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Methodologies for Evaluating the Importance of Highway Bridges

by

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Preface

The Multidisciplinary Center for Earthquake Engineering Research (MCEER) is a national center of excellence in advanced technology applications that is dedicated to the reduction of earthquake losses nationwide. Headquartered at the State University of New York at Buffalo, the Center was originally established by the National Science Foundation in 1986, as the National Center for Earthquake Engineering Research (NCEER).

Comprising a consortium of researchers from numerous disciplines and institutions throughout the United States, the Center's mission is to reduce earthquake losses through research and the application of advanced technologies that improve engineering, pre-earthquake planning and post-earthquake recovery strategies. Toward this end, the Center coordinates a nationwide program of multidisciplinary team research, education and outreach activities.

MCEER's research is conducted under the sponsorship of two major federal agencies, the National Science Foundation (NSF) and the Federal Highway Administration (FHWA), and the State of New York. Significant support is also derived from the Federal Emergency Management Agency (FEMA), other state governments, academic institutions, foreign governments and private industry.

The Center's FHWA-sponsored Highway Project develops retrofit and evaluation methodologies for existing bridges and other highway structures (including tunnels, retaining structures, slopes, culverts, and pavements), and improved seismic design criteria and procedures for bridges and other highway structures. Specifically, tasks are being conducted to:

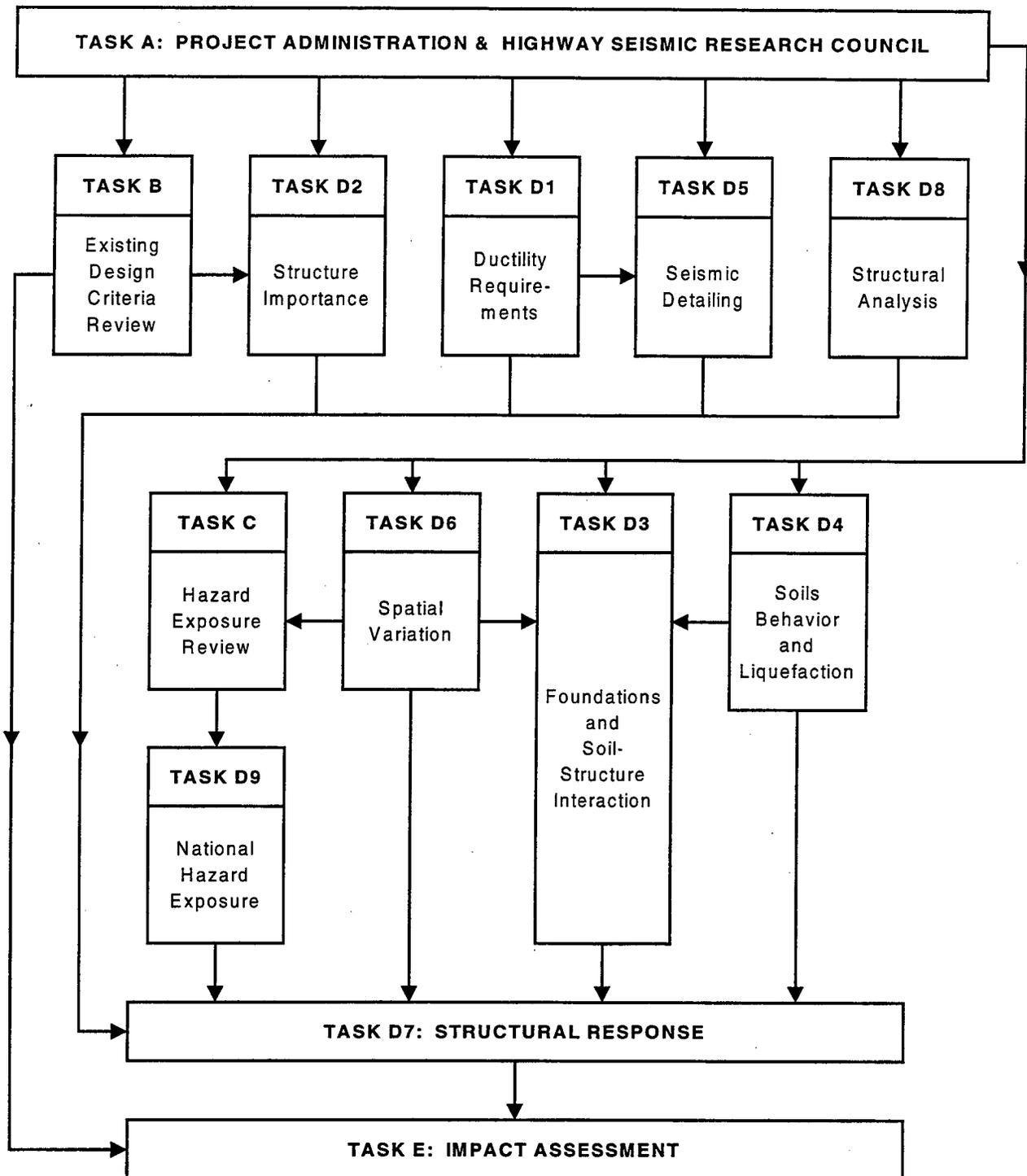
- assess the vulnerability of highway systems, structures and components
- develop concepts for retrofitting vulnerable highway structures and components;
- develop improved design and analysis methodologies for bridges, tunnels, and retaining structures, which include consideration of soil-structure interaction mechanisms and their influence on structural response;
- review and recommend improved seismic design and performance criteria for new highway structures.

Highway Project research focuses on two distinct areas: the development of improved design criteria and philosophies for new or future highway construction, and the development of improved analysis and retrofitting methodologies for existing highway systems and structures. The research discussed in this report is a result of work conducted under the new highway structures project, and was performed within Task 112-D-2, "Evaluation of Structure Importance" of that project as shown in the flowchart on the following page.

The overall objective of this task was to identify, assess and develop recommended improvements to existing methodologies for defining the importance of highway bridges. The report describes the work that was conducted leading to a simple bridge importance evaluation methodology developed by the authors. The 50 state transportation agencies were surveyed to identify how each state determines and classifies the importance of their bridges. Twelve importance methods were chosen from these replies for further investigation. Following a comparison of these methods, two were

selected for further evaluation: one from Illinois and the other from Montana. A recommended method, based on these two methods and additional refinements, was developed which works with a state's existing National Bridge Inventory (NBI) data and does not require the collection of new data. The method fills a need for states in low to moderate zones which need to develop or implement an importance method at little or no cost.

SEISMIC VULNERABILITY OF NEW HIGHWAY CONSTRUCTION
FHWA Contract DTFH61-92-C-00112



PREFACE

The objective of this report is to identify and assess existing methods for quantifying the importance of highway bridges. Several existing methods are compared and a preferred method is recommended for use in the design of new bridges and the retrofit of existing structures.

It is common practice to use importance, along with hazard exposure and structure vulnerability, to prioritize and specify minimum requirements for the retrofit of existing bridges. Similarly, hazard and importance are frequently used to specify minimum levels of analysis and design requirements for new bridges. But the importance of a bridge is a difficult attribute to quantify and although there have been many attempts to do so, there is little consensus about a preferred methodology. Generally these methods include traffic volume, detour length, the presence or absence of utilities and some form of functional classification (e.g. emergency route, interstate highway, defense route, and the like.) Few, if any, include network redundancy and socio-economic issues, both of which are even more difficult to quantify than the earlier set of attributes.

Nevertheless it is essential that an agreed definition of importance be developed particularly in view of the increasing number of owner-agencies who are establishing bridge retrofit programs. The prudent allocation of scarce resources to individual bridges is dependent on a rational methodology for assessing bridge importance.

This report therefore examines several of the most common methods and makes a comparative assessment of their relative work, first against each other and then against engineering judgment for two different inventories. Recommendations are made for a preferred method and modifications to existing AASHTO and FHWA provisions are suggested which indicate how this method might be included in these specifications.

In order to achieve this result, the difficult issues of network redundancy and socio-economic impacts have been set aside. (Whereas detour length has been included in this work, as a measure of network redundancy, it is not a reliable one since there is always the possibility that the identified detour is closed by the same earthquake.) These issues are the subject of another research task in the Highway Project at NCEER. Network redundancy is being explicitly modelled in a seismic risk assessment task and future expansions to this task will likely include economic factors. However, the routine application of this work, to the prioritization of retrofit projects for example, is still some years away. In the meantime the recommendations made in this report are expected to serve a useful purpose.

ABSTRACT

The location of a structure with respect to seismic hazards, its seismic vulnerability and its importance are factors which are used in determining what seismic design or seismic retrofit level a structure belongs in. This research evaluated methods for determining the importance of a structure and how to use this importance in seismic design and retrofitting specifications.

This report develops a method for determining the importance of a bridge. This importance ranking of a bridge is then used in proposed revisions to seismic bridge design and retrofitting specifications. Depending on the relative importance bridge ranking, design or retrofitting requirements will be increased or decreased (e.g. the higher the importance ranking, the greater the seismic design or retrofitting requirements). This report also provides for existing importance methods to be used with the seismic design and retrofitting specifications.

ACKNOWLEDGMENT

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The authors would like to thank Mr. Ayaz H. Malik of the New York State Department of Transportation (NYSDOT) and Mr. Hal Rogers of Pennsylvania Department of Transportation (PennDOT) for providing their state's bridge management data to us for our use.

We would also like to thank the many persons from the various government agencies who provided us with information and responded to our surveys.

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SECTION 1 INTRODUCTION

In the summer of 1993, the National Center for Earthquake Engineering Research (NCEER) initiated a research program with the goal of providing improved design and analysis procedures intended to minimize the seismic vulnerability of new highway infrastructure. The research is sponsored by the Federal Highway Administration (FHWA) of the U.S. Department of Transportation and consists of a series of studies, each focussed on the seismic design and analysis of particular highway system components and structural elements, and performed by researchers with expertise in that area of study.

