair	47
FAS 748	STREAM	35.7	34.1	Good	90

Buchanan County, Iowa

The examination of bridges in Buchanan County, Iowa included 281 total local structures. The analysis method found 66-74 bridges that could not accommodate heavier trucks, with a cost of $20.8 million to $22.7 million.

The following is a report by Brian Keierleber, Buchanan County Engineer, on the results for his county.

Brian Keierleber, P.E. County Engineer, Buchanan County, Iowa

> I grew up on a ranch near Winner, South Dakota and learned from an early age about the importance of infrastructure. Our pastures were separated by miles of road and our high school was 28 miles away. I attended school for civil engineering at South Dakota State and then was commissioned as a Combat Engineer Officer and was sent to the US Army Engineer School at Ft. Belvoir in Virginia. Through the Army I have constructed bridges with Reserve Units that had never constructed a bridge. We would form and precast concrete beams, construct the abutments, pour the deck and complete the bridges with three separate units over 6 weeks of training.
>
> My professional experience began with the Oklahoma Department of Transportation doing construction inspections. I worked there for 1.5 years and was recruited to work for the City of Bartlesville Oklahoma where I spent the next 4.5 years doing design and construction on secondary roads and bridges. The knowledge gained there was a major asset and taught me about the challenges faced by local government.
>
> I moved to Iowa and became the Palo Alto County Engineer. After 6 years in Palo Alto County, I moved to Buchanan County where I have spent the last 29 years. During my time in Palo Alto County, we constructed 4 bridges across the West Fork of the Des Moines River. I had approximately 110 bridges and 990 miles of roads in Palo Alto and moving to Buchanan County I have 260 bridges and 963 miles of roads.
>
> There were many opportunities for success due to the extreme age of the bridges I had accepted. **I had 3 bridges that pre-dated General Custer's expedition at the Battle of Little Big Horn and two of them were major river crossings over the Wapsipinicon River. I had approximately 35 others that pre-dated the production of the model "T" automobile.**
>
> Bridges are a major emphasis and we have implemented numerous non-traditional methods of replacement and repairs due to our severely limited budget. This has included constructing 32 bridges using railroad flat cars.
>
> We have had to post bridges for weight, particularly the structures that are severely outdated and have not kept up with the vehicles of modern agriculture. There is only

one way that posting bridges is effective – if I am standing on the bridge and watching over it! While we post bridges according to state guidelines, it is far from a solution. At best, we hope it buys a tiny bit of time as we work to repair or replace the structure.

At our current funding level we can overlay about 2 miles of roadway every year. Without additional funding we can get to each mile in about 100 years. I do have pavements that are over 50 years old and do not appear in my 5-year plan. We have many maintenance activities that are on hold due to funding. We have been able to keep up solely through the use of innovative bridge construction and repair methods, which are far from ideal but allow us to maintain a baseline level of bridge effectiveness.

Funding is always a major concern as the needs always exceed the resources. The world we are dealing with has changed significantly in the past few years. Our personnel capabilities are different and the public has gotten more frustrated and demanding. Better infrastructure requires higher taxes, which is a challenge given a population in the county of just over 20,000.

In light of the extreme budgetary pressures and outdated infrastructure we are already dealing with, adding even heavier trucks to our system would make our exceedingly difficult situation impossible absent additional revenue. In the short term, we would have to rerate our bridges for the new standard loads and post those that could not accommodate the loads. As I have seen for decades, posting won't work. Absent significant additional funding, this is a recipe for disaster.

Our county would be devastated by changes in truck weight laws. One immediate effect would be the requirement that we post bridges, which can cost upwards of $1,000 per bridge. That would be an up front cost of tens of thousands of dollars that were not budgeted for. While posting is not an effective solution, it would be a required first step.

Based on the number of bridges, the cost of replacement and the size of our budget, closures would be an inevitability. There would be no way around it as these bridges are simply incapable of handling these heavier weights. Our county has significant rivers and streams, including the Wapsipinicon River which intersects the entire county. A closed bridge can mean significant delays to both motorists and truck traffic. There are sections of river nearly 10 miles long with a single crossing, meaning what used to be a short trip to work could be tripled in travel time. And if two consecutive bridges have to be closed? Or three? We are talking long term, dramatic impacts to the ability to travel efficiently through our county that would increase costs for businesses and motorists.

