LOAD RATING FOR NORTH CAROLINA LEGAL VEHICLES

by

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ABSTRACT

JASON WEIGER. Load rating for North Carolina legal vehicles. (Under the direction of DR. THOMAS NICHOLAS II)

Bridge load rating is the process by which the continued health and capacity of bridges are determined by state authorities. This process was established after the collapse of the Silver Bridge over the Ohio River due to overloading resulted in 46 deaths and has been federally mandated since 1968. NCDOT currently uses 29 legal vehicles to load rate bridges, of which 16 are generated by NC general statutes. Most states have successfully optimized their rating vehicles to fewer than five legal vehicles for the same purpose. The work presented in this thesis provides a proposed methodology to optimize the number of legal vehicles used by NCDOT. Values were calculated for maximum bending moment, lowest operating weight, and lowest posting weight for the current legal vehicles. Steel girder bridges with spans ranging between 19.5 ft. and 162.9 ft. were tested at varying levels of effectiveness and section modulus loss. The resulting values for the vehicle operating weights of the legal vehicles were then used to determine the impact of degradation on the controlling posting vehicles. This process showed that seven of the sixteen vehicles used to load rate non-interstate bridges were redundant in the load rating process for steel girder bridges. Additionally, a computer program was developed to generate potential legal vehicles that comply with North Carolina general statutes determining maximum vehicle weights. This can be utilized by NCDOT to replace the current legal vehicle representing cotton trucks, which was found to be non-compliant with the general statute.

ACKNOWLEDGEMENTS

"No man is an island, though too many think they can be a peninsula."

- Anonymous

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LIST OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
GDF	Girder Distribution Factor
LRFR	Load and Resistance Factor Rating
NBIS	National Bridge Inspection Standards
NCDOT	North Carolina Department of Transportation
RF	Rating Factor
STAA	Surface Transportation Assistance Act
SV	Single-Unit Vehicles
TT	Tractor Truck Semi Trailers
WIGINS	Wearable Inspection and Grading Information Network System

Chapter 1: Introduction

1.1 Problem Statement

The North Carolina Department of Transportation (NCDOT) is currently responsible for managing 18,169 structures. This includes 13,558 bridges, as well as 4,611 pipes and culverts with a minimum span of twenty feet and are thus classified as bridges. As of 2013, over 4000 of these structures are weight restricted (ASCE, 2013), and this number is expected to rise as inventory continues to age. The NCDOT follows the National Bridge Inspection Standards; these standards require every bridge to be inspected every two years. Any inspected bridge that no longer performs at the original design load levels is evaluated based on Legal Loads as described by North Carolina general statutes.

The NCDOT currently load rates bridges for thirteen vehicles that can legally travel on interstate highways and sixteen vehicles that can legally travel on non-interstate highways as broadly described by NC general statutes (GS §20-118). The NC general statutes provides allowable axle loads at varying spacing, grouped into single vehicles (SV) and tractor truck semi-trailers (TT). The process of determining the controlling load rating (or vehicle) is cumbersome, especially on multi-span bridges. Maintenance of the fleet of vehicles required to perform these load ratings on the 13,500 bridges managed by the NCDOT is unnecessarily burdensome. Many states have optimized their respective legal loads to a more manageable number of rating and posting vehicles, in an effort to streamline the live load generation process.

1.2 Objectives and Scope of Study

The objectives of this study are as follows:

1. Develop a methodology to optimize existing NC posting vehicles. Efforts included in this task will result in development of a framework to reduce the number of vehicles currently used to load rate bridges. The methodology will be based on current NCDOT bridge load rating practices as well as the use of influence lines to determine maximum moment envelopes produced by legal vehicles at varying span lengths.
2. Utilize the developed framework to optimize the list of posting vehicles. The methodology developed in task 1 will be used to define groups of vehicles that produce similar load effects on the spans and to identify specific vehicles that can represent the group.
3. Develop an automated computer program that generates NC posting vehicles from NC general statutes. The program will utilize the axle loading matrix found in NC general statute §20-118 along with user-defined parameters and will return a list of trucks sorted by maximum bending moment. The program will be written in C and will concentrate on single vehicles with 2 to 7 axles, and tandem trucks with 3 to 7 axles.

1.3 Organization of thesis

This thesis consists of six chapters. In the first chapter, the problem statement is presented, and the scope and objectives of the study are described. In the second chapter, the literature review describes the current state of practice for bridge loading and presents previous work on the Muller-Breslau principle (influence lines) and the determination of live load envelopes. In the third and fourth chapters, the methodologies utilized in this study are specified: in the third chapter, optimization of the legal posting vehicles is investigated, and chapter four presents the generation of the automated computer model. The results of the methodologies are presented in the fifth chapter. The summary and conclusion of the study are provided in the sixth chapter.

Chapter 2: Literature Review

2.1 Introduction

The following literature review describes the current state of practice governing the regulations of vehicle weights for both federal and state mandated vehicles. The history of federal legislation is provided, and the establishment of grandfather clauses permitting oversized vehicles is highlighted. The literature review identifies the relevant statutes in North Carolina law that govern vehicle weight limits, as well as the vehicle exceptions written into state law. A state-by-state review of load rating processes was conducted. The literature review provides a foundation of similar work to the development of equivalent uniform live load envelopes (Schaffer, 1952), where maximum moments and shears were calculated for bridges consisting of different numbers of lane and lane widths; these maximum moments and shears for each discrete bridge condition were combined to form the load envelope, a tool that identifies the range of the effects of load at all locations along a member. Load envelopes have been developed utilizing nonlinear analysis of bridges subjected to moving loads; the moment or shear failure at three critical locations were analyzed to produce the influence lines for the structure (Fiorillo, 2015).

2.2 Current State of Practice

Regulation of truck size and weight was first mandated by the federal government with the Federal-Aid Highway Act of 1956. In this legislation, the weight limits on trucks operating on the Interstate system were delineated to prevent the premature deterioration of the newly-created highways. Regulated vehicle weights included a maximum single axle weight of 18,000 lbs., a maximum tandem axle weight of 32,000 lbs., and a maximum overall gross vehicle weight of 73,280 lbs. These vehicle weight limits are codified by Title 23 USC§127, Vehicle Weight Limitations, Interstate System. The 1956 Federal-Aid Highway Act also allowed states to exempt vehicles that exceeded federal weight limits, provided that the states had such vehicle weight laws in effect in 1956 (Tabsh and Tabatabi, 2001). The National Bridge Inspection Standards (NBIS) were introduced in the Federal-Aid Highway Act of 1968, in response to the "Silver Bridge" bridge failure in 1967. The NBIS regulations require that each bridge be rated with respect to the AASHTO Design Manual or restricted based on state law when the operating loads are exceeded. Each state has established legal live loads based on tire, wheel, single axle, tandem axles and/or gross vehicle weight meeting or exceeding federally mandated weight limits for interstate systems and safe vehicle weights for state roadway systems. Although the federal limits on axle loads were raised by the Federal-Aid Highway Amendments of 1974, these increases were not mandatory; furthermore, a provision in those amendments permitted states with existing weight tables or axle spacing formulas to be exempt from the new requirements. These increased weight limits were imposed by law in 1982 when Congress passed the Surface Transportation Assistance Act (STAA). The federal weight limits have not been altered since 1982; the current federal weight limits include a single axle maximum weight of 20,000 lbs., a maximum tandem axle weight of 34,000 lbs., and a maximum gross vehicle weight of 80,000 lbs. (Fox, 2015).

North Carolina had truck weight laws in effect by 1956, and those laws have been grandfathered in all subsequent laws pertaining to trucks operating on the federal national network. Single axle and gross vehicle weight maximums match federal law; however, North Carolina allows a maximum tandem axle load of 38,000 lbs., an additional 10% tolerance to state limits that does not apply to single axle, tandem axle, or gross vehicle weight limits, and numerous commodity-specific weight exceptions, as specified in North Carolina general statute §20-118 and detailed below.

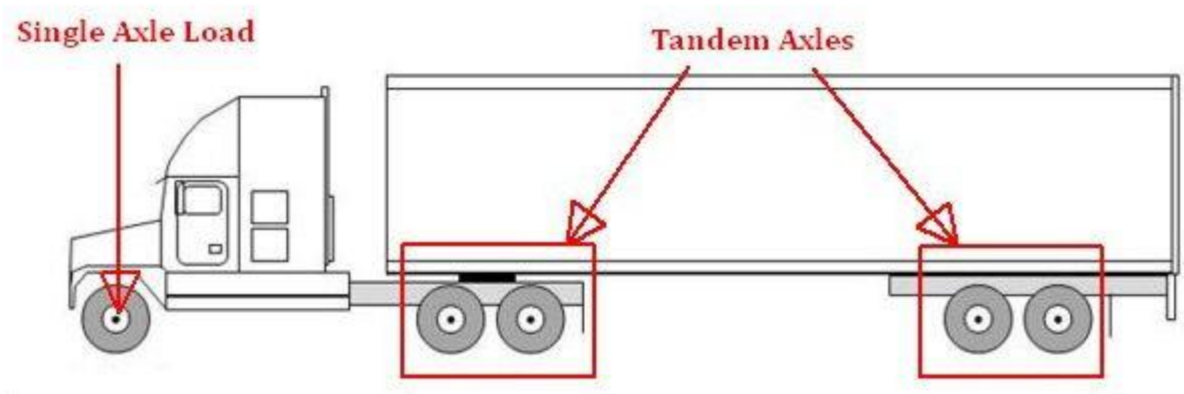

Figure 2.1: Tandem truck, single/tandem axles.

Vehicle Weight Limits

The statute specifies the following weight limits to vehicles operating on state highways:

- Single axle maximum: 20,000 lb.
- Tandem axle maximum: 38,000 lb.

- Gross weight maximum: based on the matrix found in §20-118(b)(3), as shown below in Figure 2.2.

Exceptions

The statute exempts eight classes of vehicles from one or more of the above restrictions:

1. Garbage. This exception applies to "fully enclosed motor vehicles designed specifically for collecting, compacting and hauling garbage from residences or from garbage dumpsters."
2. Agriculture: including dairy and crop products; water, fertilizer, pesticides, seeds, fuel, or animal waste; meats, livestock, or live poultry; feeds, or feed ingredients; forest products, wood residuals, raw logs, or Christmas trees. These exceptions apply for vehicles transporting the above materials within 150 miles of point of origin.
3. Aggregates. This exception applies to vehicles hauling aggregates "from a distribution yard or State-permitted production site" to a location across a contiguous state line.
4. Mineral: including soil, rock, sand, or asphalt millings. This exception applies to vehicles transporting the above materials "from a site that does not have a certified scale for weighing the vehicle."
5. Concrete. This exception applies to vehicles "hauling unhardened ready-mix concrete."

Axles*	2 Axles	3 Axles	4 Axles	5 Axles	6 Axles	7 Axles
4	38000					
5	38000					
6	38000					
7	38000					
8 or less	38000	38000				
more than 8	38000	42000				
9	39000	42500				
10	40000	43500				
11		44000				
12		45000	50000			
13		45500	50500			
14		46500	51500			
15		47000	52000			
16		48000	52500	58000		
17		48500	53500	58500		
18		49500	54000	59000		
19		50000	54500	60000		
20		51000	55500	60500	66000	
21		51500	56000	61000	66500	
22		52500	56500	61500	67000	
23		53000	57500	62500	68000	
24		54000	58000	63000	68500	74000
25		54500	58500	63500	69000	74500
26		55500	59500	64000	69500	75000
27		56000	60000	65000	70000	75500
28		57000	60500	65500	71000	76500
29		57500	61500	66000	71500	77000
30		58500	62000	66500	72000	77500
31		59000	62500	67500	72500	78000
32		60000	63500	68000	73000	78500
33			64000	68500	74000	79000
34			64500	69000	74500	80000
35			65500	70000	75000	
36			66000**	70500	75500	
37			66500**	71000	76000	
38			67500**	72000	77000	
39			68000	72500	77500	
40			68500	73000	78000	
41			69500	73500	78500	
42			70000	74000	79000	
43			70500	75000	80000	
44			71500	75500		
45			72000	76000		
46			72500	76500		
47			73500	77500		
48			74000	78000		
49			74500	78500		
50			75500	79000		
51			76000	80000		
52			76500			
53			77500			
54			78000			
55			78500			
56			79500			
57			80000			

Figure 2.2: Vehicle gross weight limits, according to NC general statute §20-118(b)(3).

6. Utility: including vehicles owned by, operated by, or under contract to a "public utility, electric or telephone membership cooperation."
7. Construction: including vehicles hauling construction equipment or metal commodities.
8. Cotton. This exception applies to vehicles "equipped with a self-loading bed … which is designed and used exclusively to transport compressed seed cotton from the farm to a cotton gin, or sage to market.

The exceptions placed in the statute for the vehicles listed above are as follows:

- Garbage: steering axle maximum = 23,500 lbs.
- Agriculture: An agriculture vehicle is excepted if it meets any of the three configurations:
    - Single axle maximum = 22,000 lbs.; tandem axle maximum = 42,000 lbs.; gross weight maximum = 90,000 lbs.
    - Five (or more) axles; minimum wheelbase = 48 feet; single axle maximum = 26,000 lbs.; tandem axle maximum = 44,000 lbs.; gross weight maximum = 90,000 lbs.
    - Two axles; minimum wheelbase = 14 feet; Single axle maximum = 27,000 lbs.; gross weight maximum = 37,000 lbs.
- Aggregates: gross weight maximum = 69,500 lbs.; tri-axle maximum = 53,580 lbs.

- Mineral: Single axle maximum = 22,000 lbs.; tandem axle maximum = 42,000 lbs.; gross weight maximum = 4,000 lbs. in excess of gross weight maximum found in §20-118(b)(3).
- Concrete: A concrete vehicle is excepted if it meets all of the following conditions:
    - Single axle maximum = 22,000 lbs.; tandem axle maximum = 46,000 lbs.
    - Three axle vehicle with a minimum wheelbase of 21 feet: gross weight maximum = 66,000 lbs.
    - Four axle vehicle with a minimum wheelbase of 36 feet: gross weight maximum = 72,600 lbs.
- Utility: single axle maximum = 28,000 lbs.; gross weight maximum = 48,000 lbs.
- Construction: single axle maximum = 26,000 lbs.; tandem axle maximum = 44,000 lbs.; gross weight maximum = 90,000 lbs.
- Cotton: tandem axle maximum = 50,000 lbs.

The possible load combinations derived from these matrices can be cumbersome to the bridge rating engineer in determining live load envelops. In an effort to streamline the live load generation process some states have optimized their respective legal loads to a more manageable number of rating/posting vehicles. A state-by-state review of load rating processes was performed, and the results are summarized in Table 1. Three states do not make their load rating process publicly available. One state does not include vehicle or legal load data in their publicly-available literature. Twenty-six states specify legal vehicles in their load rating processes. Twenty states only specify live load models as opposed to specific legal vehicles. These live load models include:

- HS-20: three axle truck with a total gross weight of 72,000 lbs.
- HS-25: three-axle truck with axle loads 25% higher than HS-20, with a total gross weight of 90,000 lbs.
- HL-93: vehicle design load consisting of three parts: one, a three-axle truck with a total gross weight of 72,000 lbs.; two, a design tandem axle consisting of two axles spaced four feet apart with axle loads of 25,000 lbs. each; three, a design lane load of 0.64 kips per linear foot. The design force of HL-93 is either the three axle truck load plus the design lane load, or the design tandem axle plus the design lane load, whichever is greater.

AL	2	IO	1	NE	3	RI	1
AZ	1	KA	1	NV	1	SC	1
AR	1	KY	6	NH	1	SD	4
CA	1	LA	1	NJ	4	TX	1
CO	1	ME	1	NM	11	UT	14
CN	2	MD	2	NY	1	VT	21
DE	8	MA	4	NC	29	VA	4
FL	8	MI	28	ND	1	WA	9
GA	1	MN	7	OH	7	WV	5
ID	1	MS	5	OR	4	WI	8
IL	2	MO	1	PA	4	WO	1
IN	11	MT	2				

Key	
	1
	2-5
	6-10
	11-15
	16-25
	25+

Figure 2.3: Current count of legal vehicles for states with publicly available data.

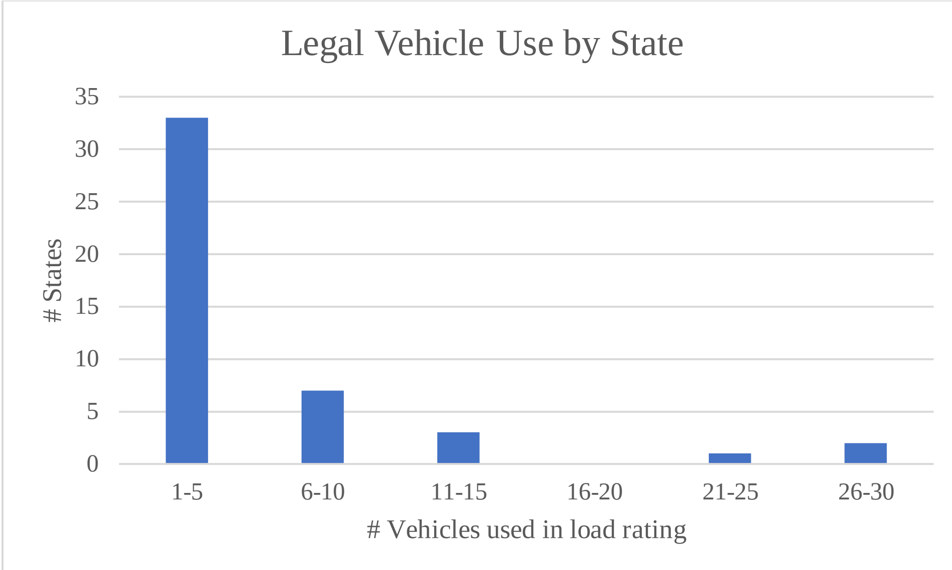

Figure 2.4: Comparison of state legal vehicle counts.

2.3 Vehicles that Exceed Federal Legal Loads

As described in section 2.2, there are three separate grandfather clauses in Title 23 USC§127. The 1956 grandfather clause relates principally to axle weights, gross weights, and permitting practices. The 1975 grandfather clause deals with bridge formula and axle spacing tables. Lastly, the 1991 grandfather clause codifies state practices relating to Longer Combination Vehicles (Fox, 2015). These clauses allow states flexibility in balancing the eventual degradation of roadway structures with the impact to local economies, freight movements, and traffic densities that can be positively impacted by allowing greater freedom of movement to overweight vehicles.

In addition to these grandfather clauses, states have specific exemptions for vehicles that exceed federal weight limits. These include grandfathered provisions to the axle weight limits and exemptions for specific vehicle types; these pertain to vehicles considered vital to local industry (vehicles hauling coal in Kentucky or West Virginia are

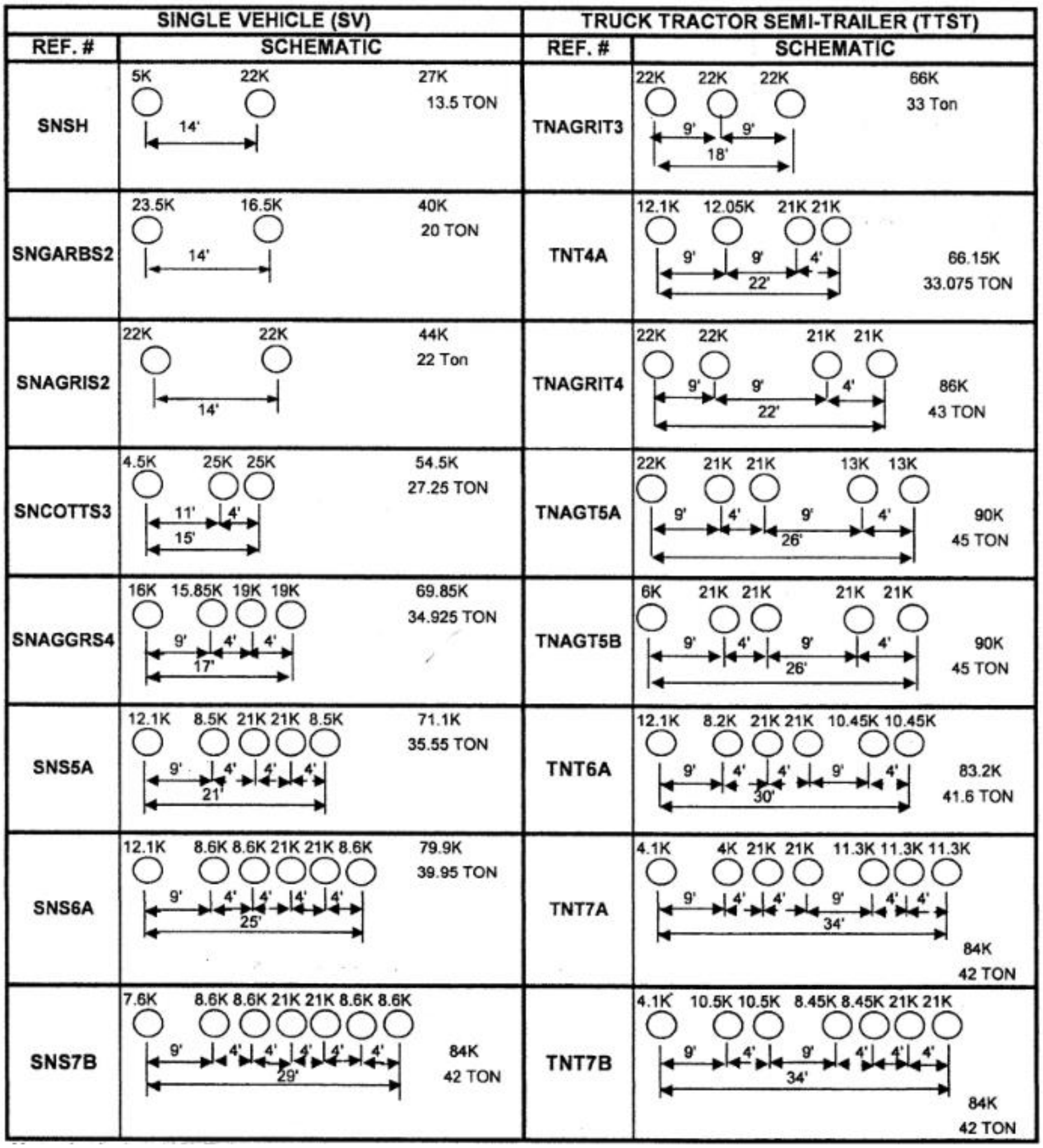

Figure 2.5: North Carolina non-interstate legal vehicles

permitted to weigh up to 120,000 lbs.; trucks transporting lumber in California are allowed a maximum tandem axle load of 69,000 lbs.; trucks carrying cotton/seed in southern states such as North Carolina are allowed a maximum tandem axle load of 50,000 lbs.), vehicles considered vital to infrastructure construction/rehabilitation (ready-mix concrete trucks,

trucks carrying construction materials or equipment), and vehicles considered vital to public health (garbage trucks, solid waste removal vehicles).

2.4 Influence Lines

Influence lines are spatial functions that represent the response of a structure at a fixed point due to a unit load at another (moving) point. For one dimensional skeletal structures, influence lines can be thought of as functions of the position x of the unit load. The response of the structure usually involves a generalized displacement, and a generalized internal force at the point under consideration. For beam structures, the internal forces are typically the bending moment or the shear force, but influence lines for strains, stresses, or reactions at a point are also of common occurrence. The present study will concentrate on shear and bending moment influence lines. Influence lines have been around since the late nineteenth century, the first references dating from 1867 (Charlton, 1982).

For statically determinate structures such as simply supported beam structures, influence lines can be calculated directly using the principles of statics. They can also be determined using the principle of virtual work. Influence lines for statically determinate structures like simple beams consists of straight line segments.

Table 1: Legal Vehicles

State	Legal Vehicles
Alabama	HS20-44, and Alternate PPM20-4, 8/10/56 for Interstates only
Alaska	No publicly available data
Arizona	HL-93
Arkansas	HS20
California	HL-93
Colorado	HL-93
Connecticut	HS20, HL-93
Delaware	HL-93, HS 20-44, S220, S335, S437, T330, T435, and T540
Florida	HL-93, SU2, SU3, SU4, ST5, C3, C4, C5
Georgia	HL-93
Hawaii	No vehicles/legal loads listed
Idaho	HL-93
Illinois	IL-120, HL-93
Indiana	HL-93; Legal loads R1, R2, R3; Permit Loads R4, R5, S1, S2, S3, S4, S5
Iowa	HL-93
Kansas	HL-93
Kentucky	HL-93, HS20, Type 1 (H-truck), Type 2 (Tandem Truck), Type 3 (Tri-axle truck), Type 4 (Five-axle tractor-trailer)
Louisiana	HL-93
Maine	HL-93, Legal Load Configurations 1-8
Maryland	HL-93, HS20
Massachusetts	H20, Type 3, Type 3S2, HS20
Michigan	28 legal vehicles
Minnesota	M3, M3S2-40, M3S3-40, SU4, SU5, SU6, SU7
Mississippi	HS20, H-Truck, Concrete Truck, HS-Short, HS-Long
Missouri	HL-93
Montana	HL-93, HS25
Nebraska	Type 3, Type 3S2, Type 3-3
Nevada	HL-93
New Hampshire	HL-93

Table 1: Legal Vehicles (cont'd)

State	Legal Vehicles
New Jersey	HS20-36T, 3-25T, 3S2-40T, 3-3-40T
New Mexico	HS20, HL93, (1) two-axle load, (3) three-axle load, (1) four-axle load, (1) five-axle load, (3) six-axle load - (11) total
New York	HL-93
North Carolina	SH, S3A, S3C, S4A, S5A, S6A, S7A, S7B, T4A, T5B, T6A, T7A, T7B, SNSH, SNGARBS2, SNAGRIS2, SNCOTTS3, SNAGGRS4, SNS5A, SNS6A, SNS7B, TNAGRIT3, TNT4A, TNAGRIT4, TNAGR5A, TNAGT5B, TNT6A, TNT7A, TNT7B
North Dakota	HL-93
Ohio	2F1, 3F1, 4F1, 5C1, HL-93, HS25, HS20-44
Oklahoma	No publicly available data
Oregon	HL-93, OR-STP-4D, OR-STP-5BW, OR-STP-4E
Pennsylvania	PHL-93, Permit Load P-82, ML-80, TK527
Rhode Island	HL-93
South Carolina	HL-93
South Dakota	HL-93, Type 3, Type 3S2, Type 3-2
Tennessee	No publicly available data
Texas	HL-93
Utah	HL-93, HS-20, Type 3, Type 3S2, Type 3-3, SU4, SU5, SU6, SU7, Permit vehicles UT-P6, UT-P7, UT P8, UT-P9a, UT-P9b
Vermont	3S2, 6 axle trailer, 3 axle straight, 4 axle straight, 5 axle semi, HS20, HL93
Virginia	HL-93, HS-20, VA Type 3, VA Type 3S2
Washington	HL-93, HS20, Type 3, Type 3S2, Type 3-3, NRL, Legal Lane, OL1 and OL2
West Virginia	HL93, H, Type 3, WV-SU4, HS, 3S2. Bridges on a coal resource transportation system shall be load rated for WV-SU40, WV-SU45, WV-3S55, WV-3S60
Wisconsin	HL-93, Type 3, Type 3S2, Type 3-3, SU4, SU5, SU6, and SU7
Wyoming	HL-93

For statically indeterminate structures like continuous beams, the calculation of influence lines is usually performed using the principle of virtual work in conjunction with Maxwell-Betti's Law of reciprocal displacements. This combination is known as Muller-Breslau's Principle which also dates from the late 19th century (Charlton, 1982).

Recent studies use influence lines in the areas of health monitoring of structures (Catbas e. al., 2012)), and to find the ultimate capacity of bridge structures under moving loads (Fiorillo et. al., 2015). Another recent study uses force-based finite elements to develop a procedure to analyze structures under moving loads that has proven useful for load rating of bridges (Kidarsa et. al., 2008). Figure 2.5 shows an influence line for bending moment of a single span constructed using Muller Breaslau's Principle; Figure 2.6 shows an influence line for bending moment at midspan of a 2-span continuous beam.

Influence lines are used to identify the loading and loading configurations that produce the greatest effect on a structure. Several methods to developing influence lines for moving loads are discussed below.

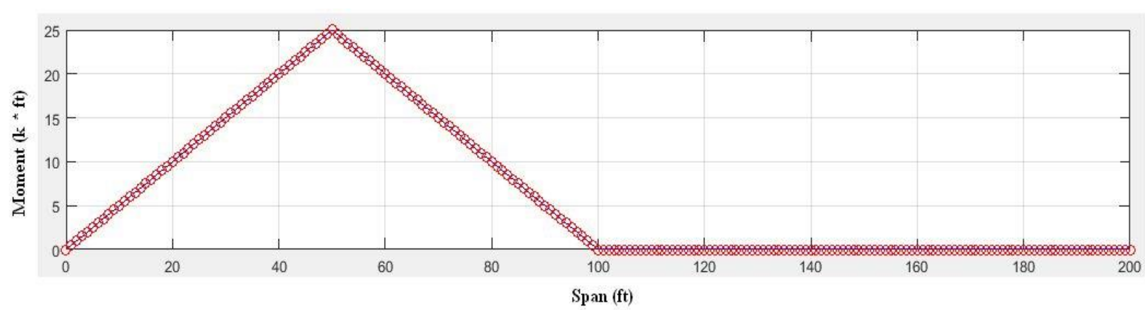

Figure 2.6: Influence Line for Moving Vehicles, Two Consecutive Single Spans.

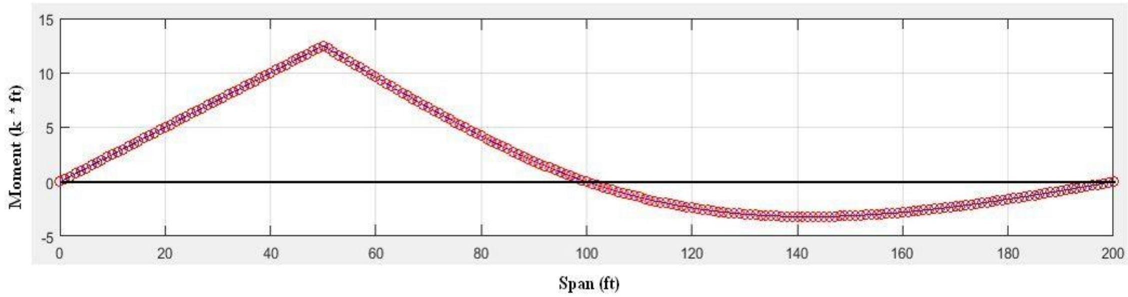

Figure 2.7: Influence Line for Moving Vehicles, Two Continuous Multiple Span.

In the first method, unit influence lines (UIL) are developed using computer images and sensor data. Influence lines are created by applying a unit load and moving it across the structure. The influence lines are generated by plotting the reactions to this unit load at a given location of interest. To generate this UIL, the following formula should be used (Zaurin, 2010):

$$\{r\} = [w] * \{u\}$$

Where:

> $\{r\}$ is a vector containing the response of a given location resulting from the moving load,
>
> [w] is a matrix of the axle weights, and $\{u\}$ is the UIL vector.

UIL can be calculated by rearranging the following equation:

$$\{u\} = [w]^{-1} * \{r\}$$

When using this formula, $\{r\}$ and [w] are collected from the monitoring data as well as axle loads and locations and $[w]^{-1}$ is calculated using standard numerical techniques (Catbas, 2012).

This methodology was tested by creating a simulation of two remote controlled vehicles moving over an undamaged structure. The raw data collected from the simulation consists of a combination of a static response, a dynamic response, and noise. The dynamic response and noise must be filtered out from the static response by using a Fourier transformation that changes the time domain to frequency domain. The result from this filtering process is then converted back to the time domain. Through synchronized computer image data, the response of the structure is correlated with the corresponding input force and location. The UIL can then be calculated. Due to their ability to provide a more localized response, the UILs for strain could be used for instance to pinpoint damage to a structure (Zaurin, 2010).

A second method utilizes a nonlinear analysis of the bridge subjected to moving loads. The moment or shear at three critical locations are analyzed to obtain the influence lines for the structure. The three critical locations are labeled with the letters B, S, and C. The corresponding ultimate moment capacity and shear are labeled with $M_{u,B}$, $M_{u,S}$, $M_{u,C}$, and $V_{u,B}$, $V_{u,S}$, $V_{u,C}$. The influence line for moment and shear are (Fiorillo, 2015):

$$\lambda_{M,i}^{j}(x) = \sum_{k=1}^{R} \alpha_k * \lambda_{M,i}^{j}(X_k)$$

$$\lambda_{V,i}^{j}(x) = \sum_{k=1}^{R} \alpha_k * \lambda_{V,i}^{j}(X_k)$$

Where:

i is the section

j is the j-th structural configuration

k is the k-th force out of R forces located at X_k from the left origin

α_k is the ratio between the force k and the maximum force in the set applied; α_k can assume a value between 0 and 1.

To test the methodology outlined above, the results were compared to the structural analysis program SAP2000 as well as the theoretical results from solving this problem using the principle of virtual work. There is a small discrepancy in the calculated results when compared to SAP2000. This is likely due to the nonlinear structural analysis software package which is commonly subject to numerical instability. The discrepancies are minimal enough and can be attributed to the software package rather than the proposed methodology to conclude that this methodology can be used. This approach is developed as an extension of the stiffness matrix, one of the most commonly used methods for solving structural analysis problems. In addition, this approach can identify critical loading positions when these positions are unknown and considers combinations of ductile or brittle section failures resulting from shear or bending moments (Fiorillo, 2015).

A third approach to developing influence lines for moving loads is the low-order approach. Two assumptions were made that formed the basis of this approach and they are “there will be a numerical integration error for any quadrature method” and “for the common case of a prismatic element without interior loads, the integration of quadratic polynomials is sufficient to represent the product of a linear curvature distribution” (Kidarsa, 2008). Because of these assumptions, three integration weights must be treated as unknown. The remaining weights (N-3) should be specified in order to maintain accuracy. The integration points are divided into groups depending on if the weight is known (N_c) or unknown (N_f). The following integration was then developed:

$$\begin{bmatrix} 1 & 1 & \cdots & 1 \\ x_{f1} & x_{f2} & \cdots & x_{fN_f} \\ \vdots & \vdots & \ddots & \vdots \\ x_{f1}^{N_f-1} & x_{f2}^{N_f-1} & \cdots & x_{fN_f}^{N_f-1} \end{bmatrix} * \begin{bmatrix} w_{f1} \\ w_{f2} \\ \vdots \\ w_{fN_f} \end{bmatrix} = \begin{bmatrix} (b-a) - \sum_{j=1}^{N_c} w_{cj} \\ (b^2 - a^2)/2 - \sum_{j=1}^{N_c} x_{cj} w_{cj} \\ \vdots \\ \left(b^{N_f} - a^{N_f}\right)/N_f - \sum_{j=1}^{N_c} x_{cj}^{N_f-1} w_{cj} \end{bmatrix}$$

Where:

> x_f and x_c are the integration point locations, their corresponding weights are w_f and w_c, and [a,b] is the interval of integration.

This method is suitable for both moving load analysis and for nonlinear material response over a set length (Kidarsa, 2008).

The low-order approach was applied to a moving load analysis of the McKenzie River Bridge near Eugene, OR. A three-axle AASHTO HS-20 truck was moved across the bridge. Integration weights were assigned to sections 1, 2, 6, and 7 while sections 3-5 were left unknown. The internal moment and shear demand resulting from the moving load are computed using one force-based beam element at each of the critical locations. The calculated moment and shear were compared to the actual values and the errors were small, concluding that this is an accurate and reliable approach. The results of this research are now used in load rating software developed for the Oregon Department of Transportation to efficiently rate state bridges (Kidarsa, 2008).

2.5 Determination of Live Load Envelopes

Prior to the development of federal standards for vehicle weight limits, equivalent uniform live load envelopes were developed in an effort to simplify and standardize bridge design. In this methodology, design moments and shears, equivalent uniform loads for moments, and equivalent uniform moments for shear were calculated for three classes of bridges. The bridge classes include: industrial bridges, pertaining to all spans normally carrying heavy trucking loads; route bridges, consisting of interstate and highway bridges experiencing normal interstate trucking loads; and rural bridges, consisting of lightly travelled structures that do not experience heavy truck loads. The results of this methodology is a series of live load envelopes, as opposed to single uniform loads (Schaffer, 1952).

In later research, live load distribution generated by oversized trucks was examined. In this research, modification factors were developed for girder distribution factors (GDF) for girder bridges subject to vehicles with a gauge larger than 6 feet, examining vehicles that would normally require a permit to use routes that included bridge crossings. Finite-element modeling was utilized to determine shear GDF and flexural GDF for three different composite steel bridge structures. This analysis showed a reduction in GDF corresponding to an increase in gauge length, indicated that the first interior girder received the largest percentage of live load, and showed that gauge width affects shear more than it affects flexure (Tabish and Tabatabai, 2001).

In additional research, bridge rating when subjected to loads from military vehicles was investigated. In this investigation, the bridge response when subjected to loads from military vehicles to those when the bridge was subjected to standard AASHTO HS20 trucks was compared. The study compared AASHTO's Load and Resistance Factor Rating (LRFR) rating equation with the rating equation specified in the Canadian Highway Bridge Code, as well as rating equations relating to military vehicles specifically proposed by Pinero (Pinero, 2001) and Ortiz (Ortiz, 2007). Four vehicles and six bridge models were tested; in examining the effects of the loads on each girder in the six bridge models, a total of 144 cases were considered. The study found that the wheel-line spacing of the military trucks contributed the highest factor to the distribution of the live load for all girders, interior or exterior. It further found the AASHTO LRFR provisions were adequate at predicting the load effect of the military trucks (Kim, et al, 2013).

2.6 Summary

The number of vehicles currently utilized by the NCDOT to load rate bridges is significantly higher than are used in most states. This list of vehicles can be optimized by determining the vehicles that control during the load rating process. Influence line analysis will be utilized to determine moment and shear envelopes for the vehicles. The moment and shear envelopes could subsequently be used to determine operating weights for the vehicles. The controlling vehicles will be the ones with the lowest operating weights. Applying this analysis to a variety of bridges will allow for the determination of the controlling vehicles. The resulting optimized list of vehicles will be populated by the vehicles found to control through this analysis.

Chapter 3: Optimization of Legal Posting Vehicles

3.1 Optimization Methodology

The optimization methodology began by duplicating the results obtained by NCDOT in bridge maintenance analysis. Sample analysis results were provided for four bridge spans. These include two timber beam bridges (bridge number 500225 and bridge number 480221) and two spans of one steel beam bridge (bridge number 490054). An examination of the methods used to determine the operating and inventory rating for the truck loads on the provided bridge spans is presented below.

Operating and inventory ratings are used to determine the operating and inventory weights for each vehicle used during the load rating process. Multiplying the gross weight of a vehicle by the operating rating yields the operating weight; multiplying the gross weight of a vehicle by the inventory rating yields the inventory weight. The inventory weight represents the vehicle load that can safely traverse the bridge frequently and repeatedly. The operating weight represents the maximum permissible vehicle load to which a bridge may be subjected; repeated exposure to vehicles at operating weight may shorten the life of the bridge. The operating rating also indicates whether the bridge must be posted for maximum vehicle loads. If a legal vehicle type has an operating rating at or above 1.0, no posting for that vehicle is necessary; if the operating rating is below 1.0, the bridge must have a sign indicating the maximum inventory weight for that classification of vehicle.

The spans for bridge 490054 include a 19.75 ft. span and a 39.0 ft. span. Analysis for the 19.75 ft. span was performed on an interior W12x27 bean; analysis for the 39.0 ft. span was performed on an interior W16x50 beam. Relevant details for each span are as follows:

Table 2: Timber Span Analysis

	W12x27	W16x50
Percent effect	98.0	98.0
Yield stress (lb/in^2)	33000	33000
Deck material	Timber	Timber
Beam spacing (ft)	2.115	2.583
Non-composite dead load (lb/ft)	134	179
Impact + 1	1.3	1.3
Reduced S_x (in^3)	30.5923	58.1735

Due to the age of the bridge, the rating factor for the spans was determined with the load factor rating (LRF) formula:

$$RF = \frac{C - A_1 * D}{A_2 * L * GDF * (1 + I)}$$

Where:

RF = rating factor

C = capacity

A_1 = dead load factor

D = dead load effect

A_2 = live load factor

L = live load effect

GDF = girder distribution factor

I = impact

Girder distribution factor is used to account for the spacings of the girders. For steel girder bridges, GDF is determined with the following equation:

$$GDF = \frac{Beam\ Spacing}{4}$$

Where:

GDF = girder distribution factor

Beam spacing = distance between center of girders

Impact reflects the dynamic effects of moving loads on a bridge. Impact has a maximum value of 0.3, and is determined with the following equation:

$$I = \frac{50}{L + 125}$$

Where:

I = impact

L = length of span

The dead and live load factors for the inventory and operating levels are listed below:

Table 3: Live Load Factors

	A_1	A_2
Inventory	1.3	2.17
Operating	1.3	1.3

The difference between the two rating factors is the live load factor. The ratio between the Inventory rating and the operating rating is 3:5; this ratio is induced into the LRF formula by multiplying the live load factor used to determine the operating rating by 5/3 when calculating the inventory rating.

Capacity is determined by multiplying the section modulus (S_X) by the yield stress (F_Y):

$$C = S_X * F_Y$$

The distribution factor for the live load effect for a bridge with one lane in either direction and a timber deck is found by dividing the beam spacing by four. This distribution factor represents one wheel line; doubling the distribution factor will return a rating factor for the axle load.

Using the appropriate dead and live load factors, rating factors for the operating and inventory level are calculated. The operating and inventory weights are then determined by multiplying the rating factor by the truck weight:

$$Operating\ Weight = Truck\ Weight * RF$$

For the sake of brevity, the demonstration of the process will focus on one specific truck load, that of the HS truck. Similarly, the demonstration will focus on the 39.0 ft. span, and concentrate on the operating rating and weight. Results obtained from this analysis were found to be representative of all results obtained, for all truck loads, both spans, and both Operating and Inventory levels. The truck weight for an HS truck is 15.0 tons, and the Live Load moment for the HS truck on a 39.0 ft. span based on its axle load is 319.38 kip * ft.

The first step was to determine the target rating factor. This was merely a process of rewriting the Operating weight equation:

$$RF = \frac{Operating\ Weight}{Truck\ Weight}$$

The next step was to determine the component values to use in the LRF RF equation. The dead load moment was determined as such:

$$D = \frac{wL^2}{8} = \frac{\left(179\frac{lb}{ft}\right) * (39\ ft)^2 * \frac{12\ in}{1\ ft} * \frac{1\ kip}{1000\ lb}}{8} = 408.4\ kip * in$$

Capacity was determined by multiplying the reduced section modulus of the damaged W16x50 beam by its yield stress:

$$C = 58.1735\ in^3 * 33000\frac{lb}{in^2} * \frac{1\ kip}{1000\ lb} = 1919.7\ kip * in$$

The live load moment was converted into kip * in, and halved to represent the wheel load:

$$L = 319.38\ k * ft * 0.5 * \frac{12\ in}{1\ ft} = 1916.3\ kip * in$$

The distribution factor for the span was obtained:

$$DF = \frac{Beam\ Spacing}{4} = \frac{2.538}{4} = 0.646$$

The obtained results were entered into the RF equation:

$$RF = \frac{C - A_1 * D}{A_2 * DF * L * (1 + I)} = \frac{(1919.7\ kip * in) - (1.3) * (408.4\ kip * in)}{(1.3) * (0.646) * (1916.3\ kip * in) * (1.3)} = 0.664$$

Applying this rating factor to the truck weight for the HS truck yields the following Operating Weight:

$$Operating\ Weight = Truck\ Weight * RF = 15\ tons * 0.664 = 9.96\ tons$$

With a rating factor for a legal vehicle that is determined to be below 1.0, this bridge would be weight restricted, and the need for that is apparent in the calculated operating weight. An HS truck operating at its maximum weight of 15 tons would not be able to cross this span without the risk of damaging the bridge. To prevent damage, the HS truck would be restricted to a total maximum gross weight of 9.96 tons.

3.2 Serviceability Check

The span was subsequently checked to determine whether the controlling factor in the bridge rating was strength or serviceability. The process for strength rating is as described above. The check for serviceability for non-composite sections is determined with the following equation:

$$RF_O = \frac{0.80\ F_Y - F_{DL}}{1.67 * F_{LL+1}}$$

Where:

RF_O = operating rating factor

F_Y = yield stress of member

F_{DL} = total dead load stress = M_{DL}/S_X

F_{LL+1} = total live load stress = M_{LL+1}/S_X

M_{LL+1} = M_{LL} * DF * 1 + I

The dead load stress was calculated:

$$F_{DL} = \frac{408.4\ kip * in}{58.1735\ in^3} = 7.02\frac{kip}{in^2}$$

The total live load stress was determined:

$$F_{LL+1} = \frac{1916.3\ kip * in * 0.646 * 1.3}{58.1735\ in^3} = 27.66\frac{kip}{in^2}$$

The obtained values for the stresses was subsequently used to determine the rating factor for serviceability:

$$RF_O = \frac{\left(0.80 * 33\frac{kip}{in^2}\right) - 7.02\frac{kip}{in^2}}{1.67 * 27.66\frac{kip}{in^2}} = 0.419$$

Since the rating factor due to serviceability was lower than the rating factor due to strength, the serviceability was found to control for this span.

3.3 NC Legal Vehicles M_{max} Matrix

The maximum bending moment for each of the 29 legal vehicles was determined for bridge spans between 40' and 200', in 10' intervals. For each vehicle, the centroid distance was determined. Placing the line of action for the vehicle at a point between the centroid of the vehicle and the center axle of the vehicle provided the maximum bending moment for that vehicle at that span distance.

The centroid was found with the following formula:

$$C = \frac{\sum(D_A * P_A)_{left} - \sum(D_A * P_A)_{right}}{W_T}$$

Where:

C = centroid of the axle loads

D_A = distance between axle and center of vehicle

P_A = load on axle

W_T = total vehicle weight

As an example of this process, consider the HS-20 truck on a span 100 ft. long. The HS-20 has a front axle with an 8 kip load, a central axle 14 ft. behind the front axle with a 32 kip load, and a rear axle 14 ft. behind the central axle with a 32 kip load, as seen below in Figure 3.1:

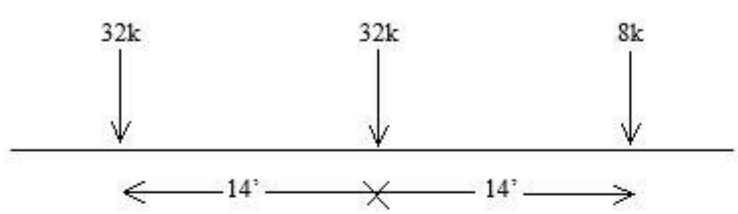

Figure 3.1: Graphical representation of axle loads and geometry of HS-20.