The overall objective of Task 112-D-2 is to identify, assess and develop improvements to existing methodologies for defining structure importance, and to provide recommended definitions of importance and classification systems based on importance.

The location of a structure with respect to seismic hazards, its seismic vulnerability and its importance are factors which are used in determining the level to which a structure should be seismically designed or retrofitted. This research studied how to determine the importance of a structure and how to use this importance in seismic design and retrofitting specifications. This research envisions structural importance being used for preliminary ranking and screening for seismic retrofitting and as a design and/or retrofit parameter. Since seismic hazard and seismic vulnerability were not specific issues in this research, the structural importance information provided in this report could also be used to determine priorities for bridge issues unrelated to seismic activities.

A survey conducted under NCEER Highway Project Task 106-B(h) showed that nearly all states in high seismic risk areas had employed an importance ranking method. Therefore the most likely users of a importance method developed from this project would be those states which do not presently have an importance methodology in place or those which are still attempting to refine their procedures. This survey also indicated that twenty states, nearly all of them in low to moderate seismic risk zones, did not have an importance method. It is the researchers opinion that any system for determining importance must allow existing importance classification systems to be used. Further, any importance ranking method developed from this project must be cost effective and easy enough for those in low to moderate seismic risk areas to implement.

Figure 1-1 provides a general sequence of the major steps within this NCEER task from the review of the existing importance methods to the development of recommended specifications.

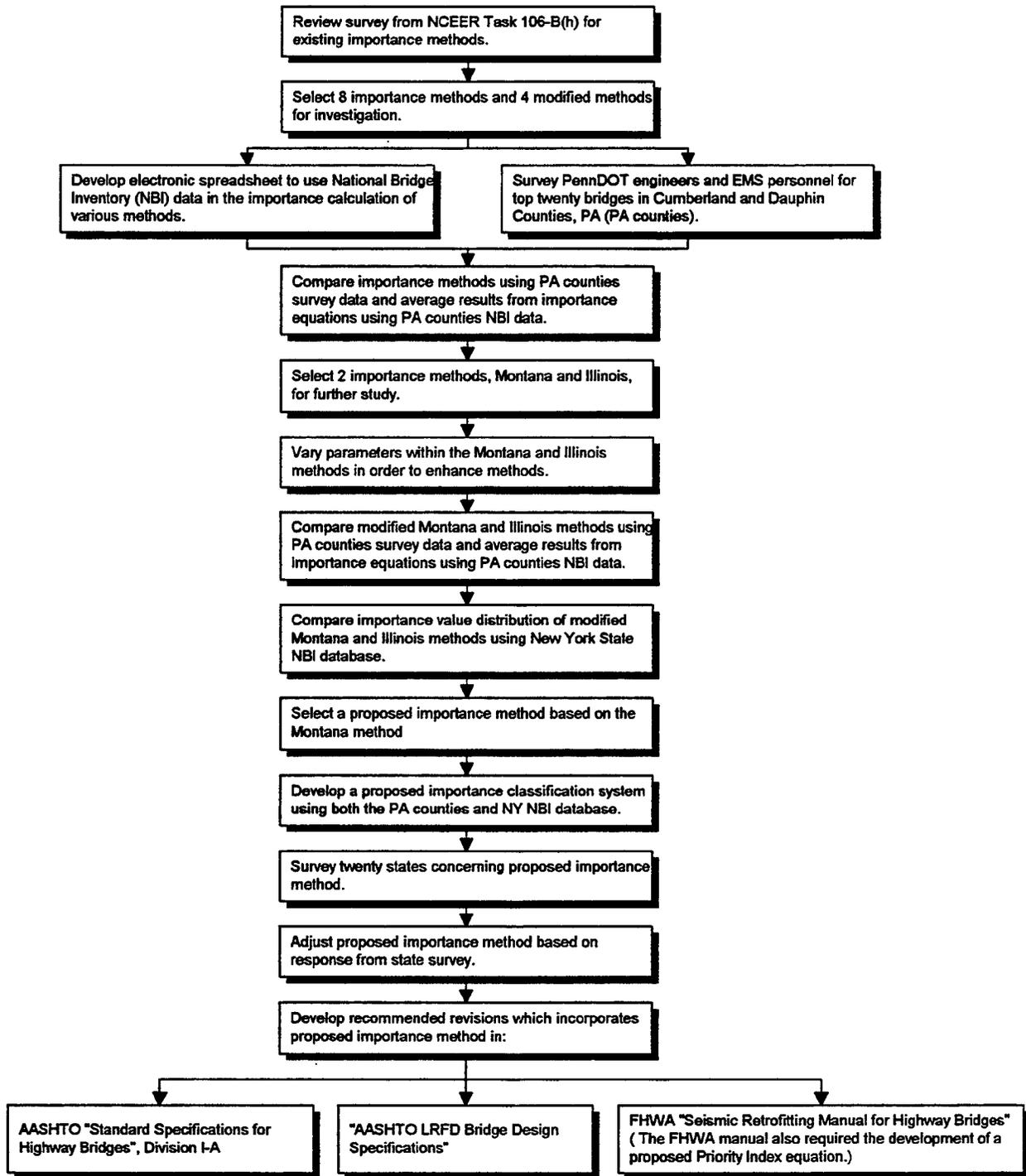


FIGURE 1-1 Sequence of Major Research Steps

SECTION 2 EVALUATION OF EXISTING IMPORTANCE METHODS

The investigation of defining structural importance was initiated with a survey via NCEER Highway Project Task 106-B(h) of the 50 states to identify how each state determines the importance of their bridges. Eight importance methods were chosen from the replies for investigation. In addition to those eight methods, four modified methods were also investigated resulting in a total of 12 methods. The investigation was based on information required in the National Bridge Inventory (NBI) records.

A definition list of terms used throughout this report is given below:

| | |
|------------------------|---|
| ADT: | Average Daily Traffic. |
| FADT: | Future Average Daily Traffic. |
| Bridge Length: | Total structure length as defined in FHWA-ED-89-044. |
| Critical Route: | The controlling route being considered if there is more than one route on or under the structure. |
| Carry: | Relating to the critical route on the structure being investigated. |
| Cross: | Relating to the critical route under the structure being investigated. |
| Bridge Rank: | A bridge's position in order of importance. |
| Rankings: | A list of bridges ranked in order of importance. |

The equation and the definition of terms for each of the 12 methods are given in Appendix A. A general description of the highlights of each method is listed below:

- **Babaei and Hawkins '91 (B&H):** This method uses an ADT reference value of 30,000 and does not make a distinction among bridges with detour lengths greater than 16 km, (used by the Washington DOT).
- **Modified Babaei and Hawkins:** The reference ADT was adjusted from 30,000 to 6,000.
- **Buckle '95:** Includes a definition of a critical bridge as well as an equation to calculate the priority index, importance value, (used by the New York DOT). This investigation used only the equation.
- **Modified Buckle '95:** FADT was replaced by ADT.
- **Caltrans:** Importance calculations include a variable, leased air space, when considering the item being crossed by a structure. Leased air space is divided into two importance categories, residential/office and parking/storage. Since FHWA does not require this data to be collected in the NBIS, the lease air space variable was removed from this investigation. If the item crossed is not a waterway, road, or railroad, then it shall be categorized as other.
- **Montana:** This is a modification of the Babaei and Hawkins method. The terms

modified are the ADT reference value, detour length coefficient, utility considerations, and river crossing considerations. The reference value used in the Montana method is 6000 not 30,000 as in the Babaei and Hawkins method. This method considers five detour length categories as opposed to three. The coefficients for these categories are 0.7, 0.8, 0.9, 1.0 and 1.2, while Babaei and Hawkins uses 0.75, 0.8, and 1.0. The final modification is replacing the utility carried term with a river crossing term. The river crossing term is based on the structure length for structures crossing water.

- Nevada: This method includes a separate railroad consideration, most methods did not have this consideration. The importance of a railroad falls between primary and secondary routes according to this method. Therefore, this method places a higher importance ranking on bridges that carry or cross railroads than the other methods investigated. The Nevada method also included a maximum ADT value of 90,000. This maximum value was neglected in this investigation.
- South Carolina: This method calculates importance rating values as an integer. Minimums and maximum are applied to these values. This results in ratings ranging from 0 to 10. Because of the integer ratings, bridges are divided into 11 importance rankings.
- Modified South Carolina: The maximum rating values were removed for this method.
- Missouri: This method bases the importance value on a spacing factor instead of the actual ADT value. This spacing factor is an estimate of the vehicle spacing based on the ADT. The spacing factor ranges from 0.2 to 2.0 based on the ADT. There are five categories of ADT each having a corresponding spacing coefficient. One category is for routes with an ADT of 50,000 to 100,000. The Missouri method makes no distinction between a route with an ADT of 50,000 than one with an ADT of 100,000. The other methods use the actual ADT value and therefore make a distinction between these routes.
- Modified Missouri: The Missouri method was modified by setting a maximum bridge length = 1610 m (5280 ft). This prevented structures with a total structure length larger than 1610 m from dominating the importance rankings.
- IDOT: This method considers the Illinois Earthquake Emergency Routes. Similarly to the leased air space in the Caltrans method, this data is not required by the FHWA. Therefore, the emergency route variable was removed from this investigation.

All states are currently required to inspect all public bridges greater than 6.0 meters biennially. The

Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, FHWA-ED-89-044, describes the requirements of NBI records. The Guide describes the minimum amount of bridge data required by FHWA. However, a state may collect more data than required by the Guide but shall only report the required data to FHWA. This investigation used the information required by the Guide as a limit for the input. Therefore, all states already have and maintain the data required by the importance equations. A state can implement the proposed method without changing their database. In addition, all importance calculations can be performed without addition human input because there is no interpretation of input data necessary. The ranking process can be automated because there is no human input. However, some engineering judgement should still be used in the analysis of the importance results.