Buchanan County Bridges At Risk with Heavier Truck Configurations

Route Carried	Feature Intersected	Operating Rating (US tons)	Structure Length (ft.)	Bridge Condition	Bridge Age (yr)
LOCAL IOWA AVE	BEAR CR	30.6	102	Fair	69
LOCAL 310TH ST	LIME CR	30.6	102	Fair	65
FM	LIME CREEK	18.5	151.9	Fair	68
LOCAL 260TH ST	BUFFALO CREEK	30.4	210	Fair	73
PARRISH AVE	PINE CR	31	102	Poor	62
FM 140TH ST	SMALL STREAM	19	58.1	Poor	64
LOCAL 230TH ST	PINE CR	29.3	65	Fair	15
FM 145TH ST	LITTLE WAPSIPINICON	23.3	202.1	Fair	57
LOCAL	SMALL STREAM	30.8	78.1	Poor	71
LOCAL	MALONE CR	13	35.1	Poor	97
LOCAL 305TH ST.	LIME CR	0	81	Poor	112
LOCAL 325TH ST	MUD CR	0	101	Poor	69
DANIAL AVE	SPRING CR	33.7	63	Fair	66
LOC 100TH ST	BUFFALO CR	5	57.1	Fair	82
3RD ST NE	MELONE CREEK	36.8	100.1	Fair	53
WASHINGTON ST	DRAINAGE	25.7	77.1	Fair	63
1ST ST W	WAPSIPINICON RIVER	25.6	255.9	Fair	105
RACINE AVE	SMALL NATURAL STREAM	36	91.9	Poor	68
330TH ST	LIME CREEK	36.3	91.9	Fair	71
330TH ST	BEAR CREEK	34.8	154.9	Poor	71
280TH ST	BUFFALO CREEK	37.1	81	Fair	18
FM STEWART AV	SMALL CREEK	37.6	77.1	Fair	59
VINCENT AVE	DRY CREEK	35.3	102	Fair	62
330TH ST	DRY CREEK	34.1	67.9	Fair	15
LOCAL 330TH ST	WALTON CREEK	33.4	68.9	Fair	16
SCOTT BLVD	SMALL STREAM	33.5	67.9	Good	8
QUINSET AVE	SAND CREEK	33.1	125	Fair	64
NOLAN AVE	SAND CREEK	33.5	67.9	Fair	10
320TH ST	DRAINAGE	34.2	67.9	Fair	17
FM LAPORTE RD	MUD CREEK	30.6	102	Fair	55
LOCAL DUGAN AVE	LIME CR	33.1	127	Fair	70
LOCAL	SMALL STREAM	33.4	67.9	Fair	17
LOCAL 240TH ST	PINE CR	35.1	77.1	Fair	61
LOCAL 250TH ST	SMALL CREEK	34.6	77.1	Fair	65
PINE CREEK AVE	SMALL STREAM	34.6	77.1	Fair	65
LOCAL 250TH ST	SMALL STREAM	36	71.9	Good	12

