DEVELOPMENT OF TRUCK AXLE SPECTRA FROM OREGON WEIGH-IN-MOTION DATA FOR USE IN PAVEMENT DESIGN AND ANALYSIS

Final Report

SPR 635

DEVELOPMENT OF TRUCK AXLE SPECTRA FROM OREGON WEIGH-IN-MOTION DATA FOR USE IN PAVEMENT DESIGN AND ANALYSIS
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16. Abstract

Four weigh-in-motion (WIM) sites in Oregon, representing high, moderate, and low average daily truck traffic (ADTT) volumes, were selected to characterize axle weight and spacing spectra on Oregon state highways. Seasonal variations were considered by investigating data occurring over the four seasons: winter, spring, summer, and fall. WIM data were cleaned and filtered, and analyzed. Axle data, including group and individual axle weights as well as axle spacings, were evaluated. Hourly truck volumes were also examined. Results were summarized and statistics were developed for the characteristic data. The characterized Oregon WIM axle data were incorporated into the Mechanistic Empirical Pavement Design Guide (MEPDG) software program to permit State and ADTT volume-specific axle weight spectra, average axle group spacing, and hourly volume data to be used in the pavement analysis/design. In order to implement the Oregon WIM data, a "virtual" truck classification was created in the MEPDG program. The Oregon-specific data that were required for input into the MEPDG were hourly truck volume distribution, site-specific axle weight data, average number of axles per truck, and average axle spacing. Implementation of the Oregon WIM data will improve the pavement design process in the State by designing to more realistic local loading conditions.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
	NOTE: Volumes greater than 1000 L shall be shown in m^3.			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit	(F-32)/1.8	Celsius	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
m^2	meters squared	1.196	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
ml	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius	1.8C+32	Fahrenheit	°F

*SI is the symbol for the International System of Measurement

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DISCLAIMER

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1.0 INTRODUCTION

Oregon collects Weigh-in-Motion (WIM) data from 22 sites around the state. Data from four of these sites, each with different truck volumes, were selected to quantify truck axle characteristics in the state. Raw WIM data were first cleaned, filtered, and then sorted into axle groups. The processed data were used to describe truck volume as well as axle weight and spacing. Data from different months were analyzed to identify any seasonal variability within the year. Finally, axle weight and spacing parameters were developed from the WIM data for input into the state-of-the-art pavement design program.

2.0 METHODS

2.1 WIM DATA SITE SELECTION

WIM sites located on state highways, with different truck volume levels, were selected to identify axle weight characteristics in Oregon. Selection of the sites was based on previous work for calibration of two-lane loaded live load factors for the Oregon Department of Transportation (ODOT) by Pelphrey and Higgins (*2006*). Pelphrey and Higgins used Average Daily Truck Traffic (ADTT) to describe load factors that vary depending on truck volume levels. WIM sites distributed across Oregon were chosen to represent three different ADTT levels as shown in Table 2.1. The sites are located on all of Oregon's major truck freight corridors. These sites were used to broadly classify the WIM data for high (5,000), moderate (1,500) and low (500) ADTT volume. Two sites were selected to quantify low volume conditions as these may be more variable than higher volume sites.

Table 2.1: Selected WIM sites, locations, and ADTT

Corridor	Site Location	Site Designation	ADTT	% ADTT	Vol. Class
I-5	Woodburn NB	WBNB	5550	13%	"High"
US97	Bend NB	BNB	607	8%	"Low"
OR58	Lowell WB	LWB	581	7%	"Low"
I-84	Emigrant Hill WB	EHWB	1786	36%	"Moderate"

To identify possible seasonal variation in the WIM data, one month was selected from each of the four seasons by examining the last two years of archived ODOT WIM data compiled by Oregon State University. A month was selected out of each season that had a continuous data record for each day in the month. The representative seasonal month chosen for each site was used in subsequent analyses. The WIM data used in this analysis ranged from September 2005 to August 2006 (Table 2.2).

Table 2.2: List of months and years chosen to represent each season and site

Season	Months	WBNB	EHWB	LWB	BNB
Winter	Dec, Jan, Feb	Dec_05	Jan_06	Jan_06	Jan_06
Spring	Mar, Apr, May	Mar_06	Mar_06	Apr_06	Apr_06
Summer	Jun, Jul, Aug	Jun_06	Aug_06	Aug_06	Aug_06
Fall	Sept, Oct, Nov	Sept_05	Oct_05	Oct_05	Oct_05

To quantify typical daily truck traffic volume characteristics, a 24-hour period was randomly chosen from each representative seasonal month for all sites. Days of the week were considered uniformly distributed and were randomly selected using Monte Carlo simulation (Table 2.3). Within each site and season a maximum of one weekend day was allowed in the analysis. In order to minimize the influence of weekend traffic, which was seen to have reduced volume compared to weekdays, a limit of one weekend day per site and per season was imposed.

Table 2.3: Randomly selected days for each ADTT level and WIM site (numbers in table represent random numbers used to select the day of the week).

	5000 ADTT (WBNB)				1500 ADTT (EHWB)				500 ADTT (LWB)				500 ADTT (BNB)			
week #	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Winter	3.7 (Thu)	1.7 (Tue)	0.0 (Mon)	0.3 (Mon)	5.0 (Fri)	5.6 (Sat)	0.0 (Mon)	2.8 (Wed)	5.4 (Sat)	3.8 (Thu)	1.0 (Tue)	4.8 (Fri)	3.6 (Thu)	5.1 (Sat)	1.2 (Tue)	3.9 (Thu)
Spring	4.1 (Fri)	4.3 (Fri)	1.6 (Tue)	6.4 (Sun)	1.5 (Tue)	2.5 (Wed)	1.6 (Tue)	6.5 (Sun)	4.2 (Fri)	2.7 (Wed)	6.1 (Sun)	3.6 (Thu)	6.5 (Sun)	1.1 (Tue)	3.1 (Thu)	2.0 (Tue)
Summer	3.3 (Thu)	0.1 (Mon)	0.1 (Mon)	3.8 (Thu)	1.7 (Tue)	4.1 (Fri)	6.1 (Sun)	1.8 (Tue)	3.0 (Thu)	5.3 (Sat)	0.5 (Mon)	2.3 (Wed)	3.0 (Thu)	4.1 (Fri)	1.3 (Tue)	5.9 (Sat)
Fall	3.8 (Thu)	4.7 (Fri)	0.5 (Mon)	4.4 (Fri)	4.9 (Fri)	1.6 (Tue)	1.5 (Tue)	5.8 (Sat)	1.6 (Tue)	0.8 (Mon)	1.1 (Tue)	5.3 (Sat)	4.9 (Fri)	3.4 (Thu)	5.0 (Fri)	3.2 (Thu)

2.2 WIM DATA QUALITY ASSURANCE

WIM data from the four Oregon sites will be inputted into a model to predict pavement damage and aid in the development of a more accurate pavement design. As such, the WIM data must be well maintained and reliable. Two classifiable types of errors, random and systematic, were found in WIM data according to Prozzi and Hong (*2007*). Random errors are inherent in WIM data instrumentation and found to be positive or negative. Prozzi and Hong found that random errors led to overestimation of loads and commonly resulted in a more conservative design (*2007*). Systematic errors, on the other hand, result from a bias in the measurement and can lead to either under or overestimation of loads. This type of error may be caused by equipment drift or inaccuracies in calibration. Data may be adjusted for the two types of error as illustrated in Figure 2.1.

Prozzi and Hong found that WIM system calibration was an important factor in determining the validity and accuracy of load pavement damage estimation (*2007*). To assure quality pavement design, system errors should be minimized by ensuring that WIM data is reliable and calibrated correctly. Oregon WIM data from ODOT are downloaded and archived every month by Oregon State University. As part of this process, each site is reviewed to check for completeness of the data and to detect anomalies in the records.

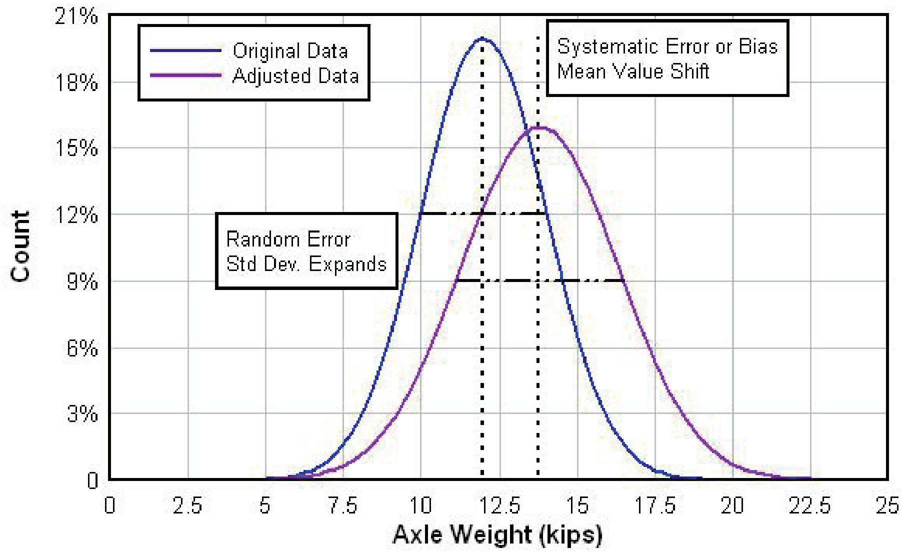

Figure 2.1: Chart showing data adjustment curves for WIM random and systematic errors.

WIM calibrations are typically performed by ODOT every six months. Approximately 20 trucks are flagged for static weighing and the data are compared to the WIM scale measurements. Static and WIM gross vehicle weight (GVW) data are compared and, when necessary, the WIM measurements adjusted. Calibration error plots used at the time this report was written are compiled in Appendix A. The statistics showed that combined average error in GVW for three out of the four WIM sites (calibrations for the Bend site were unavailable) were less than 3.6 percent, with a 4.9 percent standard deviation. Figure 2.2 shows that the GVW data from all three sites correlated fairly well to a normal error distribution trend.

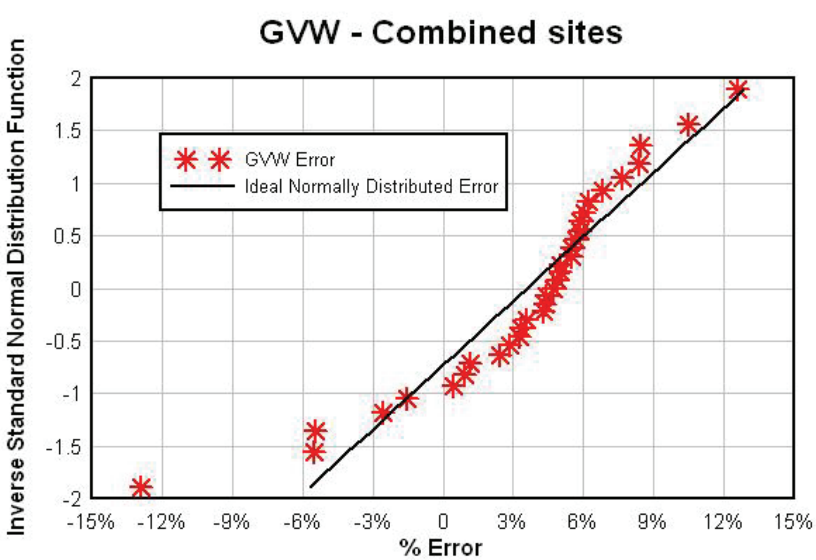

Figure 2.2: GVW WIM error data.

Individual axle data, not GVW, are used as input for pavement design, and trends in individual axle weights are accordingly examined in the current study. This type of data has not been routinely collected and saved as there has been no way of calibrating the WIM scales at the individual axle level. For verification of pavement design parameters proposed, individual axle group weights were examined from the most current calibration (Appendix A). The summary data of the individual axle group weights for the combined WIM sites showed the mean error varied slightly more than the GVW. The average individual axle weight error was 4.6 percent and the data were not as well described as normally distributed (Figure 2.3) with over 12 percent standard deviation.

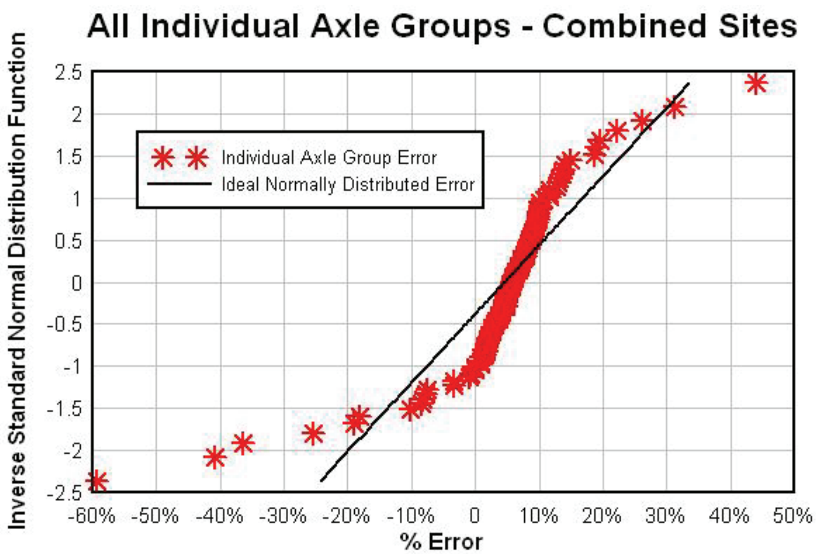

Figure 2.3: Individual axle group WIM error data.

2.2.1 WIM Data Filtering

Raw WIM data, collected by ODOT, were cleaned with two FORTRAN programs developed at OSU, which were referred to as "Filter_1" and "Filter_2" for the purpose of the study. A report detailing this process has previously been written and reviewed (*Pelphrey and Higgins 2006*). In summary, the first stage of the filtering process sorted out erroneous records where GVW equaled zero or the data did not represent an actual truck. It also sorted out inaccurate records (those that had inconsistencies from the general WIM data format) or incomplete records. The resulting output provided valid WIM entries that were reformatted for subsequent data analyses.

The second program utilized filtered data from the first stage process as input to further filter records based on the criteria listed below. The second program filtered out any record with:

- misplaced characters, such as a letter where a number should be or a number where a letter should be.
- an individual axle weight greater than 50 kips

- a speed less than 10 mph
- a speed greater than 99 mph
- a length greater than 200 ft
- the sum of the axle spacings greater than the length of the truck
- the sum of the axle spacings less than 7 ft
- the first axle spacing less than 5 ft
- total axle count greater than 13
- GVW greater than 280 kips
- any axle spacing less than 3.4 ft
- GVW +/- the sum of the axle weights by more than 7 percent

A number of invalid WIM records were removed from the data by the filter programs (Table 2.4). Large proportions of invalid records were removed due to incomplete records, data format errors, and axle spacing less that was less than 3.4 ft.

Table 2.4: Table showing the percentage of WIM records filtered out by data filter programs.

		Filter #1			Filter #2				
		Valid Events	**Null Events**	**% Filtered Out of Record**	**Valid Trucks**	**Null Events**	**% Filtered Out of Record**	**Total % Filtered Out of Record**	**Avg. %**
WBNB	Winter	140258	117222	46	135813	4444	3	47	42
	Spring	162279	130220	45	159344	2935	2	46	
	Summer	159730	96228	38	152673	7057	4	40	
	Fall	157008	84540	35	153178	3830	2	37	
EHWB	Winter	44792	14148	24	37730	7062	16	36	31
	Spring	55398	11780	18	52049	3349	6	23	
	Summer	62606	25610	29	58429	4177	7	34	
	Fall	57871	18623	24	51560	6311	11	33	
LWB	Winter	14032	10276	42	13544	488	3	44	32
	Spring	20749	10509	34	19480	1269	6	38	
	Summer	30638	10702	26	28042	2596	8	32	
	Fall	29074	1804	6	26738	2336	8	13	
BNB	Winter	14865	5703	28	12374	2491	17	40	29
	Spring	20837	2202	10	18060	2777	13	22	
	Summer	26482	3861	13	21963	4519	17	28	
	Fall	22731	3836	14	19067	3664	16	28	

2.2.2 Compiling Axle Weight and Spacing Data

After filtering, data for axle weight and spacing were processed through FORTRAN programs also written at OSU. The programs are called "HistoWeight_#" and HistoSpacing_#". The # in the title referred to the axle or spacing category considered. No number was used in the file name to indicate the output for steer axles. For single axles #1 was used, on up to #5 for penta axles. Axle spacings started at #2 for tandem-axle spacings and ended at #5 for penta-axle spacings. The output from the programs was sorted into axle categories, *HistoWeight_(axle category)* and *HistoSpacing_(axle category)*. The total weight, or length, as well as the individual axle data within each axle category, were summarized in the output files. For example, the program "HistoWeight_3" compiled the axle weight data for triple axles into the output file, *HistoWeight_TRIPLES*. The output summarized the data for the overall triple axle weight (the sum of the weight of the individual axles) as well as for each of the three individual axle weights. Similarly, *HistoSpacing_TRIPLES* compiled the data for the overall axle length and the two individual axle spaces between the three axles.

The output of the "Histo" programs formatted the axle data into three columns: Bin, Count, and Frequency. Bin described the column of data that defined the limits for the parameter being examined, either weight (units: kips) or spacing (units: feet). The value for the bin size and the number of bins was chosen based on preferences for the histogram resolution and range and the definitions for each were written into the FORTRAN program source code. Sample output format is shown in Table 2.5 for total triple axle weight from one of the two low volume sites during the summer (LWB_June06). Here the bin size is equal to 3.00 kips and there are a total of 20 bins that range from 0 to 60 kips. One complete sample output file from this program is contained in Appendix A along with the other FORTRAN program outputs. The count shown in Table 2.5 represents the total number of WIM data records within the range of the corresponding bin. The count value was calculated using the corresponding bin number as the lower bound and the subsequent bin as the upper bound. For example, in the sample output in Table 2.5, the count value corresponding to Bin 12.00 represents the number of triple axles whose total weight is greater than 12.00 kips but less than or equal to 15.00 kips. Frequency represents the fraction of the corresponding bin to the total number of records in the data set. At the bottom of each entry, the mean and standard deviation was calculated and displayed for both the total and individual axle groups.

Table 2.5: Sample output for "HistoWeight_3"

Triple Axle Weight		
Bin	**Count**	**Frequency**
0.00	2	.0001
3.00	25	.0010
6.00	412	.0169
9.00	1502	.0617
12.00	2627	.1079
15.00	1400	.0575
18.00	798	.0328
21.00	1133	.0465
24.00	1515	.0622
27.00	942	.0387
30.00	1\643	.0675
33.00	2689	.1105
36.00	5191	.2132
39.00	3628	.1490
42.00	615	.0253
45.00	77	.0032
48.00	55	.0023
51.00	39	.0016
54.00	23	.0009
57.00	15	.0006
Mean	29.160	
Standard Deviation	10.86	

2.3 INCORPORATING DATA INTO THE MECHANISTIC EMPIRICAL PAVEMENT DESIGN GUIDE

Mechanistic Empirical Pavement Design Guide (MEPDG), developed in 2002 by the Transportation Research Board, serves as a state-of-the-art tool for rigid and flexible pavement design (*NCHRP 2003*). Incorporation of loading data developed from the Oregon WIM sites may improve analysis results by applying state-specific load demands rather than relying on national data that may not necessarily reflect actual loading conditions. In addition to the MEPDG software, the National Cooperative Highway Research Program (NCHRP) produced the program, "TrafLoad" (*2004*), which can translate WIM data into a format readily inputted into MEPDG. However, this program does not provide data cleaning, filtering, and review, such as has been provided by the methodology developed here and described above. Further, the data classification used in Oregon has not been the same as that used nationally, and a more direct method was developed to implement the Oregon WIM data into the MEPDG.

MEPDG currently uses truck percentages within each vehicle classification as well as axle group load distributions as inputs. The MEPDG program employs the Federal Highway Administration (FHWA) classification system using 13 vehicle classes (Figure 2.4). This classification system is different than that currently used in the ODOT WIM data as defined previously. The "TrafLoad" software allows for alternative vehicle classifications but the translation can result in a loss of accuracy. In addition, asphalt damage as calculated by MEPDG does not directly use the vehicle classification except as a way to determine the axle weight distributions and as a way to incorporate classification specific growth rates. It is not likely that the current growth models have adequate sophistication to accurately predict growth of individual vehicle classifications except in exceptional circumstances.

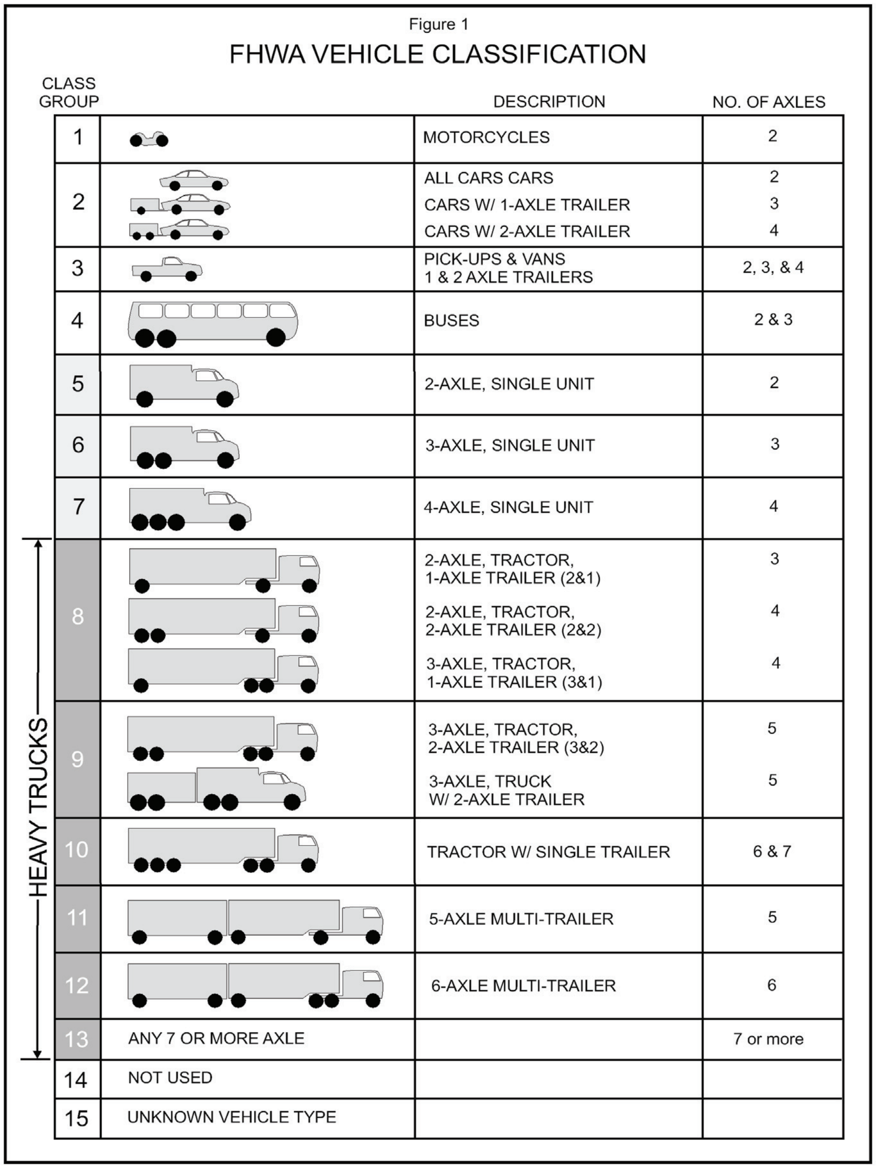

Figure 1

FHWA VEHICLE CLASSIFICATION

CLASS GROUP		DESCRIPTION	NO. OF AXLES
1		MOTORCYCLES	2
2		ALL CARS CARS CARS W/ 1-AXLE TRAILER CARS W/ 2-AXLE TRAILER	2 3 4
3		PICK-UPS & VANS 1 & 2 AXLE TRAILERS	2, 3, & 4
4		BUSES	2 & 3
5		2-AXLE, SINGLE UNIT	2
6		3-AXLE, SINGLE UNIT	3
7		4-AXLE, SINGLE UNIT	4
8		2-AXLE, TRACTOR, 1-AXLE TRAILER (2&1) 2-AXLE, TRACTOR, 2-AXLE TRAILER (2&2) 3-AXLE, TRACTOR, 1-AXLE TRAILER (3&1)	3 4 4
9		3-AXLE, TRACTOR, 2-AXLE TRAILER (3&2) 3-AXLE, TRUCK W/ 2-AXLE TRAILER	5 5
10		TRACTOR W/ SINGLE TRAILER	6 & 7
11		5-AXLE MULTI-TRAILER	5
12		6-AXLE MULTI-TRAILER	6
13	ANY 7 OR MORE AXLE		7 or more
14	NOT USED		
15	UNKNOWN VEHICLE TYPE		

HEAVY TRUCKS (classes 8–13)

Figure 2.4: FHWA vehicle classifications (*Sarasota/Manatee Metropolitan Planning Organization 2006*).

3.0 RESULTS

3.1 WIM DATA CHARACTERIZATION

To characterize the cleaned and filtered WIM data, two FORTRAN programs were developed to count and sort the truck axles, "AxleSorter" and "AxleStats." "AxleSorter" used the filtered and cleaned output data to classify the trucks into axle group categories. The output was separated into the following axle groups: *Steers*, *Singles*, *Tandems*, *Triples*, *Quads*, and *Pentas*. To distinguish axle groups, a maximum axle spacing limit of 8.0 ft was imposed. Axle category definitions were taken from current ODOT limits (*Fifer 2006*), which were consistent with the national tandem definition (*US DOT 2007*). Therefore, an axle spacing less-than or equal-to 8.0 ft indicated adjacent axles were related as an axle group that acted together. For example, if only one spacing met the 8.0 ft or smaller criteria, the two adjacent axles were classified as a tandem axle; if two successive spacings met the criteria, the three adjacent axles were classified as a triple axle, and so on. The exception to this rule was the steer axle, which was always identified as the first axle in the record.

Output files were created for each axle category in which the data were summarized and the statistics calculated. Other information was also recorded from the WIM data record, such as the truck increment number (assigned sequentially by the first filter program), ODOT vehicle classification as defined by the WIM station (Figure 3.1), axle configuration, total weight and length, as well as the individual axle weights and spacings. Example output from all FORTRAN programs can be found in Appendix B.

Along with the axle categories output created by "AxleSorter," additional files titled *Summary* and *No Class* were generated. The total number of trucks, axles, and the different axle categories were summed and stored in the output file *Summary*. For example, a tandem-axle group was counted only once (even though there were two individual axles) in order to provide axle group configuration totals, instead of individual axle totals. In the output file, *AxleStats*, described subsequently, the total number of individual axles in each axle category was also recorded. The *No Class* output collected all records for trucks not meeting the defined axle category criteria. Very few trucks were sorted into this category. There were only 24 trucks in all four seasons of the WBNB site and eight in the EHWB site. A verification check of two of the WBNB seasons found 12 trucks were placed in the *No Class* category. These were all verified as correctly sorted because they contained hexa-axle configurations. This axle category was such a small fraction of the data as to not be considered in the analysis. Further, this axle group and the penta-axle group were not considered in the asphalt design program discussed subsequently.

The second FORTRAN program "AxleStats" took the output from "AxleSorter" and computed the summary statistics in terms of individual counts. Two different statistical categories were produced, one for trucks and one for the axle groups. The total number of trucks with a certain type of axle configuration were tallied along with the percentage of total trucks in that axle category. A given truck may have had consistant axle group configurations which caused it to be counted multiple times for truck statistics. The trucks identified in this category represented the percentage of the trucks within the WIM record that contained one or more axle configurations. Similarly, the total number of individual axles of each type of axle configuration were tallied and a percentage of the total axles was given. In this program, a tandem axle counted as two axles, a triple axles counted as three, etc.

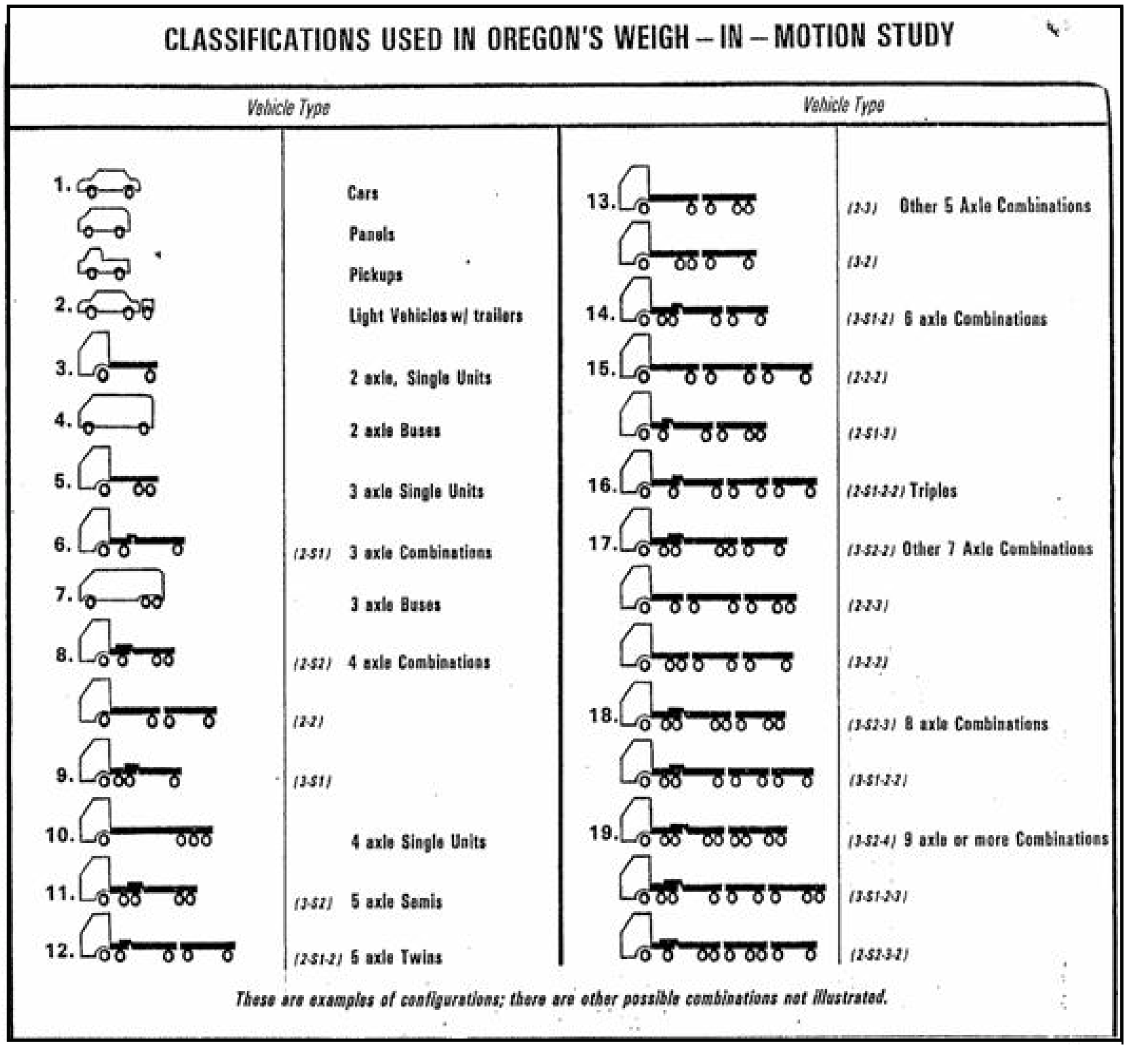

Figure 3.1: ODOT vehicle classifications

3.1.1 Traffic Volume

The “AxleStats” and “AxleSorter” programs were used to develop statistical information about the truck volume demand patterns at the four WIM sites, over the four seasons. ADTT was averaged over all seasons. The count proved similar to the predicted ADTT level for the four sites (Table 2.1). Assuming a 30 day month, ADTT was 5008, 1665, 732, and 596 for the WBNB, EHWB, LWB, and BNB sites, respectively.

There was evidence of seasonal variation in the overall traffic volume, with less traffic occurring in the winter months. There was less variation for the WBNB site, where seasonal changes were not large and the north-south interstate appeared to serve as a significant transportation corridor more or less independent of the season (Table 3.1).

Table 3.1: Seasonal variation in total trucks volume for WIM sites.

	% Difference from Average Total Trucks			
	Winter	**Spring**	**Summer**	**Fall**
WBNB	-10	6	2	2
EHWB	-24	4	17	3
LWB	-38	-11	28	22
BNB	-31	1	23	7

Daily truck volume patterns were also investigated. Patterns were investigated by selecting random days within the seasons for every site using the process described previously. Weekend days exhibited lighter truck volume then weekdays as illustrated in Figure 3.2. Most truck traffic occurred between the hours of 8:00 a.m. to 5:00 p.m., with the peak occurring sometime between 12:00 p.m. and 1:00 p.m. Compilation of the daily (24-hour) traffic volume distributions for all sites and seasons is contained in Appendix C.

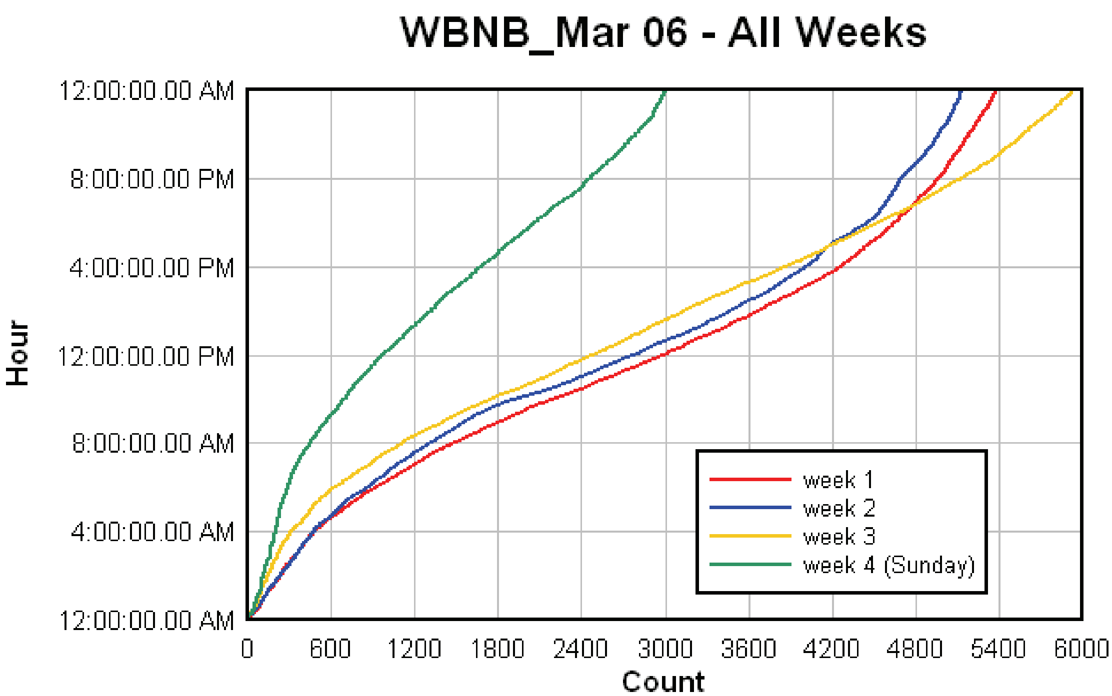

Figure 3.2: Example cumulative truck counts observed in 24-hour period for WBNB in spring.

The shape of the daily truck volume data did not vary significantly between sites or seasons, as shown in the combined truck volumes for all days in all of the seasons (Figure 3.3). The averaged weekly data in cumulative distribution function (CDF) form, for each site and season, are shown in Appendix D.

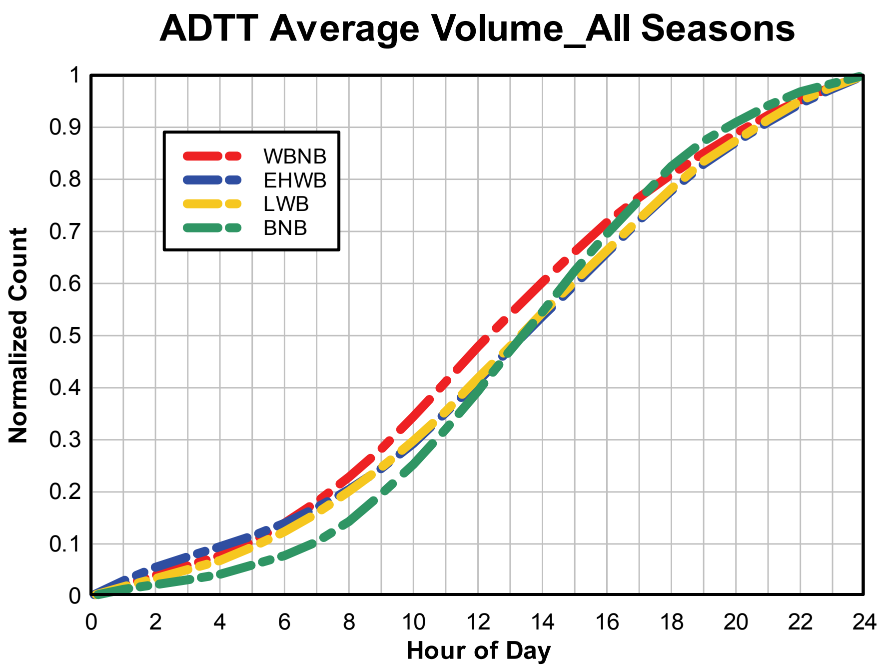

Figure 3.3: Averaged truck volume CDF for all WIM sites.

The averaged combined data may be appropriate for general design applications but in some cases, a more in-depth analysis or pavement design is warranted. In these instances, hourly data may be preserved across the seasons and WIM sites, as some slight variations do exist. These may be important if temperatures are a key component in the pavement design and actual corresponding loads during critical times are necessary. Slight shifting in peak time (Figure 3.4) and peak magnitude (Figure 3.5) were observed, and these features could be kept distinct if desired by an analyst.

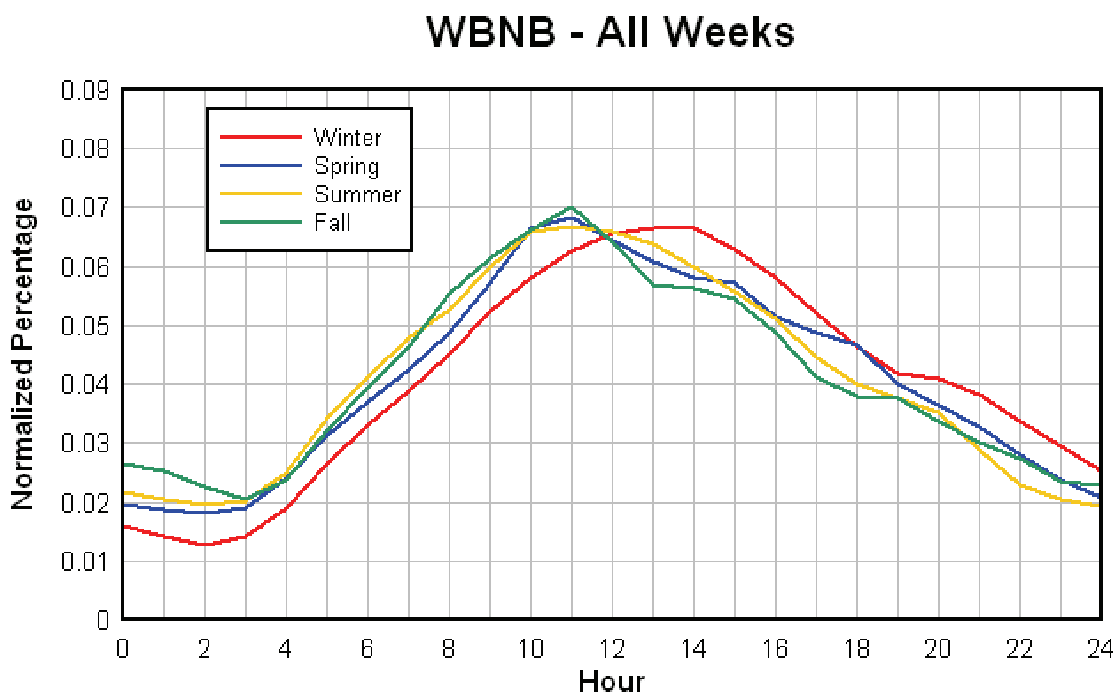

Figure 3.4: Averaged hourly truck volume PDF for WBNB across all seasons.