The general information required by each of the 12 methods is given in tables 2-1 and 2-2. Table 2-1 and table 2-2 pertains to data on the structure and under the structure, respectively.

TABLE 2-1 On the Structure Data Requirements

| Method | Feature Carried | | | | | | | | | | | | | |
|---------------------|-----------------|------------|-------------|---|---|------------|-----|------|---------------|-------|------------|-----------|-----------|--------------|
| | Service Type | Route Type | Func. Class | L | W | # of Lanes | ADT | FADT | Detour Length | Util. | Fed. Fund. | Def. Des. | Nat. Net. | *Lease Space |
| B & H '91 | | | X | X | | | X | | X | X | | X | | |
| Mod. B & H '91 | | | X | X | | | X | | X | X | | X | | |
| Buckle'95 | | | X | | | | | X | X | X | | | | |
| Mod. Buckle'95 | | | X | | | | X | | X | X | | | | |
| Caltrans | | X | | | | | X | | X | X | X | | | X |
| Montana | | | X | X | | | X | | X | | | | | |
| Nevada | X | | X | X | X | | X | | X | X | | X | | |
| South Carolina | | X | | X | X | | X | | X | | | X | X | |
| Mod. South Carolina | | X | | X | X | | X | | X | | | X | X | |
| Missouri | | | X | X | X | | X | | X | | | | | |
| Mod. Missouri | | | X | X | X | | X | | X | | | | | |
| IDOT | X | | | X | X | | X | | X | X | | X | | |

L = Bridge Length Util. = Utilities Nat. Net. = Designated National Network
W = Bridge Width Def. Des. = Defense Highway Designation * = Data not required in NBI records

TABLE 2-2 Under the Structure Data Requirements

| Method | Feature Crossed | | | | | | | |
|---------------------|-----------------|------------|-------------|------------|-----|---------------|------------|-----------|
| | Service Type | Route Type | Func. Class | # of Lanes | ADT | Detour Length | Fed. Fund. | Def. Des. |
| B&H '91 | | | X | | X | X | | X |
| Mod. B&H '91 | | | X | | X | X | | X |
| Buckle '95 | | | | | | | | |
| Mod. Buckle '95 | | | | | | | | |
| Caltrans | | X | | | X | | X | |
| Montana | X | | X | | X | X | | |
| Nevada | X | | X | X | X | X | | X |
| South Carolina | X | X | | | | | | |
| Mod. South Carolina | X | X | | | | | | |
| Missouri | | | | X | X | | | |
| Mod. Missouri | | | | X | X | | | |
| IDOT | X | | | | X | X | | X |

New York State Department of Transportation (NYSDOT) provided a copy of their Bridge Management System (BMS) database which contained all the FHWA required structure inventory data for 19,740 bridges. The necessary data was imported into an Microsoft EXCEL Spreadsheet. A macro was written to calculate the importance rating for all 19,740 bridges using each of the 12 methods.

South Carolina and Modified South Carolina methods are based on two importance classifications (IC), I and II. A bridge is classified as IC=I, when the structure carries or crosses an interstate, defense highway, designated truck network, or access to a critical facility. All other bridges are classified as IC=II. The basic ratings are assigned an initial integer rating value of 1 or 6 for IC = II or I, respectively. Then integer values of -1 to 3 are added to the initial rating based on importance criteria, i.e. ADT, interchanges, deck area and item crossed. Maximum rating values of 5 and 10 are used for IC = II and IC = I, respectively. The IC = II limit insures that a bridge with an IC = II can not be ranked higher than an IC = I bridge. Based on the NYSDOT database calculations both integer rating methods were eliminated as possible methods, because this type of rating results in a large number of bridges with the same importance value. In the case of the South Carolina method, 2,193 of the 19,740 bridges were ranked as the most important bridge. While some engineering judgement is required to interpret the results from all the methods, deciding among 2,193 bridges would be too subjective.

The Modified South Carolina method was developed to decrease the amount of bridges ranked as the most important by eliminating the maximum rating values of 10 and 5 for IC=I and II, respectively. The highest calculated importance rating value was 13. This distributed the 2,193 bridges among 4 rankings. The redistribution among the four rankings values, i.e. 13, 12, 11, and 10, are 12, 281, 926, and 974 bridges, respectively. Although this method provided a better distribution of bridge importance than the South Carolina method, the results were very subjective when compared with the remaining 10 methods. It was felt that an effective importance method should be more discriminating and thereby limit the amount of interpretation required.

The NYSDOT database proved too large to be used as a comparison database for an initial investigation. With 19,740 bridges and 12 importance methods, conclusions could not be drawn for individual bridges. Comparisons of at least the top 500 ranked bridges would be required to establish importance value trends on bridge types. Therefore, the NYSDOT database was only used to examine the distribution of the importance values. It also provided a check for possible errors in the importance methods and/or the EXCEL macro when they were used with a large database.

Pennsylvania Department of Transportation (PennDOT) provided a copy of their Bridge Management System (BMS) database for Cumberland and Dauphin Counties. The PennDOT databases were used for further investigation because of their size, the diversity of bridges, and the researchers' familiarity with these counties.

Dauphin and Cumberland Counties are located in South Central Pennsylvania. Along with a third county, Perry County, this section is sometimes referred to as the Capitol Area Region. Both counties include industrial, residential, agricultural and forested land. Therefore, a wide variety of bridge crossings and traffic conditions exist within these counties. The population of Dauphin County is 246,338 and the largest city is Harrisburg, which is the state capitol, with a population of 54,238. The population of Cumberland County is 205,959 and the largest city is Carlisle with a population of 18,419. The average number of daily commuters in Dauphin and Cumberland County as per the 1990 census is 116,181 and 98,577, respectively. However, these figures are not reflective of the current traffic volumes due to the regional population increases in the last 8 years.

There are three interstate highways (I-83, I-81, and I-76), two rail services (Amtrak and Conrail), and numerous 4 lane routes and bypasses are located within these counties. Some critical importance issues to consider in these counties are Three Mile Island Nuclear Reactor, Naval Inventory Control Point (NAVICP)- Mechanicsburg, Defense Distribution Center (DDC), 7 hospitals, Susquehanna River, major truck terminals and I-81 access to Fort Indian Town Gap. Therefore, Dauphin and Cumberland County provided a wide range of importance issues to be analyzed.

I-83 extends north from Baltimore, Maryland to Harrisburg, Pennsylvania. Adjacent to Baltimore, I-83 connects with I-70, I-95, and I-695. At the Harrisburg end, I-83 connects with I-76 and I-81. I-81 is a north-south connector to I-80, I-78, and I-84. I-81 extends from Knoxville, Tennessee through New York and into Canada. This interstate is one of the major trucking routes between the Southern, Mid-Atlantic, and New England states. The Pennsylvania Turnpike, I-76, is an east-west connector which extends from Ohio to New Jersey. The major cities of Philadelphia and Pittsburgh are located along I-76 adjacent to the New Jersey and Ohio borders, respectively. Most major truck terminals in the Capitol Area Region are located in Carlisle at the intersection of I-81 and I-76. Philadelphia, Baltimore, and Washington D.C. can be reached using these interstates in 2 hours or less. New York City and Pittsburgh are approximately 4 hours away.

Using EXCEL, the 549 Cumberland County Bridges and 606 Dauphin County Bridges were rated for each method including the South Carolina methods, with the exception of the Modified Missouri method. The Modified Missouri method was not investigated because all the bridges in these counties had span lengths smaller than the maximum of 1610 m (5280'). Since the only difference between the two Missouri methods is the arbitrary setting of a maximum span length of 1610 m, both Missouri methods would give identical results. The South Carolina methods were used with the PennDOT database. However, as mentioned previously these techniques were not viable options. The South Carolina results were used only as a comparison.

The bridges were ranked for each county by each importance method. The top 3% of bridges identified by each method were plotted on county maps. In an ideal situation, all of the methods would rank the same 3% of bridges as the most important. However, this was not the case in this investigation. The bridges ranked most important by the each method were plotted to determine if a specific controlling importance issue could be the reason for the difference. Once the bridges are plotted on a map, trends to several controlling importance issues are detectable. The most noticeable trend is dependency upon traffic volume. This was shown by the plotted bridges being located upon several of the large interstates in these counties. Which interstate bridges depended on what other issue or issues the particular method being investigated considered important. Some importance issue trends noticed for the route on the bridge include; ADT, bridge length, rail traffic, and detour length. Some importance issue trends noticed for the route crossed by the bridge include; ADT, water crossings, and rail traffic. Once a trend for a method was noticed, several major importance issues for each method could be noted. This information was critical in later investigations when variations of the methods were made. The knowledge of major importance issues for a given method aided in determining what issue needed to be adjusted to obtain the desired results. In addition to the graphing, the results were compared to the following five rankings:

- An average ranking of all the methods for Dauphin County.
- An average ranking of all the methods for Cumberland County.
- The average results of a survey of PennDOT Engineers in Dauphin County.
- The average results of a survey of PennDOT Engineers in Cumberland County.
- The results of a survey of the Emergency Management System (EMS) of Dauphin County.

Cumberland County EMS was asked to participate, but did not respond to the survey.

The PennDOT survey involved the input of five state engineers working in both Dauphin and Cumberland Counties. The survey requested that the engineer list, in order, the twenty bridges which were the most important in their opinion. A copy of the survey letter is given in Appendix B.

The opinions of the five PennDOT engineers on the twenty most important structures in each county varied. The Cumberland and Dauphin County survey results are given in tables 2-3 and 2-4, respectively. Among the responses from the engineers, 49 different bridges were ranked in the top twenty for Cumberland County. Likewise, 45 different bridges were ranked in the top twenty for Dauphin County. Therefore, even the engineers familiar with these bridges have a wide variance in the concept of their structural importance. The five survey results for each county were averaged together to get an overall top twenty ranking.