The determination of the vehicle centroid, relative to the central axle, is shown below:

$$C = \frac{(14\,ft * 32\,K) - (14\,ft * 8k)}{72k} = 4.667\,ft$$

A positive value for the centroid places it to the left of the central axle. The line of action for the vehicle is placed between the centroid and the central axle, as seen below in Figure 3.2:

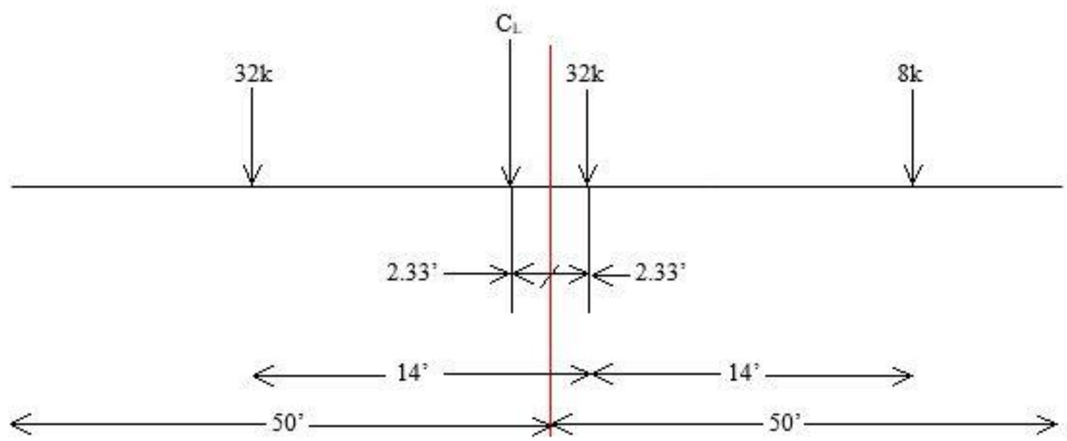

Figure 3.2: Line of action (in red) for HL-20 on a 100 ft. span bridge.

The maximum bending moment values were obtained by drawing shear and bending moment diagrams. These values were subsequently verified with the program MOVLOADS. These values were tabulated (Figures 3.1 and 3.2), and the minimum and maximum bending moments for each span length were identified. Minimum values were highlighted in beige, and maximum values were highlighted in green.

	Span (ft.)								
Vehicle	40	50	60	70	80	90	100	110	120
SNSH	263.1	303.4	370.8	438.1	505.6	573.0	640.5	707.9	775.4
SNGARBS2	292.8	391.2	490.1	589.3	688.7	788.2	887.8	987.5	1087.3
SNAGRIS2	299.5	406.8	515.0	623.7	732.7	842.0	951.4	1060.9	1170.5
SNCOTTS3	470.5	606.7	742.9	879.2	1015.4	1151.6	1287.9	1424.1	1560.3
SNAGGRS4	528.2	702.2	876.3	1050.6	1225.0	1399.4	1573.9	1748.4	1922.9
SNS5A	539.5	717.2	894.9	1072.7	1250.4	1428.2	1605.9	1783.6	1961.4
SNS6A	570.1	769.4	968.9	1168.5	1368.1	1567.7	1767.4	1967.1	2166.8
SNS7B	595.5	805.8	1015.8	1225.8	1435.8	1645.8	1855.8	2065.8	2275.8
TNAGRIT3	462.0	627.0	792.0	957.0	1122.0	1287.0	1452.0	1617.0	1782.0
TNT4A	461.9	626.2	790.8	955.7	1120.6	1285.7	1450.8	1616.0	1781.2
TNAGRIT4	535.1	749.1	963.4	1177.9	1392.5	1607.3	1822.0	2036.8	2251.7
TNAGT5A	572.5	797.4	1022.3	1247.3	1472.2	1697.2	1922.2	2147.2	2372.2
TNAGT5B	594.3	818.0	1042.2	1266.6	1491.1	1715.8	1940.5	2165.3	2390.1
TNT6A	540.6	748.3	956.2	1164.1	1372.0	1579.9	1787.9	1995.8	2203.8
TNT7A	531.6	740.7	950.0	1159.6	1369.2	1579.0	1788.7	1998.6	2208.4
TNT7B	519.6	716.8	920.7	1128.7	1337.1	1545.9	1755.0	1964.2	2173.5

	Span (ft.)							
Vehicle	130	140	150	160	170	180	190	200
SNSH	842.8	910.3	977.8	1045.3	1112.8	1180.3	1247.7	1315.2
SNGARBS2	1187.1	1286.9	1386.7	1486.6	1586.5	1686.4	1786.3	1886.2
SNAGRIS2	1280.1	1389.9	1499.6	1609.4	1719.2	1829.0	1938.8	2048.7
SNCOTTS3	1696.6	1832.8	1969.1	2105.3	2241.6	2377.8	2514.1	2650.3
SNAGGRS4	2097.5	2272.0	2446.6	2621.2	2795.7	2970.3	3144.9	3319.5
SNS5A	2139.1	2316.9	2494.6	2672.4	2850.1	3027.9	3205.6	3383.4
SNS6A	2366.5	2566.2	2765.9	2965.6	3165.3	3365.1	3564.8	3764.5
SNS7B	2485.8	2695.8	2905.8	3115.8	3325.8	3535.8	3745.8	3955.8
TNAGRIT3	1947.0	2112.0	2277.0	2442.0	2607.0	2772.0	2937.0	3102.0
TNT4A	1946.5	2111.7	2277.0	2442.3	2607.6	2772.9	2938.2	3103.5
TNAGRIT4	2466.6	2681.4	2896.4	3111.3	3326.2	3541.1	3756.1	3971.0
TNAGT5A	2597.2	2822.1	3047.1	3272.1	3497.1	3722.1	3947.1	4172.1
TNAGT5B	2614.9	2839.8	3064.7	3289.6	3514.5	3739.4	3964.3	4189.3
TNT6A	2411.8	2619.7	2827.7	3035.7	3243.7	3451.7	3659.6	3867.6
TNT7A	2418.3	2628.2	2838.1	3048.0	3257.9	3467.9	3677.8	3887.8
TNT7B	2383.0	2592.5	2802.1	3011.7	3221.4	3431.1	3640.9	3850.6

Figure 3.3: M_{max} matrix, non-interstate vehicles.

For the non-interstate trucks, the smallest maximum bending moments all occurred with vehicle SNSH. The largest maximum bending moment at 40 ft. was SNS7B; for all spans between 50 ft. and 200 ft., the largest maximum bending moment was TNAGT5B.

	Span (ft)								
Vehicle	40	50	60	70	80	90	100	110	120
SH	216.2	278.5	340.8	403.2	465.6	528.0	590.5	652.9	715.4
S3A	383.3	497.0	610.8	724.5	838.3	952.0	1065.8	1179.5	1293.3
S3C	364.6	472.1	579.5	687.0	794.5	902.0	1009.5	1117.0	1224.5
S4A	415.2	548.7	682.4	816.0	949.7	1083.4	1217.1	1350.8	1484.6
S5A	464.7	617.2	769.6	922.1	1074.6	1227.1	1379.6	1532.1	1684.6
S6A	493.6	665.7	838.0	1010.3	1182.7	1355.1	1527.5	1700.0	1872.4
S7A	508.5	708.5	908.5	1108.4	1308.4	1508.4	1708.4	1908.4	2108.4
S7B	526.5	719.0	911.5	1104.0	1296.5	1489.0	1681.5	1874.0	2066.5
T4A	398.2	538.7	679.4	820.3	961.2	1102.3	1243.3	1384.4	1525.6
T5B	452.8	612.7	772.7	932.7	1092.6	1252.6	1412.6	1572.6	1732.6
T6A	468.6	648.5	828.4	1008.4	1188.3	1368.3	1548.3	1728.2	1908.2
T7A	477.2	677.2	877.2	1077.1	1277.1	1477.1	1677.1	1877.1	2077.1
T7B	442.0	613.2	805.1	1001.6	1198.9	1396.9	1595.2	1793.9	1992.8

	Span (ft)							
Vehicle	130	140	150	160	170	180	190	200
SH	777.9	840.4	902.8	965.3	1027.8	1090.3	1152.8	1215.2
S3A	1407.0	1520.8	1634.5	1748.3	1862.0	1975.8	2089.5	2203.3
S3C	1332.0	1439.5	1547.0	1654.5	1762.0	1869.5	1977.0	2084.5
S4A	1618.3	1752.0	1885.8	2019.5	2153.2	2287.0	2420.7	2554.4
S5A	1837.1	1989.6	2142.1	2294.5	2447.0	2599.5	2752.0	2904.5
S6A	2044.9	2217.3	2389.8	2562.3	2734.7	2907.2	3079.7	3252.2
S7A	2308.4	2508.4	2708.4	2908.4	3108.4	3308.4	3508.4	3708.4
S7B	2259.0	2451.5	2644.0	2836.5	3029.0	3221.5	3414.0	3606.5
T4A	1666.7	1807.9	1949.1	2090.2	2231.4	2372.6	2513.8	2655.0
T5B	1892.6	2052.6	2212.6	2372.6	2532.6	2692.6	2852.6	3012.6
T6A	2088.2	2268.2	2448.2	2628.2	2808.2	2988.1	3168.1	3348.1
T7A	2277.1	2477.1	2677.1	2877.1	3077.1	3277.1	3477.1	3677.0
T7B	2191.8	2391.0	2590.3	2789.7	2989.2	3189.1	3389.0	3589.0

Figure 3.4: M_{max} matrix, interstate vehicles.

For the interstate trucks, the smallest maximum bending moments all occurred with vehicle SH. The largest maximum bending moment from 40 ft. to 60 ft. was S7B; for all spans between 70 ft. and 200 ft., the largest maximum bending moment was S7A.

3.4 NCDOT Bridge Analysis

In addition to the initial sample analysis of the four spans, NCDOT provided analysis data of 18 additional bridges. The controlling factor for most of the provided bridges was Serviceability; Strength was the controlling factor for two bridges (bridge # 770056 and bridge # 900028). The provided data was analyzed for two purposes:

1. To determine the total number of controlling vehicles.
2. To determine whether the same Rating Factor values that were obtained by NCDOT could be calculated for bridges where strength was the controlling factor.

The data provided for bridge 770056 was entered into a spreadsheet, and RF_O and RF_I were calculated for all 16 non-interstate trucks at varying levels of bridge effectiveness and varying levels of section modulus. Effectiveness was calculated beginning at 100%, and for all values declining by 1% until 90% effectiveness was reached. Section modulus was calculated beginning at 100%, and for all values declining by 5% until 70% was reached; additionally, a value for section modulus at 50% was also calculated. Each level of effectiveness was calculated for each level of section modulus; in total, 88 RF_O and RF_I values were calculated for all 16 vehicles (Figure 3.5).

The controlling vehicle for each combined set of conditions was the vehicle with the lowest value for operating weight (disregarding the notional vehicle HS). For bridge 770056, in all combined set of conditions, SNSH was determined to be the controlling vehicle (Figure 3.6).

Bridge # 770056 W18x47	LL moment (k*ft)	LL moment (k*in)		Vehicle Weight	Operating Weight	Inventory Weight	Calculated OPER RF	Calculated INV RF
HS	120.00	1440.00	HS	15.00	31.9	19.1	2.127	1.274
SNSH	110.00	1320.00	SNSH	13.50	31.3	18.8	2.320	1.390
SNGARBS2	117.50	1410.00	SNGARBS2	20.00	43.4	26.0	2.172	1.301
SNAGRIS2	110.00	1320.00	SNAGRIS2	22.00	51.0	30.6	2.320	1.390
SNCOTTS3	202.50	2430.00	SNCOTTS3	27.25	34.3	20.6	1.260	0.755
SNAGGRS4	199.59	2395.08	SNAGGRS4	34.92	44.7	26.8	1.279	0.766
SNS5A	204.95	2459.40	SNS5A	35.55	44.3	26.5	1.245	0.746
SNS6A	211.45	2537.40	SNS6A	39.95	48.2	28.9	1.207	0.723
SNS7B	211.45	2537.40	SNS7B	42.00	50.7	30.4	1.207	0.723
TNAGRIT3	132.14	1585.68	TNAGRIT3	33.00	63.7	38.2	1.932	1.157
TNT4A	174.16	2089.92	TNT4A	33.08	48.5	29.0	1.466	0.878
TNT6A	193.25	2319.00	TNT6A	41.60	54.9	32.9	1.321	0.791
TNT7A	181.26	2175.12	TNT7A	42.00	59.1	35.4	1.408	0.844
TNT7B	201.86	2422.32	TNT7B	42.00	53.1	31.8	1.264	0.757
TNAGRIT4	181.54	2178.48	TNAGRIT4	43.00	60.5	36.2	1.406	0.842
TNAGT5A	181.54	2178.48	TNAGT5A	45.00	63.3	37.9	1.406	0.842
TNAGT5B	180.69	2168.28	TNAGT5B	45.00	63.6	38.1	1.413	0.846
Noncomp DL =	643	lb/ft			% eff	1.00		
span =	20	ft			fy =	33	ksi	
GDF =	0.894				Sx =	85.3111	in^3	
DL moment =	385.8	k*in			Capacity =	2815.3	k*in	

Figure 3.5: RF_o and RF_i values calculated for bridge 770056 at 100% section modulus and 100% effectiveness.

Furthermore, when SNSH was removed from consideration, the controlling vehicle for all combined sets of conditions was found to be SNCOTTS3. At all levels of effectiveness between 90% and 100%, and all levels of section modulus between 70% and 100%, SNSH had the lowest operating weight, and SNCOTTS3 had the second-lowest operating weight.

Section Loss \ Bridge Efficiency	100	99	98	97	96	95	94	93	92	91	90
100	SNSH 31.3	SNSH 30.9	SNSH 30.6	SNSH 30.2	SNSH 29.8	SNSH 29.4	SNSH 29.0	SNSH 28.7	SNSH 28.3	SNSH 27.9	SNSH 27.5
95	SNSH 29.4	SNSH 29.1	SNSH 28.7	SNSH 28.3	SNSH 28.0	SNSH 27.6	SNSH 27.2	SNSH 26.9	SNSH 26.5	SNSH 26.2	SNSH 25.8
90	SNSH 27.5	SNSH 27.2	SNSH 26.8	SNSH 26.5	SNSH 26.1	SNSH 25.8	SNSH 25.5	SNSH 25.1	SNSH 24.8	SNSH 24.4	SNSH 24.1
85	SNSH 25.6	SNSH 25.3	SNSH 25.0	SNSH 24.6	SNSH 24.3	SNSH 24.0	SNSH 23.7	SNSH 23.3	SNSH 23.0	SNSH 22.7	SNSH 22.4
80	SNSH 23.7	SNSH 23.4	SNSH 23.1	SNSH 22.8	SNSH 22.5	SNSH 22.2	SNSH 21.9	SNSH 21.6	SNSH 21.3	SNSH 21.0	SNSH 20.7
75	SNSH 21.8	SNSH 21.5	SNSH 21.2	SNSH 20.9	SNSH 20.7	SNSH 20.4	SNSH 20.1	SNSH 19.8	SNSH 19.5	SNSH 19.2	SNSH 18.9
70	SNSH 19.9	SNSH 19.6	SNSH 19.4	SNSH 19.1	SNSH 18.8	SNSH 18.6	SNSH 18.3	SNSH 18.0	SNSH 17.8	SNSH 17.5	SNSH 17.2
50	SNSH 12.3	SNSH 12.1	SNSH 11.9	SNSH 11.7	SNSH 11.5	SNSH 11.3	SNSH 11.1	SNSH 10.9	SNSH 10.7	SNSH 10.6	SNSH 10.4

Figure 3.6: Controlling vehicle for all combined set of conditions on bridge # 770056, and their respective operating weights (measured in tons).

This analysis was subsequently conducted on bridge #320006, one of the 16 bridges provided by NCDOT where Serviceability was the controlling factor. SNSH was found to be the controlling vehicle in all combined sets of conditions, with SNCOTTS3 controlling once SNSH was removed from consideration.

The analysis provided by NCDOT for bridge #770056 indicated a bridge at 98% effectiveness, with a section modulus value of 85.3111 in^3. The results obtained for the operating and inventory weights of trucks at that combined set of conditions is very similar to the results provided by NCDOT (Figure 3.5).

3.5 Optimized Load Critical Vehicles

28 steel girder bridges were tested in NCDOTs Wearable Inspection and Grading Information Network System (WGINS). Group 1 bridges consisted of sixteen bridges tested at varying levels of percent effectiveness and section modulus loss; group 2 bridges consisted of the twelve bridges tested at varying levels of percent effectiveness. The results of these tests were compiled to determine what effect the degradation of these bridge characteristics had on the posting vehicle for the bridge.

The rating factor for a vehicle is determined by dividing the operating/inventory weight by the gross vehicle weight. If any of the sixteen test vehicles returns an operating rating factor below 1.0, that bridge is determined to be weight restricted. The posting vehicle for a bridge is the vehicle with the lowest operating weight among the vehicles with an operating rating factor below 1.0.

Bridge effectiveness is listed in the bridge report as a percentage. This value is determined through subjective judgement by an NCDOT analyst based on the findings of a bridge inspection group. Section modulus refers to that value for the controlling steel girder of the bridge. This value cannot be directly adjusted in WIGINS, so the cross-sectional area of the girder was adjusted until the target section modulus value was obtained. WIGINS permits adjusting the percent effectiveness for most steel girder bridges but does not permit the user to adjust beam characteristics for bridges where the steel girder

```
        NORTH CAROLINA DEPARTMENT OF TRANSPORTATION - BRIDGE MAINTENANCE
                             ANALYSIS SECTION
--------------------------------------------------------------------------------
Bridge Number:          080037                  Date Of Rating:   09-21-2017
County:                 BLADEN                  Rated By:             WIGINS
Date Of Inspection:  09-21-2017                  Checked By:                 null
Roadway Width(Inspection ) :33.4             Deck Out to Out :       36.5

                             Load Factor Method
                          Noncomposite Beam Rating
--------------------------------------------------------------------------------
    Truck   Weight   Operating   Inventory LLmoment  Section             Controls
            tons         tons     tons      K-ft
        HS  15.00    36.2       21.7       290.80  Compact              Serviceability
--------------------------------------------------------------------------------
      SNSH  13.50    44.4       26.6       212.62  Compact              Serviceability
  SNGARBS2  20.00    54.3       32.6       258.64  Compact              Serviceability
  SNAGRIS2  22.00    59.1       35.5       262.27  Compact              Serviceability
  SNCOTTS3  27.25    45.0       27.0       422.88  Compact              Serviceability
  SNAGGRS4  34.92    52.2       31.3       467.43  Compact              Serviceability
     SNS5A  35.55    52.0       31.2       477.29  Compact              Serviceability
     SNS6A  39.95    55.8       33.5       500.33  Compact              Serviceability
     SNS7B  42.00    56.1       33.7       522.35  Compact              Serviceability
--------------------------------------------------------------------------------
  TNAGRIT3  33.00    57.0       34.2       404.25  Compact              Serviceability
     TNT4A  33.08    57.2       34.3       404.57  Compact              Serviceability
     TNT6A  41.60    62.1       37.3       467.89  Compact              Serviceability
     TNT7A  42.00    64.0       38.4       459.78  Compact              Serviceability
     TNT7B  42.00    64.5       38.7       455.11  Compact              Serviceability
  TNAGRIT4  43.00    65.3       39.2       460.30  Compact              Serviceability
   TNAGT5A  45.00    63.6       38.2       493.79  Compact              Serviceability
   TNAGT5B  45.00    61.0       36.6       516.10  Compact              Serviceability
--------------------------------------------------------------------------------
                           Non-Interstate Traffic
Component: I-beam I-Bm  Input:
Target Beam: Interior

I-Beam     = W24 x 130.0   % Effect   = 100.000 %     Fy         =   36000 psi
                                                     f'c        =   0.000 psi
Span       =  36.500 ft
Rdwy width =  34.000 ft    Deck mat'l =    NC conc    AWS thick  =   0.000 in
Deck width =  36.500 ft    Deck thick =   7.750 in    Lt ovrhng  =   2.750 ft
Beam Spcng (ft): 7.75       Buildup thick = 0.0in      Buildup width = 0.0in
Analyse At =  Max moment   Brace pt 1 =   0.000 ft
                          Brace pt 2 =   0.000 ft
Dist fact = 1.409

Computed by the program:
Non-compDL (#/ft) Beam   Deck  Rails  WSurf  Diaph   BU   SIP/Ex Total
                   130    751    48     0      9      0      0     938
   Impact + 1 = 1.3
```

Figure 3.7: WIGINS bridge analysis output for bridge #080037 at 100% effectiveness and 100% section modulus.

was reinforced with steel plates. As a result, group 1 bridges were tested at declining values of percent effectiveness and section modulus loss, and group 2 bridges were tested only for declining values of percent effectiveness. Section modulus was tested initially at 100%; subsequent tests were made at declining intervals of 5%, with the final test occurring at 70%. For group 1 bridges, effectiveness was initially tested at 100%; subsequent tests were made at declining intervals of 1%, with the final test occurring at 90%. For group 2 bridges, effectiveness was initially tested at the highest remaining value that resulted in all 16 vehicles receiving a rating factor of 1.0 or greater; subsequent tests were made at declining intervals of 1%, with the final test occurring once the rating factor for SNCOTTS3 fell below 1.0. Group 1 bridges ranged in span length from 19.5 feet to 56.9 feet. Group 2 bridges ranged in span length from 50.8 feet to 162.9 feet. Group 2 bridges were included, despite the user's inability to adjust the section modulus, to examine the effect of effectiveness loss on larger bridge spans.

3.6 Summary

Three methodologies were developed to optimize the list of legal vehicles used by NCDOT to load rate non-interstate bridges. The maximum moment analysis showed that the vehicles providing the smallest maximum bending moments were SNSH (non-interstate vehicles) and SH (interstate vehicles). For shorter spans, the vehicles providing the largest maximum bending moments were SNS7B (non-interstate vehicles) and S7B (interstate vehicles); for longer spans, the vehicles providing the largest maximum bending moments were TNAGT5B (non-interstate vehicles) and S7A (interstate vehicles). The

NCDOT bridge analysis showed that SNSH controlled in all tested conditions. The optimized load critical vehicle method was found to be the most effective at determining the controlling posting vehicles; results of this methodology are presented in Chapter 5.

Chapter 4: Automated Computer Program

4.1 Introduction

This computer program is designed to create possible truck configurations for varying axle combinations with varying lengths between the axles as allowed by the North Carolina Statutory Weights of Legal Vehicles as outlined in NC general statute § 20-118 (b)(3), and the Federal Bridge Formula. By imputing the North Carolina statutes distance and weights matrix and four axle distances, the program will generate possible truck combinations allowed by the statues. The following information will detail how to use the program and explain its outputs.

This computer program consists of three components:

- User Input File
- NC Statute Matrix
- Legal Truck Generation Program

The User Input File and NC Statute Matrix are text files, and the Legal Truck Generation Program is a program file written in the C programming language. The Legal Truck Generation Program reads the two text files and outputs a fourth component, the Truck Output File. This output file is a text file containing the trucks generated by the program, based on the parameters included in the input files.

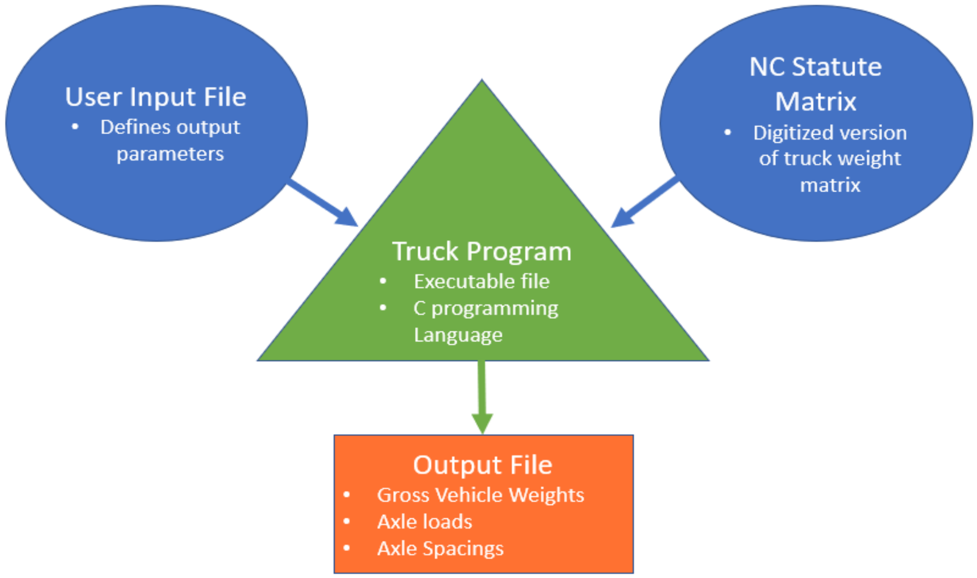

Figure 4.1: Legal truck generation program process visualization.

4.2 User Input File

The User Input File (ncst_in.txt) permits the user to define the output parameters of the truck program. This text file consists of six sections. In the first section, the user specifies which trucks will be in the output file through the use of a Boolean operator, as seen in Figure 4.2:

```
Single Vehicles
2 1
3 1
4 1
5 0
6 0
7 0
Tractor Trailers
3 0
4 0
5 1
6 1
7 1
```

Figure 4.2: User truck selection.

This section has two columns. The left column corresponds to the number of axles on the truck, and the right column is the Boolean operator for that truck type. If a truck axle combination has a value of 1, it will be included in the output file; if the value is zero, that truck combination will not be included in the output file. Running the truck program with an input file as shown in Figure 4.2 will return results for single vehicles with 2, 3, and 4 axles, and tandem trucks with 5, 6, and 7 axles.

The second section of the user input file gives the user the ability to dictate which formula will be used to generate the maximum legal weight for the trucks in the output file, as shown below in Figure 4.3. When a 1 is entered in this section, the maximum weight will be determined using the NC general statute; when a 0 is entered, the maximum weight will be determined using the Federal Bridge Formula.

```
Determination of Maximum Legal Weight. 1: NC statute; 0: Federal Bridge Formula (FBF)
1
```

Figure 4.3: Maximum gross weight calculation.

The third section permits the user to generate a range of axle combinations for each truck axle type. This is controlled with a single parameter in this section. If this parameter is equal to 1, a small number of axle combinations (termed “reduced”) will be generated. If this parameter is equal to 2, an intermediate number of axle combinations will be generated, and if the parameter is equal to 3, a large number of axle combinations will be generated. The number of trucks generated by the program also depends on the number of axles, and on whether the truck is a single vehicle or a tractor trailer. In its present form, the number of trucks generated by the program for each number of axles ranges from 3 (for single vehicle 2-axle configurations) to 1128 (for 7-axle tractor trailers with the "large" axle combination option).

The fourth section permits the user to specify a maximum truck weight corresponding to an exception (e.g., a weight that is not in the statute matrix) and a minimum truck length to apply the exception.

The fifth section of the user input file allows the user to specify the truck axle spacings that will be used to generate the trucks in the output file. There is a maximum of four different distances for each truck (a, b, c, d). Distances should be entered in terms of feet where 'a' is the smallest value, and values increase to 'd', the largest value. A different set of distances can be set for each truck type. These values can be changed by the user; however, it is important that the values are entered in ascending order, and that the smallest distance value corresponds to the distance between the axles in a tandem axle.

```
Specified distances between axles - SINGLE VEHICLE 2-axles
Number of distances
4
Actual distances
4.0 9.0 11.0 14.0
```

Figure 4.4: Sample axle spacings, single vehicle, two axles.

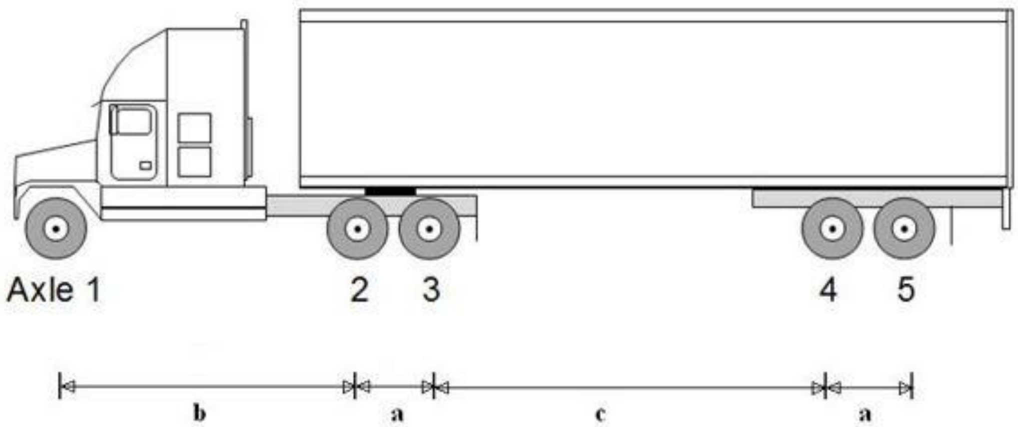

Figure 4.5: Truck axle spacing diagram with a/b/c distances.

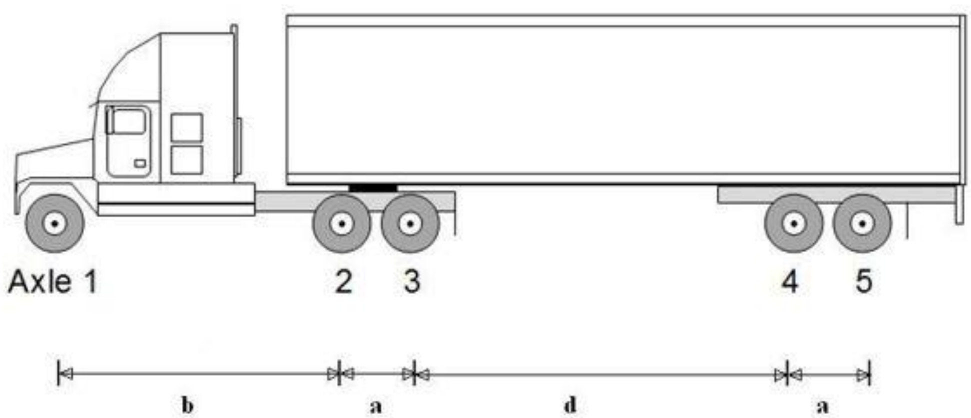

Figure 4.6: Truck axle spacing diagram with a/b/d distances.

Actual axle spacings and total truck length will be based on the values entered in the fifth section. Potential axle spacings, based on the a/b/c/d values, will remain constant; the variety of potential spacings will be based on the user selection of the "reduced," "intermediate," or "large" output file. An example of axle combinations for a reduced output of five axle tandem trucks is presented below in Figure 4.7.

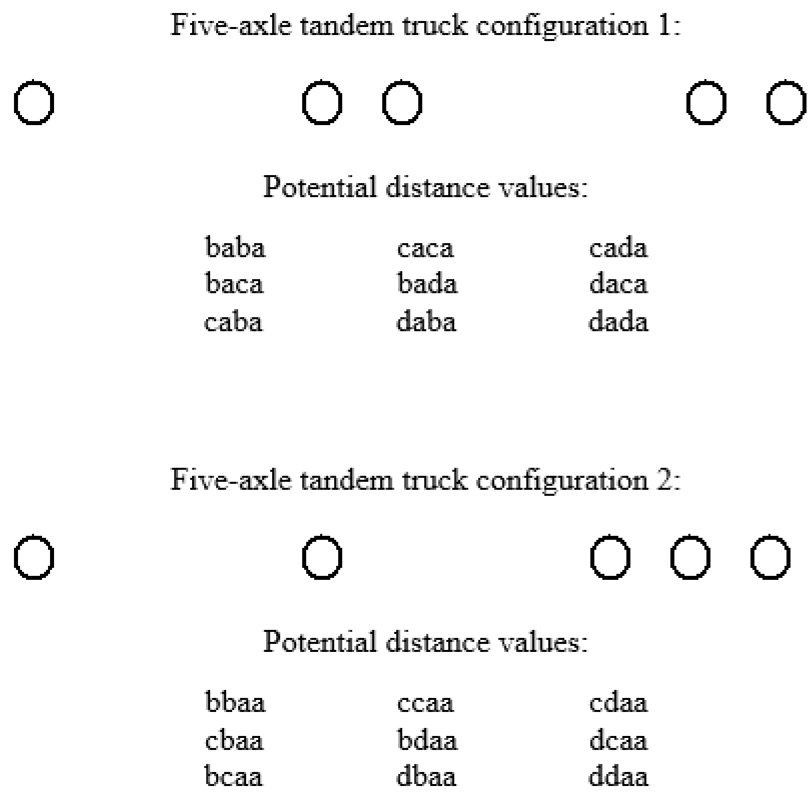

Figure 4.7: Example of axle combinations with distance values for a reduced output of five-axle tandem trucks.

The sixth section permits the user to enter the value for the bridge span used in the maximum bending moment calculations. This value is used by the program to calculate the maximum bending moment value for each generated vehicle.

The program utilized the influence line method to generate the maximum bending moment value for each generated vehicle at the user-specified span length. This method places one of the interior vehicle axles at the center of the span (Figure 4.8).

In the example presented in Figure 4.8 below, the five-axle truck has the axle distance combination of “b a c a.” According to the values in Figure 4.4, that represents spacings of 9 feet, 4 feet, 11 feet, and 4 feet, respectively. The length of the center influence line (originating at axle three and moving down to the x-axis) has a length equal to half of the span; for a 100 ft. span, the center influence line would represent 50 feet. The influence lines for the other axles have a length equal to half the span minus the distance between the specific axle and the center axle. For example, the influence line for A1 would have a length of 37 feet (50' – 4' – 9' = 37'). The bending moment for this vehicle would be calculated by multiplying the axle loads by the length of their influence lines and summing the totals.

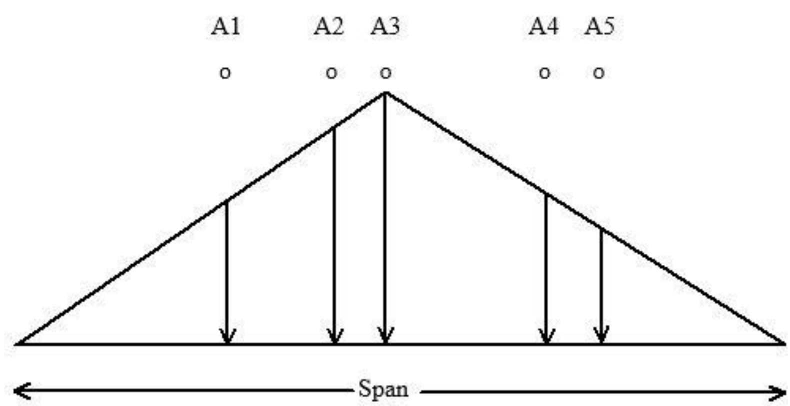

Figure 4.8: Graphic representation of influence line method of generating maximum bending moment.

Due to the variety of possible truck geometries, the program calculates multiple bending moments for tandem trucks with five or more axles. One calculation is made by placing axle 3 at midspan, and another is made by placing axle 4 at midspan. The program compares the results and returns the largest possible bending moment in the output file. This process is illustrated in the logic diagram presented below in Figure 4.9:

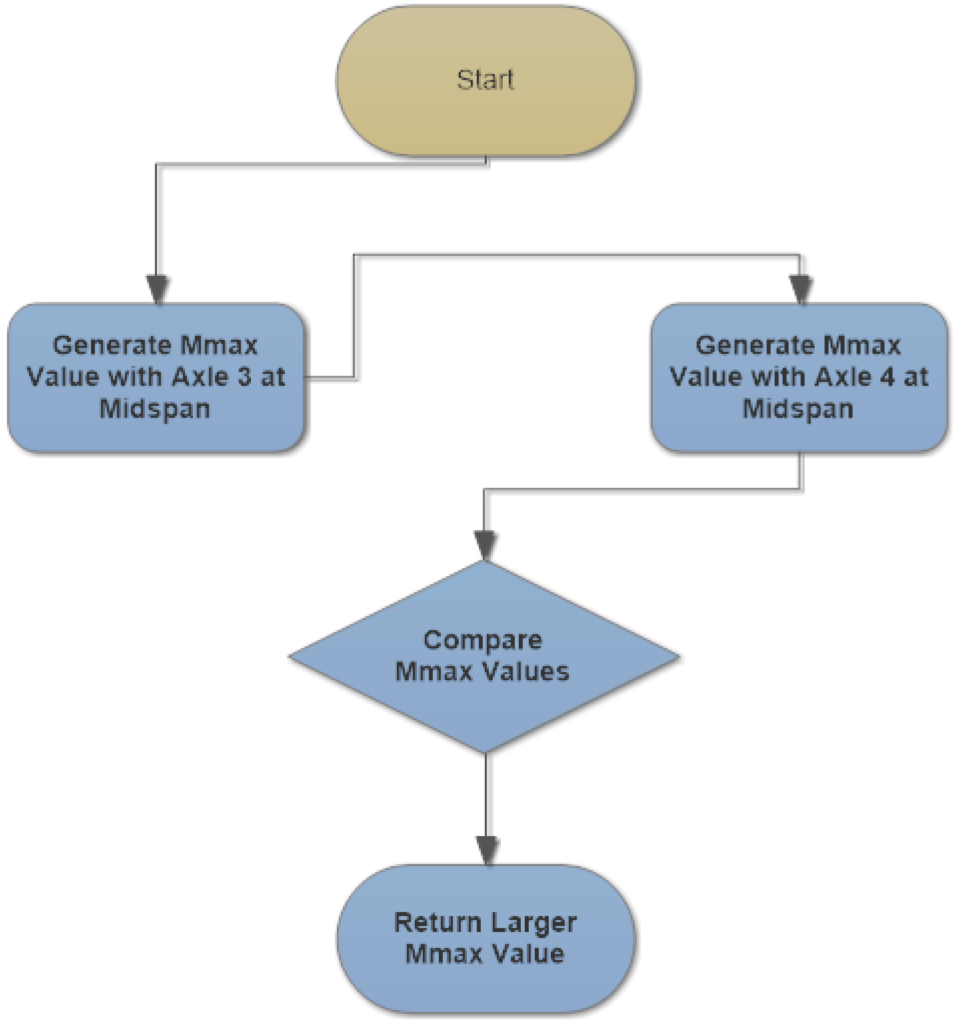

Figure 4.9: Maximum bending moment calculation logic diagram.

The coding language used to execute this process is shown below in Figure 4.10. The first maximum bending moment calculation begins on line 3870 with the third axle located at midspan, and follows the process shown in Figure 4.8 above. The second maximum bending moment calculation begins on line 3882; for this calculation, the fourth axle (Ax4 in Figure 4.8) is placed at midspan. Comparison of the two values occurs in lines 3894 through 3897.

```
// Calculating maximum bending moment
    for (jj = 1; jj <= n_trucks; jj++)
        {m_max1[jj] = ((trucks_array[jj][6] * 0.5 * ((span_half) - (trucks_array[jj][7]
                        + trucks_array[jj][9])))
            + (trucks_array[jj][8] * 0.5 * (span_half - trucks_array[jj][9]))
                        + (trucks_array[jj][10] * span_quarter)
            + (trucks_array[jj][12] * 0.5 * (span_half - trucks_array[jj][11]))
            + (trucks_array[jj][14] * 0.5 * (span_half - (trucks_array[jj][11]
                        + trucks_array[jj][13])))
            + (trucks_array[jj][16] * 0.5 * (span_half - (trucks_array[jj][11]
                        + trucks_array[jj][13] + trucks_array[jj][15])))
            + (trucks_array[jj][18] * 0.5 * (span_half - (trucks_array[jj][11]
                        + trucks_array[jj][13] + trucks_array[jj][15] + trucks_array[jj][17]))))/

        m_max2[jj] = ((trucks_array[jj][6] * 0.5 * ((span_half) - (trucks_array[jj][7]
                        + trucks_array[jj][9] + trucks_array[jj][11])))
            + (trucks_array[jj][8] * 0.5 * ((span_half) - (trucks_array[jj][9]
                        + trucks_array[jj][11])))
            + (trucks_array[jj][10] * 0.5 * ((span_half) - trucks_array[jj][11]))
                        + (trucks_array[jj][12] * (span_quarter))
            + (trucks_array[jj][14] * 0.5 * ((span_half) - trucks_array[jj][13]))
            + (trucks_array[jj][16] * 0.5 * ((span_half) - (trucks_array[jj][13]
                        + trucks_array[jj][15])))
            + (trucks_array[jj][18] * 0.5 * ((span_half) - (trucks_array[jj][13]
                        + trucks_array[jj][15] + trucks_array[jj][17]))))/1000;

        if (m_max1[jj] > m_max2[jj]) {
            m_max[jj] = m_max1[jj];
        }
        else {m_max[jj] = m_max2[jj];}
    }
```

Figure 4.10: Excerpt of truck program code that executes the maximum bending moment calculation.

4.3 NC Statute Matrix

The NC Statute Matrix (statute_weights.txt) consists of the matrix of maximum truck gross weight based on axle count and truck length found in NC §20-118 (b)(3), as shown in Figure 4.11.

The axles column in the statute matrix represents the distance between the front and rear axles of the truck. The matrix text file utilizes the value of -1 to represent a blank value, as a value of 0 would be included in the calculations, whereas a negative value would not.

Axles*	2 Axles	3 Axles	4 Axles	5 Axles	6 Axles	7 Axles
4	38000					
5	38000					
6	38000					
7	38000					
8 or less	38000	38000				
more than 8	38000	42000				
9	39000	42500				
10	40000	43500				
11		44000				
12		45000	50000			
13		45500	50500			
14		46500	51500			
15		47000	52000			
16		48000	52500	58000		
17		48500	53500	58500		
18		49500	54000	59000		
19		50000	54500	60000		
20		51000	55500	60500	66000	
21		51500	56000	61000	66500	
22		52500	56500	61500	67000	
23		53000	57500	62500	68000	
24		54000	58000	63000	68500	74000
25		54500	58500	63500	69000	74500
26		55500	59500	64000	69500	75000
27		56000	60000	65000	70000	75500
28		57000	60500	65500	71000	76500
29		57500	61500	66000	71500	77000
30		58500	62000	66500	72000	77500
31		59000	62500	67500	72500	78000
32		60000	63500	68000	73000	78500
33			64000	68500	74000	79000
34			64500	69000	74500	80000
35			65500	70000	75000	
36			66000**	70500	75500	
37			66500**	71000	76000	
38			67500**	72000	77000	
39			68000	72500	77500	
40			68500	73000	78000	
41			69500	73500	78500	
42			70000	74000	79000	
43			70500	75000	80000	
44			71500	75500		
45			72000	76000		
46			72500	76500		
47			73500	77500		
48			74000	78000		
49			74500	78500		
50			75500	79000		
51			76000	80000		
52			76500			
53			77500			
54			78000			
55			78500			
56			79500			
57			80000			

```
Distance - weights matrix
0.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
1.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
2.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
3.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
4.0 38000.0 -1.0 -1.0 -1.0 -1.0 -1.0
5.0 38000.0 -1 -1 -1 -1 -1
6.0 38000.0 -1 -1 -1 -1 -1
7.0 38000.0 -1 -1 -1 -1 -1
7.5 38000.0 38000.0 -1 -1 -1 -1
8.0 38000.0 38000.0 -1 -1 -1 -1
8.5 38000.0 42000.0 -1 -1 -1 -1
9.0 39000.0 42500.0 -1 -1 -1 -1
10 40000 43500 -1 -1 -1 -1
11 -1 44000 -1 -1 -1 -1
12 -1 45000 50000 -1 -1 -1
13 -1 45500 50500 -1 -1 -1
14 -1 46500 51500 -1 -1 -1
15 -1 47000 52000 -1 -1 -1
16 -1 48000 52500 58000 -1 -1
17 -1 48500 53500 58500 -1 -1
18 -1 49500 54000 59000 -1 -1
19 -1 50000 54500 60000 -1 -1
20 -1 51000 55500 60500 66000 -1
21 -1 51500 56000 61000 66500 -1
22 -1 52500 56500 61500 67000 -1
23 -1 53000 57500 62500 68000 -1
24 -1 54000 58000 63000 68500 74000
25 -1 54500 58500 63500 69000 74500
26 -1 55500 59500 64000 69500 75000
27 -1 56000 60000 65000 70000 75500
28 -1 57000 60500 65500 71000 76500
29 -1 57500 61500 66000 71500 77000
30 -1 58500 62500 66500 72000 77500
31 -1 59000 62500 67500 72500 78000
32 -1 60000 63500 68000 73000 78500
33 -1 -1 64000 68500 74000 79000
34 -1 -1 64500 69000 74500 80000
35 -1 -1 65500 70000 75000 -1
36 -1 -1 67999 70500 75500 -1
37 -1 -1 67999 71000 76000 -1
38 -1 -1 67999 72000 77000 -1
39 -1 -1 68000 72500 77500 -1
40 -1 -1 68500 73000 78000 -1
41 -1 -1 69500 73500 78500 -1
42 -1 -1 70000 74000 79000 -1
43 -1 -1 70500 75000 80000 -1
44 -1 -1 71500 75500 -1 -1
45 -1 -1 72000 76000 -1 -1
46 -1 -1 72500 76500 -1 -1
47 -1 -1 73500 77500 -1 -1
48 -1 -1 74000 78000 -1 -1
49 -1 -1 74500 78500 -1 -1
50 -1 -1 75500 79000 -1 -1
51 -1 -1 76000 80000 -1 -1
52 -1 -1 76500 -1 -1 -1
53 -1 -1 77500 -1 -1 -1
54 -1 -1 78000 -1 -1 -1
55 -1 -1 78500 -1 -1 -1
56 -1 -1 79500 -1 -1 -1
57 -1 -1 80000 -1 -1 -1
```

Figure 4.11: Maximum truck gross weight as seen in NC §20-118 (b)(3) (left image), and as seen in statute_weights.txt (right image)

4.4 Output File

When the truck program is executed, an output file is produced (Trucks_out.txt). This output file displays a list of generated trucks based on the parameters set by the user in the input file. Trucks are assigned an output number, and values are listed for the following variables (all distances are feet, all loads are pounds, all moments are in pounds feet):

Axls:	Number of axles present on generated truck
Lngth:	Distance between first and last axle
NCS:	Maximum gross truck weight based on NC general statute matrix
Weight:	Sum of axle loads for generated truck
Ax1:	Axle load for the first axle on generated truck (Ax2 = 2^{nd} axle, etc.)
d1:	Distance between first and second axle for generated truck (d2 = distance between second and third axle, etc.)
Mmax:	Maximum bending moment calculated for generated truck on the span specified in the user input file, calculated by influence line method
Span:	Span length specified in the user input file

NORTH CAROLINA SINGLE VEHICLE 3-AXLE POSSIBLE TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	Mmax	Span
1	3	13	45500	45500	15833	9	14833	4	14833	1036	100
2	3	15	47000	47000	16333	11	15333	4	15333	1054	100
3	3	18	49500	49500	17167	14	16167	4	16167	1085	100

Figure 4.12: Sample output file, single vehicle, three-axles

Some constraints were placed on the potential truck configurations. As mentioned above, the shortest distance between axles (the 'a' distance) is used for all tandem axles; additionally, the 'a' distance is excluded from use as the distance between the first and second axles. For single vehicles with 3, 4, or 5 axles, all axle distances past axle two were considered tandem axles; for single vehicles with 6 or 7 axles, all axle distances except the first and last were considered tandem axles. For tandem trucks with three axles, no axle spacings were considered tandem axles; for tandem trucks with five axles, the last axle spacing was considered to be tandem axles. For tandem trucks with six axles, the last three axles were considered tandem axles; for tandem trucks with seven axles, axles 2 and 3 as well as axles 6 and 7 were considered tandem axles. These constraints are hard-coded into the program itself.