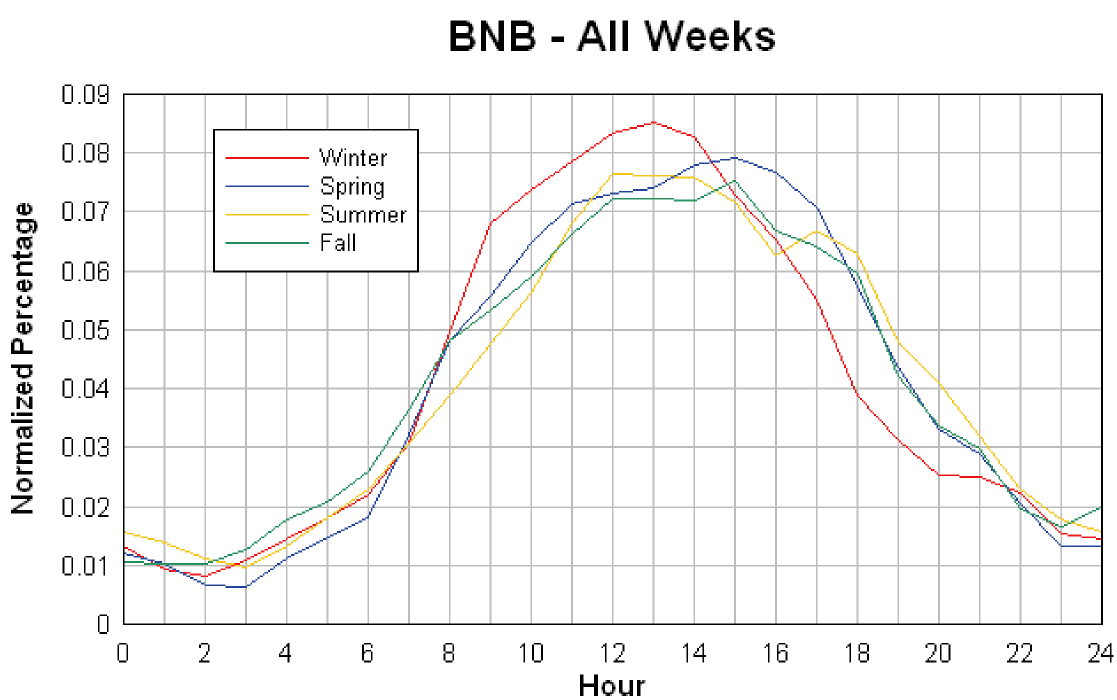

Figure 3.5: Averaged hourly truck volume PDF for BNB across all seasons.

Two separate low volume sites were included in this analysis to account for possible variability due to less data in the lower volume sites. Examination of the hourly volumes between the two low volume sites (BNB and LWB) showed that while the general shape of the volume curves were similar, BNB had higher demands at mid-day and less demands early and late in the day (Figure 3.6). This further validated inclusion of two low volume sites in the data analysis and indicated hourly volumes across sites should not be combined if a more advanced pavement design is needed.

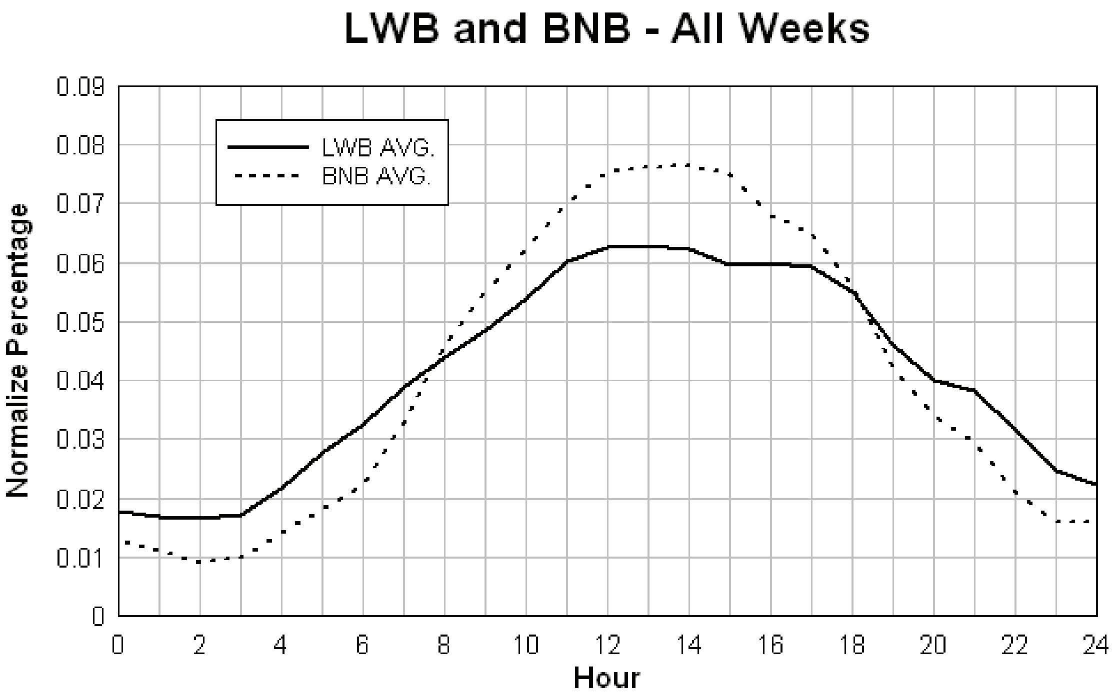

Figure 3.6: Averaged hourly truck volume PDF for low volume sites BNB and LWB

3.1.2 Results of Axle Weight and Spacing Data

Axle weight and axle spacing data for each site and season were examined after the WIM data had been cleaned, processed, and sorted into axle group categories. Histograms, cumulative distribution functions, as well as summary statistical data were generated for the overall axle weights and axle spacings as well as for individual axle data. Weight and spacing data were counted in the group of FORTRAN programs "HistoWeight_#" and HistoSpacing_#" described previously in Section 2.2.2.

CDF plots for axle weight and length data were compiled and are shown in Appendices E-H for all four WIM sites, all four seasons, and all six axle categories. The total axle weight plots in Appendix E permit comparisons of seasonal weights of the individual axle categories. The data showed there was negligible seasonal variation for axle weight among like axle configurations for the WIM sites but there were differences observed in the weight distributions between axle categories. For example, there was little variation seen in the distribution of the total tandem axle weight for the high traffic volume site (WBNB) between the four seasons as shown in Figure 3.7. Other axles and other sites showed similar trends. The exception was the penta-axle category which had low numbers of records which resulted in higher variability.

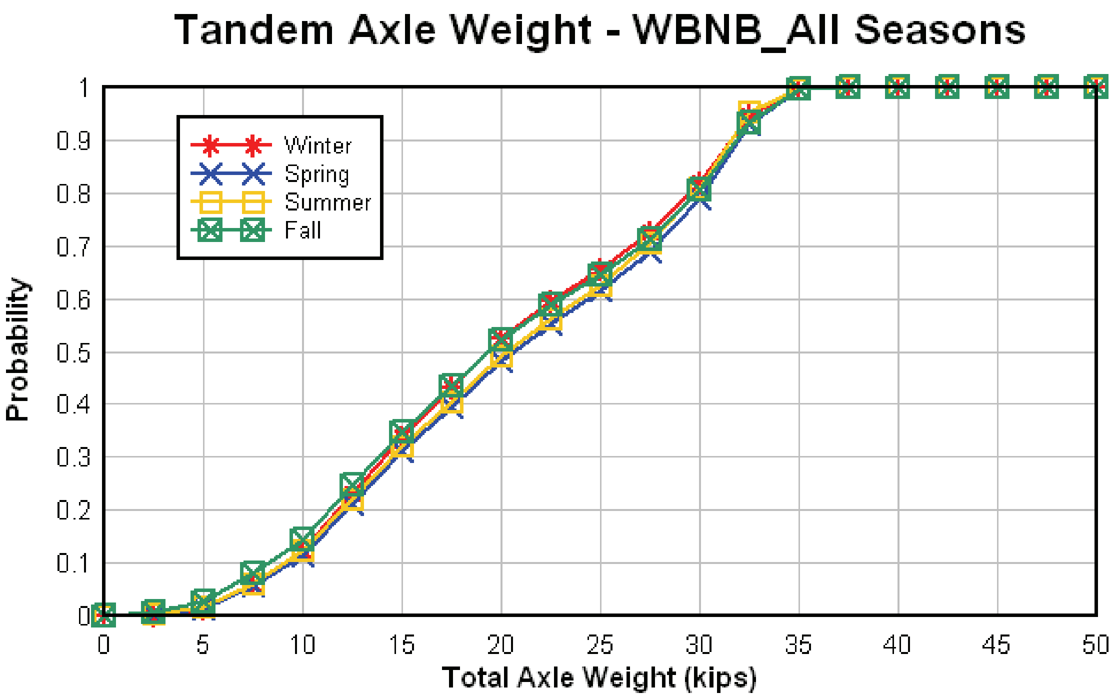

Figure 3.7: Total axle weight distributions for tandem axle group at WBNB for all seasons

The similarity between seasonal axle weights was also seen in the low variation between average axle weights for each season. Table 3.2 summarizes the average group axle weights and their coefficients of variation (COV) for all sites. Excluding the penta-axle group, which had only a few records and wider scatter, the maximum variation in the group axle weight data for all other axle categories was 5.9 percent. The entire data set for individual axles, as well as the axle group weights, are shown in Appendix I. In general, steer axle weights varied little compared to other categories. Higher ADTT levels had lower COVs with the 5000 ADTT level having a maximum COV of 2.2 percent when excluding the penta-axle group.

Table 3.2: Average and COV of axle weights for axle groups at all four WIM sites.

	WBNB.		EHWB		LWB		BNB		
	Weight (kips)	COV (%)	Weight (kips)	COV (%)	Weight (kips)	COV (%)	Weight (kips)	COV (%)	Largest COV(%)
STEERS	9.96	0.8	9.40	2.6	9.32	1.5	10.28	2.6	2.6
SINGLES	10.06	0.8	10.16	2.6	9.49	3.9	9.13	5.6	5.6
TANDEMS	20.42	1.9	19.79	3.3	20.08	3.1	22.70	4.4	4.4
TRIPLES	28.84	1.8	25.95	4.8	27.11	1.8	26.44	4.9	4.9
QUADS	39.19	0.9	34.30	5.2	38.18	3.4	42.73	5.8	5.8
PENTS	30.14	22.9	28.38	51.7	18.72	13.2	-	-	51.7

Comparisons between individual axle weight distributions by axle group category for a single site and season are shown in Appendix F. The individual axle weight distributions for the sites and seasons exhibited certain distinct characteristics based principally on axle categories and truck volume levels. While an axle group category tended to not vary between seasons for a given site (see Figure 3.7), the individual axle weights did vary between axle group categories (Figure 3.8). As seen in Figure 3.8, the steer-axle group exhibited a weight distribution that was tightly clustered around the 8 to 12 kips range, while the single-axle group had weights that were more similar to the individual axles within the tandem and triple-axle categories with weights more uniformly distributed over the axle weight range. The individual axles within the penta-axle group, and even the quad-axle, were quite variable due partially to the low numbers of records in this category.

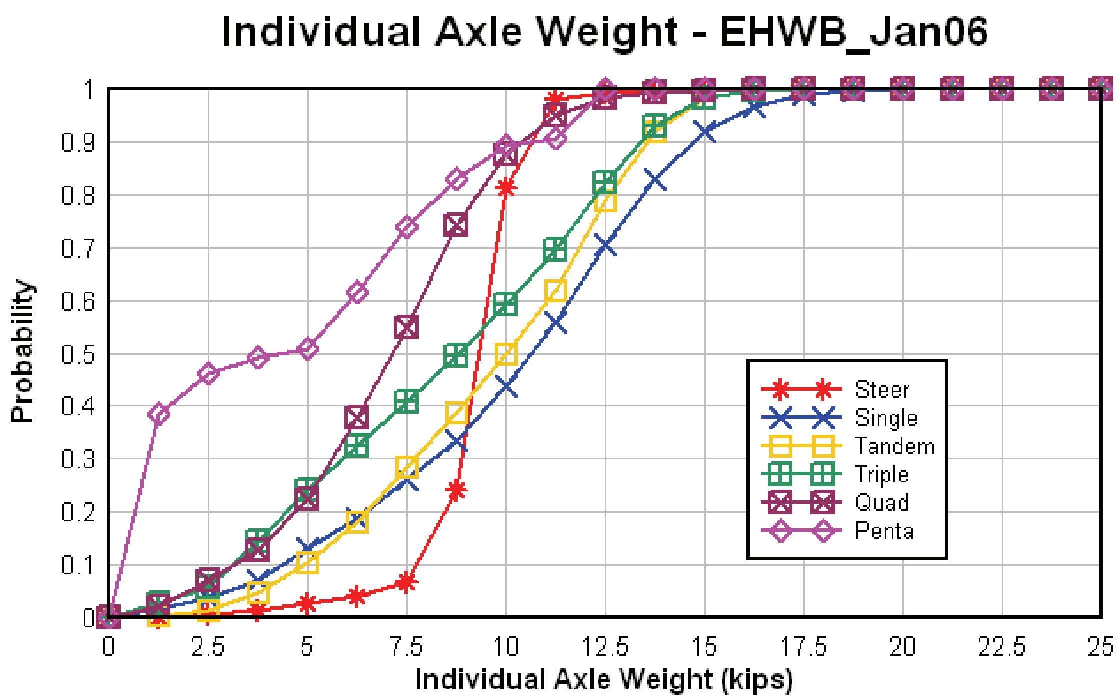

Figure 3.8: Distributions of individual axle weights for different axle group categories at EHWB in winter

The axle weight comparisons in Appendix F and Figure 3.8 took an average of all individual axles together. If the axle groups that contained multiple axes were further broken down into their individual axles, it would be clear that there are different distributions among the axles within some of the axle categories. For example, the first axle in a triple axle group was on average lighter than the rear axle (third axle in group). The axle configuration distributions described subsequently are for the high-volume site (WBNB) only because the individual axle weight trends were not as pronounced for the lower truck traffic volume sites which contain fewer records.

The observed differences between the steer and individual axles were noteworthy, especially as it pertained to input into the Mechanistic Empirical Pavement Design Guide (MEPDG), the state-of-the art asphalt design program (*NCHRP 2003*). The steer axle-groups were narrowly banded, while the single axles were distributed over a wider range of weights as shown in Figure 3.9.

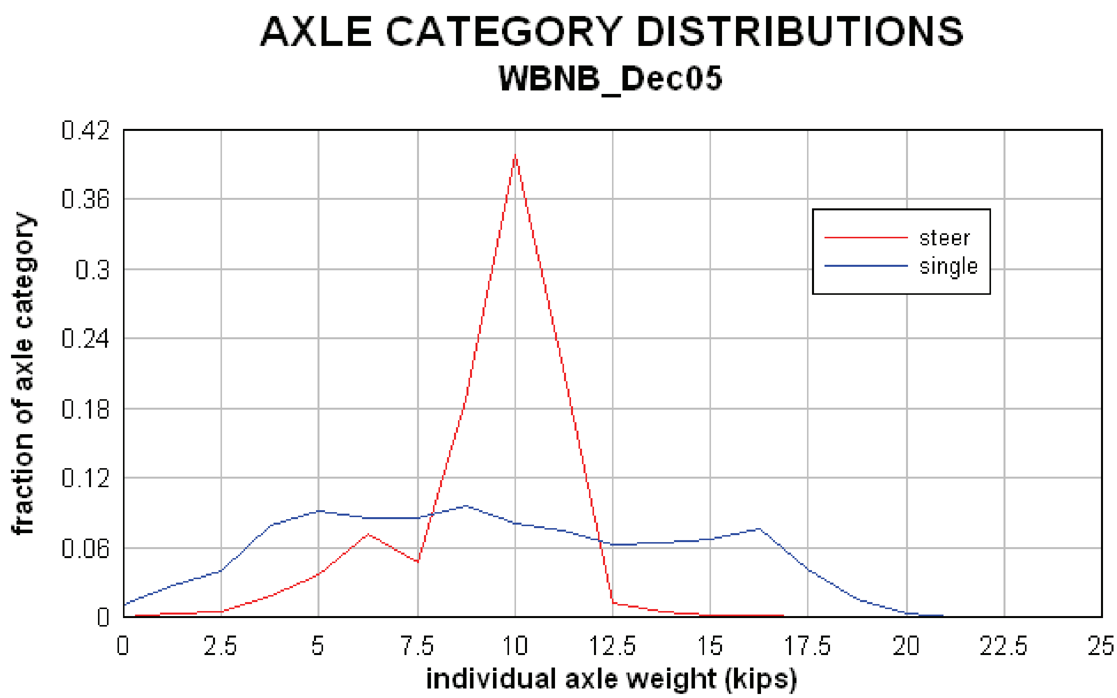

Figure 3.9: Distribution of individual axle weight for steer and single-axle categories at WBNB in winter.

Distributions of total axle weight for tandem and triple-axle groups were similar, but the individual axle weights within these groups exhibited different distributions. Both of the individual axle weights within the tandem group had very similar distributions, while the triple group had different distributions. The front axle in the triple-axle configuration tended to be lighter on average then the rear two axles which had more of a bimodal distribution (Figure 3.10). This phenomenon may have highlighted the role of drop-axles within the axle group. Drop-axles commonly have just two tires on the axle and thus would have approximately half the weight of the adjacent four tire axles.

The four individual axle weights within the quad-axle group category showed somewhat different distributions for the different WIM sites, as compared with the singles, steers, tandems, and triple-axle weights. The weight of the first axle tended to be more uniformly distributed overall, and the rear axle weight tended to be the lightest of the group. The middle two axle weights were similarly distributed to each other and tended to be slightly heavier loaded than the outer axles, as seen in Figure 3.11.

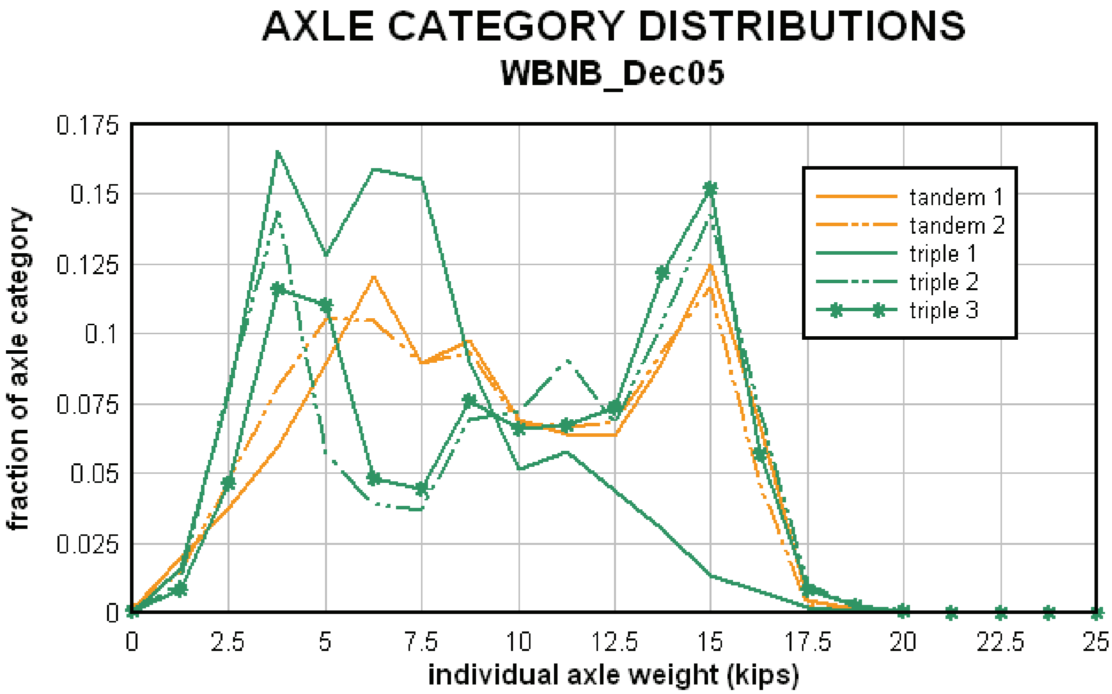

Figure 3.10: Distributions of individual axle weight for tandem and triple-axle group categories at WBNB in winter.

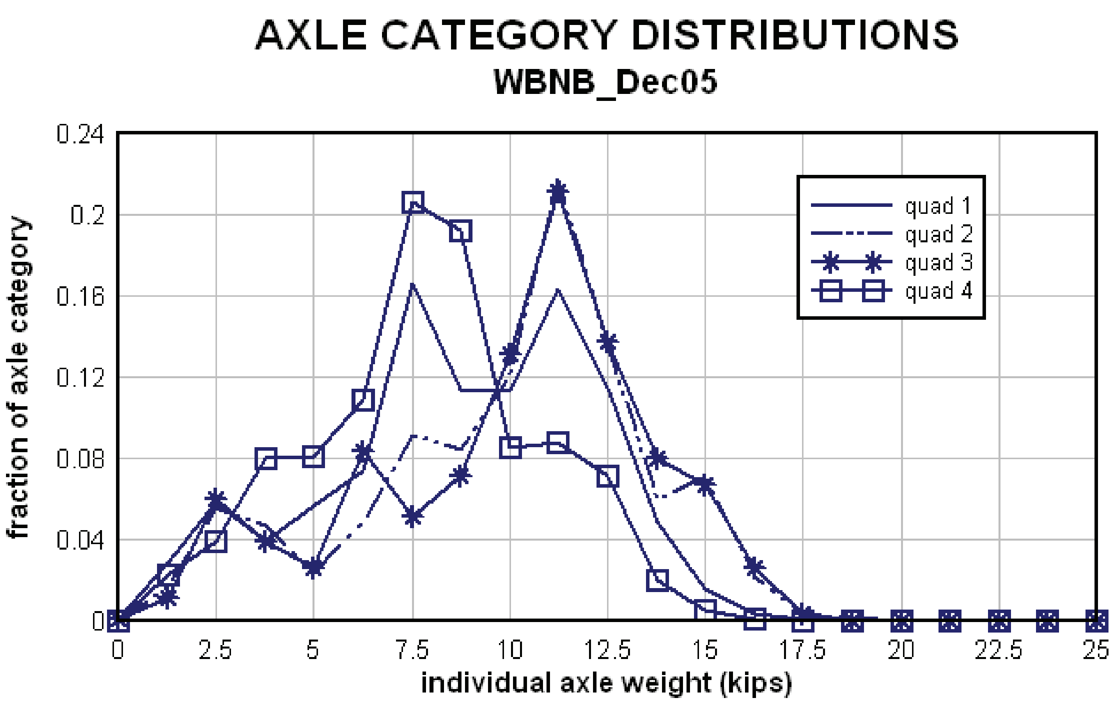

Figure 3.11: Distributions of individual axle weight for quad-axle group category at WBNB in winter.

Axle group length and individual axle spacing data are summarized in Appendices G and H. The formats used for these data were the same as those described previously for Appendices E and F (axle weights). Appendix G compares axle group length and individual axle spacing for the axle categories seasonally, and Appendix H compares axle group length and individual axle spacings between axle categories for each site and season. Seasonal variation of axle spacing was not significant as seen in Figures 3.12 and 3.13. This was consistent with the data trends of the axle weights. Axle length distributions became increasingly similar for the lower volume sites as compared to the trends observed for axle weights. In contrast, the axle weight distributions became more varied with decreasing truck volume. This indicated a similarity in truck configurations traveling through low-volume sites, but higher variability in loads carried by these trucks.

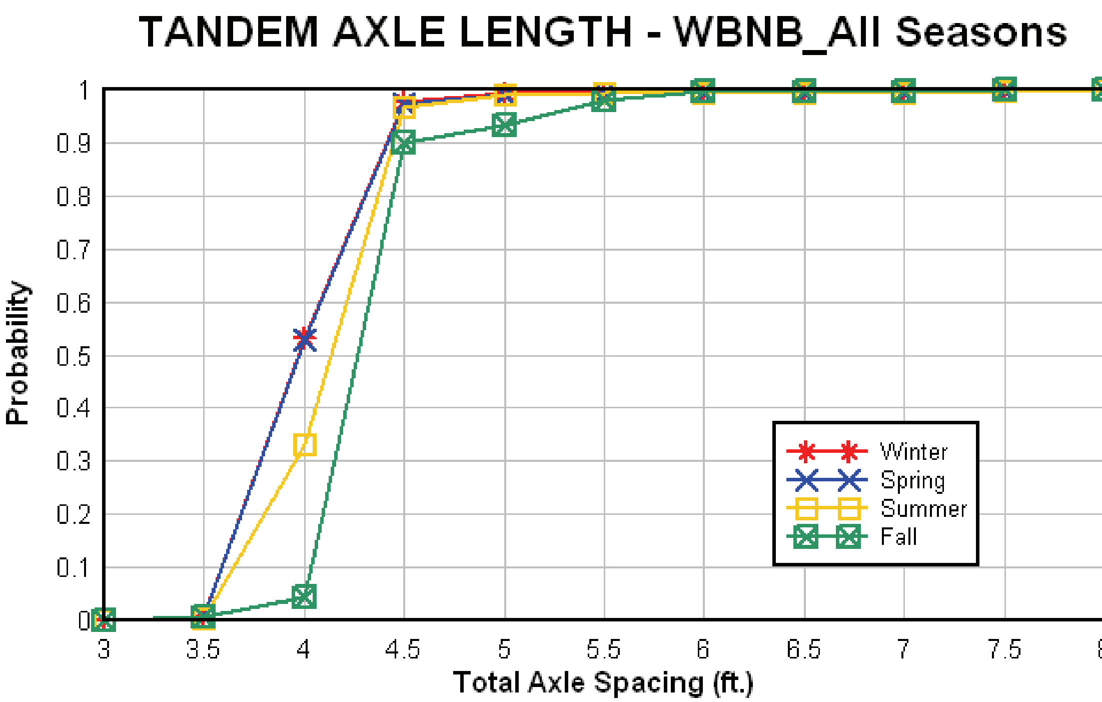

Figure 3.12: Distribution of axle spacing for tandem-axle group at WBNB for all seasons.

Individual axle lengths within the different axle categories are shown in Appendix H for each site and for the different seasons. Like the axle weight data, differences were seen among the individual axle spacings within the different axle groups, but due to the more narrowly defined axle spacing definition (ranging between 3.4-ft. and 8-ft) the variations were smaller. A typical axle group spacing distribution is shown in Figure 3.14. The triple- and quad-axle group categories had a larger percentage of longer axle spacings then the tandem axle group which was more narrowly banded. The penta-axle group spacing data were again more highly variable than the other axle group types.

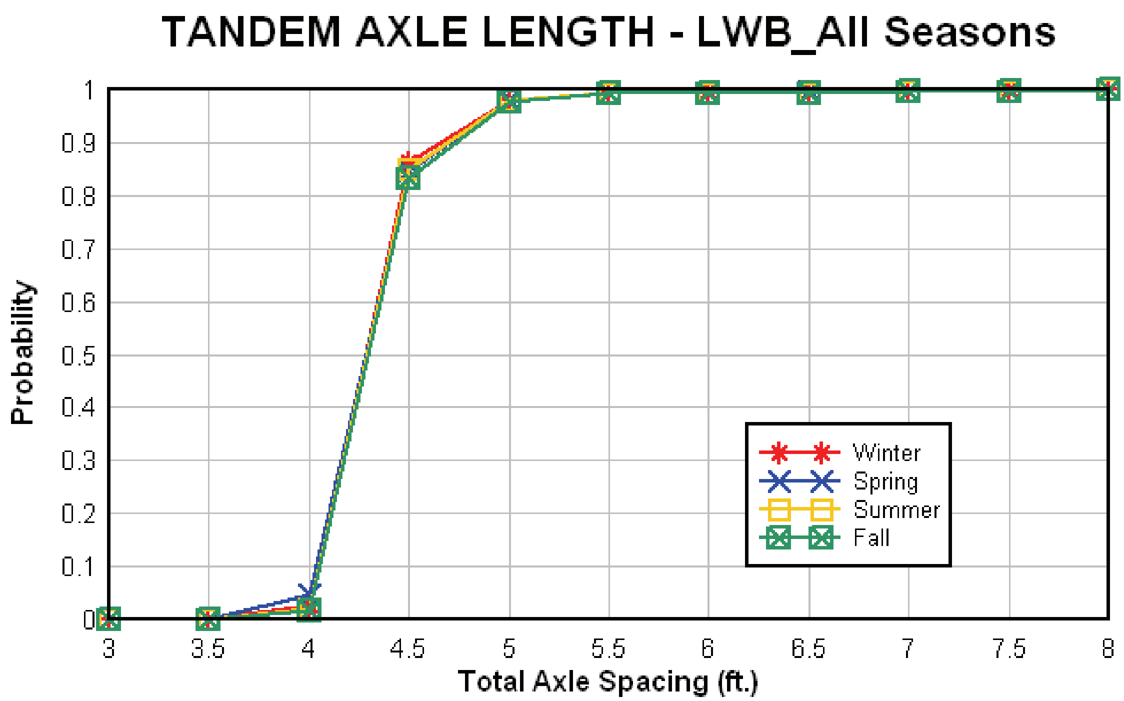

Figure 3.13: Distribution of axle spacing for tandem-axle group at LWB for all seasons.

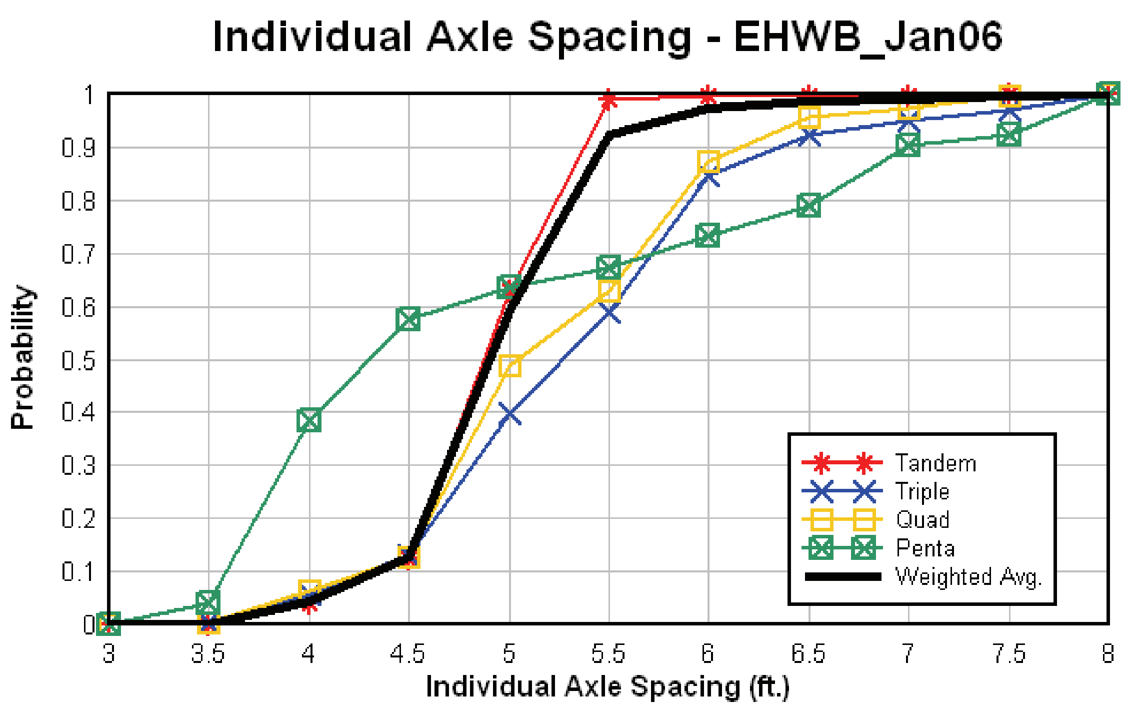

Figure 3.14: Distribution of spacing between individual axles for all axle groups at EHWB in winter.

3.2 IMPLEMENTATION OF WIM DATA INTO MEPDG

Axle weight, axle length, and truck volume data from the different Oregon WIM sites were implemented into the Mechanistic Empirical Pavement Design Guide (MEPDG) for pavement damage assessment (*NCHRP 2003*).

Asphalt damage from loads is dependent on the axle group volume, axle weight distribution, and axle spacing and these are the parameters that were implemented for Oregon-specific loading demands in MEPDG. A simple and straightforward approach was developed to modify the input for MEPDG based on the Oregon WIM data truck volume, the axle weight distributions, and the average axle lengths, irrespective of vehicle classification. This was accomplished by establishing a "virtual" truck classification, which is described in the following section.

3.2.1 MEPDG Input Process for the Load Setup

The outline below describes the steps required to input the axle spectra and volume data from Oregon WIM sites into the MEPDG program. Only those parameters related to loading are described and additional data such as asphalt and subgrade material properties were required by MEPDG to perform the design analysis but are not addressed in this paper. An example implementation is provided with electronic data files available at: http://kiewit.oregonstate.edu/research/#Data. Implementation of the Oregon specific data provided for four different volume levels: High volume site (ADTT ~ 5000) with seasonal variations, moderate volume site (ADTT~1500) with seasonal variations, and two low volume sites (ADTT~500) with seasonal variations. Two data sets were used for low volume sites due to increased variability in the data.

The following MEPDG inputs must be changed to use Oregon-specific data in pavement analysis:

1. Traffic Volume Adjustment Factors
    - Vehicle Class Distribution
        - A single vehicle class is selected and the "ADTT Distribution by Vehicle Class" is set equal to 100 percent. All other classes are set equal to zero percent.
        - "Hourly Distribution" values are entered manually based on the averaged hourly truck volumes obtained from the WIM sites.
2. Axle Load Distribution Factors
    - "Level 1, site-specific data" is selected
        - Values are manually entered for the chosen vehicle class established in the previous step. All other class factors may be set to zero or left as default. Input values based on Oregon WIM data for each of the four MEPDG axle categories (singles through quad-axles) must be entered.
3. General Traffic Inputs
    - "Number Axles/Truck" is manually entered for the single vehicle class chosen in step 1. These values are based on the Oregon WIM data. All other classes may be set to zero or left as default.

- “Axle Spacing” is manually entered for the three axle categories (tandems through quad-axles). The values are calculated from the average axle spacings for the axles groups from the Oregon WIM data.

A more detailed description of the input required to these three sections in the MEPDG program follows.

3.2.2 Traffic Volume Adjustment Factors

Vehicle Class Distribution has been generally used to describe the percentage of each of the FHWA vehicle classifications that make up the traffic flow. However, due to differences between Oregon WIM and FHWA classifications and the possible loss of precision in approximating the relationships between the two systems, one “virtual” vehicle class was used to describe the Oregon axle group weight spectra. This virtual class, by definition, made up 100 percent of the data by setting “ADTT Distribution By Vehicle Class” = 100 percent for the single vehicle class selected in the MEPDG. All other remaining vehicle classes were set to zero percent. In the example implementation described here, the Oregon axle spectra data were placed into the Class 4 vehicles (100% of trucks defined as Class 4).

Hourly distribution data were entered for each of the four different WIM sites. Average hourly distribution data from each of the Oregon WIM sites were collected from the randomly chosen week and weekend days as described in a previous section. The distribution data did not exhibit much seasonal variation and thus the sampled days were combined across all four seasons for each site, and are summarized in Table 3.3. These values were suitable for input into MEPDG, which does not allow for seasonal hourly input. If the site hourly volume is unavailable or such analysis was not warranted at a particular site, averaged data from all four sites may be used to give a general hourly volume representation (Table 3.4).

Table 3.3: Hourly truck volume for all four WIM sites (data were seasonally invariant).

Time of day	WBNB (High Volume) Total Trucks	WBNB (High Volume) % of Total	EHWB (Moderate Volume) Total Trucks	EHWB (Moderate Volume) % of Total	LWB (Low Volume) Total Trucks	LWB (Low Volume) % of Total	BNB (Low Volume) Total Trucks	BNB (Low Volume) % of Total
12:00 AM	1787	2.1	747	2.9	210	1.8	133	1.3
1:00 AM	1567	1.9	677	2.6	190	1.6	96	0.9
2:00 AM	1532	1.8	519	2.0	201	1.7	94	0.9
3:00 AM	1594	1.9	498	1.9	203	1.7	110	1.1
4:00 AM	2275	2.7	529	2.1	307	2.6	184	1.8
5:00 AM	2970	3.5	623	2.4	347	2.9	187	1.8
6:00 AM	3406	4.1	781	3.0	417	3.5	275	2.7
7:00 AM	3998	4.8	887	3.4	498	4.2	402	3.9
8:00 AM	4513	5.4	1039	4.0	537	4.6	547	5.3
9:00 AM	5209	6.2	1237	4.8	608	5.2	591	5.7
10:00 AM	5573	6.7	1523	5.9	662	5.6	698	6.7
11:00 AM	5668	6.8	1556	6.0	756	6.4	757	7.3
12:00 PM	5216	6.2	1601	6.2	720	6.1	809	7.8
1:00 PM	5142	6.1	1605	6.2	762	6.5	766	7.4
2:00 PM	4901	5.9	1547	6.0	708	6.0	817	7.9
3:00 PM	4703	5.6	1586	6.2	700	5.9	734	7.1
4:00 PM	4022	4.8	1603	6.2	712	6.0	677	6.5
5:00 PM	3713	4.4	1457	5.7	688	5.8	668	6.5
6:00 PM	3393	4.1	1325	5.1	615	5.2	500	4.8
7:00 PM	3153	3.8	1077	4.2	473	4.0	374	3.6
8:00 PM	2928	3.5	998	3.9	471	4.0	332	3.2
9:00 PM	2437	2.9	903	3.5	431	3.7	276	2.7
10:00 PM	2189	2.6	746	2.9	317	2.7	163	1.6
11:00 PM	1837	2.2	667	2.6	264	2.2	166	1.6
TOTALS	83726	100	25731	100	11797	100	10356	100

Table 3.4: Average hourly volume distribution

Time of Day	All Sites	
	Total trucks	% of total
12:00 AM	2877	2.2
1:00 AM	2530	1.9
2:00 AM	2346	1.8
3:00 AM	2405	1.8
4:00 AM	3295	2.5
5:00 AM	4127	3.1
6:00 AM	4879	3.7
7:00 AM	5785	4.4
8:00 AM	6636	5.0
9:00 AM	7645	5.8
10:00 AM	8456	6.4
11:00 AM	8737	6.6
12:00 PM	8346	6.3
1:00 PM	8275	6.3
2:00 PM	7973	6.1
3:00 PM	7723	5.9
4:00 PM	7014	5.3
5:00 PM	6526	5.0
6:00 PM	5833	4.4
7:00 PM	5077	3.9
8:00 PM	4729	3.6
9:00 PM	4047	3.1
10:00 PM	3415	2.6
11:00 PM	2934	2.2
TOTALS	131610	100

3.2.3 Axle Load Distribution Factors

In the MEPDG program axle load distribution factors are dependent on the weight distributions of the axle categories, vehicle class, and month of the year. The axle weight classification bins are defined for each axle group by the program and can not be modified.

The present analysis has shown that the average axle group weight data were not particularly sensitive to seasonal variation as was illustrated in Figure 3.7, although some seasonal variability was observed, particularly at the lower volume sites. Therefore, additional refinement of the axle weight spectra at monthly intervals (the standard input for MEPDG) would not provide improved accuracy and only the four seasonal variations were implemented. The axle weight spectra were entered in three month blocks to reflect the seasonal data. Axle weight distributions used as input into MEPDG have been compiled and shown in Appendix J for all sites and seasons. Alternatively, since the data was seasonally invariant, the axle group weight data input can be generalized to a single month (i.e. summer) when more refined data are unavailable or unnecessary for the pavement design being considered.

In addition to the minimal seasonal variation, the average axle weights of Table 3.2 showed little variation across the different WIM sites. This indicates that further simplifications in the MEPDG input may be made by averaging the data across all four representative WIM sites. However, some loss of accuracy will result, as can be seen in the compilation of weight data distributions compiled in Appendix J. In this appendix, weight distributions as defined by MEPDG were compiled for all sites and axle categories. Highlighted are the three most concentrated weight ranges which show distinct variation and trends within the sites. For example, the low volume site, BNB, for all axle groups, had a higher peak weight range compared to LWB, the other low volume site selected for analysis. The BNB site even had a higher proportion of heavy loads compared to EHWB, the moderate volume site. An average of axle weight distributions is shown in Table 3.5. The pavement designer would need to make a decision about how representative the available axle spectra data are for the site of interest and evaluate if combined average data across all sites and seasons is reasonable (Table 3.5) or if the variation in weight that is discernible is important to retain.

One limitation of the input format for axle weights in MEPDG is that no distinction has been made between steer and single axles. Axle weight distributions from all four Oregon WIM sites showed that the axle weights for steer and single axles were different. When the data were combined and blended together, any individual characteristic were lost. A second limitation in MEPDG is that there has not been means to include axle spacing between adjacent axles or to provide the individual axle weights within axle groups. Tandem axles were shown to have similar weight magnitudes and distributions for the front and rear axle but triple axles showed different individual weights among the three axles in the group. These characteristics were unable to be recorded in the MEPDG program using the axle group weight spectra data and average axle spacing. The data in Appendix J also showed another limitation of the MEPDG input. The overall triple axle weights showed an unusually high proportion of trucks with triple axles in the lowest weight bin. This indicates that a large number of triple axle weights fell below this minimum and any variation was lost by lumping them into the minimum value.