TABLE 2-3 PennDOT Survey Responses for Cumberland County

| Structural ID Number | Bridge Rank | | | | |
|----------------------|-------------|------------|------------|------------|------------|
| | Engineer 1 | Engineer 2 | Engineer 3 | Engineer 4 | Engineer 5 |
| 21001107400000 | | | 3 | | |
| 21001107600000 | 5 | 8 | 7 | | 2 |
| 21001108701474 | 10 | | 8 | | 4 |
| 21001108711456 | | | | | 5 |
| 21001108900000 | | | 9 | | |
| 21001109800000 | 6 | | 4 | | 16 |
| 21001109810485 | | | | | 17 |
| 21001500601043 | 9 | | | | |
| 21001501700000 | 7 | | 6 | | |
| 21001501700863 | 8 | | | | |
| 21003403500025 | | 11 | | | |
| 21007400202954 | | 10 | | | |
| 21008103140410 | 11 | | | | |
| 21008103540163 | | | | 20 | |
| 21008103642258 | | 19 | | 13 | |
| 21008103901611 | | | | 11 | |
| 21008103911674 | | | | 12 | |
| 21008104400185 | 18 | 18 | 17 | | |
| 21008104540557 | 17 | 17 | 16 | | |
| 21008104601016 | | | | 18 | |
| 21008104640250 | 16 | 16 | 15 | 9 | |
| 21008104641546 | | | | 7 | |
| 21008104650367 | | | | 10 | |
| 21008104651675 | | | | 8 | |
| 21008104800066 | 15 | 15 | 14 | 5 | |
| 21008104810053 | | | | 6 | |
| 21008104840101 | 14 | 14 | 13 | 3 | |
| 21008104850246 | | | | 4 | |
| 21008104902459 | | 13 | 12 | | |
| 21008105100190 | 13 | 12 | 11 | 1 | |
| 21008105110135 | | | | 2 | |
| 21008105140000 | 2 | | 10 | | |
| 21008105502205 | 3 | 1 | 5 | | 6 |
| 21008105742141 | | | | 17 | |
| 21008304041288 | | 6 | 1 | 14 | |
| 21008304140000 | | | 2 | | |
| 21008304160483 | | | | | 11 |
| 21011400601951 | 20 | | | 16 | 9 |
| 21017400400367 | | | 20 | | |
| 21058100301760 | 12 | 3 | | 15 | 8 |
| 21058100600203 | | | | | 14 |
| 21058101200000 | | | 18 | | |
| 21064102401212 | | 20 | | | |
| 21101001201023 | | | | | 18 |
| 21101001201163 | | | | | 19 |
| 21101500100878 | | 4 | | | 7 |
| 21203500500000 | | | | | 12 |
| 21203500500133 | 1 | | | | 13 |
| 21707699021516 | 4 | | | | 15 |

TABLE 2-4 PennDOT Survey Responses for Dauphin County

| Structural ID Number | Bridge Rank | | | | |
|----------------------|-------------|------------|------------|------------|------------|
| | Engineer 1 | Engineer 2 | Engineer 3 | Engineer 4 | Engineer 5 |
| 22001100100000 | | | | | 8 |
| 22002200500208 | 6 | 3 | 6 | 6 | 4 |
| 22002200900000 | | | | | 7 |
| 22002201501231 | | | | | 17 |
| 22002202310000 | | 11 | | | 6 |
| 22002202901786 | | | | 9 | |
| 22002202911867 | | | | 10 | 9 |
| 22002204200000 | 9 | | | | |
| 22003903300000 | | 20 | | | 18 |
| 22008106520000 | 2 | 2 | 1 | 2 | 2 |
| 22008106601047 | | 8 | 9 | | 11 |
| 22008106811866 | | 9 | | | |
| 22008106851552 | | 10 | 10 | | |
| 22008106940918 | | | 7 | | |
| 22008107750790 | | 17 | | | |
| 22008107852486 | | 16 | | | |
| 22008304200000 | 1 | 1 | 2 | 1 | 1 |
| 22008304340000 | | 5 | 11 | 14 | |
| 22008304340713 | | 6 | 12 | | |
| 22008304601012 | | 7 | | | |
| 22008304611029 | | | | 7 | |
| 22008304650343 | | | | | 12 |
| 22008304952447 | | 12 | | | |
| 22008305011814 | | | 8 | | |
| 22014700403231 | 19 | 15 | | | 16 |
| 22014703100842 | 20 | | | | |
| 22022500540371 | | 13 | | | |
| 22022501301860 | 17 | 14 | | | 15 |
| 22028300252054 | | | | 8 | 13 |
| 22030000100964 | 12 | | | | |
| 22030000710851 | 13 | 18 | | | |
| 22030001812288 | 16 | | | | |
| 22032201700000 | 11 | 19 | | 13 | 10 |
| 22044100802058 | 18 | | | | |
| 22300901900601 | 7 | | 4 | | |
| 22301200300000 | 4 | | 15 | 5 | 5 |
| 22301200800233 | | | 17 | 12 | |
| 22301400300190 | 8 | | 16 | 11 | 19 |
| 22301600100000 | 3 | | 5 | 4 | 3 |
| 22302200200250 | 14 | | | | |
| 22303400100000 | | | 18 | | 20 |
| 22707699024665 | 5 | 4 | 3 | 3 | 14 |
| 22707699024676 | | | 13 | | |
| 22707699024709 | | | 14 | | |
| 22801805000557 | 15 | | | 15 | |

The EMS survey involved the input of an emergency management specialist working in Dauphin County. The survey was similar to the PennDOT survey.

After all of the analytic methods listed above were examined, the method(s) that best corresponded to the above comparison rankings were chosen for possible modification. The methods were compared using average rankings which were determined in two ways. The average ranking for the methods is determined by averaging the rankings from all methods for the bridges ranked in the top 20 by the method being investigated. The average ranking for the surveys is determined by taking the average bridge rank from the method being investigated for the bridges ranked in the top 20 by a survey. A low average indicates that the bridges being investigated are ranked high in importance. Therefore, as the average ranking value decreases, the correlation between the comparison ranking and the method being examined increases. Tables of all of the comparison rankings are given in Appendix C.

A summary of these average rankings are given in table 2-5. The method with the lowest cumulative average indicates the best method because it ranks all bridges closest to the five comparison rankings. The examined methods were modified later in an attempt to provide results similar to the comparison rankings.

TABLE 2-5 Average Results for the Comparison Rankings

| Importance Method | Methods for Dauphin County | Methods for Cumberland County | PennDOT Survey for Dauphin County | PennDOT Survey for Cumberland County | EMS Survey for Dauphin County | Cumulative Average |
|-------------------|----------------------------|-------------------------------|-----------------------------------|--------------------------------------|-------------------------------|--------------------|
| B&H | 86.7 | 72.0 | 79.3 | 105.5 | 133.3 | 95.4 |
| Modified B&H | 79.2 | 69.0 | 67.0 | 75.7 | 135.0 | 85.2 |
| Buckle | 46.6 | 114.0 | 96.0 | 91.5 | 182.9 | 106.2 |
| Modified Buckle | 48.0 | 115.6 | 99.5 | 104.1 | 184.9 | 110.4 |
| Caltrans | 58.4 | 59.4 | 77.5 | 96.3 | 171.4 | 92.6 |
| Montana | 78.3 | 66.8 | 56.7 | 55.6 | 118.5 | 75.2 |
| Nevada | 52.9 | 66.4 | 73.2 | 89.8 | 164.2 | 89.3 |
| Missouri | 66.5 | 80.5 | 66.8 | 77.9 | 150.1 | 88.3 |
| IDOT | 54.3 | 65.1 | 66.9 | 68.0 | 108.0 | 72.5 |

Note: B&H is an abbreviation for Babaei & Hawkins

The three methods that compared best to the five comparison rankings were chosen for further analysis and/or modification. The three methods, in order of lowest cumulative average of the comparison rankings, were:

- IDOT Method

$$I = 0.69 * \text{Vehicles Impacted} + 0.15 * \text{Emergency Route} + 0.10 * \text{Detour} + 0.05 * \text{Defense Route} + 0.01 * \text{Utilities}$$

where:

"on" indicates the critical route on the bridge

"under" indicates the critical route under the bridge

$$\text{Vehicles Impacted} = \frac{\text{ADT}_{\text{on}}(\text{Length}_{\text{bridge}} + 72) + \text{ADT}_{\text{under}}(\text{Deck width} + 72)}{1,546,400}$$

Emergency Route was not used in this equation.

$$\text{Detour} = \frac{\text{ADT}_{\text{on}} * \text{detour length}_{\text{on}}}{161,000} + \frac{0.39 * (\text{ADT}_{\text{under}} * \text{detour length}_{\text{under}})}{161,000} + 15 * I_{\text{NW}} + 5 * I_{\text{RR}}$$

$I_{\text{NW}} = 1$ if bridge is over navigable water

$I_{\text{RR}} = 1$ if bridge is over railroad

Defense Route = 0.8 for priority route on bridge

= 0.2 for priority route under bridge

= 0.7 for secondary route on bridge

= 0.1 for secondary route under bridge

= 0 for non-defense route

Utilities = 1 if utilities on bridge

- Montana Method

$$C = \frac{[(RT_{\text{carry}})(DL_{\text{carry}} * N_{\text{carry}})]}{0.34[(\text{ADT}_{\text{carry}}/6,000)(L)]^{0.25} + RV_{\text{cross}}} + \frac{2/3(RT_{\text{cross}})(DL_{\text{cross}} * N_{\text{cross}})}{0.34[(\text{ADT}_{\text{carry}}/6,000)(L)]^{0.25} + RV_{\text{cross}}}$$

where:

"carry" indicates the critical route on the bridge

"cross" indicates the critical route under the bridge

RT_{carry} = factor for the nature of the route

= 1.0; interstate route, principal artery, or confirmed emergency route

= 0.8; all other routes

DL_{carry} = factor representing criticality of detour length

= 1.20; When detour length > 155 km

= 1.00; When $80 \leq$ detour length < 155 km

= 0.90; When $15 \leq$ detour length < 80 km

= 0.80; When $5 \leq$ detour length < 15 km

= 0.70; When detour length < 5 km

N_{carry} = factor representing criticality of detour due to traffic congestion

= $\text{ADT}_{\text{carry}}/6,000]^{0.25} \geq 1$

$\text{ADT}_{\text{carry}}$ = average daily traffic of the route

RT_{cross} = factor representing the nature of the route

= 1.0; interstate route, principal artery, railroads, or confirmed emergency route

= 0.8; all other routes

DL_{cross} = factor representing criticality of detour length

= 1.20; When detour length > 155 km

= 1.00; When $80 \leq$ detour length < 155 km

= 0.90; When $15 \leq$ detour length < 80 km

$$\begin{aligned}
&= 0.80; \text{ When } 5 \leq \text{detour length} < 15 \text{ km} \\
&= 0.70; \text{ When detour length} < 5 \text{ km} \\
N_{\text{cross}} &= \text{factor representing criticality of detour due to traffic congestion} \\
&= \text{ADT}_{\text{cross}}/6,000]^{0.25} >= 1 \\
\text{ADT}_{\text{cross}} &= \text{average daily traffic} \\
L &= \text{length of the bridge(m)} \\
\text{RV}_{\text{cross}} &= 3.28*10^{-3}*L \text{ for river crossings}
\end{aligned}$$

- Modified Babaei and Hawkins Method

$$C = \frac{[(\text{RN}_{\text{carry}})(\text{DL}_{\text{carry}}*\text{N}_{\text{carry}})] + [\text{UT}_{\text{carry}}] + (2/3)[(\text{RN}_{\text{cross}})(\text{DL}_{\text{cross}}*\text{N}_{\text{cross}})] + 0.34[(\text{ADT}_{\text{carry}}/6,000)(L)]^{0.25}}{1}$$

where:

"carry" indicates the critical route on the bridge

"cross" indicates the critical route under the bridge

RN_{carry} = factor for the nature of the route

= 1.0; interstate route, principal artery, or confirmed emergency route
= 0.8; all other routes

DL_{carry} = factor representing criticality of detour length

= 1.00; When detour length > 15 km
= 0.80; When $5 \leq$ detour length < 15 km
= 0.75; When detour length < 5 km

N_{carry} = factor representing criticality of detour due to traffic congestion

= $\text{ADT}_{\text{carry}}/6,000]^{0.25} >= 1$

$\text{ADT}_{\text{carry}}$ = average daily traffic of the route

UT_{carry} = factor representing utility lines

= 1; bridge carrying a confirmed essential utility line
= 0; all other bridges

RN_{cross} = factor representing the nature of the route

= 1.0; confirmed emergency route
= 0.8; all other routes
= 0.0; no route under the bridge

DL_{cross} = factor representing criticality of detour length

= 1.00; When detour length > 15 km
= 0.80; When $5 \leq$ detour length < 15 km
= 0.75; When detour length < 5 km

N_{cross} = factor representing criticality of detour due to traffic congestion

= $\text{ADT}_{\text{cross}}/6,000]^{0.25} >= 1$

$\text{ADT}_{\text{cross}}$ = average daily traffic

L = length of the bridge(m)

The Montana method is also a modification of the Babaei and Hawkins method. The Modified Babaei and Hawkins method uses a utility factor, 1 or 0, instead of the river crossing factor in the Montana method. Therefore, the results of the two methods were similar. As previously noted, in order to automate the importance screening, any data not required in the NBI records should be eliminated. While both New York and Pennsylvania keep utility data, it is not required. Therefore, a utility factor should not be included in the proposed importance equation. Thus,

methods which required a utility factor or comparable human input would have to be modified or eliminated. In this context, the Modified Babaei and Hawkins method was eliminated.

In summary, after a comparison of eight importance methods and four initial modified methods, two methods were selected for further evaluation through systematic variation of parameters.

SECTION 3 DEVELOPMENT OF PROPOSED IMPORTANCE METHOD

Several modifications were performed on both the Illinois Department of Transportation (IDOT) and Montana methods in an effort to increase the correlation of the methods to the five comparison rankings.

3.1 Modified IDOT

Twelve variations of the IDOT methods were investigated. These methods included changes to the ADT reference values, detour mile coefficients, rail traffic considerations and importance equation coefficients. The twelve variations are combinations of the adjustments listed below. Table 3-1 provides the adjustment combinations for each variation. The reasoning for those adjustments are described as follows:

- The emergency route factor was deleted. This was done because some states, like Pennsylvania and New York, do not keep this information in their BMS file. Also, defining an emergency route can be subjective.
- The emergency route factor was replaced partially by a rail traffic factor. The IDOT method gave little importance to railroad bridges. The IDOT method ranked railroad bridges much lower than the five comparison rankings. Therefore, it was decided to use part of the emergency route portion of the IDOT Importance as a railroad consideration.
- In the vehicle detour factor, the coefficient for the route under the bridge was increased while the navigable water coefficient was decreased. This was done to bring the maximum possible importance contribution from these items nearly equal i.e., the maximum ADT_{under} importance = water crossing importance. Responses from the survey of the 50 states indicate that there are two bases for importance rankings, loss of life and cost of replacement. Therefore, the maximum loss of life under the bridge was considered to be as important as the largest replacement costs. It was assumed that navigable waters are usually the largest bodies of water and therefore incur the largest replacement costs.
- The detour length for the route under the bridge was set at a constant of 1.6 kilometers, due to the fact that both New York and Pennsylvania do not keep this information in their database. In their opinion, this data is not necessary because the closing of a route under the bridge would be temporary and could be easily cleared. This modification works in conjunction with an increased "under" coefficient in the vehicle detour factor.
- The importance equation coefficients were modified to increase the importance of rural routes by decreasing the ADT effects and increasing the detour length effects. This revision was implemented in an attempt to increase the correlation with the EMS evaluation. EMS apparently rated bridge importance based on accessing rural areas.
- Average ADT and detour length reference values were investigated. Average values were investigated to allow each state to customize the importance equation. Every state has different typical traffic volumes and detour lengths. Therefore, an appropriate reference value for one state

may not be appropriate for another.

- The importance equation coefficient for defense routes was increased from 0.05 to 0.10. This was revised in part to account for deleting the emergency route factor.

TABLE 3-1 Variations of the IDOT Method

| Variation | Coefficient | | | | | ADT Reference Value | Additional IDOT Equation Adjustments (see original IDOT equation on page 5) |
|---|-------------|------|------|------|------|---------------------|---|
| | A | B | C | D | E | | |
| MIDOT | 0.70 | 0.14 | 0.10 | 0.01 | 0.05 | 161,000 | Detour: Remove DL_{under} Detour: ADT_{under} coefficient from 0.39 to 5 |
| M&M1 | 0.60 | 0.20 | 0.10 | 0.01 | 0.09 | 161,000 | see MIDOT |
| M&M2 | 0.65 | 0.15 | 0.10 | 0.01 | 0.09 | 161,000 | see MIDOT and Detour: I_{NW} coefficient from 15 to 20 |
| M&M3 | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | 161,000 | see MIDOT |
| M&M4 | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | 161,000 | see MIDOT and Detour: I_{NW} coefficient from 15 to 5 |
| M&M5 | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | 161,000 | see M&M4 and Defense: Coefficients from 0.8, 0.2, 0.7, 0.1 and 0.0 to 1.0, 0.6, 0.9, 0.4 and 0.0, respectively |
| M&M6 | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | 161,000 | see M&M4 and Defense: Coefficients from 0.8, 0.2, 0.7, 0.1 and 0.0 to 1.0, 0.4, 0.6, 0.3 and 0.0, respectively |
| M&M4a | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | 80,500 | see M&M4 |
| M&M4b | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | 241,500 | see M&M4 |
| M&M4c | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | Y | see M&M4 and $Y = \text{data average of } (ADT_{carry} * DL_{carry})$ |
| M&M4d | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | Z | see M&M4 and $Z = \text{data average } ADT_{carry} * \text{data average } DL_{carry}$ |
| M&M4e | 0.50 | 0.30 | 0.10 | 0.01 | 0.09 | 2*Y | see M&M4 |
| Modified Equation: $I = A * \text{Vehicles Impacted} + B * \text{Detour} + C * \text{Defense Route} + D * \text{Utilities} + E * \text{Rail}$ | | | | | | | |

These 12 variations were compared against each other using the same comparison ranking concepts that were described in section 2. A summary of the average rankings are given in table 3-2.

TABLE 3-2 Average Results for IDOT Variations

| Variation | Methods for Dauphin County | Methods for Cumberland County | PennDOT Survey for Dauphin County | PennDOT Survey for Cumberland County | EMS Survey for Dauphin County | Cumulative Average | Standard Deviation |
|-----------|----------------------------|-------------------------------|-----------------------------------|--------------------------------------|-------------------------------|--------------------|--------------------|
| MIDOT | 47.5 | 64.6 | 69.6 | 64.7 | 123.0 | 73.9 | 25.7 |
| M&M1 | 47.0 | 70.8 | 70.7 | 151.8 | 127.0 | 93.4 | 39.3 |
| M&M2 | 49.4 | 69.4 | 69.1 | 102.3 | 123.2 | 82.7 | 26.4 |
| M&M3 | 56.2 | 73.9 | 154.7 | 245.4 | 146.5 | 135.3 | 67.3 |
| M&M4 | 48.7 | 60.7 | 53.8 | 71.0 | 113.6 | 69.5 | 23.3 |
| M&M5 | 51.4 | 62.8 | 58.6 | 72.1 | 119.0 | 72.8 | 24.0 |
| M&M6 | 52.6 | 55.6 | 57.2 | 69.6 | 117.2 | 70.4 | 24.1 |
| M&M4a | 45.2 | 63.4 | 53.8 | 76.2 | 111.2 | 70.0 | 23.1 |
| M&M4b | 52.9 | 60.1 | 53.1 | 68.7 | 114.4 | 69.9 | 23.0 |
| M&M4c | 45.2 | 63.4 | 53.8 | 80.0 | 111.3 | 70.7 | 23.3 |
| M&M4d | 48.7 | 63.4 | 54.0 | 77.3 | 113.5 | 71.4 | 23.2 |
| M&M4e | 48.7 | 62.2 | 53.8 | 73.4 | 113.4 | 70.3 | 23.1 |

The M&M4c and M&M4d average reference values produced similar results to M&M4 for Dauphin County. The results for Cumberland County had a lower correlation than using a set ADT reference value of 161,000. Therefore, the concept of an average reference value was disregarded as a viable option in the IDOT variations.