Chapter 5: Results

5.1 Introduction

The results presented in this thesis cover two subjects. The first subject is a comparison of the legal vehicles and the North Carolina general statute governing truck weights and the exceptions delineated within. The second subject presents the results of the optimized load critical vehicle methodology, in which twenty-eight steel girder bridges were tested in NCDOTs Wearable Inspection and Grading Information Network System (WGINS). Group 1 bridges consisted of sixteen bridges tested at of percent effectiveness beginning at 100% and declining in intervals of 1% until 90% was reached, and section modulus beginning at 100% and declining in intervals of 5% until 70% was reached. Each group 1 bridge was subjected to 77 tests, for a total of 1232 tests performed on group 1 bridges. Group 2 bridges consisted of the twelve bridges tested at varying levels of percent effectiveness. Testing began at the highest level of effectiveness that resulted in no vehicles recording an operating rating factor below 1.0 and decreased in intervals of 1% until the operating rating factor for SNCOTTS3 fell below 1.0; the only exception was bridge #590126, which had multiple vehicles with an operating rating factor below 1.0 at 100% efficiency. A total of 155 tests were performed on group 2 bridges. The results of these tests were compiled to determine what effect the degradation of these bridge characteristics had on the posting vehicle for the bridge.

5.2 Non-Compliant Legal Vehicle

A comparison of North Carolina general statute §20-118(b)(3) and the list of 16 legal vehicles utilized by NCDOT to load rate non-interstate bridges reveals that one of the legal vehicles does not comply with the general statute. SNCOTTS3 has a total length of 15 ft. and a gross weight of 54,500 lbs., as shown in Figure 5.1. According to the stature, as shown in Figure 2.2 (page 8), the maximum weight for a vehicle with three axles and a length of 15 ft. is 47,000 lbs.

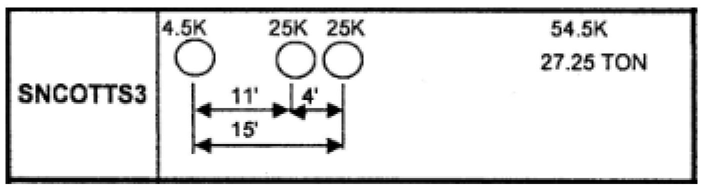

Figure 5.1: SNCOTTS3 axle loads and geometry.

SNCOTTS3 represents a cotton truck, and cotton trucks have a weight exception written into the statue, as shown below in Figure 5.2. However, that exception only covers the tandem axle weight, and does not provide an exception for gross vehicle weight. According to North Carolina general statute §20-118(k):

> *"A vehicle which is equipped with a self-loading bed and which is designed and used exclusively to transport compressed seed cotton from the farm to a cotton gin, or sage to market, may operate on the highways of the State, except interstate highways, with a tandem-axle weight not exceeding 50,000 pounds."*

To bring the legal vehicle representing cotton trucks into compliance with current law, the gross weight of the vehicle would have to be reduced to 47,000 lbs., or the vehicle length would have to be increased to 25 ft.

5.3 Group 1 Bridges

Group 1 bridges were found to have a consistent progression of emerging posting vehicles. In general, the operating rating factors dropped below 1.0 in a progression consistent with the vehicles' gross weights; the heaviest vehicles saw their operating rating factor drop below 1.0 first, and the rest followed in order of declining gross vehicle weight. Consequently, the heaviest vehicle in any categorization group would be the initial posting vehicle and would remain so until the next lightest vehicle's operating rating factor dropped below 1.0, at which point the lighter vehicle would become the posting vehicle.

The eight single unit legal vehicles exhibit relatively large gaps in gross vehicle weight, with one exception, as seen in Figure 3.5 (page 33). With the exception of SNAGGRIS4, each subsequent vehicle is a minimum of two tons lighter than the preceding vehicle. As a result, the progression of posting vehicles follows the declining rating vehicles, beginning with SNS7B and continuing through the cotton truck SNCOTTS3. After the cotton truck, the next two lighter two-axle vehicles have significantly higher operating weights, and the lightest vehicle, SNSH, has the lowest operating weight of all tested legal vehicles.

Figure 5.2 displays the posting single unit vehicle for all tested conditions on bridge #220015. The progression mentioned above is visible for both methods of bridge

Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	40.6	37.5	33.1	30.3	25.1	22.5
	99	#N/A	SNS6A	SNS5A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	39.9	35.5	32.6	29.8	24.7	22.1
	98	#N/A	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	39.3	34.9	32.1	26.9	24.3	21.7
	97	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.7	38.7	34.4	31.6	26.5	23.9	21.4
	96	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.1	38.1	33.9	31.1	26.0	23.5	21.0
	95	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		40.5	37.5	33.3	30.6	25.6	23.1	20.6
	94	SNS7B	SNS5A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		40.5	35.5	32.8	30.1	25.1	22.7	20.2
	93	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		39.1	34.9	32.2	27.1	24.7	22.3	19.8
	92	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.5	34.3	31.7	26.7	24.3	21.8	19.4
	91	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.9	33.8	31.2	26.2	23.8	21.4	19.0
	90	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.3	33.2	30.6	25.7	23.4	21.0	18.7

Figure 5.2: Posting single unit vehicles with operating weights for bridge #220015.

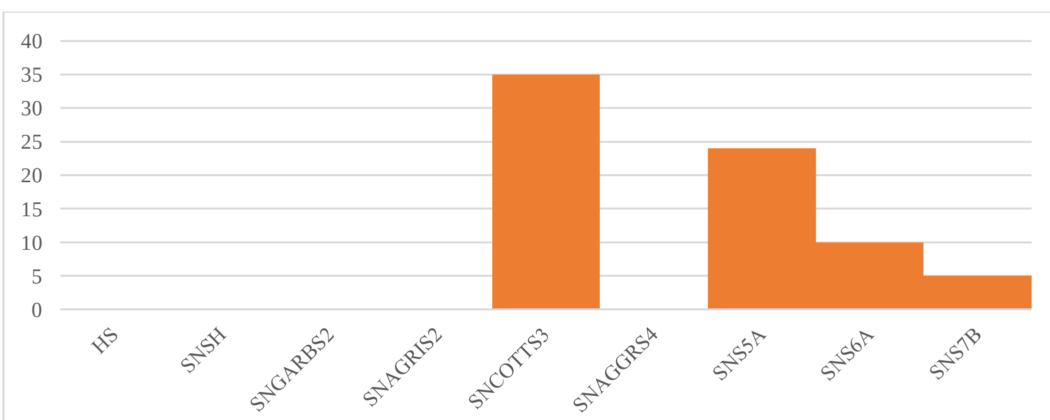

Figure 5.3: Posting frequency of single unit vehicles for bridge #220015.

degradation. At 100% efficiency, SNS7B emerged as the posting vehicle at 95% section modulus. At that testing condition, only SNS7B had an operating rating factor below 1.0. The operating rating factor for SNS6A fell below 1.0 at 90% section modulus; with a lower operating weight than SNS7B, SNS6A became the posting vehicle at this condition. SNS5A emerged at 85% section modulus, and SNCOTTS3 became the posting vehicle at 75%. This same pattern can be seen reading Figure 5.2 vertically; at 95% section modulus, SNS7B was the posting vehicle at 100% efficiency, but SNS7B gave way to SNS6A at 99% effectiveness, and SNS5A emerged at 94% effectiveness.

Figure 5.3 shows the controlling frequency for each single unit vehicle during the tests on bridge #220015. SNCOTTS3 was the posting vehicle for 35 of the conditions tested, SNS5A was the posting vehicle for 24 of the conditions tested, SNS6A was the posting vehicle for 10 of the conditions tested, and SNS7B was the posting vehicle for 5 of the conditions tested. As seen in Figure 5.2, there was no posting vehicle for three of the conditions tested.

The consistent pattern in group 1 for single unit vehicles is SNS7B > SNS6A > SNS5A > SNCOTTS3 > SNSH. This pattern can be seen in Figure 5.4.

Gaps or omissions in this progression present in Figure 5.5 occur for one of several reasons:

- The state of the bridge is such that, when examined at 100% effectiveness and 100% section modulus, multiple single unit vehicles already have an operating rating factor below 1.0. This occurs for bridges 490054, 100309, 310089, 010003, 310008, 240138, 220025, and 480189.

Bridge #	Length	Progression of controlling SU Rating Vehicle				
		First --->				---> Last
490054	19.5		SNS6A		SNCOTTS3	
350022	25.0	SNS7B	SNS6A	SNS5A	SNCOTTS3	
100309	26.7				SNCOTTS3	
310089	30.1				SNCOTTS3	SNSH
10003	34.3				SNCOTTS3	SNSH
80037	36.5	SNS7B	SNS6A	SNS5A	SNCOTTS3	
310008	37.0				SNCOTTS3	SNSH
110105	38.3	SNS7B	SNS6A	SNS5A	SNCOTTS3	
100152	39.0	SNS7B				
240138	39.0		SNS6A	SNS5A	SNCOTTS3	
590054	39.5	SNS7B	SNS6A	SNS5A	SNCOTTS3	
330276	41.0	SNS7B	SNS6A	SNS5A		
220025	44.1			SNS5A	SNCOTTS3	
430003	53.6	SNS7B	SNS6A	SNS5A		
220015	56.4	SNS7B	SNS6A	SNS5A	SNCOTTS3	
480189	56.9				SNCOTTS3	SNSH

Figure 5.4: Posting single unit vehicles from group 1 set, including progression.

- The state of the bridge is such that, at the lowest values tested for % effectiveness and section modulus loss, there remain vehicles in the progression with operating rating factors above 1.0. This happens frequently relating to vehicle SNSH, which has an operating weight well below that of SNCOTTS3. This occurs for larger vehicles for bridges 100152, 330276, and 430003.
- Integer increments of section modulus loss or effectiveness loss obscure a vehicle that would otherwise control. This occurs for bridge 490054.

According to the data presented in Figure 5.5, at 99% effectiveness/100% section modulus, both SNCOTTS3 and SNS5A had operating rating values above 1.0; at 98% effectiveness/100% section modulus, both had operating rating values below 1.0. In both instances, the operating rating value for SNS5A was lower than that for SNCOTTS3; it is

	Vehicle Weight	Operating Weight	Inventory Weight	Calculated OPER RF	Calculated INV RF		Vehicle Weight	Operating Weight	Inventory Weight	Calculated OPER RF	Calculated INV RF
HS	15.00	25.3	15.2	1.687	1.013	HS	15.00	25.0	15.0	1.667	1.000
SNSH	13.50	24.9	14.9	1.844	1.104	SNSH	13.50	24.6	14.8	1.822	1.096
SNGARBS2	20.00	34.5	20.7	1.725	1.035	SNGARBS2	20.00	34.1	20.5	1.705	1.025
SNAGRIS2	22.00	40.5	24.3	1.841	1.105	SNAGRIS2	22.00	40.1	24.0	1.823	1.091
SNCOTTS3	27.25	27.4	16.5	1.006	0.606	SNCOTTS3	27.25	27.1	16.3	0.994	0.598
SNAGGRS4	34.92	35.8	21.5	1.025	0.616	SNAGGRS4	34.92	35.4	21.2	1.014	0.607
SNS5A	35.55	35.6	21.3	1.001	0.599	SNS5A	35.55	35.2	21.1	0.990	0.594
SNS6A	39.95	38.9	23.3	0.974	0.583	SNS6A	39.95	38.5	23.1	0.964	0.578
SNS7B	42.00	40.9	24.5	0.974	0.583	SNS7B	42.00	40.4	24.3	0.962	0.579
TNAGRIT3	33.00	51.6	31.0	1.564	0.939	TNAGRIT3	33.00	51.1	30.6	1.548	0.927
TNT4A	33.08	39.0	23.4	1.179	0.707	TNT4A	33.08	38.6	23.2	1.167	0.701
TNT6A	41.60	44.0	26.4	1.058	0.635	TNT6A	41.60	43.5	26.1	1.046	0.627
TNT7A	42.00	47.3	28.4	1.126	0.676	TNT7A	42.00	46.8	28.1	1.114	0.669
TNT7B	42.00	42.7	25.6	1.017	0.610	TNT7B	42.00	42.2	25.3	1.005	0.602
TNAGRIT4	43.00	49.0	29.4	1.140	0.684	TNAGRIT4	43.00	48.4	29.1	1.126	0.677
TNAGT5A	45.00	51.2	30.7	1.138	0.682	TNAGT5A	45.00	50.7	30.4	1.127	0.676
TNAGT5B	45.00	51.5	30.9	1.144	0.687	TNAGT5B	45.00	50.9	30.5	1.131	0.678
	% eff	0.99					% eff	0.98			
	Sx =	1.0					Sx =	1.0			

Figure 5.5: Analysis results for bridge 490054 at 99% effectiveness/100% section modulus (left) and 98% effectiveness/100% section modulus (right).

therefore reasonable to conclude the operating rating factor for SNS5A would fall below 1.0 before that of SNCOTTS3, and SNS5A would control for a value of % effectiveness between 88% and 98%.

Compared to the single unit vehicles, the seven tandem trucks showed a lower degree of stratification of gross weights, as shown in Figure 3.5 (page 33). TNAGRIT3 and TNT4A are separated by 160 pounds; both five axle trucks, and both seven axle trucks, have identical gross weights; and TNT6A is only 800 pounds lighter than either of the seven axle trucks.

Figure 5.6 displays the posting tandem truck for all tested conditions on bridge #240138. At 100% efficiency/100% section modulus, only TNAGT5A and TNAGT5B had operating rating factors below 1.0; as TNAGT5B consistently had a lower operating weight than TNAGT5A, it was the posting vehicle at 100% efficiency/100% section modulus. As

Tandem Trucks								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		41.3	38.6	35.9	31.2	28.7	26.2	23.7
	99	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		40.7	38.1	35.4	30.8	28.3	25.8	23.3
	98	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		40.2	37.6	32.8	30.4	27.9	25.4	22.9
	97	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		39.6	37.1	32.3	29.9	27.5	25.0	22.6
	96	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		39.1	36.5	31.9	29.5	27.1	24.6	22.2
	95	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		38.5	36.0	31.4	29.0	26.6	24.3	21.9
	94	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		38.0	35.5	31.0	28.6	26.2	23.9	21.5
	93	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		37.4	32.8	30.5	28.2	25.8	23.5	21.1
	92	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		36.9	32.3	30.0	27.7	25.4	23.1	20.8
	91	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		36.4	31.9	29.6	27.3	25.0	22.7	20.4
	90	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		35.8	31.4	29.1	26.8	24.6	22.3	20.1

Figure 5.6: Posting tandem trucks with operating weights for bridge #240138.

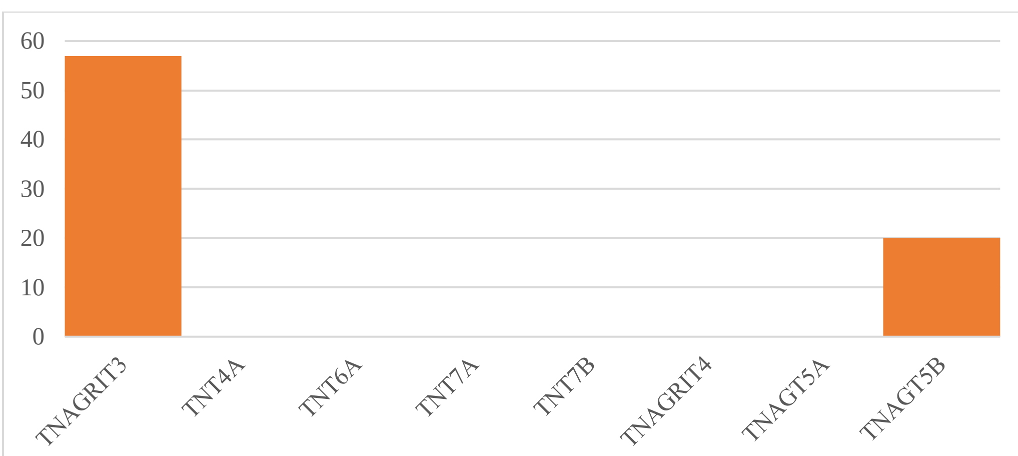

Figure 5.7: Posting frequency of tandem trucks for bridge #240138.

with the single unit vehicles, the progression displayed in Figure 5.6 is evident both horizontally and vertically. At 100% efficiency, TNAGT5B was the posting vehicle until 85% section modulus was tested. From that condition through all remaining declining values of section modulus, TNAGRIT3 was the posting vehicle. At 95% section modulus, TNAGT5B was the posting vehicle at 100% efficiency, and TNAGRIT3 emerged as the posting vehicle at 93% efficiency and remained the posting vehicle for all subsequent declining values of % efficiency.

Figure 5.7 shows the controlling frequency for each tandem truck during the tests on bridge # 240138. TNAGT5B was the posting vehicle for 20 of the conditions tested, and TNAGRIT3 was the posting vehicle for 57 of the conditions tested.

Two progression patterns are present for tandem trucks on group 1 bridges, as shown below in Figure 5.8. For spans below 31 feet, the pattern for tandem trucks is TNT7B > TNT4A; for spans above 31 feet, the pattern is TANGT5B > TNAGRIT3.

Omissions from these patterns present in Figure 5.7 occur for the following reasons:

- The state of the bridge is such that, when examined at 100% effectiveness and 100% section modulus, multiple tandem trucks already have an operating rating factor below 1.0. This occurs for bridges 310089 and 480189.
- The state of the bridge is such that, at the lowest values tested for % effectiveness and section modulus loss, there remain vehicles in the progressions with operating rating factors above 1.0. This occurs for bridges 330276 and 430003. This also

occurs for bridge 100152, for which none of the tandem trucks recorded an operating rating factor below 1.0.

Bridge #	Length	Progression of controlling TT Rating Vehicle			
		First --->			---> Last
490054	19.5		TNT7B	TNT4A	
350022	25.0		TNT7B	TNT4A	
100309	26.7		TNT7B	TNT4A	
310089	30.1			TNT4A	
10003	34.3				TNAGRIT3
80037	36.5	TNAGT5B			TNAGRIT3
310008	37.0				TNAGRIT3
110105	38.3	TNAGT5B			TNAGRIT3
100152	39.0				
240138	39.0	TNAGT5B			TNAGRIT3
590054	39.5	TNAGT5B			TNAGRIT3
330276	41.0	TNAGT5B			
220025	44.1	TNAGT5B			TNAGRIT3
430003	53.6	TNAGT5B			
220015	56.4	TNAGT5B			TNAGRIT3
480189	56.9				TNAGRIT3

Figure 5.8: Posting tandem trucks from group 1 set, including progression.

5.4 Group 2 Bridges

Group 2 bridges generally followed then same progression pattern as the group 1 bridges, with some minor differences and inclusions. Single unit vehicles continue to follow the pattern SNS7A > SNS6A > SNS5A > SNCOTTS3, although SNAGGRS4 does appear as a posting vehicle on three of the bridges (Figure 5.9). As seen in the group 1 bridges, there is an instance where the bridge condition is such that multiple vehicles have

Bridge #	Length	Progression of controlling SV Rating Vehicle				
		First --->				---> Last
330305	50.8	SNS7B	SNS6A	SNS5A		SNCOTTS3
330049	55.3	SNS7B	SNS6A	SNS5A		SNCOTTS3
330048	63.8	SNS7B	SNS6A	SNS5A		SNCOTTS3
330302	69.6	SNS7B	SNS6A	SNS5A		SNCOTTS3
500062	71.2	SNS7B	SNS6A	SNS5A		SNCOTTS3
840010	74.9	SNS7B	SNS6A	SNS5A	SNAGGRS4	SNCOTTS3
590404	91.9	SNS7B	SNS6A	SNS5A		SNCOTTS3
590169	97.7	SNS7B	SNS6A	SNS5A		SNCOTTS3
590126	111.6			SNS5A	SNAGGRS4	SNCOTTS3
90096	119.3	SNS7B	SNS6A	SNS5A		SNCOTTS3
590516	121.1	SNS7B	SNS6A	SNS5A		SNCOTTS3
590182	162.9		SNS6A		SNAGGRS4	SNCOTTS3

Figure 5.9: Posting single unit vehicles from group 2 set, including progression.

an operating rating factor below 1.0 at the maximum values for % effectiveness and section modulus; this occurs for bridge 590126. There is also a bridge where a gap in the progression occurs when multiple vehicles have an operating rating factor fall below 1.0 at the same time; this occurs for bridge 590182 as the % effectiveness falls from 58% to 57%. As seen previously, if the change in effectiveness occurs below the level of whole integers, SNS7B would control at a point between 58% and 57% effectiveness.

Progression for the group 2 tandem trucks follows the pattern evident in the longer group 1 bridges, TNAGT5B > TNAGRIT3, although again a few other vehicles appeared in the intermediate range (Figure 5.10). Of interest is the reemergence of TNT4A as a posting vehicle over TNAGRIT3 on two of the longer spans, something previously seen in spans shorter than 30.1 feet; this occurs for bridge 590169 and 590182, where the operating weight for TNT4A is consistently lower than the operating weight for TNAGRIT3. Additional posting tandem trucks present in group 2 include TNT6A and TNAGRIT4.

Bridge #	Length	Progression of controlling TT Rating Vehicle				
		First --->				---> Last
330305	50.8	TNAGT5B				TNAGRIT3
330049	55.3	TNAGT5B				TNAGRIT3
330048	63.8	TNAGT5B				TNAGRIT3
330302	69.6	TNAGT5B				TNAGRIT3
500062	71.2	TNAGT5B				TNAGRIT3
840010	74.9	TNAGT5B				TNAGRIT3
590404	91.9	TNAGT5B				TNAGRIT3
590169	97.7	TNAGT5B			TNT4A	
590126	111.6	TNAGT5B				TNAGRIT3
90096	119.3	TNAGT5B		TNT6A		TNAGRIT3
590516	121.1	TNAGT5B		TNT6A		TNAGRIT3
590182	162.9	TNAGT5B	TNAGRIT4		TNT4A	

Figure 5.10: Posting tandem trucks from group 2 set, including progression.

The additional posting trucks present in the group 2 analysis can all be considered redundant. Three group 2 bridges have an additional posting single unit vehicle, SNAGGRIS4. This vehicle controls whenever it has an operating weight equal to or less than that of SNS5A. For the three bridges where SNAGGRIS4 appears in the posting progression, the difference in operating weight between it and SNS5A is never more than 200 lbs., as seen in Figure 5.11 below:

840010		
% Eff	Vehicle	OP Weight (k*ft)
55	SNAGGRS4	31.5
	SNS5A	31.4
54	SNAGGRS4	30.9
	SNS5A	30.9
53	SNAGGRS4	30.4
	SNS5A	30.3

590126		
% Eff	Vehicle	OP Weight (k*ft)
98	SNAGGRS4	33.2
	SNS5A	33.1
97	SNAGGRS4	32.4
	SNS5A	32.4
96	SNAGGRS4	31.7
	SNS5A	31.6

590182		
% Eff	Vehicle	OP Weight (k*ft)
55	SNAGGRS4	33.9
	SNS5A	33.9
54	SNAGGRS4	31.3
	SNS5A	31.4
53	SNAGGRS4	28.8
	SNS5A	28.8

Figure 5.11: Operating weight comparison for group 2 single unit vehicles.

In all three instances where SNAGGRS4 appears in Figure 5.11, it only temporarily controls over SNS5A when the weight difference between the two vehicles is less than 100 lbs., and the total operating weight difference between the two in all testing conditions never rises above 200 lbs.

Three group 2 bridges have one of two additional posting tandem trucks, TNT6A and TNAGRIT4 (Figure 5.10). As seen before with the single unit vehicles, these two additional vehicles only control when they have an operating weight within 200 lbs. of another vehicle that typically controls, as shown in Figure 5.12 below:

90096		
% Eff	Vehicle	OP Weight (k*ft)
55	TNT6A TNAGT5B	38.8 38.7
54	TNT6A TNAGT5B	37.0 37.0
53	TNT6A TNAGT5B	35.3 35.3
52	TNT6A TNAGT5B	33.6 33.5

590516		
% Eff	Vehicle	OP Weight (k*ft)
53	TNT6A TNAGT5B	42.7 42.6
52	TNT6A TNAGT5B	40.6 40.6
51	TNT6A TNAGT5B	38.6 38.5
50	TNT6A TNAGT5B	36.5 36.5
49	TNT6A TNAGT5B	34.4 34.4
48	TNT6A TNAGT5B	32.4 32.3

590182		
% Eff	Vehicle	OP Weight (k*ft)
57	TNAGRIT4 TNAGT5B	40.1 40.0
56	TNAGRIT4 TNAGT5B	37.4 37.4
55	TNAGRIT4 TNAGT5B	34.8 34.7

Figure 5.12: Operating weight comparison for group 2 tandem trucks.

TNT6A appears in the progression of posting vehicles on two bridges, and only in instances where the operating weight of that vehicle is within 200 lbs. of an established posting vehicle, TNAGT5B. For bridge 590516, TNT6A appears twice, in non-contiguous

Group 1 Totals		Group 2 Totals		All Bridge Totals	
All Vehicles		**All Vehicles**		**All Vehicles**	
Vehicle	Count	Vehicle	Count	Vehicle	Count
HS	0	HS	0	HS	0
SNSH	53	SNSH	0	SNSH	0
SNGARBS2	0	SNGARBS2	0	SNGARBS2	0
SNAGRIS2	0	SNAGRIS2	0	SNAGRIS2	0
SNCOTTS3	672	SNCOTTS3	21	SNCOTTS3	92
SNAGGRS4	0	SNAGGRS4	5	SNAGGRS4	5
SNS5A	122	SNS5A	64	SNS5A	82
SNS6A	54	SNS6A	27	SNS6A	39
SNS7B	40	SNS7B	18	SNS7B	23
TNAGRIT3	0	TNAGRIT3	0	TNAGRIT3	0
TNT4A	0	TNT4A	0	TNT4A	0
TNT6A	0	TNT6A	0	TNT6A	0
TNT7A	0	TNT7A	0	TNT7A	0
TNT7B	0	TNT7B	0	TNT7B	0
TNAGRIT4	0	TNAGRIT4	0	TNAGRIT4	0
TNAGT5A	0	TNAGT5A	0	TNAGT5A	0
TNAGT5B	4	TNAGT5B	10	TNAGT5B	11
Single Unit		**Single Unit**		**Single Unit**	
Vehicle	Count	Vehicle	Count	Vehicle	Count
HS	0	HS	0	HS	0
SNSH	53	SNSH	0	SNSH	0
SNGARBS2	0	SNGARBS2	0	SNGARBS2	0
SNAGRIS2	0	SNAGRIS2	0	SNAGRIS2	0
SNCOTTS3	672	SNCOTTS3	21	SNCOTTS3	92
SNAGGRS4	0	SNAGGRS4	5	SNAGGRS4	5
SNS5A	122	SNS5A	64	SNS5A	84
SNS6A	54	SNS6A	27	SNS6A	37
SNS7B	40	SNS7B	18	SNS7B	23
Tandem Trucks		**Tandem Trucks**		**Tandem Trucks**	
Vehicle	Count	Vehicle	Count	Vehicle	Count
TNAGRIT3	428	TNAGRIT3	42	TNAGRIT3	80
TNT4A	246	TNT4A	8	TNT4A	29
TNT6A	0	TNT6A	6	TNT6A	6
TNT7A	0	TNT7A	0	TNT7A	0
TNT7B	48	TNT7B	0	TNT7B	12
TNAGRIT4	0	TNAGRIT4	1	TNAGRIT4	1
TNAGT5A	0	TNAGT5A	0	TNAGT5A	0
TNAGT5B	206	TNAGT5B	87	TNAGT5B	113

Figure 5.13: Total occurrences for posting vehicles across all bridge tests.

levels of % effectiveness, and only controls when that vehicle has an operating weight within 100 lbs. of TNAGT5B. TNAGRIT4 only appears in the posting progression once, on one bridge, and that occurs when hat vehicle has an operating weight within 100 lbs. of TNAGT5B.

5.5 Posting Vehicle Frequency

In Figure 5.12, the total counts for posting vehicles across all bridge tests conducted in WIGINS is displayed; the total counts for single unit vehicles is displayed in Figure 5.13, and the total counts for tandem trucks us displayed in Figure 5.14. Group 1 totals reflect tests executed on group 1 bridges for all declining values of % effectiveness and section modulus loss; for the 16 bridges analyzed, this returned a total of 1232 possible

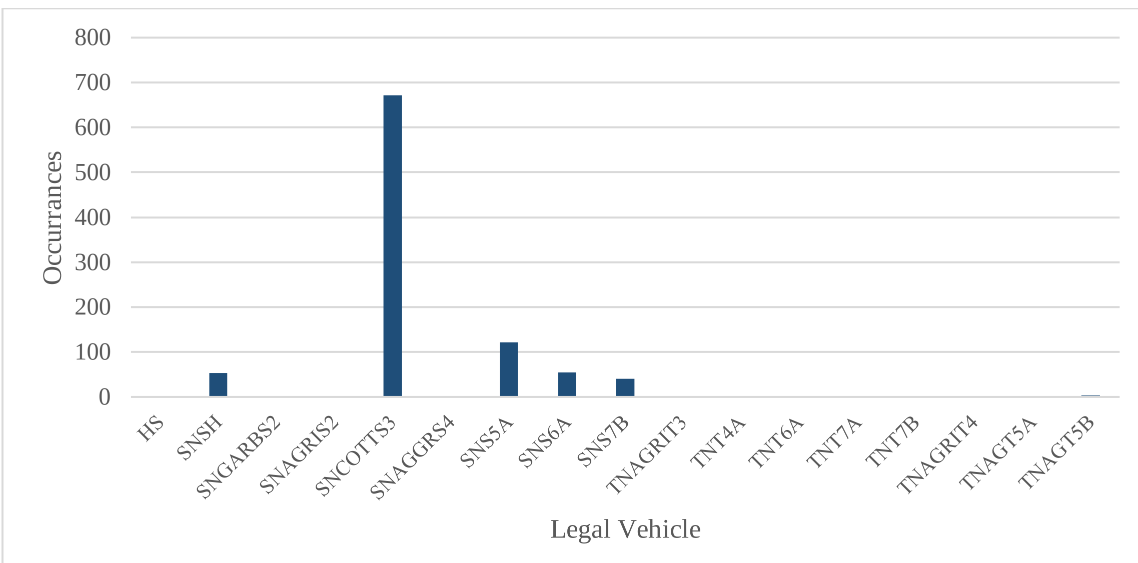

Figure 5.14: Posting vehicle frequency for all group 1 vehicles.

posting vehicles. None of the individual groups (all vehicles, single unit vehicles, tandem trucks) combine to 1232 vehicles due to the instances where there were no vehicles with an operating rating value below 1.0 at that specific instance. Results were grouped in three ways: first, all vehicles; then single unit vehicles only; and lastly, tandem trucks only.

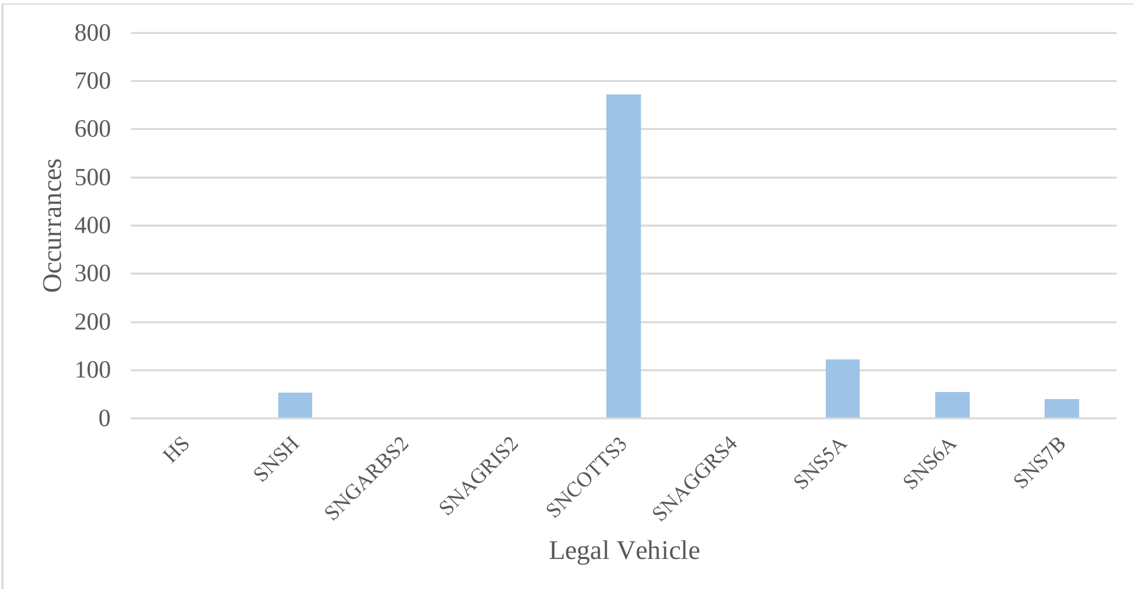

Figure 5.15: Posting vehicle frequency for all group 1 single unit vehicles.

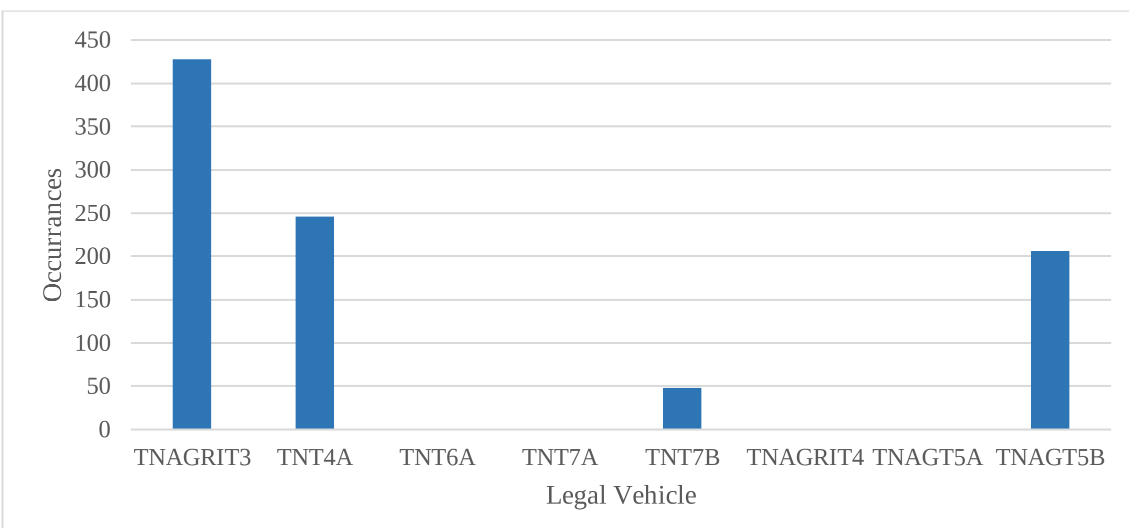

Figure 5.16: Posting vehicle frequency for all group 1 tandem trucks.

Group 2 totals shown in Figure 5.17 reflect tests executed on group 2 bridges at full section modulus and declining values of % effectiveness. Results were grouped in three ways: first, all vehicles; then single unit vehicles only; and lastly, tandem trucks only.

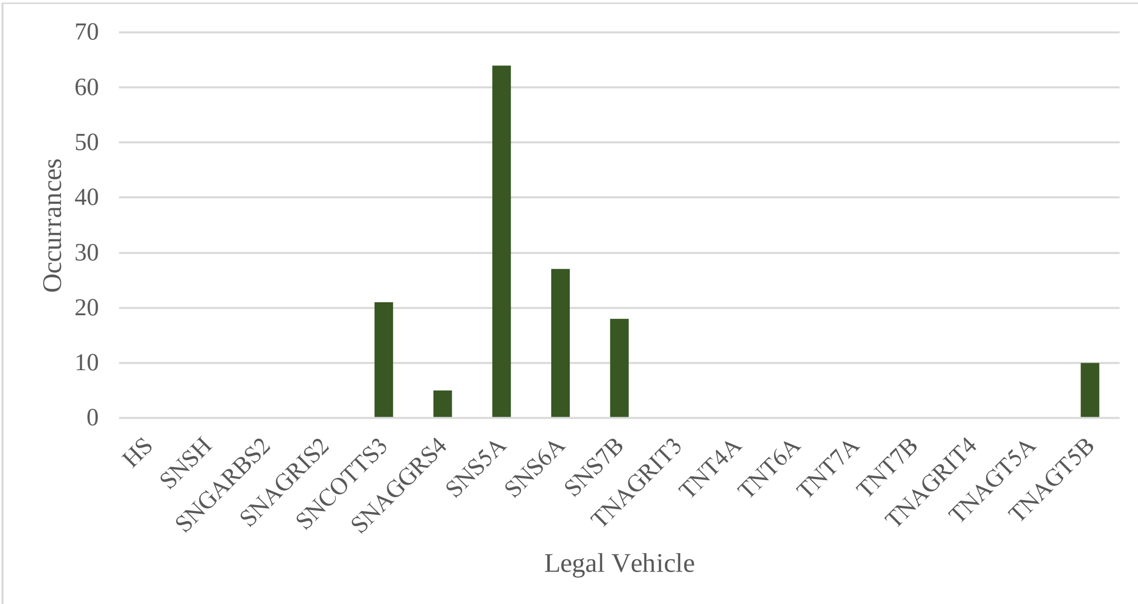

Figure 5.17: Posting vehicle frequency for all group 2 vehicles.

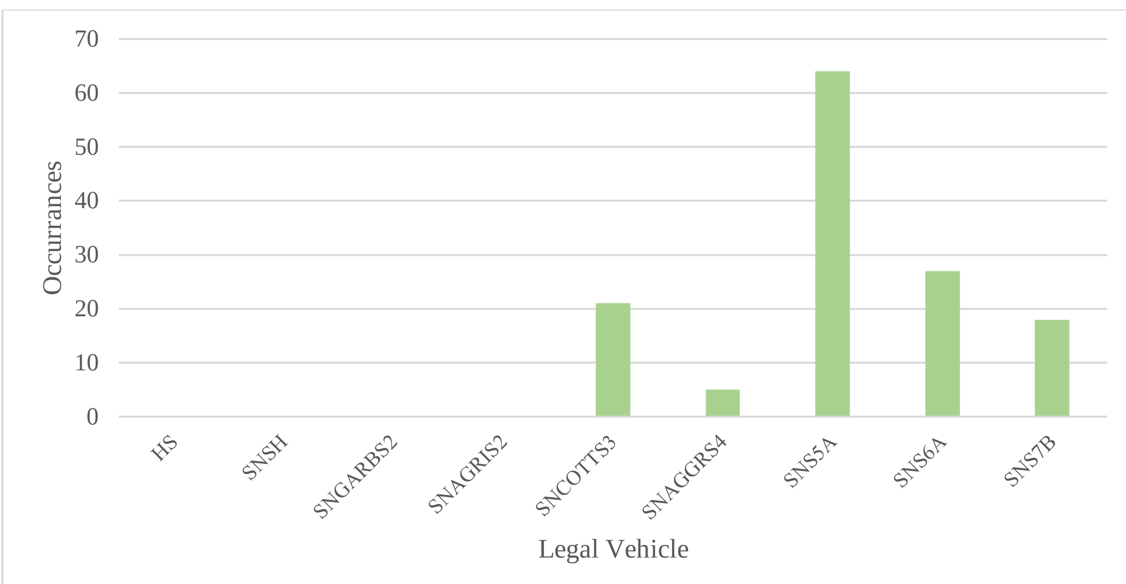

Figure 5.18: Posting vehicle frequency for all group 2 single unit vehicles.

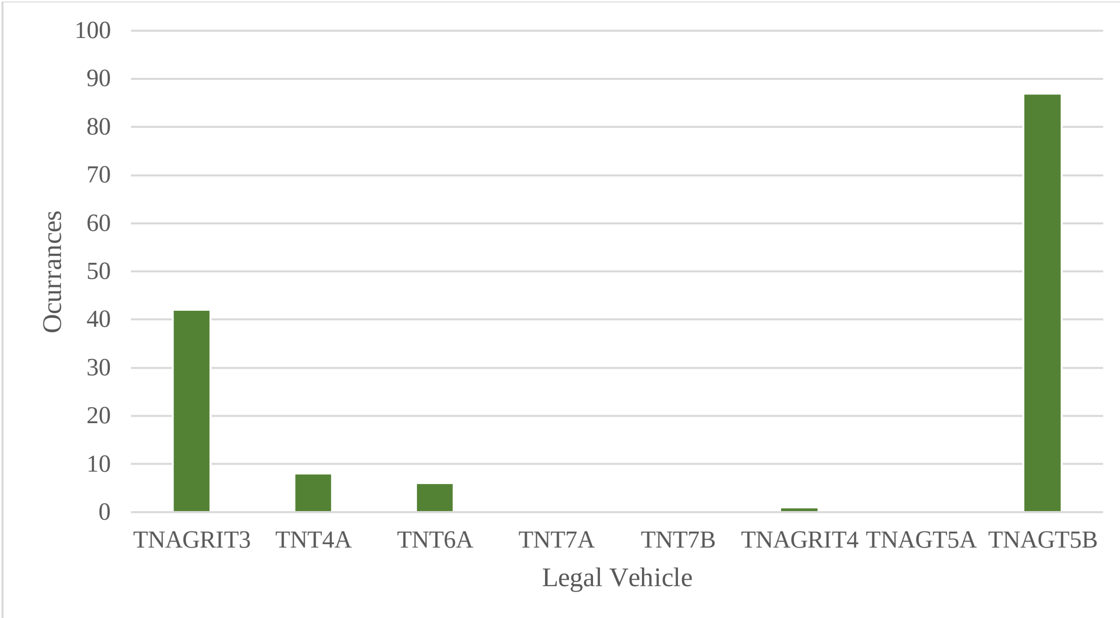

Figure 5.19: Posting vehicle frequency for all group 2 tandem trucks.

All bridge totals, as shown in Figure 5.20, were a result of combining the results from the group 2 analysis shown above with results taken from group 1 analysis; for the purpose of this analysis, only results from group 1 bridges at 100% section modulus were

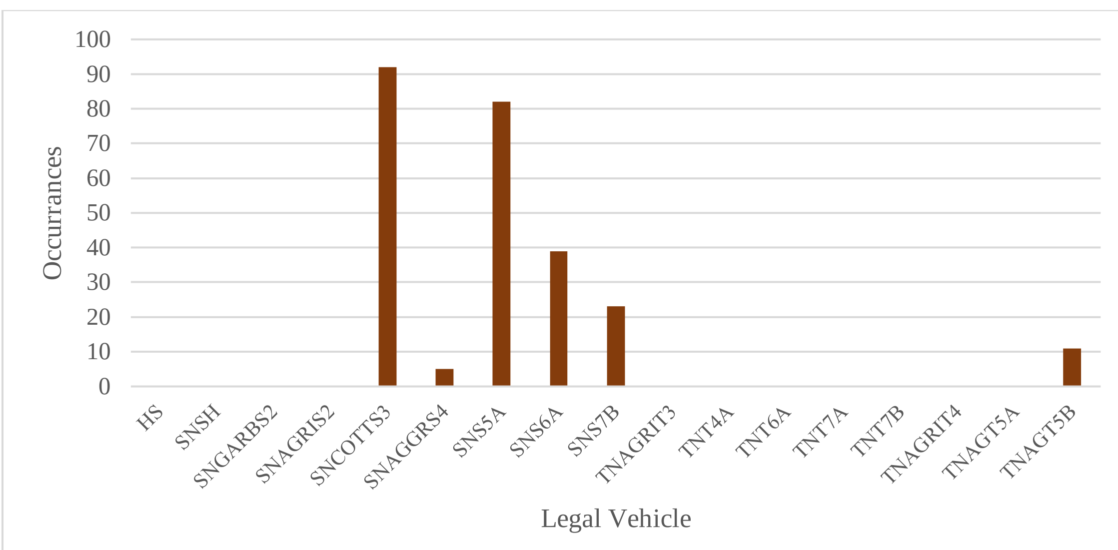

Figure 5.20: Posting vehicle frequency for all vehicles at 100% section modulus.

considered. In Figure 5.21, the total vehicle counts for single unit vehicles is displayed, and the total vehicle counts for tandem trucks is displayed in Figure 5.22.