Table 3.5: Average axle weight distribution.

All Sites							
Singles		Tandems		Triples		Quads	
Weight	% Occur	Weight	% Occur	Weight	% Occur	Weight	% Occur
0		0		0		0	
1000		2000		3000		3000	
2000		4000		6000		6000	
3000	8.45	**6000**	5.28	**9000**	24.56	**9000**	7.02
4000	3.63	8000	4.82	12000	5.29	12000	1.99
5000	2.97	10000	6.96	15000	2.65	15000	0.90
6000	4.00	12000	8.09	18000	3.62	18000	1.09
7000	4.39	14000	7.27	21000	5.77	21000	1.71
8000	9.21	16000	6.84	24000	7.64	24000	3.63
9000	18.21	18000	6.82	27000	12.61	27000	4.87
10000	17.88	20000	6.84	30000	13.69	30000	8.87
11000	13.12	22000	7.31	33000	11.55	33000	12.38
12000	5.42	24000	8.60	36000	8.30	36000	12.25
13000	3.04	26000	9.08	39000	2.97	39000	13.71
14000	2.61	28000	7.64	42000	0.63	42000	16.19
15000	2.27	30000	7.29	45000	0.22	45000	11.46
16000	2.01	32000	5.70	48000	0.19	48000	3.50
17000	1.56	34000	1.30	51000	0.16	51000	0.33
18000	0.81	36000	0.10	54000	0.06	54000	0.01
19000	0.31	38000	0.03	57000	0.06	57000	0.00
20000	0.09	40000	0.02	60000	0.03	60000	0.00
21000	0.03	42000	0.01	63000	0.01	63000	0.05
22000	0.01	44000	0.00	66000	0.01	66000	0.00
23000	0.00	46000	0.00	69000	0.00	69000	0.05
24000	0.00	48000	0.00	72000	0.00	72000	0.00
25000	0.00	50000	0.00	75000	0.00	75000	0.00
26000	0.00	52000	0.00	78000	0.00	78000	0.00
27000	0.00	54000	0.00	81000	0.00	81000	0.00
28000	0.00	56000	0.00	84000	0.00	84000	0.00
29000	0.00	58000	0.00	87000	0.00	87000	0.00
30000	0.00	60000	0.00	90000	0.00	90000	0.00
31000	0.00	62000	0.00	93000	0.00	93000	0.00
32000	0.00	64000	0.00	96000	0.00	96000	0.00
33000	0.00	66000	0.00	99000	0.00	99000	0.00
34000	0.00	68000	0.00	102000	0.00	102000	0.00
35000	0.00	70000	0.00	105000	0.00	105000	0.00
36000	0.00	72000	0.00	108000	0.00	108000	0.00
37000	0.00	74000	0.00	111000	0.00	111000	0.00
38000	0.00	76000	0.00	114000	0.00	114000	0.00
39000	0.00	78000	0.00	117000	0.00	117000	0.00
40000	0.0	80000	0.00	120000	0.00	120000	0.00
41000	0.00	82000	0.00	123000	0.00	123000	0.00

3.2.4 General Traffic Inputs

General Traffic Inputs are the third and final section of MEPDG that was edited with Oregon data. The first parameter changed was the number of axles per truck for each axle group category. The Oregon data were obtained from truck and axle counts at the four WIM sites as detailed previously and tabulated in Appendix K. The average number of axles per truck as well as axle group types for all sites and each season is summarized in Table 3.6. The COVs for each axle type at each site were very low with all but three categories varying less than 10 percent. The three COVs higher than 10 percent were found in the low volume sites and in the triple and quad-axle group categories. The number of records for these axle groups were fewer compared to the more common, smaller axle categories and were not deemed to be indicative of seasonal variation but rather a reflection of the small data sample. Since the data did not vary significantly with each season, and to be consistent with the format used by MEPDG, seasonal data were averaged into a single input for the program and are the highlighted values in Table 3.6. The average number of Axles/Truck in the table was calculated by dividing the average total number of trucks by the average total number of individual axles for each of the WIM sites. The average number of axle groups per truck for each of the four axle types was calculated by multiplying the average number of Axles/Truck by the percentage of each axle type in the record. For the MEPDG implementation, the data reported for singles represents both steer and single axles. The data in Table 3.6 show that the 3S2 trucks (5 axles: 2 tandems, 1 steer) were dominant in WIM data for all sites investigated.

Table 3.6: Average axles per truck, total and individual axle group, for each site and season (singles and steers combined for MEPDG implementation).

		Axles/ Truck	Single	Tandem	Triple	Quad		Axles/ Truck	Single	Tandem	Triple	Quad
Fall	WBNB	5.23	1.66	2.95	0.43	0.18	LWB	4.94	1.64	3.04	0.21	0.05
Winter		5.26	1.57	3.05	0.45	0.18		5.06	1.63	3.04	0.3	0.08
Spring		5.25	1.62	2.97	0.46	0.2		5.1	1.68	3.06	0.28	0.08
Summer		5.23	1.65	2.91	0.48	0.19		5.01	1.69	3.02	0.22	0.07
Average		5.24	1.63	2.97	0.45	0.19		5.01	1.66	3.04	0.24	0.07
St. dev.		0.02	0.04	0.06	0.02	0.01		0.07	0.03	0.01	0.04	0.02
COV		0.30%	2.30%	2.00%	4.40%	5.30%		1.40%	1.90%	0.40%	17.80 %	24.50%
Fall	EHWB	5.26	1.71	3.04	0.38	0.13	BNB	4.68	1.61	2.77	0.27	0.03
Winter		5.2	1.63	3.11	0.34	0.12		4.76	1.58	2.88	0.26	0.03
Spring		5.26	1.69	3.08	0.34	0.14		4.78	1.65	2.76	0.32	0.04
Summer		5.27	1.73	3.02	0.38	0.15		4.69	1.72	2.63	0.29	0.05
Average		5.25	1.69	3.06	0.36	0.14		4.72	1.65	2.74	0.29	0.04
St. dev.		0.03	0.04	0.04	0.02	0.01		0.05	0.06	0.1	0.03	0.01
COV		0.60%	2.40%	1.40%	5.80%	9.80%		1.00%	3.80%	3.80%	9.80%	18.90%

The final parameter required for implementation of Oregon WIM data in MEPDG was the average axle spacing in the Axle Configuration section of the General Traffic Inputs. No seasonal variation option was available in MEPDG for this parameter and the plots from Appendix G confirmed the minimal variation of the total axle length across the different seasons. The same was true for average individual axle lengths where the COVs for the individual axles ranged from two percent to three percent for the most highly varied site, WBNB, with most other

COVs ranging around one percent to two percent. Average individual axle spacings within each axle group for the Oregon WIM data were computed for each site as shown in Table 3.7 and were the input values used in the MEPDG program.

Table 3.7: Average individual axle spacing and variation for different axle groups and sites.

	WIM Sites							
	WBNB		**EHWB**		**LWB**		**BNB**	
Axle Group	Avg. Spacing (in)	COV (%)	Avg. Spacing (in)	COV (%)	Avg. Spacing (in)	COV (%)	Avg. Spacing (in)	COV (%)
Tandems	49.9	0.3	59.2	0.0	52.7	0.0	49.5	0.0
Triples	56.8	0.6	65.2	0.4	59.2	0.5	53.2	0.3
Quads	52.0	0.1	64.5	0.2	56.8	0.1	56.4	0.4

As noted earlier, site data may be unavailable to the pavement designer and/or the site may not warrant a detailed WIM analysis. In this case, a designer may deem it sufficient to use a combined average in lieu of the more detailed WIM evaluation for input into MEPDG. Tables 3.8 and 3.9 show the combined input data as averaged across all sites for the number of axles/truck and the individual axle spacing. The data did not vary significantly except for larger axle groups, triples and quads and may not represent a significant loss in design accuracy.

Table 3.8: Average number of axles/truck.

	All Sites		
	Avg.	Std. dev.	COV
Axles/Truck	5.06	0.22	4.4%
Singles	1.65	0.05	2.8%
Tandems	2.96	0.13	4.6%
Triples	0.34	0.08	24.8%
Quads	0.11	0.06	57.3%

Table 3.9: Average individual axle spacing.

	All Sites		
	Avg. Spacing (in.)	Std. dev.	COV
Tandems	52.8	4.50	8.5%
Triples	58.6	5.08	8.7%
Quads	57.4	5.19	9.0%

4.0 SUMMARY AND CONCLUSIONS

Four WIM sites were selected to characterize axle weight and spacing spectra on Oregon state highways. Sites were selected for high, moderate, and low truck volume. ADTT volume of 5000, 1500, and 500 were chosen to represent the high, moderate, and low volumes, respectively. Seasonal variations were considered by investigating data occurring over the four seasons: winter (December, January, or February), spring (March, April, or May), summer (June, July, or August), or fall (September, October, or November). The WIM data were cleaned and filtered, then were converted into a format suitable for data analysis. Axle data, including group and individual axle weights as well as axle spacing, were evaluated for each of the selected WIM sites and seasons. Hourly truck volumes were also examined from randomly chosen days in each of the seasonally selected months. Results were summarized and statistical averages and COVs were developed for the characteristic data.

The characterized Oregon WIM axle data were incorporated into the MEPDG software program to permit State and ADTT volume-specific axle weight spectra, average axle group spacing, and hourly volume data to be used in the pavement analysis/design. In order to implement the Oregon WIM data, a "virtual" truck classification was created in the MEPDG program. This approach bypasses the MEPDG dependence on truck classification. It is anticipated that implementation of the Oregon WIM data will increase accuracy of the pavement design process in the State by designing to more realistic loading conditions as compared to reliance on national data which may not be representative of local conditions. The Oregon-specific data that were required for input into the MEPDG were:

- Hourly truck volume distribution.
- Site-specific Axle Weight Data
- Average Number of Axles Per Truck
- Average Axle Spacing

Data files of the WIM axle data from all four sites are available for download from the internet for use in MEPDG. Data were arranged to provide detailed as well as possible simplifications to MEPDG inputs. Different options may be implemented depending on the level of sophistication desired by the analyst. Based on the data analysis presented, conclusions have been presented on: volume, axle weights, axle spacings, and axles per truck, with respect to the MEPDG inputs.

4.1 VOLUME

- Weekday truck volumes were higher than those observed on weekend days (Appendix C). The data assembled for this study used only one weekend day to permit identification, but also to minimize the influence of lighter traffic volume days. MEPDG inputs do not currently differentiate between days of the week and weekday and weekend data, instead, they are averaged.

- The overall shape of the cumulative hourly volume did not vary significantly from site to site and very little seasonal variation was noted (Appendix D).

- The highest truck traffic volume usually occurred between 12:00 and 1:00 p.m. (Appendix D). Different peak traffic amplitudes and peak hours shifted slightly in some sites (Figure 3.4 and 3.5). These small deviations in hourly volume between WIM sites could be of interest to some pavement analysts.

- Seasonal variation was present in overall truck volumes, with lower truck volumes in the winter months (axle weights were seasonally invariant as described subsequently). This trend was less evident in the high volume sites, which indicates that major regional/national freight transportation corridors appear less affected by seasonal fluctuations (Table 3.2). These data should be kept distinct as MEPDG input allows for monthly adjust factors (MAFs) that account for overall seasonal volume and weight spectra variations.

4.2 AXLE WEIGHTS

- Axle group weight distributions did not vary seasonally (Figure 3.7) and average axle weights did not vary significantly from site-to-site (Table 3.3). Average weight data could reasonably be combined across sites and seasons for basic designs. However, individual axle weight site variation was retained for MEPDG input and data files were developed to provide for this level of refinement.

- The group axle weight data, as classified by the MEPDG format weight bins, showed some variation between the different WIM sites. Appendix J shows that the highest concentration of trucks within an axle weight bin range shifted slightly between sites. This site specific axle weight data would be important to retain for the highest level of refinement but, in general, axle weight data could be combined across sites and seasons for a more general State pavement design application.

- Axle group categories differed significantly in the shape of their weight distributions (Figure 3.8). Most notably the steer-axle group had narrow weight distributions compared to the more uniformly distributed single, tandem and triple-axle groups. Some individual axle weights within an axle category also differed (Figure 3.10). Individual axles within the tandem groups tended to be similar but the individual axles within the triple axle group had differing average axle weight distributions. Axle weight data for the distinct axle groups should not be combined.

4.3 AXLE SPACINGS

- Axle lengths did not vary seasonally (Figures 3.12 and 3.13) nor did they vary significantly across the different WIM sites or axle group categories (Table 3.8). It should be noted that axle groups having higher numbers of axles and higher volume WIM sites tended to have more axle spacing variability. Still, these variability's were small and the axle spacing data could be combined for simplified MEPDG analyses.

4.4 AXLES PER TRUCK

- The average number of axles per truck was 5.06 for all seasons and all WIM sites. This statistic clearly showed the dominance of the 3S2 truck in traffic stream. The variance in the number of axles per truck was low, especially when the sample size was larger. Seasonally, the number axles per truck varied less then ten percent except for the triple and quad axles in the low volume sites. Averages across sites varied only between the two low volume sites which had 5 percent (LWB) and 10 percent (BNB) lower total average number of axles per truck. MEPDG does not have seasonal dependence for the average number of axles per truck and the site dependence could be effectively removed without significant loss of precision.

In conclusion, there are two main options for implementing the Oregon WIM data into the MEPDG for pavement analysis.

1) The first option, when a more exact design is unnecessary or unwarranted, is to combine the WIM data where possible to simplify the MEPDG analysis inputs. The WIM data that could be grouped for MEPDG input simplification by combining data across all seasons and sites were: average hourly volume distribution (Table 3.5) average number of axles per truck (Table 3.9), and average individual axle spacing, (Table 3.10). However, the axle group categories would not be combined due to distinctions between the groups that preclude lumping the data together (i.e. tandem, triple, quad data remain distinct). As a result, each WIM site (representing high, moderate and low volume state highways) has separate axle group weight spectra. Electronic input files for these simplifications are provided for their direct use into MEPDG.

2) The second option is to retain as much of the original WIM axle weight and spacing data as possible. For this scenario, individual data sets are provided for each WIM site (representing high, moderate and low volume state highways). Each WIM site has input for average hourly volume distribution, average number of axles per truck and, average axle spacing. Seasonal axle weight data are provided for each axle group at each WIM site using three month blocks of data (taken as winter, spring, summer and fall).

5.0 RECOMMENDATIONS

WIM data collection and analysis are key elements of the pavement design load models and bridge rating factors used by the Oregon Department of Transportation (ODOT). It is recommended that resources be provided to maintain high-quality WIM data collection efforts. It is further recommended that the WIM data from all available sites continue to be collected, reviewed, and archived for future use in load modeling and load factor calibrations. The long and continuous high-quality WIM data record, developed from ODOT WIM sites over the past several years should be maintained, either internally by ODOT or by an outside agency or consultant.

6.0 REFERENCES

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Sarasota/Manatee Metropolitan Planning Organization. Electronic document: http://www.sarasota-manateempo.org/Figures/figure1.pdf, acquired February 6, 2006.

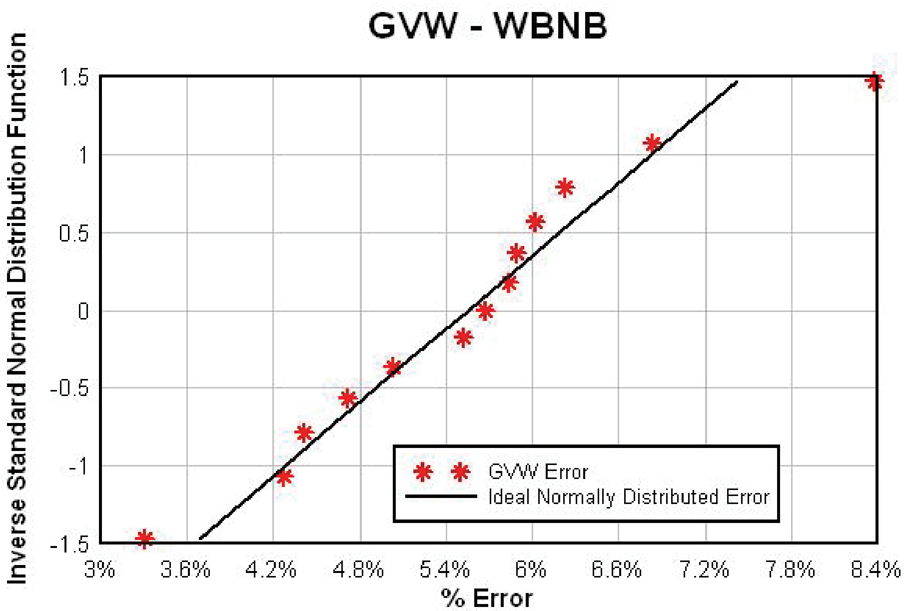
U.S. Department of Transportation, Federal Highway Administration, Office of Operations. Electronic document: http://vsw.fhwa.dot.gov/qa/qa.jsp?category=23%20CFR%20658.17#S0-103, acquired February 15, 2007.

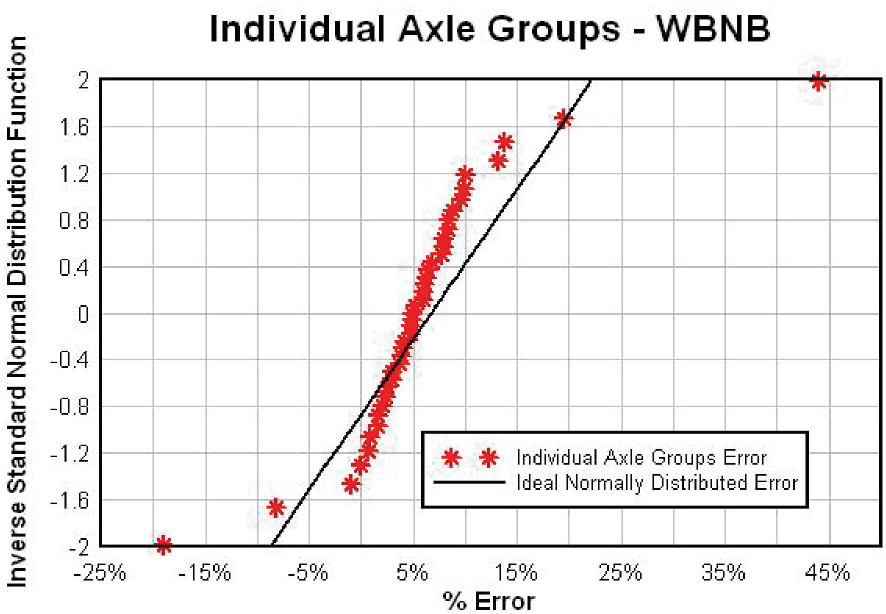
APPENDIX A

WIM CALIBRATION SUMMARIES

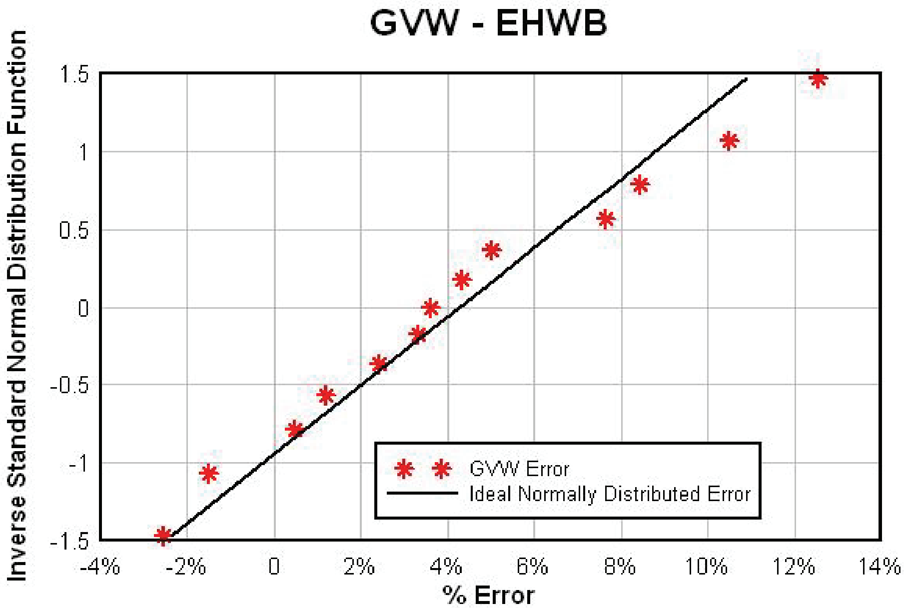
GVW & AXLE GROUPS

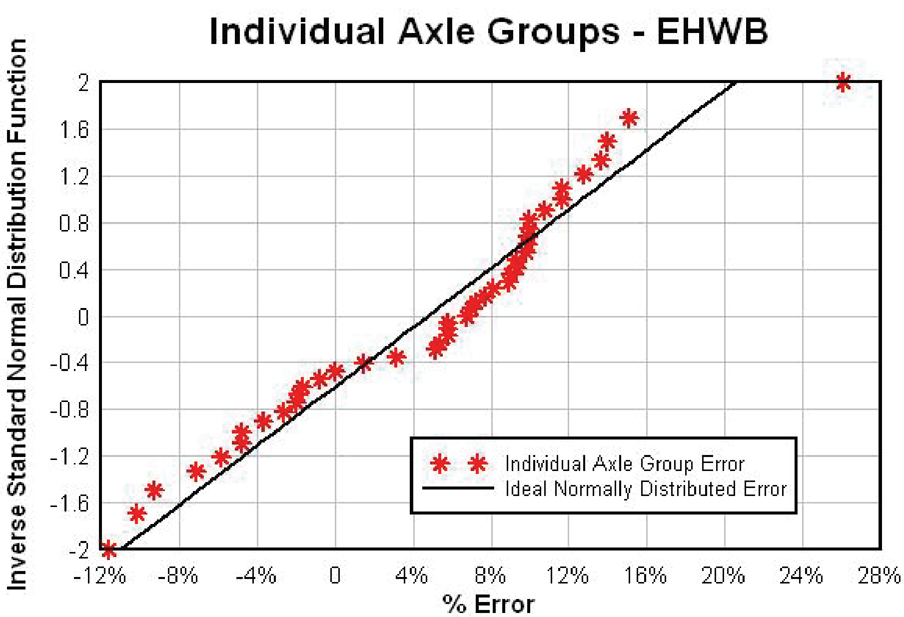
WBNB


GVW - WBNB
Inverse Standard Normal Distribution Function
1.5
1
0.5
0
-0.5
-1
-1.5
3%
3.6%
4.2%
4.8%
5.4%
6%
6.6%
7.2%
7.8%
8.4%
% Error
GVW Error
Ideal Normally Distributed Error

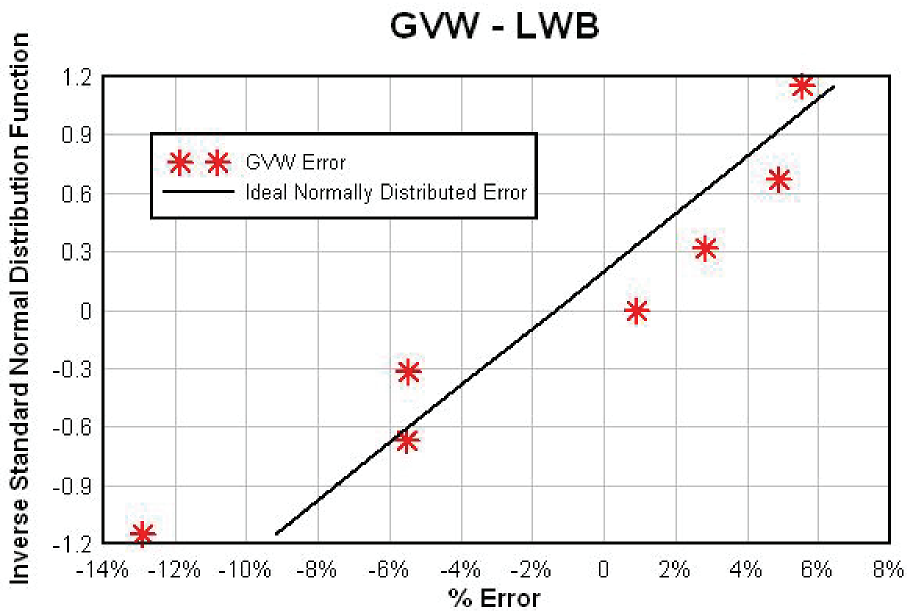

Individual Axle Groups - WBNB
Inverse Standard Normal Distribution Function
2
1.6
1.2
0.8
0.4
0
-0.4
-0.8
-1.2
-1.6
-2
-25%
-15%
-5%
5%
15%
25%
35%
45%
% Error
Individual Axle Groups Error
Ideal Normally Distributed Error

EHWB

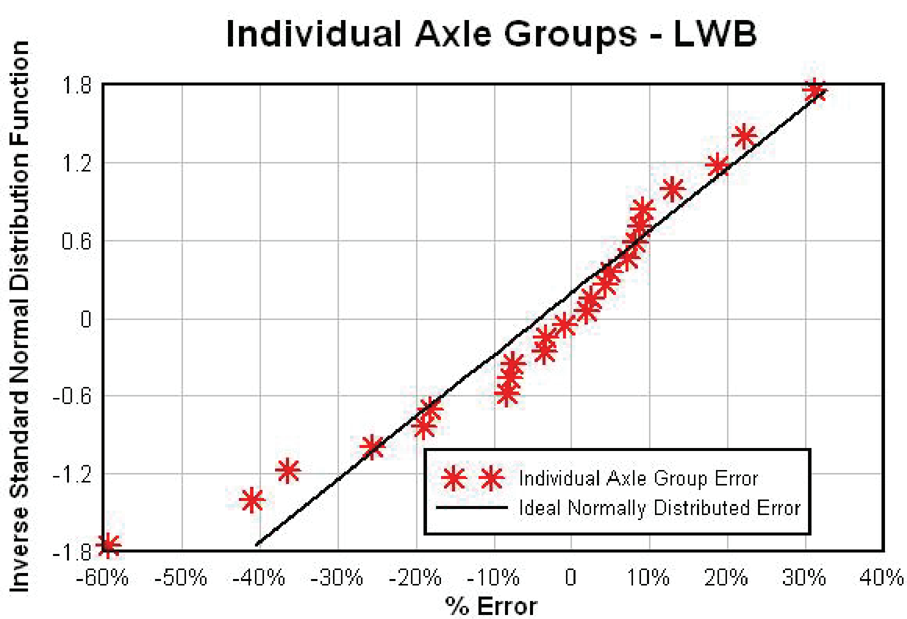

GVW - EHWB
Inverse Standard Normal Distribution Function
1.5
1
0.5
0
-0.5
-1
-1.5
-4%
-2%
0
2%
4%
6%
8%
10%
12%
14%
% Error
GVW Error
Ideal Normally Distributed Error


Individual Axle Groups - EHWB
Inverse Standard Normal Distribution Function
2
1.6
1.2
0.8
0.4
0
-0.4
-0.8
-1.2
-1.6
-2
-12%
-8%
-4%
0
4%
8%
12%
16%
20%
24%
28%
% Error
Individual Axle Group Error
Ideal Normally Distributed Error

LWB



GVW - LWB
Inverse Standard Normal Distribution Function
1.2
0.9
0.6
0.3
0
-0.3
-0.6
-0.9
-1.2
GVW Error
Ideal Normally Distributed Error
-14%
-12%
-10%
-8%
-6%
-4%
-2%
0
2%
4%
6%
8%
% Error



Individual Axle Groups - LWB
Inverse Standard Normal Distribution Function
1.8
1.2
0.6
0
-0.6
-1.2
-1.8
Individual Axle Group Error
Ideal Normally Distributed Error
-60%
-50%
-40%
-30%
-20%
-10%
0
10%
20%
30%
40%
% Error

APPENDIX B

FORTRAN OUTPUT FILES EXAMPLES

FORTRAN PROGRAM: "AxleSorter2"
INPUT: "Liger_(SITE)_(SEASON).txt"
OUTPUT: "Steers.txt-Pents.txt", "Noclass.txt", "Summary.txt"
(e.g. "Tandems.txt" EHWB_Jan06)

Truck #	Class	Tandem WT	Len	Axle #1	#2	W1	W2	S1
3	11	22.4000	5.0000	2	3	12.0000	10.4000	5.0000
3	11	22.7000	4.7000	4	5	11.5000	11.2000	4.7000
5	11	12.0000	4.2000	2	3	6.4000	5.6000	4.2000
5	11	11.8000	3.9000	4	5	5.3000	6.5000	3.9000
8	11	16.5000	5.0000	2	3	8.3000	8.2000	5.0000
8	11	17.7000	4.6000	4	5	9.0000	8.7000	4.6000
11	11	23.8000	5.1000	2	3	12.3000	11.5000	5.1000
11	11	18.9000	4.8000	4	5	9.6000	9.3000	4.8000
12	18	24.3000	5.1000	3	4	12.4000	11.9000	5.1000
13	11	19.8000	5.0000	2	3	10.0000	9.8000	5.0000
13	11	12.7000	4.9000	4	5	7.3000	5.4000	4.9000
15	17	12.9000	4.9000	2	3	6.9000	6.0000	4.9000
15	17	8.1000	4.8000	4	5	4.5000	3.6000	4.8000
17	7	22.7000	4.9000	2	3	14.1000	8.6000	4.9000
18	7	6.3000	5.0000	2	3	3.1000	3.2000	5.0000
24	11	16.9000	4.2000	2	3	8.5000	8.4000	4.2000
24	11	18.3000	4.1000	4	5	10.1000	8.2000	4.1000
27	11	8.2000	4.2000	2	3	4.2000	4.0000	4.2000
27	11	8.2000	4.0000	4	5	4.3000	3.9000	4.0000
28	11	14.3000	5.0000	2	3	7.5000	6.8000	5.0000
28	11	16.6000	4.8000	4	5	8.6000	8.0000	4.8000
29	11	14.3000	4.9000	2	3	7.6000	6.7000	4.9000
29	11	19.0000	4.7000	4	5	10.6000	8.4000	4.7000
32	11	12.6000	5.0000	2	3	6.4000	6.2000	5.0000
32	11	15.2000	4.8000	4	5	8.4000	6.8000	4.8000
33	19	17.9000	5.0000	2	3	8.9000	9.0000	5.0000
33	19	19.7000	4.7000	4	5	10.4000	9.3000	4.7000
33	19	18.9000	4.6000	6	7	10.7000	8.2000	4.6000
33	19	19.1000	4.6000	8	9	9.8000	9.3000	4.6000
34	5	6.3000	4.6000	2	3	3.3000	3.0000	4.6000
38	11	17.7000	4.4000	2	3	9.2000	8.5000	4.4000
38	11	8.4000	4.1000	4	5	4.3000	4.1000	4.1000
39	11	27.9000	4.2000	2	3	14.7000	13.2000	4.2000
40	11	14.9000	4.9000	2	3	7.7000	7.2000	4.9000
40	11	13.8000	5.1000	4	5	7.0000	6.8000	5.1000
41	11	21.3000	5.0000	2	3	10.8000	10.5000	5.0000
41	11	22.1000	4.7000	4	5	10.8000	11.3000	4.7000
43	11	13.4000	5.1000	2	3	6.9000	6.5000	5.1000
43	11	12.3000	4.9000	4	5	5.8000	6.5000	4.9000
45	11	21.2000	5.0000	2	3	11.2000	10.0000	5.0000
45	11	17.3000	4.8000	4	5	8.6000	8.7000	4.8000
46	11	8.8000	4.4000	2	3	5.6000	3.2000	4.4000
46	11	5.9000	4.3000	4	5	3.0000	2.9000	4.3000
47	15	17.9000	5.1000	2	3	9.5000	8.4000	5.1000
48	11	23.4000	4.4000	2	3	11.7000	11.7000	4.4000
48	11	23.0000	4.1000	4	5	11.6000	11.4000	4.1000
49	11	12.4000	5.1000	2	3	6.8000	5.6000	5.1000
49	11	7.4000	4.8000	4	5	3.6000	3.8000	4.8000
52	11	18.7000	5.0000	2	3	9.6000	9.1000	5.0000
52	11	7.4000	4.7000	4	5	3.8000	3.6000	4.7000

(incomplete record)

FORTRAN PROGRAM: “AxleSorter2”
OUTPUT: “Noclass.txt” (e.g. EHWB_Jan06)

```
Truck #  Class
   3466    19
```

FORTRAN PROGRAM: “AxleSorter2”
OUTPUT: “Summary.txt” (e.g. EHWB_Jan06)

```
Total number of trucks in record:         37730

Total number of truck axles in record:   196284

Total number of steer axles in record:    37730

Total number of single axles in record:   23898

Total number of tandem axles in record:   58633

Total number of triple axles in record:    4312

Total number of quad axles in record:      1097

Total number of penta axles:                 13
```

FORTRAN PROGRAM: "AxleStats"
INPUT: "Steers.txt-Pents.txt", "Noclass.txt", "Summary.txt"
OUTPUT: "AxleStats", (e.g. WBNB_Sept05)

```
The total number of trucks in this record evaluated: 153178.

Total number of trucks with a steer axle:           153178.
The percentage of trucks with steer axles:           100.%

Total number of trucks with a single axle(s):        47344.
The percentage of trucks with single axles:           30.9%

Total number of trucks with a tandem axle(s):       127761.
The percentage of trucks with tandem axles:           83.4%

Total number of trucks with a triple axles(s):       19374.
The percentage of trucks with triple axles:           12.6%

Total number of trucks with a quad axle(s):           7044.
The percentage of trucks with quad axles:              4.6%

Total number of trucks with a penta axle(s):            52.
The percentage of trucks with penta axles:            0.03%



The total number of axles in this record evaluated:  800391.

Total number of steer axles:                        153178.
The percentage of axles that are steer axles:         19.1%

Total number of single axles:                       100847.
The percentage of axles that are single axles:        12.6%

Total number of tandem axles:                       452060.
The percentage of axles that are tandem axles:        56.5%

Total number of triple axles:                        65862.
The percentage of axles that are triple axles:         8.2%

Total number of quad axles:                          28176.
The percentage of trucks with quad axles:              3.5%

Total number of penta axles:                           260.
The percentage of trucks with penta axles:            0.03%
```

FORTRAN PROGRAM: "HistoWeight_(#)"
OUTPUT: "HistoWeight_(AXLE CATEGORY)"
(e.g. "HistoWeight_Triples" LWB_Jan06)

```
Bin   Count   Frequency

 TRIPLE AXLE WEIGHT
 0.00      2. .0001
 3.00     25. .0010
 6.00    412. .0169
 9.00   1502. .0617
12.00   2627. .1079
15.00   1400. .0575
18.00    798. .0328
21.00   1133. .0465
24.00   1515. .0622
27.00    942. .0387
30.00   1643. .0675
33.00   2689. .1105
36.00   5191. .2132
39.00   3628. .1490
42.00    615. .0253
45.00     77. .0032
48.00     55. .0023
51.00     39. .0016
54.00     23. .0009
57.00     15. .0006

 MEAN          STD DEV
29.160          10.86

 FRONT AXLE WEIGHT
 0.00     16. .0007
 1.25    390. .0160
 2.50   1642. .0674
 3.75   3603. .1480
 5.00   3285. .1349
 6.25   4208. .1729
 7.50   3842. .1578
 8.75   2389. .0981
10.00   1455. .0598
11.25   1154. .0474
12.50   1058. .0435
13.75    676. .0278
15.00    328. .0135
16.25    175. .0072
17.50     63. .0026
18.75     34. .0014
20.00     18. .0007
21.25      6. .0002
22.50      1. .0000
23.75      0. .0000

 MEAN          STD DEV
 7.661           3.23
```

MIDDLE AXLE WEIGHT

0.00	8.	.0003
1.25	215.	.0088
2.50	1612.	.0662
3.75	3095.	.1271
5.00	1212.	.0498
6.25	945.	.0388
7.50	950.	.0390
8.75	1680.	.0690
10.00	1973.	.0810
11.25	2253.	.0925
12.50	1744.	.0716
13.75	2721.	.1118
15.00	3746.	.1539
16.25	1773.	.0728
17.50	303.	.0124
18.75	81.	.0033
20.00	24.	.0010
21.25	9.	.0004
22.50	0.	.0000
23.75	0.	.0000

MEAN	STD DEV
10.777	4.62

REAR AXLE WEIGHT

0.00	14.	.0006
1.25	177.	.0073
2.50	949.	.0390
3.75	2676.	.1099
5.00	2168.	.0891
6.25	1156.	.0475
7.50	1084.	.0445
8.75	2011.	.0826
10.00	1879.	.0772
11.25	1846.	.0758
12.50	2021.	.0830
13.75	3161.	.1298
15.00	3670.	.1508
16.25	1238.	.0509
17.50	189.	.0078
18.75	67.	.0028
20.00	25.	.0010
21.25	9.	.0004
22.50	2.	.0001
23.75	2.	.0001

MEAN	STD DEV
10.721	4.39

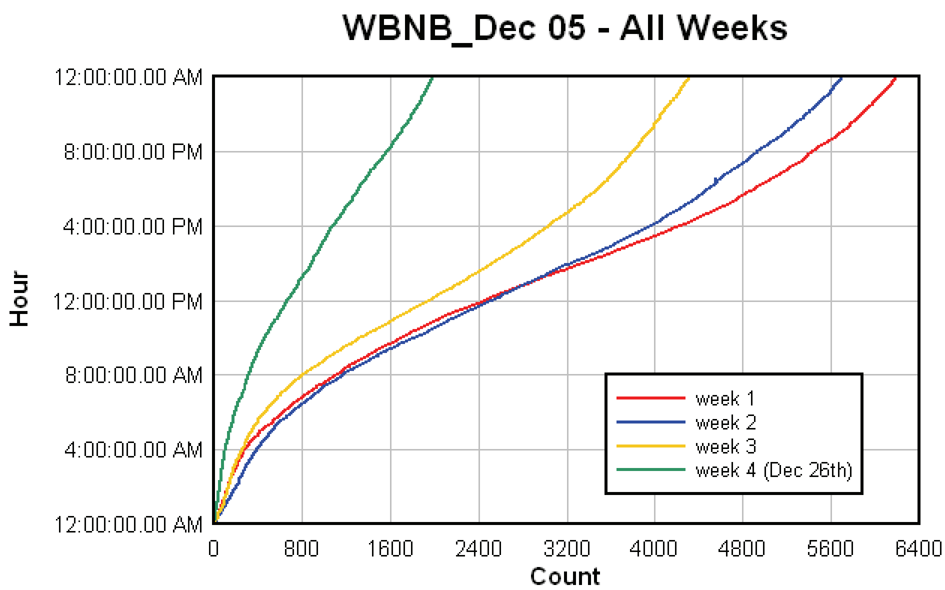
FORTRAN PROGRAM: "HistoSpacing_(#)"
OUTPUT: "HistoSpacing_(AXLE CATEGORY)"
(e.g. "HistoSpacing_Triples" LWB_Jan06)

```
Bin   Count   Frequency

 TRIPLE AXLE SPACING
 0.00      0. .0000
 1.00      0. .0000
 2.00      0. .0000
 3.00      0. .0000
 4.00      0. .0000
 5.00      0. .0000
 6.00      0. .0000
 7.00      9. .0066
 8.00    348. .2548
 9.00    495. .3624
10.00    343. .2511
11.00    128. .0937
12.00     40. .0293
13.00      3. .0022
14.00      0. .0000
15.00      0. .0000

 MEAN         STD DEV
 9.827          1.05

 FIRST AXLE SPACING
 0.00      0. .0000
 0.50      0. .0000
 1.00      0. .0000
 1.50      0. .0000
 2.00      0. .0000
 2.50      0. .0000
 3.00      1. .0007
 3.50     24. .0176
 4.00    359. .2628
 4.50    282. .2064
 5.00    415. .3038
 5.50     88. .0644
 6.00     89. .0652
 6.50     54. .0395
 7.00     25. .0183
 7.50     29. .0212

 MEAN         STD DEV
 5.130          0.86

 SECOND AXLE SPACING
 0.00      0. .0000
 0.50      0. .0000
 1.00      0. .0000
 1.50      0. .0000
 2.00      0. .0000
 2.50      0. .0000
 3.00      0. .0000
 3.50     15. .0110
 4.00    637. .4663
 4.50    432. .3163
 5.00    224. .1640
 5.50     32. .0234
 6.00      9. .0066
 6.50      5. .0037
 7.00      4. .0029
 7.50      8. .0059

 MEAN         STD DEV
 4.697          0.51
```