LOCAL 265TH ST	BEAR CR	35.1	77.1	Fair	60
LOCAL 265TH ST	SPRING CREEK	34.6	77.1	Fair	63
LOCAL	SPRING CR	34.1	67.9	Good	17
LOCAL	PRAIRIE CR	20	44	Fair	69
170TH ST	PRAIRIE CREEK	33.5	68.9	Good	8
LOCAL	PRAIRIE CR	20	44	Fair	69
LOCAL RD	BUFFALO CREEK	31.7	80.1	Fair	42
FM	BUFFALO CREEK	33.2	169	Fair	60
PINE CREEK AVE	SMALL STREAM	25.7	49.9	Poor	10
LOCAL	SMALL STREAM	34.5	67.9	Good	12
FM	PINE CREEK	35.1	127	Fair	62
FM	HARTER CR	37.6	75.1	Fair	59
FM	WAPSIPINICON RIVER	32.5	351	Poor	60
FM	OVFLOW WAPSIPINICON RIVE	32.2	102	Fair	54
LOC 100TH ST	STREAM	30.3	56.1	Fair	82
LOC HARRISON AV	SMALL STREAM	34.6	78.1	Fair	63
LOC 110TH ST	HUNTER CR	35.1	76.1	Fair	59
FM LAWRENCE AVE	SMALL STREAM	19	58.1	Fair	69
INDIANA AVE	OTTER CR	36.6	66.9	Fair	12
LOC 150TH ST	OTTER CR	35.1	203.1	Poor	69
LOC CENTRAL AVE	SMALL STREAM	35.1	77.1	Fair	55
VINCENT AVE	DRY CREEK	22.2	46.9	Fair	82
LOCAL 335TH ST.	SMALL STREAM	23.3	28.9	Fair	24
CONCORD ST	DRAINAGE	35.7	53.1	Poor	122
LOC FINLEY AVE	LIME CR	43.9	94.2	Poor	97
POSTEL AVE	SMALL STREAM	42.3	67.9	Fair	11
FM	WAPSIPINICON RIVER	43.4	253.9	Fair	54
130TH ST	SMALL STREAM	43.5	67.9	Good	6
150TH ST	SMALL STREAM	43.5	67.9	Good	4
OVERLAND AVE	SMALL STREAM	43.5	69.6	Good	2
2ND ST NE	MELONE CREEK	44.3	103	Fair	37
LOCAL	SMALL STREAM	40	55.1	Poor	71
QUASQUETON BLVD	SMALL STREAM	46.4	71.9	Good	8
136TH ST	BUFFALO CR	46.4	111.9	Good	14
FM	BUCK CREEK	46.4	143	Fair	57
FM STEWART AV	SMITH CREEK	33.1	32.2	Fair	64
FM 140TH ST	SMALL STREAM	33.1	32.2	Poor	64
LOC TAYLOR AVE	BUFFALO CR	51.9	39	Poor	71

Johnson County, Texas

The examination of bridges in Johnson County, Texas included 183 total local structures. The analysis method found 8-14 bridges that could not accommodate heavier trucks, with a cost of $2.4 to $4.1 million.

The following is a report by Rick Bailey, Johnson County Commissioner, on the results for his county.

> I have lived in Johnson County for 35 years and am very involved in the infrastructure construction in my precinct. I know my constituents, the roads they use and what we need to do in order to maintain safe and effective infrastructure.
>
> Our county budget is based solely on property taxes, and we are constrained in many ways, as many counties across the country are. The state provides significant assistance, primarily in the form of management of the inspection and rating process for our bridges. But ultimately, our limited county budget is the foundation of our infrastructure funding.
>
> Our infrastructure faces numerous issues. Age is a problem. 98 of the local bridges in our county are over the age of 50 years, and four exceed 100 years old. Not only have these structures been degraded over decades, but many were designed for far lighter and smaller trucks.
>
> We also have serious issues with flooding. This affects maintenance when floodwaters damage roads and bridges, but also raises the costs of construction as we need to conduct flood studies and downstream impact reviews. With those costs, a single bridge can take over a year of planning and time to set aside the money and will need as much as 50% of our budget.
>
> Over the years, projects that were once done in-house are now contracted out due to the amount of time required for construction and the size of the backlog. This has dramatically increased the costs that we face when we replace a structure.
>
> **With the older ages and unique conditions, we are already on pins and needles when it comes to many of our bridges, doing our best with a limited staff of only 13 to prevent tragic accidents.** We struggle to accommodate existing truck traffic, which has increased dramatically due to the housing boom, with more cement trucks, lumber trucks and sand/gravel trucks on our county roads.
>
> These challenges are only a part of what our county faces. I represent a single precinct of four, amplifying the budgetary issues. An average of $600,000 annually goes to culverts and watersheds alone.

The review of the analysis of our bridge stock did require unique attention due to some understatement of the problem that heavier trucks would have. Since inspection and weight rating are conducted by the state, we are not involved in that process. The state heavily utilizes the assigned rating method, where certain bridges that qualify are allowed to have a state-legal weight assigned as the operating rating. These bridges were not in the analysis because assigned rating bridges were excluded, but after review there were two that would need to be replaced to accommodate heavier trucks, and these were added to the list. The rest were rated using traditional methods, either load factor or allowable stress, and had operating ratings that reflected the true carrying capacity.

An example of this is the County Road 1206 crossing Mustang Creek, a 62-year-old bridge that uses an outdated design load vehicle. While it has an assigned rating based on the bridge design that says it would accommodate heavier trucks, the reality on the ground is that this bridge often sees substantial flooding, sometimes as much as 15 feet over the bridge. The tremendous force of this water has weakened the structure and the underlying soil and would need to be replaced to accommodate larger truck travel.