Several of the variations obtained similar results. M&M5 and M&M6 used the M&M4 equation with variations of defense route coefficients. The defense route coefficients caused only minor differences in the results. However, none of them were improvements upon the M&M4 variation. The method with lowest cumulative average ranking and standard deviation for the five comparison rankings was M&M4 as shown in table 3-2. The M&M4 equation is given below:

M&M4 Equation:

$$I = 0.5 * \text{Vehicles Impacted} + 0.3 * \text{Detour} + 0.1 * \text{Defense Route} + 0.01 * \text{Utilities} + 0.09 * \text{Rail}$$

where:

$$\text{Detour} = (\text{ADT}_{\text{on}} * \text{detour length}_{\text{on}}) / 161,000 + 5 * \text{ADT}_{\text{under}} / 161,000 + 5 * I_{\text{NW}} + 5 * I_{\text{RR}}$$

$I_{\text{NW}} = 1$ if bridge is over navigable water

$I_{\text{RR}} = 1$ if bridge is over railroad

Rail = 1 if bridge carries railroad

Other variables are the same as previously defined for the IDOT method.

3.2 Modified Montana

Seven variations of the Montana equations were investigated. These methods included adjustments to ADT reference values, bridge length reference values, rail traffic considerations and route importance values. The seven variations are combinations of the adjustments listed below. Table 3-3 provides the adjustment combinations for each variation. The reasoning for the adjustments mentioned above are described as follows:

- The Detour length_{under} variable was replaced with a constant value of 0.9 because of a lack of data in the BMS files for this item. The value, 0.9, corresponds to a detour length of 15 to 80 kilometers in the original Montana method.
- The ADT reference values were changed to an average database ADT value to allow each state to customize the reference value to their traffic. The reference value of 6000 used in Montana does not compare with Washington's reference value of 30,000. Therefore, an appropriate reference value for one state may not be appropriate for another. The average database ADT, Ave ADT, is determined by taking the sum of all the controlling ADT values for the feature being carried by a structure, ADT_{carry} , and dividing by the number of bridges in the database. This adjustment sets $N_{carry} = 1$ for a bridge with a traffic volume equivalent to the average for that state.
- The N_{carry} equation was replaced by a constant value of 1 for bridges carrying rail traffic. This sets a railroad bridge equal to a highway bridge with an average ADT for the "carry" factor in the importance equation. Without this modification, the ADT of a railroad bridge is 0, which results in railroad bridges being ranked very low.
- The river crossing reference value was replaced by a value equal to the maximum bridge length in the specified database, L_{max} . Therefore, this portion of the equation can not exceed 1. This will increase the effects of the route on the bridge, thus increasing the importance of rural bridges and improving the correlation with the EMS survey. Rural routes in the test databases tended to be small river crossings. The structural importance of a rural route depends highly on the route it is carrying. Therefore, this adjustment tended to have a larger effect on the importance of rural routes.
- The route type coefficients were modified to increase correlation with EMS. The route coefficients were increased for routes on the bridge and decreased for routes under the bridge. This increased the importance of the route on the structure, which tended to have more of an affect on rural bridges.

TABLE 3-3 Variations of the Montana Method

| Variation | ADT Reference Value | N _{carry} for railroads | River Crossing Reference | DL _{cross} | RT _{carry} | RT _{cross} |
|-----------|---------------------|----------------------------------|--------------------------|---------------------------------------|---------------------|---------------------|
| MNT1 | Ave ADT | 0.0 | 3.28*10 ⁻³ | 0.9 for Railroads, 1.0 for all others | 1.0, 0.8 | 1.0, 0.8 |
| MNT2 | Ave ADT | 1.0 | 3.28*10 ⁻³ | 0.9 for Railroads, 1.0 for all others | 1.0, 0.8 | 1.0, 0.8 |
| MNT3 | Ave ADT | 1.0 | L _{max} | 0.9 for Railroads, 1.0 for all others | 1.0, 0.8 | 1.0, 0.8 |
| MNT4 | Ave ADT | 1.0 | L _{max} | 0.9 for Railroads, 1.0 for all others | 1.1, 0.9 | 1.0, 0.8 |
| MNT5 | Ave ADT | 1.0 | L _{max} | 0.9 for all | 1.1, 0.9 | 0.9, 0.8 |
| MNT6 | Ave ADT | 1.0 | L _{max} | 0.9 for Railroads, 1.0 for all others | 1.1, 0.9 | 0.9, 0.7 |
| MNT7 | 1.25*Ave ADT | 1.0 | L _{max} | 0.9 for Railroads, 1.0 for all others | 1.1, 0.9 | 0.9, 0.8 |

The seven variations were compared against each other by the same comparison ranking concepts from section 2. A summary of the average rankings are given in table 3-4.

TABLE 3-4 Average Results for Montana Variations

| Variation | Methods for Dauphin County | Methods for Cumberland County | PennDOT Survey for Dauphin County | PennDOT Survey for Cumberland County | EMS Survey for Dauphin County | Cumulative Average | Standard Deviation |
|-----------|----------------------------|-------------------------------|-----------------------------------|--------------------------------------|-------------------------------|--------------------|--------------------|
| MNT1 | 72.1 | 63.5 | 57.2 | 100.2 | 118.0 | 82.2 | 23.2 |
| MNT2 | 72.1 | 54.9 | 47.2 | 55.0 | 121.7 | 70.2 | 27.0 |
| MNT3 | 48.8 | 57.6 | 46.4 | 59.1 | 127.6 | 67.9 | 30.2 |
| MNT4 | 44.5 | 51.7 | 45.8 | 59.0 | 127.2 | 65.6 | 31.2 |
| MNT5 | 51.7 | 56.4 | 42.4 | 57.9 | 125.8 | 66.8 | 30.0 |
| MNT6 | 51.7 | 62.1 | 45.3 | 58.0 | 124.1 | 68.2 | 28.5 |
| MNT7 | 51.4 | 62.5 | 42.4 | 57.6 | 124.0 | 67.6 | 29.0 |

As shown in table 3-4, the three best methods were MNT4, MNT5 and MNT7. These three methods were chosen for further investigation because they had the lowest cumulative average and lower standard deviations. MNT4, MNT5 and MNT7 had different combinations of RT_{cross} coefficients. The "cross" factor of importance is not a major influencing factor in the Montana importance value.

In the MNT7 equation an ADT reference value of 1.25*Average ADT was used. The ADT reference value revision has more of an affect on bridges that do not receive a large portion of their importance value from ADT. Therefore, the most important structures were not affected with respect to rank due to the different reference value. However, the revised RT_{cross} coefficients did affect the distribution of the importance values. For the ADT and bridge length reference values, the average and maximum length, respectively, were used for both county databases. These adjustable reference values would allow each state to adjust these values to reflect their traffic and bridges. The maximum bridge length is the longest total structure in the database being ranked i.e. total distance from abutment to abutment not individual span length. This would help to prevent one state from getting an uneven distribution of importance values while another would get a more even distribution of values by using the same equation.

The basic equation for all three variations is given below:

Equation for the Montana Variations, MNT4, MNT5 and MNT7:

$$C = [(RT_{carry})(DL_{carry} * N_{carry})] + 0.6(RT_{cross} * N_{cross}) + 0.34[(ADT_{carry}/Ave ADT)(L)]^{0.25} + RV_{cross}$$

where:

Ave ADT = Average ADT_{carry} in the classification database

$N_{carry} = (ADT_{carry}/Ave ADT)^{0.25}$ for MNT4

$= (ADT_{carry}/Ave ADT)^{0.25}$ for MNT5

$= (ADT_{carry}/(1.25 * Ave ADT))^{0.25}$ for MNT7

$= 1$ for bridges carrying railroads (MNT4, MNT5 and MNT7)