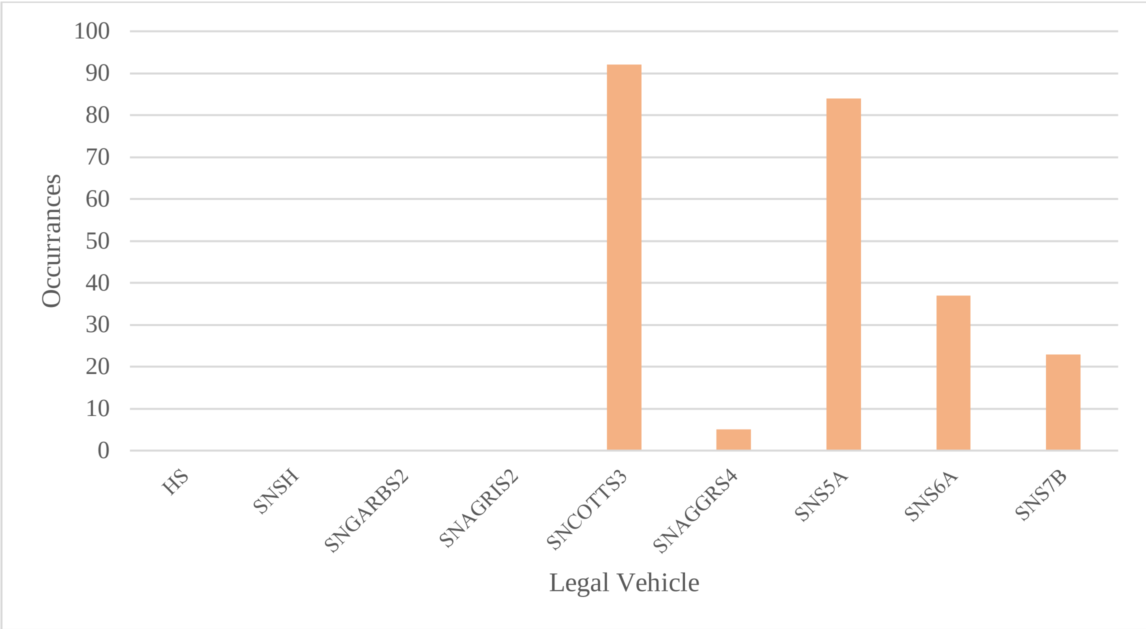

Figure 5.21: Posting vehicle frequency for all single unit vehicles at 100% section modulus.

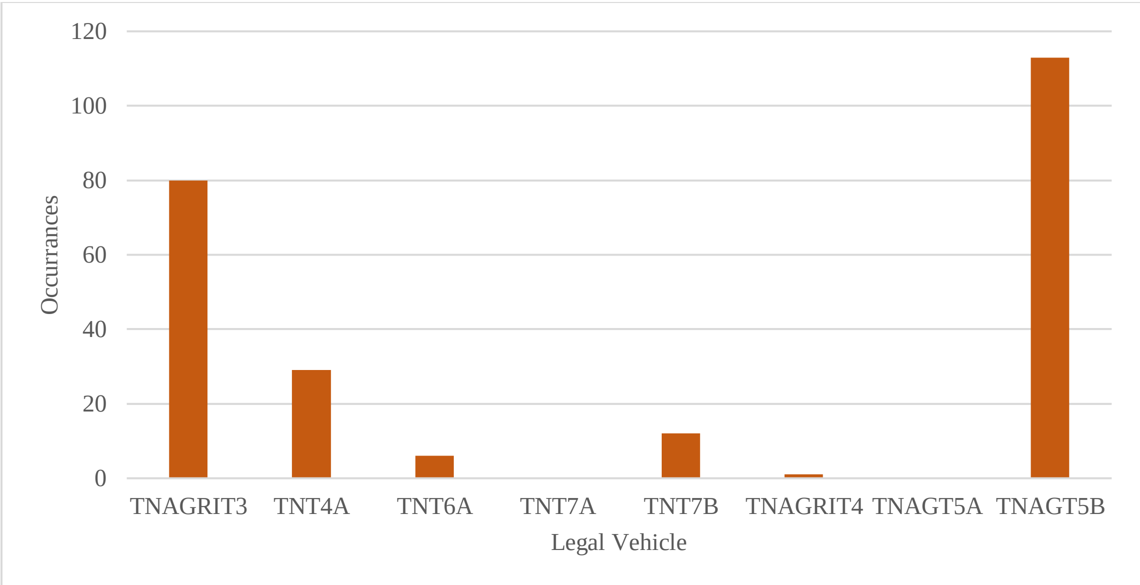

Figure 5.22: Posting vehicle frequency for all tandem trucks at 100% section modulus.

In Figure 5.21, the data illustrates how four single unit vehicles represented the majority of posting vehicles during the conducted tests. Two hundred forty-one single unit vehicles were found to be the posting vehicle during the 100% efficiency testing; SNAGGRS4 was calculated to be the posting vehicle 5 times.

In Figure 5.22, the data illustrates how three tandem trucks represented the majority of posting vehicles during the conducted tests. 241 tandem trucks were found to be the posting vehicle during the 100% efficiency testing; TNAGRIT4 occurs as the posting vehicle once, and TNT6A occurs as the posting vehicle 6 times.

5.6 Summary

Testing of steel girder bridges at progressive levels of % efficiency and section modulus loss revealed common progressions of posting vehicles. For single unit vehicles, SNS7B was consistently the first vehicle with an operating rating factor to fall below 1.0; that vehicle would be the posting vehicle until the rating factor for SNS6A fell below 1.0. The progression for single unit vehicles was found to be SNS7B > SNS6A > SNS5A > SNCOTTS3 > SNSH. SNAGGRS4 occurred as a posting vehicle five times; in all such instances, the operating weight for SNAGGRS4 was within 100 lbs. of SNS5A.

For tandem trucks, two progressions were found: TNAGT5B > TNAGRIT3 and TNT7B > TNT4A. TNT6A occurred as the posting vehicle six times, and TNAGRIT4 occurred as the posting vehicle once; in all such instances, the operating weights for TNT6A or TNAGRIT4 was within 100 lbs. of TNAGT5B.

Finally, there were four vehicles that were never identified by the analysis as a posting vehicle in these tests: SNGARBS2, SNAGRIS2, TNT7A, and TNAGT5A.

Chapter 6: Conclusions and Recommendations

6.1 Conclusions

NCDOT is currently responsible for managing 13,558 bridges, over 4000 of which are weight restricted, and this number is increasing as the statewide network is expanded and improved. These bridges are required to be inspected every two years. The NCDOT currently load rates bridges for thirteen vehicles that can legally travel on interstate highways and sixteen vehicles that can legally travel on non-interstate highways. The NC general statutes provides allowable axle loads at varying spacing. The process of determining the controlling load rating (or vehicle) is cumbersome, especially on multi-span bridges. Maintenance of the fleet of vehicles required to perform these load ratings on the bridges managed by the NCDOT is unnecessarily burdensome. Many states have optimized their respective legal loads to a more manageable number of rating and posting vehicles, in an effort to streamline the live load generation process.

This study had three objectives, as presented in Section 1.1:

1. Develop a methodology to optimize existing NC posting vehicles.
2. Utilize the developed framework to optimize the list of posting vehicles.
3. Develop an automated computer model that generates NC posting vehicles from NC general statutes.

The developed methodology determined the posting vehicle for 28 steel girder bridges; the sixteen bridges comprising group 1 were tested for all 16 non-interstate trucks at varying levels of bridge effectiveness and varying levels of section modulus loss, and the twelve bridges comprising group two were tested for all 16 non-interstate trucks at varying levels of bridge effectiveness.

This methodology was then utilized to optimize the list of posting vehicles. This process showed a distinct and consistent progression of vehicles' rating factors falling below 1.0. The observed progressions included a total of twelve of the sixteen legal vehicles. Three of these vehicles were found to be redundant for load rating purposes. As a result, the optimized list of legal vehicles used to load rate steel girder bridges may be reduced to the vehicles that appear in the controlling progression.

Based on the analysis performed, as described in Chapters 3 and 5, the following vehicles should be included in the optimized list:

- SNSH. This legal vehicle is a representation of a school bus. An example of such a vehicle is the Thomas Minotour.
- SNCOTTS3. This legal vehicle is a representation of a cotton truck. An example of such a vehicle is the Kenworth T800 cotton truck.
- SHS5A. This legal vehicle is a representation of a truck chassis used in garbage trucks, dump trucks, and concrete mixers. An example of such a vehicle is the McNeilus 5-axle front loading garbage truck.

- SNS6A. This legal vehicle is a representation of a truck chassis used in garbage trucks, dump trucks, and concrete mixers. An example of such a vehicle is the Freightliner 114SD 6-axle dump truck.
- SNS7B. This legal vehicle is a representation of a truck chassis used in garbage trucks, dump trucks, and concrete mixers. An example of such a vehicle is the Terex FDB7000 concrete mixer.
- TNAGRIT3. This legal vehicle is a representation of a two-axle tractor and a one-axle trailer. An example of such a vehicle is an International 8600 4x2 tractor hauling a 22 ft. Jet steel grain trailer
- TNT4A. This legal vehicle is a representation of a two-axle tractor and a two-axle trailer. An example of such a vehicle is an International 8600 4x2 tractor hauling a 40 ft. Great Dane Champion semi-trailer.
- TNAGT5B. This legal vehicle is a representation of a three-axle tractor and a two-axle trailer. An example of such a vehicle is a Peterbilt 579 tractor hauling a 40 ft. Great Dane Champion semi-trailer.
- TNT7B. This legal vehicle is a notional vehicle, designed without a specific counterpart in use in the trucking industry.

SNCOTTS3 should be re-evaluated, due to non-compliance with NC general statute §20-118. Recommendations for a legally compliant legal cotton vehicle include a version with the current axle geometry and a reduced gross weight of 47,000 lbs., or a vehicle with the current axle loads and a truck length of 25 ft.

A computer program was developed to generate potential vehicles that comply with the NC general statutes (including exceptions) that could be used in the load rating process. This program consists of input files and an executable program. The input files contain the NC Statute Matrix and the user-defined input variables; the executable program utilizes the input files to produce an output file consisting of a list of generated trucks based on the parameters set by the user in the input file. The output file is organized by truck type and number of axles and is sorted in declining values of maximum bending moment.

6.2 Limitations

This study tested the impact of non-interstate vehicles on steel girder bridges at declining levels of effectiveness and section modulus loss. As such, legal vehicles used on interstate bridges were not considered past the maximum bending moment calculations, and the impact of legal vehicles on other bridge types fell outside of the scope of study.

6.3 Recommendations

The results of this study can be used as the foundation of future research into the impact of legal vehicles on other bridge types, including box beam, concrete beam, and truss bridges. Additionally, the methodology presented in this study could be used to execute a similar study on the effect of legal vehicles on interstate bridges. Research comparing the list of legal vehicles used for non-interstate bridges with the list of legal vehicles used on interstate bridges, in an attempt to determine vehicle redundancy between the two lists, could prove to be of considerable value. An updated legal version of the cotton truck, one in compliance with NC general statute §20-118, will need to be the subject of further testing to determine whether it will remain in the optimized list of posting vehicles. Further research may explore whether HL-93 would be sufficient for all bridge load rating, as is currently done in 17 states. This study represents the first critical step in the lengthy and ongoing process of optimizing the list of legal vehicles used by NCDOT to load rate bridges.

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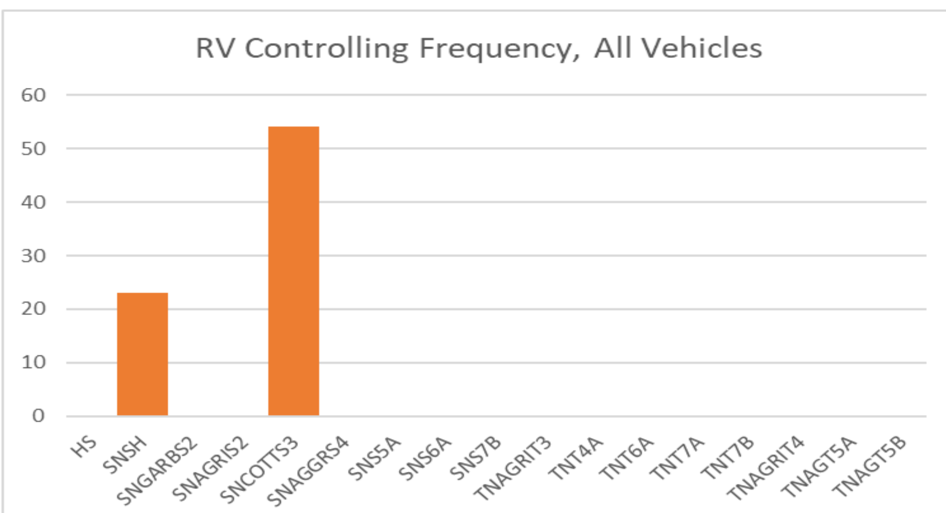
Appendix I:

WIGINS Bridge Analysis Data

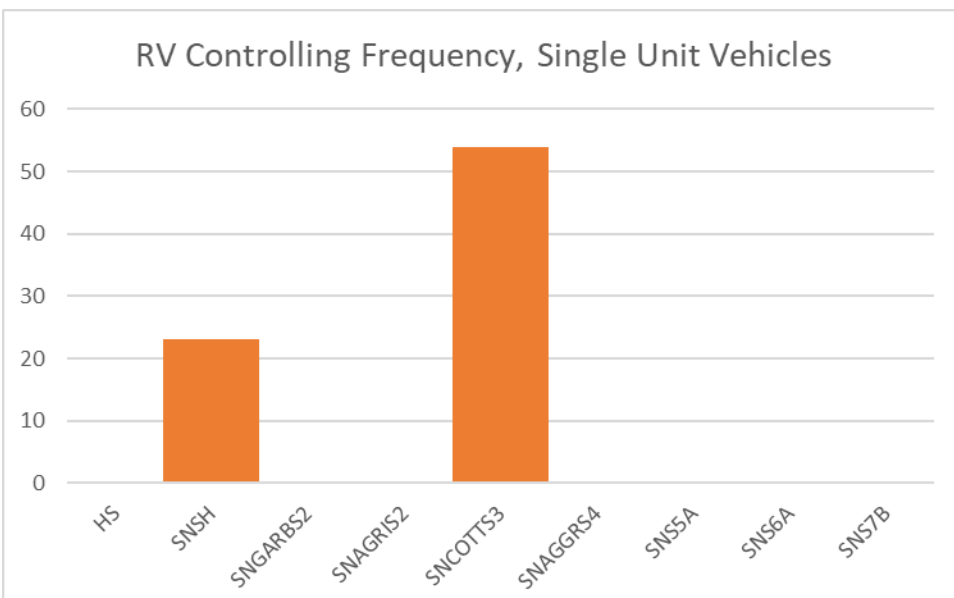
Group 1 Bridges, Rating Vehicles:

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNCOTTS3 22.1	SNCOTTS3 20.5	SNCOTTS3 18.8	SNCOTTS3 17.2	SNCOTTS3 15.6	SNCOTTS3 13.9	SNSH 12.1
	99	SNCOTTS3 21.8	SNCOTTS3 20.2	SNCOTTS3 18.5	SNCOTTS3 16.9	SNCOTTS3 15.3	SNCOTTS3 13.7	SNSH 11.9
	98	SNCOTTS3 21.5	SNCOTTS3 19.9	SNCOTTS3 18.2	SNCOTTS3 16.6	SNCOTTS3 15.0	SNSH 13.2	SNSH 11.7
	97	SNCOTTS3 21.1	SNCOTTS3 19.5	SNCOTTS3 17.9	SNCOTTS3 16.3	SNCOTTS3 14.8	SNSH 13.0	SNSH 11.4
	96	SNCOTTS3 20.8	SNCOTTS3 19.2	SNCOTTS3 17.6	SNCOTTS3 16.0	SNCOTTS3 14.5	SNSH 12.7	SNSH 11.2
	95	SNCOTTS3 20.5	SNCOTTS3 18.9	SNCOTTS3 17.3	SNCOTTS3 15.8	SNCOTTS3 14.2	SNSH 12.5	SNSH 11.0
	94	SNCOTTS3 20.1	SNCOTTS3 18.6	SNCOTTS3 17.0	SNCOTTS3 15.5	SNCOTTS3 13.9	SNSH 12.2	SNSH 10.7
	93	SNCOTTS3 19.8	SNCOTTS3 18.3	SNCOTTS3 16.7	SNCOTTS3 15.2	SNCOTTS3 13.7	SNSH 12.0	SNSH 10.5
	92	SNCOTTS3 19.4	SNCOTTS3 17.9	SNCOTTS3 16.4	SNCOTTS3 14.9	SNSH 13.2	SNSH 11.8	SNSH 10.3
	91	SNCOTTS3 19.1	SNCOTTS3 17.6	SNCOTTS3 16.1	SNCOTTS3 14.6	SNSH 13.0	SNSH 11.5	SNSH 10.0
	90	SNCOTTS3 18.8	SNCOTTS3 17.3	SNCOTTS3 15.8	SNCOTTS3 14.3	SNSH 12.7	SNSH 11.3	SNSH 9.8



Bridge 010003, All Vehicles

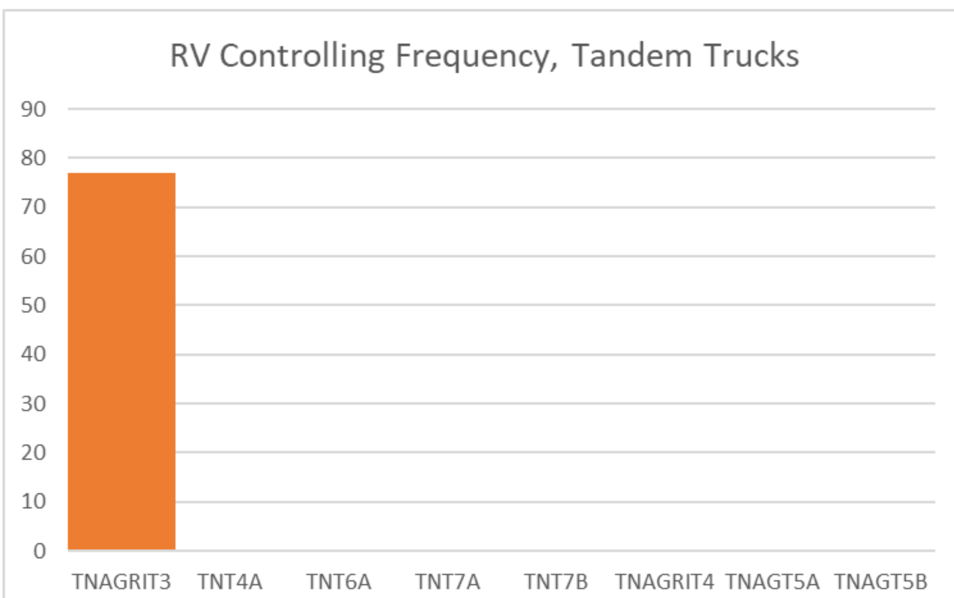
Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNCOTTS3 22.1	SNCOTTS3 20.5	SNCOTTS3 18.8	SNCOTTS3 17.2	SNCOTTS3 15.6	SNCOTTS3 13.9	SNSH 12.1
	99	SNCOTTS3 21.8	SNCOTTS3 20.2	SNCOTTS3 18.5	SNCOTTS3 16.9	SNCOTTS3 15.3	SNCOTTS3 13.7	SNSH 11.9
	98	SNCOTTS3 21.5	SNCOTTS3 19.9	SNCOTTS3 18.2	SNCOTTS3 16.6	SNCOTTS3 15.0	SNSH 13.2	SNSH 11.7
	97	SNCOTTS3 21.1	SNCOTTS3 19.5	SNCOTTS3 17.9	SNCOTTS3 16.3	SNCOTTS3 14.8	SNSH 13.0	SNSH 11.4
	96	SNCOTTS3 20.8	SNCOTTS3 19.2	SNCOTTS3 17.6	SNCOTTS3 16.0	SNCOTTS3 14.5	SNSH 12.7	SNSH 11.2
	95	SNCOTTS3 20.5	SNCOTTS3 18.9	SNCOTTS3 17.3	SNCOTTS3 15.8	SNCOTTS3 14.2	SNSH 12.5	SNSH 11.0
	94	SNCOTTS3 20.1	SNCOTTS3 18.6	SNCOTTS3 17.0	SNCOTTS3 15.5	SNCOTTS3 13.9	SNSH 12.2	SNSH 10.7
	93	SNCOTTS3 19.8	SNCOTTS3 18.3	SNCOTTS3 16.7	SNCOTTS3 15.2	SNCOTTS3 13.7	SNSH 12.0	SNSH 10.5
	92	SNCOTTS3 19.4	SNCOTTS3 17.9	SNCOTTS3 16.4	SNCOTTS3 14.9	SNSH 13.2	SNSH 11.8	SNSH 10.3
	91	SNCOTTS3 19.1	SNCOTTS3 17.6	SNCOTTS3 16.1	SNCOTTS3 14.6	SNSH 13.0	SNSH 11.5	SNSH 10.0
	90	SNCOTTS3 18.8	SNCOTTS3 17.3	SNCOTTS3 15.8	SNCOTTS3 14.3	SNSH 12.7	SNSH 11.3	SNSH 9.8



Bridge 010003, Single Unit Vehicles

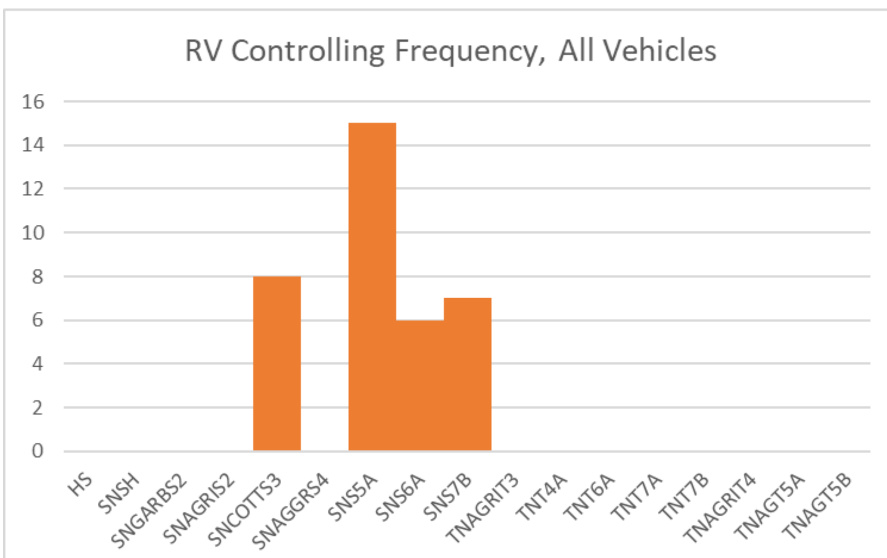
Tandem Trucks

Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	TNAGRIT3 28.6	TNAGRIT3 26.5	TNAGRIT3 24.4	TNAGRIT3 22.2	TNAGRIT3 20.1	TNAGRIT3 18.0	TNAGRIT3 15.8
	99	TNAGRIT3 28.2	TNAGRIT3 26.1	TNAGRIT3 24.0	TNAGRIT3 21.8	TNAGRIT3 19.8	TNAGRIT3 17.6	TNAGRIT3 15.5
	98	TNAGRIT3 27.8	TNAGRIT3 25.7	TNAGRIT3 23.6	TNAGRIT3 21.5	TNAGRIT3 19.4	TNAGRIT3 17.3	TNAGRIT3 15.2
	97	TNAGRIT3 27.3	TNAGRIT3 25.2	TNAGRIT3 23.2	TNAGRIT3 21.1	TNAGRIT3 19.1	TNAGRIT3 17.0	TNAGRIT3 14.9
	96	TNAGRIT3 26.9	TNAGRIT3 24.8	TNAGRIT3 22.8	TNAGRIT3 20.7	TNAGRIT3 18.7	TNAGRIT3 16.7	TNAGRIT3 14.6
	95	TNAGRIT3 26.4	TNAGRIT3 24.4	TNAGRIT3 22.4	TNAGRIT3 20.4	TNAGRIT3 18.4	TNAGRIT3 16.3	TNAGRIT3 14.3
	94	TNAGRIT3 26.0	TNAGRIT3 24.0	TNAGRIT3 22.0	TNAGRIT3 20.0	TNAGRIT3 18.0	TNAGRIT3 16.0	TNAGRIT3 14.0
	93	TNAGRIT3 25.6	TNAGRIT3 23.6	TNAGRIT3 21.6	TNAGRIT3 19.6	TNAGRIT3 17.7	TNAGRIT3 15.7	TNAGRIT3 13.7
	92	TNAGRIT3 25.1	TNAGRIT3 23.2	TNAGRIT3 21.2	TNAGRIT3 19.3	TNAGRIT3 17.3	TNAGRIT3 15.4	TNAGRIT3 13.4
	91	TNAGRIT3 24.7	TNAGRIT3 22.8	TNAGRIT3 20.8	TNAGRIT3 18.9	TNAGRIT3 17.0	TNAGRIT3 15.0	TNAGRIT3 13.1
	90	TNAGRIT3 24.3	TNAGRIT3 22.4	TNAGRIT3 20.4	TNAGRIT3 18.5	TNAGRIT3 16.6	TNAGRIT3 14.7	TNAGRIT3 12.8



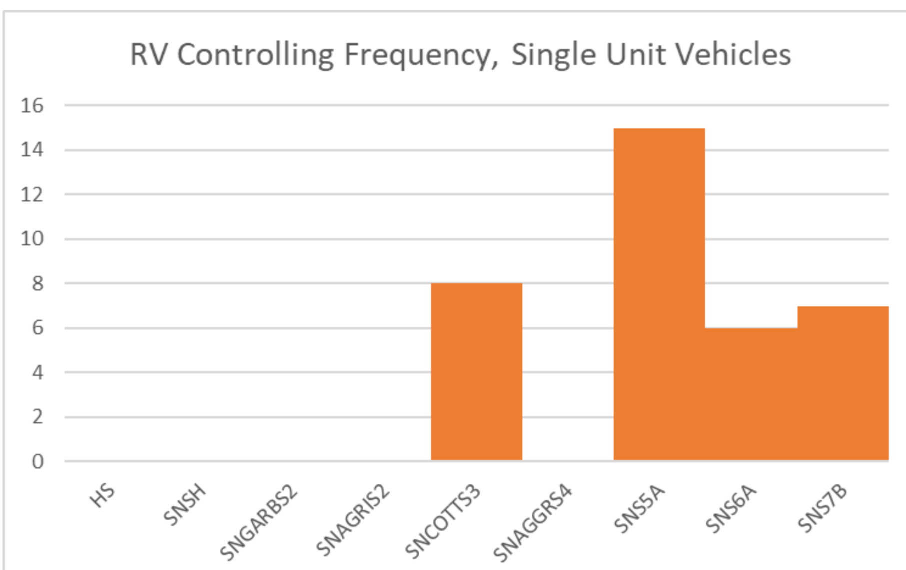
Bridge 010003, Tandem Trucks

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	N/A	38.8	33.0
	99	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	41.9	38.3	32.5
	98	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	41.3	35.2	32.1
	97	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	40.8	34.7	31.6
	96	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	40.2	34.2	27.0
	95	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	39.4	33.8	26.6
	94	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	38.9	33.3	26.2
	93	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	41.7	38.3	32.8	25.8
	92	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	41.1	35.2	32.3	25.4
	91	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	40.5	34.7	31.8	25.0
	90	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	39.7	34.2	27.1	24.6



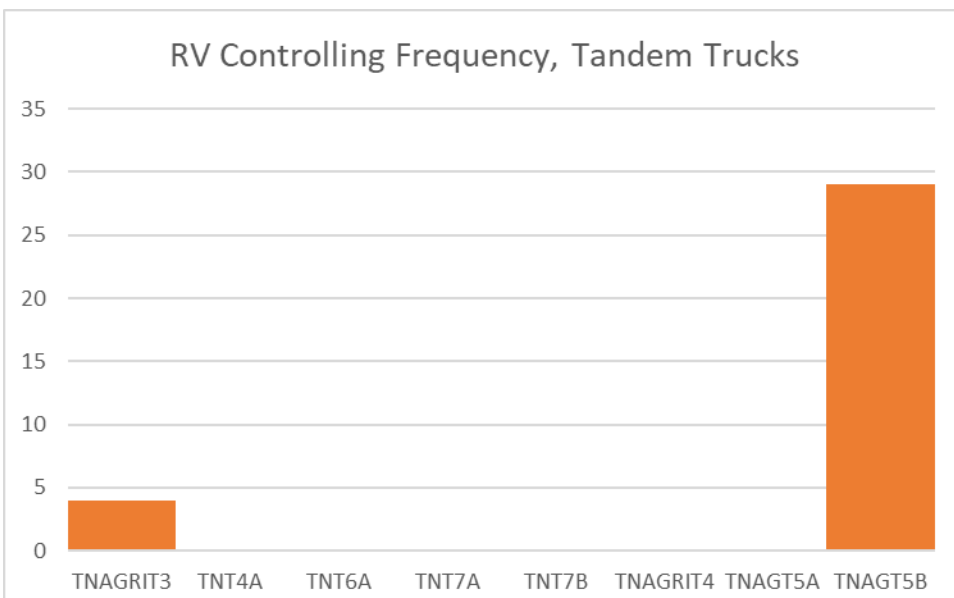
Bridge 080037, All Vehicles

Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	N/A	38.8	33.0
	99	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	41.9	38.3	32.5
	98	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	41.3	35.2	32.1
	97	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	40.8	34.7	31.6
	96	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	40.2	34.2	27.0
	95	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	39.4	33.8	26.6
	94	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	38.9	33.3	26.2
	93	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	41.7	38.3	32.8	25.8
	92	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	41.1	35.2	32.3	25.4
	91	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	40.5	34.7	31.8	25.0
	90	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	39.7	34.2	27.1	24.6



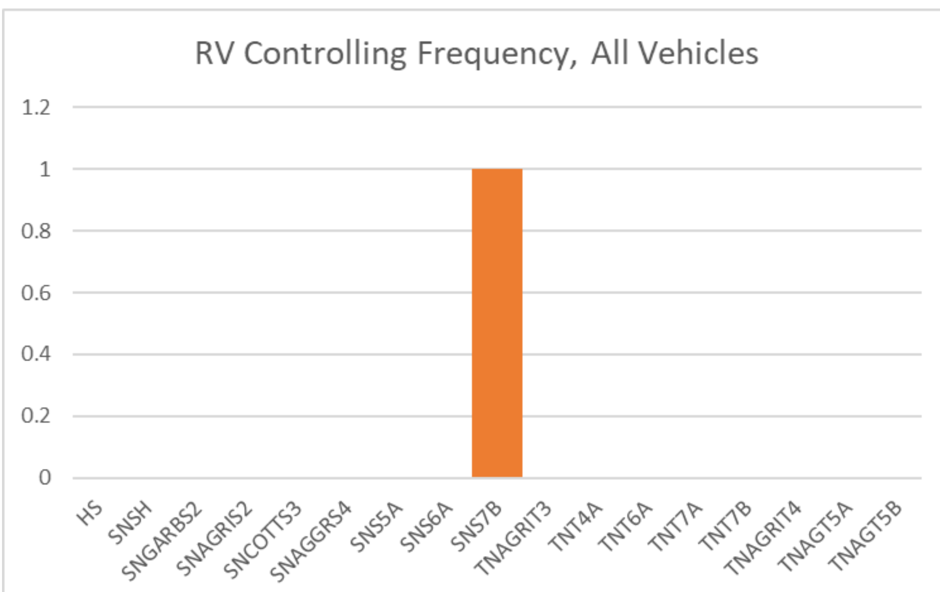
Bridge 080037, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.5	TNAGT5B 38.7
	99	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 41.9	TNAGT5B 38.2
	98	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 41.3	TNAGT5B 37.7
	97	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.4	TNAGT5B 40.8	TNAGT5B 37.2
	96	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.7	TNAGT5B 40.2	TNAGT5B 36.6
	95	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.1	TNAGT5B 39.6	TNAGT5B 36.1
	94	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.5	TNAGT5B 39.1	TNAGT5B 35.6
	93	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 41.9	TNAGT5B 38.5	TNAGRIT3 32.7
	92	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.7	TNAGT5B 41.3	TNAGT5B 37.9	TNAGRIT3 32.2
	91	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.1	TNAGT5B 40.7	TNAGT5B 37.4	TNAGRIT3 31.7
	90	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.4	TNAGT5B 40.1	TNAGT5B 36.8	TNAGRIT3 31.2



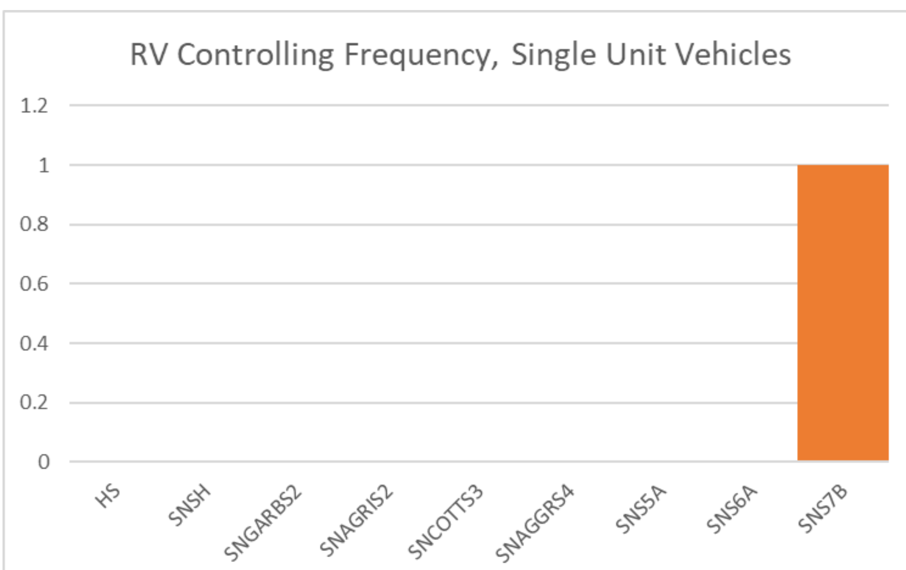
Bridge 080037, Tandem Trucks

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	99	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	98	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	97	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	96	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	95	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	94	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	93	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	92	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	91	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	90	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B
		N/A	N/A	N/A	N/A	N/A	N/A	41.9



Bridge 100152, All Vehicles

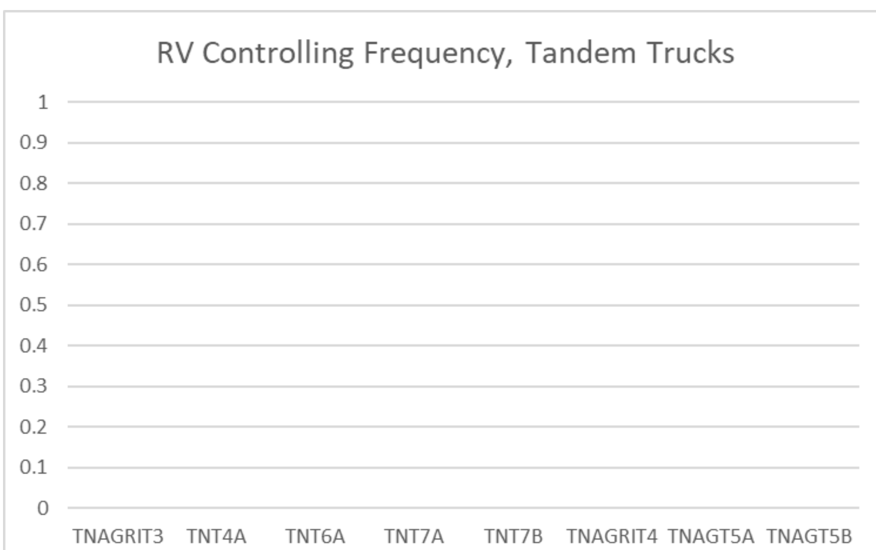
Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	99	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	98	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	97	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	96	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	95	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	94	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	93	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	92	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	91	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A
	90	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.9



Bridge 100152, Single Unit Vehicles

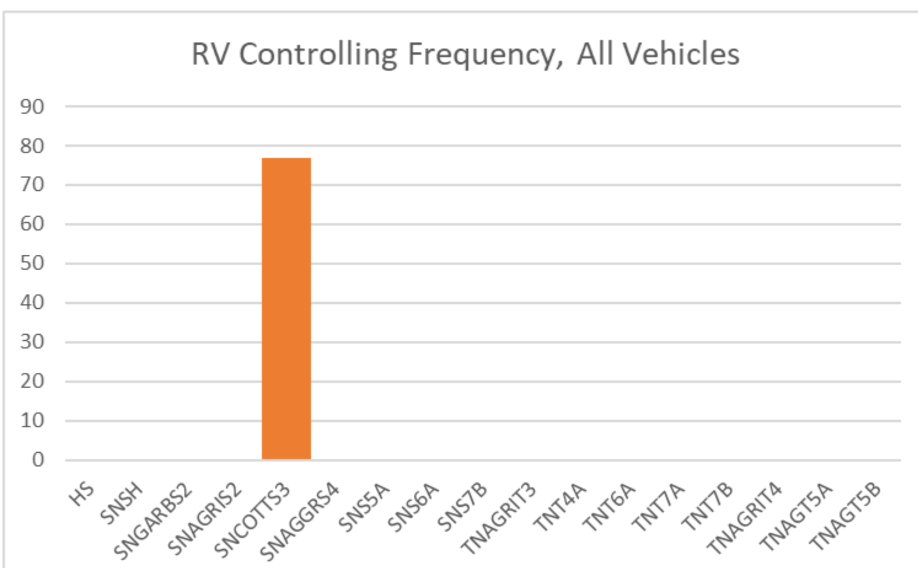
Tandem Trucks

Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	99	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	98	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	97	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	96	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	95	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	94	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	93	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	92	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	91	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A
	90	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
		N/A	N/A	N/A	N/A	N/A	N/A	N/A



Bridge 100152, Tandem Trucks

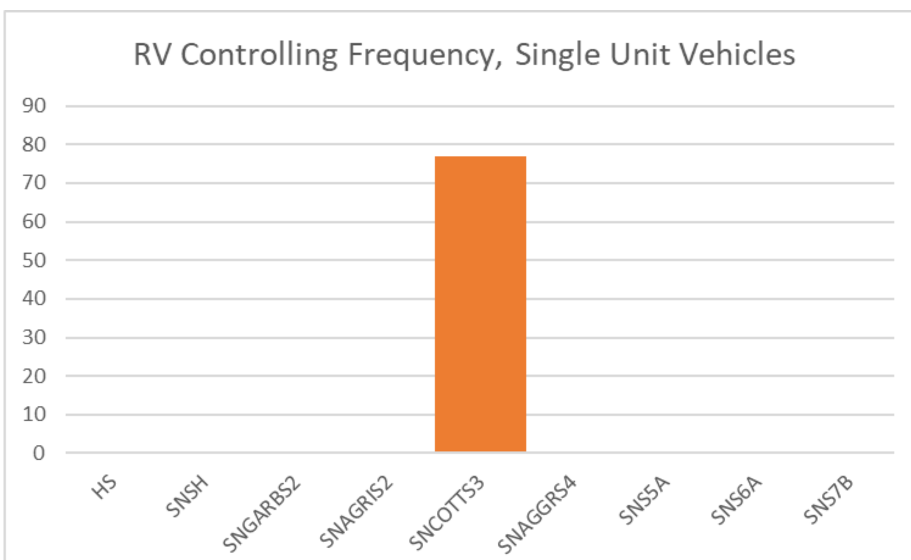
All Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	SNCOTTS3 25.1	SNCOTTS3 23.7	SNCOTTS3 22.4	SNCOTTS3 21.0	SNCOTTS3 19.6	SNCOTTS3 18.2	SNCOTTS3 16.8
	99	SNCOTTS3 24.8	SNCOTTS3 23.5	SNCOTTS3 22.1	SNCOTTS3 20.7	SNCOTTS3 19.3	SNCOTTS3 18.0	SNCOTTS3 16.6
	98	SNCOTTS3 24.5	SNCOTTS3 23.2	SNCOTTS3 21.8	SNCOTTS3 20.5	SNCOTTS3 19.1	SNCOTTS3 17.8	SNCOTTS3 16.4
	97	SNCOTTS3 24.2	SNCOTTS3 22.9	SNCOTTS3 21.6	SNCOTTS3 20.3	SNCOTTS3 18.9	SNCOTTS3 17.6	SNCOTTS3 16.2
	96	SNCOTTS3 24.0	SNCOTTS3 22.7	SNCOTTS3 21.3	SNCOTTS3 20.0	SNCOTTS3 18.7	SNCOTTS3 17.3	SNCOTTS3 16.0
	95	SNCOTTS3 23.7	SNCOTTS3 22.4	SNCOTTS3 21.1	SNCOTTS3 19.8	SNCOTTS3 18.4	SNCOTTS3 17.1	SNCOTTS3 15.8
	94	SNCOTTS3 23.4	SNCOTTS3 22.1	SNCOTTS3 20.8	SNCOTTS3 19.5	SNCOTTS3 18.2	SNCOTTS3 16.9	SNCOTTS3 15.6
	93	SNCOTTS3 23.1	SNCOTTS3 21.8	SNCOTTS3 20.6	SNCOTTS3 19.3	SNCOTTS3 18.0	SNCOTTS3 16.7	SNCOTTS3 15.4
	92	SNCOTTS3 22.8	SNCOTTS3 21.6	SNCOTTS3 20.3	SNCOTTS3 19.1	SNCOTTS3 17.8	SNCOTTS3 16.5	SNCOTTS3 15.2
	91	SNCOTTS3 22.6	SNCOTTS3 21.3	SNCOTTS3 20.1	SNCOTTS3 18.8	SNCOTTS3 17.5	SNCOTTS3 16.3	SNCOTTS3 15.0
	90	SNCOTTS3 22.3	SNCOTTS3 21.0	SNCOTTS3 19.8	SNCOTTS3 18.6	SNCOTTS3 17.3	SNCOTTS3 16.1	SNCOTTS3 14.8



Bridge 100309, All Vehicles

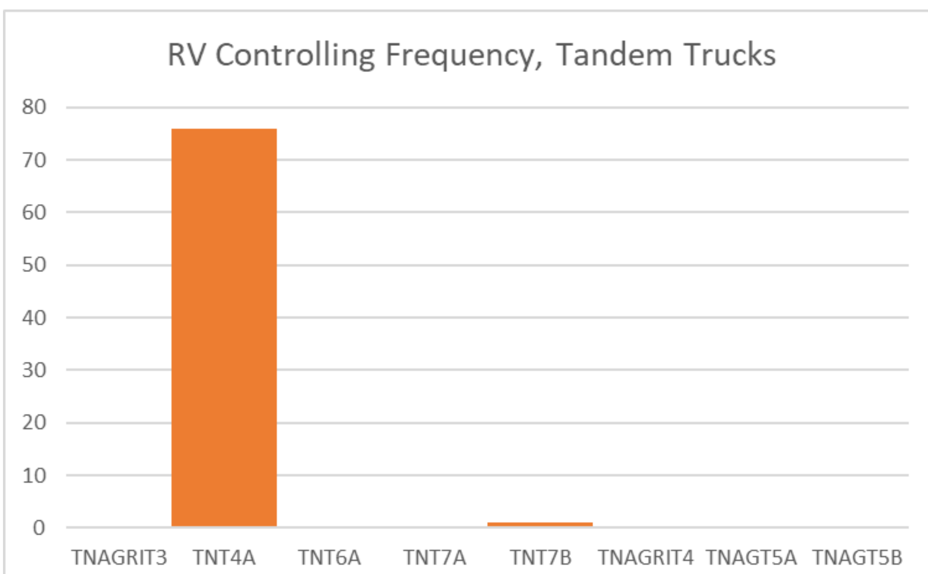
Single Unit Vehicles

Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNCOTTS3 25.1	SNCOTTS3 23.7	SNCOTTS3 22.4	SNCOTTS3 21.0	SNCOTTS3 19.6	SNCOTTS3 18.2	SNCOTTS3 16.8
	99	SNCOTTS3 24.8	SNCOTTS3 23.5	SNCOTTS3 22.1	SNCOTTS3 20.7	SNCOTTS3 19.3	SNCOTTS3 18.0	SNCOTTS3 16.6
	98	SNCOTTS3 24.5	SNCOTTS3 23.2	SNCOTTS3 21.8	SNCOTTS3 20.5	SNCOTTS3 19.1	SNCOTTS3 17.8	SNCOTTS3 16.4
	97	SNCOTTS3 24.2	SNCOTTS3 22.9	SNCOTTS3 21.6	SNCOTTS3 20.3	SNCOTTS3 18.9	SNCOTTS3 17.6	SNCOTTS3 16.2
	96	SNCOTTS3 24.0	SNCOTTS3 22.7	SNCOTTS3 21.3	SNCOTTS3 20.0	SNCOTTS3 18.7	SNCOTTS3 17.3	SNCOTTS3 16.0
	95	SNCOTTS3 23.7	SNCOTTS3 22.4	SNCOTTS3 21.1	SNCOTTS3 19.8	SNCOTTS3 18.4	SNCOTTS3 17.1	SNCOTTS3 15.8
	94	SNCOTTS3 23.4	SNCOTTS3 22.1	SNCOTTS3 20.8	SNCOTTS3 19.5	SNCOTTS3 18.2	SNCOTTS3 16.9	SNCOTTS3 15.6
	93	SNCOTTS3 23.1	SNCOTTS3 21.8	SNCOTTS3 20.6	SNCOTTS3 19.3	SNCOTTS3 18.0	SNCOTTS3 16.7	SNCOTTS3 15.4
	92	SNCOTTS3 22.8	SNCOTTS3 21.6	SNCOTTS3 20.3	SNCOTTS3 19.1	SNCOTTS3 17.8	SNCOTTS3 16.5	SNCOTTS3 15.2
	91	SNCOTTS3 22.6	SNCOTTS3 21.3	SNCOTTS3 20.1	SNCOTTS3 18.8	SNCOTTS3 17.5	SNCOTTS3 16.3	SNCOTTS3 15.0
	90	SNCOTTS3 22.3	SNCOTTS3 21.0	SNCOTTS3 19.8	SNCOTTS3 18.6	SNCOTTS3 17.3	SNCOTTS3 16.1	SNCOTTS3 14.8