The budgetary impacts on our county would be disastrous and would either require cuts in other critical areas or new taxes, which would be especially painful given the small size of our tax base. Absent devastating budgetary shifts, closures would be inevitable, which would create significant hardships for everyday motorists and commercial vehicles alike.

Johnson County Bridges At Risk with Heavier Truck Configurations

Route Carried	Features Intersected	Operating Rating (US tons)	Structure Length (ft.)	Bridge Condition	Bridge Age (yr)
NOLAN RIV RD-PCT 1	NOLAN RIVER	28	101	Fair	56
FM 1434	ROBINSON BRANCH	39	200.1	Fair	58
CR 108 - PCT 4	COTTONWOOD CREEK	36	79.1	Fair	82
CR 210 - PCT 4	TRIB OF COTTONWOOD CK	25	29.9	Fair	28
CR 1208 - PCT. 1	PILOT BRANCH	25	29.9	Fair	74
CR-1206 PCT 1	MUSTANG CREEK	36	75.1	Fair	62
CR 604	IH 35W	41	237.9	Good	59
FM2331	MUSTANG CREEK	43	163.1	Good	56
FM 1434	CAMP CREEK	44	120.1	Fair	53
FM 3391	TR QUILL MILLER CK	44	65.9	Good	25

CR 714 - PCT. 3	VILLAGE CREEK	44	67.9	Good	27
CR 508 - PCT 3	MOUNTAIN CREEK	46	80.1	Fair	28
CR 401 - PCT 4	S FORK OF CHAMBERS CREEK	48	100.1	Fair	80
FM 731	VILLAGE CREEK	47	80.1	Good	59

National Analysis

After a thorough review of the case study counties, the method of evaluating bridges that would be at risk for replacement if heavier trucks were allowed was shown to closely match the findings of each county engineer and did not deviate substantially in any review. In fact, most inaccuracies found were bridges that had not been included in the initial list.

Absent a detailed engineering analysis of every local bridge in the nation, any method of analysis will be imperfect. The methodology applied here provides a useful tool for state and federal policymakers charged with making decisions about truck size and weight laws.

Summary of Data

The application of this method produces conservative results. Not all bridges were examined due to assigned ratings, resulting in an overall undercount of the total at-risk structures. Cost estimates do not account for recent dramatic increases in raw material prices and exclude 22 specific line items. Finally, this study examines only the initial cost and does not account for future deterioration caused by increased loads.

Nationally, a total of 423,422 local bridges were examined.

National Summary of Heavier Configuration Monetary Impact

Configuration	Local Bridges At Risk	Overall Cost
88,000 lbs. 5-axle	69,231	$54.6 billion
91,000 lbs. 6-axle	72,240	$60.8 billion
97,000 lbs. 6-axle	87,455	$78.4 billion

In terms of the governmental entities bearing the impact, local bridges owned by state highway agencies had the second highest amount of at-risk bridges, but have a far higher replacement cost due to a larger average size. **In terms of local governmental entities, counties bear the highest burden, with total costs ranging from $18.6-$24 billion, which represents 19.6-23.1% of their bridges.**

An important conclusion drawn from the following tables is that the impact of heavier trucks is not isolated to a single level of government. From top to bottom, there are significant costs associated with replacing bridges that cannot accommodate heavier configurations.

Heavier Truck Impact by Governmental Level

Governmental Entity	88,000 lb. at-risk bridges	88,000 lb. replacement cost	91,000 lb. at-risk bridges	91,000 lb. replacement cost	97,000 lb. at-risk bridges	97,000 lb. replacement cost
County Highway Agencies	40,354	$18.6 billion	40,907	$20 billion	47,558	$24 billion
State Highway Agencies	17,684	$23.5 billion	19,470	$26.9 billion	25,872	$37.8 billion
City or Municipal Highway Agencies	4,230	$5.9 billion	4,541	$6.8 billion	5,529	$8.2 billion
Town or Township Highway Agencies	2,378	$1.2 billion	2,459	$1.4 billion	2,957	$1.7 billion

Conclusion

Policymakers in both Congress and in state legislatures across the country have been tasked with setting vehicle weight limits since the dawn of commercial motor vehicles. They seek to strike a balance between the benefits to commerce and the costs to society.