$N_{cross} = (ADT_{cross}/Ave ADT)^{0.25}$ for MNT4

$= (ADT_{cross}/Ave ADT)^{0.25}$ for MNT5

$= (ADT_{cross}/(1.25 * Ave ADT))^{0.25}$ for MNT7

L_{max} = Maximum bridge length in the classification database

$RV_{cross} = L/L_{max}$ for river crossings

$RT_{carry} = 1.1$ or 0.9

$RT_{cross} = 1.0$ or 0.8 for MNT4

$= 0.9$ or 0.8 for MNT5

$= 0.9$ or 0.8 for MNT7

Other variables are the same as previously defined for the Montana method

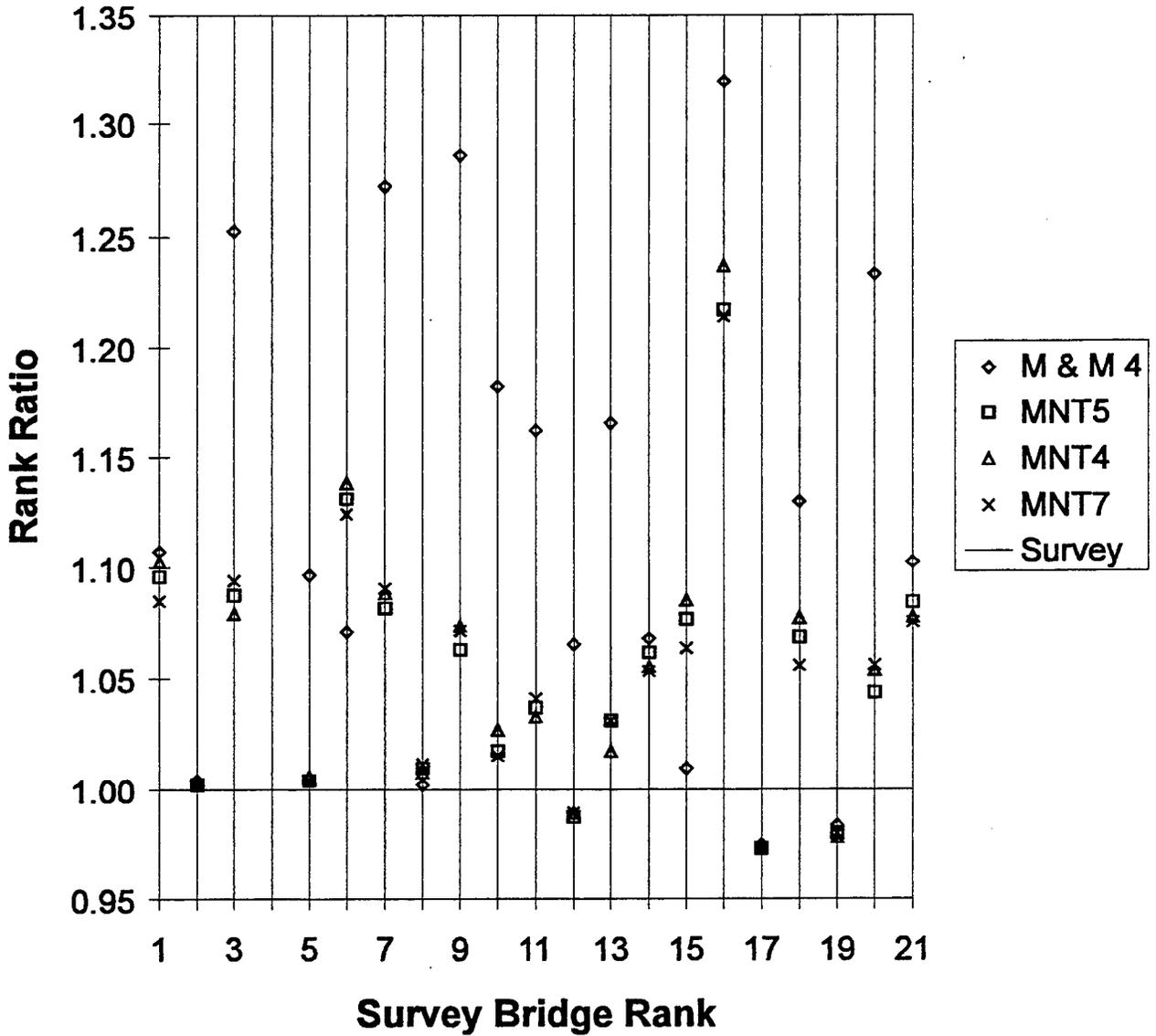
3.3 Comparison of M&M4, MNT4, MNT5 and MNT7

The revised modified IDOT and modified Montana methods, M&M4, MNT4, MNT5 and MNT7, were compared to each other in order to determine the recommended importance equation. The 20 or 21 bridge ranked most important by the surveys and their corresponding ranking by the modified methods were used as the final comparison. This comparison procedure was used throughout this investigation to aid in determining which parameter should be revised. Tables 3-5, 3-6, and 3-7 show the results of the M&M4, MNT4, MNT5, and MNT7 methods for Cumberland County PennDOT Survey, Dauphin County PennDOT Survey, and Dauphin County EMS Survey, respectively.

The rankings from tables 3-5, 3-6, and 3-7 were also graphed in figures 3-1, 3-2 and 3-3. The graphical comparison was based on a rank ratio, where the rank ratio relates the number of bridges ranked below a specific bridge by the survey to the number of bridges ranked below that bridge for a given importance method. The rank ratio equation is given in each of the figures 3-1, 3-2, and 3-3. A rank ratio greater than 1.0 means that a given importance method ranked the bridge lower than the survey. The ideal method would have a rank ratio of 1.0 for all bridges in the survey. A rank ratio was used because each importance rating method had a different range of importance values and each county had a different size database. The figures indicated graphically which bridge, if any, skewed the average results. If the results were skewed by one bridge, the method being investigated may be neglecting a controlling importance issue for that bridge.

TABLE 3-5 Cumberland County PennDOT Rankings

| Structure ID Number | SURVEY RANK | M&M4 RANK | MNT5 RANK | MNT4 RANK | MNT7 RANK |
|---------------------|-------------|-----------|-----------|-----------|-----------|
| 21008105502205 | 1 | 54 | 49 | 52 | 44 |
| 21001107600000 | 2 | 4 | 3 | 3 | 3 |
| 21008105100190 | 3 | 113 | 47 | 43 | 50 |
| 21058100301760 | 4 | 288 | 484 | 484 | 484 |
| 21008304041288 | 5 | 53 | 7 | 8 | 7 |
| 21001108701474 | 6 | 42 | 69 | 72 | 66 |
| 21008104840101 | 7 | 123 | 48 | 51 | 52 |
| 21001109800000 | 8 | 9 | 13 | 12 | 14 |
| 21008104800066 | 9 | 129 | 41 | 46 | 45 |
| 21101500100878 | 10 | 93 | 19 | 24 | 18 |
| 21008105140000 | 11 | 86 | 30 | 28 | 32 |
| 21001501700000 | 12 | 45 | 5 | 6 | 6 |
| 21008104640250 | 13 | 89 | 29 | 22 | 29 |
| 21203500500133 | 14 | 48 | 45 | 42 | 41 |
| 21707699021516 | 15 | 20 | 53 | 57 | 47 |
| 21008105110135 | 16 | 145 | 111 | 118 | 110 |
| 21008304140000 | 17 | 3 | 2 | 2 | 2 |
| 21011400601951 | 18 | 79 | 52 | 56 | 46 |
| 21001107400000 | 19 | 10 | 8 | 7 | 8 |
| 21008104850246 | 20 | 120 | 42 | 47 | 48 |
| 21008104902459 | 21 | 70 | 62 | 59 | 58 |
| Average Rank | - | 77.3 | 58.0 | 59.0 | 57.6 |
| Standard Deviation | - | 63.6 | 98.7 | 98.9 | 98.7 |



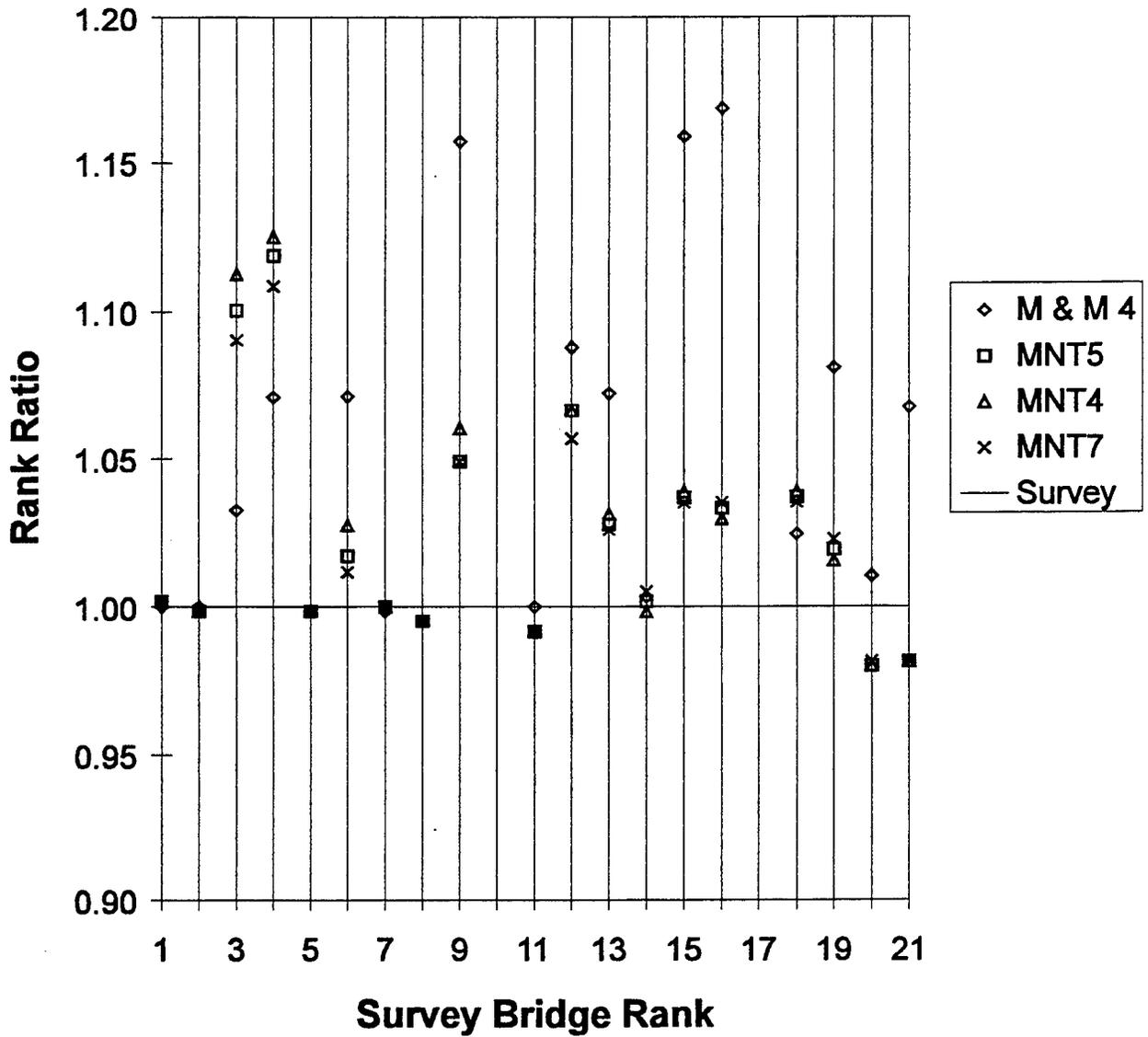
$$\text{Rank Ratio} = (\# \text{ of bridges} - \text{Survey Rank}) / (\# \text{ of bridges} - \text{Method Rank})$$

| Bridges not shown in graph | | | | |
|----------------------------|--------|--------|--------|--------|
| Survey Rank | M&M4 ◇ | MNT5 □ | MNT4 △ | MNT7 X |
| 4 | 2.09 | 8.38 | 8.38 | 8.38 |