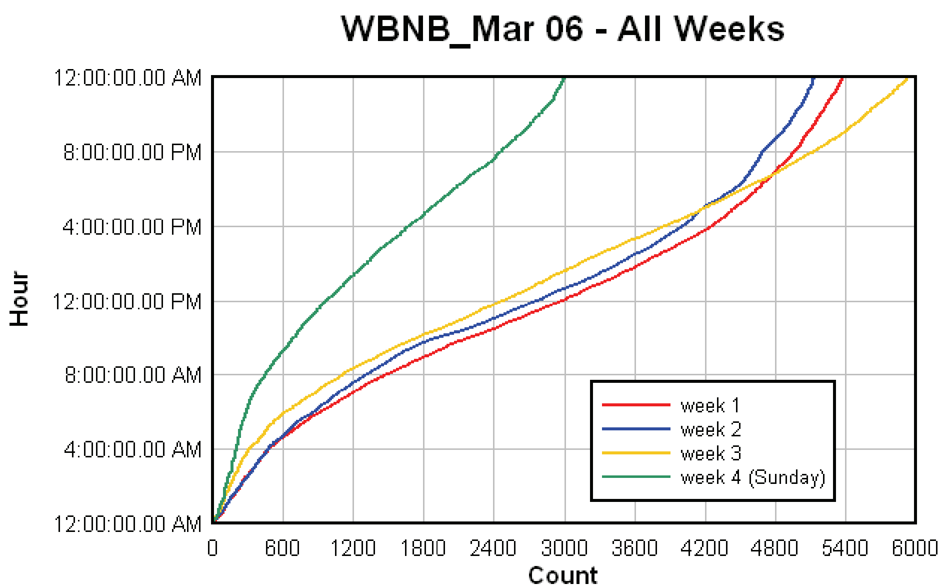
APPENDIX C

24-HOUR TRUCK VOLUMES BY WEEK

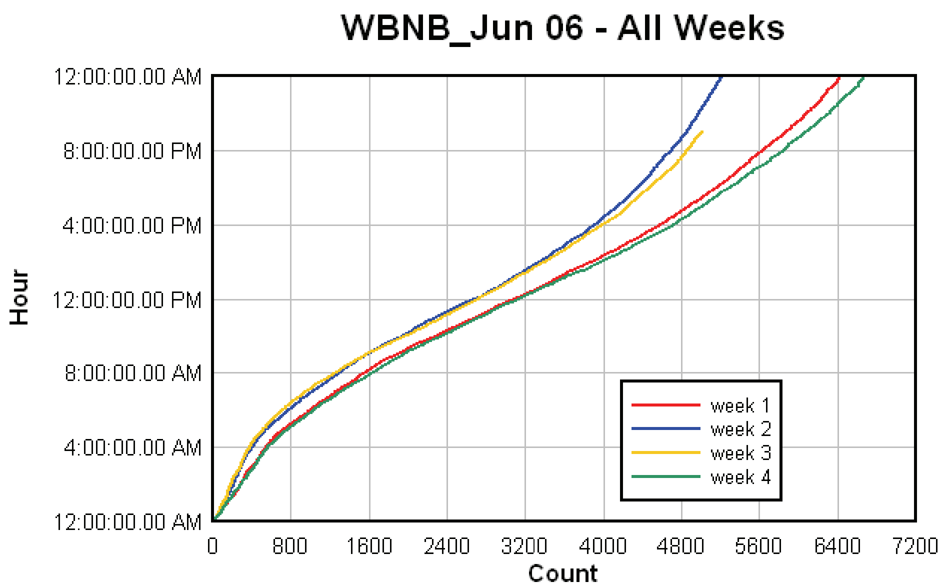
WBNB

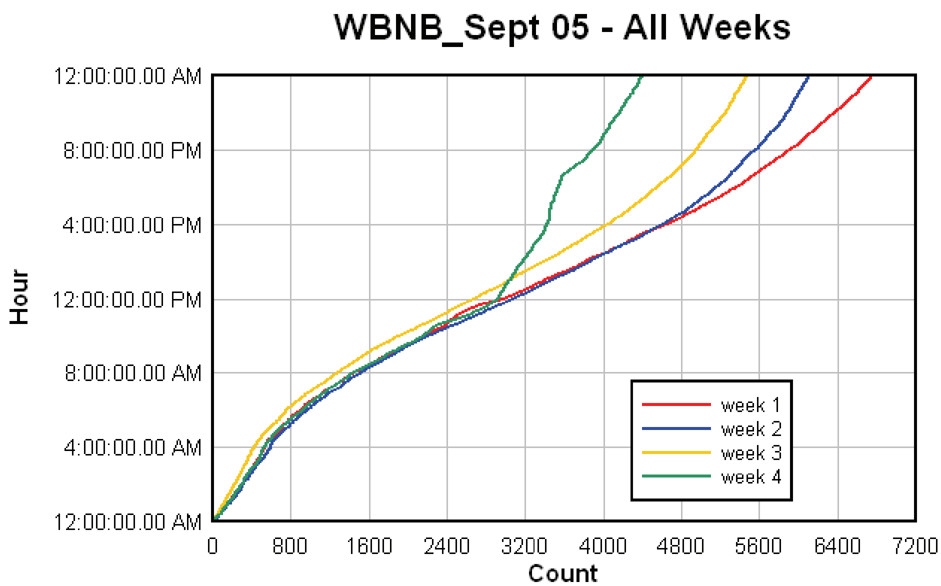


WBNB_Dec 05 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
800
1600
2400
3200
4000
4800
5600
6400
Count
week 1
week 2
week 3
week 4 (Dec 26th)

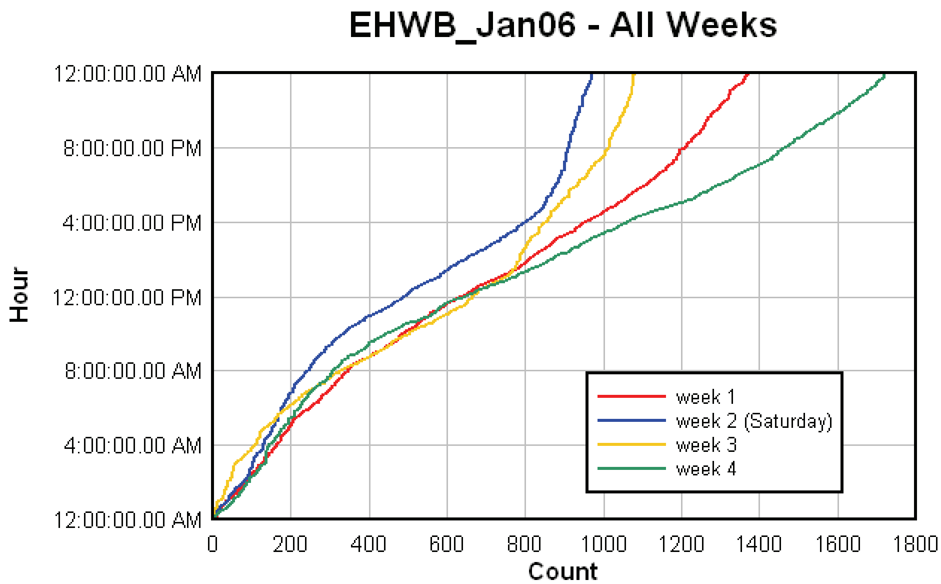


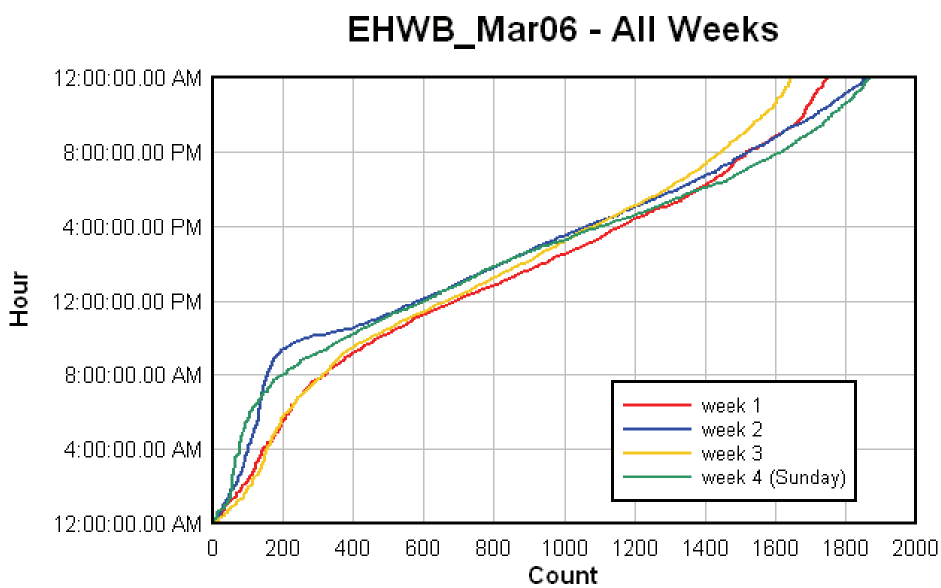
WBNB_Mar 06 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
600
1200
1800
2400
3000
3600
4200
4800
5400
6000
Count
week 1
week 2
week 3
week 4 (Sunday)

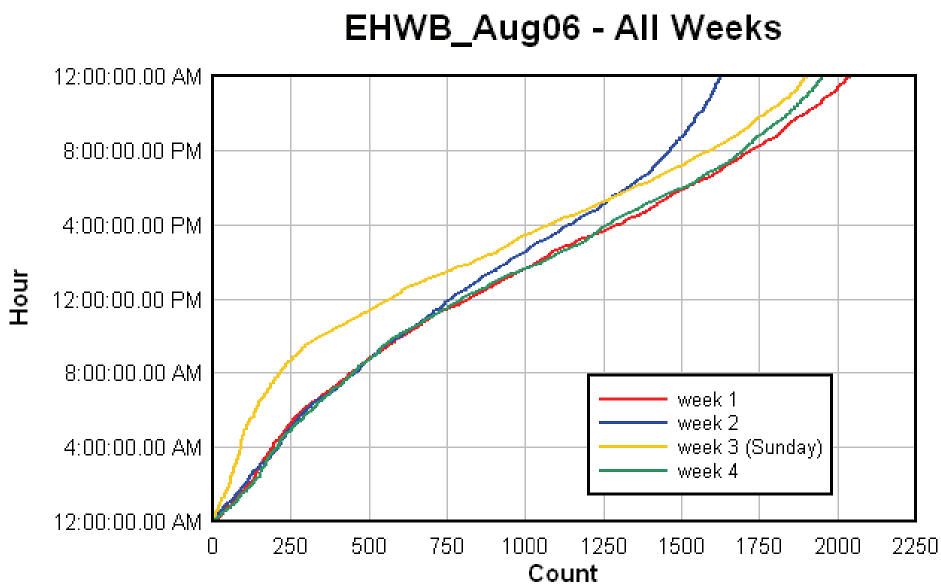

WBNB_Jun 06 - All Weeks
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
Hour
0
800
1600
2400
3200
4000
4800
5600
6400
7200
Count
week 1
week 2
week 3
week 4

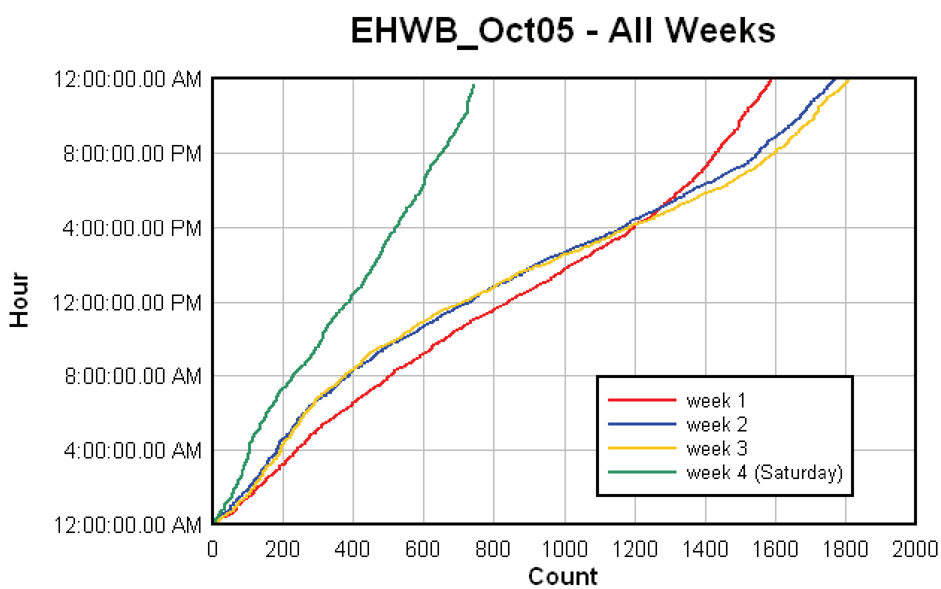

WBNB_Sept 05 - All Weeks
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
Hour
0
800
1600
2400
3200
4000
4800
5600
6400
7200
Count
week 1
week 2
week 3
week 4

EHWB

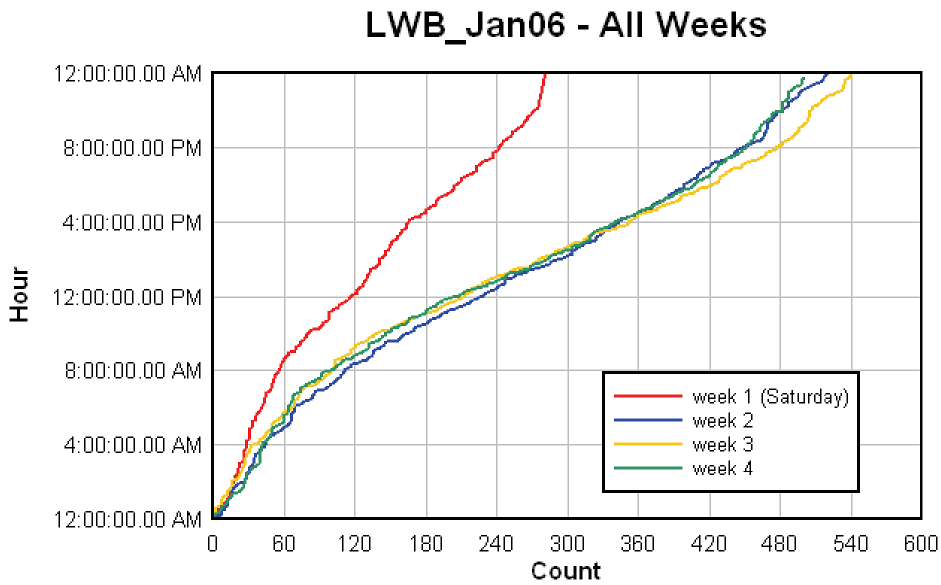

EHWB_Jan06 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
200
400
600
800
1000
1200
1400
1600
1800
Count
week 1
week 2 (Saturday)
week 3
week 4

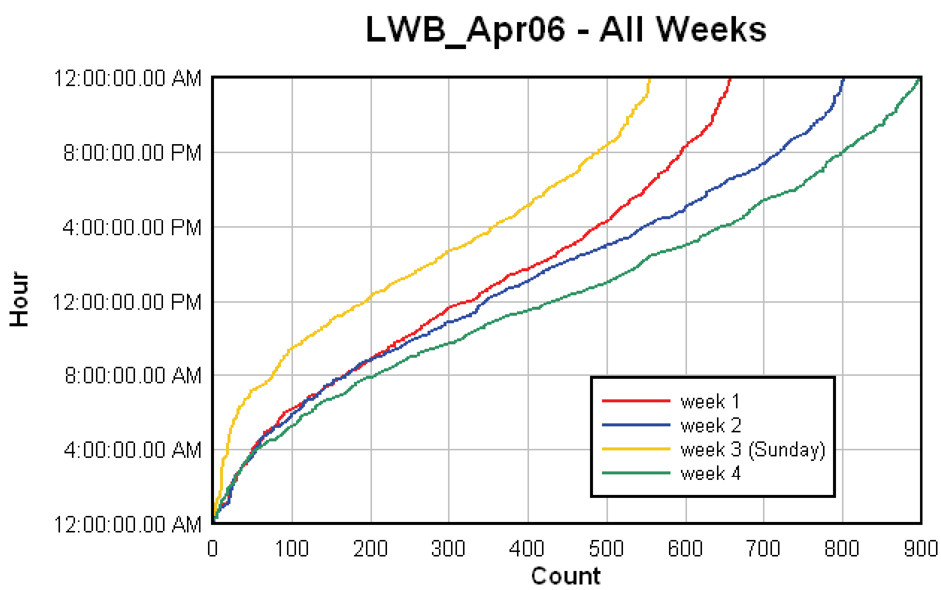

EHWB_Mar06 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Count
week 1
week 2
week 3
week 4 (Sunday)

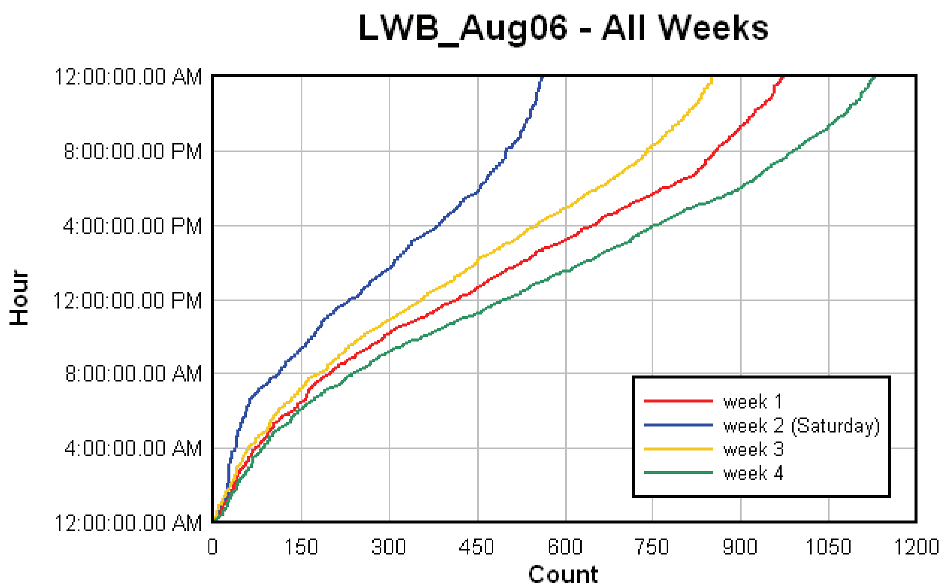

EHWB_Aug06 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
250
500
750
1000
1250
1500
1750
2000
2250
Count
week 1
week 2
week 3 (Sunday)
week 4

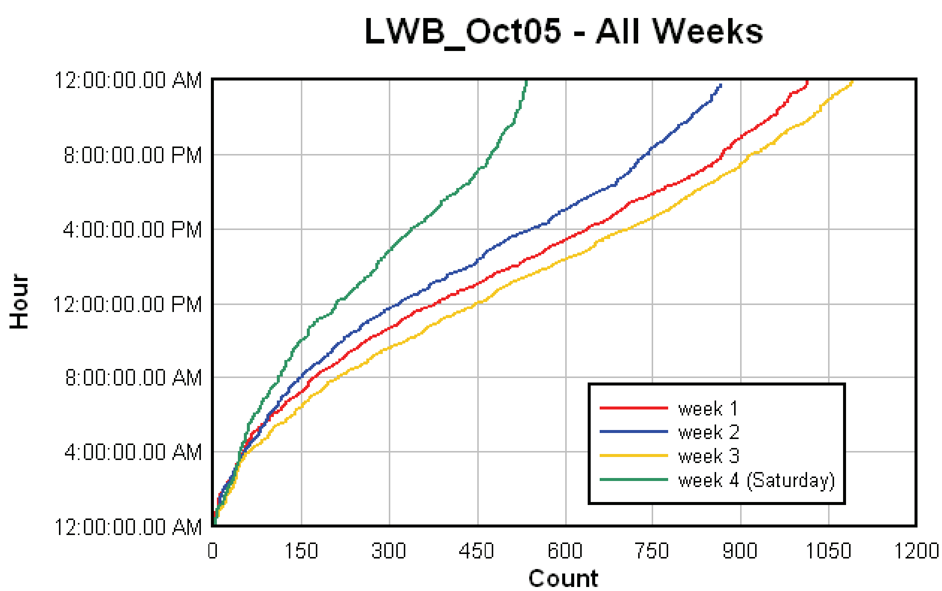

EHWB_Oct05 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Count
week 1
week 2
week 3
week 4 (Saturday)

LWB

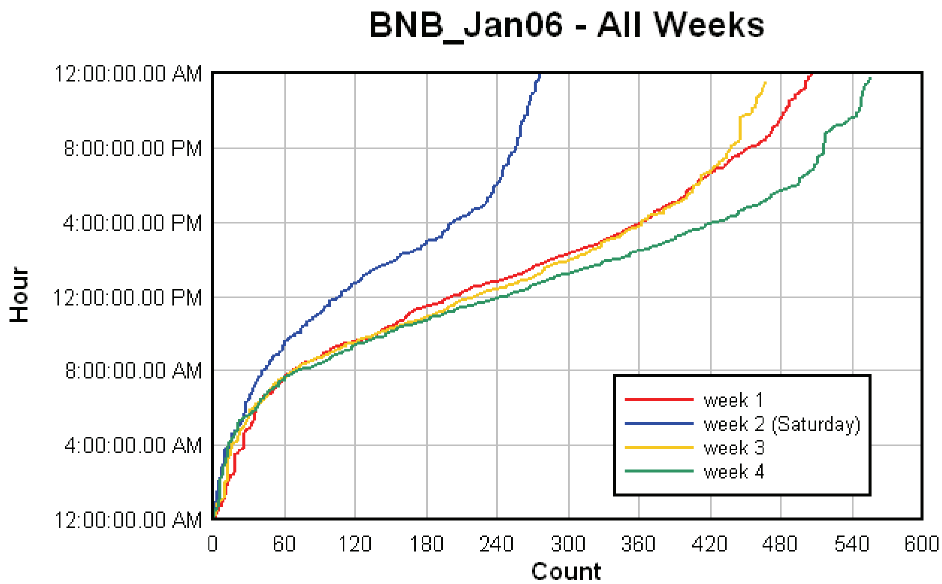

LWB_Jan06 - All Weeks
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
Hour
0
60
120
180
240
300
360
420
480
540
600
Count
week 1 (Saturday)
week 2
week 3
week 4

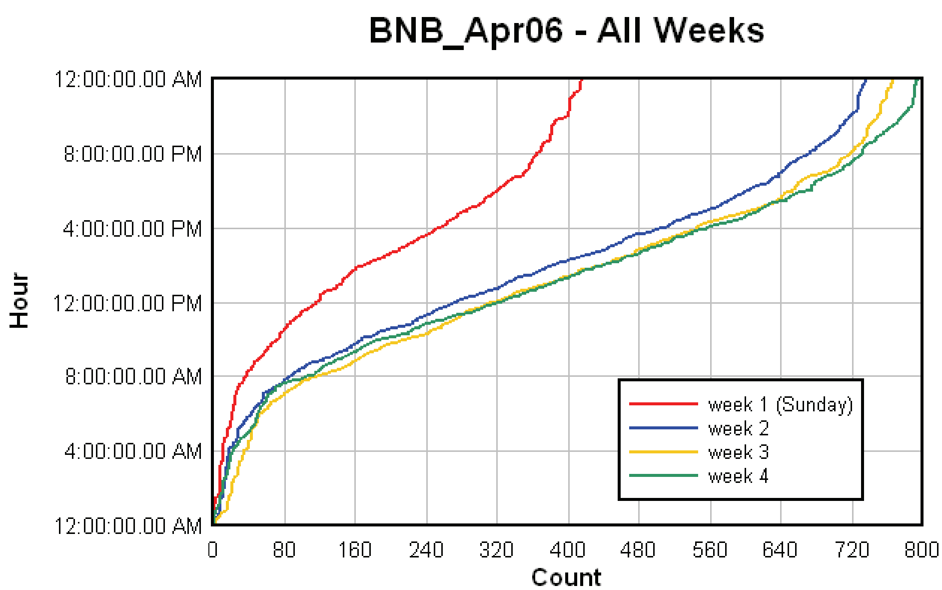

LWB_Apr06 - All Weeks
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
Hour
0
100
200
300
400
500
600
700
800
900
Count
week 1
week 2
week 3 (Sunday)
week 4

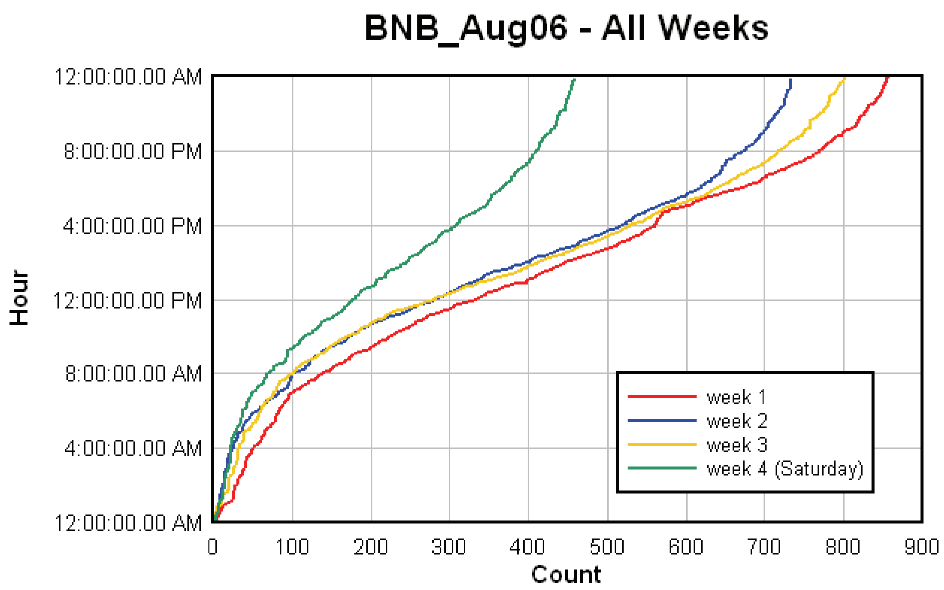

LWB_Aug06 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
150
300
450
600
750
900
1050
1200
Count
week 1
week 2 (Saturday)
week 3
week 4

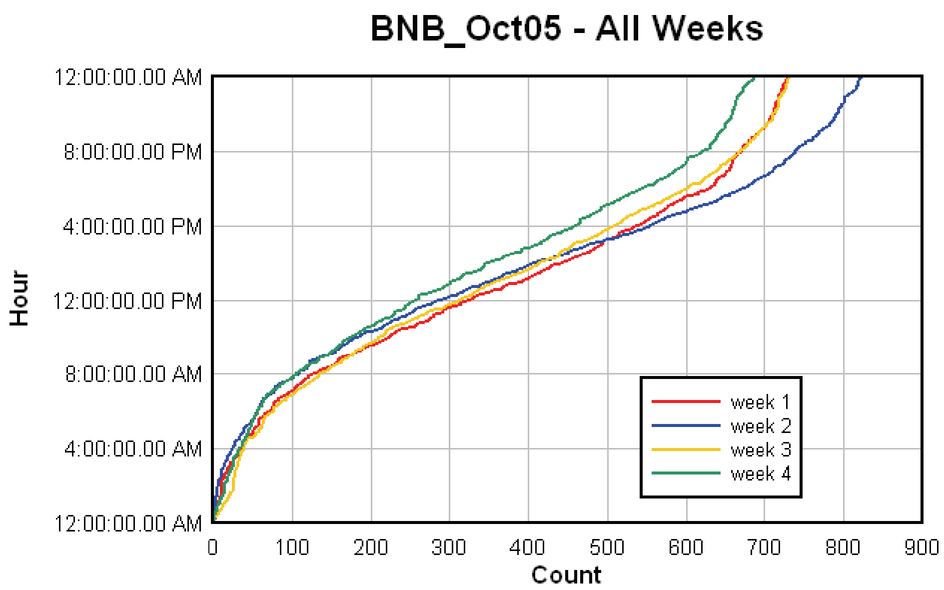

LWB_Oct05 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
150
300
450
600
750
900
1050
1200
Count
week 1
week 2
week 3
week 4 (Saturday)

BNB


BNB_Jan06 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
60
120
180
240
300
360
420
480
540
600
Count
week 1
week 2 (Saturday)
week 3
week 4

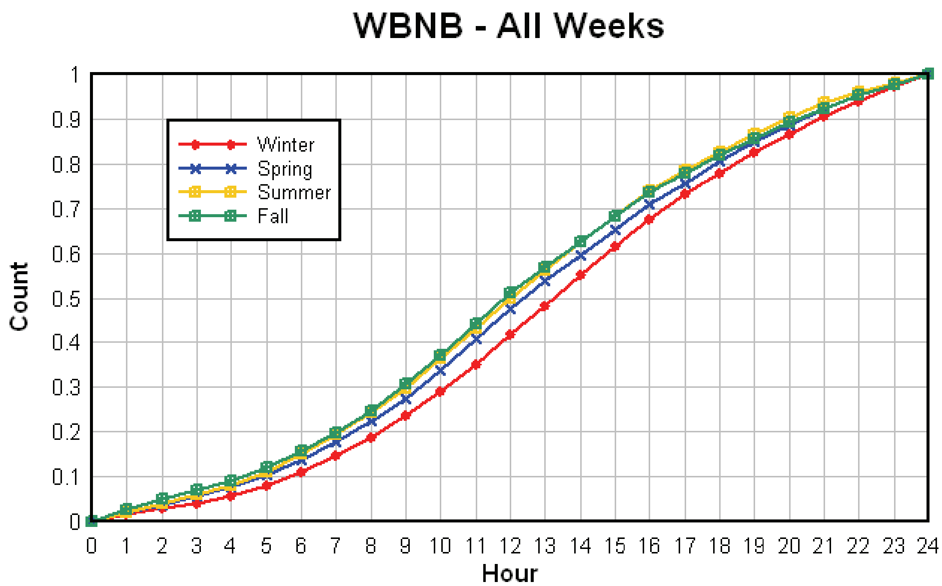

BNB_Apr06 - All Weeks
Hour
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
80
160
240
320
400
480
560
640
720
800
Count
week 1 (Sunday)
week 2
week 3
week 4

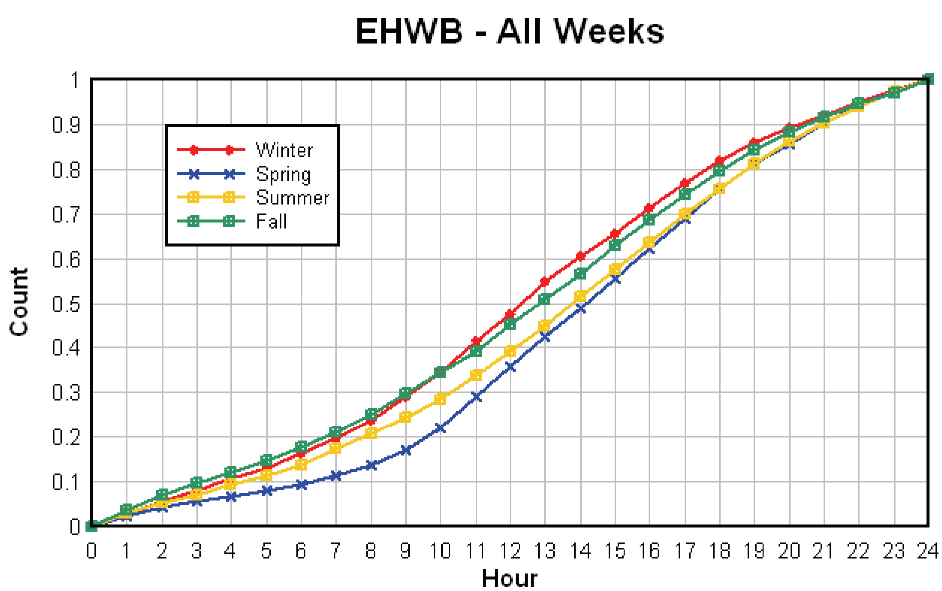

BNB_Aug06 - All Weeks
Hour
Count
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
100
200
300
400
500
600
700
800
900
week 1
week 2
week 3
week 4 (Saturday)

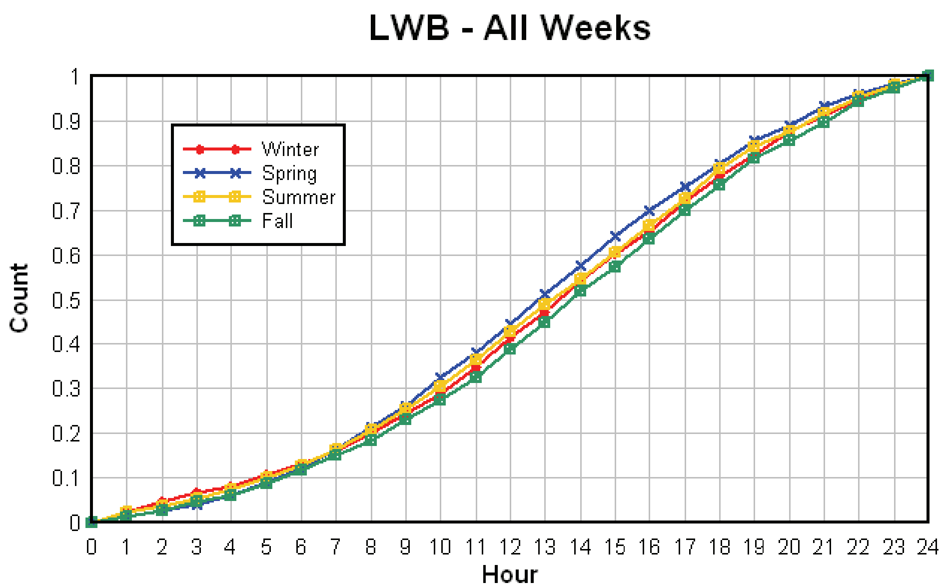

BNB_Oct05 - All Weeks
Hour
Count
12:00:00.00 AM
8:00:00.00 PM
4:00:00.00 PM
12:00:00.00 PM
8:00:00.00 AM
4:00:00.00 AM
12:00:00.00 AM
0
100
200
300
400
500
600
700
800
900
week 1
week 2
week 3
week 4

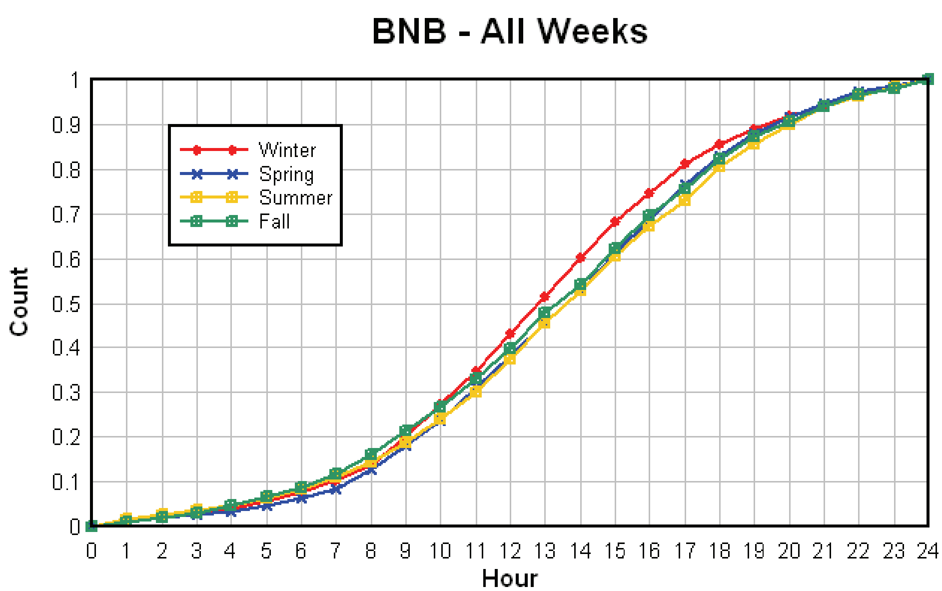
APPENDIX D

AVERAGE 24-HOUR TRAFFIC VOLUMES BY SEASON CDFs


WBNB - All Weeks
Winter
Spring
Summer
Fall
Count
Hour
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24


EHWB - All Weeks
Winter
Spring
Summer
Fall
Count
Hour
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

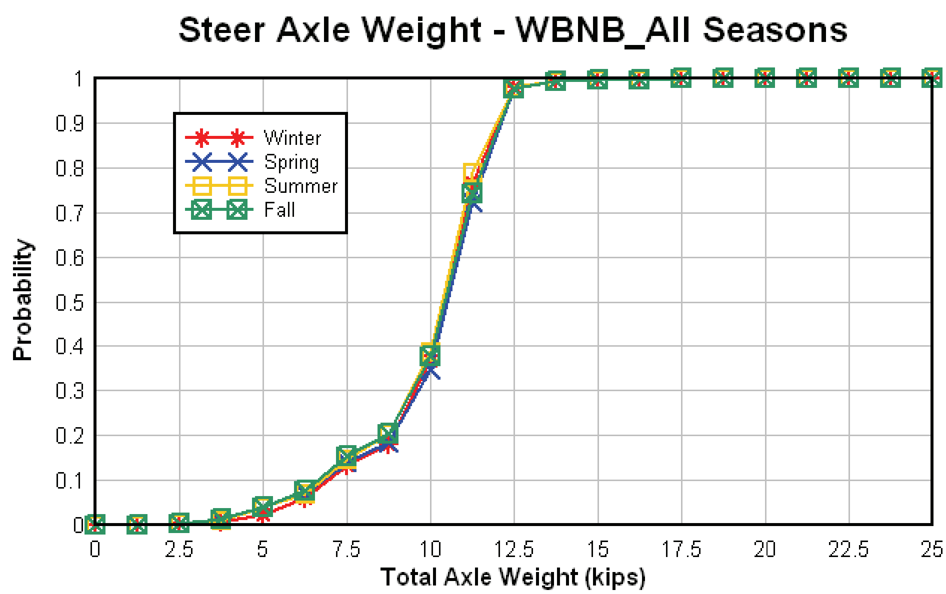

LWB - All Weeks
Winter
Spring
Summer
Fall
Count
Hour
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24


BNB - All Weeks
Winter
Spring
Summer
Fall
Count
Hour
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