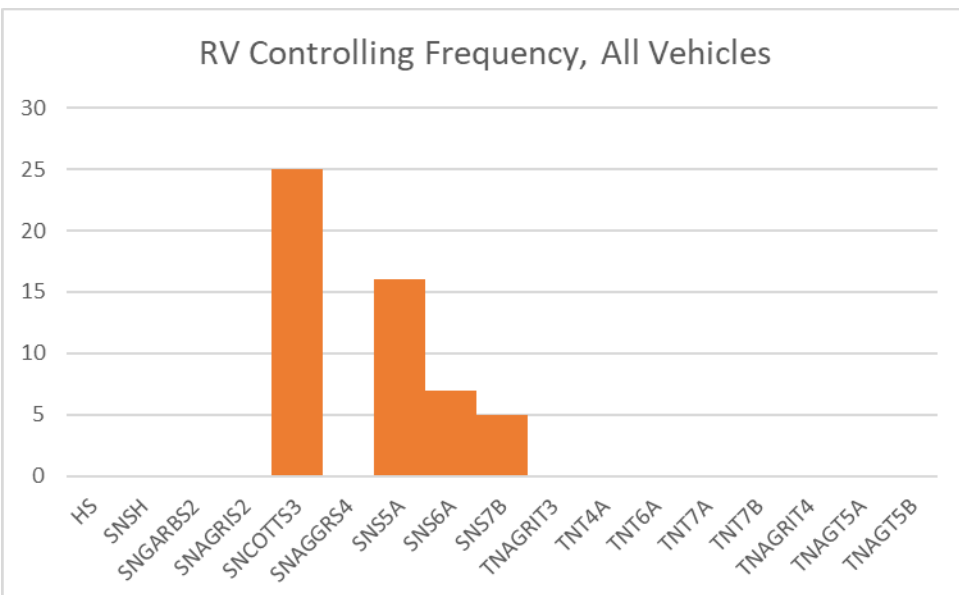
Bridge 100309, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	TNT7B 37.3	TNT4A 31.5	TNT4A 29.7	TNT4A 27.8	TNT4A 26.0	TNT4A 24.1	TNT4A 22.3
	99	TNT4A 32.9	TNT4A 31.1	TNT4A 29.3	TNT4A 27.5	TNT4A 25.7	TNT4A 23.9	TNT4A 22.0
	98	TNT4A 32.6	TNT4A 30.8	TNT4A 29.0	TNT4A 27.2	TNT4A 25.4	TNT4A 23.6	TNT4A 21.7
	97	TNT4A 32.2	TNT4A 30.4	TNT4A 28.7	TNT4A 26.9	TNT4A 25.1	TNT4A 23.3	TNT4A 21.5
	96	TNT4A 31.8	TNT4A 30.1	TNT4A 28.3	TNT4A 26.6	TNT4A 24.8	TNT4A 23.0	TNT4A 21.2
	95	TNT4A 31.4	TNT4A 29.7	TNT4A 28.0	TNT4A 26.2	TNT4A 24.5	TNT4A 22.7	TNT4A 21.0
	94	TNT4A 31.1	TNT4A 29.4	TNT4A 27.6	TNT4A 25.9	TNT4A 24.2	TNT4A 22.4	TNT4A 20.7
	93	TNT4A 30.7	TNT4A 29.0	TNT4A 27.3	TNT4A 25.6	TNT4A 23.9	TNT4A 22.2	TNT4A 20.4
	92	TNT4A 30.3	TNT4A 28.6	TNT4A 27.0	TNT4A 25.3	TNT4A 23.6	TNT4A 21.9	TNT4A 20.2
	91	TNT4A 29.9	TNT4A 28.3	TNT4A 26.6	TNT4A 25.0	TNT4A 23.3	TNT4A 21.6	TNT4A 19.9
	90	TNT4A 29.6	TNT4A 27.9	TNT4A 26.3	TNT4A 24.6	TNT4A 23.0	TNT4A 21.3	TNT4A 19.6



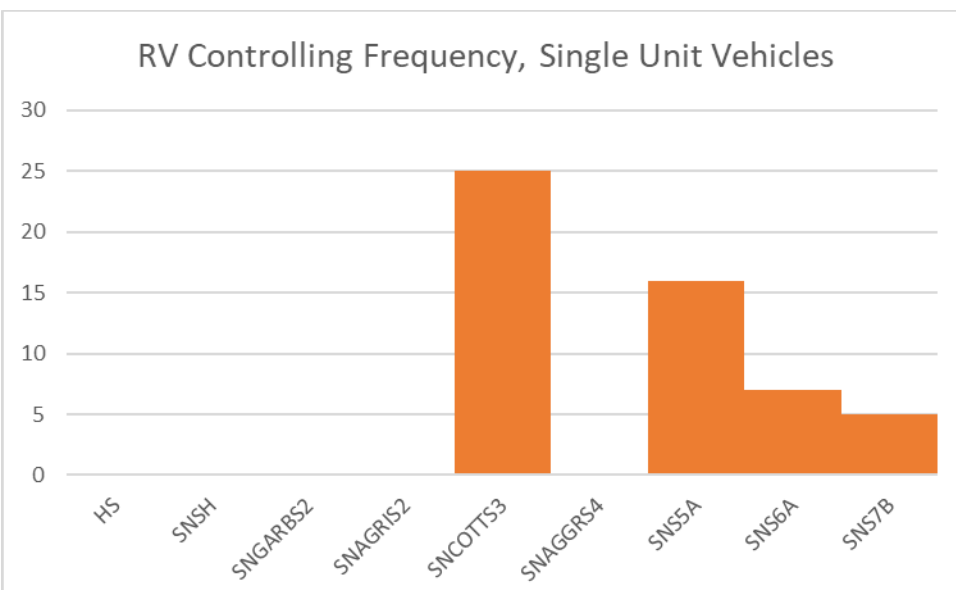
Bridge 100309, Tandem Trucks

All Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	40.4	34.5	31.3	24.5
	99	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	39.6	34.0	26.9	24.1
	98	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	39.1	33.4	26.4	23.7
	97	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	38.5	32.9	26.0	23.3
	96	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	41.4	35.4	32.4	25.6	22.9
	95	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	40.8	34.9	31.9	25.1	22.5
	94	#N/A	#N/A	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	39.9	34.3	31.4	24.7	22.1
	93	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	N/A	39.3	33.8	26.9	24.3	21.7
	92	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	N/A	38.7	33.2	26.4	23.9	21.3
	91	#N/A	SNS7B	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	41.4	38.0	32.6	26.0	23.4	20.9
	90	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	40.7	35.0	32.1	25.5	23.0	20.5



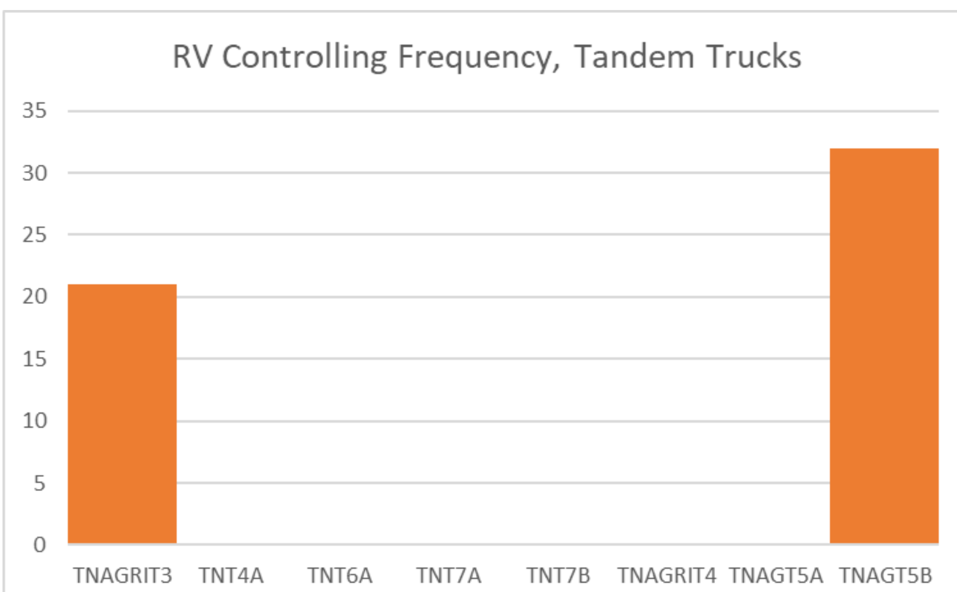
Bridge 110105, All Vehicles

Single Unit Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	40.4	34.5	31.3	24.5
	99	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	39.6	34.0	26.9	24.1
	98	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	39.1	33.4	26.4	23.7
	97	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	N/A	38.5	32.9	26.0	23.3
	96	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	41.4	35.4	32.4	25.6	22.9
	95	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	40.8	34.9	31.9	25.1	22.5
	94	#N/A	#N/A	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	N/A	39.9	34.3	31.4	24.7	22.1
	93	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	N/A	39.3	33.8	26.9	24.3	21.7
	92	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	N/A	38.7	33.2	26.4	23.9	21.3
	91	#N/A	SNS7B	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	41.4	38.0	32.6	26.0	23.4	20.9
	90	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	40.7	35.0	32.1	25.5	23.0	20.5



Bridge 110105, Single Unit Vehicles

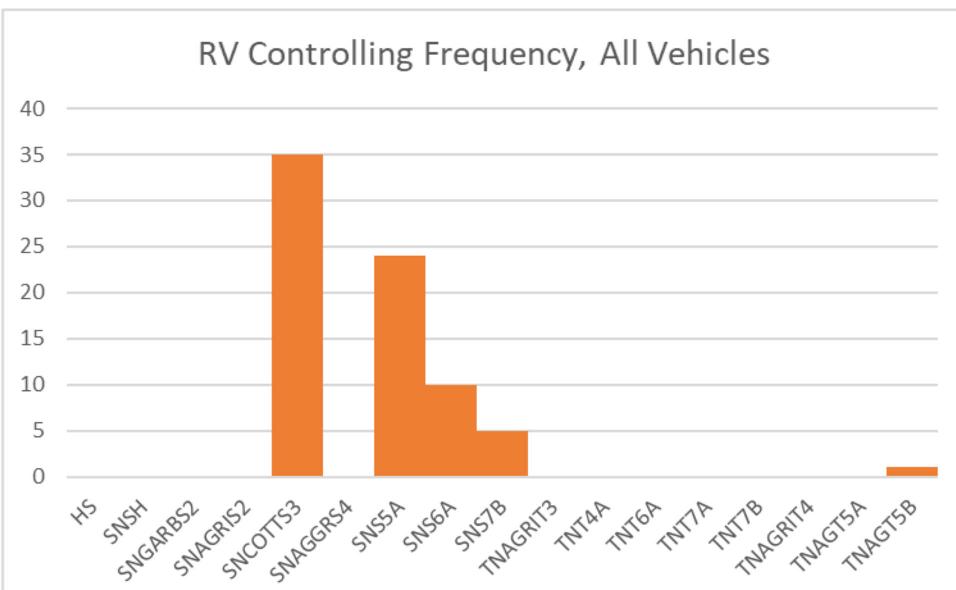
Tandem Trucks								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3
		N/A	N/A	N/A	43.8	40.1	36.4	30.5
	99	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3
		N/A	N/A	N/A	43.2	39.5	35.8	30.0
	98	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3
		N/A	N/A	N/A	42.5	38.9	35.3	29.5
	97	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3
		N/A	N/A	N/A	41.9	38.3	32.5	29.0
	96	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3
		N/A	N/A	44.8	41.2	37.7	31.9	28.5
	95	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3
		N/A	N/A	44.1	40.6	37.1	31.4	28.0
	94	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3
		N/A	N/A	43.4	39.9	36.5	30.8	27.5
	93	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3
		N/A	N/A	42.8	39.3	35.9	30.3	27.0
	92	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3
		N/A	N/A	42.1	38.6	35.3	29.8	26.5
	91	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3
		N/A	44.8	41.4	38.0	32.4	29.2	26.0
	90	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3
		N/A	44.1	40.7	37.3	31.9	28.7	25.5



Bridge 110105, Tandem Trucks

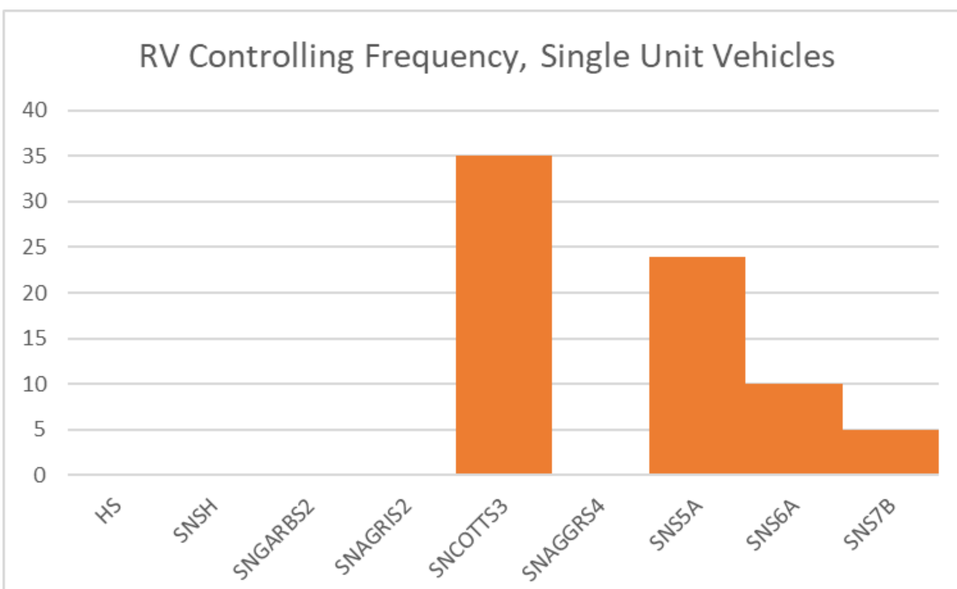
All Vehicles

Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	#N/A	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	40.6	37.5	33.1	30.3	25.1	22.5
	99	#N/A	SNS6A	SNS5A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	39.9	35.5	32.6	29.8	24.7	22.1
	98	TNAGT5B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		44.4	39.3	34.9	32.1	26.9	24.3	21.7
	97	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.7	38.7	34.4	31.6	26.5	23.9	21.4
	96	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.1	38.1	33.9	31.1	26.0	23.5	21.0
	95	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		40.5	37.5	33.3	30.6	25.6	23.1	20.6
	94	SNS7B	SNS5A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		40.5	35.5	32.8	30.1	25.1	22.7	20.2
	93	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		39.1	34.9	32.2	27.1	24.7	22.3	19.8
	92	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.5	34.3	31.7	26.7	24.3	21.8	19.4
	91	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.9	33.8	31.2	26.2	23.8	21.4	19.0
	90	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.3	33.2	30.6	25.7	23.4	21.0	18.7



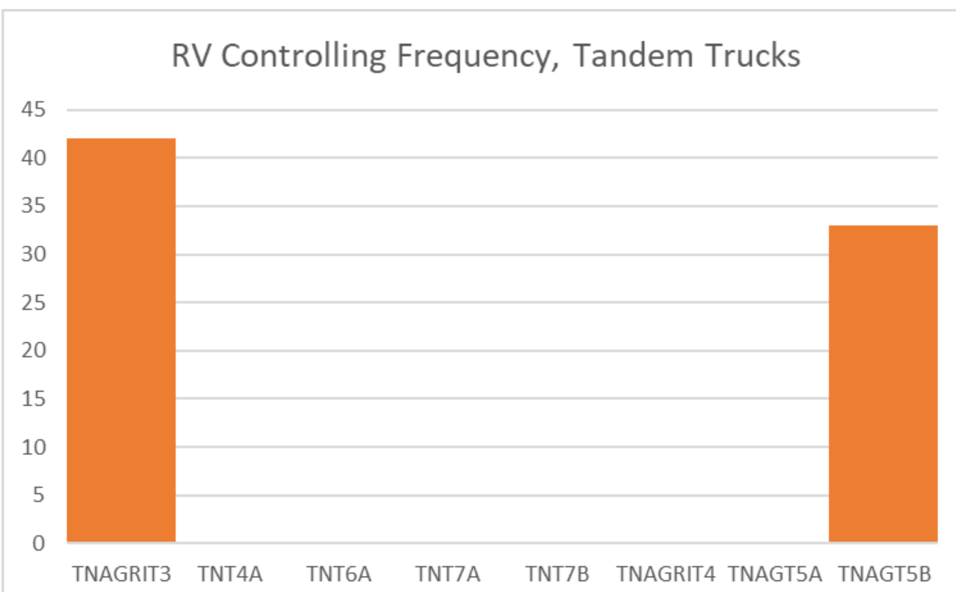
Bridge 220015, All Vehicles

Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	40.6	37.5	33.1	30.3	25.1	22.5
	99	#N/A	SNS6A	SNS5A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3
		N/A	39.9	35.5	32.6	29.8	24.7	22.1
	98	#N/A	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	39.3	34.9	32.1	26.9	24.3	21.7
	97	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.7	38.7	34.4	31.6	26.5	23.9	21.4
	96	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.1	38.1	33.9	31.1	26.0	23.5	21.0
	95	SNS7B	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		40.5	37.5	33.3	30.6	25.6	23.1	20.6
	94	SNS7B	SNS5A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3
		40.5	35.5	32.8	30.1	25.1	22.7	20.2
	93	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		39.1	34.9	32.2	27.1	24.7	22.3	19.8
	92	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.5	34.3	31.7	26.7	24.3	21.8	19.4
	91	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.9	33.8	31.2	26.2	23.8	21.4	19.0
	90	SNS6A	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.3	33.2	30.6	25.7	23.4	21.0	18.7



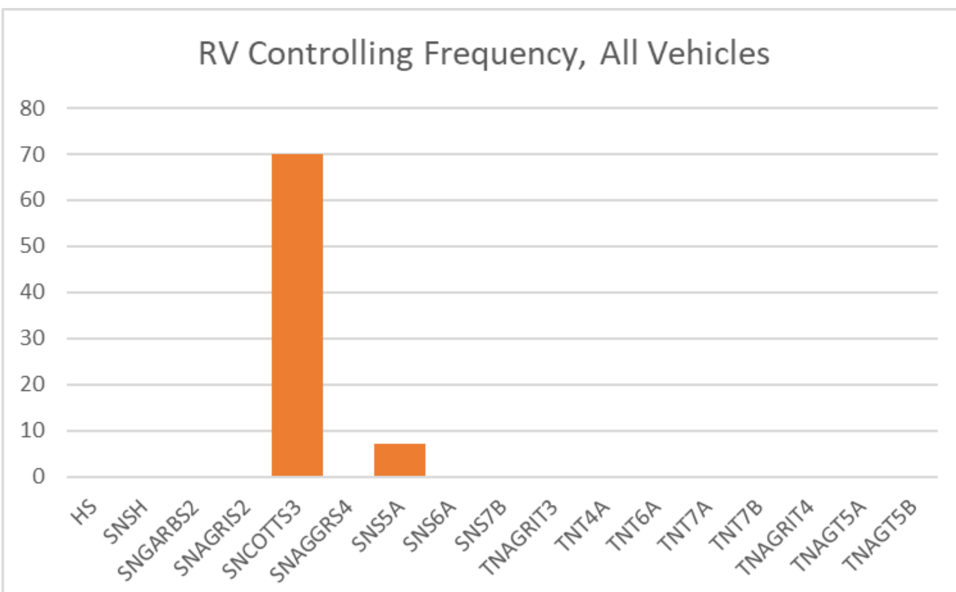
Bridge 220015, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3
		N/A	42.6	39.5	36.3	31.9	28.8	25.8
	99	#N/A	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3
		N/A	42.0	38.9	35.8	31.4	28.4	25.4
	98	TNAGT5B	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3
		44.4	41.4	38.3	35.2	30.9	27.9	24.9
	97	TNAGT5B	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3
		43.8	40.7	37.7	34.6	30.4	27.4	24.5
	96	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		43.1	40.1	37.1	32.7	29.8	26.9	24.0
	95	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		42.5	39.5	36.5	32.2	29.3	26.5	23.6
	94	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		42.5	38.9	35.9	31.7	28.8	26.0	23.2
	93	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		41.2	38.2	35.3	31.1	28.3	25.5	22.7
	92	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		40.5	37.6	34.8	30.6	27.8	25.0	22.3
	91	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		39.9	37.0	32.8	30.1	27.3	24.6	21.8
	90	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		39.2	36.4	32.2	29.5	26.8	24.1	21.4



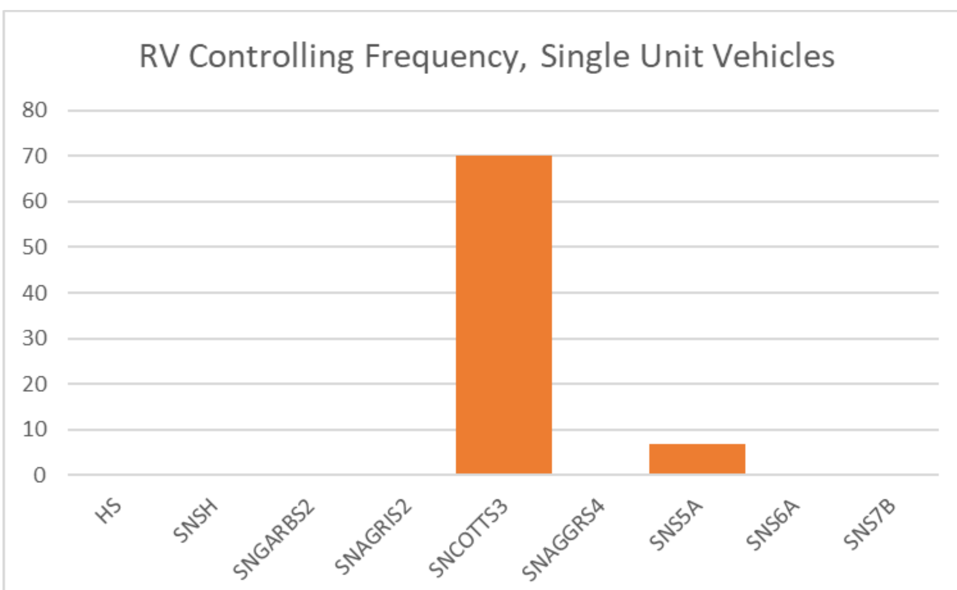
Bridge 220015, Tandem Trucks

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		33.2	30.9	25.4	23.3	21.2	19.1	17.0
	99	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		32.7	27.1	25.0	22.9	20.8	18.8	16.7
	98	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		32.3	26.7	24.6	22.6	20.5	18.4	16.4
	97	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		31.8	26.3	24.2	22.2	20.2	18.1	16.1
	96	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		31.3	25.9	23.9	21.8	19.8	17.8	15.8
	95	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		30.8	25.5	23.5	21.5	19.5	17.5	15.5
	94	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		27.0	25.1	23.1	21.1	19.1	17.1	15.2
	93	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		26.6	24.7	22.7	20.7	18.8	16.8	14.9
	92	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		26.2	24.2	22.3	20.4	18.4	16.5	14.6
	91	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		25.7	23.8	21.9	20.0	18.1	16.2	14.3
	90	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		25.3	23.4	21.5	19.6	17.7	15.8	14.0



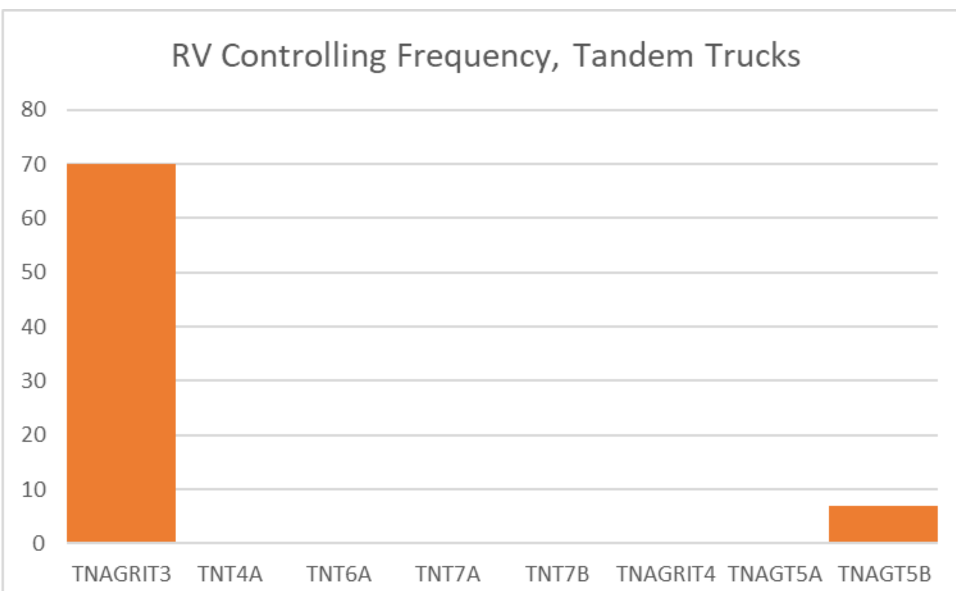
Bridge 220025, All Vehicles

Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNS5A 33.2	SNS5A 30.9	SNCOTTS3 25.4	SNCOTTS3 23.3	SNCOTTS3 21.2	SNCOTTS3 19.1	SNCOTTS3 17.0
	99	SNS5A 32.7	SNCOTTS3 27.1	SNCOTTS3 25.0	SNCOTTS3 22.9	SNCOTTS3 20.8	SNCOTTS3 18.8	SNCOTTS3 16.7
	98	SNS5A 32.3	SNCOTTS3 26.7	SNCOTTS3 24.6	SNCOTTS3 22.6	SNCOTTS3 20.5	SNCOTTS3 18.4	SNCOTTS3 16.4
	97	SNS5A 31.8	SNCOTTS3 26.3	SNCOTTS3 24.2	SNCOTTS3 22.2	SNCOTTS3 20.2	SNCOTTS3 18.1	SNCOTTS3 16.1
	96	SNS5A 31.3	SNCOTTS3 25.9	SNCOTTS3 23.9	SNCOTTS3 21.8	SNCOTTS3 19.8	SNCOTTS3 17.8	SNCOTTS3 15.8
	95	SNS5A 30.8	SNCOTTS3 25.5	SNCOTTS3 23.5	SNCOTTS3 21.5	SNCOTTS3 19.5	SNCOTTS3 17.5	SNCOTTS3 15.5
	94	SNCOTTS3 27.0	SNCOTTS3 25.1	SNCOTTS3 23.1	SNCOTTS3 21.1	SNCOTTS3 19.1	SNCOTTS3 17.1	SNCOTTS3 15.2
	93	SNCOTTS3 26.6	SNCOTTS3 24.7	SNCOTTS3 22.7	SNCOTTS3 20.7	SNCOTTS3 18.8	SNCOTTS3 16.8	SNCOTTS3 14.9
	92	SNCOTTS3 26.2	SNCOTTS3 24.2	SNCOTTS3 22.3	SNCOTTS3 20.4	SNCOTTS3 18.4	SNCOTTS3 16.5	SNCOTTS3 14.6
	91	SNCOTTS3 25.7	SNCOTTS3 23.8	SNCOTTS3 21.9	SNCOTTS3 20.0	SNCOTTS3 18.1	SNCOTTS3 16.2	SNCOTTS3 14.3
	90	SNCOTTS3 25.3	SNCOTTS3 23.4	SNCOTTS3 21.5	SNCOTTS3 19.6	SNCOTTS3 17.7	SNCOTTS3 15.8	SNCOTTS3 14.0



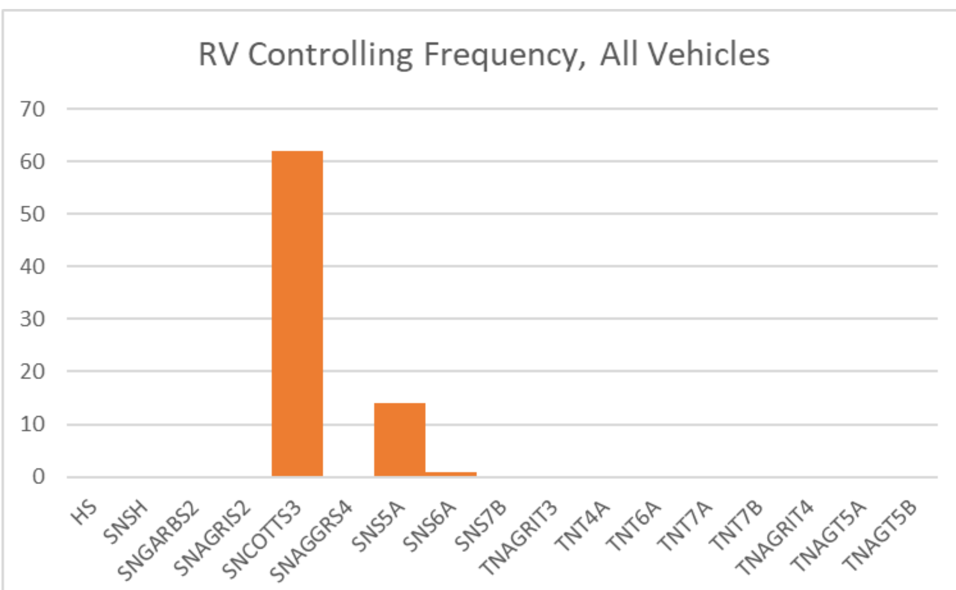
Bridge 220025, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	TNAGT5B 37.6	TNAGT5B 35.0	TNAGRIT3 30.6	TNAGRIT3 28.0	TNAGRIT3 25.5	TNAGRIT3 23.0	TNAGRIT3 20.4
	99	TNAGT5B 37.1	TNAGRIT3 32.6	TNAGRIT3 30.1	TNAGRIT3 27.6	TNAGRIT3 25.1	TNAGRIT3 22.6	TNAGRIT3 20.1
	98	TNAGT5B 36.5	TNAGRIT3 32.1	TNAGRIT3 29.6	TNAGRIT3 27.2	TNAGRIT3 24.7	TNAGRIT3 22.2	TNAGRIT3 19.7
	97	TNAGT5B 36.0	TNAGRIT3 31.6	TNAGRIT3 29.2	TNAGRIT3 26.7	TNAGRIT3 24.3	TNAGRIT3 21.8	TNAGRIT3 19.4
	96	TNAGT5B 35.5	TNAGRIT3 31.1	TNAGRIT3 28.7	TNAGRIT3 26.3	TNAGRIT3 23.8	TNAGRIT3 21.4	TNAGRIT3 19.0
	95	TNAGT5B 34.9	TNAGRIT3 30.7	TNAGRIT3 28.2	TNAGRIT3 25.8	TNAGRIT3 23.4	TNAGRIT3 21.0	TNAGRIT3 18.6
	94	TNAGRIT3 32.5	TNAGRIT3 30.2	TNAGRIT3 27.8	TNAGRIT3 25.4	TNAGRIT3 23.0	TNAGRIT3 20.6	TNAGRIT3 18.3
	93	TNAGRIT3 32.0	TNAGRIT3 29.7	TNAGRIT3 27.3	TNAGRIT3 24.9	TNAGRIT3 22.6	TNAGRIT3 20.2	TNAGRIT3 17.9
	92	TNAGRIT3 31.5	TNAGRIT3 29.2	TNAGRIT3 26.8	TNAGRIT3 24.5	TNAGRIT3 22.2	TNAGRIT3 19.8	TNAGRIT3 17.5
	91	TNAGRIT3 31.0	TNAGRIT3 28.7	TNAGRIT3 26.4	TNAGRIT3 24.1	TNAGRIT3 21.8	TNAGRIT3 19.4	TNAGRIT3 17.2
	90	TNAGRIT3 30.4	TNAGRIT3 28.2	TNAGRIT3 25.9	TNAGRIT3 23.6	TNAGRIT3 21.3	TNAGRIT3 19.1	TNAGRIT3 16.8



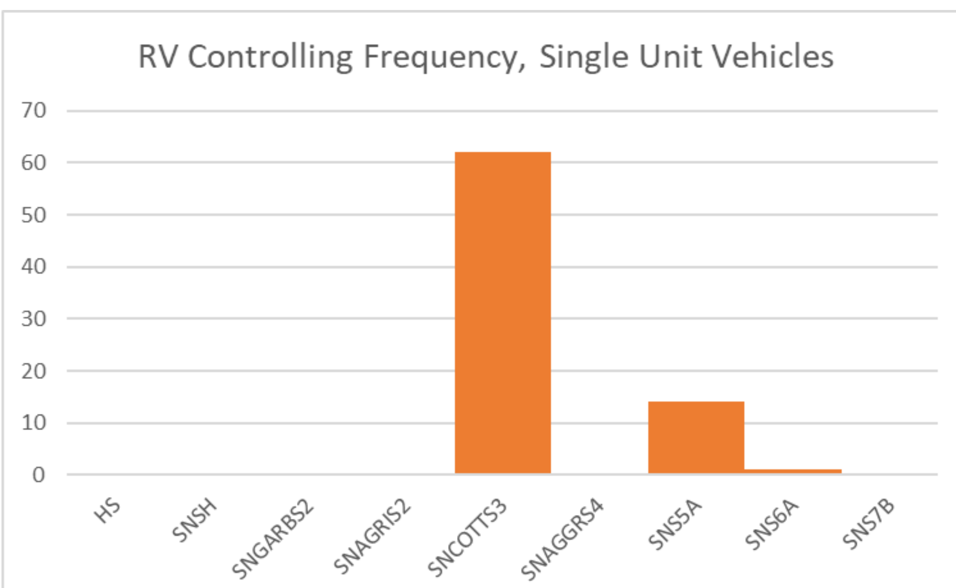
Bridge 220025, Tandem Trucks

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.0	33.4	27.2	25.1	23.1	21.1	19.1
	99	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		35.2	32.9	26.8	24.8	22.8	20.8	18.8
	98	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		34.7	32.5	26.4	24.4	22.4	20.5	18.5
	97	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		34.2	32.0	26.0	24.1	22.1	20.2	18.2
	96	SNS5A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		33.8	31.6	25.7	23.7	21.8	19.9	17.9
	95	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		33.3	27.2	25.3	23.4	21.5	19.5	17.6
	94	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		32.8	26.8	24.9	23.0	21.1	19.2	17.3
	93	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		32.3	26.4	24.6	22.7	20.8	18.9	17.0
	92	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		31.9	26.0	24.2	22.3	20.5	18.6	16.7
	91	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		31.4	25.7	23.8	22.0	20.1	18.3	16.4
	90	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		27.1	25.3	23.4	21.6	19.8	18.0	16.2



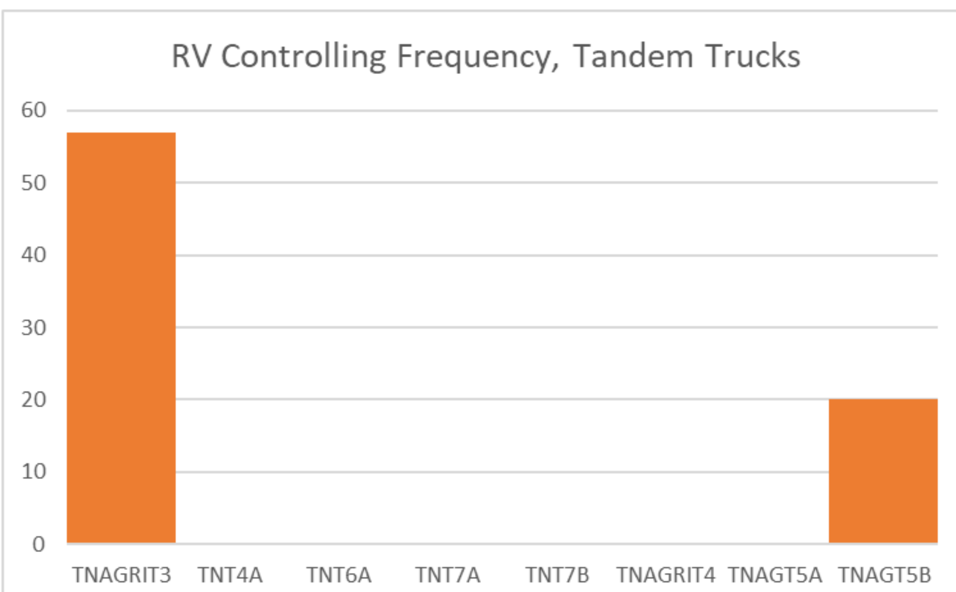
Bridge 240138, All Vehicles

Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNS6A 38.0	SNS5A 33.4	SNCOTTS3 27.2	SNCOTTS3 25.1	SNCOTTS3 23.1	SNCOTTS3 21.1	SNCOTTS3 19.1
	99	SNS5A 35.2	SNS5A 32.9	SNCOTTS3 26.8	SNCOTTS3 24.8	SNCOTTS3 22.8	SNCOTTS3 20.8	SNCOTTS3 18.8
	98	SNS5A 34.7	SNS5A 32.5	SNCOTTS3 26.4	SNCOTTS3 24.4	SNCOTTS3 22.4	SNCOTTS3 20.5	SNCOTTS3 18.5
	97	SNS5A 34.2	SNS5A 32.0	SNCOTTS3 26.0	SNCOTTS3 24.1	SNCOTTS3 22.1	SNCOTTS3 20.2	SNCOTTS3 18.2
	96	SNS5A 33.8	SNS5A 31.6	SNCOTTS3 25.7	SNCOTTS3 23.7	SNCOTTS3 21.8	SNCOTTS3 19.9	SNCOTTS3 17.9
	95	SNS5A 33.3	SNCOTTS3 27.2	SNCOTTS3 25.3	SNCOTTS3 23.4	SNCOTTS3 21.5	SNCOTTS3 19.5	SNCOTTS3 17.6
	94	SNS5A 32.8	SNCOTTS3 26.8	SNCOTTS3 24.9	SNCOTTS3 23.0	SNCOTTS3 21.1	SNCOTTS3 19.2	SNCOTTS3 17.3
	93	SNS5A 32.3	SNCOTTS3 26.4	SNCOTTS3 24.6	SNCOTTS3 22.7	SNCOTTS3 20.8	SNCOTTS3 18.9	SNCOTTS3 17.0
	92	SNS5A 31.9	SNCOTTS3 26.0	SNCOTTS3 24.2	SNCOTTS3 22.3	SNCOTTS3 20.5	SNCOTTS3 18.6	SNCOTTS3 16.7
	91	SNS5A 31.4	SNCOTTS3 25.7	SNCOTTS3 23.8	SNCOTTS3 22.0	SNCOTTS3 20.1	SNCOTTS3 18.3	SNCOTTS3 16.4
	90	SNCOTTS3 27.1	SNCOTTS3 25.3	SNCOTTS3 23.4	SNCOTTS3 21.6	SNCOTTS3 19.8	SNCOTTS3 18.0	SNCOTTS3 16.2



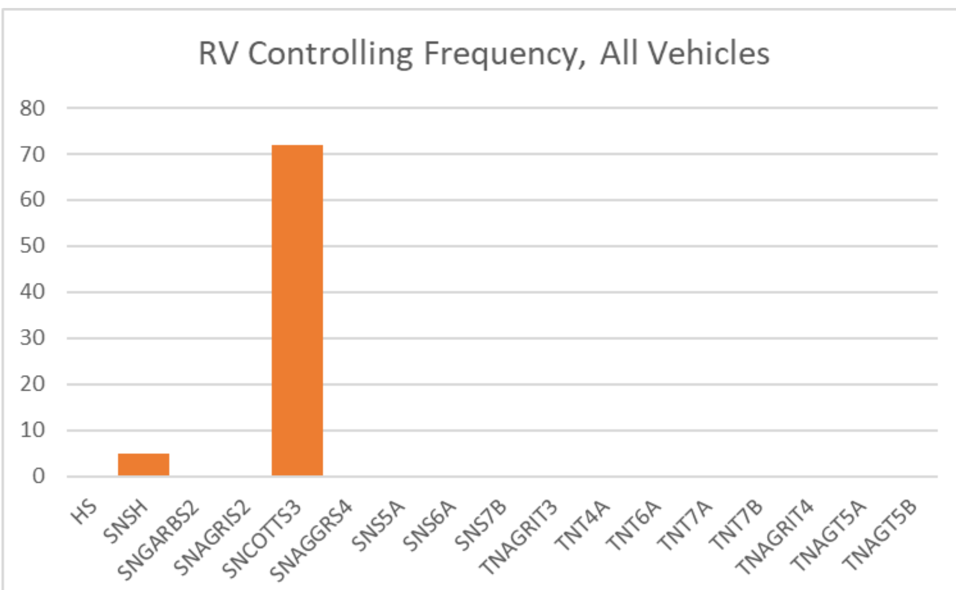
Bridge 240138, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		41.3	38.6	35.9	31.2	28.7	26.2	23.7
	99	TNAGT5B	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		40.7	38.1	35.4	30.8	28.3	25.8	23.3
	98	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		40.2	37.6	32.8	30.4	27.9	25.4	22.9
	97	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		39.6	37.1	32.3	29.9	27.5	25.0	22.6
	96	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		39.1	36.5	31.9	29.5	27.1	24.6	22.2
	95	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		38.5	36.0	31.4	29.0	26.6	24.3	21.9
	94	TNAGT5B	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		38.0	35.5	31.0	28.6	26.2	23.9	21.5
	93	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		37.4	32.8	30.5	28.2	25.8	23.5	21.1
	92	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		36.9	32.3	30.0	27.7	25.4	23.1	20.8
	91	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		36.4	31.9	29.6	27.3	25.0	22.7	20.4
	90	TNAGT5B	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3	TNAGRIT3
		35.8	31.4	29.1	26.8	24.6	22.3	20.1



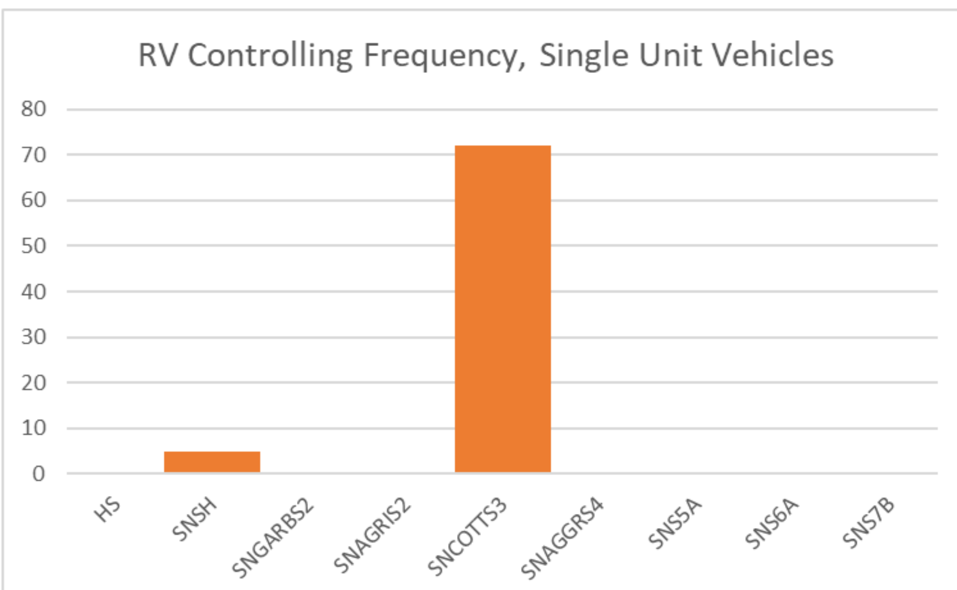
Bridge 240138, Tandem Trucks

All Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		22.6	21.3	20.0	18.7	17.4	16.1	14.7
	99	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		22.3	21.0	19.7	18.4	17.2	15.9	14.6
	98	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		22.0	20.8	19.5	18.2	16.9	15.7	14.4
	97	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		21.8	20.5	19.3	18.0	16.7	15.4	14.2
	96	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		21.5	20.3	19.0	17.7	16.5	15.2	14.0
	95	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		21.2	20.0	18.8	17.5	16.3	15.0	13.8
	94	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNSH
		21.0	19.7	18.5	17.3	16.1	14.8	13.4
	93	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNSH
		20.7	19.5	18.3	17.0	15.9	14.6	13.3
	92	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNSH
		20.4	19.2	18.0	16.8	15.6	14.4	13.1
	91	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNSH
		20.1	19.0	17.8	16.6	15.4	14.2	12.9
	90	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNSH
		19.9	18.7	17.6	16.4	15.2	14.0	12.7



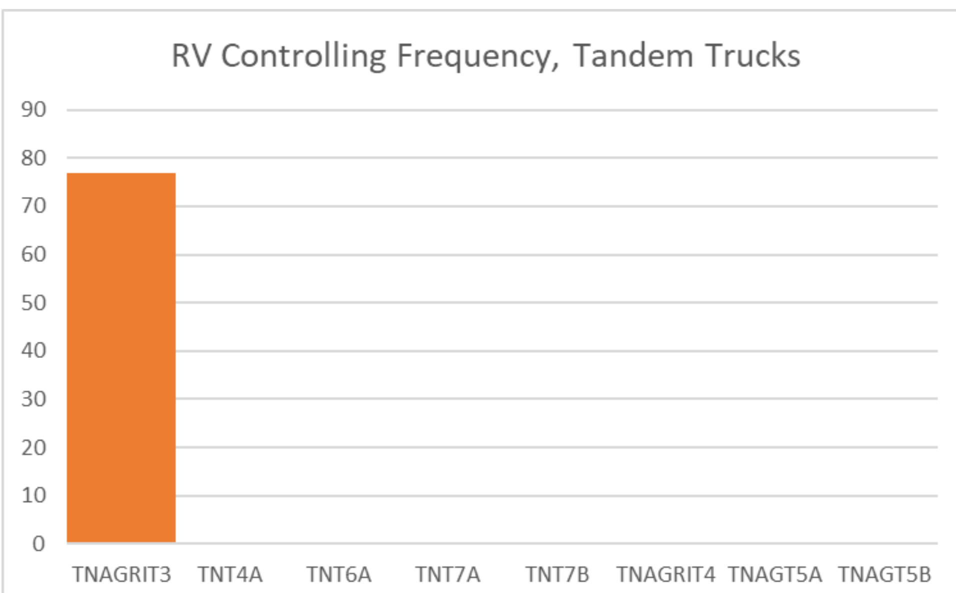
Bridge 310008, All Vehicles

Single Unit Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	SNCOTTS3 22.6	SNCOTTS3 21.3	SNCOTTS3 20.0	SNCOTTS3 18.7	SNCOTTS3 17.4	SNCOTTS3 16.1	SNCOTTS3 14.7
	99	SNCOTTS3 22.3	SNCOTTS3 21.0	SNCOTTS3 19.7	SNCOTTS3 18.4	SNCOTTS3 17.2	SNCOTTS3 15.9	SNCOTTS3 14.6
	98	SNCOTTS3 22.0	SNCOTTS3 20.8	SNCOTTS3 19.5	SNCOTTS3 18.2	SNCOTTS3 16.9	SNCOTTS3 15.7	SNCOTTS3 14.4
	97	SNCOTTS3 21.8	SNCOTTS3 20.5	SNCOTTS3 19.3	SNCOTTS3 18.0	SNCOTTS3 16.7	SNCOTTS3 15.4	SNCOTTS3 14.2
	96	SNCOTTS3 21.5	SNCOTTS3 20.3	SNCOTTS3 19.0	SNCOTTS3 17.7	SNCOTTS3 16.5	SNCOTTS3 15.2	SNCOTTS3 14.0
	95	SNCOTTS3 21.2	SNCOTTS3 20.0	SNCOTTS3 18.8	SNCOTTS3 17.5	SNCOTTS3 16.3	SNCOTTS3 15.0	SNCOTTS3 13.8
	94	SNCOTTS3 21.0	SNCOTTS3 19.7	SNCOTTS3 18.5	SNCOTTS3 17.3	SNCOTTS3 16.1	SNCOTTS3 14.8	SNSH 13.4
	93	SNCOTTS3 20.7	SNCOTTS3 19.5	SNCOTTS3 18.3	SNCOTTS3 17.0	SNCOTTS3 15.9	SNCOTTS3 14.6	SNSH 13.3
	92	SNCOTTS3 20.4	SNCOTTS3 19.2	SNCOTTS3 18.0	SNCOTTS3 16.8	SNCOTTS3 15.6	SNCOTTS3 14.4	SNSH 13.1
	91	SNCOTTS3 20.1	SNCOTTS3 19.0	SNCOTTS3 17.8	SNCOTTS3 16.6	SNCOTTS3 15.4	SNCOTTS3 14.2	SNSH 12.9
	90	SNCOTTS3 19.9	SNCOTTS3 18.7	SNCOTTS3 17.6	SNCOTTS3 16.4	SNCOTTS3 15.2	SNCOTTS3 14.0	SNSH 12.7