While some bridges continue to stand since the times of horse drawn carriages, the weight of commercial vehicles has continued to increase, putting immense strain on a system that requires hundreds of billions of dollars to stay standing each year.

Governments of all shapes and sizes are responsible for the maintenance of our roads and bridges. From the tiniest of townships to large metropolises and the federal government, all play a role in the construction and maintenance of our bridges. And the money that funds these projects comes from a variety of sources: user fees, registration fees and taxes on income, property and fuel. While the trucks that cause this damage offset some of the cost, systemic underpayment means that taxpayers, at every level, ultimately pay for the shortfall.[22]

The strength of our research lies in close consultation with the local officials who know their bridges the best and know the budgetary difficulties that would accompany additional costs. When changes are proposed to truck size and weight, they can provide the most specific insight into the damage that would be caused to our bridges and the difficult, if not impossible, task of coming up with additional funding.

The data garnered from this study shows a dramatic and devastating cost associated with proposals that would raise the national weight limit. This cost is not limited to the Federal government, with the ability to print money and take out significant amounts of debt, but is spread out among nearly every township, city, county and state in the nation. Failure to replace bridges not capable of holding heavier vehicles would result in a patchwork of closed bridges, creating massive delays for residents and businesses alike. Bridges can and will fail, resulting in the loss of human life.

While the cost of inaction is too high for many units of government, so is the cost of replacing these bridges. Smaller units of government are severely limited in how much revenue they can generate by small tax bases. This is the case in many of the counties that we represent.

The data generated by this research approach should be used by policymakers to evaluate the costs that heavier truck proposals would incur at all levels of government.

[22] Federal Highway Administration. (2000). *Addendum to the 1997 Federal Highway Cost Allocation Study Final Report*

Appendix

Table 1: Costs per ft² for Replacement/Strengthening[23]

State	Cost (dollars/ft²)
Alabama	$130
Alaska	$372
Arizona	$223
Arkansas	$179
California	$409
Colorado	$235
Connecticut	$540
Delaware	$455
District Of Columbia	$1,468
Florida	$174
Georgia	$162
Hawaii	$1,436
Idaho	$243
Illinois	$199
Indiana	$176
Iowa	$115
Kansas	$133
Kentucky	$266
Louisiana	$165
Maine	$301
Maryland	$421
Massachusetts	$594
Michigan	$267
Minnesota	$148
Mississippi	$117
Missouri	$122
Montana	$213
Nebraska	$202
Nevada	$291
New Hampshire	$605
New Jersey	$492
New Mexico	$255
New York	$335
North Carolina	$144

[23] Federal Highway Administration. (2022). *Bridge Replacement Unit Costs 2021*.

North Dakota	$170
Ohio	$194
Oklahoma	$127
Oregon	$297
Pennsylvania	$332
Rhode Island	$868
South Carolina	$126
South Dakota	$200
Tennessee	$126
Texas	$100
Utah	$196
Vermont	$370
Virginia	$348
Washington	$294
West Virginia	$232
Wisconsin	$132
Wyoming	$155
Puerto Rico	$295

Table 2: Local bridges put at risk by 91,000 pound trucks, by Congressional District (2023)

State	Congressional District	# Bridges fail 91k	Cost
Alaska	At-Large	242	$193,489,513
Alabama	1	134	$67,068,521
	2	489	$267,721,392
	3	464	$198,238,066
	4	436	$223,609,542
	5	219	$118,139,895
	6	145	$87,607,975
	7	439	$323,316,058
Arkansas	1	890	$501,950,035
	2	211	$139,755,951
	3	253	$151,280,633
	4	894	$532,290,972
Arizona	1	25	$27,721,799
	2	135	$106,475,244
	3	9	$13,618,320
	4	2	$19,584,886
	5	6	$13,931,880
	6	58	$89,752,193
	7	49	$137,592,093
	8	2	$5,530,801
	9	37	$51,719,743
California	1	634	$1,080,196,444
	2	351	$778,854,733
	3	233	$321,604,226
	4	124	$239,435,430
	5	204	$280,494,409
	6	15	$111,851,807
	7	50	$178,229,030
	8	24	$66,839,025
	9	53	$143,622,763
	10	30	$65,913,745
	11	4	$23,556,151
	12	15	$65,738,815
	13	214	$451,265,733