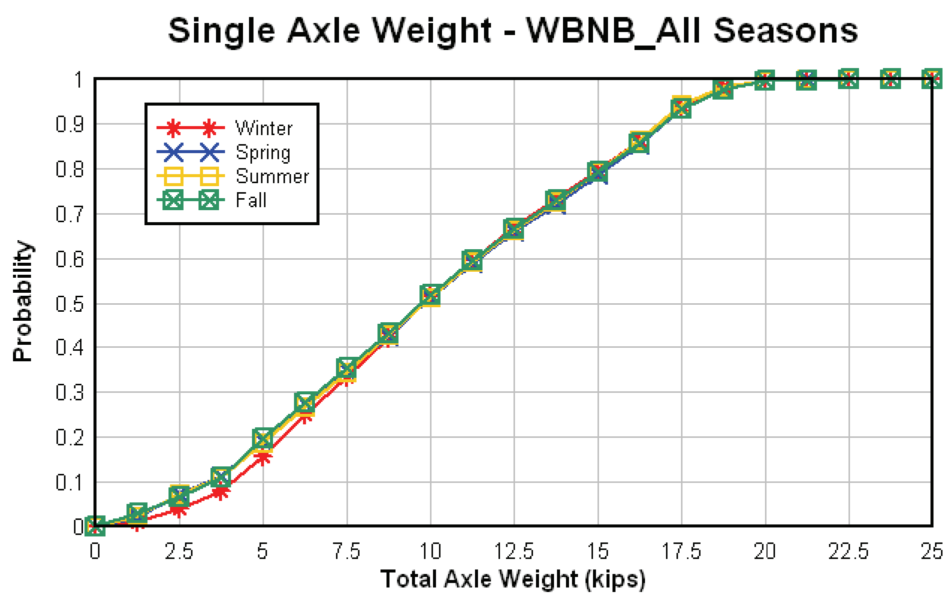
APPENDIX E

TOTAL AXLE WEIGHT BY SEASON CDFs

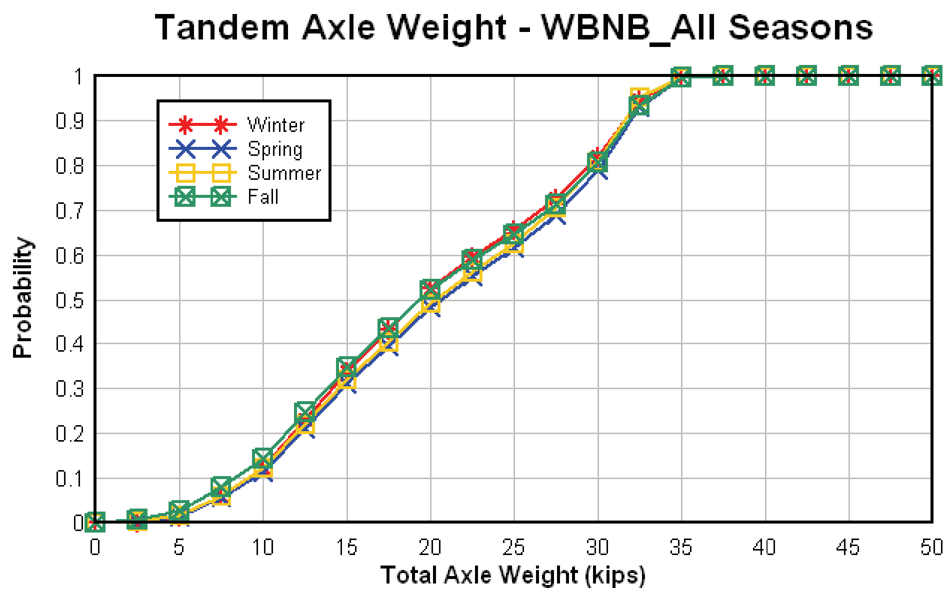
WBNB

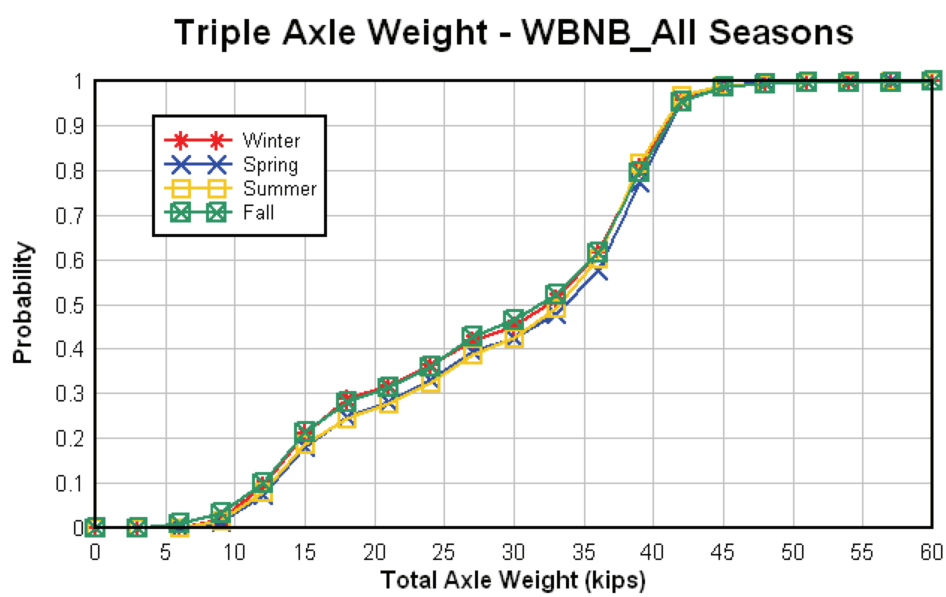


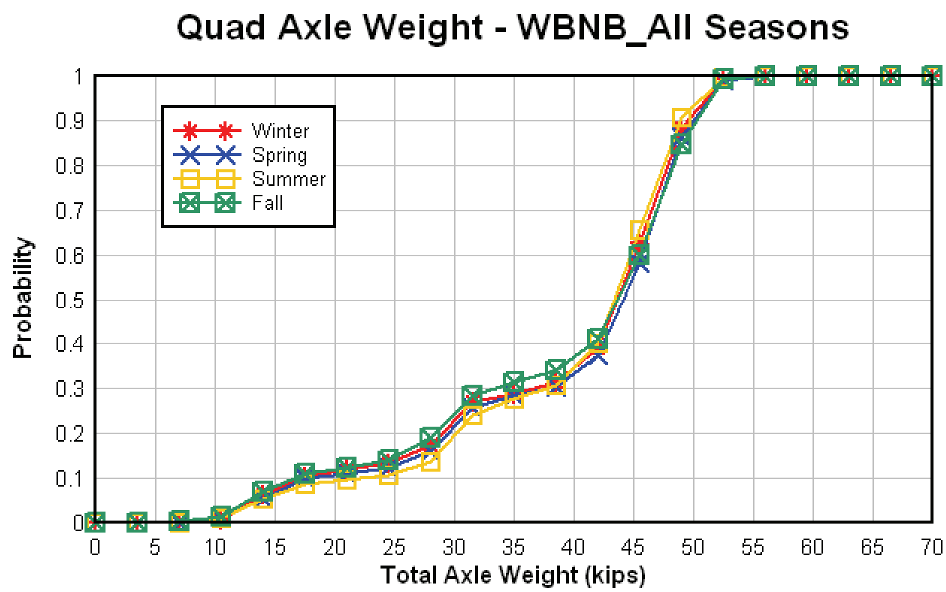
Steer Axle Weight - WBNB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25

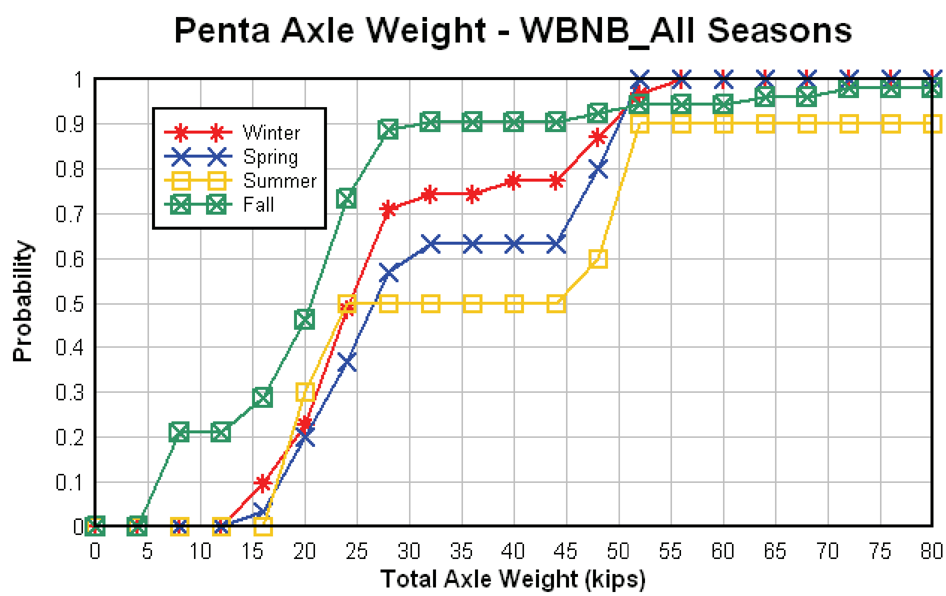


Single Axle Weight - WBNB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25

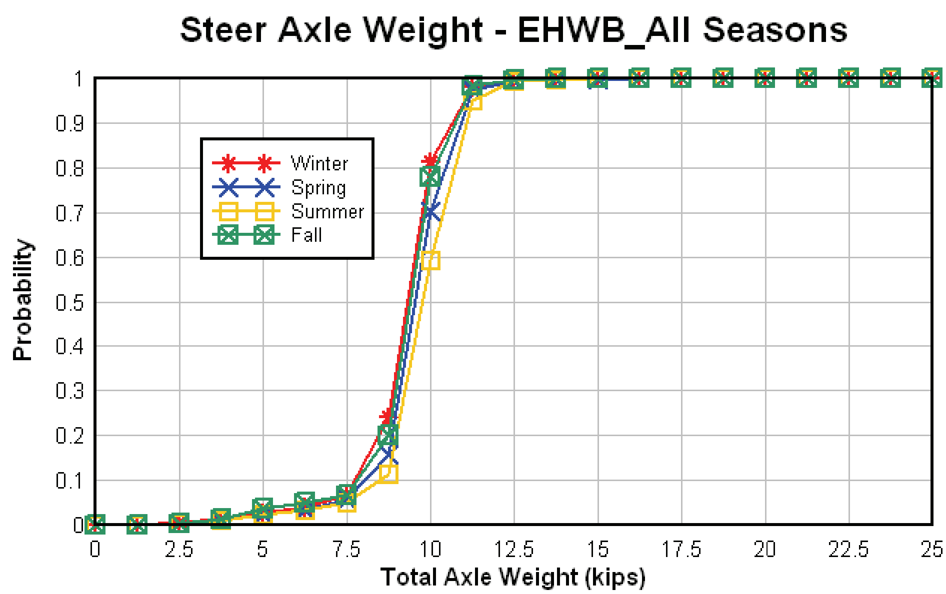

Tandem Axle Weight - WBNB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50

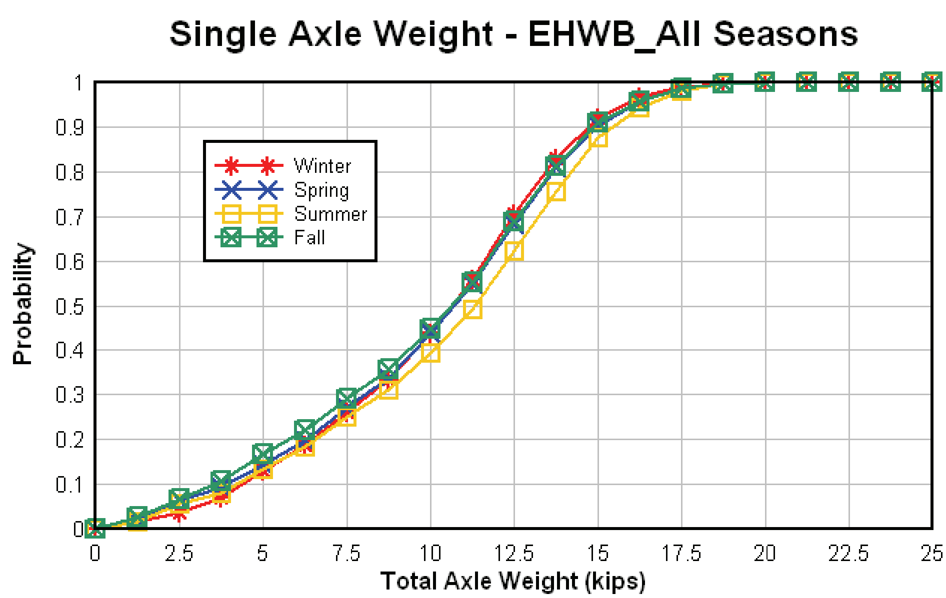

Triple Axle Weight - WBNB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50
55
60

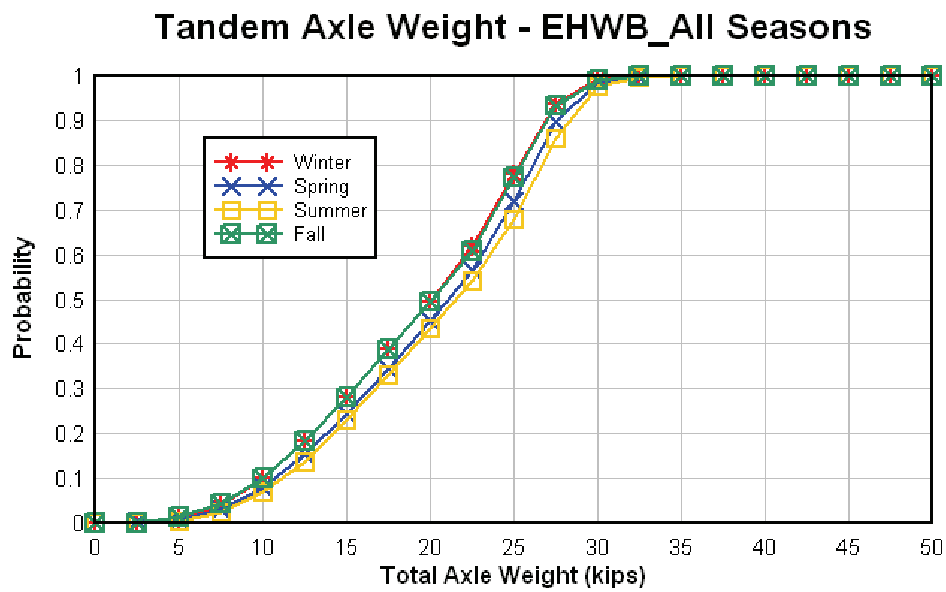

Quad Axle Weight - WBNB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

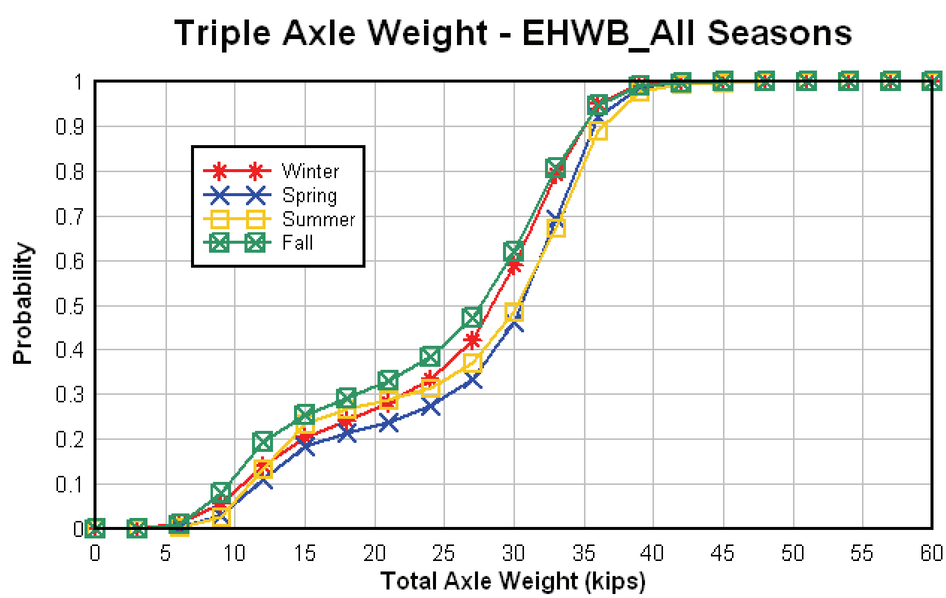

Penta Axle Weight - WBNB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

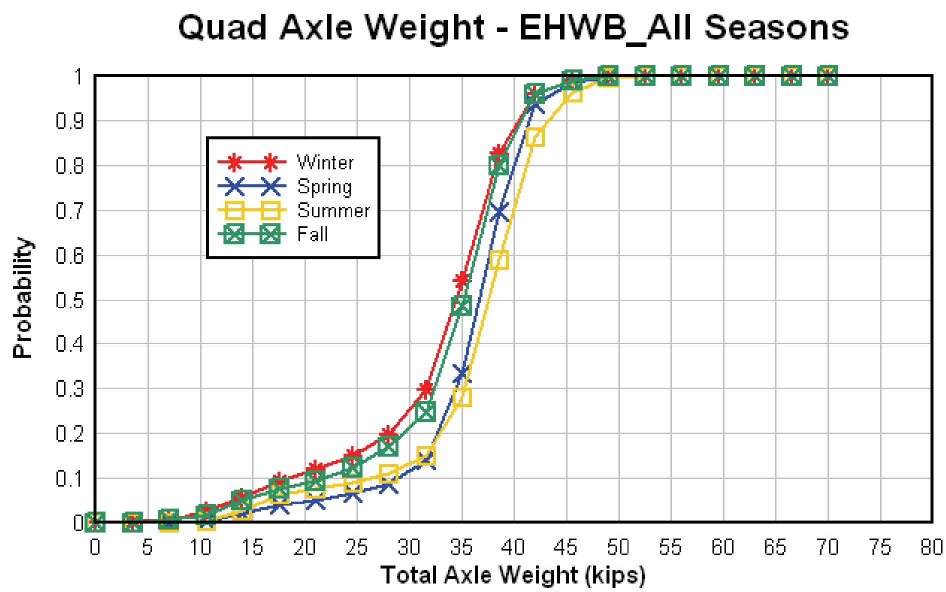
EHWB


Steer Axle Weight - EHWB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25

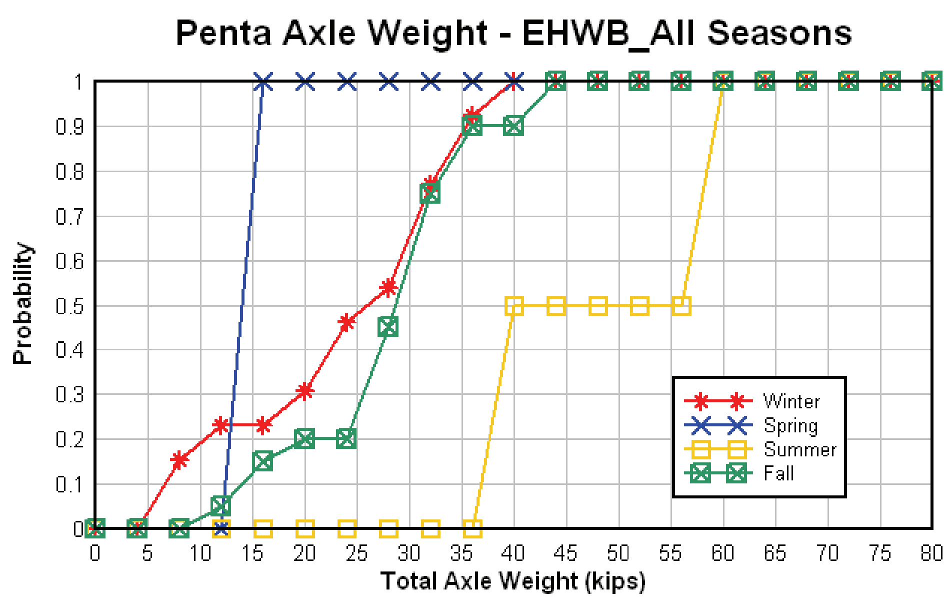

Single Axle Weight - EHWB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25


Tandem Axle Weight - EHWB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50


Triple Axle Weight - EHWB_All Seasons
Winter
Spring
Summer
Fall
Probability
Total Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50
55
60

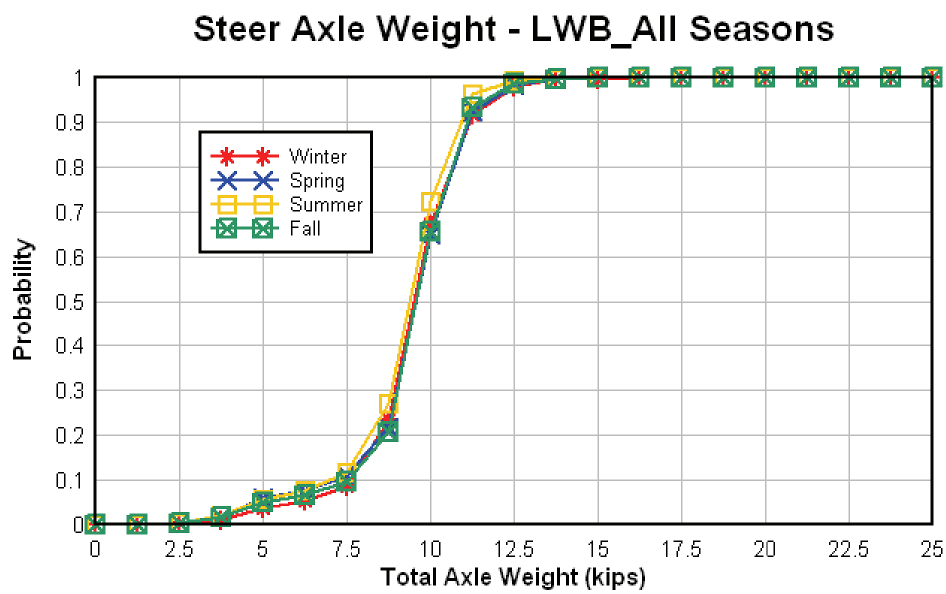


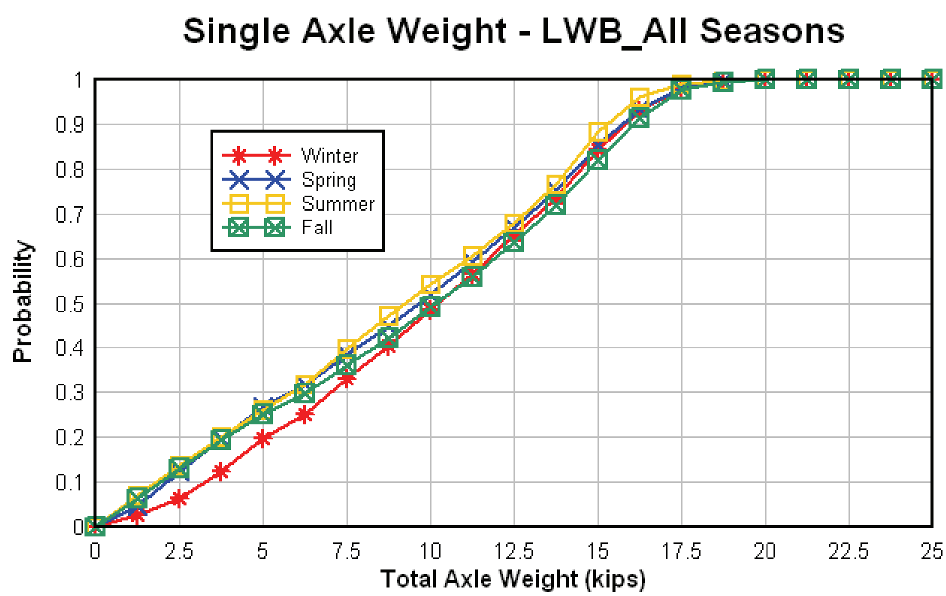
Quad Axle Weight - EHWB_All Seasons
Probability
Total Axle Weight (kips)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

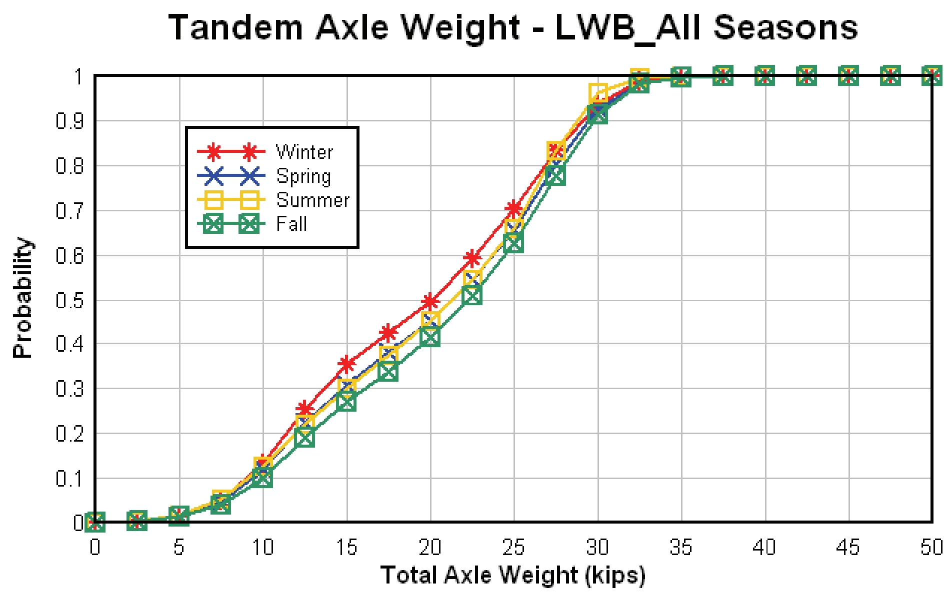


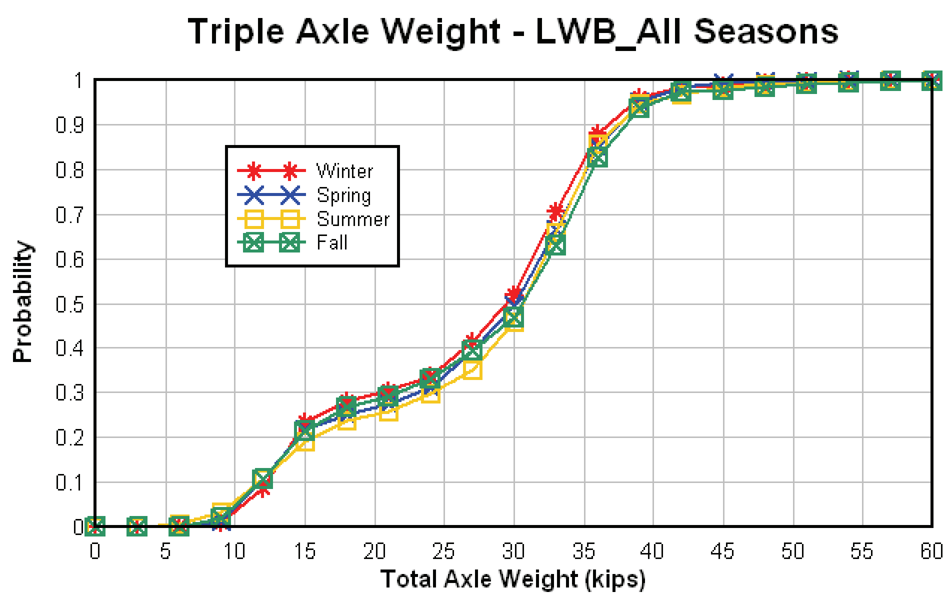
Penta Axle Weight - EHWB_All Seasons
Probability
Total Axle Weight (kips)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

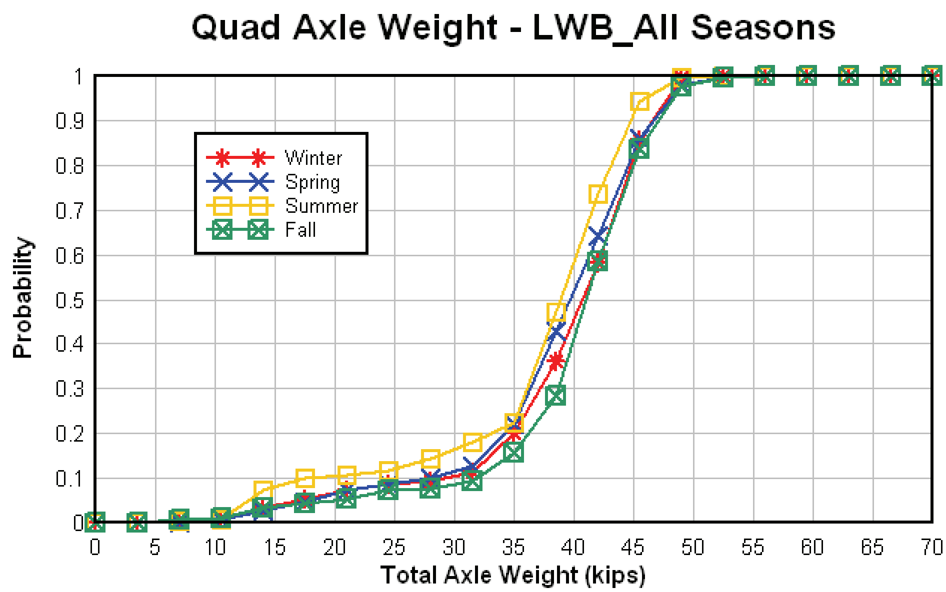
LWB


Steer Axle Weight - LWB_All Seasons
Probability
Total Axle Weight (kips)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25


Single Axle Weight - LWB_All Seasons
Probability
Total Axle Weight (kips)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25

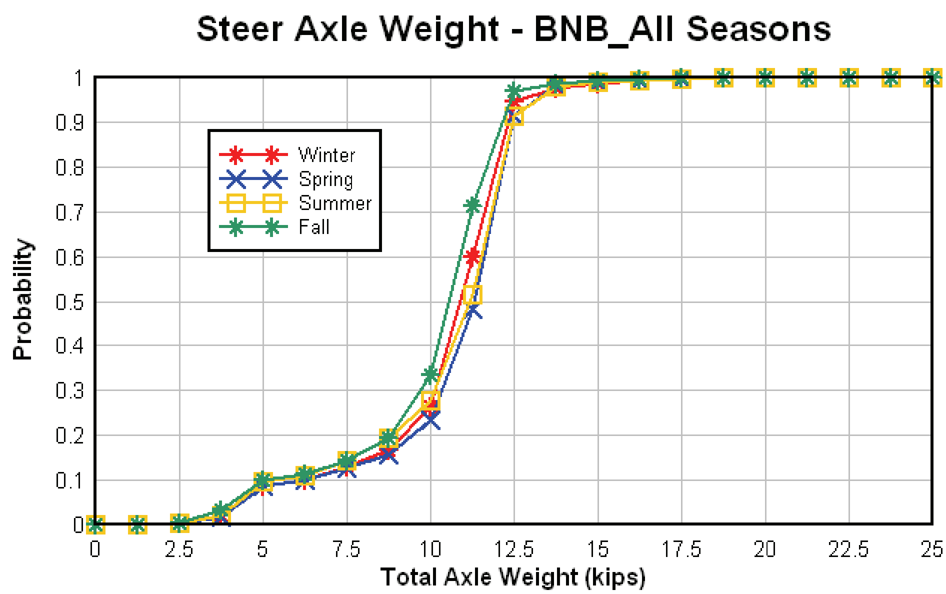

Tandem Axle Weight - LWB_All Seasons
Winter
Spring
Summer
Fall
Probability
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50
Total Axle Weight (kips)


Triple Axle Weight - LWB_All Seasons
Winter
Spring
Summer
Fall
Probability
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50
55
60
Total Axle Weight (kips)

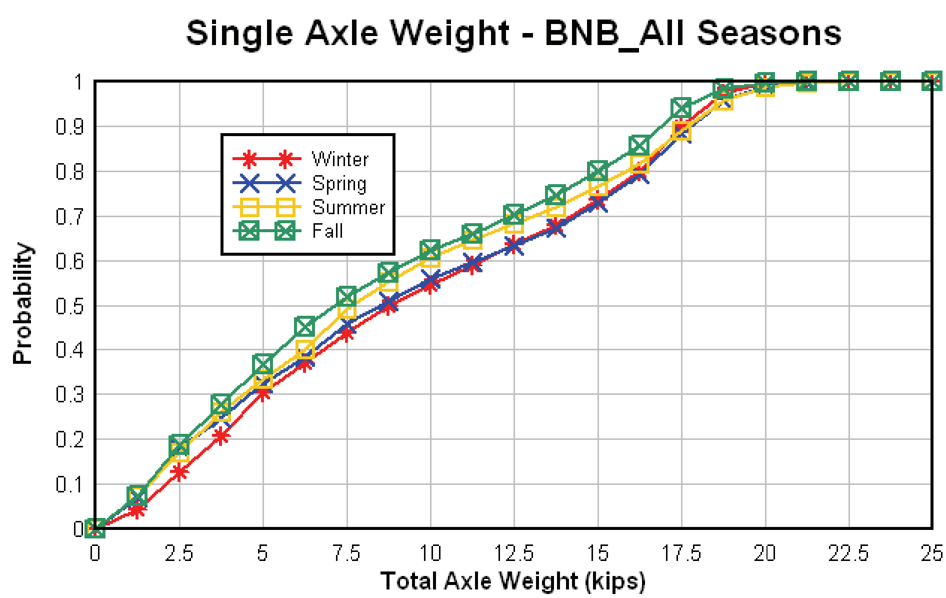

Quad Axle Weight - LWB_All Seasons
Probability
Total Axle Weight (kips)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70


Penta Axle Weight - LWB_All Seasons
Probability
Total Axle Weight (kips)
Spring
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80

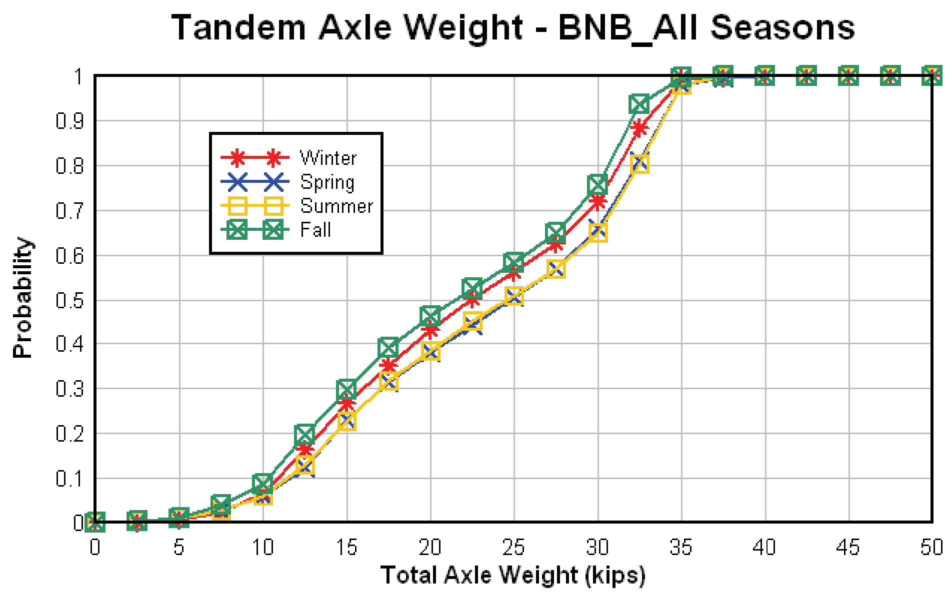
BNB

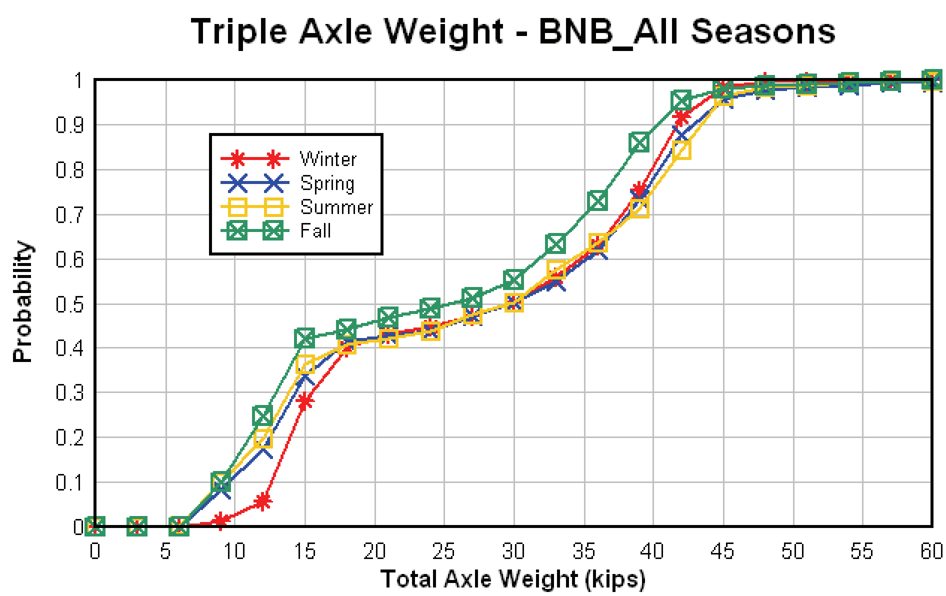


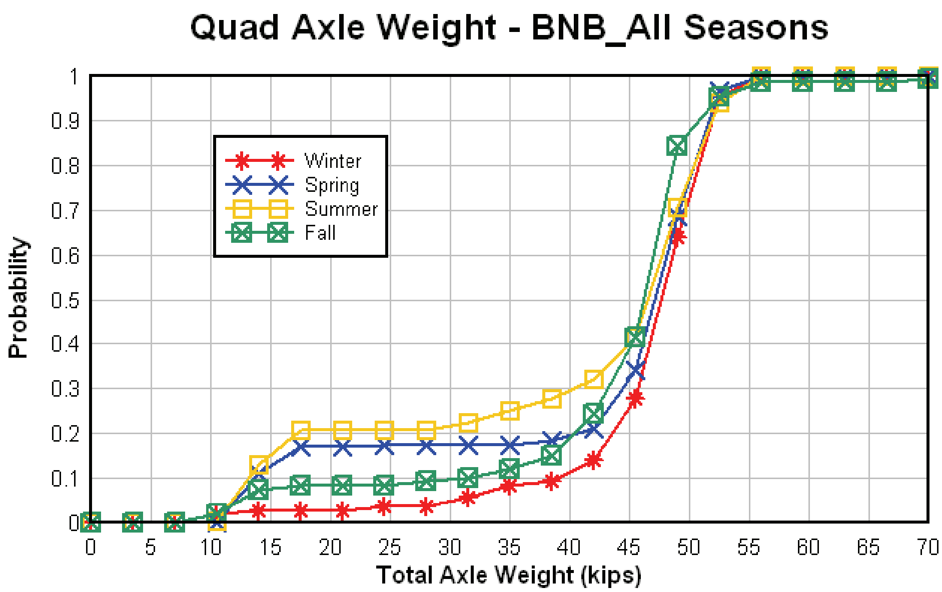
Steer Axle Weight - BNB_All Seasons
Winter
Spring
Summer
Fall
Probability
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Total Axle Weight (kips)



Single Axle Weight - BNB_All Seasons
Winter
Spring
Summer
Fall
Probability
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Total Axle Weight (kips)


Tandem Axle Weight - BNB_All Seasons
Probability
Total Axle Weight (kips)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50


Triple Axle Weight - BNB_All Seasons
Probability
Total Axle Weight (kips)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50
55
60