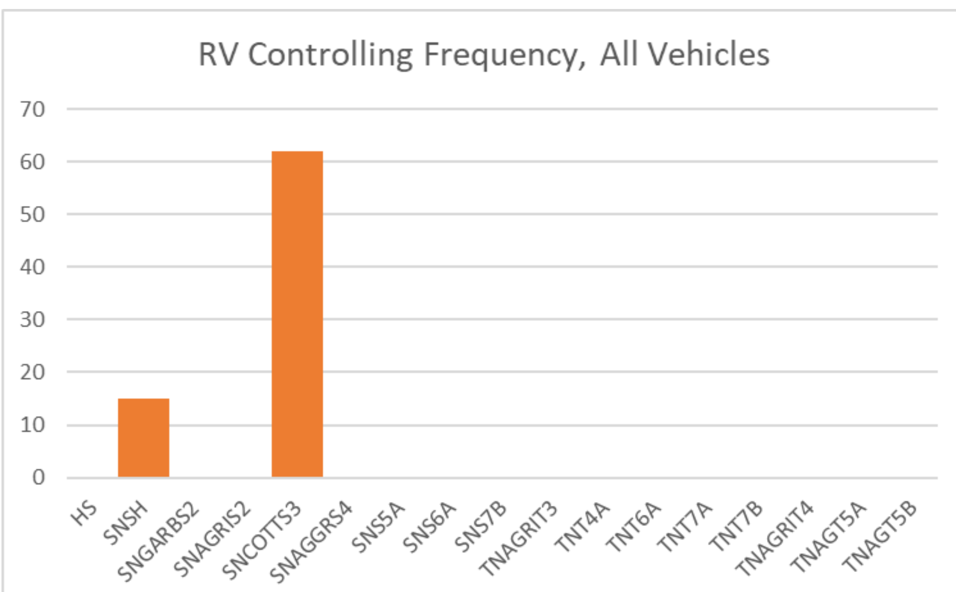
Bridge 310008, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	TNAGRIT3 28.5	TNAGRIT3 26.8	TNAGRIT3 25.2	TNAGRIT3 23.5	TNAGRIT3 21.9	TNAGRIT3 20.2	TNAGRIT3 18.6
	99	TNAGRIT3 28.1	TNAGRIT3 26.5	TNAGRIT3 24.9	TNAGRIT3 23.2	TNAGRIT3 21.6	TNAGRIT3 20.0	TNAGRIT3 18.4
	98	TNAGRIT3 27.8	TNAGRIT3 26.2	TNAGRIT3 24.6	TNAGRIT3 22.9	TNAGRIT3 21.4	TNAGRIT3 19.7	TNAGRIT3 18.1
	97	TNAGRIT3 27.5	TNAGRIT3 25.9	TNAGRIT3 24.3	TNAGRIT3 22.7	TNAGRIT3 21.1	TNAGRIT3 19.5	TNAGRIT3 17.9
	96	TNAGRIT3 27.1	TNAGRIT3 25.5	TNAGRIT3 24.0	TNAGRIT3 22.4	TNAGRIT3 20.8	TNAGRIT3 19.2	TNAGRIT3 17.6
	95	TNAGRIT3 26.8	TNAGRIT3 25.2	TNAGRIT3 23.7	TNAGRIT3 22.1	TNAGRIT3 20.5	TNAGRIT3 19.0	TNAGRIT3 17.4
	94	TNAGRIT3 26.4	TNAGRIT3 24.9	TNAGRIT3 23.4	TNAGRIT3 21.8	TNAGRIT3 20.3	TNAGRIT3 18.7	TNAGRIT3 17.2
	93	TNAGRIT3 26.1	TNAGRIT3 24.6	TNAGRIT3 23.1	TNAGRIT3 21.5	TNAGRIT3 20.0	TNAGRIT3 18.5	TNAGRIT3 16.9
	92	TNAGRIT3 25.7	TNAGRIT3 24.2	TNAGRIT3 22.8	TNAGRIT3 21.2	TNAGRIT3 19.7	TNAGRIT3 18.2	TNAGRIT3 16.7
	91	TNAGRIT3 25.4	TNAGRIT3 23.9	TNAGRIT3 22.5	TNAGRIT3 20.9	TNAGRIT3 19.5	TNAGRIT3 18.0	TNAGRIT3 16.5
	90	TNAGRIT3 25.1	TNAGRIT3 23.6	TNAGRIT3 22.1	TNAGRIT3 20.6	TNAGRIT3 19.2	TNAGRIT3 17.7	TNAGRIT3 16.2



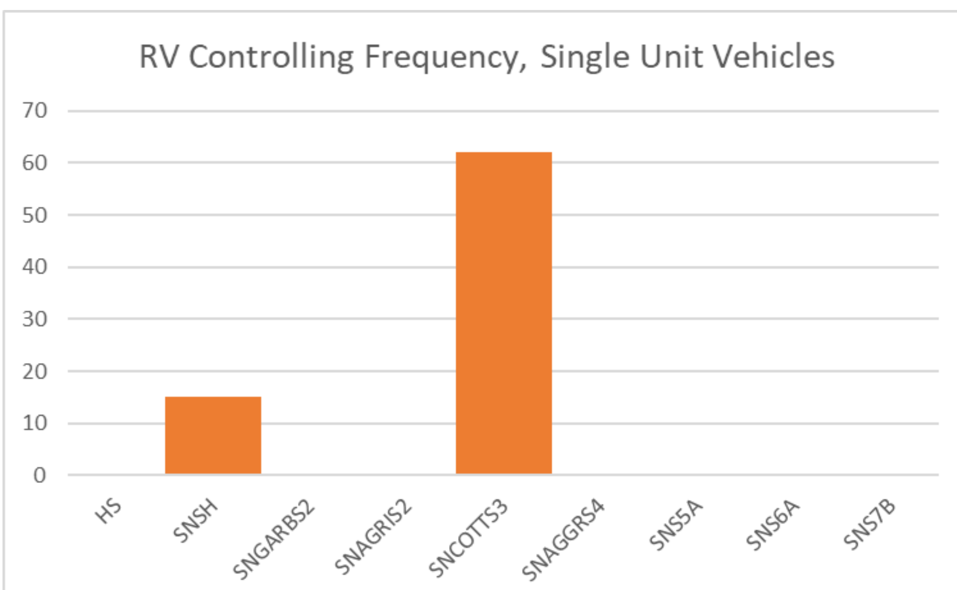
Bridge 310008, Tandem Trucks

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNCOTTS3 20.7	SNCOTTS3 19.5	SNCOTTS3 18.3	SNCOTTS3 17.1	SNCOTTS3 16.0	SNCOTTS3 14.8	SNSH 13.4
	99	SNCOTTS3 20.4	SNCOTTS3 19.3	SNCOTTS3 18.1	SNCOTTS3 16.9	SNCOTTS3 15.8	SNCOTTS3 14.6	SNSH 13.2
	98	SNCOTTS3 20.2	SNCOTTS3 19.0	SNCOTTS3 17.9	SNCOTTS3 16.7	SNCOTTS3 15.6	SNCOTTS3 14.4	SNSH 13.0
	97	SNCOTTS3 19.9	SNCOTTS3 18.8	SNCOTTS3 17.7	SNCOTTS3 16.5	SNCOTTS3 15.4	SNCOTTS3 14.3	SNSH 12.9
	96	SNCOTTS3 19.7	SNCOTTS3 18.6	SNCOTTS3 17.5	SNCOTTS3 16.3	SNCOTTS3 15.2	SNCOTTS3 14.1	SNSH 12.7
	95	SNCOTTS3 19.5	SNCOTTS3 18.3	SNCOTTS3 17.2	SNCOTTS3 16.1	SNCOTTS3 15.0	SNCOTTS3 13.9	SNSH 12.5
	94	SNCOTTS3 19.2	SNCOTTS3 18.1	SNCOTTS3 17.0	SNCOTTS3 15.9	SNCOTTS3 14.8	SNCOTTS3 13.7	SNSH 12.4
	93	SNCOTTS3 19.0	SNCOTTS3 17.9	SNCOTTS3 16.8	SNCOTTS3 15.7	SNCOTTS3 14.6	SNSH 13.3	SNSH 12.2
	92	SNCOTTS3 18.7	SNCOTTS3 17.7	SNCOTTS3 16.6	SNCOTTS3 15.5	SNCOTTS3 14.4	SNSH 13.1	SNSH 12.1
	91	SNCOTTS3 18.5	SNCOTTS3 17.4	SNCOTTS3 16.4	SNCOTTS3 15.3	SNCOTTS3 14.2	SNSH 12.9	SNSH 11.9
	90	SNCOTTS3 18.3	SNCOTTS3 17.2	SNCOTTS3 16.2	SNCOTTS3 15.1	SNCOTTS3 14.0	SNSH 12.8	SNSH 11.7



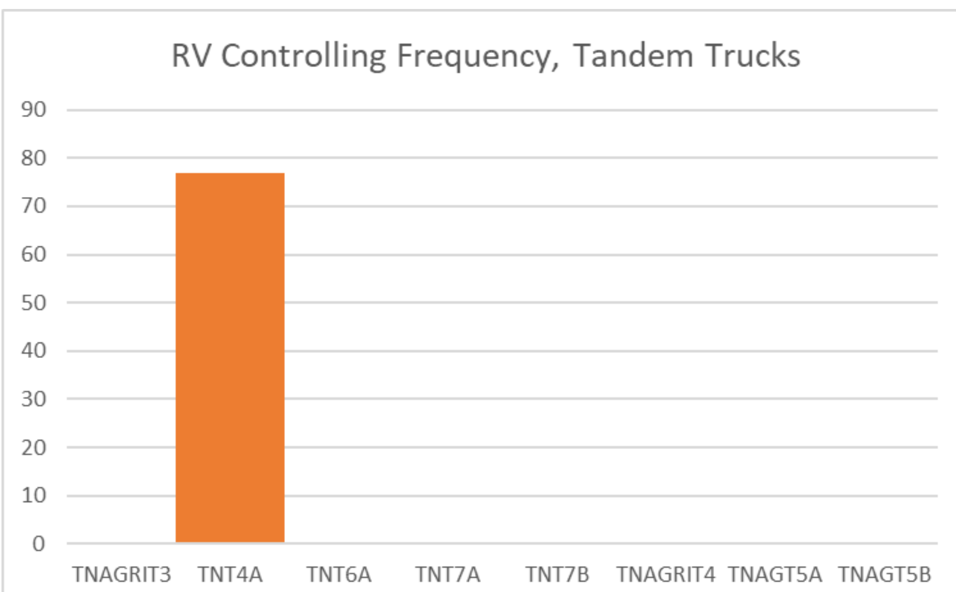
Bridge 310089, All Vehicles

Single Unit Vehicles								
Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNCOTTS3 20.7	SNCOTTS3 19.5	SNCOTTS3 18.3	SNCOTTS3 17.1	SNCOTTS3 16.0	SNCOTTS3 14.8	SNSH 13.4
	99	SNCOTTS3 20.4	SNCOTTS3 19.3	SNCOTTS3 18.1	SNCOTTS3 16.9	SNCOTTS3 15.8	SNCOTTS3 14.6	SNSH 13.2
	98	SNCOTTS3 20.2	SNCOTTS3 19.0	SNCOTTS3 17.9	SNCOTTS3 16.7	SNCOTTS3 15.6	SNCOTTS3 14.4	SNSH 13.0
	97	SNCOTTS3 19.9	SNCOTTS3 18.8	SNCOTTS3 17.7	SNCOTTS3 16.5	SNCOTTS3 15.4	SNCOTTS3 14.3	SNSH 12.9
	96	SNCOTTS3 19.7	SNCOTTS3 18.6	SNCOTTS3 17.5	SNCOTTS3 16.3	SNCOTTS3 15.2	SNCOTTS3 14.1	SNSH 12.7
	95	SNCOTTS3 19.5	SNCOTTS3 18.3	SNCOTTS3 17.2	SNCOTTS3 16.1	SNCOTTS3 15.0	SNCOTTS3 13.9	SNSH 12.5
	94	SNCOTTS3 19.2	SNCOTTS3 18.1	SNCOTTS3 17.0	SNCOTTS3 15.9	SNCOTTS3 14.8	SNCOTTS3 13.7	SNSH 12.4
	93	SNCOTTS3 19.0	SNCOTTS3 17.9	SNCOTTS3 16.8	SNCOTTS3 15.7	SNCOTTS3 14.6	SNSH 13.3	SNSH 12.2
	92	SNCOTTS3 18.7	SNCOTTS3 17.7	SNCOTTS3 16.6	SNCOTTS3 15.5	SNCOTTS3 14.4	SNSH 13.1	SNSH 12.1
	91	SNCOTTS3 18.5	SNCOTTS3 17.4	SNCOTTS3 16.4	SNCOTTS3 15.3	SNCOTTS3 14.2	SNSH 12.9	SNSH 11.9
	90	SNCOTTS3 18.3	SNCOTTS3 17.2	SNCOTTS3 16.2	SNCOTTS3 15.1	SNCOTTS3 14.0	SNSH 12.8	SNSH 11.7



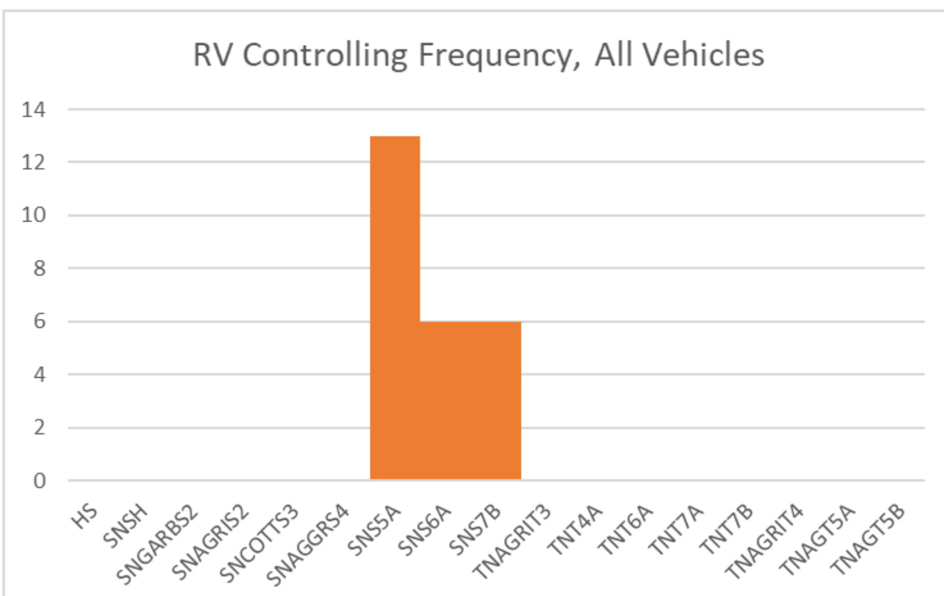
Bridge 310089, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	TNT4A 27.1	TNT4A 25.6	TNT4A 24.0	TNT4A 22.5	TNT4A 20.9	TNT4A 19.4	TNT4A 17.9
	99	TNT4A 26.8	TNT4A 25.3	TNT4A 23.8	TNT4A 22.2	TNT4A 20.7	TNT4A 19.2	TNT4A 17.6
	98	TNT4A 26.5	TNT4A 25.0	TNT4A 23.5	TNT4A 22.0	TNT4A 20.4	TNT4A 18.9	TNT4A 17.4
	97	TNT4A 26.2	TNT4A 24.7	TNT4A 23.2	TNT4A 21.7	TNT4A 20.2	TNT4A 18.7	TNT4A 17.2
	96	TNT4A 25.8	TNT4A 24.4	TNT4A 22.9	TNT4A 21.4	TNT4A 19.9	TNT4A 18.5	TNT4A 17.0
	95	TNT4A 25.5	TNT4A 24.1	TNT4A 22.6	TNT4A 21.2	TNT4A 19.7	TNT4A 18.2	TNT4A 16.8
	94	TNT4A 25.2	TNT4A 23.8	TNT4A 22.3	TNT4A 20.9	TNT4A 19.4	TNT4A 18.0	TNT4A 16.5
	93	TNT4A 24.9	TNT4A 23.5	TNT4A 22.1	TNT4A 20.6	TNT4A 19.2	TNT4A 17.8	TNT4A 16.3
	92	TNT4A 24.6	TNT4A 23.2	TNT4A 21.8	TNT4A 20.3	TNT4A 18.9	TNT4A 17.5	TNT4A 16.1
	91	TNT4A 24.3	TNT4A 22.9	TNT4A 21.5	TNT4A 20.1	TNT4A 18.7	TNT4A 17.3	TNT4A 15.9
	90	TNT4A 24.0	TNT4A 22.6	TNT4A 21.2	TNT4A 19.8	TNT4A 18.4	TNT4A 17.1	TNT4A 15.7



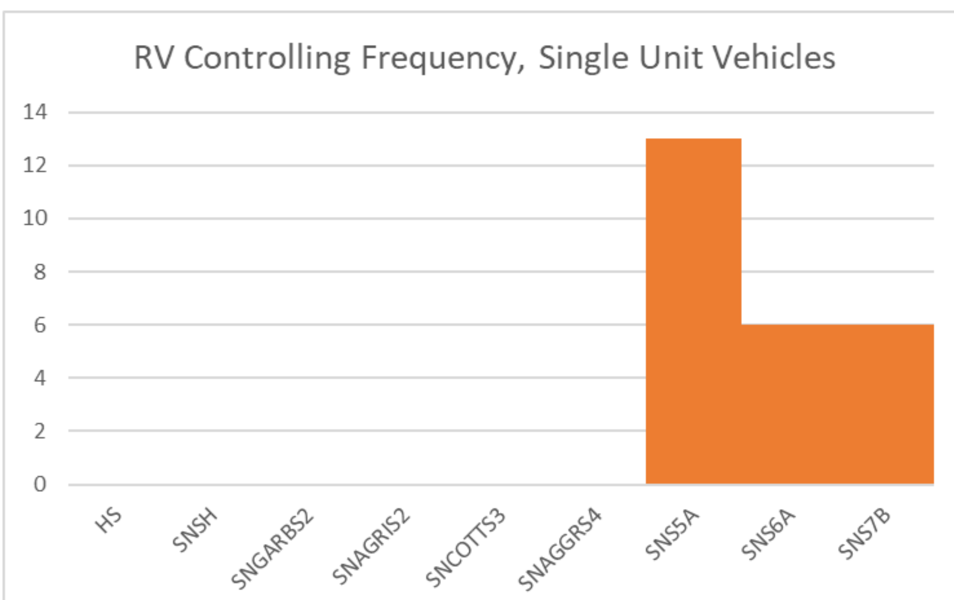
Bridge 310089, Tandem Trucks

All Vehicles								
Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 38.1
	99	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.4	SNS5A 35.4
	98	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.8	SNS5A 34.9
	97	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.3	SNS5A 34.4
	96	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.5	SNS5A 33.9
	95	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.0	SNS5A 33.4
	94	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 38.4	SNS5A 32.9
	93	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.5	SNS6A 37.8	SNS5A 32.4
	92	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.8	SNS5A 35.1	SNS5A 31.9
	91	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.2	SNS5A 34.5	SNS5A 31.4
	90	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.4	SNS5A 34.0	SNS5A 30.9



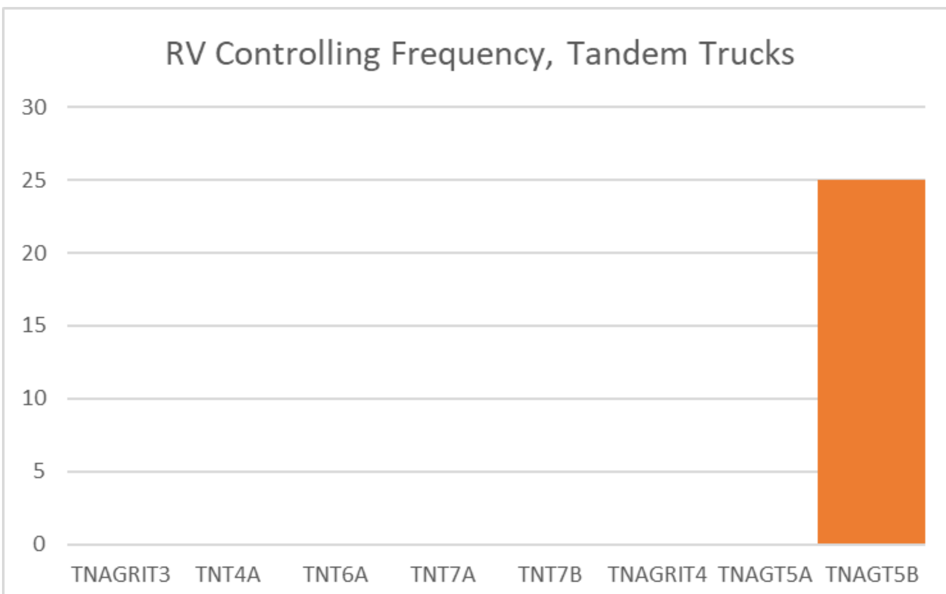
Bridge 330276, All Vehicles

Single Unit Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	**100**	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 38.1
	99	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.4	SNS5A 35.4
	98	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.8	SNS5A 34.9
	97	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.3	SNS5A 34.4
	96	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.5	SNS5A 33.9
	95	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.0	SNS5A 33.4
	94	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 38.4	SNS5A 32.9
	93	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.5	SNS6A 37.8	SNS5A 32.4
	92	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.8	SNS5A 35.1	SNS5A 31.9
	91	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.2	SNS5A 34.5	SNS5A 31.4
	90	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.4	SNS5A 34.0	SNS5A 30.9



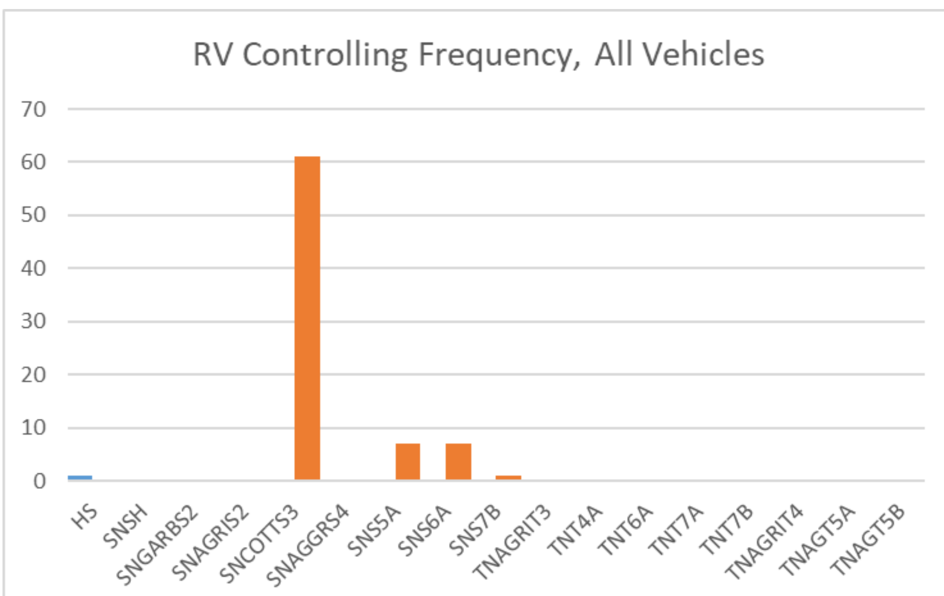
Bridge 330276, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	TNAGT5B
		N/A	N/A	N/A	N/A	N/A	N/A	41.1
	99	#N/A	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	N/A	44.5	40.6
	98	#N/A	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	N/A	43.9	40.0
	97	#N/A	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	N/A	43.3	39.4
	96	#N/A	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	N/A	42.7	38.9
	95	#N/A	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	N/A	42.0	38.3
	94	#N/A	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	N/A	41.4	37.7
	93	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	44.5	40.8	37.2
	92	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	43.9	40.2	36.6
	91	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	43.2	39.6	36.0
	90	#N/A	#N/A	#N/A	#N/A	TNAGT5B	TNAGT5B	TNAGT5B
		N/A	N/A	N/A	N/A	42.6	39.0	35.5



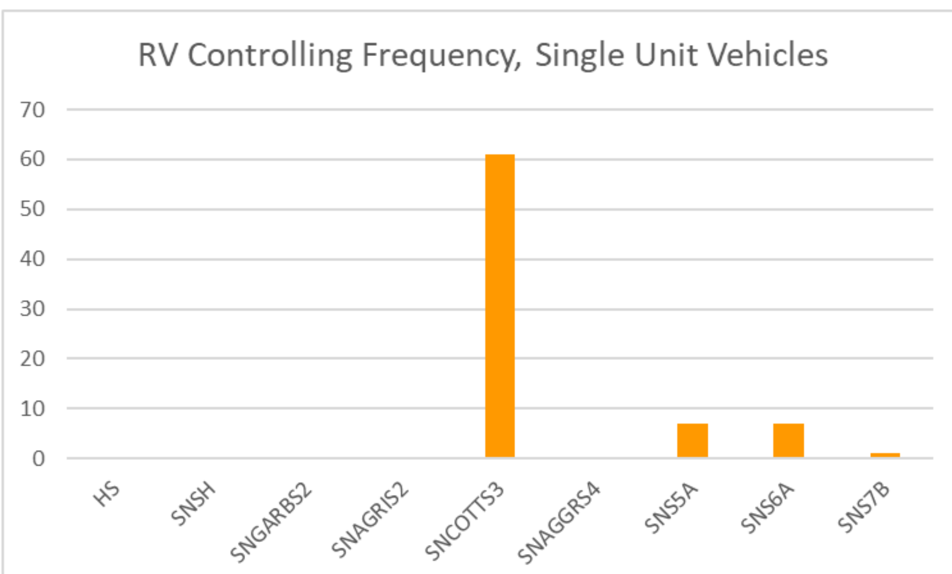
Bridge 330276, Tandem Trucks

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	SNS6A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	37.9	27.2	25.3	23.5	21.6	19.7
	99	SNS7B	SNS6A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.7	37.9	26.8	25.0	23.1	21.3	19.4
	98	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		39.8	35.5	26.5	24.7	22.8	21.0	19.2
	97	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		39.3	35.0	26.2	24.3	22.5	20.7	18.9
	96	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.8	34.6	25.8	24.0	22.2	20.4	18.6
	95	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.3	34.1	25.5	23.7	21.9	20.1	18.4
	94	SNS6A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.8	26.9	25.1	23.4	21.6	19.9	18.1
	93	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		35.4	26.5	24.8	23.0	21.3	19.6	17.8
	92	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		34.9	26.2	24.5	22.7	21.0	19.3	17.6
	91	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		34.4	25.8	24.1	22.4	20.7	19.0	17.3
	90	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		27.1	25.5	23.8	22.1	20.4	18.7	17.0



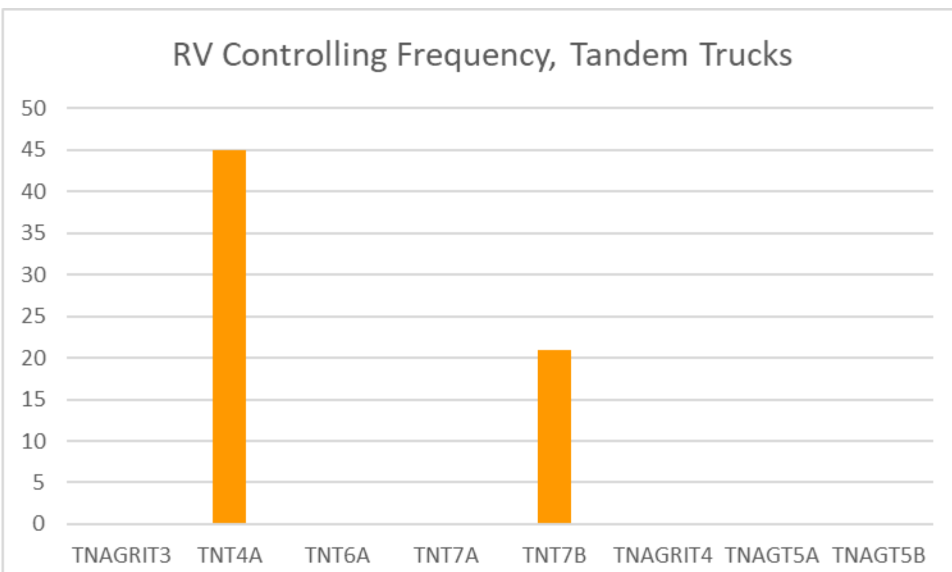
Bridge 350022, All Vehicles

Single Unit Vehicles								
Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	SNS6A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		N/A	37.9	27.2	25.3	23.5	21.6	19.7
	99	SNS7B	SNS6A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		41.7	37.9	26.8	25.0	23.1	21.3	19.4
	98	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		39.8	35.5	26.5	24.7	22.8	21.0	19.2
	97	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		39.3	35.0	26.2	24.3	22.5	20.7	18.9
	96	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.8	34.6	25.8	24.0	22.2	20.4	18.6
	95	SNS6A	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		38.3	34.1	25.5	23.7	21.9	20.1	18.4
	94	SNS6A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		37.8	26.9	25.1	23.4	21.6	19.9	18.1
	93	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		35.4	26.5	24.8	23.0	21.3	19.6	17.8
	92	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		34.9	26.2	24.5	22.7	21.0	19.3	17.6
	91	SNS5A	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		34.4	25.8	24.1	22.4	20.7	19.0	17.3
	90	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3	SNCOTTS3
		27.1	25.5	23.8	22.1	20.4	18.7	17.0



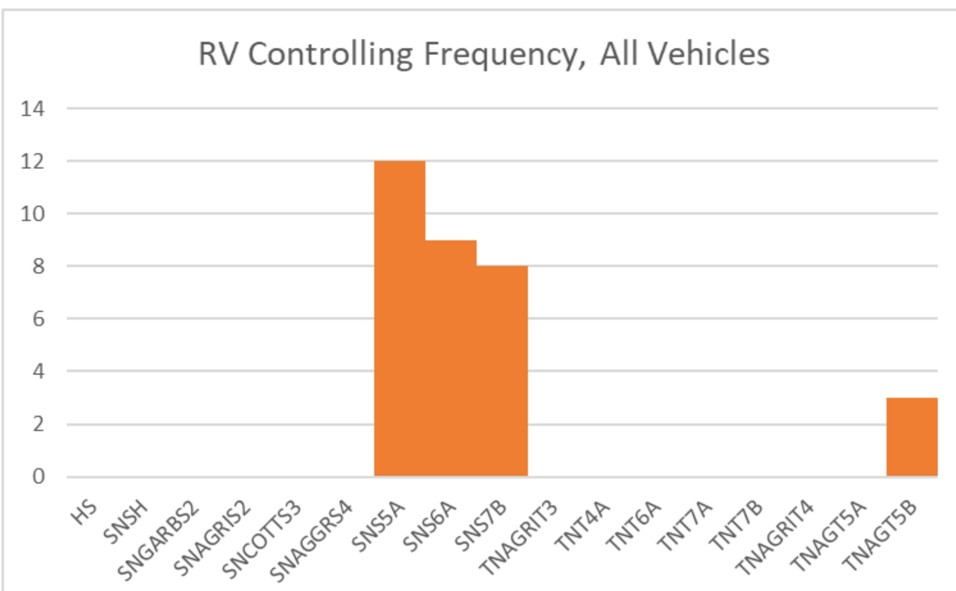
Bridge 350022, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A N/A	#N/A N/A	TNT7B 40.5	TNT7B 37.7	TNT4A 31.4	TNT4A 28.8	TNT4A 26.3
	99	#N/A N/A	#N/A N/A	TNT7B 40.0	TNT7B 37.2	TNT4A 31.0	TNT4A 28.5	TNT4A 26.0
	98	#N/A N/A	#N/A N/A	TNT7B 39.5	TNT4A 33.0	TNT4A 30.5	TNT4A 28.1	TNT4A 25.6
	97	#N/A N/A	TNT7B 41.7	TNT7B 39.0	TNT4A 32.5	TNT4A 30.1	TNT4A 27.7	TNT4A 25.3
	96	#N/A N/A	TNT7B 41.2	TNT7B 38.5	TNT4A 32.1	TNT4A 29.7	TNT4A 27.3	TNT4A 24.9
	95	#N/A N/A	TNT7B 40.6	TNT7B 38.0	TNT4A 31.7	TNT4A 29.3	TNT4A 26.9	TNT4A 24.6
	94	#N/A N/A	TNT7B 40.1	TNT7B 37.4	TNT4A 31.2	TNT4A 28.9	TNT4A 26.6	TNT4A 24.2
	93	#N/A N/A	TNT7B 39.5	TNT7B 36.9	TNT4A 30.8	TNT4A 28.5	TNT4A 26.2	TNT4A 23.8
	92	TNT7B 41.6	TNT7B 39.0	TNT4A 32.7	TNT4A 30.4	TNT4A 28.1	TNT4A 25.8	TNT4A 23.5
	91	TNT7B 41.0	TNT7B 38.5	TNT4A 32.2	TNT4A 30.0	TNT4A 27.7	TNT4A 25.4	TNT4A 23.1
	90	TNT7B 40.4	TNT7B 37.9	TNT4A 31.8	TNT4A 29.5	TNT4A 27.3	TNT4A 25.0	TNT4A 22.8



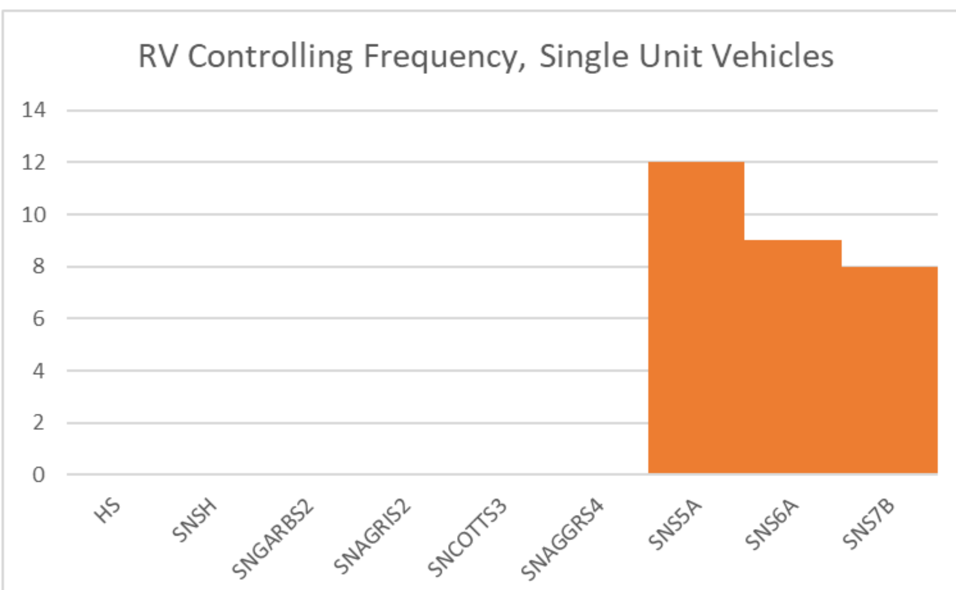
Bridge 350022, Tandem Trucks

All Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A
		N/A	N/A	N/A	N/A	N/A	41.1	37.8
	99	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A
		N/A	N/A	N/A	N/A	N/A	40.6	37.3
	98	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A
		N/A	N/A	N/A	N/A	N/A	40.1	35.3
	97	#N/A	#N/A	#N/A	#N/A	TNAGT5B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	44.9	39.5	34.9
	96	#N/A	#N/A	#N/A	#N/A	TNAGT5B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	44.4	39.0	34.4
	95	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	41.7	38.5	34.0
	94	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	41.1	38.0	33.6
	93	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	40.6	37.5	33.1
	92	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	40.1	35.5	32.7
	91	#N/A	#N/A	#N/A	TNAGT5B	SNS6A	SNS5A	SNS5A
		N/A	N/A	N/A	44.6	39.4	35.0	32.2
	90	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A	SNS5A
		N/A	N/A	N/A	41.9	38.9	34.5	31.8



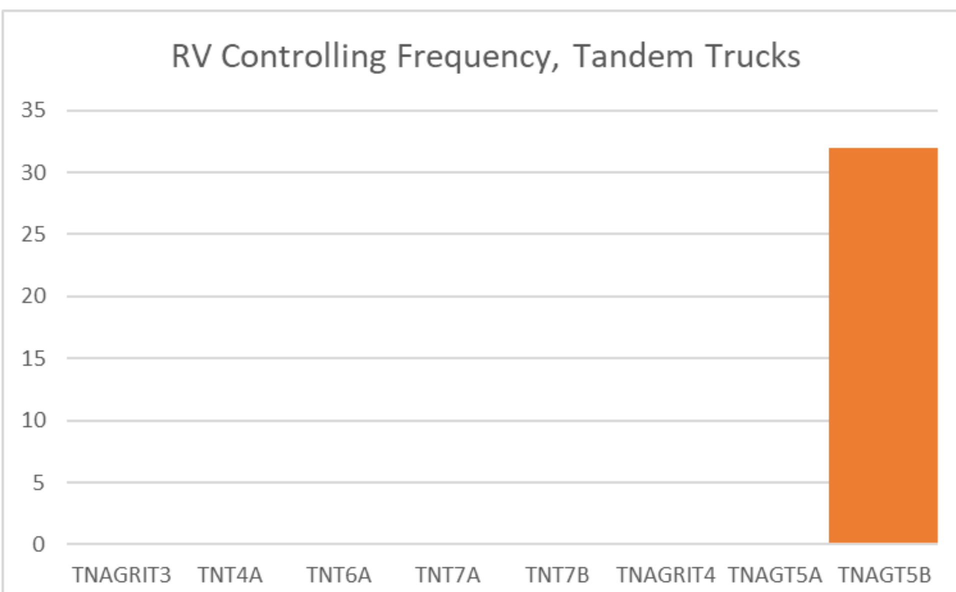
Bridge 430003, All Vehicles

Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.1	SNS6A 37.8
	99	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.6	SNS6A 37.3
	98	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.1	SNS5A 35.3
	97	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.5	SNS5A 34.9
	96	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.0	SNS5A 34.4
	95	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.7	SNS6A 38.5	SNS5A 34.0
	94	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.1	SNS6A 38.0	SNS5A 33.6
	93	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.6	SNS6A 37.5	SNS5A 33.1
	92	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 40.1	SNS5A 35.5	SNS5A 32.7
	91	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	SNS6A 39.4	SNS5A 35.0	SNS5A 32.2
	90	#N/A N/A	#N/A N/A	#N/A N/A	SNS7B 41.9	SNS6A 38.9	SNS5A 34.5	SNS5A 31.8



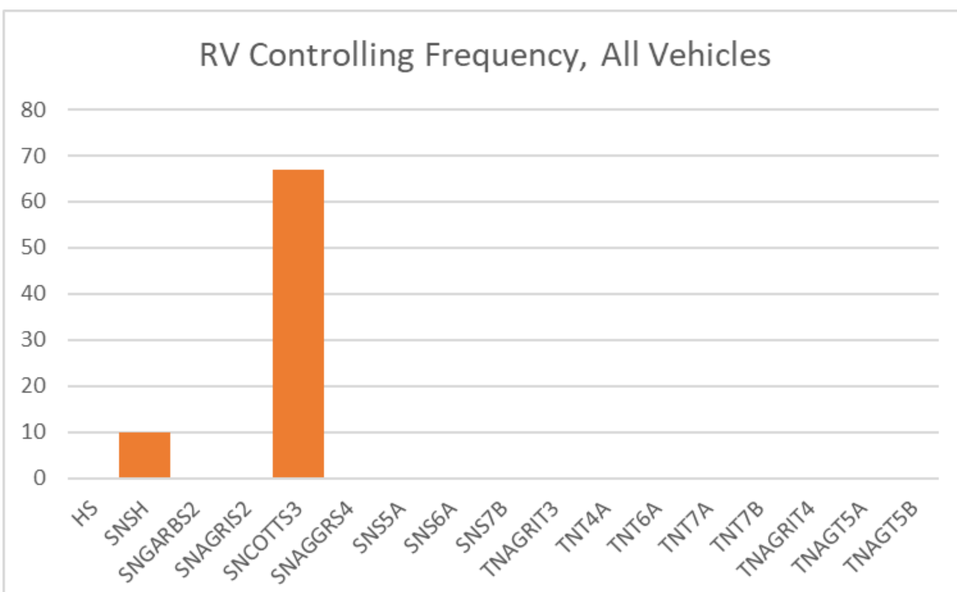
Bridge 430003, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.3	TNAGT5B 39.9
	99	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.7	TNAGT5B 39.4
	98	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.2	TNAGT5B 38.9
	97	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.9	TNAGT5B 41.7	TNAGT5B 38.4
	96	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.4	TNAGT5B 41.2	TNAGT5B 37.9
	95	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.8	TNAGT5B 40.6	TNAGT5B 37.4
	94	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.3	TNAGT5B 40.1	TNAGT5B 37.0
	93	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.7	TNAGT5B 39.6	TNAGT5B 36.5
	92	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.2	TNAGT5B 39.1	TNAGT5B 36.0
	91	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.6	TNAGT5B 41.6	TNAGT5B 38.5	TNAGT5B 35.5
	90	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.1	TNAGT5B 41.0	TNAGT5B 38.0	TNAGT5B 35.0



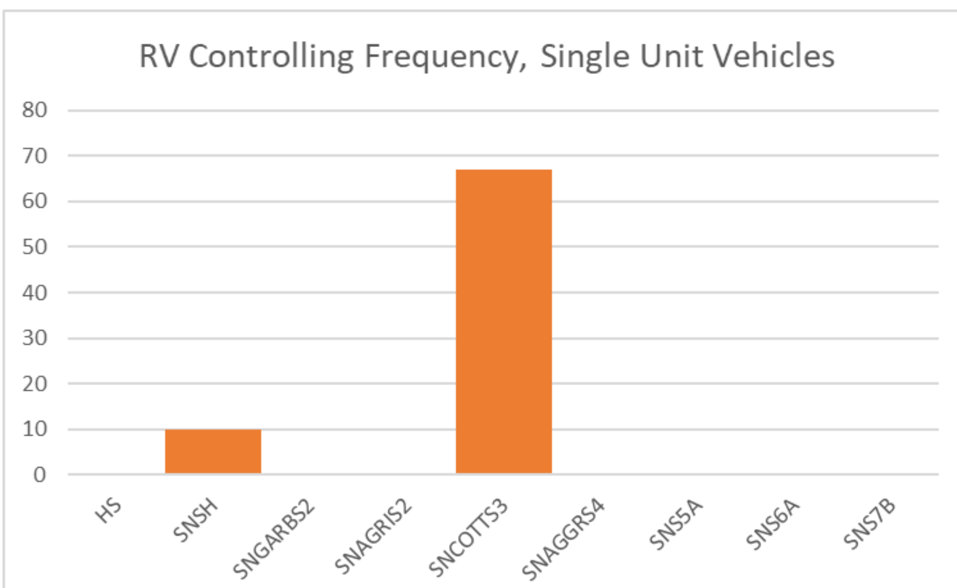
Bridge 430003, Tandem Trucks

All Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNCOTTS3 27.1	SNCOTTS3 25.0	SNCOTTS3 22.9	SNCOTTS3 20.8	SNCOTTS3 18.6	SNCOTTS3 16.5	SNCOTTS3 14.4
	99	SNCOTTS3 26.7	SNCOTTS3 24.6	SNCOTTS3 22.5	SNCOTTS3 20.4	SNCOTTS3 18.3	SNCOTTS3 16.2	SNCOTTS3 14.1
	98	SNCOTTS3 26.3	SNCOTTS3 24.2	SNCOTTS3 22.1	SNCOTTS3 20.0	SNCOTTS3 17.9	SNCOTTS3 15.8	SNCOTTS3 13.7
	97	SNCOTTS3 25.8	SNCOTTS3 23.7	SNCOTTS3 21.7	SNCOTTS3 19.6	SNCOTTS3 17.6	SNCOTTS3 15.5	SNSH 13.4
	96	SNCOTTS3 25.4	SNCOTTS3 23.3	SNCOTTS3 21.3	SNCOTTS3 19.2	SNCOTTS3 17.2	SNCOTTS3 15.2	SNSH 13.1
	95	SNCOTTS3 24.9	SNCOTTS3 22.9	SNCOTTS3 20.9	SNCOTTS3 18.9	SNCOTTS3 16.9	SNCOTTS3 14.8	SNSH 12.7
	94	SNCOTTS3 24.5	SNCOTTS3 22.5	SNCOTTS3 20.5	SNCOTTS3 18.5	SNCOTTS3 16.5	SNCOTTS3 14.5	SNSH 12.4
	93	SNCOTTS3 24.0	SNCOTTS3 22.1	SNCOTTS3 20.1	SNCOTTS3 18.1	SNCOTTS3 16.1	SNCOTTS3 14.2	SNSH 12.1
	92	SNCOTTS3 23.6	SNCOTTS3 21.6	SNCOTTS3 19.7	SNCOTTS3 17.7	SNCOTTS3 15.8	SNCOTTS3 13.8	SNSH 11.8
	91	SNCOTTS3 23.2	SNCOTTS3 21.2	SNCOTTS3 19.3	SNCOTTS3 17.4	SNCOTTS3 15.4	SNSH 13.4	SNSH 11.5
	90	SNCOTTS3 22.7	SNCOTTS3 20.8	SNCOTTS3 18.9	SNCOTTS3 17.0	SNCOTTS3 15.1	SNSH 13.1	SNSH 11.2