	14	18	$75,746,064
	15	14	$72,712,102
	16	37	$70,503,175
	17	12	$62,684,649
	18	73	$206,926,802
	19	120	$205,632,357
	20	82	$215,767,009
	21	75	$153,920,851
	22	129	$257,165,294
	23	114	$160,123,541
	24	69	$153,729,194
	25	77	$144,573,729
	26	31	$90,918,042
	27	16	$70,139,083
	28	14	$42,436,572
	29	4	$4,512,006
	30	13	$64,846,746
	31	9	$41,174,562
	32	7	$6,472,875
	33	16	$69,177,033
	34	18	$87,031,805
	35	6	$29,017,323
	36	4	$29,625,751
	37	4	$28,715,522
	38	6	$39,593,122
	39	9	$25,573,134
	40	8	$29,980,763
	41	16	$52,102,060
	42	16	$72,084,410
	43	10	$68,832,410
	44	2	$11,746,807
	45	7	$52,843,945
	46	6	$46,081,089
	47	10	$36,801,738
	48	25	$69,117,973
	49	26	$123,805,282
	50	18	$99,691,869
	51	5	$41,774,115
	52	9	$51,798,214
Colorado	1	22	$61,221,730
	2	128	$130,776,651

	3	326	$290,397,478
	4	242	$268,168,600
	5	35	$43,415,522
	6	15	$33,208,085
	7	72	$73,289,309
	8	26	$58,220,498
Connecticut	1	38	$178,291,206
	2	59	$200,676,960
	3	32	$151,908,588
	4	29	$111,380,022
	5	40	$150,138,144
District of Columbia	At-Large	9	$144,791,482
Delaware	At-Large	54	$378,662,785
Florida	1	120	$256,427,153
	2	225	$137,661,422
	3	102	$73,889,609
	4	65	$98,167,196
	5	19	$56,511,337
	6	31	$24,208,881
	7	15	$91,655,179
	8	19	$17,756,526
	9	21	$106,205,267
	10	10	$9,708,156
	11	15	$12,489,337
	12	3	$4,942,696
	13	9	$44,809,855
	14	22	$36,671,283
	15	3	$10,373,462
	16	20	$53,519,860
	17	44	$67,909,851
	18	58	$50,351,320
	19	15	$51,119,669
	20	16	$25,821,078
	21	24	$47,906,132
	22	11	$48,374,854
	23	40	$63,462,550
	24	26	$47,726,843
	25	9	$33,210,301
	26	26	$51,281,785
	27	11	$37,646,727
	28	13	$61,143,878

Georgia	1	153	$205,441,114
	2	330	$240,634,824
	3	281	$214,683,741
	4	47	$71,991,828
	5	43	$88,248,334
	6	57	$40,137,476
	7	13	$25,032,240
	8	415	$348,806,977
	9	227	$152,528,661
	10	244	$204,572,571
	11	65	$69,586,679
	12	277	$313,146,140
	13	68	$57,572,840
	14	224	$191,967,045
Hawaii	1	62	$644,495,899
	2	163	$568,689,172
Iowa	1	849	$269,920,723
	2	1045	$316,567,356
	3	1425	$381,609,332
	4	1752	$499,162,509
Idaho	1	304	$213,345,618
	2	290	$210,752,338
Illinois	1	14	$20,301,065
	2	89	$51,164,563
	3	5	$5,966,299
	4	5	$4,101,609
	5	6	$59,167,695
	6	4	$8,369,343
	7	21	$127,061,799
	8	4	$8,984,452
	9	9	$13,732,771
	10	19	$25,215,668
	11	22	$23,946,745
	12	228	$186,782,977
	13	58	$57,859,748
	14	46	$34,771,608
	15	395	$191,962,902
	16	218	$161,932,429
	17	105	$85,279,002
Indiana	1	52	$85,443,882
	2	125	$108,535,874