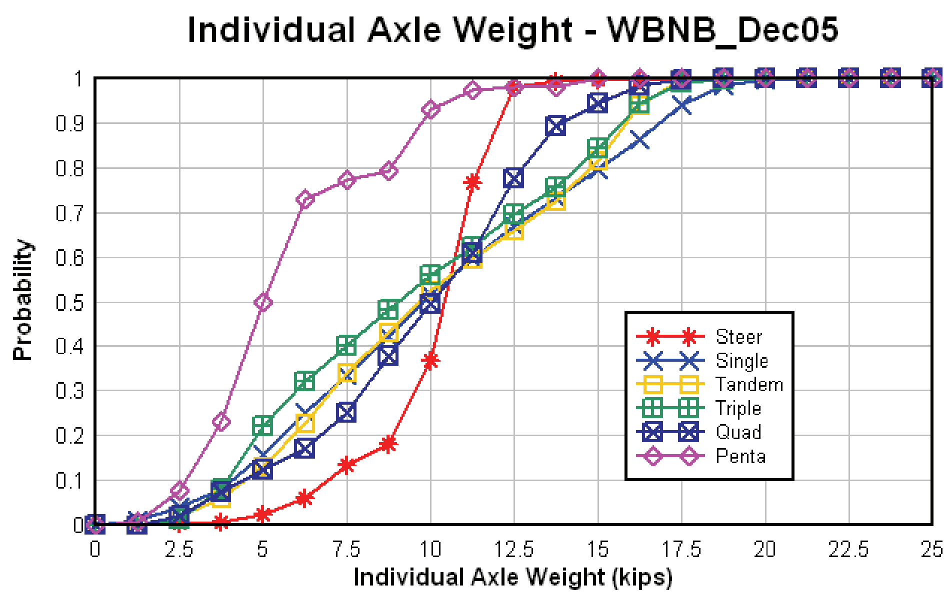


NO PENTA AXLES FOR THIS SITE

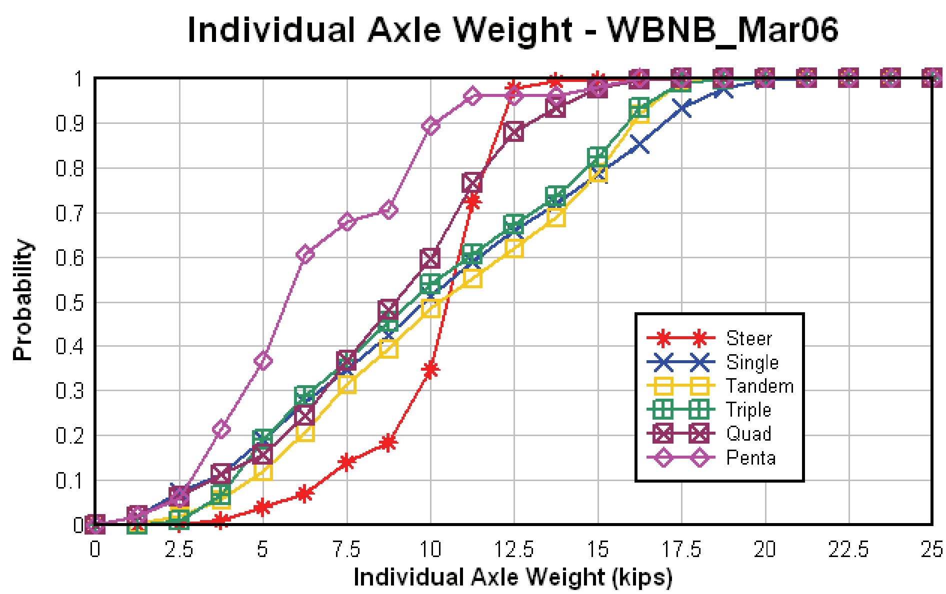
APPENDIX F

INDIVIDUAL AXLE WEIGHT BY AXLE CATEGORY CDFs

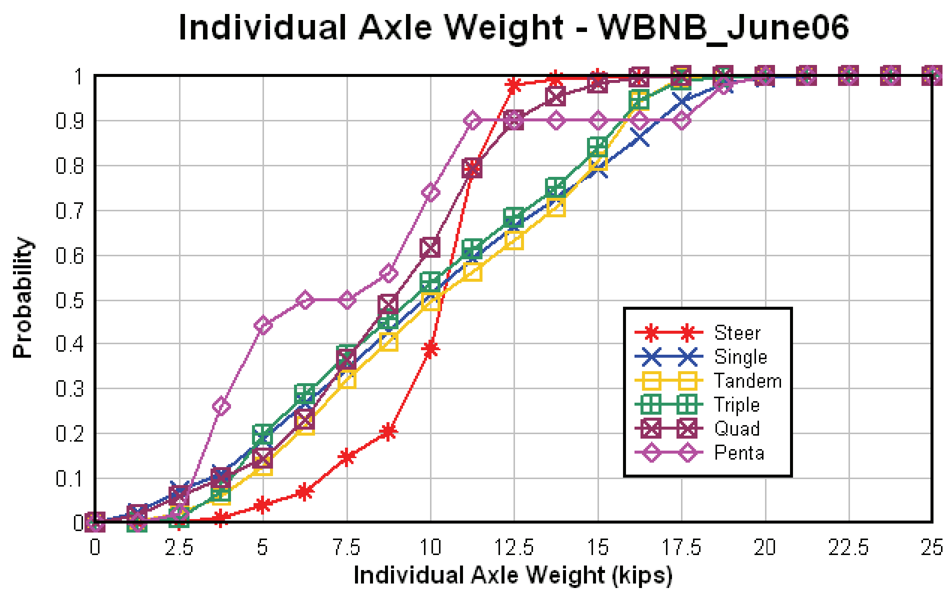
WBNB

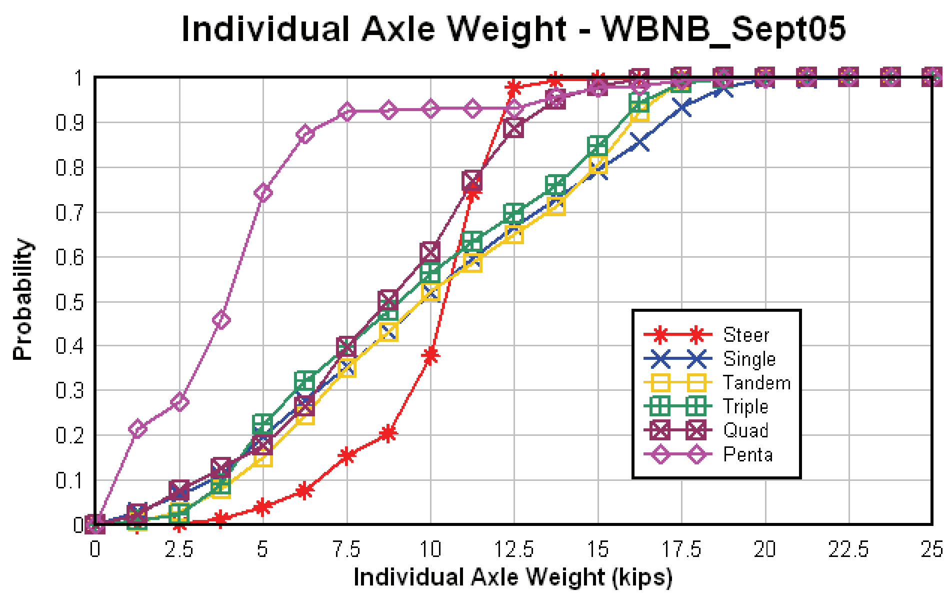


Individual Axle Weight - WBNB_Dec05
Probability
Individual Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Steer
Single
Tandem
Triple
Quad
Penta

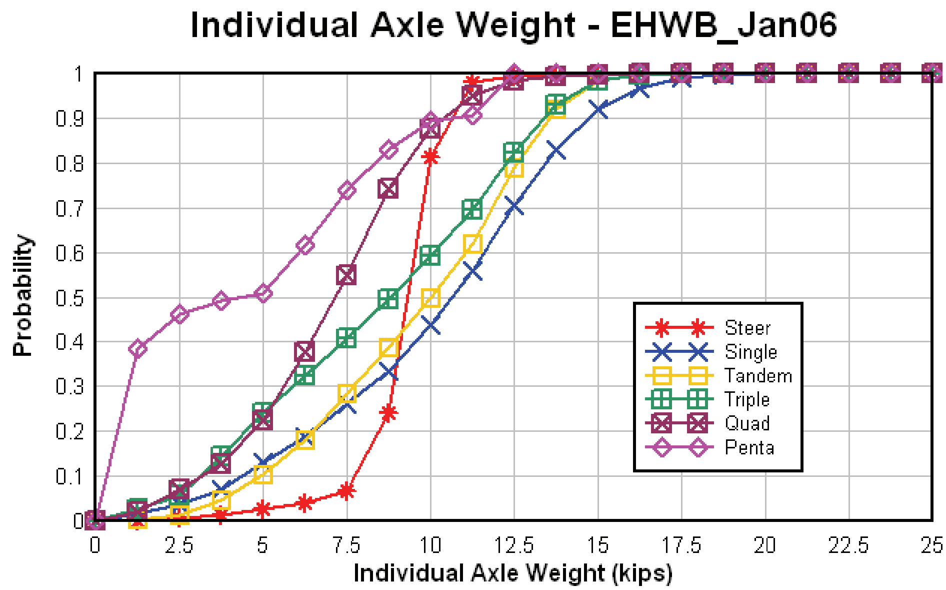


Individual Axle Weight - WBNB_Mar06
Probability
Individual Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Steer
Single
Tandem
Triple
Quad
Penta

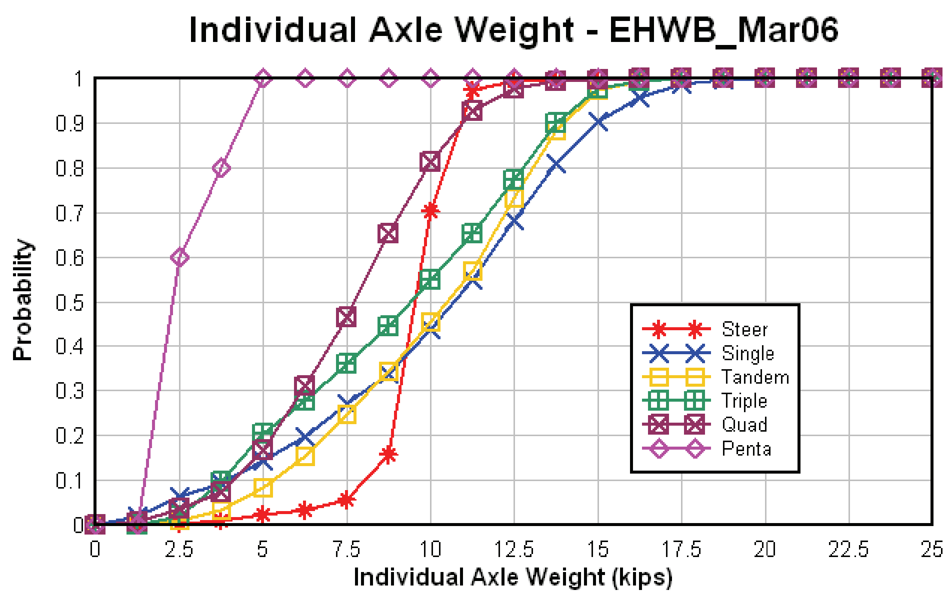

Individual Axle Weight - WBNB_June06
Probability
Individual Axle Weight (kips)
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Steer
Single
Tandem
Triple
Quad
Penta


Individual Axle Weight - WBNB_Sept05
Probability
Individual Axle Weight (kips)
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Steer
Single
Tandem
Triple
Quad
Penta

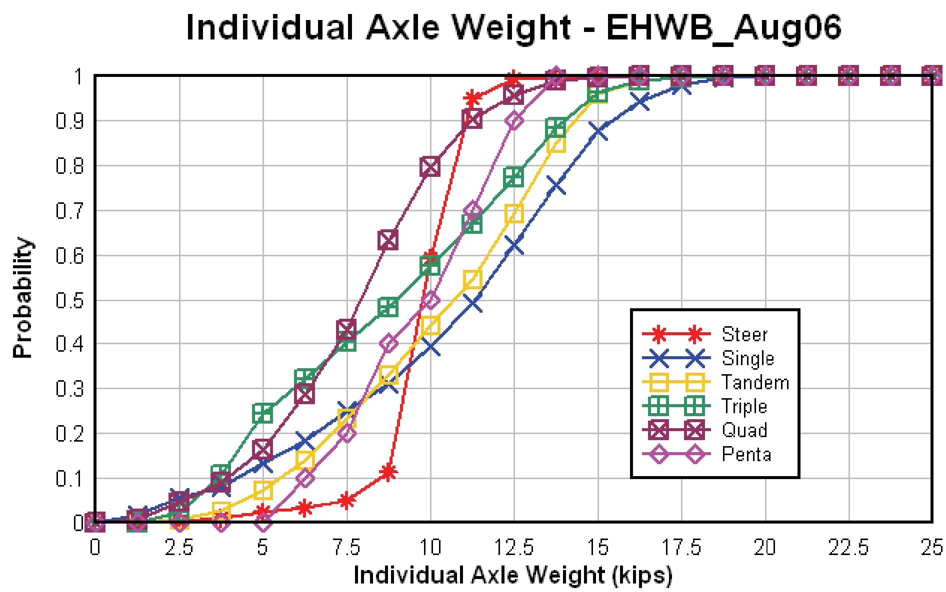
EHWB

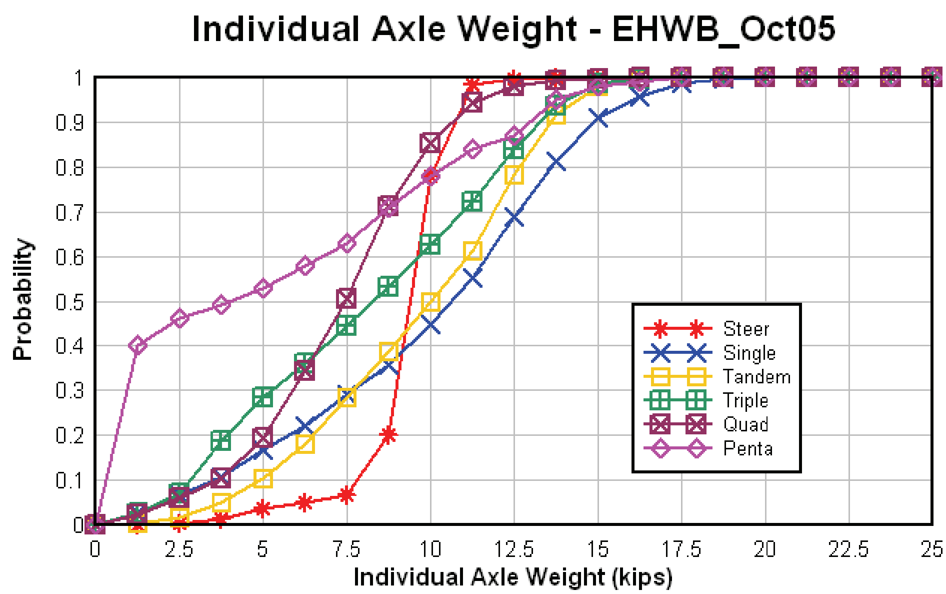


Individual Axle Weight - EHWB_Jan06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Individual Axle Weight (kips)
Steer
Single
Tandem
Triple
Quad
Penta

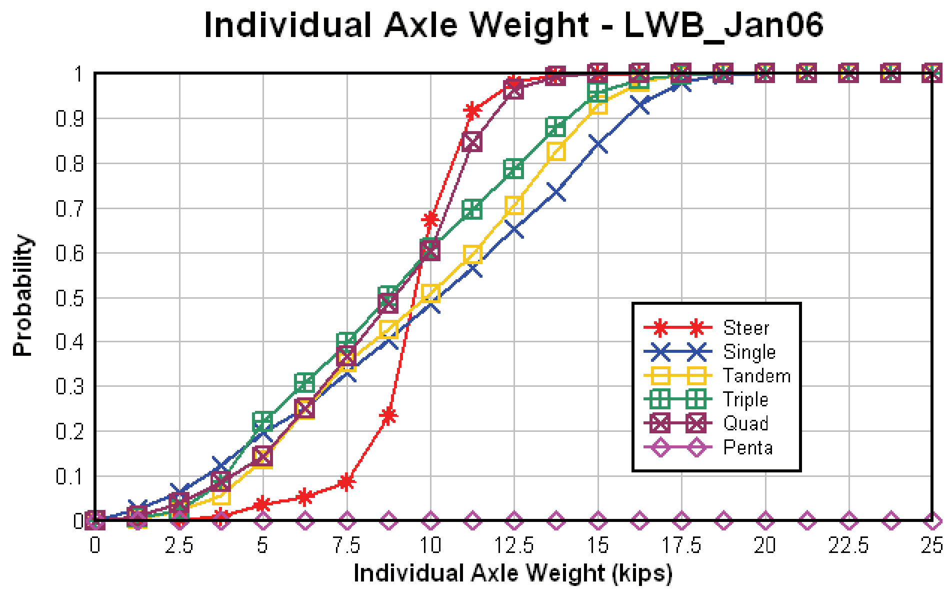


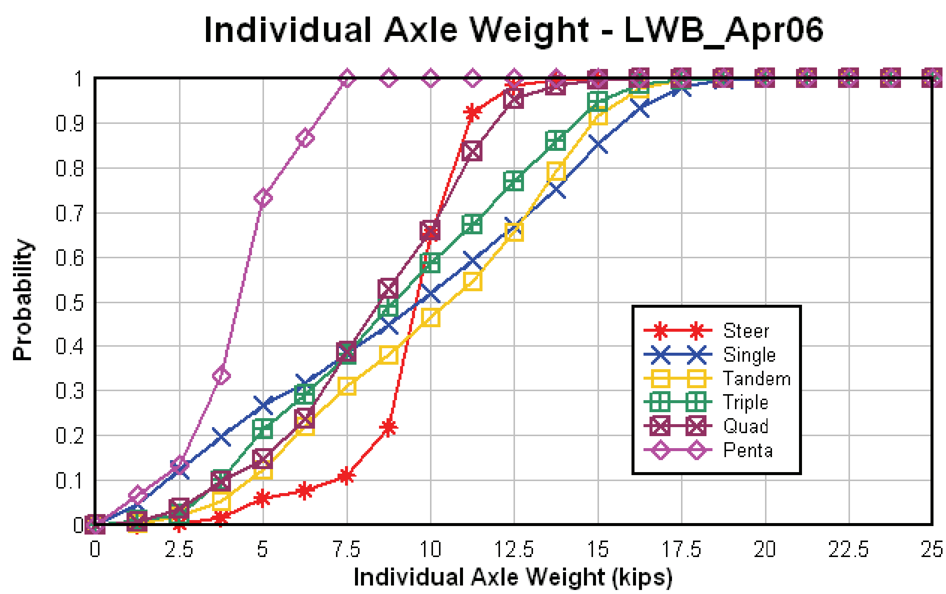
Individual Axle Weight - EHWB_Mar06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Individual Axle Weight (kips)
Steer
Single
Tandem
Triple
Quad
Penta

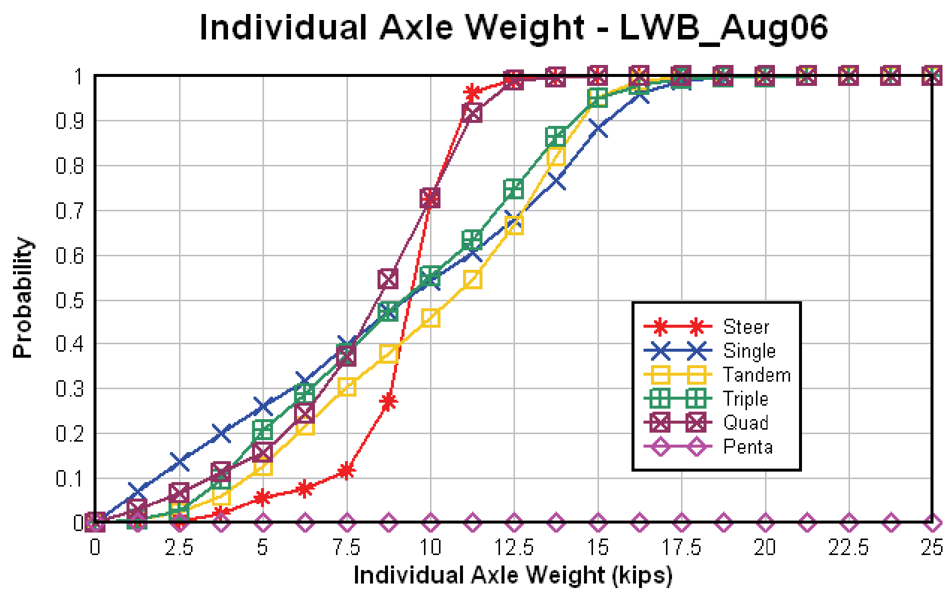

Individual Axle Weight - EHWB_Aug06
Probability
Individual Axle Weight (kips)
Steer
Single
Tandem
Triple
Quad
Penta
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25


Individual Axle Weight - EHWB_Oct05
Probability
Individual Axle Weight (kips)
Steer
Single
Tandem
Triple
Quad
Penta
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25

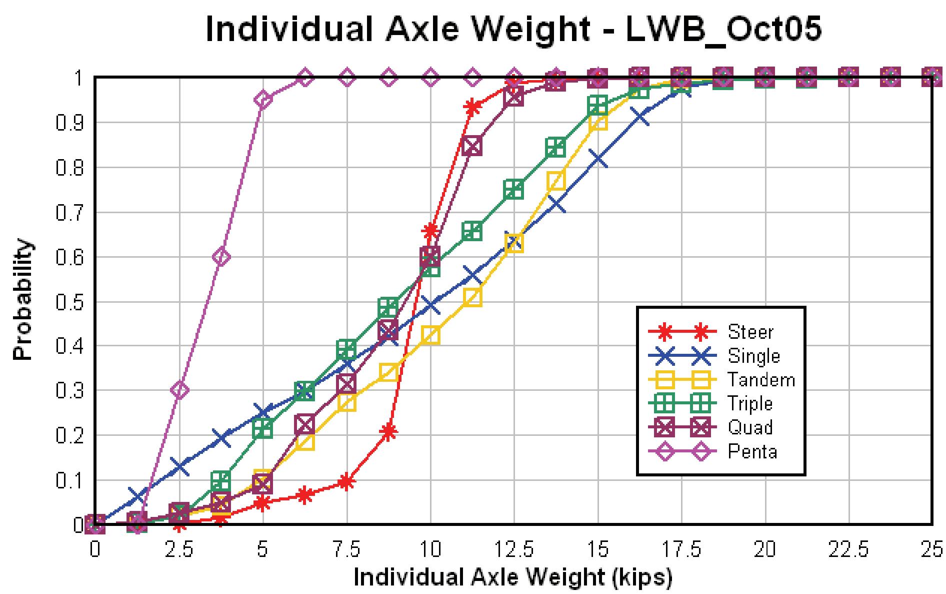
LWB


Individual Axle Weight - LWB_Jan06
Probability
Individual Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Steer
Single
Tandem
Triple
Quad
Penta


Individual Axle Weight - LWB_Apr06
Probability
Individual Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Steer
Single
Tandem
Triple
Quad
Penta

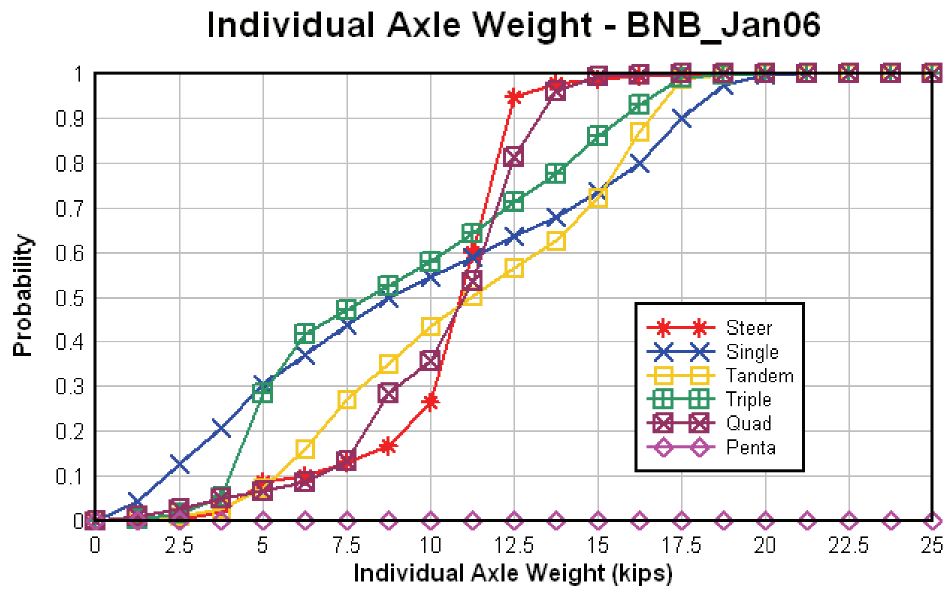


Individual Axle Weight - LWB_Aug06
Probability
Individual Axle Weight (kips)
Steer
Single
Tandem
Triple
Quad
Penta

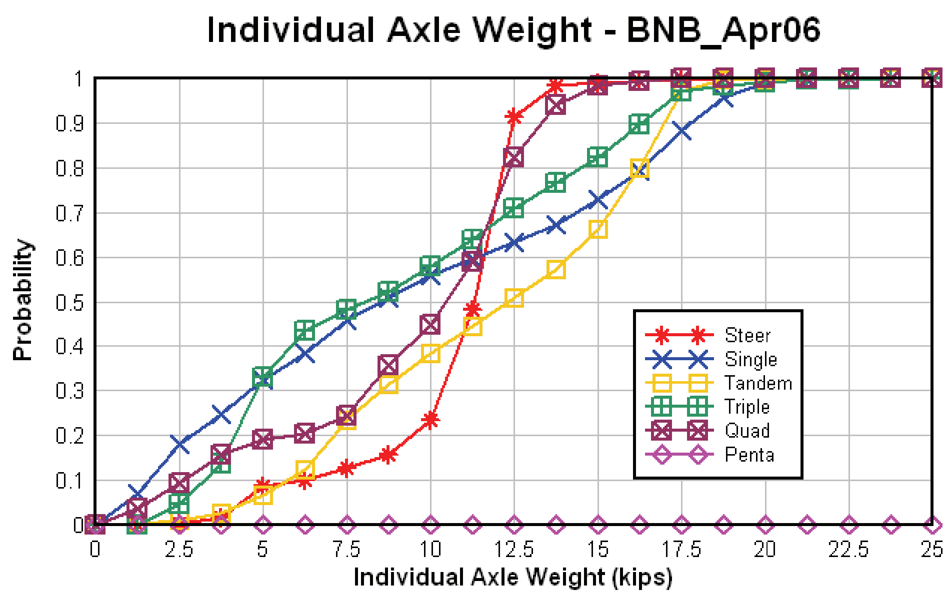


Individual Axle Weight - LWB_Oct05
Probability
Individual Axle Weight (kips)
Steer
Single
Tandem
Triple
Quad
Penta

BNB

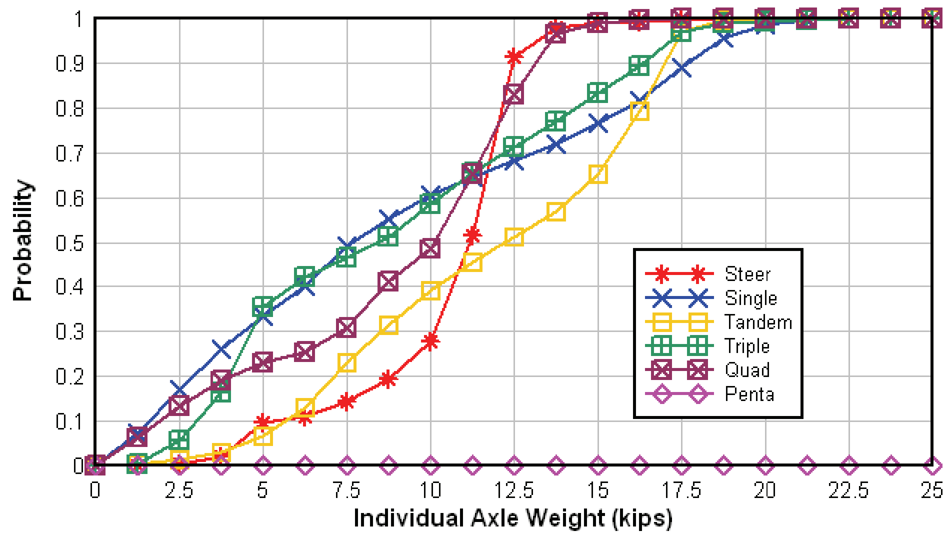


Individual Axle Weight - BNB_Jan06
Probability
Individual Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Steer
Single
Tandem
Triple
Quad
Penta

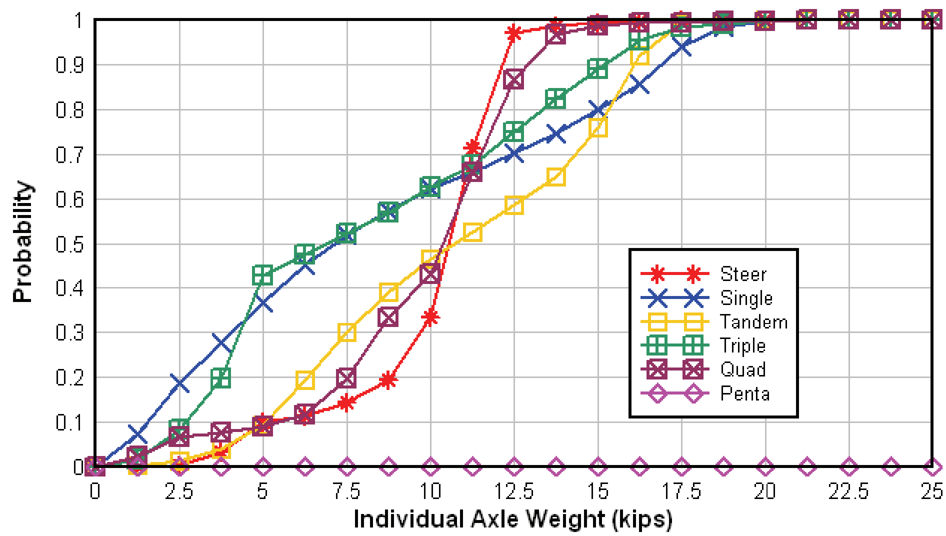


Individual Axle Weight - BNB_Apr06
Probability
Individual Axle Weight (kips)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Steer
Single
Tandem
Triple
Quad
Penta

Individual Axle Weight - BNB_Aug06



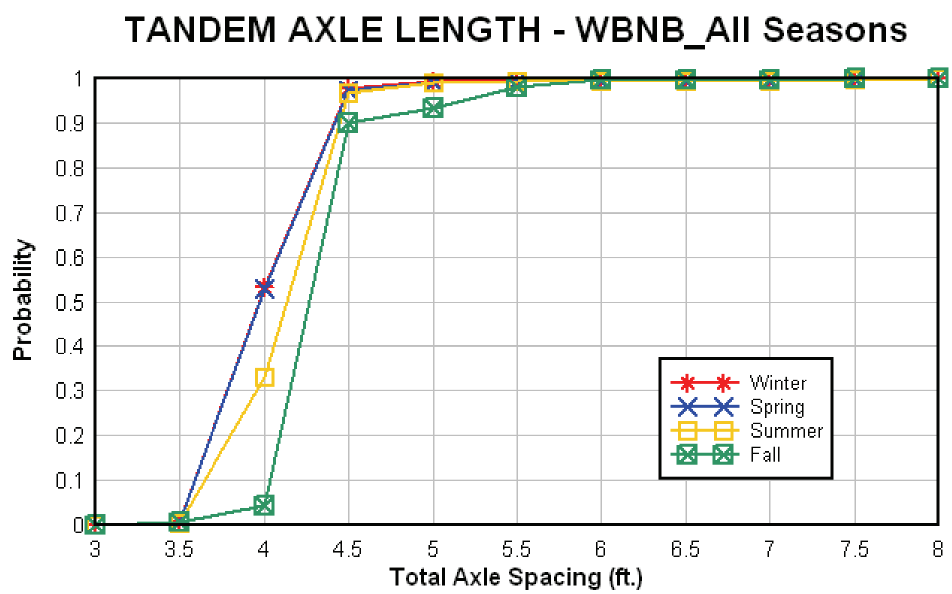
Individual Axle Weight - BNB_Oct05

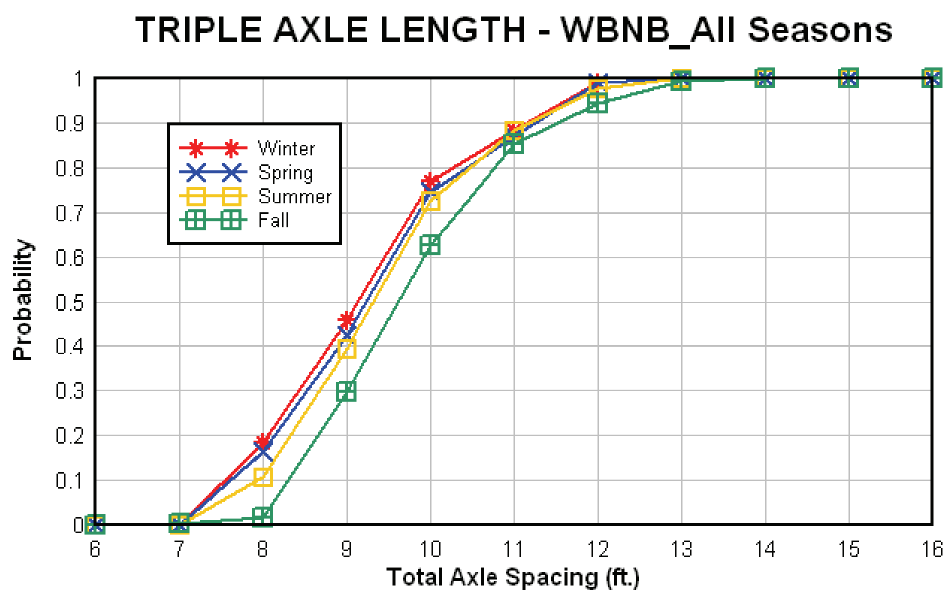


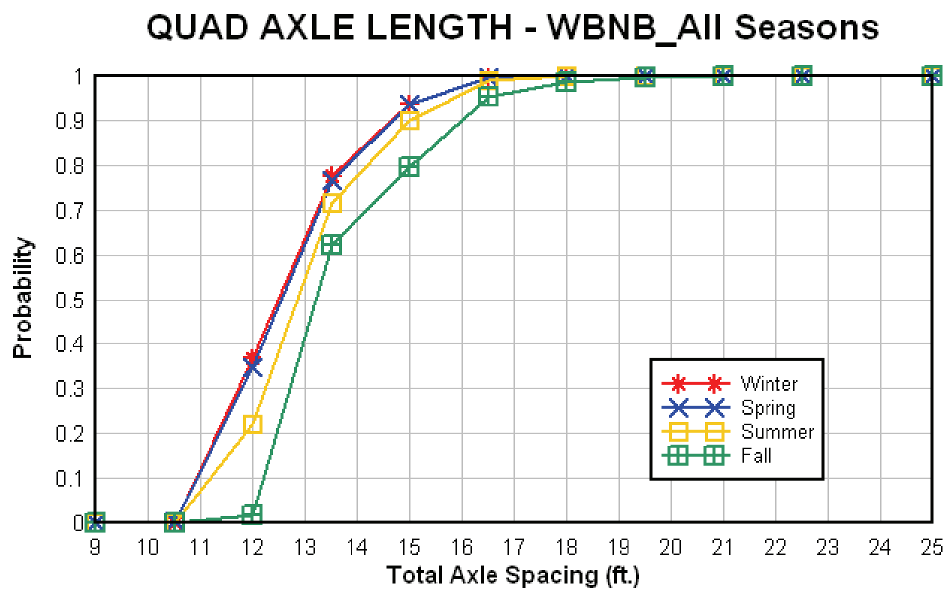
APPENDIX G

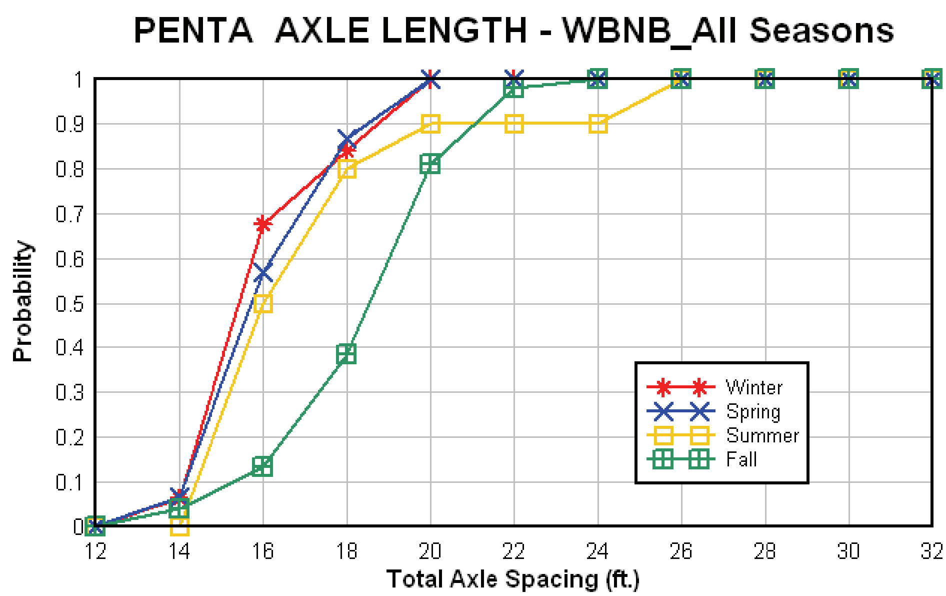
TOTAL AXLE LENGTH BY SEASON CDFs

WBNB

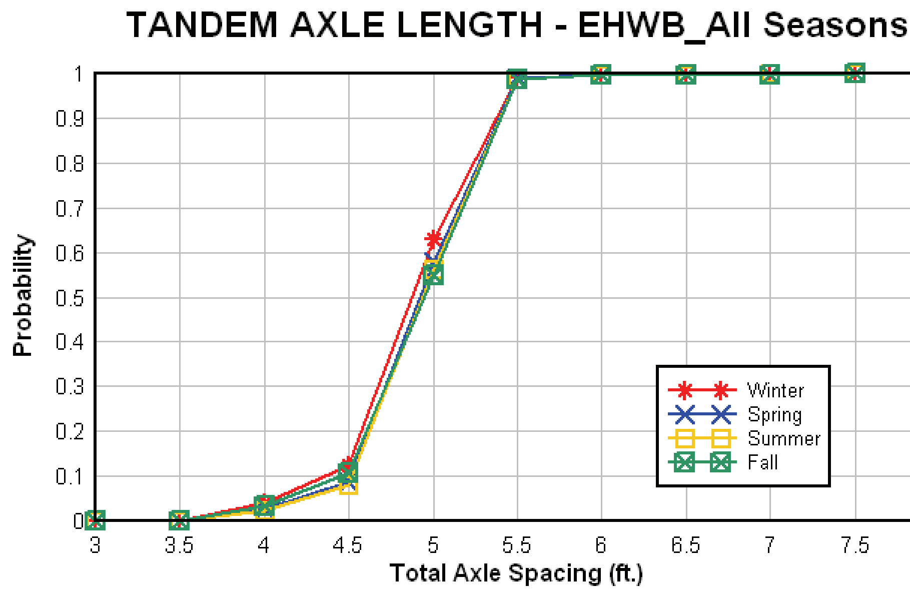

TANDEM AXLE LENGTH - WBNB_All Seasons
Probability
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8

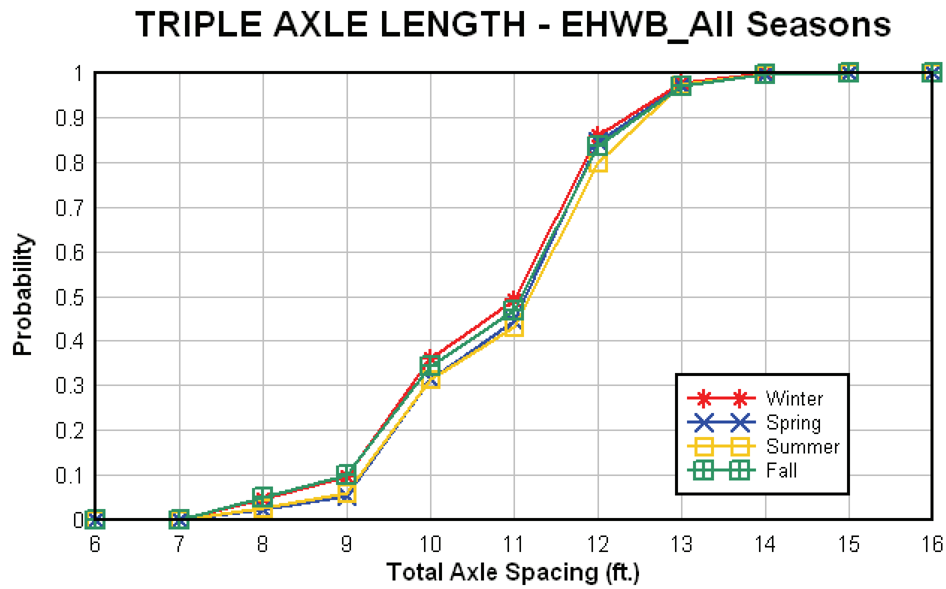

TRIPLE AXLE LENGTH - WBNB_All Seasons
Probability
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6
7
8
9
10
11
12
13
14
15
16

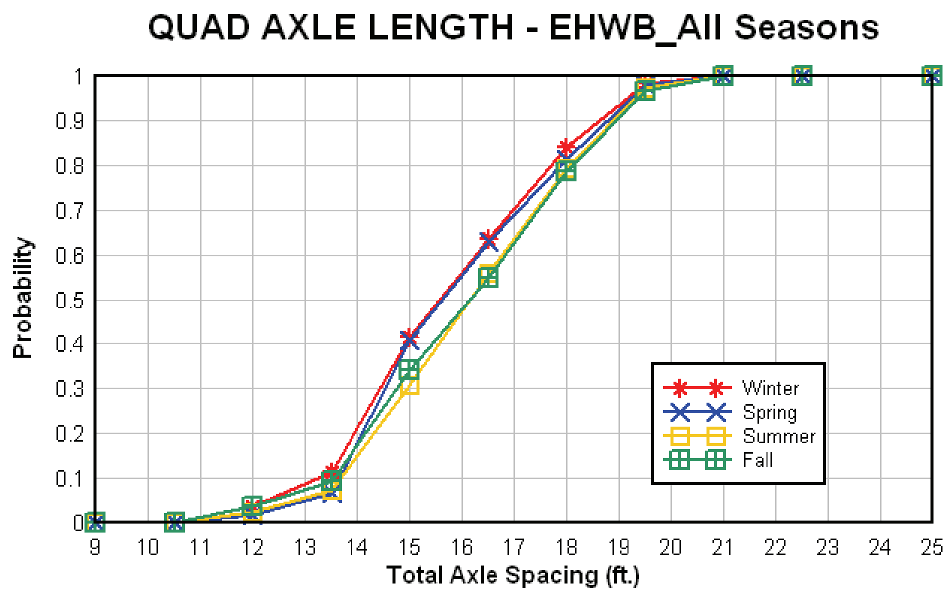

QUAD AXLE LENGTH - WBNB_All Seasons
Probability
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall

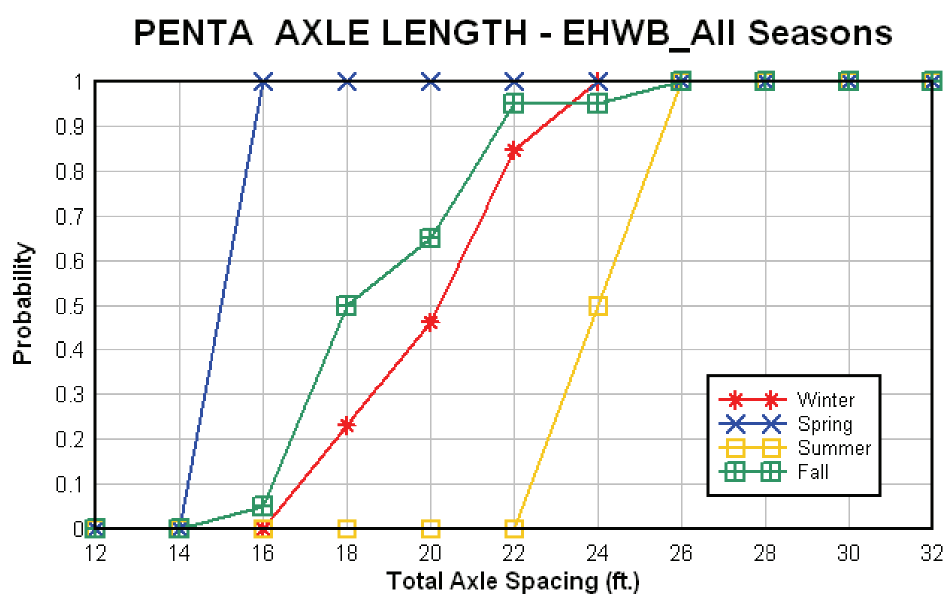

PENTA AXLE LENGTH - WBNB_All Seasons
Probability
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall

EHWB

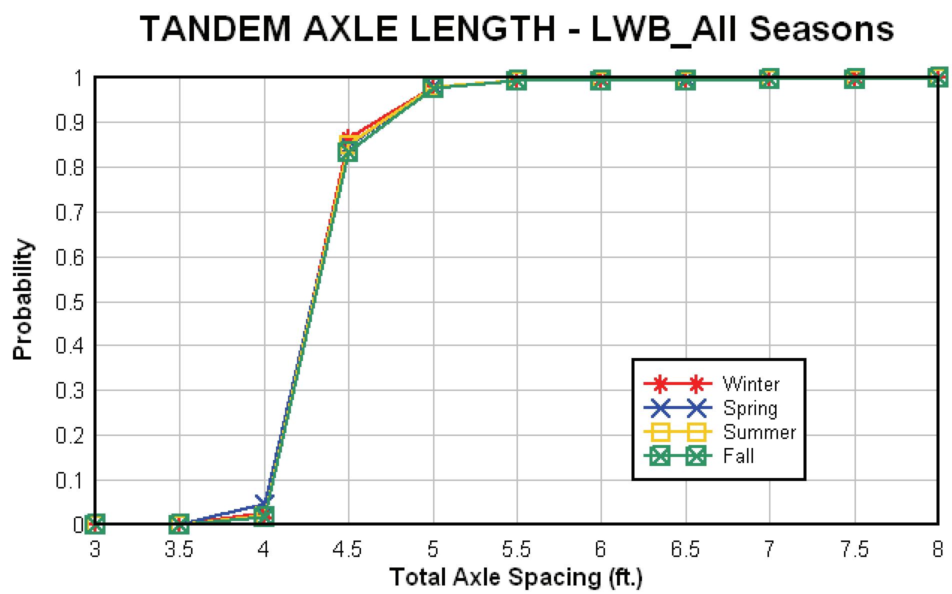

TANDEM AXLE LENGTH - EHWB_All Seasons
Probability
Total Axle Spacing (ft.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Winter
Spring
Summer
Fall


TRIPLE AXLE LENGTH - EHWB_All Seasons
Probability
Total Axle Spacing (ft.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6
7
8
9
10
11
12
13
14
15
16
Winter
Spring
Summer
Fall

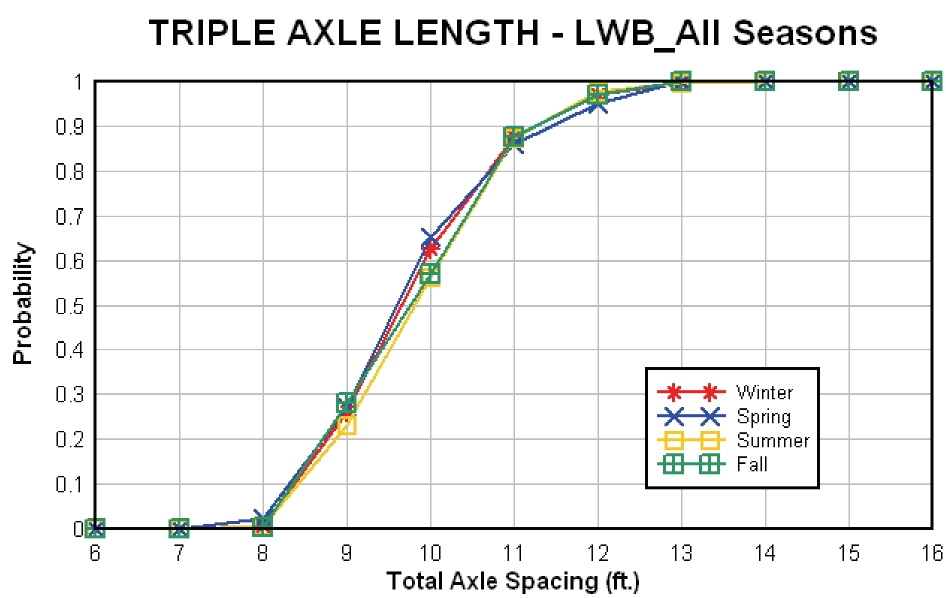

QUAD AXLE LENGTH - EHWB_All Seasons
Probability
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25


PENTA AXLE LENGTH - EHWB_All Seasons
Probability
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12 14 16 18 20 22 24 26 28 30 32

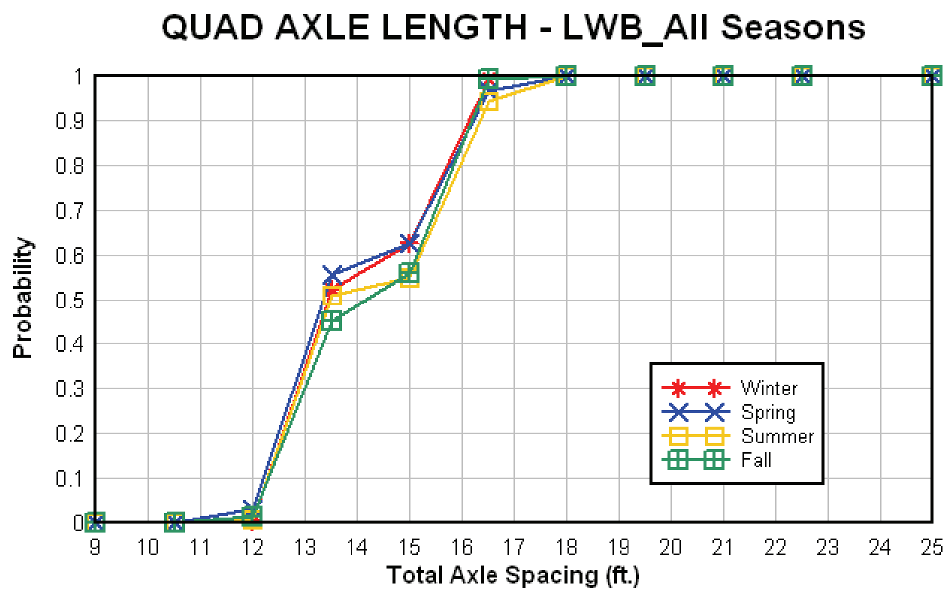
LWB

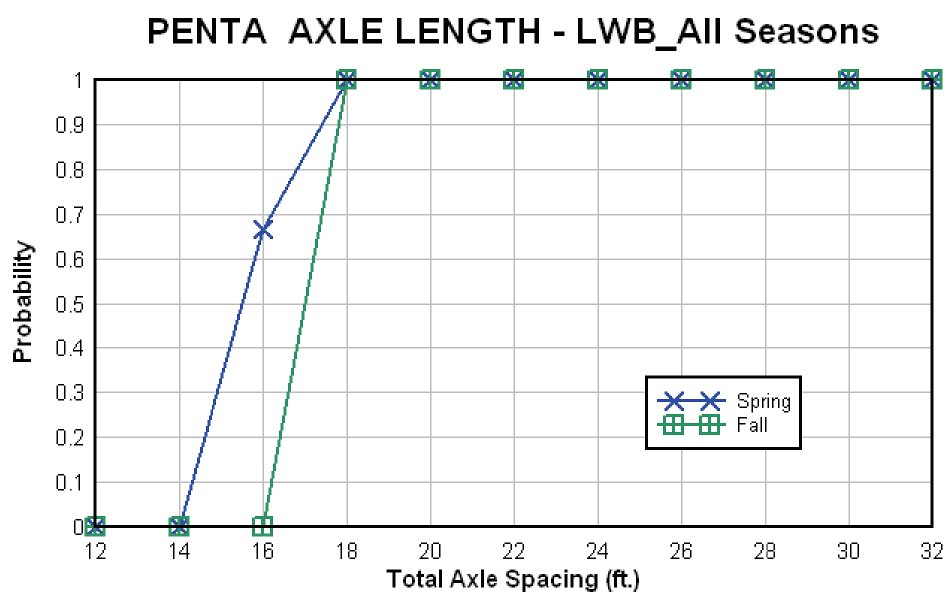


TANDEM AXLE LENGTH - LWB_All Seasons
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall

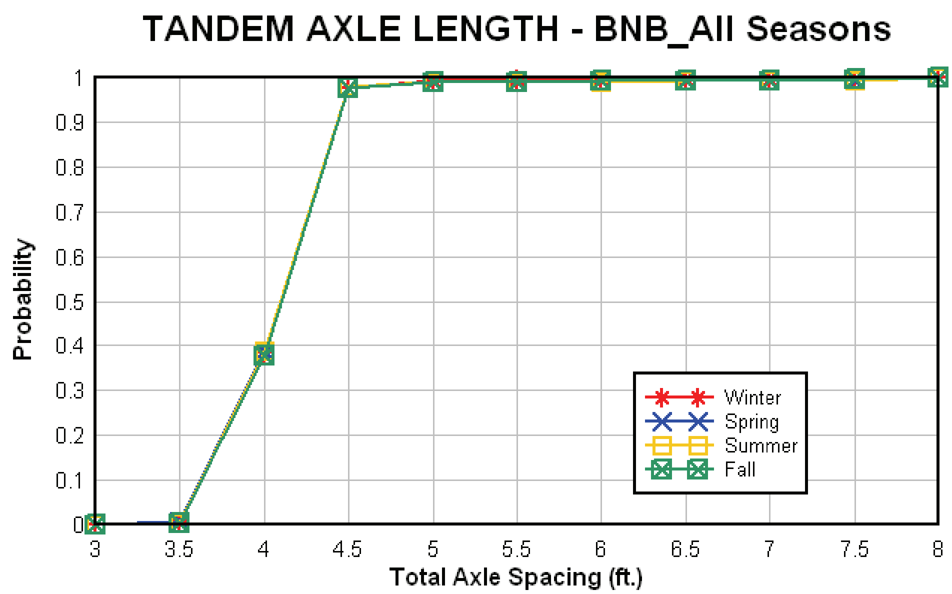


TRIPLE AXLE LENGTH - LWB_All Seasons
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6
7
8
9
10
11
12
13
14
15
16
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall

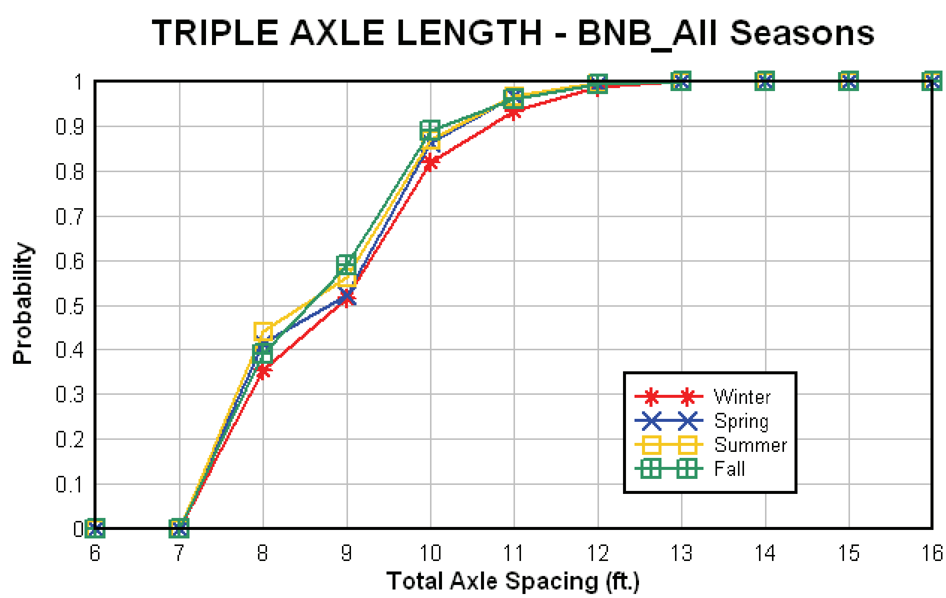

QUAD AXLE LENGTH - LWB_All Seasons
Probability
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25


PENTA AXLE LENGTH - LWB_All Seasons
Probability
Total Axle Spacing (ft.)
Spring
Fall
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12
14
16
18
20
22
24
26
28
30
32

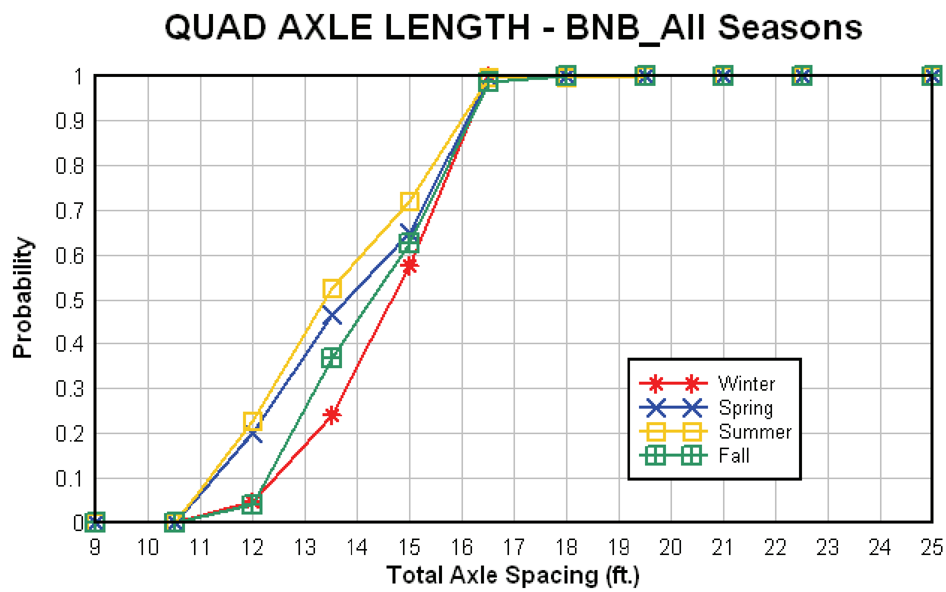
BNB



TANDEM AXLE LENGTH - BNB_All Seasons
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall



TRIPLE AXLE LENGTH - BNB_All Seasons
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6
7
8
9
10
11
12
13
14
15
16
Total Axle Spacing (ft.)
Winter
Spring
Summer
Fall

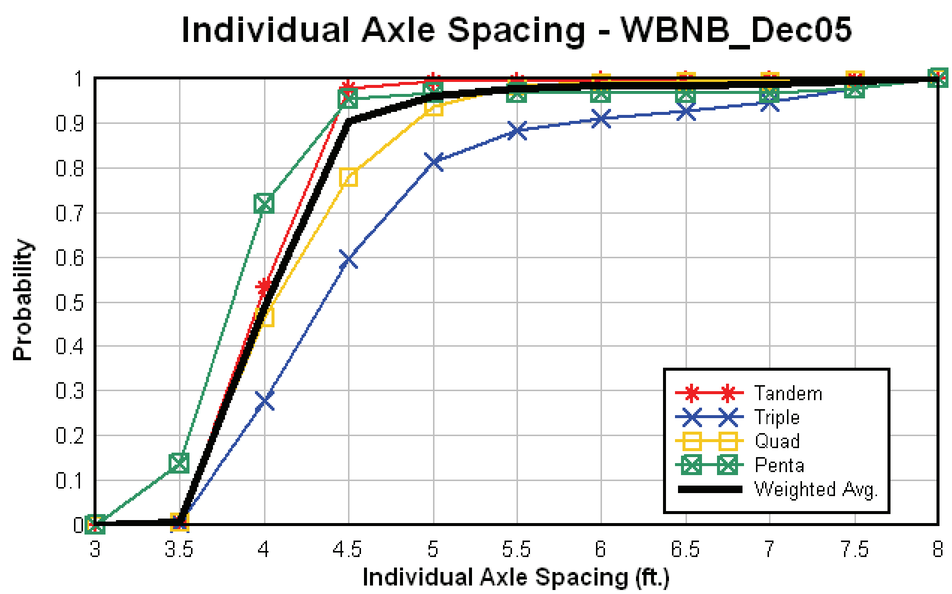


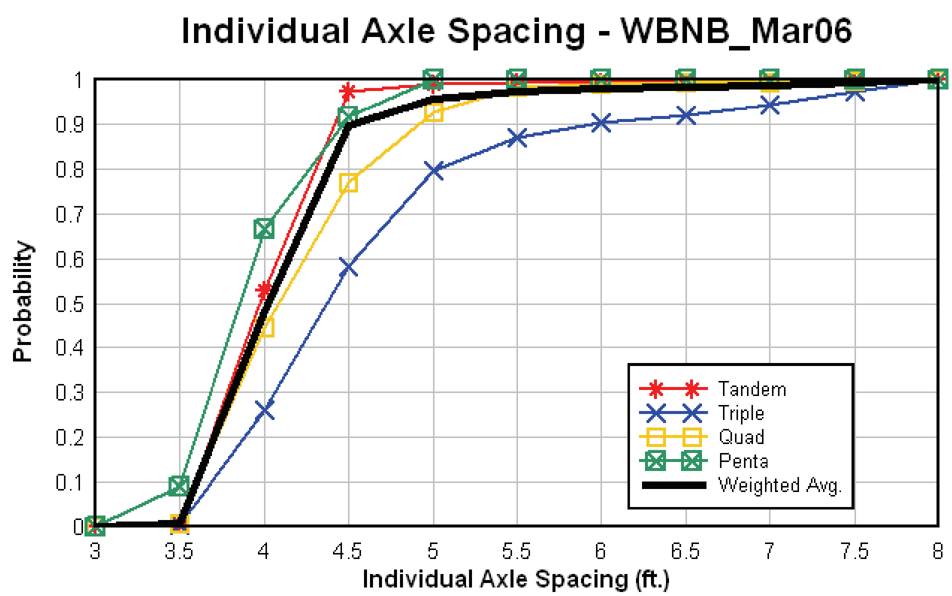
NO PENTA AXLES FOR THIS SITE

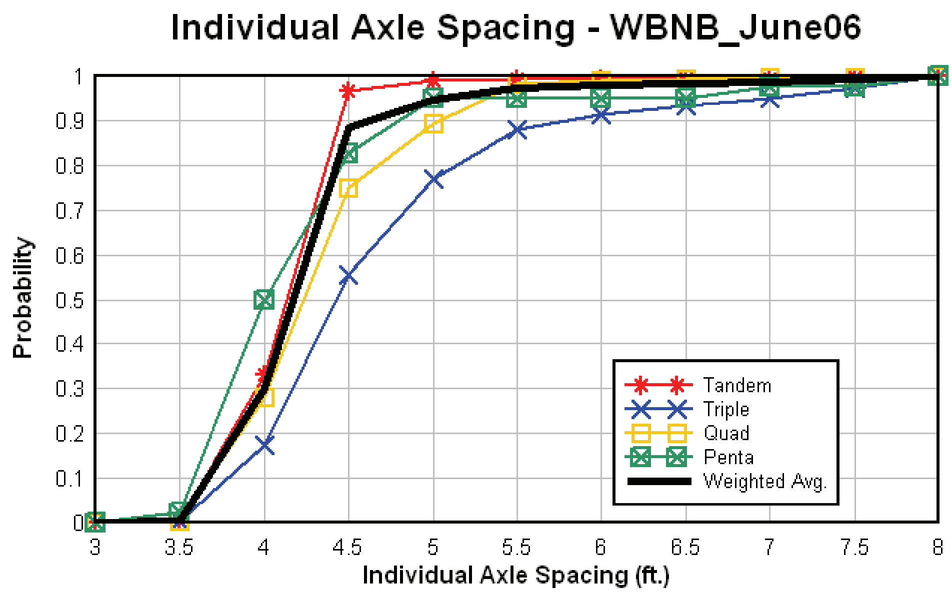
APPENDIX H

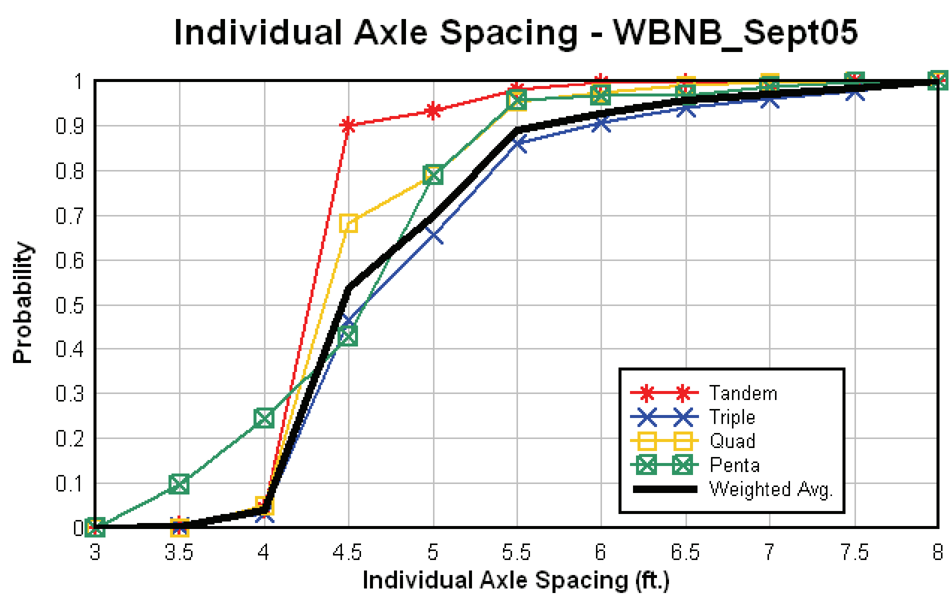
INDIVIDUAL AXLE SPACING BY AXLE CATEGORY CDFs

WBNB

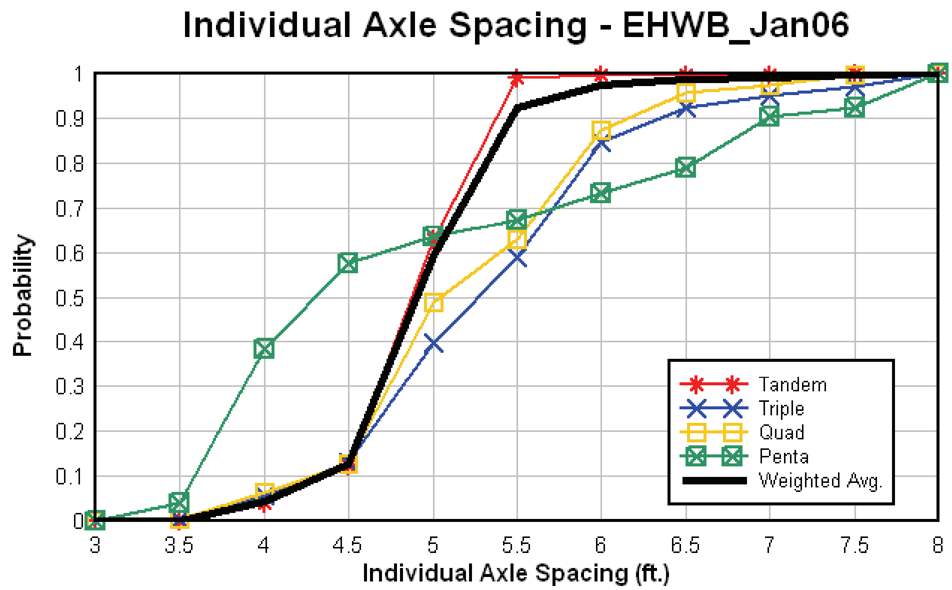

Individual Axle Spacing - WBNB_Dec05
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8

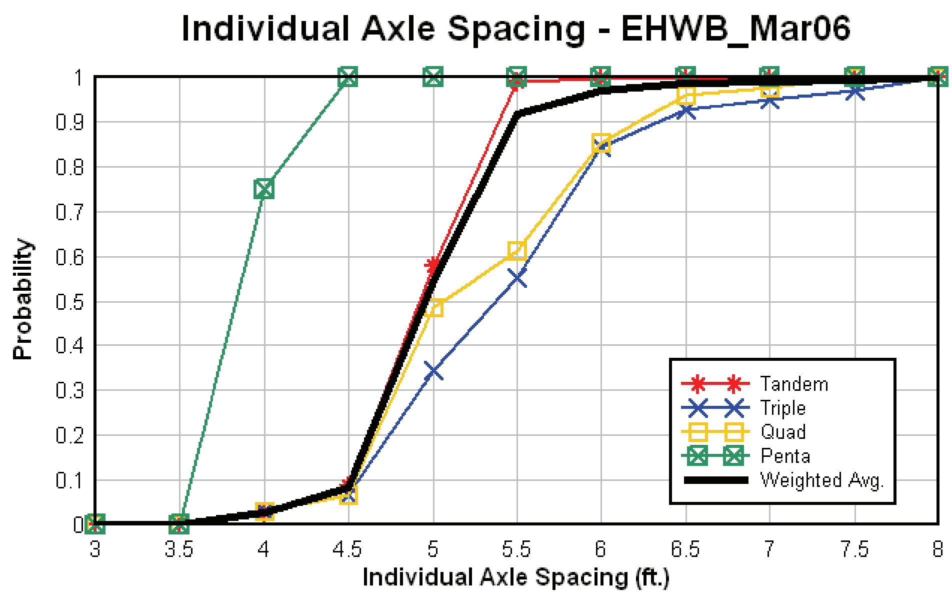

Individual Axle Spacing - WBNB_Mar06
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8

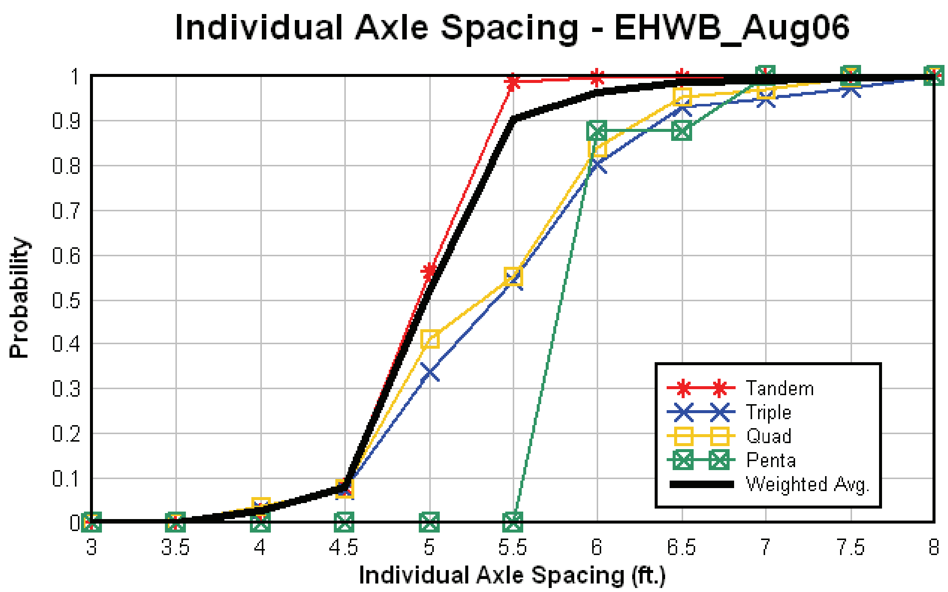

Individual Axle Spacing - WBNB_June06
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.

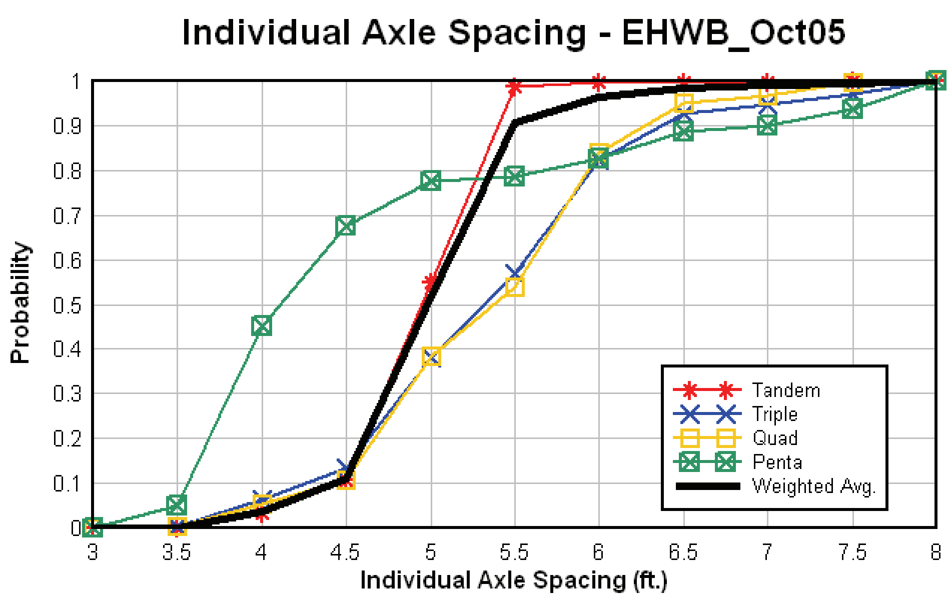

Individual Axle Spacing - WBNB_Sept05
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.

EHWB

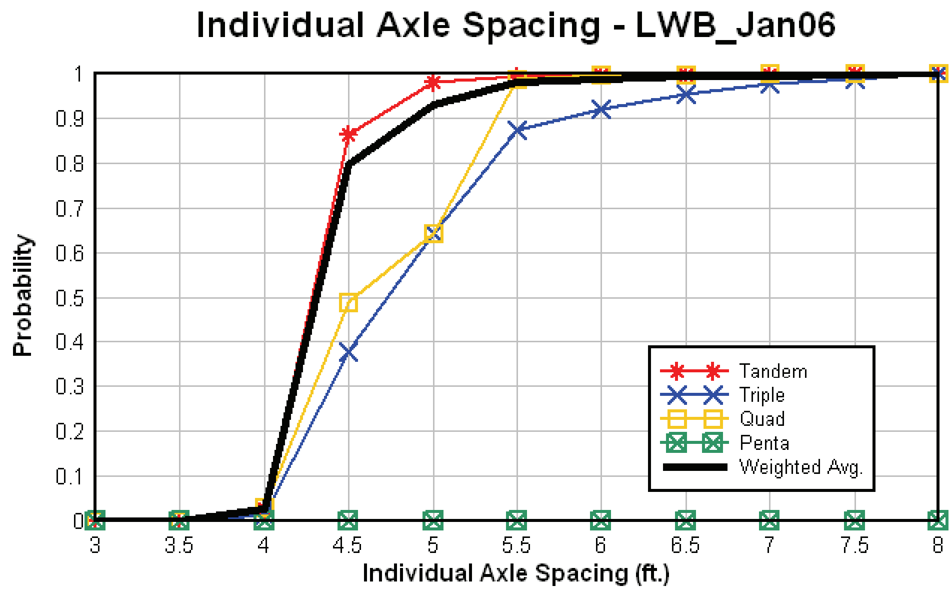

Individual Axle Spacing - EHWB_Jan06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.


Individual Axle Spacing - EHWB_Mar06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.

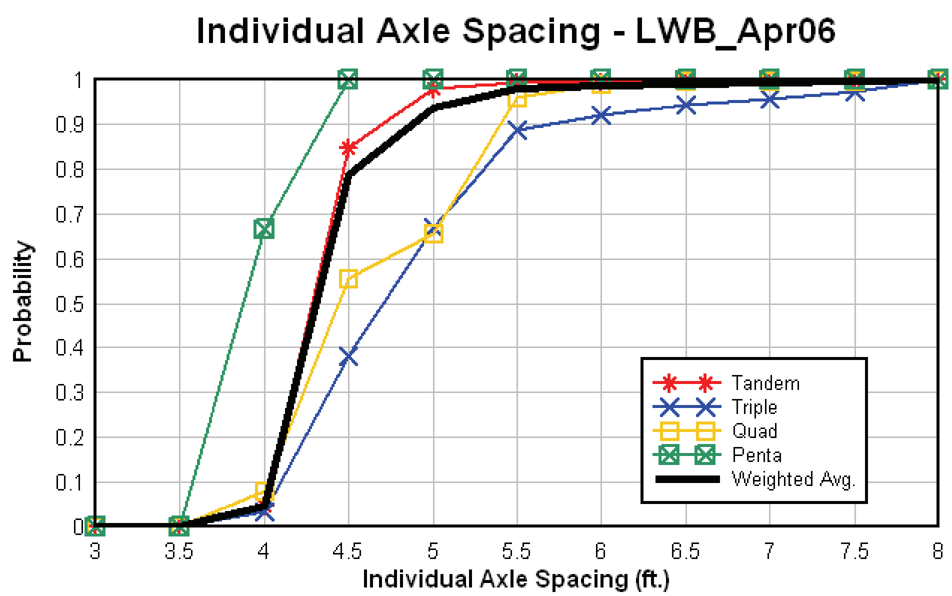

Individual Axle Spacing - EHWB_Aug06
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.


Individual Axle Spacing - EHWB_Oct05
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.

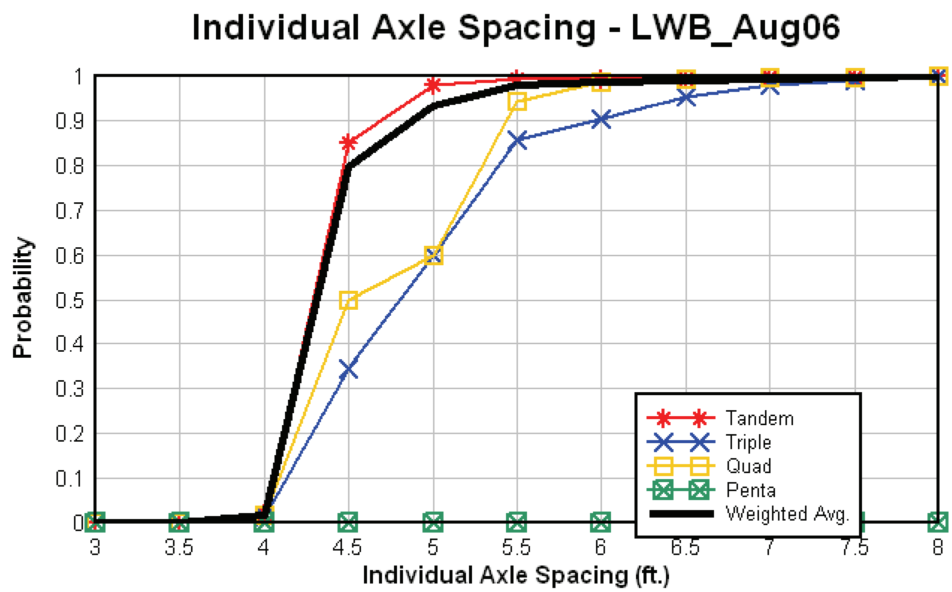
LWB

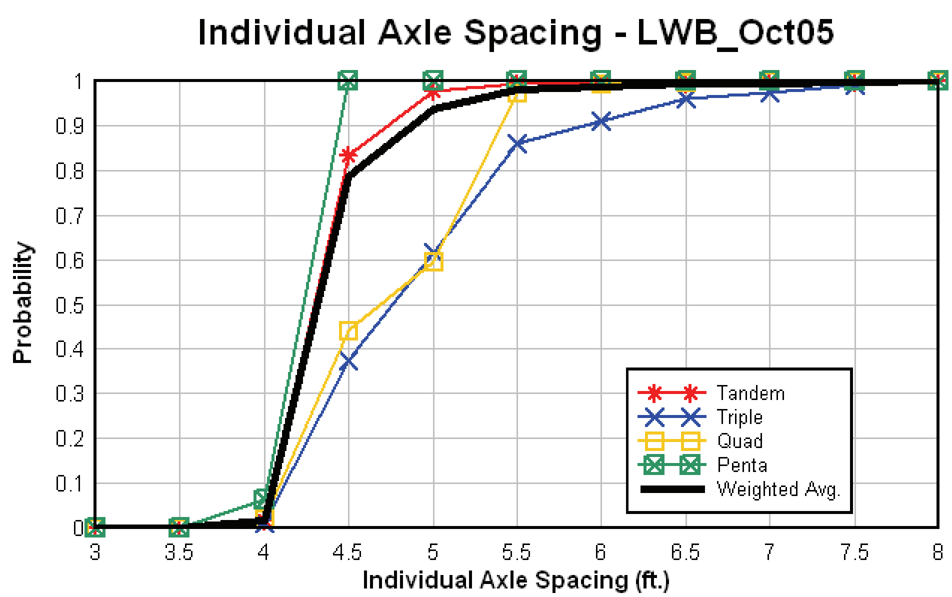


Individual Axle Spacing - LWB_Jan06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.

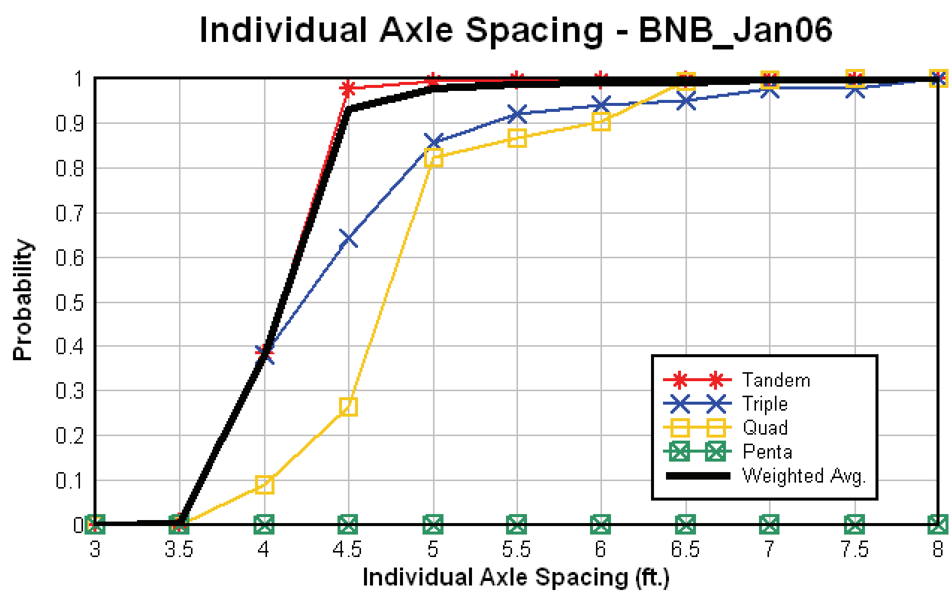


Individual Axle Spacing - LWB_Apr06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.