Bridge 480189, All Vehicles

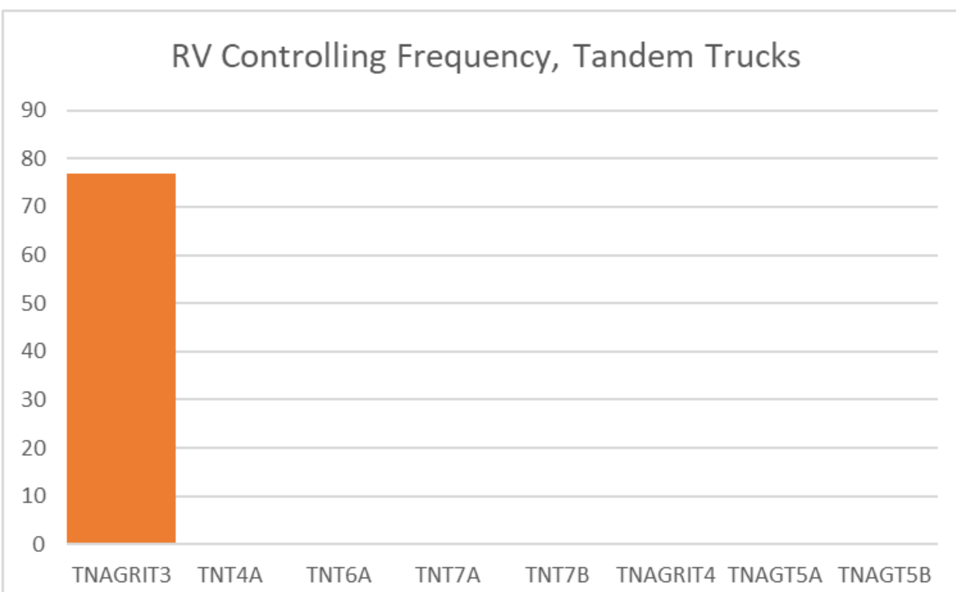
Single Unit Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	SNCOTTS3 27.1	SNCOTTS3 25.0	SNCOTTS3 22.9	SNCOTTS3 20.8	SNCOTTS3 18.6	SNCOTTS3 16.5	SNCOTTS3 14.4
	99	SNCOTTS3 26.7	SNCOTTS3 24.6	SNCOTTS3 22.5	SNCOTTS3 20.4	SNCOTTS3 18.3	SNCOTTS3 16.2	SNCOTTS3 14.1
	98	SNCOTTS3 26.3	SNCOTTS3 24.2	SNCOTTS3 22.1	SNCOTTS3 20.0	SNCOTTS3 17.9	SNCOTTS3 15.8	SNCOTTS3 13.7
	97	SNCOTTS3 25.8	SNCOTTS3 23.7	SNCOTTS3 21.7	SNCOTTS3 19.6	SNCOTTS3 17.6	SNCOTTS3 15.5	SNSH 13.4
	96	SNCOTTS3 25.4	SNCOTTS3 23.3	SNCOTTS3 21.3	SNCOTTS3 19.2	SNCOTTS3 17.2	SNCOTTS3 15.2	SNSH 13.1
	95	SNCOTTS3 24.9	SNCOTTS3 22.9	SNCOTTS3 20.9	SNCOTTS3 18.9	SNCOTTS3 16.9	SNCOTTS3 14.8	SNSH 12.7
	94	SNCOTTS3 24.5	SNCOTTS3 22.5	SNCOTTS3 20.5	SNCOTTS3 18.5	SNCOTTS3 16.5	SNCOTTS3 14.5	SNSH 12.4
	93	SNCOTTS3 24.0	SNCOTTS3 22.1	SNCOTTS3 20.1	SNCOTTS3 18.1	SNCOTTS3 16.1	SNCOTTS3 14.2	SNSH 12.1
	92	SNCOTTS3 23.6	SNCOTTS3 21.6	SNCOTTS3 19.7	SNCOTTS3 17.7	SNCOTTS3 15.8	SNCOTTS3 13.8	SNSH 11.8
	91	SNCOTTS3 23.2	SNCOTTS3 21.2	SNCOTTS3 19.3	SNCOTTS3 17.4	SNCOTTS3 15.4	SNSH 13.4	SNSH 11.5
	90	SNCOTTS3 22.7	SNCOTTS3 20.8	SNCOTTS3 18.9	SNCOTTS3 17.0	SNCOTTS3 15.1	SNSH 13.1	SNSH 11.2



Bridge 480189, Single Unit Vehicles

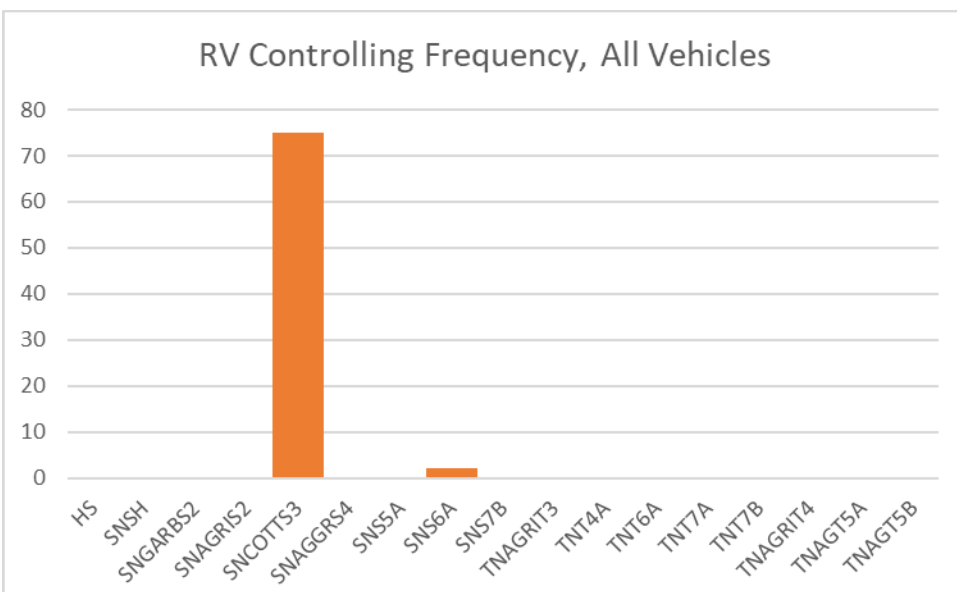
Tandem Trucks

Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	**100**	TNAGRIT3 31.1	TNAGRIT3 28.6	TNAGRIT3 26.2	TNAGRIT3 23.8	TNAGRIT3 21.3	TNAGRIT3 18.9	TNAGRIT3 16.5
	99	TNAGRIT3 30.6	TNAGRIT3 28.2	TNAGRIT3 25.8	TNAGRIT3 23.3	TNAGRIT3 20.9	TNAGRIT3 18.5	TNAGRIT3 16.1
	98	TNAGRIT3 30.1	TNAGRIT3 27.7	TNAGRIT3 25.3	TNAGRIT3 22.9	TNAGRIT3 20.5	TNAGRIT3 18.1	TNAGRIT3 15.7
	97	TNAGRIT3 29.6	TNAGRIT3 27.2	TNAGRIT3 24.8	TNAGRIT3 22.5	TNAGRIT3 20.1	TNAGRIT3 17.7	TNAGRIT3 15.4
	96	TNAGRIT3 29.1	TNAGRIT3 26.7	TNAGRIT3 24.4	TNAGRIT3 22.0	TNAGRIT3 19.7	TNAGRIT3 17.4	TNAGRIT3 15.0
	95	TNAGRIT3 28.6	TNAGRIT3 26.2	TNAGRIT3 23.9	TNAGRIT3 21.6	TNAGRIT3 19.3	TNAGRIT3 17.0	TNAGRIT3 14.7
	94	TNAGRIT3 28.0	TNAGRIT3 25.8	TNAGRIT3 23.5	TNAGRIT3 21.2	TNAGRIT3 18.9	TNAGRIT3 16.6	TNAGRIT3 14.3
	93	TNAGRIT3 27.5	TNAGRIT3 25.3	TNAGRIT3 23.0	TNAGRIT3 20.7	TNAGRIT3 18.5	TNAGRIT3 16.2	TNAGRIT3 14.0
	92	TNAGRIT3 27.0	TNAGRIT3 24.8	TNAGRIT3 22.6	TNAGRIT3 20.3	TNAGRIT3 18.1	TNAGRIT3 15.8	TNAGRIT3 13.6
	91	TNAGRIT3 26.5	TNAGRIT3 24.3	TNAGRIT3 22.1	TNAGRIT3 19.9	TNAGRIT3 17.7	TNAGRIT3 15.5	TNAGRIT3 13.3
	90	TNAGRIT3 26.0	TNAGRIT3 23.8	TNAGRIT3 21.6	TNAGRIT3 19.5	TNAGRIT3 17.3	TNAGRIT3 15.1	TNAGRIT3 12.9



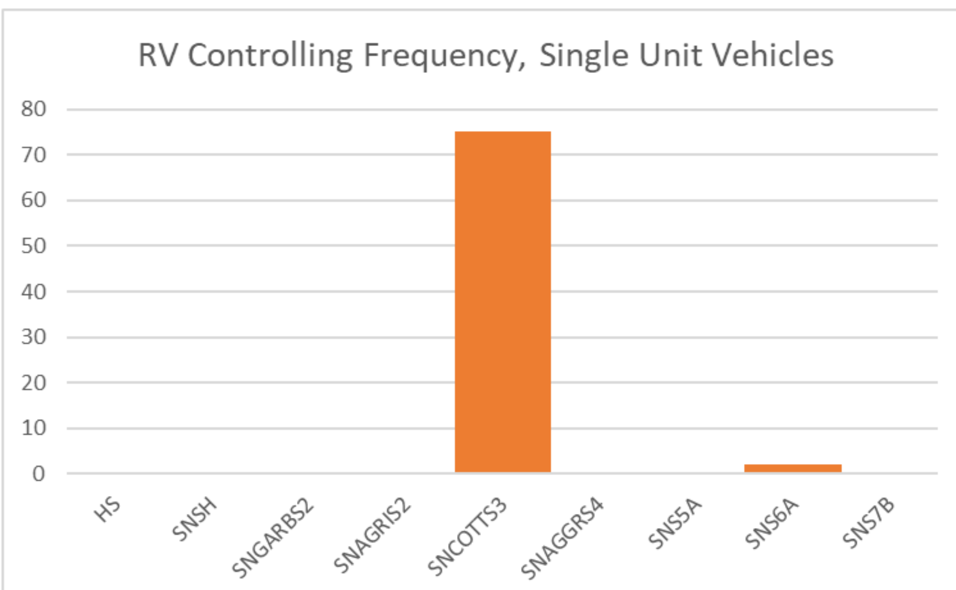
Bridge 480189, Tandem Trucks

All Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	SNS6A 39.3	SNCOTTS3 26.2	SNCOTTS3 24.8	SNCOTTS3 23.3	SNCOTTS3 21.7	SNCOTTS3 20.3	SNCOTTS3 18.8
	99	SNS6A 38.9	SNCOTTS3 26.0	SNCOTTS3 24.5	SNCOTTS3 23.1	SNCOTTS3 21.5	SNCOTTS3 20.1	SNCOTTS3 18.6
	98	SNCOTTS3 27.1	SNCOTTS3 25.7	SNCOTTS3 24.2	SNCOTTS3 22.8	SNCOTTS3 21.3	SNCOTTS3 19.8	SNCOTTS3 18.4
	97	SNCOTTS3 26.8	SNCOTTS3 25.4	SNCOTTS3 24.0	SNCOTTS3 22.5	SNCOTTS3 21.0	SNCOTTS3 19.6	SNCOTTS3 18.2
	96	SNCOTTS3 26.5	SNCOTTS3 25.1	SNCOTTS3 23.7	SNCOTTS3 22.3	SNCOTTS3 20.8	SNCOTTS3 19.4	SNCOTTS3 17.9
	95	SNCOTTS3 26.2	SNCOTTS3 24.8	SNCOTTS3 23.4	SNCOTTS3 22.0	SNCOTTS3 20.5	SNCOTTS3 19.1	SNCOTTS3 17.7
	94	SNCOTTS3 25.9	SNCOTTS3 24.5	SNCOTTS3 23.1	SNCOTTS3 21.8	SNCOTTS3 20.3	SNCOTTS3 18.9	SNCOTTS3 17.5
	93	SNCOTTS3 25.6	SNCOTTS3 24.2	SNCOTTS3 22.9	SNCOTTS3 21.5	SNCOTTS3 20.0	SNCOTTS3 18.7	SNCOTTS3 17.3
	92	SNCOTTS3 25.3	SNCOTTS3 23.9	SNCOTTS3 22.6	SNCOTTS3 21.2	SNCOTTS3 19.8	SNCOTTS3 18.5	SNCOTTS3 17.1
	91	SNCOTTS3 25.0	SNCOTTS3 23.7	SNCOTTS3 22.3	SNCOTTS3 21.0	SNCOTTS3 19.6	SNCOTTS3 18.2	SNCOTTS3 16.9
	90	SNCOTTS3 24.7	SNCOTTS3 23.4	SNCOTTS3 22.0	SNCOTTS3 20.7	SNCOTTS3 19.3	SNCOTTS3 18.0	SNCOTTS3 16.7



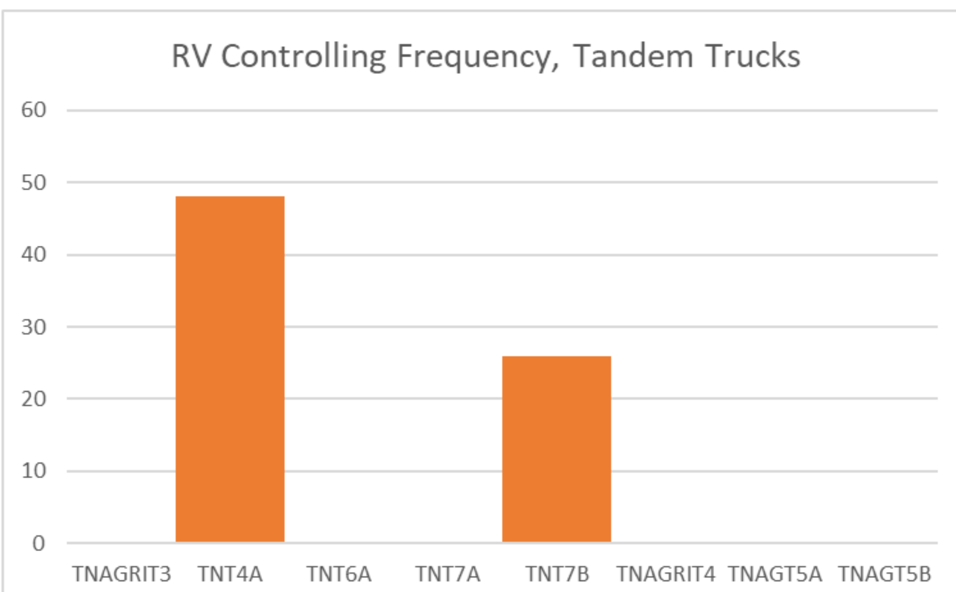
Bridge 490054, All Vehicles

Single Unit Vehicles								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	SNS6A 39.3	SNCOTTS3 26.2	SNCOTTS3 24.8	SNCOTTS3 23.3	SNCOTTS3 21.7	SNCOTTS3 20.3	SNCOTTS3 18.8
	99	SNS6A 38.9	SNCOTTS3 26.0	SNCOTTS3 24.5	SNCOTTS3 23.1	SNCOTTS3 21.5	SNCOTTS3 20.1	SNCOTTS3 18.6
	98	SNCOTTS3 27.1	SNCOTTS3 25.7	SNCOTTS3 24.2	SNCOTTS3 22.8	SNCOTTS3 21.3	SNCOTTS3 19.8	SNCOTTS3 18.4
	97	SNCOTTS3 26.8	SNCOTTS3 25.4	SNCOTTS3 24.0	SNCOTTS3 22.5	SNCOTTS3 21.0	SNCOTTS3 19.6	SNCOTTS3 18.2
	96	SNCOTTS3 26.5	SNCOTTS3 25.1	SNCOTTS3 23.7	SNCOTTS3 22.3	SNCOTTS3 20.8	SNCOTTS3 19.4	SNCOTTS3 17.9
	95	SNCOTTS3 26.2	SNCOTTS3 24.8	SNCOTTS3 23.4	SNCOTTS3 22.0	SNCOTTS3 20.5	SNCOTTS3 19.1	SNCOTTS3 17.7
	94	SNCOTTS3 25.9	SNCOTTS3 24.5	SNCOTTS3 23.1	SNCOTTS3 21.8	SNCOTTS3 20.3	SNCOTTS3 18.9	SNCOTTS3 17.5
	93	SNCOTTS3 25.6	SNCOTTS3 24.2	SNCOTTS3 22.9	SNCOTTS3 21.5	SNCOTTS3 20.0	SNCOTTS3 18.7	SNCOTTS3 17.3
	92	SNCOTTS3 25.3	SNCOTTS3 23.9	SNCOTTS3 22.6	SNCOTTS3 21.2	SNCOTTS3 19.8	SNCOTTS3 18.5	SNCOTTS3 17.1
	91	SNCOTTS3 25.0	SNCOTTS3 23.7	SNCOTTS3 22.3	SNCOTTS3 21.0	SNCOTTS3 19.6	SNCOTTS3 18.2	SNCOTTS3 16.9
	90	SNCOTTS3 24.7	SNCOTTS3 23.4	SNCOTTS3 22.0	SNCOTTS3 20.7	SNCOTTS3 19.3	SNCOTTS3 18.0	SNCOTTS3 16.7



Bridge 490054, Single Unit Vehicles

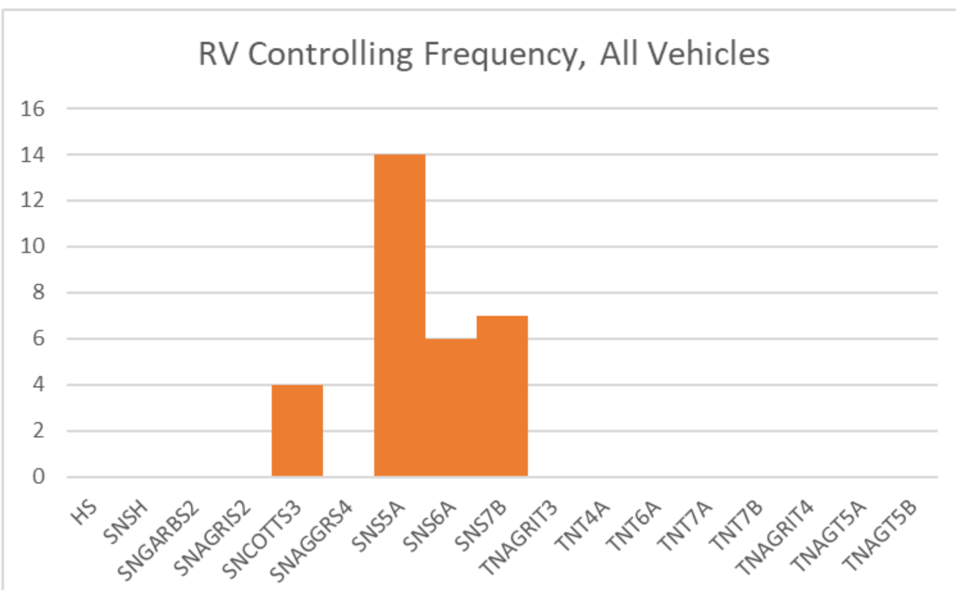
Tandem Trucks								
Rating Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	100	#N/A	TNT7B	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A
		N/A	40.8	38.5	36.2	30.9	28.8	26.7
	99	#N/A	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A
		N/A	40.3	38.1	32.8	30.6	28.5	26.4
	98	#N/A	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A
		N/A	39.9	37.7	32.4	30.2	28.2	26.1
	97	TNT7B	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A
		41.7	39.4	37.2	32.0	29.9	27.9	25.8
	96	TNT7B	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A
		41.2	39.0	36.8	31.7	29.5	27.5	25.5
	95	TNT7B	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A
		40.8	38.5	36.4	31.3	29.2	27.2	25.2
	94	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A	TNT4A
		40.3	38.1	32.9	30.9	28.8	26.9	24.9
	93	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A	TNT4A
		39.8	37.7	32.5	30.6	28.5	26.6	24.6
	92	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A	TNT4A
		39.4	37.2	32.1	30.2	28.2	26.2	24.3
	91	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A	TNT4A
		38.9	36.8	31.7	29.8	27.8	25.9	24.0
	90	TNT7B	TNT7B	TNT4A	TNT4A	TNT4A	TNT4A	TNT4A
		38.4	36.3	31.3	29.5	27.5	25.6	23.7



Bridge 490054, Tandem Trucks

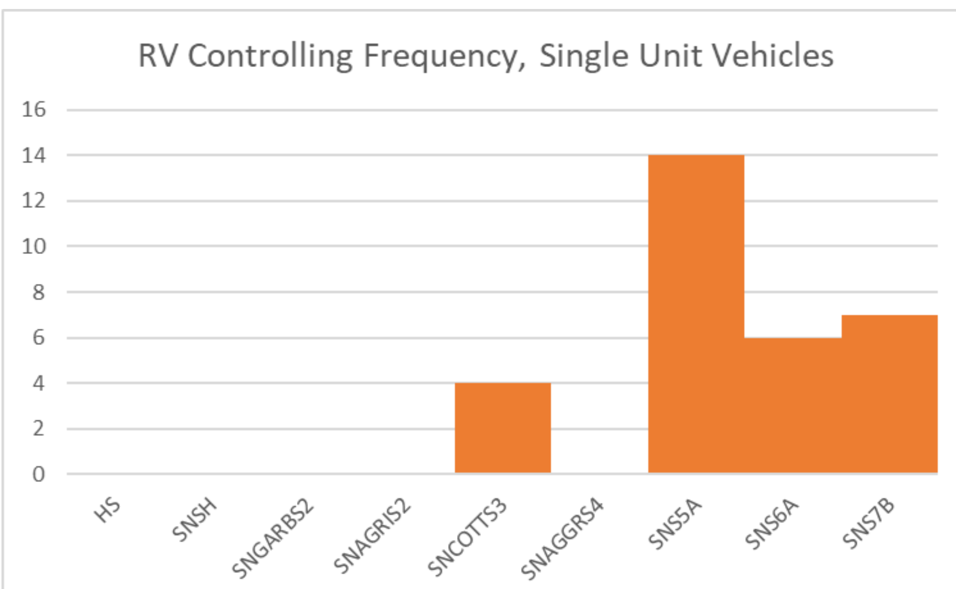
All Vehicles

Rating Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A
		N/A	N/A	N/A	N/A	N/A	40.8	34.9
	99	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A
		N/A	N/A	N/A	N/A	N/A	40.2	34.3
	98	#N/A	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	N/A	39.4	33.7
	97	#N/A	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	N/A	38.7	33.1
	96	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	41.6	38.1	32.6
	95	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	40.9	35.1	32.0
	94	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	40.2	34.5	31.4
	93	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	39.4	33.9	27.0
	92	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	38.7	33.3	26.5
	91	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	41.3	38.0	32.7	26.0
	90	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	40.6	35.0	32.1	25.5



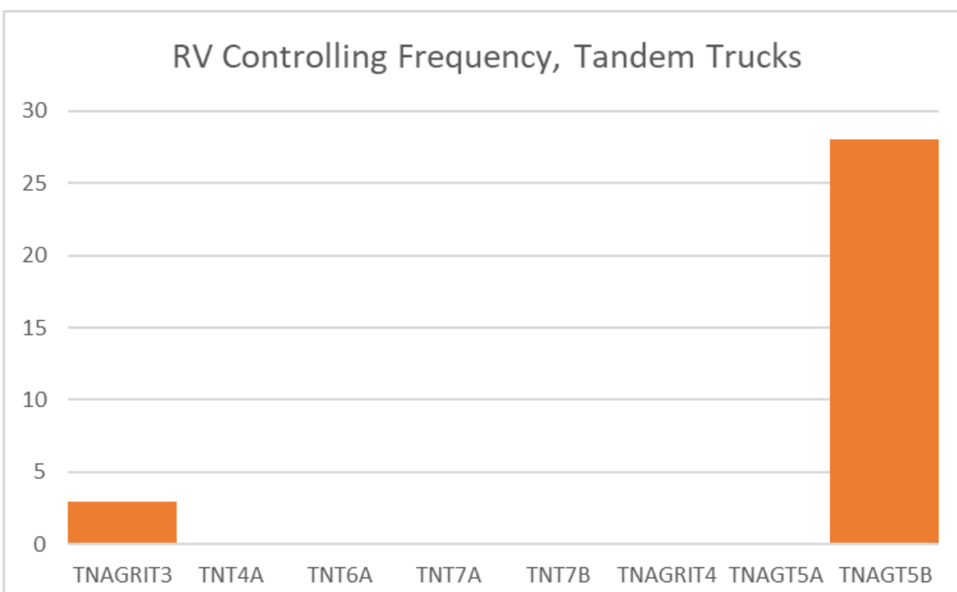
Bridge 590054, All Vehicles

Single Unit Vehicles								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A
		N/A	N/A	N/A	N/A	N/A	40.8	34.9
	99	#N/A	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A
		N/A	N/A	N/A	N/A	N/A	40.2	34.3
	98	#N/A	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	N/A	39.4	33.7
	97	#N/A	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	N/A	38.7	33.1
	96	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A
		N/A	N/A	N/A	N/A	41.6	38.1	32.6
	95	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	40.9	35.1	32.0
	94	#N/A	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A
		N/A	N/A	N/A	N/A	40.2	34.5	31.4
	93	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	39.4	33.9	27.0
	92	#N/A	#N/A	#N/A	#N/A	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	N/A	38.7	33.3	26.5
	91	#N/A	#N/A	#N/A	SNS7B	SNS6A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	41.3	38.0	32.7	26.0
	90	#N/A	#N/A	#N/A	SNS7B	SNS5A	SNS5A	SNCOTTS3
		N/A	N/A	N/A	40.6	35.0	32.1	25.5



Bridge 590054, Single Unit Vehicles

Tandem Trucks								
Rating Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.1	TNAGT5B 40.3
	99	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.4	TNAGT5B 39.7
	98	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.7	TNAGT5B 39.0
	97	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.0	TNAGT5B 38.3
	96	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.9	TNAGT5B 41.3	TNAGT5B 37.7
	95	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.2	TNAGT5B 40.6	TNAGT5B 37.0
	94	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.5	TNAGT5B 39.9	TNAGT5B 36.3
	93	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.7	TNAGT5B 39.2	TNAGT5B 35.7
	92	#N/A N/A	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 42.0	TNAGT5B 38.5	TNAGRIT3 32.8
	91	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 44.6	TNAGT5B 41.2	TNAGT5B 37.8	TNAGRIT3 32.2
	90	#N/A N/A	#N/A N/A	#N/A N/A	TNAGT5B 43.8	TNAGT5B 40.5	TNAGT5B 37.1	TNAGRIT3 31.6



Bridge 590054, Tandem Trucks

Group 1 Bridges, Critical Vehicles:

Critical Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		21.8	20.2	18.6	17.0	15.4	13.7	12.1
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		21.5	19.9	18.3	16.7	15.1	13.5	11.9
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		21.2	19.6	18.0	16.4	14.8	13.2	11.7
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.8	19.3	17.7	16.1	14.6	13.0	11.4
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.5	19.0	17.4	15.8	14.3	12.7	11.2
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.2	18.6	17.1	15.6	14.0	12.5	11.0
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.9	18.3	16.8	15.3	13.8	12.2	10.7
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.5	18.0	16.5	15.0	13.5	12.0	10.5
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.2	17.7	16.2	14.7	13.2	11.8	10.3
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		18.9	17.4	15.9	14.4	13.0	11.5	10.0
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		18.5	17.1	15.6	14.2	12.7	11.3	9.8

Bridge 010003

Critical Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		44.4	41.7	39.0	36.3	33.6	30.9	28.2
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		43.8	41.2	38.5	35.8	33.1	30.5	27.8
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		43.3	40.6	38.0	35.3	32.7	30.1	27.4
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		42.7	40.1	37.5	34.9	32.3	29.7	27.0
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		42.2	39.6	37.0	34.4	31.8	29.2	26.6
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		41.6	39.1	36.5	33.9	31.4	28.8	26.2
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		41.1	38.5	36.0	33.5	30.9	28.4	25.9
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		40.5	38.0	35.5	33.0	30.5	28.0	25.5
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		40.0	37.5	35.0	32.5	30.1	27.6	25.1
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		39.4	37.0	34.5	32.1	29.6	27.2	24.7
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		38.9	36.4	34.0	31.6	29.2	26.8	24.3

Bridge 080037

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		55.9	52.9	50.0	47.0	44.0	41.0	38.0
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		55.3	52.4	49.4	46.5	43.5	40.6	37.6
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		54.7	51.8	48.9	46.0	43.0	40.1	37.2
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		54.1	51.2	48.3	45.5	42.5	39.7	36.8
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		53.5	50.6	47.8	44.9	42.1	39.2	36.3
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		52.9	50.0	47.2	43.9	41.6	38.7	35.9
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		52.3	49.5	46.7	43.9	41.1	38.3	35.5
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		51.7	48.9	46.1	43.4	40.6	37.8	35.1
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		51.0	48.3	45.6	42.9	40.1	37.4	34.6
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		50.4	47.7	45.0	42.3	39.6	36.9	34.2
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		49.8	47.1	44.5	41.8	39.1	36.5	33.8

Bridge 100152

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.5	23.2	21.8	20.5	19.1	17.8	16.4
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.2	22.9	21.6	20.3	18.9	17.6	16.2
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.0	22.7	21.3	20.0	18.7	17.4	16.0
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.7	22.4	21.1	19.8	18.5	17.2	15.8
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.4	22.1	20.8	19.6	18.2	16.9	15.6
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.1	21.9	20.6	19.3	18.0	16.7	15.4
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.9	21.6	20.4	19.1	17.8	16.5	15.2
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.6	21.3	20.1	18.9	17.6	16.3	15.1
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.3	21.1	19.9	18.6	17.4	16.1	14.9
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.0	20.8	19.6	18.4	17.1	15.9	14.7
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		21.8	20.6	19.4	18.2	16.9	15.7	14.5

Bridge 100309

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		40.8	38.0	35.2	32.5	29.7	27.0	24.2
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		40.2	37.5	34.7	32.0	29.3	26.5	23.8
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		39.6	37.0	34.2	31.5	28.8	26.1	23.4
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		39.1	36.4	33.7	31.0	28.4	25.7	23.0
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		38.5	35.9	33.2	30.5	27.9	25.3	22.6
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		37.9	35.4	32.7	30.1	27.5	24.9	22.2
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		37.4	34.8	32.2	29.6	27.0	24.4	21.8
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		36.8	34.3	31.7	29.1	26.6	24.0	21.4
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		36.3	33.7	31.2	28.6	26.1	23.6	21.0
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		35.7	33.2	30.7	28.2	25.7	23.2	20.6
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		35.1	32.7	30.2	27.7	25.2	22.7	20.2

Bridge 110105

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		38.1	35.4	32.8	30.2	27.6	25.0	22.4
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		37.5	34.9	32.3	29.7	27.2	24.6	22.0
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		37.0	34.4	31.8	29.3	26.7	24.2	21.6
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		36.4	33.9	31.4	28.8	26.3	23.7	21.2
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		35.9	33.4	30.9	28.4	25.9	23.3	20.8
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		35.3	32.9	30.4	27.9	25.4	22.9	20.5
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		35.3	32.3	29.9	27.4	25.0	22.5	20.1
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		34.2	31.8	29.4	27.0	24.5	22.1	19.7
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		33.7	31.3	28.9	26.5	24.1	21.7	19.3
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		33.2	30.8	28.4	26.0	23.7	21.3	18.9
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		32.6	30.3	27.9	25.6	23.2	20.9	18.5

Bridge 220015

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		29.3	27.3	25.2	23.1	21.0	18.9	16.8
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.9	26.9	24.8	22.7	20.7	18.6	16.5
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.5	26.5	24.4	22.4	20.3	18.3	16.2
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.1	26.0	24.0	22.0	20.0	17.9	15.9
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.6	25.6	23.6	21.6	19.6	17.6	15.6
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.2	25.2	23.2	21.3	19.3	17.3	15.3
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.8	24.8	22.9	20.9	18.9	17.0	15.0
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.3	24.4	22.5	20.5	18.6	16.7	14.7
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		25.9	24.0	22.1	20.2	18.3	16.3	14.4
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		25.5	23.6	21.7	19.8	17.9	16.0	14.1
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		25.1	23.2	21.3	19.4	17.6	15.7	13.8

Bridge 220025

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		30.8	28.9	26.8	24.9	22.8	20.9	18.8
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		30.4	28.5	26.5	24.5	22.5	20.5	18.6
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		30.0	28.1	26.1	24.2	22.2	20.2	18.3
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		29.6	27.7	25.7	23.8	21.9	19.9	18.0
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		29.2	27.3	25.4	23.5	21.5	19.6	17.7
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.8	26.9	25.0	23.1	21.2	19.3	17.4
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.4	26.5	24.6	22.8	20.9	19.0	17.1
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.0	26.1	24.3	22.4	20.6	18.7	16.8
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.6	25.7	23.9	22.1	20.2	18.4	16.5
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.2	25.4	23.5	21.7	19.9	18.1	16.3
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.7	25.0	23.2	21.4	19.6	17.8	16.0

Bridge 240138

Critical Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.3	21.0	19.7	18.4	17.1	15.8	14.6
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.0	20.7	19.5	18.2	16.9	15.6	14.4
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		21.7	20.5	19.2	18.0	16.7	15.4	14.2
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		21.5	20.2	19.0	17.7	16.5	15.2	14.0
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		21.2	20.0	18.8	17.5	16.3	15.0	13.8
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.9	19.7	18.5	17.3	16.1	14.8	13.6
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.7	19.5	18.3	17.0	15.9	14.6	13.4
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.4	19.2	18.0	16.8	15.6	14.4	13.3
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.1	19.0	17.8	16.6	15.4	14.2	13.1
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.9	18.7	17.6	16.4	15.2	14.0	12.9
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.6	18.5	17.3	16.1	15.0	13.8	12.7

Bridge 310008

Critical Vehicle		Section Loss						
		100	95	90	85	80	75	70
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.3	19.1	18.0	16.8	15.7	14.5	13.4
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		20.0	18.9	17.8	16.6	15.5	14.4	13.2
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.8	18.7	17.6	16.4	15.3	14.2	13.0
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.6	18.4	17.4	16.2	15.1	14.0	12.9
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.3	18.2	17.1	16.0	14.9	13.8	12.7
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		19.1	18.0	16.9	15.8	14.7	13.6	12.5
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		18.9	17.8	16.7	15.6	14.5	13.5	12.4
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		18.6	17.6	16.5	15.4	14.3	13.3	12.2
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		18.4	17.3	16.3	15.2	14.2	13.1	12.1
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		18.2	17.1	16.1	15.0	14.0	12.9	11.9
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		17.9	16.9	15.9	14.8	13.8	12.8	11.7

Bridge 310089

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		49.4	46.4	43.4	40.4	37.3	34.3	31.3
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		48.8	45.8	42.8	39.8	36.9	33.9	30.9
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		48.2	45.2	42.3	39.3	36.4	33.4	30.4
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		47.6	44.7	41.7	38.8	35.9	32.9	30.0
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		47.0	44.1	41.2	38.3	35.4	32.5	29.6
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		46.4	43.5	40.6	37.7	34.9	32.0	29.1
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		45.7	42.9	40.1	37.2	34.4	31.5	28.7
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		45.1	42.3	39.5	36.7	33.9	31.1	28.3
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		44.5	41.7	39.0	36.2	33.4	30.6	27.8
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		43.9	41.1	38.4	35.6	32.9	30.1	27.4
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		43.3	40.5	37.8	35.1	32.4	29.7	27.0

Bridge 330276

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		29.7	27.5	26.1	24.3	22.5	20.7	18.9
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		29.3	27.5	25.8	24.0	22.2	20.4	18.6
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		29.0	27.2	25.4	23.7	21.9	20.1	18.4
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.6	26.8	25.1	23.3	21.6	19.9	18.1
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		28.2	26.5	24.8	23.0	21.3	19.6	17.9
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.9	26.2	24.4	22.7	21.0	19.3	17.6
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.5	25.8	24.1	22.4	20.7	19.1	17.4
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.1	25.5	23.8	22.1	20.5	18.8	17.1
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.8	25.1	23.5	21.8	20.2	18.5	16.8
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.4	24.8	23.1	21.5	19.9	18.2	16.6
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.0	24.4	22.8	21.2	19.6	18.0	16.3

Bridge 350022

Critical Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		49.4	46.7	43.9	41.1	38.3	35.6	32.8
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		48.9	46.1	43.4	40.6	37.9	35.1	32.4
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		48.3	45.6	42.9	40.1	37.4	34.7	32.0
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		47.7	45.0	42.4	39.7	37.0	34.3	31.6
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		47.1	44.5	41.8	39.2	36.5	33.9	31.2
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		46.6	43.9	41.3	38.7	36.1	33.4	30.8
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		46.0	43.4	40.8	38.2	35.6	33.0	30.4
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		45.4	42.8	40.3	37.7	35.1	32.6	30.0
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		44.8	42.3	39.8	37.2	34.7	32.1	29.6
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		44.3	41.7	39.3	36.7	34.2	31.7	29.2
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		43.7	41.2	38.7	36.2	33.8	31.3	28.8

Bridge 430003

Critical Vehicle		Section Loss						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		27.0	24.8	22.7	20.6	18.5	16.4	14.3
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.5	24.4	22.3	20.3	18.2	16.1	14.0
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		26.1	24.0	21.9	19.9	17.8	15.7	13.7
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		25.6	23.6	21.5	19.5	17.5	15.4	13.4
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		25.2	23.2	21.2	19.1	17.1	15.1	13.1
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.8	22.8	20.8	18.8	16.8	14.7	12.7
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.3	22.3	20.4	18.4	16.4	14.4	12.4
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.9	21.9	20.0	18.0	16.0	14.1	12.1
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.4	21.5	19.6	17.6	15.7	13.8	11.8
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.0	21.1	19.2	17.3	15.3	13.4	11.5
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.6	20.7	18.8	16.9	15.0	13.1	11.2

Bridge 480189

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		25.1	23.8	22.4	21.1	19.7	18.4	17.0
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.9	23.5	22.2	20.9	19.5	18.2	16.8
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.6	23.3	21.9	20.6	19.3	18.0	16.6
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.3	23.0	21.7	20.4	19.0	17.7	16.4
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		24.0	22.7	21.5	20.2	18.8	17.5	16.3
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.8	22.5	21.2	19.9	18.6	17.3	16.1
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.5	22.2	21.0	19.7	18.4	17.1	15.9
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		23.2	21.9	20.7	19.5	18.2	16.9	15.7
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.9	21.7	20.5	19.2	17.9	16.7	15.5
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.7	21.4	20.2	19.0	17.7	16.5	15.3
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		22.4	21.2	20.0	18.8	17.5	16.3	15.1

Bridge 490054

Critical Vehicle		**Section Loss**						
		100	**95**	**90**	**85**	**80**	**75**	**70**
Bridge Efficiency	**100**	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		46.6	44.1	41.4	38.6	35.9	33.1	30.3
	99	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		46.0	43.5	40.8	38.1	35.4	32.6	29.8
	98	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		45.3	42.9	40.2	37.5	34.8	32.0	29.3
	97	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		44.7	42.2	39.6	36.9	34.3	31.5	28.8
	96	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		44.0	41.6	39.0	36.3	33.7	31.0	28.3
	95	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		43.4	41.0	38.4	35.8	33.1	30.5	27.8
	94	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		42.7	40.3	37.8	35.2	32.6	29.9	27.3
	93	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		42.1	39.7	37.2	34.6	32.0	29.4	26.8
	92	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		41.4	39.1	36.6	34.0	31.5	28.9	26.3
	91	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		40.7	38.4	35.9	33.4	30.9	28.4	25.8
	90	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH	SNSH
		40.1	37.8	35.3	32.9	30.4	27.8	25.3

Bridge 590054

Group 2 Bridges, Rating Vehicles:

All Vehicles		
% eff	Min Op Wt	Control RV
59	-	#N/A
58	43.9	TNAGT5B
57	41.3	SNS7B
56	39.5	SNS6A
55	37.9	SNS6A
54	35.5	SNS5A
53	33.9	SNS5A
52	32.2	SNS5A
51	30.6	SNS5A
50	28.9	SNS5A
49	26.3	SNCOTTS3

Single Unit Vehicles		
% eff	Min Op Wt	Control RV
59	-	#N/A
58	-	#N/A
57	41.3	SNS7B
56	39.5	SNS6A
55	37.9	SNS6A
54	35.5	SNS5A
53	33.9	SNS5A
52	32.2	SNS5A
51	30.6	SNS5A
50	28.9	SNS5A
49	26.3	SNCOTTS3

Tandem Trucks		
% eff	Min Op Wt	Control RV
59	-	#N/A
58	43.9	TNAGT5B
57	42.1	TNAGT5B
56	40.4	TNAGT5B
55	38.7	TNAGT5B
54	37.0	TNT6A
53	35.3	TNT6A
52	32.9	TNAGRIT3
51	31.2	TNAGRIT3
50	29.6	TNAGRIT3
49	27.9	TNAGRIT3

Bridge 090096

All Vehicles		
% eff	Min Op Wt	Control RV
67	-	#N/A
66	44.3	TNAGT5B
65	41.3	SNS7B
64	40.2	SNS7B
63	39.0	SNS6A
62	37.8	SNS6A
61	35.4	SNS5A
60	34.3	SNS5A
59	33.2	SNS5A
58	32.1	SNS5A
57	31.0	SNS5A
56	29.9	SNS5A
55	26.8	SNCOTTS3
54	25.8	SNCOTTS3

Single Unit Vehicles		
% eff	Min Op Wt	Control RV
67	-	#N/A
66	-	#N/A
65	41.3	SNS7B
64	40.2	SNS7B
63	39.0	SNS6A
62	37.8	SNS6A
61	35.4	SNS5A
60	34.3	SNS5A
59	33.2	SNS5A
58	32.1	SNS5A
57	31.0	SNS5A
56	29.9	SNS5A
55	26.8	SNCOTTS3
54	25.8	SNCOTTS3

Tandem Trucks		
% eff	Min Op Wt	Control RV
67	-	#N/A
66	44.3	TNAGT5B
65	43.1	TNAGT5B
64	41.9	TNAGT5B
63	40.7	TNAGT5B
62	39.6	TNAGT5B
61	38.4	TNAGT5B
60	37.2	TNAGT5B
59	36.0	TNAGT5B
58	34.8	TNAGT5B
57	32.4	TNAGRIT3
56	31.3	TNAGRIT3
55	30.1	TNAGRIT3
54	29.0	TNAGRIT3

Bridge 330048

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
81	-	#N/A	81	-	#N/A	81	-	#N/A
80	41.6	SNS7B	80	41.6	SNS7B	80	43.8	TNAGT5B
79	40.6	SNS7B	79	40.6	SNS7B	79	42.7	TNAGT5B
78	39.4	SNS6A	78	39.4	SNS6A	78	41.6	TNAGT5B
77	38.3	SNS6A	77	38.3	SNS6A	77	40.5	TNAGT5B
76	37.3	SNS6A	76	37.3	SNS6A	76	39.3	TNAGT5B
75	34.7	SNS5A	75	34.7	SNS5A	75	38.2	TNAGT5B
74	33.7	SNS5A	74	33.7	SNS5A	74	37.1	TNAGT5B
73	32.6	SNS5A	73	32.6	SNS5A	73	35.9	TNAGT5B
72	31.6	SNS5A	72	31.6	SNS5A	72	34.8	TNAGT5B
71	30.6	SNS5A	71	30.6	SNS5A	71	32.2	TNAGRIT3
70	27.1	SNCOTTS3	70	27.1	SNCOTTS3	70	31.1	TNAGRIT3
69	26.1	SNCOTTS3	69	26.1	SNCOTTS3	69	30.0	TNAGRIT3

Bridge 330049

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
59	-	#N/A	59	-	#N/A	59	-	#N/A
58	44.6	TNAGT5B	58	-	#N/A	58	44.6	TNAGT5B
57	41.6	SNS7B	57	41.6	SNS7B	57	43.2	TNAGT5B
56	40.3	SNS7B	56	40.3	SNS7B	56	41.8	TNAGT5B
55	38.9	SNS6A	55	38.9	SNS6A	55	40.4	TNAGT5B
54	37.5	SNS6A	54	37.5	SNS6A	54	39.1	TNAGT5B
53	35.0	SNS5A	53	35.0	SNS5A	53	37.7	TNAGT5B
52	33.8	SNS5A	52	33.8	SNS5A	52	36.3	TNAGT5B
51	32.5	SNS5A	51	32.5	SNS5A	51	34.9	TNAGT5B
50	31.2	SNS5A	50	31.2	SNS5A	50	32.4	TNAGRIT3
49	29.9	SNS5A	49	29.9	SNS5A	49	31.1	TNAGRIT3
48	26.7	SNCOTTS3	48	26.7	SNCOTTS3	48	29.7	TNAGRIT3
47	25.5	SNCOTTS3	47	25.5	SNCOTTS3	47	28.4	TNAGRIT3

Bridge 330302

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
63	-	#N/A	63	-	#N/A	63	-	#N/A
62	41.1	SNS7B	62	41.1	SNS7B	62	43.6	TNAGT5B
61	39.6	SNS6A	61	39.6	SNS6A	61	42.1	TNAGT5B
60	38.2	SNS6A	60	38.2	SNS6A	60	40.6	TNAGT5B
59	35.1	SNS5A	59	35.1	SNS5A	59	39.1	TNAGT5B
58	33.7	SNS5A	58	33.7	SNS5A	58	37.6	TNAGT5B
57	32.4	SNS5A	57	32.4	SNS5A	57	36.1	TNAGT5B
56	31.0	SNS5A	56	31.0	SNS5A	56	32.9	TNAGRIT3
55	26.9	SNCOTTS3	55	26.9	SNCOTTS3	55	31.4	TNAGRIT3
54	25.7	SNCOTTS3	54	25.7	SNCOTTS3	54	30.0	TNAGRIT3