	3	161	$166,863,664
	4	321	$257,652,930
	5	170	$164,623,026
	6	171	$148,695,307
	7	44	$83,709,947
	8	596	$393,338,319
	9	278	$220,339,078
Kansas	1	2699	$956,326,941
	2	1483	$674,896,708
	3	221	$186,583,399
	4	1251	$533,183,574
Kentucky	1	493	$256,350,428
	2	173	$217,670,073
	3	64	$65,623,344
	4	188	$198,812,204
	5	591	$331,464,223
	6	180	$121,437,751
Louisiana	1	263	$192,480,540
	2	142	$554,063,037
	3	550	$433,840,572
	4	826	$581,191,397
	5	1125	$690,165,117
	6	336	$238,487,436
Massachusetts	1	81	$163,230,428
	2	82	$235,711,674
	3	25	$73,395,531
	4	22	$129,843,826
	5	13	$30,615,176
	6	16	$63,470,920
	7	12	$1,080,176,051
	8	8	$40,555,469
	9	22	$136,340,404
Maryland	1	49	$151,944,499
	2	30	$37,642,031
	3	13	$38,657,020
	4	8	$23,486,538
	5	10	$40,590,462
	6	64	$61,473,915
	7	4	$30,643,538
	8	8	$25,193,272
Maine	1	122	$331,852,874

	2	253	$368,751,518
Michigan	1	143	$68,050,527
	2	80	$73,711,998
	3	11	$15,211,978
	4	26	$15,095,139
	5	103	$62,690,265
	6	27	$29,819,868
	7	46	$32,060,265
	8	60	$58,649,647
	9	58	$34,734,244
	10	5	$5,452,113
	11	10	$38,740,338
	12	8	$45,632,970
	13	13	$102,826,559
Minnesota	1	215	$122,154,331
	2	17	$14,855,678
	3	13	$26,528,689
	4	22	$52,292,130
	5	32	$74,397,306
	6	35	$33,831,690
	7	293	$193,899,392
	8	139	$107,924,135
Missouri	1	27	$69,103,789
	2	59	$36,886,676
	3	317	$129,807,536
	4	863	$348,348,271
	5	39	$63,740,340
	6	1540	$457,734,346
	7	330	$177,743,703
	8	928	$363,200,905
Mississippi	1	605	$222,258,067
	2	1180	$488,832,716
	3	580	$218,182,625
	4	298	$154,059,038
Montana	1	346	$292,437,477
	2	579	$421,848,098
North Carolina	1	119	$60,639,034
	2	21	$12,192,768
	3	101	$81,425,090
	4	59	$41,873,774
	5	225	$86,171,688

	6	51	$30,921,725
	7	51	$21,357,923
	8	76	$33,675,714
	9	141	$44,579,894
	10	188	$89,201,794
	11	389	$141,197,924
	12	15	$10,348,891
	13	26	$12,899,650
	14	19	$12,385,901
North Dakota	At-Large	591	$184,308,833
Nebraska	1	646	$268,085,532
	2	273	$123,969,602
	3	2583	$1,028,325,039
New Hampshire	1	52	$155,961,382
	2	199	$312,230,266
New Jersey	1	18	$55,822,271
	2	52	$293,533,547
	3	35	$99,697,109
	4	19	$92,550,120
	5	19	$38,253,148
	6	16	$128,993,938
	7	97	$181,782,942
	8	16	$104,463,064
	9	22	$107,813,534
	10	18	$200,207,100
	11	14	$25,110,056
	12	29	$61,680,121
New Mexico	1	35	$20,496,696
	2	88	$83,212,875
	3	158	$117,997,578
Nevada	1	6	$14,058,734
	2	45	$70,528,797
	3	2	$14,342,081
	4	6	$32,866,268
New York	1	15	$37,330,357
	2	7	$27,880,710
	3	6	$13,121,816
	4	4	$7,384,874
	5	3	$12,444,413
	6	1	$5,284,826
	7	0	$75,886,847

	8	0	$29,654,535
	9	3	$5,286,535
	10	6	$15,194,227
	11	0	$279,876,353
	12	14	$71,786,648
	13	2	$65,794,436
	14	1	$16,712,346
	15	7	$27,947,945
	16	18	$46,803,721
	17	32	$70,417,335
	18	62	$93,388,084
	19	170	$182,807,179
	20	16	$27,887,075
	21	201	$135,100,006
	22	56	$76,539,393
	23	155	$172,290,869
	24	103	$121,693,306
	25	35	$51,684,102
	26	28	$104,234,413
Ohio	1	49	$180,562,396
	2	352	$276,852,823
	3	31	$101,693,035
	4	286	$233,808,606
	5	268	$194,235,535
	6	246	$183,157,883
	7	81	$68,584,471
	8	107	$92,081,012
	9	149	$150,639,855
	10	37	$53,700,403
	11	22	$109,075,530
	12	324	$198,968,088
	13	43	$74,027,315
	14	99	$106,626,241
	15	121	$189,842,793
Oklahoma	1	82	$80,765,802
	2	876	$327,596,208
	3	1136	$408,623,427
	4	401	$145,871,794
	5	426	$150,533,494
Oregon	1	218	$621,256,522
	2	736	$914,003,965