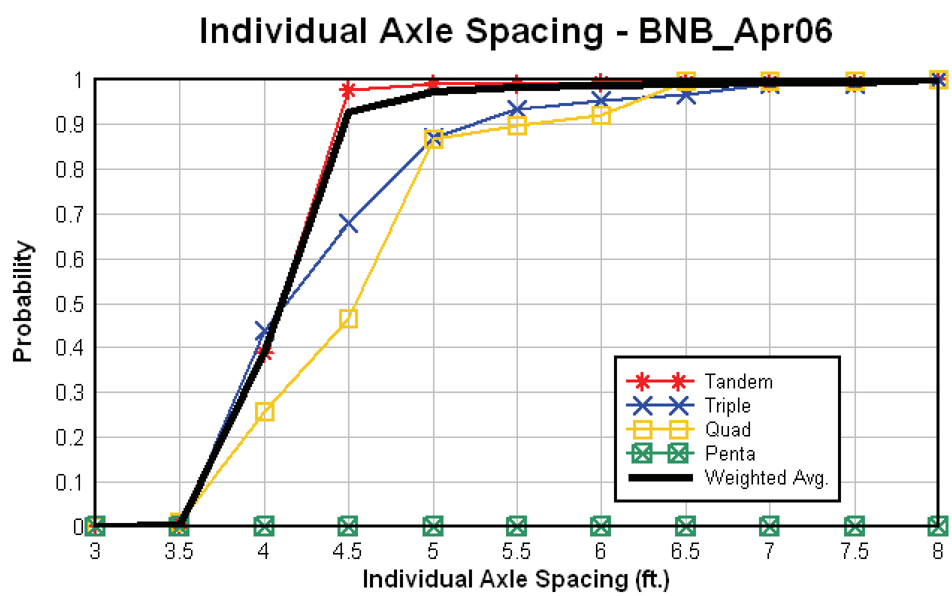

Individual Axle Spacing - LWB_Aug06
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8


Individual Axle Spacing - LWB_Oct05
Probability
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8

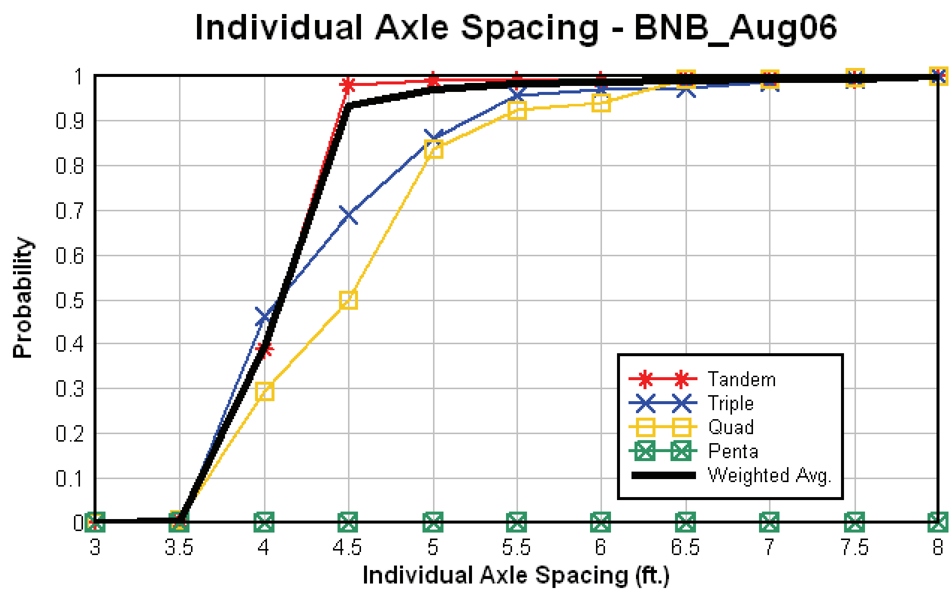
BNB



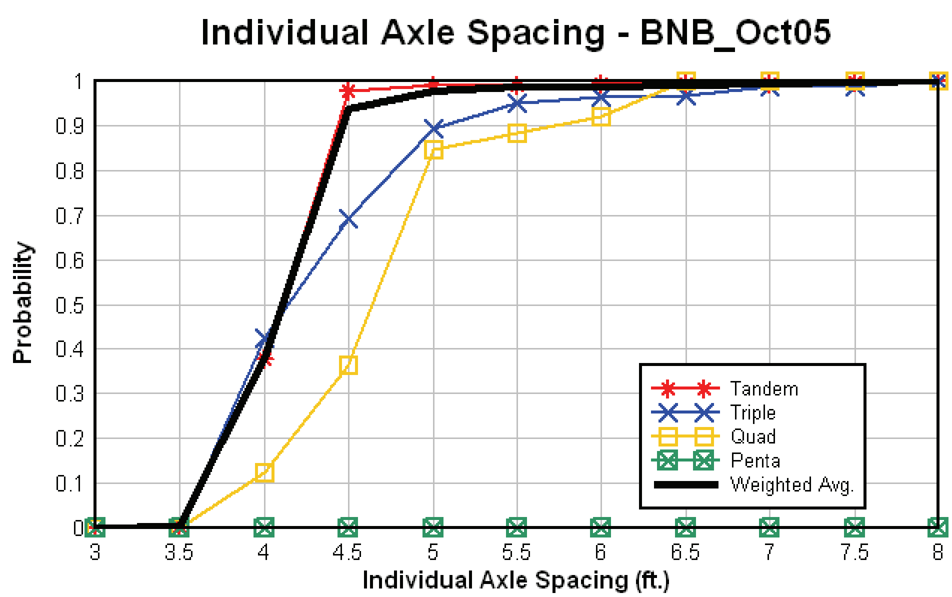
Individual Axle Spacing - BNB_Jan06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.



Individual Axle Spacing - BNB_Apr06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.



Individual Axle Spacing - BNB_Aug06
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.



Individual Axle Spacing - BNB_Oct05
Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Individual Axle Spacing (ft.)
Tandem
Triple
Quad
Penta
Weighted Avg.

APPENDIX I

SUMMARY WEIGHT DATA BY CATEGORY TABLES

	TOTAL AVERAGE WEIGHT DATA (kips)								
	WBNB AVG.		EHWB AVG.		LWB AVG.		BNB AVG.		
	Weight (kips)	COV	Weight (kips)	COV	Weight (kips)	COV	Weight (kips)	COV	max
TOTAL									
STEERS	9.96	0.8%	9.40	2.6%	9.32	1.5%	10.28	2.6%	2.6%
SINGLES	10.06	0.8%	10.16	2.6%	9.49	3.9%	9.13	5.6%	5.6%
TANDEMS	20.42	1.9%	19.79	3.3%	20.08	3.1%	22.70	4.4%	4.4%
TRIPLES	28.84	1.8%	25.95	4.8%	27.11	1.8%	26.44	4.9%	4.9%
QUADS	39.19	0.9%	34.30	5.2%	38.18	3.4%	42.73	5.8%	5.8%
PENTS	30.14	22.9%	28.38	51.7%	18.72	13.2%	-	-	51.7%
1ST AXLE									
STEERS	9.96	0.8%	9.40	2.6%	9.32	1.5%	10.28	2.6%	2.6%
SINGLES	10.06	0.8%	10.16	2.6%	9.49	3.9%	9.13	5.6%	5.6%
TANDEMS	10.38	1.8%	10.30	3.3%	10.13	3.3%	11.26	4.8%	4.8%
TRIPLES	7.64	1.2%	7.91	4.9%	7.46	1.3%	7.16	3.9%	4.9%
QUADS	9.47	0.9%	9.29	5.0%	10.13	4.3%	10.46	6.5%	6.5%
PENTS	5.60	25.3%	5.67	41.6%	4.56	29.1%	-	-	41.6%
2ND AXLE									
TANDEMS	10.04	2.0%	9.49	3.3%	9.95	2.9%	11.44	4.0%	4.0%
TRIPLES	10.58	2.2%	9.20	4.0%	9.99	2.2%	9.60	4.2%	4.2%
QUADS	10.57	0.7%	9.20	7.0%	10.62	5.9%	11.50	7.5%	7.5%
PENTS	5.86	26.6%	6.09	59.1%	4.25	12.6%	-	-	59.1%
3RD AXLE									
TRIPLES	10.62	2.0%	8.84	5.8%	9.66	2.6%	9.68	6.7%	6.7%
QUADS	10.65	1.2%	8.94	5.0%	10.08	3.6%	11.98	6.9%	6.9%
PENTS	6.29	23.5%	6.40	45.5%	3.85	0.8%	-	-	45.5%
4TH AXLE									
QUADS	8.47	0.7%	6.88	4.5%	7.35	1.7%	8.81	1.6%	4.5%
PENTS	6.62	24.6%	5.80	56.6%	3.35	11.8%	-	-	56.6%
5TH AXLE									
PENTS	5.90	18.2%	4.42	71.5%	2.70	9.0%	-	-	71.5%

MAX COV SUMMARY

STEERS	2.6%	1ST
SINGLES	5.6%	3RD
TANDEMS	4.8%	2ND
TRIPLES	6.7%	4TH
QUADS	7.5%	5TH
PENTS	71.5%	6TH

	WBNB AVERAGE WEIGHT DATA (kips)						
	Fall	Winter	Spring	Summer	Average	StdDev	COV
TOTAL							
STEERS	9.92	10.00	10.04	9.87	9.96	0.08	0.8%
SINGLES	9.99	10.17	10.07	10.02	10.06	0.08	0.8%
TANDEMS	20.08	20.14	20.90	20.56	20.42	0.38	1.9%
TRIPLES	28.33	28.46	29.43	29.16	28.84	0.53	1.8%
QUADS	38.76	39.02	39.61	39.36	39.19	0.37	0.9%
PENTS	21.90	28.36	31.87	38.41	30.14	6.89	22.9%
1ST AXLE							
STEERS	9.92	10.00	10.04	9.87	9.96	0.08	0.8%
SINGLES	9.99	10.17	10.07	10.02	10.06	0.08	0.8%
TANDEMS	10.22	10.25	10.62	10.46	10.38	0.19	1.8%
TRIPLES	7.56	7.59	7.76	7.66	7.64	0.09	1.2%
QUADS	9.40	9.39	9.55	9.55	9.47	0.09	0.9%
PENTS	4.19	5.32	5.34	7.57	5.60	1.42	25.3%
2ND AXLE							
TANDEMS	9.86	9.89	10.28	10.11	10.04	0.20	2.0%
TRIPLES	10.38	10.38	10.80	10.78	10.58	0.23	2.2%
QUADS	10.49	10.52	10.66	10.61	10.57	0.08	0.7%
PENTS	4.09	5.45	6.06	7.85	5.86	1.56	26.6%
3RD AXLE							
TRIPLES	10.40	10.49	10.87	10.72	10.62	0.22	2.0%
QUADS	10.49	10.63	10.80	10.69	10.65	0.13	1.2%
PENTS	4.50	5.78	6.95	7.92	6.29	1.48	23.5%
4TH AXLE							
QUADS	8.39	8.48	8.51	8.51	8.47	0.06	0.7%
PENTS	4.59	6.03	7.94	7.94	6.62	1.63	24.6%
5TH AXLE							
PENTS	4.54	5.79	6.13	7.13	5.90	1.07	18.2%

max	26.6%
max w/o pents	2.2%

MAX COV SUMMARY

STEERS	0.8%	1ST
SINGLES	0.8%	2ND
TANDEMS	2.0%	4TH
TRIPLES	2.2%	5TH
QUADS	1.2%	3RD
PENTS	26.6%	6TH

	EHWB AVERAGE WEIGHT DATA (kips)						
	Fall	Winter	Spring	Summer	Average	StdDev	COV
TOTAL							
STEERS	9.25	9.17	9.48	9.70	9.40	0.24	2.6%
SINGLES	9.92	10.10	10.10	10.54	10.16	0.26	2.6%
TANDEMS	19.28	19.23	20.09	20.58	19.79	0.65	3.3%
TRIPLES	24.43	25.53	27.24	26.59	25.95	1.23	4.8%
QUADS	33.23	32.40	35.50	36.09	34.30	1.77	5.2%
PENTS	27.80	23.92	13.40	48.40	28.38	14.67	51.7%
1ST AXLE							
STEERS	9.25	9.17	9.48	9.70	9.40	0.24	2.6%
SINGLES	9.92	10.10	10.10	10.54	10.16	0.26	2.6%
TANDEMS	10.04	10.00	10.47	10.70	10.30	0.34	3.3%
TRIPLES	7.47	7.71	8.24	8.23	7.91	0.39	4.9%
QUADS	9.25	8.66	9.51	9.75	9.29	0.47	5.0%
PENTS	5.26	3.83	4.50	9.10	5.67	2.36	41.6%
2ND AXLE							
TANDEMS	9.24	9.24	9.62	9.87	9.49	0.31	3.3%
TRIPLES	8.71	9.21	9.59	9.28	9.20	0.36	4.0%
QUADS	8.58	8.72	9.71	9.79	9.20	0.64	7.0%
PENTS	4.81	6.20	2.40	10.95	6.09	3.60	59.1%
3RD AXLE							
TRIPLES	8.25	8.61	9.41	9.08	8.84	0.51	5.8%
QUADS	8.57	8.53	9.32	9.33	8.94	0.45	5.0%
PENTS	5.58	6.62	3.20	10.20	6.40	2.91	45.5%
4TH AXLE							
QUADS	6.84	6.48	6.97	7.22	6.88	0.31	4.5%
PENTS	7.13	4.49	2.00	9.60	5.80	3.28	56.6%
5TH AXLE							
PENTS	5.04	2.78	1.30	8.55	4.42	3.16	71.5%

max	71.5%
max w/o pents	7.0%

MAX COV SUMMARY

STEERS	2.6%	1ST
SINGLES	2.6%	2ND
TANDEMS	3.3%	3RD
TRIPLES	5.8%	4TH
QUADS	7.0%	5TH
PENTS	71.5%	6TH

	LWB AVERAGE WEIGHT DATA (kips)						
	Fall	Winter	Spring	Summer	Average	StdDev	COV
TOTAL							
STEERS	9.39	9.43	9.35	9.12	9.32	0.14	1.5%
SINGLES	9.63	9.92	9.31	9.08	9.49	0.37	3.9%
TANDEMS	20.86	19.34	20.16	19.95	20.08	0.63	3.1%
TRIPLES	27.40	26.48	27.01	27.55	27.11	0.47	1.8%
QUADS	39.49	38.63	38.19	36.42	38.18	1.29	3.4%
PENTS	16.98	0.00	20.47	0.00	18.72	2.47	13.2%
1ST AXLE							
STEERS	9.39	9.43	9.35	9.12	9.32	0.14	1.5%
SINGLES	9.63	9.92	9.31	9.08	9.49	0.37	3.9%
TANDEMS	10.56	9.74	10.17	10.06	10.13	0.34	3.3%
TRIPLES	7.59	7.45	7.37	7.42	7.46	0.09	1.3%
QUADS	10.71	10.21	9.89	9.71	10.13	0.44	4.3%
PENTS	3.63	0.00	5.50	0.00	4.56	1.33	29.1%
2ND AXLE							
TANDEMS	10.30	9.61	9.99	9.89	9.95	0.29	2.9%
TRIPLES	10.04	9.67	10.07	10.19	9.99	0.22	2.2%
QUADS	10.83	11.08	10.88	9.70	10.62	0.62	5.9%
PENTS	3.88	0.00	4.63	0.00	4.25	0.54	12.6%
3RD AXLE							
TRIPLES	9.77	9.36	9.57	9.94	9.66	0.25	2.6%
QUADS	10.49	10.17	10.05	9.61	10.08	0.36	3.6%
PENTS	3.88	0.00	3.83	0.00	3.85	0.03	0.8%
4TH AXLE							
QUADS	7.46	7.17	7.37	7.40	7.35	0.12	1.7%
PENTS	3.08	0.00	3.63	0.00	3.35	0.39	11.8%
5TH AXLE							
PENTS	2.53	0.00	2.87	0.00	2.70	0.24	9.0%

***note: zero data not included in averages**

max	29.1%
max w/o pents	5.9%

MAX COV SUMMARY

STEERS	1.5%	1ST
SINGLES	3.9%	4TH
TANDEMS	3.3%	3RD
TRIPLES	2.6%	2ND
QUADS	5.9%	5TH
PENTS	29.1%	6TH

	BNB AVERAGE WEIGHT DATA (kips)						
	Fall	Winter	Spring	Summer	Average	StdDev	COV
TOTAL							
STEERS	9.91	10.30	10.55	10.35	10.28	0.27	2.6%
SINGLES	8.48	9.61	9.46	8.98	9.13	0.51	5.6%
TANDEMS	21.46	22.32	23.51	23.49	22.70	1.00	4.4%
TRIPLES	24.51	27.28	27.08	26.87	26.44	1.29	4.9%
QUADS	43.13	45.86	41.96	39.95	42.73	2.47	5.8%
PENTS	0.00	0.00	0.00	0.00	-	-	-
1ST AXLE							
STEERS	9.91	10.30	10.55	10.35	10.28	0.27	2.6%
SINGLES	8.48	9.61	9.46	8.98	9.13	0.51	5.6%
TANDEMS	10.61	11.03	11.69	11.70	11.26	0.54	4.8%
TRIPLES	6.80	7.47	7.14	7.23	7.16	0.28	3.9%
QUADS	10.57	11.37	10.08	9.82	10.46	0.68	6.5%
PENTS	0.00	0.00	0.00	0.00	-	-	-
2ND AXLE							
TANDEMS	10.86	11.29	11.82	11.79	11.44	0.46	4.0%
TRIPLES	9.00	9.81	9.87	9.71	9.60	0.40	4.2%
QUADS	11.77	12.47	11.35	10.40	11.50	0.86	7.5%
PENTS	0.00	0.00	0.00	0.00	-	-	-
3RD AXLE							
TRIPLES	8.71	10.00	10.08	9.93	9.68	0.65	6.7%
QUADS	12.05	13.00	11.90	10.99	11.98	0.82	6.9%
PENTS	0.00	0.00	0.00	0.00	-	-	-
4TH AXLE							
QUADS	8.74	9.03	8.74	8.74	8.81	0.15	1.6%
PENTS	0.00	0.00	0.00	0.00	-	-	-
5TH AXLE							
PENTS	0.00	0.00	0.00	0.00	-	-	-

***note: zero data not included in averages**

max	7.5%
max w/o pents	7.5%

MAX COV SUMMARY

STEERS	2.6%	1ST
SINGLES	5.6%	3RD
TANDEMS	4.8%	2ND
TRIPLES	6.7%	4TH
QUADS	7.5%	5TH
PENTS	0.0%	6TH

APPENDIX J

AXLE WEIGHT DISTRIBUTIONS BY AXLE CATEGORY

Highlighted are the three most concentrated bin weights for each site and axle category.

Singles

	WBNB				EHWB				LWB				BNB			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
0																
1000																
2000																
3000	4.21%	6.14%	6.12%	6.4%	4.35%	5.02%	4.67%	6.2%	6.72%	10.61%	10.84%	10.0%	11.34%	12.69%	14.26%	15.5%
4000	3.14%	3.57%	3.64%	4.0%	2.38%	2.26%	2.44%	2.9%	3.17%	3.79%	3.33%	2.8%	5.46%	5.25%	5.38%	4.7%
5000	4.46%	4.06%	4.08%	4.3%	2.46%	2.31%	2.13%	2.4%	2.40%	2.54%	2.86%	2.3%	2.51%	2.57%	2.81%	3.4%
6000	6.48%	5.79%	5.98%	6.2%	3.13%	3.07%	2.76%	2.9%	3.59%	3.16%	3.75%	3.0%	3.14%	3.39%	4.27%	3.4%
7000	4.43%	4.33%	4.99%	4.8%	5.21%	3.81%	3.20%	4.0%	5.44%	4.74%	6.00%	4.4%	3.57%	3.32%	4.44%	3.5%
8000	6.59%	5.85%	6.64%	6.3%	19.08%	12.18%	8.38%	14.5%	14.28%	11.14%	13.68%	11.3%	3.93%	3.67%	4.77%	5.1%
9000	12.91%	11.24%	12.32%	11.5%	30.15%	30.65%	27.16%	31.3%	24.28%	23.53%	24.39%	25.4%	6.81%	5.24%	5.71%	8.8%
10000	23.01%	20.88%	22.64%	20.4%	13.69%	19.05%	22.79%	14.9%	16.23%	17.48%	15.66%	17.8%	17.63%	12.45%	11.50%	20.0%
11000	18.75%	20.33%	16.73%	18.4%	5.37%	5.90%	7.68%	5.3%	7.08%	6.62%	4.43%	6.1%	23.62%	23.03%	21.00%	19.6%
12000	4.30%	5.01%	3.87%	5.0%	4.64%	4.71%	4.98%	4.8%	4.01%	3.97%	2.95%	3.5%	7.32%	12.24%	11.02%	4.3%
13000	2.17%	2.36%	2.50%	2.4%	3.77%	4.11%	4.79%	4.1%	3.30%	3.16%	3.51%	3.2%	2.12%	2.77%	2.54%	1.8%
14000	1.93%	2.04%	2.17%	2.1%	2.54%	2.90%	3.79%	2.9%	3.37%	3.20%	3.77%	3.2%	2.03%	2.09%	1.88%	1.8%
15000	2.09%	2.18%	2.30%	2.2%	1.58%	1.86%	2.38%	1.7%	2.91%	2.93%	2.85%	3.1%	2.24%	2.19%	1.86%	2.0%
16000	2.24%	2.47%	2.64%	2.4%	0.96%	1.16%	1.52%	1.0%	1.92%	1.84%	1.30%	2.3%	2.79%	2.77%	2.37%	2.5%
17000	1.85%	1.99%	1.97%	2.1%	0.45%	0.63%	0.83%	0.6%	0.92%	0.84%	0.45%	1.0%	3.14%	3.00%	2.86%	2.2%
18000	0.93%	1.13%	0.90%	1.1%	0.18%	0.29%	0.38%	0.3%	0.24%	0.33%	0.17%	0.4%	1.61%	1.99%	1.93%	1.0%
19000	0.37%	0.44%	0.35%	0.5%	0.04%	0.08%	0.11%	0.1%	0.09%	0.09%	0.04%	0.1%	0.54%	0.86%	0.89%	0.3%
20000	0.09%	0.14%	0.09%	0.1%	0.00%	0.00%	0.00%	0.0%	0.02%	0.03%	0.02%	0.0%	0.14%	0.33%	0.36%	0.1%
21000	0.02%	0.03%	0.04%	0.0%	0.00%	0.00%	0.00%	0.0%	0.01%	0.02%	0.01%	0.0%	0.05%	0.09%	0.09%	0.0%
22000	0.02%	0.01%	0.02%	0.0%	0.00%	0.00%	0.00%	0.0%	0.01%	0.00%	0.00%	0.0%	0.01%	0.04%	0.03%	0.0%
23000	0.01%	0.01%	0.01%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.01%	0.02%	0.0%
24000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
25000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
26000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.01%	0.00%	0.0%
27000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.01%	0.0%
28000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.01%	0.00%	0.00%	0.0%
29000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
30000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
31000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
32000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
33000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
34000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
35000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
36000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
37000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
38000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
39000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
40000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
41000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Tandems

	WBNB				EHWB				LWB				BNB			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
0																
2000																
4000																
6000	6.92%	6.40%	6.95%	9.1%	5.25%	3.92%	3.20%	5.3%	5.95%	5.79%	6.70%	4.7%	3.02%	3.04%	3.41%	4.9%
8000	5.62%	5.04%	5.36%	5.5%	4.74%	4.09%	3.68%	4.6%	7.49%	6.25%	6.01%	5.5%	3.72%	3.06%	2.64%	3.9%
10000	8.09%	7.11%	7.38%	7.8%	6.40%	5.42%	5.20%	6.6%	9.96%	8.51%	7.56%	7.2%	6.55%	4.23%	4.65%	8.7%
12000	9.20%	8.85%	8.62%	8.7%	7.51%	7.22%	7.25%	7.5%	8.15%	7.27%	6.79%	6.6%	9.92%	8.92%	8.28%	8.5%
14000	7.66%	7.16%	7.13%	7.2%	8.35%	7.83%	7.69%	8.3%	6.82%	5.94%	5.92%	5.9%	6.74%	7.66%	7.74%	8.3%
16000	7.45%	6.57%	6.79%	6.8%	8.73%	8.17%	8.26%	8.6%	5.69%	5.60%	5.90%	5.3%	6.79%	6.14%	6.33%	6.4%
18000	7.56%	7.13%	7.05%	6.9%	8.61%	8.49%	8.35%	8.5%	5.59%	5.91%	6.20%	6.4%	6.24%	5.06%	5.51%	5.7%
20000	5.78%	5.74%	5.72%	5.5%	9.49%	9.05%	8.45%	8.9%	7.45%	7.34%	7.32%	7.2%	5.86%	4.95%	5.41%	5.2%
22000	4.95%	5.09%	5.07%	4.6%	12.13%	10.92%	9.69%	11.9%	8.16%	8.08%	8.52%	8.4%	5.11%	5.21%	4.83%	4.3%
24000	5.01%	5.25%	5.42%	4.9%	13.61%	14.32%	13.05%	14.4%	10.05%	10.23%	11.37%	11.1%	4.67%	4.73%	4.41%	5.0%
26000	5.99%	6.39%	6.90%	5.9%	10.85%	13.31%	14.33%	10.8%	10.45%	12.17%	14.35%	12.4%	5.39%	5.46%	4.96%	5.8%
28000	7.57%	8.33%	8.52%	7.5%	3.56%	5.96%	8.41%	3.8%	7.97%	9.44%	9.66%	10.5%	7.95%	7.35%	6.74%	8.9%
30000	10.21%	10.85%	11.69%	10.0%	0.62%	1.07%	2.01%	0.8%	4.61%	5.24%	3.11%	6.4%	12.41%	11.60%	11.63%	14.5%
32000	7.21%	8.95%	6.76%	8.3%	0.12%	0.16%	0.38%	0.2%	1.28%	1.75%	0.47%	2.0%	13.15%	15.36%	15.87%	9.3%
34000	0.64%	0.97%	0.52%	1.0%	0.03%	0.05%	0.06%	0.0%	0.31%	0.41%	0.07%	0.4%	2.06%	6.66%	7.06%	0.5%
36000	0.08%	0.09%	0.07%	0.1%	0.00%	0.02%	0.01%	0.0%	0.06%	0.05%	0.02%	0.0%	0.22%	0.37%	0.40%	0.1%
38000	0.04%	0.03%	0.03%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.02%	0.01%	0.0%	0.11%	0.11%	0.03%	0.1%
40000	0.02%	0.02%	0.02%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.01%	0.01%	0.0%	0.04%	0.08%	0.06%	0.0%
42000	0.00%	0.01%	0.01%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.01%	0.00%	0.0%	0.01%	0.02%	0.02%	0.0%
44000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.01%	0.01%	0.01%	0.0%
46000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.01%	0.00%	0.00%	0.0%
48000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
50000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
52000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
54000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
56000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
58000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
60000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
62000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
64000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
66000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
68000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
70000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
72000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
74000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
76000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
78000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
80000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
82000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Triples

	WBNB				EHWB				LWB				BNB			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
0																
3000																
6000																
9000																
12000	21.14%	18.07%	18.76%	21.4%	20.43%	18.36%	23.37%	25.4%	23.35%	21.69%	18.87%	21.5%	28.17%	33.71%	36.56%	42.2%
15000	7.44%	6.75%	5.75%	6.8%	3.78%	2.98%	3.30%	3.8%	4.69%	3.47%	4.79%	5.2%	12.05%	7.72%	4.09%	2.1%
18000	3.12%	3.34%	3.28%	3.3%	3.83%	2.27%	2.07%	4.0%	2.27%	2.31%	2.06%	2.6%	2.78%	1.24%	1.60%	2.4%
21000	4.91%	4.90%	4.65%	4.7%	5.40%	3.68%	2.82%	5.3%	3.37%	3.63%	3.98%	4.0%	1.85%	1.18%	1.55%	2.1%
24000	5.18%	6.28%	6.22%	6.6%	8.72%	5.98%	5.53%	8.9%	7.76%	8.20%	5.32%	6.1%	2.22%	3.19%	3.62%	2.6%
27000	3.30%	3.09%	3.87%	3.9%	16.72%	12.94%	11.53%	14.6%	10.54%	10.29%	10.83%	7.5%	3.24%	3.29%	2.91%	3.7%
30000	5.96%	5.36%	6.75%	5.7%	20.34%	23.08%	18.57%	18.7%	18.59%	16.90%	20.17%	16.2%	5.47%	4.58%	7.24%	8.1%
33000	10.32%	9.78%	11.05%	9.5%	15.68%	22.56%	21.82%	13.9%	17.28%	18.55%	19.65%	19.5%	7.04%	7.00%	5.78%	9.7%
36000	19.10%	19.81%	21.32%	18.0%	4.29%	6.61%	8.44%	4.4%	8.13%	9.85%	9.10%	11.0%	12.23%	11.37%	7.80%	13.3%
39000	15.36%	17.78%	14.90%	15.6%	0.63%	1.13%	1.81%	0.7%	2.34%	3.52%	2.06%	3.8%	16.50%	14.41%	13.02%	9.3%
42000	3.27%	3.95%	2.53%	3.5%	0.12%	0.29%	0.50%	0.3%	0.29%	0.94%	1.53%	0.5%	6.86%	8.08%	12.22%	2.6%
45000	0.47%	0.41%	0.32%	0.5%	0.05%	0.10%	0.16%	0.1%	0.81%	0.44%	0.53%	0.5%	1.11%	2.06%	1.83%	0.7%
48000	0.19%	0.18%	0.23%	0.3%	0.02%	0.03%	0.04%	0.0%	0.29%	0.00%	0.43%	0.5%	0.19%	0.36%	0.47%	0.3%
51000	0.09%	0.13%	0.16%	0.2%	0.00%	0.00%	0.01%	0.0%	0.22%	0.06%	0.29%	0.4%	0.00%	0.51%	0.56%	0.4%
54000	0.08%	0.10%	0.09%	0.1%	0.00%	0.00%	0.00%	0.0%	0.07%	0.06%	0.24%	0.4%	0.28%	0.51%	0.33%	0.2%
57000	0.04%	0.05%	0.06%	0.1%	0.00%	0.00%	0.00%	0.0%	0.00%	0.06%	0.05%	0.1%	0.00%	0.10%	0.09%	0.3%
60000	0.02%	0.02%	0.05%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.06%	0.05%	0.1%	0.00%	0.36%	0.19%	0.1%
63000	0.01%	0.00%	0.02%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.1%	0.00%	0.21%	0.09%	0.0%
66000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.05%	0.0%	0.00%	0.00%	0.05%	0.0%
69000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.1%	0.00%	0.05%	0.00%	0.0%
72000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
75000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.05%	0.00%	0.0%
78000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
81000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
84000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
87000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
90000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
93000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
96000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
99000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
102000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
105000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
108000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
111000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
114000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
117000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
120000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
123000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Quads

	WBNB				EHWB				LWB				BNB			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
0																
3000																
6000																
9000																
12000	8.01%	7.04%	6.87%	8.6%	7.02%	3.21%	3.86%	6.2%	3.95%	3.74%	8.00%	4.2%	2.78%	13.50%	17.19%	8.2%
15000	2.94%	3.14%	2.07%	2.7%	2.64%	0.93%	2.70%	1.8%	2.15%	1.60%	2.11%	0.0%	0.00%	3.50%	3.52%	0.0%
18000	1.11%	0.86%	0.69%	1.1%	2.19%	0.76%	1.07%	1.2%	1.43%	2.14%	0.63%	1.3%	0.00%	0.00%	0.00%	0.0%
21000	1.16%	0.99%	0.90%	1.2%	3.10%	1.36%	1.12%	2.7%	1.08%	1.07%	0.84%	1.0%	0.93%	0.00%	0.00%	0.0%
24000	2.57%	2.45%	2.04%	3.5%	3.10%	1.74%	1.72%	3.6%	0.36%	1.60%	2.53%	1.0%	0.00%	0.50%	0.00%	0.7%
27000	8.69%	7.76%	6.87%	8.3%	6.56%	3.32%	2.28%	4.8%	1.79%	0.53%	2.11%	1.0%	1.85%	0.00%	1.56%	0.7%
30000	3.26%	5.23%	7.02%	5.2%	12.67%	8.11%	6.27%	12.0%	3.23%	4.28%	3.37%	3.6%	1.85%	0.00%	1.17%	0.7%
33000	1.64%	1.44%	1.99%	1.8%	26.34%	23.79%	15.89%	25.2%	12.54%	12.03%	7.37%	5.9%	0.93%	0.00%	3.13%	2.0%
36000	2.62%	2.06%	2.92%	2.5%	21.88%	31.85%	28.62%	26.2%	13.62%	18.18%	24.42%	16.9%	0.93%	1.00%	1.56%	2.7%
39000	7.08%	6.49%	8.81%	6.2%	10.39%	18.62%	22.68%	12.3%	17.92%	18.98%	22.11%	23.8%	4.63%	2.50%	3.91%	9.5%
42000	19.24%	16.69%	21.62%	15.8%	2.92%	4.63%	9.57%	2.8%	25.45%	19.52%	18.32%	22.2%	13.89%	10.00%	5.86%	10.9%
45000	22.72%	23.70%	22.26%	20.6%	0.82%	1.03%	2.97%	1.1%	14.34%	12.83%	6.95%	14.7%	25.93%	26.00%	25.00%	38.1%
48000	16.46%	18.56%	14.08%	18.7%	0.36%	0.60%	1.02%	0.1%	1.79%	2.67%	1.26%	3.9%	30.56%	32.00%	22.27%	19.1%
51000	2.34%	3.34%	1.72%	3.6%	0.00%	0.05%	0.14%	0.0%	0.36%	0.53%	0.00%	0.7%	14.81%	10.50%	12.50%	5.4%
54000	0.13%	0.20%	0.08%	0.2%	0.00%	0.00%	0.00%	0.0%	0.00%	0.27%	0.00%	0.0%	0.93%	0.50%	2.34%	0.7%
57000	0.02%	0.01%	0.01%	0.0%	0.00%	0.00%	0.09%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
60000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
63000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
66000	0.02%	0.00%	0.01%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.7%
69000	0.00%	0.01%	0.03%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
72000	0.02%	0.04%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.7%
75000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
78000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
81000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
84000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
87000	0.00%	0.00%	0.01%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
90000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
93000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
96000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
99000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
102000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
105000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
108000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
111000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
114000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
117000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
120000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
123000	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%	0.00%	0.00%	0.00%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

APPENDIX K

TOTAL TRUCK AND AXLE SUMMARY COUNTS

		WBNB					EHWB					LWB					BNB				
		Fall	Wi	Spr	Sum	Avg	Fall	Wi	Spr	Sum	Avg	Fall	Wi	Spr	Sum	Avg	Fall	Wi	Spr	Sum	Avg
TRUCKS	TOTAL	153178	135813	159344	152673	150252	51560	37730	52049	58429	49942	26738	13544	19480	28042	21951	19067	12374	18060	21963	17866
	Steers	153178	135813	159344	152673	150252	51560	37730	52049	58429	49942	26738	13544	19480	28042	21951	19067	12374	18060	21963	17866
		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Singles	47344	34353	44396	44914	42752	14593	10067	14825	16742	14057	8610	4623	7003	9784	7505	6168	3895	6295	8273	6158
		30.9%	25.3%	27.9%	29.4%	28.4%	28.3%	26.7%	28.5%	28.7%	28.1%	32.2%	34.1%	35.9%	34.9%	34.3%	32.3%	31.5%	34.9%	37.7%	34.1%
	Tandem	127761	115889	132367	125271	125322	44259	32902	44815	50190	43041.5	23611	11911	16685	24255	19116	15799	10491	14877	17388	14639
		83.4%	85.3%	83.1%	82.1%	83.5%	85.8%	87.2%	86.1%	85.9%	86.3%	88.3%	87.9%	85.7%	86.5%	87.1%	82.9%	84.8%	82.4%	79.2%	82.3%
	Triples	19374	17984	21378	21156	19973	5770	3706	5050	6398	5231	1729	1234	1646	1899	1627	1527	953	1766	1865	1527.8
		12.6%	13.2%	13.4%	13.9%	13.3%	11.2%	9.8%	9.7%	11.0%	10.4%	6.5%	9.1%	8.4%	6.8%	7.7%	8.0%	7.7%	9.8%	8.5%	8.5%
	Quads	7044	6228	8153	7438	7216	1733	1095	1837	2152	1704	307	279	374	475	359	147	108	200	256	178
		4.60%	4.60%	5.10%	4.90%	4.80%	3.40%	2.90%	3.50%	3.70%	3.38%	1.10%	2.10%	1.90%	1.70%	1.70%	0.80%	0.90%	1.10%	1.20%	1.00%
	Pentas	52	31	30	10	31	20	13	1	2	9	4	0	3	0	2	0	0	0	0	0
		0.03%	0.02%	0.02%	0.01%	0.02%	0.04%	0.03%	0.00%	0.00%	0.02%	0.01%	0.00%	0.02%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
AXLES	TOTAL	800391	714197	836541	798551	787420	271191	196284	273729	307913	262279	131981	68500	99278	140415	110044	89286	58847	86389	103008	84383
	Steers	153178	135813	159344	152673	150252	51560	37730	52049	58429	49942	26738	13544	19480	28042	21951	19067	12374	18060	21963	17866
		19.14%	19.02%	19.05%	19.12%	19.08%	19.01%	19.22%	19.01%	18.98%	19.04%	20.26%	19.77%	19.62%	19.97%	19.95%	21.35%	21.03%	20.91%	21.32%	21.17%
	Singles	100847	78051	98816	98732	94112	36418	23898	35980	42516	34703	17069	8536	13322	19412	14585	11703	7152	11818	15891	11641
		12.60%	10.93%	11.81%	12.36%	11.95%	13.43%	12.18%	13.14%	13.81%	13.23%	12.93%	12.46%	13.42%	13.82%	13.25%	13.11%	12.15%	13.68%	15.43%	13.80%
	Tandem	452060	414300	472506	444308	445794	156508	117266	160500	176342	152654	81238	41206	59514	84800	66690	52870	35652	49882	57746	49038
		56.48%	58.01%	56.48%	55.64%	56.61%	57.71%	59.74%	58.63%	57.27%	58.20%	61.55%	60.15%	59.95%	60.39%	60.60%	59.21%	60.58%	57.74%	56.06%	58.11%
	Triples	65862	60963	73104	73032	68240	19650	12936	17847	22008	18110	5688	4098	5451	6261	5375	5058	3237	5829	6384	5127
		8.23%	8.54%	8.74%	9.15%	8.67%	7.25%	6.59%	6.52%	7.15%	6.90%	4.31%	5.98%	5.49%	4.46%	4.88%	5.66%	5.50%	6.75%	6.20%	6.08%
	Quads	28176	24912	32612	29752	28863	6948	4388	7348	8608	6823	1228	1116	1496	1900	1435	588	432	800	1024	711
		3.52%	3.49%	3.90%	3.73%	3.67%	2.56%	2.24%	2.68%	2.80%	2.60%	0.93%	1.63%	1.51%	1.35%	1.30%	0.66%	0.73%	0.93%	0.99%	0.84%
	Pentas	260	155	150	50	154	100	65	5	10	45	20	0	15	0	9	0	0	0	0	0
		0.03%	0.02%	0.02%	0.01%	0.02%	0.04%	0.03%	0.00%	0.00%	0.02%	0.02%	0.00%	0.02%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%

	WBNB					EHWB					LWB					BNB						
	Fall	Wi	Spr	Sum	Avg	Fall	Wi	Spr	Sum	Avg	Fall	Wi	Spr	Sum	Avg	Fall	Wi	Spr	Sum	Avg	all sites	LWB & BNB
Axles/Truck	**5.23**	**5.26**	**5.25**	**5.23**	**5.24**	**5.26**	**5.20**	**5.26**	**5.27**	**5.25**	**4.94**	**5.06**	**5.10**	**5.01**	**5.01**	**4.68**	**4.76**	**4.78**	**4.69**	**4.72**	5.06	4.88
Singles	1.66	1.57	1.62	1.65	1.63	1.71	1.63	1.69	1.73	1.69	1.64	1.63	1.68	1.69	1.66	1.61	1.58	1.65	1.72	1.65	1.65	1.65
Tandems	2.95	3.05	2.97	2.91	2.97	3.04	3.11	3.08	3.02	3.06	3.04	3.04	3.06	3.02	3.04	2.77	2.88	2.76	2.63	2.74	2.96	2.90
Triples	0.43	0.45	0.46	0.48	0.45	0.38	0.34	0.34	0.38	0.36	0.21	0.30	0.28	0.22	0.24	0.27	0.26	0.32	0.29	0.29	0.34	0.27
Quads	0.18	0.18	0.20	0.19	0.19	0.13	0.12	0.14	0.15	0.14	0.05	0.08	0.08	0.07	0.07	0.03	0.03	0.04	0.05	0.04	0.11	0.05

						SITE DATA COMBINED	
		SEASONAL DATA COMBINED				all sites	LWB & BNB
Axles/Truck	stdev	0.0158	0.0307	0.0692	0.0494	0.22	0.17
	COV	0.3%	0.6%	1.4%	1.0%	4.4%	3.4%
Singles	stdev	0.0371	0.0404	0.0314	0.0624	0.0468	0.0468
	COV	2.3%	2.4%	1.9%	3.8%	2.8%	2.8%
Tandems	stdev	0.0590	0.0417	0.0128	0.1032	0.1349	0.1638
	COV	2.0%	1.4%	0.4%	3.8%	4.6%	5.6%
Triples	stdev	0.0202	0.0209	0.0435	0.0283	0.0839	0.0377
	COV	4.4%	5.8%	17.8%	9.8%	24.8%	14.0%
Quads	stdev	0.0101	0.0134	0.0160	0.0075	0.0052	0.0194
	COV	5.3%	9.8%	24.5%	18.9%	4.8%	36.1%