Bridge 330305

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
73	-	#N/A	73	-	#N/A	73	-	#N/A
72	44.1	TNAGT5B	72	-	#N/A	72	44.1	TNAGT5B
71	41.4	SNS7B	71	41.4	SNS7B	71	43.0	TNAGT5B
70	40.4	SNS7B	70	40.4	SNS7B	70	41.9	TNAGT5B
69	39.3	SNS6A	69	39.3	SNS6A	69	40.8	TNAGT5B
68	38.2	SNS6A	68	38.2	SNS6A	68	39.8	TNAGT5B
67	37.2	SNS6A	67	37.2	SNS6A	67	38.7	TNAGT5B
66	35.1	SNS5A	66	35.1	SNS5A	66	37.6	TNAGT5B
65	34.0	SNS5A	65	34.0	SNS5A	65	36.5	TNAGT5B
64	33.0	SNS5A	64	33.0	SNS5A	64	35.4	TNAGT5B
63	32.0	SNS5A	63	32.0	SNS5A	63	34.4	TNAGT5B
62	31.0	SNS5A	62	31.0	SNS5A	62	32.2	TNAGRIT3
61	30.0	SNS5A	61	30.0	SNS5A	61	31.2	TNAGRIT3
60	27.1	SNCOTTS3	60	27.1	SNCOTTS3	60	30.1	TNAGRIT3
59	26.2	SNCOTTS3	59	26.2	SNCOTTS3	59	29.1	TNAGRIT3

Bridge 500062

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
100	34.6	SNS5A	100	34.6	SNS5A	100	36.1	TNT6A
99	33.8	SNS5A	99	33.8	SNS5A	99	35.3	TNAGT5B
98	33.1	SNS5A	98	33.1	SNS5A	98	34.5	TNAGT5B
97	32.4	SNAGGRS4	97	32.4	SNAGGRS4	97	33.7	TNAGT5B
96	31.6	SNS5A	96	31.6	SNS5A	96	32.4	TNAGRIT3
95	30.9	SNS5A	95	30.9	SNS5A	95	31.6	TNAGRIT3
94	30.1	SNS5A	94	30.1	SNS5A	94	30.8	TNAGRIT3
93	29.4	SNS5A	93	29.4	SNS5A	93	30.1	TNAGRIT3
92	28.6	SNS5A	92	28.6	SNS5A	92	29.3	TNAGRIT3
91	26.8	SNCOTTS3	91	26.8	SNCOTTS3	91	28.6	TNAGRIT3
90	26.1	SNCOTTS3	90	26.1	SNCOTTS3	90	27.8	TNAGRIT3

Bridge 590126

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
66	-	#N/A	66	-	#N/A	66	-	#N/A
65	43.4	TNAGT5B	65	-	#N/A	65	43.4	TNAGT5B
64	41.3	SNS7B	64	41.3	SNS7B	64	41.8	TNAGT5B
63	39.1	SNS6A	63	39.1	SNS6A	63	40.2	TNAGT5B
62	37.5	SNS6A	62	37.5	SNS6A	62	38.6	TNAGT5B
61	35.3	SNS5A	61	35.3	SNS5A	61	36.9	TNAGT5B
60	33.8	SNS5A	60	33.8	SNS5A	60	35.3	TNAGT5B
59	32.2	SNS5A	59	32.2	SNS5A	59	32.8	TNT4A
58	30.7	SNS5A	58	30.7	SNS5A	58	31.2	TNT4A
57	29.1	SNS5A	57	29.1	SNS5A	57	29.6	TNT4A
56	26.2	SNCOTTS3	56	26.2	SNCOTTS3	56	28.1	TNT4A

Bridge 590169

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
59	-	#N/A	59	-	#N/A	59	-	#N/A
58	42.6	TNAGT5B	58	-	#N/A	58	42.6	TNAGT5B
57	39.5	SNS6A	57	39.5	SNS6A	57	40.0	TNAGT5B
56	36.9	SNS6A	56	36.9	SNS6A	56	37.4	TNAGRIT4
55	33.9	SNAGGRS4	55	33.9	SNAGGRS4	55	34.7	TNAGT5B
54	31.3	SNAGGRS4	54	31.3	SNAGGRS4	54	31.6	TNT4A
53	28.8	SNAGGRS4	53	28.8	SNAGGRS4	53	29.0	TNT4A
52	25.4	SNCOTTS3	52	25.4	SNCOTTS3	52	26.4	TNT4A
51	22.9	SNCOTTS3	51	22.9	SNCOTTS3	51	23.8	TNT4A

Bridge 590182

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
67	-	#N/A	67	-	#N/A	67	-	#N/A
66	44.3	TNAGT5B	66	-	#N/A	66	44.3	TNAGT5B
65	41.6	SNS7B	65	41.6	SNS7B	65	42.8	TNAGT5B
64	40.2	SNS7B	64	40.2	SNS7B	64	41.4	TNAGT5B
63	38.8	SNS6A	63	38.8	SNS6A	63	40.0	TNAGT5B
62	37.4	SNS6A	62	37.4	SNS6A	62	38.5	TNAGT5B
61	35.2	SNS5A	61	35.2	SNS5A	61	37.1	TNAGT5B
60	33.8	SNS5A	60	33.8	SNS5A	60	35.6	TNAGT5B
59	32.4	SNS5A	59	32.4	SNS5A	59	34.2	TNAGT5B
58	31.1	SNS5A	58	31.1	SNS5A	58	32.0	TNAGRIT3
57	29.7	SNS5A	57	29.7	SNS5A	57	30.6	TNAGRIT3
56	27.0	SNCOTTS3	56	27.0	SNCOTTS3	56	29.2	TNAGRIT3
55	25.7	SNCOTTS3	55	25.7	SNCOTTS3	55	27.7	TNAGRIT3

Bridge 590404

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
55	-	#N/A	55	-	#N/A	55	-	#N/A
54	44.7	TNAGT5B	54	-	#N/A	54	44.7	TNAGT5B
53	41.7	SNS7B	53	41.7	SNS7B	53	42.6	TNAGT5B
52	39.7	SNS6A	52	39.7	SNS6A	52	40.6	TNT6A
51	37.7	SNS6A	51	37.7	SNS6A	51	38.5	TNAGT5B
50	35.1	SNS5A	50	35.1	SNS5A	50	36.5	TNT6A
49	33.1	SNS5A	49	33.1	SNS5A	49	34.4	TNT6A
48	31.1	SNS5A	48	31.1	SNS5A	48	31.8	TNAGRIT3
47	29.1	SNS5A	47	29.1	SNS5A	47	29.7	TNAGRIT3
46	26.2	SNCOTTS3	46	26.2	SNCOTTS3	46	27.7	TNAGRIT3

Bridge 590516

All Vehicles			Single Unit Vehicles			Tandem Trucks		
% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV	% eff	Min Op Wt	Control RV
74	-	#N/A	74	-	#N/A	74	-	#N/A
73	44.5	TNAGT5B	73	-	#N/A	73	44.5	TNAGT5B
72	43.9	TNAGT5B	72	-	#N/A	72	43.9	TNAGT5B
71	41.8	SNS7B	71	41.8	SNS7B	71	43.3	TNAGT5B
70	41.2	SNS7B	70	41.2	SNS7B	70	42.6	TNAGT5B
69	40.7	SNS7B	69	40.7	SNS7B	69	42.0	TNAGT5B
68	40.1	SNS7B	68	40.1	SNS7B	68	41.4	TNAGT5B
67	39.4	SNS6A	67	39.4	SNS6A	67	40.8	TNAGT5B
66	38.8	SNS6A	66	38.8	SNS6A	66	40.2	TNAGT5B
65	38.2	SNS6A	65	38.2	SNS6A	65	39.6	TNAGT5B
64	37.6	SNS6A	64	37.6	SNS6A	64	39.0	TNAGT5B
63	37.0	SNS6A	63	37.0	SNS6A	63	38.4	TNAGT5B
62	35.4	SNS5A	62	35.4	SNS5A	62	37.8	TNAGT5B
61	34.9	SNS5A	61	34.9	SNS5A	61	37.2	TNAGT5B
60	34.3	SNS5A	60	34.3	SNS5A	60	36.6	TNAGT5B
59	33.7	SNS5A	59	33.7	SNS5A	59	35.9	TNAGT5B
58	33.1	SNS5A	58	33.1	SNS5A	58	35.3	TNAGT5B
57	32.6	SNS5A	57	32.6	SNS5A	57	34.7	TNAGT5B
56	32.0	SNS5A	56	32.0	SNS5A	56	34.1	TNAGT5B
55	31.4	SNS5A	55	31.4	SNS5A	55	32.6	TNAGRIT3
54	30.9	SNAGGRS4	54	30.9	SNAGGRS4	54	32.0	TNAGRIT3
53	30.3	SNS5A	53	30.3	SNS5A	53	31.4	TNAGRIT3
52	29.7	SNS5A	52	29.7	SNS5A	52	30.8	TNAGRIT3
51	29.1	SNS5A	51	29.1	SNS5A	51	30.2	TNAGRIT3
50	26.8	SNCOTTS3	50	26.8	SNCOTTS3	50	29.6	TNAGRIT3

Bridge 840010

Appendix II:

Truck Generation Program Instruction Manual

Introduction

The computer program performs two essentially independent tasks:

1. It generates possible truck configurations for numerous axle combinations with varying lengths between the axles as allowed by the North Carolina Statutory Weights of Legal Vehicles (as outlined in the NC general statute § 20-118 (b)(3)). The program also has the option of generating trucks according to the Federal Bridge Formula (FBF). For each generated truck, the program calculates the maximum moment produced by each truck for a specified bridge span.

2. It calculates the maximum moment corresponding to the specified bridge span for any number of specified vehicle configurations.

Input Files

The program reads the following input files:

1. Main input file: "ncst_in.txt". This file contains all the parameters desired for the program output, like which number of axles to include, whether to use the NC statute of the federal bridge formula, the distances between axles, and the specified bridge span, among other information. A sample main input file is shown in Figure 1.

```
Input file for Automatic Truck Generation of North Carolina Legal Vehicles (According to Statute 20-118 (b) 3.)
Truck Reports: # of axles followed by 1 (print report) or 0 (do not print). Leave space between numbers.
Single Vehicles
2 1
3 1
4 1
5 1
6 1
7 1
Tractor Trailers
3 1
4 1
5 1
6 0
7 0
Determination of Maximum Legal Weight: 1 = NC statute (NCS); 0 = Federal Bridge Formula (FBF)
1
Number of Axle Combinations flag: 1 = reduced; 2 = intermediate; 3 = large. Default: reduced.
1
Maximum Weight Exception and truck length for exception to take effect.
90000.0  9999.0
Specified distances between axles - SINGLE VEHICLE 2-axles
Number of distances
4
Actual distances
4.0 9.0 11.0 14.0
Specified distances between axles - SINGLE VEHICLE 3-axles
Number of distances
4
Actual distances
4.0 9.0 11.0 14.0
.
.
.
Actual distances
4.0 9.0 11.0 14.0
Specified distances between axles - TRACTOR TRAILER 3-axles
number of distances
4
Actual distances
4.0 9.0 11.0 14.0
Specified distances between axles - TRACTOR TRAILER 4-axles
number of distances
4
Actual distances
4.0 9.0 11.0 14.0
.
.
.
Span for moment calculations
100.0
EOF
```

Figure 1. Sample Main Input File ("ncst_in.txt").

2. NC statute file: "statute_weights.txt". This file contains the NC statute weights and distances between axles in the form of a matrix. A sample NC statute file is shown in Figure 2.

Axles*	2 Axles	3 Axles	4 Axles	5 Axles	6 Axles	7 Axles
4	38000					
5	38000					
6	38000					
7	38000					
8 or less	38000	38000				
more than 8	38000	42000				
9	39000	42500				
10	40000	43500				
11		44000				
12		45000	50000			
13		45500	50500			
14		46500	51500			
15		47000	52000			
16		48000	52500	58000		
17		48500	53500	58500		
18		49500	54000	59000		
19		50000	54500	60000		
20		51000	55500	60500	66000	
21		51500	56000	61000	66500	
22		52500	56500	61500	67000	
23		53000	57500	62500	68000	
24		54000	58000	63000	68500	74000
25		54500	58500	63500	69000	74500
26		55500	59500	64000	69500	75000
27		56000	60000	65000	70000	75500
28		57000	60500	65500	71000	76500
29		57500	61500	66000	71500	77000
30		58500	62000	66500	72000	77500
31		59000	62500	67500	72500	78000
32		60000	63500	68000	73000	78500
33			64000	68500	74000	79000
34			64500	69000	74500	80000
35			65500	70000	75000	
36			66000**	70500	75500	
37			66500**	71000	76000	
38			67500**	72000	77000	
39			68000	72500	77500	
40			68500	73000	78000	
41			69500	73500	78500	
42			70000	74000	79000	
43			70500	75000	80000	
44			71500	75500		
45			72000	76000		
46			72500	76500		
47			73500	77500		
48			74000	78000		
49			74500	78500		
50			75500	79000		
51			76000	80000		
52			76500			
53			77500			
54			78000			
55			78500			
56			79500			
57			80000			

```
Distance - weights matrix
0.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
1.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
2.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
3.0 20000.0 -1.0 -1.0 -1.0 -1.0 -1.0
4.0 38000.0 -1.0 -1.0 -1.0 -1.0 -1.0
5.0 38000.0 -1 -1 -1 -1 -1
6.0 38000.0 -1 -1 -1 -1 -1
7.0 38000.0 -1 -1 -1 -1 -1
7.5 38000.0 38000.0 -1 -1 -1 -1
8.0 38000.0 38000.0 -1 -1 -1 -1
8.5 38000.0 42000.0 -1 -1 -1 -1
9.0 39000.0 42500.0 -1 -1 -1 -1
10 40000 43500 -1 -1 -1 -1
11 -1 44000 -1 -1 -1 -1
12 -1 45000 50000 -1 -1 -1
13 -1 45500 50500 -1 -1 -1
14 -1 46500 51500 -1 -1 -1
15 -1 47000 52000 -1 -1 -1
16 -1 48000 52500 58000 -1 -1
17 -1 48500 53500 58500 -1 -1
18 -1 49500 54000 59000 -1 -1
19 -1 50000 54500 60000 -1 -1
20 -1 51000 55500 60500 66000 -1
21 -1 51500 56000 61000 66500 -1
22 -1 52500 56500 61500 67000 -1
23 -1 53000 57500 62500 68000 -1
24 -1 54000 58000 63000 68500 74000
25 -1 54500 58500 63500 69000 74500
26 -1 55500 59500 64000 69500 75000
27 -1 56000 60000 65000 70000 75500
28 -1 57000 60500 65500 71000 76500
29 -1 57500 61500 66000 71500 77000
30 -1 58500 62500 66500 72000 77500
31 -1 59000 62500 67500 72500 78000
32 -1 60000 63500 68000 73000 78500
33 -1 -1 64000 68500 74000 79000
34 -1 -1 64500 69000 74500 80000
35 -1 -1 65500 70000 75000 -1
36 -1 -1 67999 70500 75500 -1
37 -1 -1 67999 71000 76000 -1
38 -1 -1 67999 72000 77000 -1
39 -1 -1 68000 72500 77500 -1
40 -1 -1 68500 73000 78000 -1
41 -1 -1 69500 73500 78500 -1
42 -1 -1 70000 74000 79000 -1
43 -1 -1 70500 75000 80000 -1
44 -1 -1 71500 75500 -1 -1
45 -1 -1 72000 76000 -1 -1
46 -1 -1 72500 76500 -1 -1
47 -1 -1 73500 77500 -1 -1
48 -1 -1 74000 78000 -1 -1
49 -1 -1 74500 78500 -1 -1
50 -1 -1 75500 79000 -1 -1
51 -1 -1 76000 80000 -1 -1
52 -1 -1 76500 -1 -1 -1
53 -1 -1 77500 -1 -1 -1
54 -1 -1 78000 -1 -1 -1
55 -1 -1 78500 -1 -1 -1
56 -1 -1 79500 -1 -1 -1
57 -1 -1 80000 -1 -1 -1
```

Figure 2. NC statute weights and NC statute file ("statute_weights.txt").

3. Specified Vehicles file: "specified_vehicles.txt". This file contains any number of specified vehicles according to a specific format that is explained below. A sample specified vehicles file is shown in Figure 3.

```
NCDOT SPECIFIED VEHICLES LIST
What follows are 6 records with the number of axles followed by the number of
records per number of axles
2 7
3 6
4 7
5 6
6 5
7 4
TWO-AXLE VEHICLES
7
SNSH     2 14 -1 27000 5000  14 22000
SNGARBS2 2 14 -1 40000 23500 14 16500
SNAGRIS2 2 14 -1 44000 22000 14 22000
F_LN7000 2 22 -1 26000 7000  22 19000
FORDE350 2 16 -1 12000 4200  16 7800
HINO_268 2 26 -1 29000 10000 26 19000
THREE-AXLE VEHICLES
6
SNCOTTS3 3 15 -1 54500 4500  11 25000 4 25000
TNAGRIT3 3 18 -1 66000 22000  9 22000 9 22000
SPI112FT 3 25 -1 82000 24000 21 29000 4 29000
SAI75FT  3 26 -1 76000 24000 22 26000 4 26000
SP95FT   3 21 -1 63000 23000 17 20000 4 20000
3AX_CONC 3 13 -1 66000 20000  9 23000 4 23000
FOUR-AXLE VEHICLES
7
SNAGGRS4 4 17 -1 69850 16000  9 15850  4 19000 4 19000
TNT4A    4 22 -1 66150 12100  9 12050  9 21000 4 21000
TNAGRIT4 4 22 -1 86000 22000  9 22000  9 21000 4 21000
FD4000   4 17 -1 90000 21000  9 23000  4 23000 4 23000
4AX_CONC 4 17 -1 66000 20000  9     0  4 23000 4 23000
WP53+IP4 4 58 -1 82000 14000 19 23000 35 22500 4 22500
SC40+IP4 4 52 -1 87000 14000 19 23000 29 25000 4 25000
FIVE-AXLE VEHICLES
6
SNS5A    5 21 -1  71100 12100  9  8500 4 21000  4 21000 4  8500
TNAGT5A  5 26 -1  90000 22000  9 21000 4 21000  9 13000 4 13000
TNAGT5B  5 26 -1  90000  6000  9 21000 4 21000  9 21000 4 21000
WP53+IP6 5 60 -1 105000 14000 17 23000 4 23000 35 22500 4 22500
SC40+IP6 5 52 -1 102000 12000 15 20000 4 20000 29 25000 4 25000
FD5000   5 21 -1 113000 21000  9 23000 4 23000  4 23000 4 23000
```

Figure 3. Specified Vehicles file ("specified_vehicles.txt").

Main Input File Contents

The main input file ("ncst_in.txt") can be thought of as comprising six different sections. They are as follows.

Section 1. This section has two columns. The left column corresponds to the number of axles on the truck, and the right column is a Boolean operator for that truck type. If a number of axles combination has a value of 1 in front of it (i.e. in the second column), the truck type (i.e. trucks with this number of axles) will be generated and included in the output file; if the axle combination has a value of 0 (zero), trucks with that number of axles will not be generated and hence will not be included in the output file. Running the program with an input file like the one shown in Figure 1 for instance, will return results for single vehicles with 2 to 7 axles, and tractor trailer trucks with 3 to 5 axles.

Section 2. This section allows the user to specify a parameter that will determine the way the program calculates maximum legal weight for each generated truck. If this parameter is equal to 1, the program uses the NC statute. If it is equal to 0, the program uses the federal bridge formula. Default is the NC statute.

Section 3. The program can generate a range of axle combinations for each truck axle type. This is controlled with a single parameter in this section. If this parameter is equal to 1 a small number of axle combinations (termed "reduced") will be generated. If this parameter is equal to 2, and intermediate number of axle combinations will be generated, and if it is equal to 3, a large number of axle combinations will be generated. The number of trucks to be generated also depends on the number of axles, and on whether the truck is a single vehicle or a tractor trailer.

In its present form, the number of trucks generated by the program for each number of axles, ranges from 3 (for single-vehicle 2-axle configurations) to 1128 (for 7-axle tractor trailers with the large axle combination option).

Section 4. This section allows the user to specify a maximum truck weight corresponding to an exception (e.g., a weight that is not in the statute matrix) and a minimum truck length to apply the exception. For the values specified in this section of Figure 1, for instance, the exception weight is 90,000 lb. and this weight is to be applied to trucks with a minimum length of 9,999 ft. (which effectively prevents the exception to be applied). If this second number were equal to say 34, the program will apply the exception to all trucks with lengths equal to or larger than 34 ft.

Section 5. This section allows the user to enter the truck axle spacings that will be used to generate the truck configurations. In its present form the program requires the input of four different distances in ascending order for each axle configuration (these distances are labeled: a, b, c, and d). Distances are assumed in feet. Distance a, is assumed to be the distance corresponding to a tandem axle. A different set of distances can be specified for each axle configuration. These values can be changed by the user; however, it is important that the values are entered in ascending order, and that the smallest distance value corresponds to the distance between the axles in a tandem axle. Also, only permutations of distances b, c, and d are considered when generating the axle combinations. A schematic representation of these ideas is shown in Figure 4.

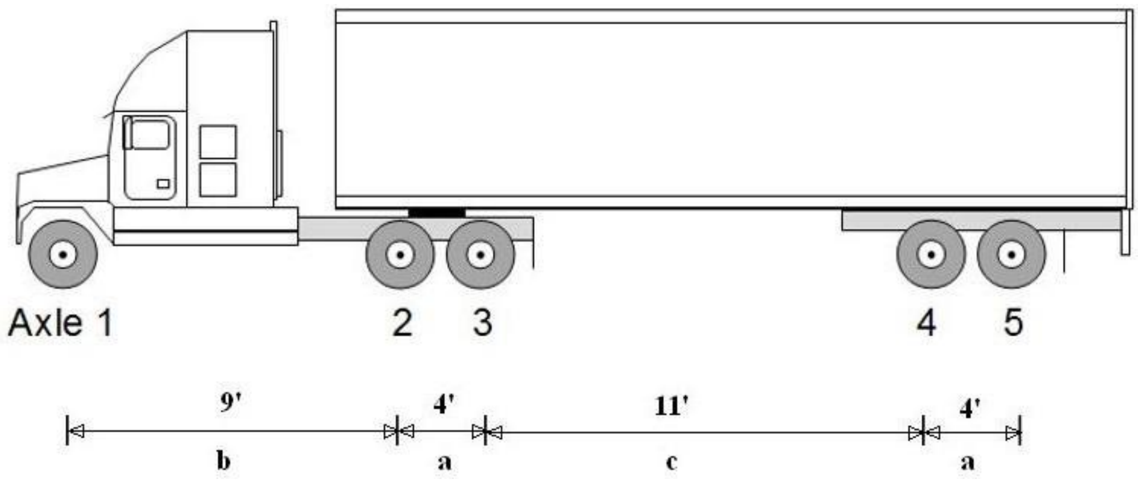


Figure 4: Truck Axle Spacing Diagram with a/b/c Distances.

Section 6. The sixth and final section allows the user to specify a span (in feet) for the maximum bending moment calculations.

Specified Vehicles File ("specified_vehicles.txt")

This file has two sections. Section 1 contains the number of vehicles for each axle configuration. The values shown in Figure 3 for instance, mean that the file will contain 7 2-axle vehicles, 6 3- axle vehicles, 7 4-axle vehicles, etc. Section 2 contains the actual specified vehicles in the following format:

Field 1 contains the truck name with no more than 6 characters.

Field 2 contains the number of axles.

Field 3 contains the total length of the truck in feet.

Field 4 contains the NC statute weight of the truck (currently not used).

Field 5 contains the actual weight of the truck.

Field 6 to Field 2*n_axles + 3 contain the combination axle weight and distance to the next axle (where n_axles is the number of axles of the truck).

Field 2*n_axles + 4 contains the weight of the last axle of the truck.

Notes:

1. All title (or comment) lines in all files are read by the program but their contents are ignored. For instance, in the main input file the contents of the first three lines are ignored by the program. These lines are in the files to remind the user of the subsequent content of the file. The contents of these lines can be modified but the lines themselves must not be removed.

2. Some lines in the input files contain the number of records that follow the line. For instance, in the specified vehicles file (see Figure 3), the line that follows the comment line "TWO-AXLE VEHICLES" contains a 7. This means that there are 7 records of 2- axle vehicles that follow that line. These numbers must correspond exactly to the number of records that follow the line and to the numbers in Section 1 of the file (see above).

Output Files

The program output consists of three (3) files: "**Trucks_out.txt**," "**WARNINGS_out.txt**," and "**DEBUG_out.txt**." The contents of these files are described next.

“**Trucks_out.txt**”: This is the main output file of the program. This file has to sections. Section 1 contains the output corresponding to the specified vehicles that were read from the “specified_vehicles,txt” file by the program. Section 2 contains the generated (possible) truck configurations. The output format for this file follows closely the format described above for the specified vehicles file. A sample output file is shown in Figure 5

The format of the main output file is as follows:

Field 1 contains the truck name with maximum of 6 characters for the specified trucks and a consecutive number for the generated trucks.

Field 2 contains the number of axles.

Field 3 contains the total length of the truck in feet.

Field 4 contains the NC statute weight of the truck (currently not used).

Field 5 contains the actual weight of the truck.

Field 6 to Field 2*n_axles + 3 contain the combination axle weight and distance to the next axle (where n_axles is the number of axles of the truck).

Field 2*n_axles + 4 contains the weight of the last axle of the truck.

Field 2*n_axles + 5 contains the span specified for the bending moment calculations, and Field 2*n_axles + 6 contains the maximum bending moment for the specified span.

“**WARNINGS_out.txt**”: This file contains warnings and errors. A common warning is generated when there is a truck-length—number-of-axles combination that is not in the NC statute (the statute weights matrix contains a -1 in this position, see Figure 2). In this case the program determines the weight of the truck using the Federal Bridge Formula and issues the corresponding warning. In general, warnings are normal, but errors are not, and the output of the program must not be trusted when errors occur.

"**DEBUG_out.txt**": This file contains debug information that can be ignored by the user. It is there to help developers pinpoint problems with the code.

Appendix III:

Sample Truck Generation Program Output File

************************************ SINGLE VEHICLES ********************************

SINGLE VEHICLE 2-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	Span	Mmax
1	2	14	44000	44000	22000	14	22000	100	946
2	2	11	41000	41000	20500	11	20500	100	912
3	2	9	38000	38000	19000	9	19000	100	864

SINGLE VEHICLE 3-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	Span	Mmax
1	3	18	49500	49500	18500	14	15500	4	15500	100	1077
2	3	15	47000	47000	17667	11	14667	4	14667	100	1049
3	3	13	45500	45500	17167	9	14167	4	14167	100	1032

SINGLE VEHICLE 4-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	Span	Mmax
1	4	22	56500	56500	21125	14	11792	4	11792	4	11792	100	1194
2	4	19	54500	54500	20625	11	11292	4	11292	4	11292	100	1181
3	4	17	53500	53500	20375	9	11042	4	11042	4	11042	100	1180

SINGLE VEHICLE 5-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	d4	Ax5	Span	Mmax
1	5	31	67500	67500	15900	14	12900	4	12900	9	12900	4	12900	100	1377
2	5	33	68500	68500	16100	14	13100	4	13100	11	13100	4	13100	100	1371
3	5	36	70500	70500	16500	14	13500	4	13500	14	13500	4	13500	100	1371
4	5	28	65500	65500	15500	11	12500	4	12500	9	12500	4	12500	100	1359
5	5	33	68500	68500	16100	11	13100	4	13100	14	13100	4	13100	100	1356
6	5	30	66500	66500	15700	11	12700	4	12700	11	12700	4	12700	100	1354
7	5	31	67500	67500	15900	9	12900	4	12900	14	12900	4	12900	100	1352
8	5	28	65500	65500	15500	9	12500	4	12500	11	12500	4	12500	100	1349
9	5	26	64000	64000	15200	9	12200	4	12200	9	12200	4	12200	100	1343
10	5	26	64000	64000	20400	14	10900	4	10900	4	10900	4	10900	100	1329
11	5	23	62500	62500	20100	11	10600	4	10600	4	10600	4	10600	100	1327
12	5	21	61000	61000	19800	9	10300	4	10300	4	10300	4	10300	100	1314

SINGLE VEHICLE 6-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	d4	Ax5	d5	Ax6	Span	Mmax
1	6	40	78000	78000	19333	14	9833	4	9833	4	9833	4	9833	14	19333	100	1485
2	6	37	76000	76000	19000	11	9500	4	9500	4	9500	4	9500	14	19000	100	1472
3	6	37	76000	76000	19000	14	9500	4	9500	4	9500	4	9500	11	19000	100	1472
4	6	35	75000	75000	18833	9	9333	4	9333	4	9333	4	9333	14	18833	100	1471
5	6	35	75000	75000	18833	14	9333	4	9333	4	9333	4	9333	9	18833	100	1471
6	6	30	72000	72000	20667	14	10267	4	10267	4	10267	4	10267	4	10267	100	1470
7	6	34	74500	74500	18750	11	9250	4	9250	4	9250	4	9250	11	18750	100	1470
8	6	27	70000	70000	20333	11	9933	4	9933	4	9933	4	9933	4	9933	100	1458
9	6	25	69000	69000	20167	9	9767	4	9767	4	9767	4	9767	4	9767	100	1457
10	6	32	73000	73000	18500	9	9000	4	9000	4	9000	4	9000	11	18500	100	1457
11	6	32	73000	73000	18500	11	9000	4	9000	4	9000	4	9000	9	18500	100	1457
12	6	30	72000	72000	18333	9	8833	4	8833	4	8833	4	8833	9	18333	100	1454

SINGLE VEHICLE 7-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	d4	Ax5	d5	Ax6	d6	Ax7	Span	Mmax
1	7	34	80000	80000	20857	14	9857	4	9857	4	9857	4	9857	4	9857	4	9857	100	1593
2	7	31	78000	78000	20571	11	9571	4	9571	4	9571	4	9571	4	9571	4	9571	100	1582
3	7	29	77000	77000	20429	9	9429	4	9429	4	9429	4	9429	4	9429	4	9429	100	1582
4	7	34	80000	80000	18857	9	8457	4	8457	4	8457	4	8457	4	8457	9	18857	100	1578
5	7	36	80000	80000	18857	9	8457	4	8457	4	8457	4	8457	4	8457	11	18857	100	1559
6	7	36	80000	80000	18857	11	8457	4	8457	4	8457	4	8457	4	8457	9	18857	100	1559
7	7	38	80000	80000	18857	11	8457	4	8457	4	8457	4	8457	4	8457	11	18857	100	1540
8	7	39	80000	80000	18857	9	8457	4	8457	4	8457	4	8457	4	8457	14	18857	100	1531
9	7	39	80000	80000	18857	14	8457	4	8457	4	8457	4	8457	4	8457	9	18857	100	1531
10	7	41	80000	80000	18857	11	8457	4	8457	4	8457	4	8457	4	8457	14	18857	100	1512
11	7	41	80000	80000	18857	14	8457	4	8457	4	8457	4	8457	4	8457	11	18857	100	1512
12	7	44	80000	80000	18857	14	8457	4	8457	4	8457	4	8457	4	8457	14	18857	100	1484

************************************* TRACTOR TRAILERS *********************************

TRACTOR TRAILER 3-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	Span	Mmax
1	3	28	57000	57000	19000	14	19000	14	19000	100	1159
2	3	25	54500	54500	18167	11	18167	14	18167	100	1135
3	3	25	54500	54500	18167	14	18167	11	18167	100	1135
4	3	23	53000	53000	17667	14	17667	9	17667	100	1122
5	3	23	53000	53000	17667	9	17667	14	17667	100	1122
6	3	22	52500	52500	17500	11	17500	11	17500	100	1120
7	3	20	51000	51000	17000	11	17000	9	17000	100	1105
8	3	20	51000	51000	17000	9	17000	11	17000	100	1105
9	3	18	49500	49500	16500	9	16500	9	16500	100	1089

TRACTOR TRAILER 4-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	Span	Mmax
1	4	32	63500	63500	17375	14	14375	4	14375	14	17375	100	1281
2	4	29	61500	61500	16875	11	13875	4	13875	14	16875	100	1265
3	4	29	61500	61500	16875	14	13875	4	13875	11	16875	100	1265
4	4	27	60000	60000	16500	14	13500	4	13500	9	16500	100	1250
5	4	27	60000	60000	16500	9	13500	4	13500	14	16500	100	1250
6	4	26	59500	59500	16375	11	13375	4	13375	11	16375	100	1248
7	4	29	61500	61500	16875	14	16875	11	13875	4	13875	100	1239
8	4	27	60000	60000	16500	14	16500	9	13500	4	13500	100	1236
9	4	32	63500	63500	17375	14	17375	14	14375	4	14375	100	1236
10	4	24	58000	58000	16000	9	13000	4	13000	11	16000	100	1232
11	4	24	58000	58000	16000	11	13000	4	13000	9	16000	100	1232
12	4	26	59500	59500	16375	11	16375	11	13375	4	13375	100	1224
13	4	29	61500	61500	16875	11	16875	14	13875	4	13875	100	1223
14	4	24	58000	58000	16000	11	16000	9	13000	4	13000	100	1219
15	4	22	56500	56500	15625	9	12625	4	12625	9	15625	100	1215
16	4	27	60000	60000	16500	9	16500	14	13500	4	13500	100	1210
17	4	24	58000	58000	16000	9	16000	11	13000	4	13000	100	1209
18	4	22	56500	56500	15625	9	15625	9	12625	4	12625	100	1203

TRACTOR TRAILER 5-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	d4	Ax5	Span	Mmax
1	5	31	67500	67500	15900	14	12900	4	12900	9	12900	4	12900	100	1377
2	5	33	68500	68500	16100	14	13100	4	13100	11	13100	4	13100	100	1371
3	5	36	70500	70500	16500	14	13500	4	13500	14	13500	4	13500	100	1371
4	5	28	65500	65500	15500	11	12500	4	12500	9	12500	4	12500	100	1359
5	5	33	68500	68500	16100	11	13100	4	13100	14	13100	4	13100	100	1356
6	5	30	66500	66500	15700	11	12700	4	12700	11	12700	4	12700	100	1354
7	5	31	67500	67500	15900	9	12900	4	12900	14	12900	4	12900	100	1352
8	5	28	65500	65500	15500	9	12500	4	12500	11	12500	4	12500	100	1349
9	5	26	64000	64000	15200	9	12200	4	12200	9	12200	4	12200	100	1343
10	5	31	67500	67500	19100	14	19100	9	9767	4	9767	4	9767	100	1323
11	5	28	65500	65500	18700	11	18700	9	9367	4	9367	4	9367	100	1310
12	5	33	68500	68500	19300	14	19300	11	9967	4	9967	4	9967	100	1305
13	5	26	64000	64000	18400	9	18400	9	9067	4	9067	4	9067	100	1297
14	5	30	66500	66500	18900	11	18900	11	9567	4	9567	4	9567	100	1293
15	5	28	65500	65500	18700	9	18700	11	9367	4	9367	4	9367	100	1291
16	5	36	70500	70500	19700	14	19700	14	10367	4	10367	4	10367	100	1287
17	5	33	68500	68500	19300	11	19300	14	9967	4	9967	4	9967	100	1276
18	5	31	67500	67500	19100	9	19100	14	9767	4	9767	4	9767	100	1276

TRACTOR TRAILER 6-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	d4	Ax5	d5	Ax6	Span	Mmax
1	6	35	75000	75000	18167	14	15167	4	15167	9	8833	4	8833	4	8833	100	1509
2	6	37	76000	76000	18333	14	15333	4	15333	11	9000	4	9000	4	9000	100	1502
3	6	34	74500	74500	18083	11	15083	4	15083	11	8750	4	8750	4	8750	100	1500
4	6	40	78000	78000	18667	14	15667	4	15667	14	9333	4	9333	4	9333	100	1499
5	6	32	73000	73000	17833	11	14833	4	14833	9	8500	4	8500	4	8500	100	1496
6	6	30	72000	72000	17667	9	14667	4	14667	9	8333	4	8333	4	8333	100	1493
7	6	37	76000	76000	18333	11	15333	4	15333	14	9000	4	9000	4	9000	100	1489
8	6	32	73000	73000	17833	9	14833	4	14833	11	8500	4	8500	4	8500	100	1488
9	6	35	75000	75000	18167	9	15167	4	15167	14	8833	4	8833	4	8833	100	1488
10	6	35	75000	75000	18833	14	18833	9	9333	4	9333	4	9333	4	9333	100	1462
11	6	32	73000	73000	18500	11	18500	9	9000	4	9000	4	9000	4	9000	100	1449
12	6	30	72000	72000	18333	9	18333	9	8833	4	8833	4	8833	4	8833	100	1446
13	6	37	76000	76000	19000	14	19000	11	9500	4	9500	4	9500	4	9500	100	1444
14	6	34	74500	74500	18750	11	18750	11	9250	4	9250	4	9250	4	9250	100	1442
15	6	32	73000	73000	18500	9	18500	11	9000	4	9000	4	9000	4	9000	100	1430
16	6	40	78000	78000	19333	14	19333	14	9833	4	9833	4	9833	4	9833	100	1426
17	6	37	76000	76000	19000	11	19000	14	9500	4	9500	4	9500	4	9500	100	1416
18	6	35	75000	75000	18833	9	18833	14	9333	4	9333	4	9333	4	9333	100	1415

TRACTOR TRAILER 7-AXLE GENERATED (POSSIBLE) TRUCK CONFIGURATIONS:

Trck	Axls	Lngth	NCS	Weight	Ax1	d1	Ax2	d2	Ax3	d3	Ax4	d4	Ax5	d5	Ax6	d6	Ax7	Span	Mmax
1	7	34	80000	80000	17714	9	14714	4	14714	9	8214	4	8214	4	8214	4	8214	100	1609
2	7	36	80000	80000	17714	11	14714	4	14714	9	8214	4	8214	4	8214	4	8214	100	1591
3	7	36	80000	80000	17714	9	14714	4	14714	11	8214	4	8214	4	8214	4	8214	100	1576
4	7	39	80000	80000	17714	14	14714	4	14714	9	8214	4	8214	4	8214	4	8214	100	1565
5	7	34	80000	80000	17714	9	8214	4	8214	4	8214	4	8214	9	14714	4	14714	100	1563
6	7	38	80000	80000	17714	11	14714	4	14714	11	8214	4	8214	4	8214	4	8214	100	1558
7	7	36	80000	80000	17714	11	8214	4	8214	4	8214	4	8214	9	14714	4	14714	100	1545
8	7	39	80000	80000	14000	9	11000	4	11000	9	11000	4	11000	9	11000	4	11000	100	1538
9	7	36	80000	80000	17714	9	8214	4	8214	4	8214	4	8214	11	14714	4	14714	100	1534
10	7	41	80000	80000	17714	14	14714	4	14714	11	8214	4	8214	4	8214	4	8214	100	1532
11	7	39	80000	80000	17714	9	14714	4	14714	14	8214	4	8214	4	8214	4	8214	100	1527
12	7	41	80000	80000	14000	11	11000	4	11000	9	11000	4	11000	9	11000	4	11000	100	1524
13	7	39	80000	80000	17714	14	8214	4	8214	4	8214	4	8214	9	14714	4	14714	100	1519
14	7	41	80000	80000	14000	9	11000	4	11000	9	11000	4	11000	11	11000	4	11000	100	1516
15	7	38	80000	80000	17714	11	8214	4	8214	4	8214	4	8214	11	14714	4	14714	100	1516
16	7	41	80000	80000	17714	11	14714	4	14714	14	8214	4	8214	4	8214	4	8214	100	1509
17	7	44	80000	80000	14000	14	11000	4	11000	9	11000	4	11000	9	11000	4	11000	100	1503
18	7	41	80000	80000	14000	9	11000	4	11000	11	11000	4	11000	9	11000	4	11000	100	1502
19	7	43	80000	80000	14000	11	11000	4	11000	9	11000	4	11000	11	11000	4	11000	100	1502
20	7	39	80000	80000	16286	9	6952	4	6952	4	6952	9	13286	4	13286	9	16286	100	1495
21	7	39	80000	80000	17714	9	8214	4	8214	4	8214	4	8214	14	14714	4	14714	100	1489
22	7	41	80000	80000	17714	14	8214	4	8214	4	8214	4	8214	11	14714	4	14714	100	1489
23	7	43	80000	80000	14000	11	11000	4	11000	11	11000	4	11000	9	11000	4	11000	100	1488

24	7	44	80000	80000	14000	9	11000	4	11000	9	11000	4	11000	14	11000	4	11000	100	1483
25	7	44	80000	80000	17714	14	14714	4	14714	14	8214	4	8214	4	8214	4	8214	100	1483
26	7	46	80000	80000	14000	14	11000	4	11000	9	11000	4	11000	11	11000	4	11000	100	1481
27	7	43	80000	80000	14000	9	11000	4	11000	11	11000	4	11000	11	11000	4	11000	100	1480
28	7	41	80000	80000	16286	11	6952	4	6952	4	6952	9	13286	4	13286	9	16286	100	1478
29	7	41	80000	80000	16286	9	6952	4	6952	4	6952	9	13286	4	13286	11	16286	100	1478
30	7	41	80000	80000	17714	11	8214	4	8214	4	8214	4	8214	14	14714	4	14714	100	1472
31	7	46	80000	80000	14000	11	11000	4	11000	9	11000	4	11000	14	11000	4	11000	100	1469
32	7	46	80000	80000	14000	14	11000	4	11000	11	11000	4	11000	9	11000	4	11000	100	1467
33	7	45	80000	80000	14000	11	11000	4	11000	11	11000	4	11000	11	11000	4	11000	100	1466
34	7	43	80000	80000	16286	11	6952	4	6952	4	6952	9	13286	4	13286	11	16286	100	1462
35	7	44	80000	80000	16286	14	6952	4	6952	4	6952	9	13286	4	13286	9	16286	100	1454
36	7	44	80000	80000	16286	9	6952	4	6952	4	6952	9	13286	4	13286	14	16286	100	1454
37	7	41	80000	80000	16286	9	6952	4	6952	4	6952	11	13286	4	13286	9	16286	100	1452
38	7	44	80000	80000	14000	9	11000	4	11000	14	11000	4	11000	9	11000	4	11000	100	1448
39	7	49	80000	80000	14000	14	11000	4	11000	9	11000	4	11000	14	11000	4	11000	100	1448
40	7	46	80000	80000	14000	9	11000	4	11000	11	11000	4	11000	14	11000	4	11000	100	1447
41	7	44	80000	80000	17714	14	8214	4	8214	4	8214	4	8214	14	14714	4	14714	100	1445
42	7	48	80000	80000	14000	14	11000	4	11000	11	11000	4	11000	11	11000	4	11000	100	1445
43	7	46	80000	80000	16286	11	6952	4	6952	4	6952	9	13286	4	13286	14	16286	100	1438
44	7	46	80000	80000	16286	14	6952	4	6952	4	6952	9	13286	4	13286	11	16286	100	1438
45	7	43	80000	80000	16286	11	6952	4	6952	4	6952	11	13286	4	13286	9	16286	100	1435
46	7	43	80000	80000	16286	9	6952	4	6952	4	6952	11	13286	4	13286	11	16286	100	1435
47	7	46	80000	80000	14000	11	11000	4	11000	14	11000	4	11000	9	11000	4	11000	100	1434
48	7	48	80000	80000	14000	11	11000	4	11000	11	11000	4	11000	14	11000	4	11000	100	1433
49	7	46	80000	80000	14000	9	11000	4	11000	14	11000	4	11000	11	11000	4	11000	100	1426
50	7	45	80000	80000	16286	11	6952	4	6952	4	6952	11	13286	4	13286	11	16286	100	1419
51	7	49	80000	80000	16286	14	6952	4	6952	4	6952	9	13286	4	13286	14	16286	100	1413
52	7	49	80000	80000	14000	14	11000	4	11000	14	11000	4	11000	9	11000	4	11000	100	1413
53	7	48	80000	80000	14000	11	11000	4	11000	14	11000	4	11000	11	11000	4	11000	100	1412
54	7	51	80000	80000	14000	14	11000	4	11000	11	11000	4	11000	14	11000	4	11000	100	1412
55	7	46	80000	80000	16286	9	6952	4	6952	4	6952	11	13286	4	13286	14	16286	100	1411
56	7	46	80000	80000	16286	14	6952	4	6952	4	6952	11	13286	4	13286	9	16286	100	1411
57	7	48	80000	80000	16286	11	6952	4	6952	4	6952	11	13286	4	13286	14	16286	100	1395
58	7	48	80000	80000	16286	14	6952	4	6952	4	6952	11	13286	4	13286	11	16286	100	1395
59	7	49	80000	80000	14000	9	11000	4	11000	14	11000	4	11000	14	11000	4	11000	100	1393
60	7	51	80000	80000	14000	14	11000	4	11000	14	11000	4	11000	11	11000	4	11000	100	1391
61	7	44	80000	80000	16286	9	6952	4	6952	4	6952	14	13286	4	13286	9	16286	100	1387
62	7	51	80000	80000	14000	11	11000	4	11000	14	11000	4	11000	14	11000	4	11000	100	1379
63	7	46	80000	80000	16286	9	6952	4	6952	4	6952	14	13286	4	13286	11	16286	100	1371
64	7	46	80000	80000	16286	11	6952	4	6952	4	6952	14	13286	4	13286	9	16286	100	1371
65	7	51	80000	80000	16286	14	6952	4	6952	4	6952	11	13286	4	13286	14	16286	100	1370
66	7	54	80000	80000	14000	14	11000	4	11000	14	11000	4	11000	14	11000	4	11000	100	1358
67	7	48	80000	80000	16286	11	6952	4	6952	4	6952	14	13286	4	13286	11	16286	100	1355
68	7	49	80000	80000	16286	14	6952	4	6952	4	6952	14	13286	4	13286	9	16286	100	1347
69	7	49	80000	80000	16286	9	6952	4	6952	4	6952	14	13286	4	13286	14	16286	100	1347
70	7	51	80000	80000	16286	14	6952	4	6952	4	6952	14	13286	4	13286	11	16286	100	1330
71	7	51	80000	80000	16286	11	6952	4	6952	4	6952	14	13286	4	13286	14	16286	100	1330
72	7	54	80000	80000	16286	14	6952	4	6952	4	6952	14	13286	4	13286	14	16286	100	1306