	3	117	$352,744,367
	4	485	$717,785,591
	5	286	$513,212,852
	6	156	$296,316,781
Pennsylvania	1	50	$60,329,691
	2	8	$13,924,810
	3	9	$51,942,031
	4	36	$34,432,085
	5	14	$19,557,688
	6	45	$33,319,420
	7	41	$46,230,431
	8	77	$72,615,663
	9	155	$89,294,654
	10	32	$41,565,039
	11	66	$39,016,308
	12	23	$71,140,230
	13	93	$77,537,218
	14	138	$87,749,692
	15	162	$109,679,420
	16	95	$70,374,206
	17	14	$27,387,477
Puerto Rico	At-Large	376	$487,046,593
Rhode Island	1	36	$227,157,249
	2	53	$271,391,249
South Carolina	1	89	$190,651,016
	2	275	$230,191,697
	3	1139	$480,007,561
	4	402	$270,299,522
	5	699	$345,600,725
	6	532	$316,688,728
	7	634	$252,430,340
South Dakota	At-Large	1077	$563,429,282
Tennessee	1	224	$149,076,245
	2	111	$93,073,268
	3	180	$132,410,389
	4	243	$147,355,071
	5	119	$76,511,182
	6	230	$138,376,405
	7	249	$193,086,344
	8	470	$243,850,835
	9	78	$91,250,057

Texas	1	121	$60,688,130
	2	15	$6,622,890
	3	18	$6,381,850
	4	78	$21,950,950
	5	44	$32,971,970
	6	107	$28,926,010
	7	6	$12,537,120
	8	35	$12,355,120
	9	5	$2,166,280
	10	130	$51,174,110
	11	144	$83,408,010
	12	34	$31,051,170
	13	143	$66,201,228
	14	22	$11,215,860
	15	56	$26,976,720
	16	9	$9,421,530
	17	229	$84,936,680
	18	5	$2,002,670
	19	122	$67,439,040
	20	17	$10,693,580
	21	46	$25,261,900
	22	53	$13,771,960
	23	188	$87,680,970
	24	20	$8,120,560
	25	107	$50,081,090
	26	29	$9,018,020
	27	111	$46,492,620
	28	71	$46,638,780
	29	9	$8,347,620
	30	12	$16,702,790
	31	87	$34,847,460
	32	8	$7,092,340
	33	8	$6,523,060
	34	5	$2,158,080
	35	27	$17,535,800
	36	53	$22,034,792
	37	7	$8,014,710
	38	4	$2,817,830
Utah	1	111	$140,986,622
	2	113	$135,226,378
	3	129	$100,278,253

	4	38	$35,942,990
Virginia	1	39	$123,906,722
	2	39	$42,218,768
	3	7	$33,301,164
	4	91	$106,004,454
	5	242	$314,874,332
	6	185	$231,067,963
	7	25	$42,870,642
	8	17	$61,728,414
	9	248	$248,398,711
	10	33	$46,904,723
	11	6	$29,284,026
Vermont	At-Large	390	$295,176,640
Washington	1	16	$46,427,804
	2	153	$232,559,498
	3	211	$329,754,251
	4	273	$275,338,115
	5	329	$335,031,718
	6	167	$341,001,574
	7	21	$143,500,959
	8	229	$258,450,520
	9	20	$67,025,797
	10	29	$65,988,770
Wisconsin	1	28	$23,943,058
	2	55	$30,798,504
	3	261	$126,225,277
	4	15	$53,287,938
	5	27	$16,144,735
	6	63	$35,368,740
	7	259	$102,709,978
	8	100	$40,976,232
West Virginia	1	251	$231,717,169
	2	172	$173,997,593
Wyoming	At-Large	284	$127,643,926