FIGURE 3-1 Comparison with PennDOT Survey for Cumberland County

TABLE 3-6 Dauphin County PennDOT Rankings

| Structure ID Number | SURVEY RANK | M&M4 RANK | MNT5 RANK | MNT4 RANK | MNT7 RANK |
|---------------------|-------------|-----------|-----------|-----------|-----------|
| 22008304200000 | 1 | 1 | 2 | 2 | 2 |
| 22008106520000 | 2 | 2 | 1 | 1 | 1 |
| 22002200500208 | 3 | 22 | 58 | 64 | 53 |
| 22707699024665 | 4 | 44 | 68 | 71 | 63 |
| 22301600100000 | 5 | 4 | 4 | 4 | 4 |
| 22301200300000 | 6 | 46 | 16 | 22 | 13 |
| 22008106601047 | 7 | 6 | 7 | 7 | 7 |
| 22008304340000 | 8 | 5 | 5 | 5 | 5 |
| 22032201700000 | 9 | 90 | 37 | 43 | 37 |
| 22300901900601 | 10 | 196 | 253 | 260 | 223 |
| 22301400300190 | 11 | 11 | 6 | 6 | 6 |
| 22002202310000 | 12 | 60 | 49 | 49 | 44 |
| 22008304340713 | 13 | 53 | 29 | 31 | 28 |
| 22002202911867 | 14 | 16 | 15 | 13 | 17 |
| 22008106851552 | 15 | 96 | 36 | 37 | 35 |
| 22028300252054 | 16 | 101 | 35 | 33 | 36 |
| 22022501301860 | 17 | 198 | 226 | 228 | 227 |
| 22002200900000 | 18 | 32 | 39 | 40 | 38 |
| 22008106940918 | 19 | 63 | 30 | 28 | 32 |
| 22008304601012 | 20 | 26 | 8 | 8 | 9 |
| 22008304611029 | 21 | 58 | 10 | 10 | 10 |
| Average Rank | - | 53.8 | 44.5 | 45.8 | 42.4 |
| Standard Deviation | - | 55.5 | 66.1 | 67.5 | 61.8 |



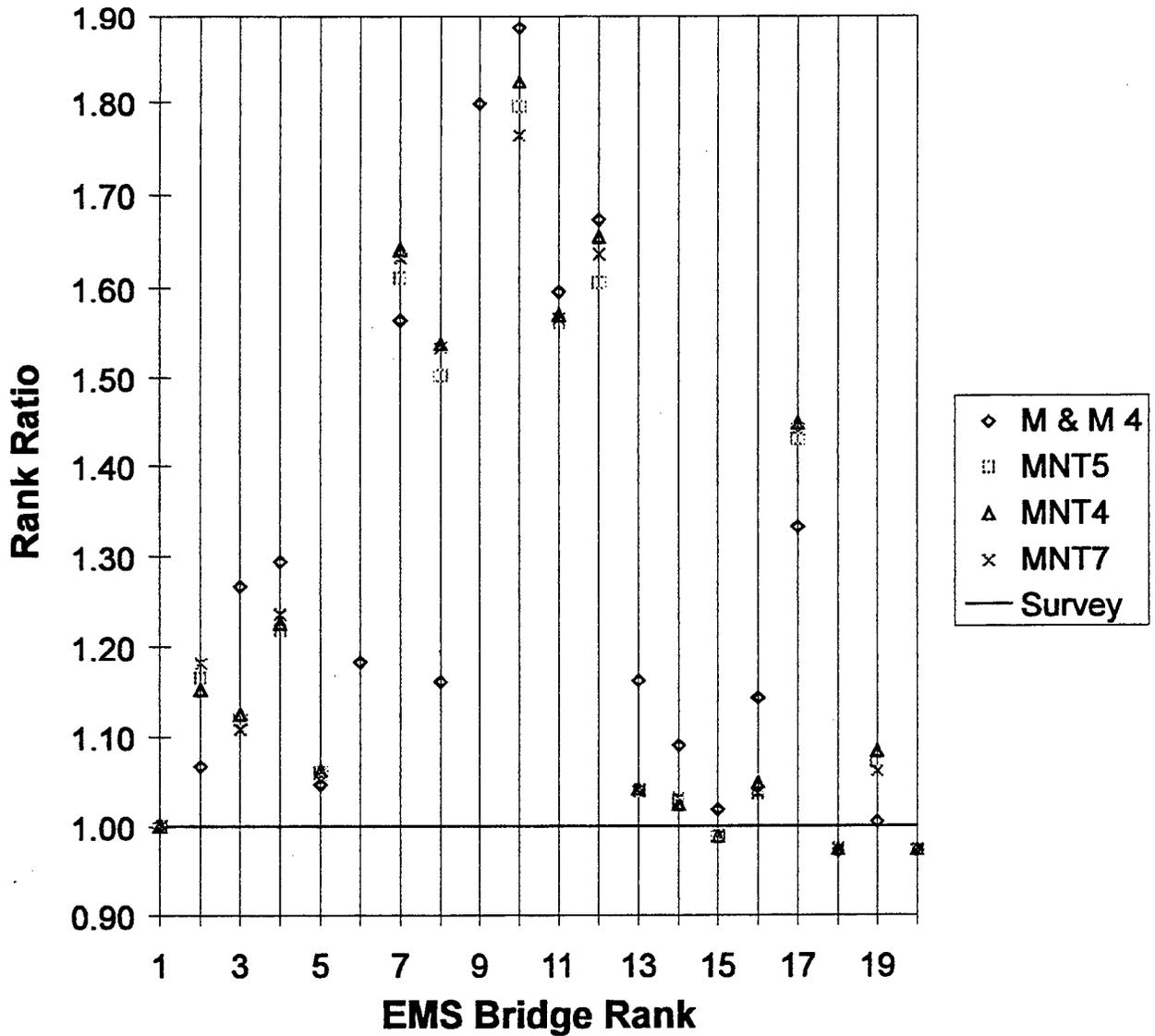
$$\text{Rank Ratio} = (\# \text{ of bridges} - \text{Survey Rank}) / (\# \text{ of bridges} - \text{Method Rank})$$

| Bridges not shown in graph | | | | |
|----------------------------|--------|--------|--------|--------|
| Survey Rank | M&M4 ◇ | MNT5 □ | MNT4 △ | MNT7 X |
| 10 | 1.45 | 1.69 | 1.72 | 1.56 |
| 17 | 1.44 | 1.55 | 1.56 | 1.55 |

FIGURE 3-2 Comparison with PennDOT Survey for Dauphin County

TABLE 3-7 Dauphin County EMS Rankings

| Structure ID Number | SURVEY RANK | M&M4 RANK | MNT5 RANK | MNT4 RANK | MNT7 RANK |
|---------------------|-------------|-----------|-----------|-----------|-----------|
| 22008106520000 | 1 | 2 | 1 | 1 | 1 |
| 22302100100000 | 2 | 40 | 88 | 82 | 95 |
| 22032200600000 | 3 | 130 | 67 | 70 | 62 |
| 22002201802643 | 4 | 141 | 112 | 115 | 119 |
| 22002200900000 | 5 | 32 | 39 | 40 | 38 |
| 22014700401898 | 6 | 99 | 321 | 323 | 323 |
| 22014702200000 | 7 | 223 | 234 | 241 | 239 |
| 22014703100842 | 8 | 91 | 208 | 217 | 216 |
| 22020900700000 | 9 | 274 | 315 | 317 | 316 |
| 22020901401722 | 10 | 290 | 274 | 279 | 268 |
| 22020902600000 | 11 | 233 | 225 | 227 | 226 |
| 22020903200000 | 12 | 251 | 236 | 247 | 243 |
| 22008106851552 | 13 | 96 | 36 | 37 | 35 |
| 22008106940918 | 14 | 63 | 30 | 28 | 32 |
| 22008304601012 | 15 | 26 | 8 | 8 | 9 |
| 22032201700000 | 16 | 90 | 37 | 43 | 37 |
| 22032202901298 | 17 | 164 | 194 | 199 | 197 |
| 22008304200000 | 18 | 1 | 2 | 2 | 2 |
| 22002200500208 | 19 | 22 | 58 | 64 | 53 |
| 22301600100000 | 20 | 4 | 4 | 4 | 4 |
| Average Rank | - | 113.6 | 124.5 | 127.2 | 125.8 |
| Standard Deviation | - | 93.5 | 110.2 | 112.0 | 111.2 |



$$\text{Rank Ratio} = (\# \text{ of bridges} - \text{Survey Rank}) / (\# \text{ of bridges} - \text{Method Rank})$$

| Bridges not shown in graph | | | | |
|----------------------------|--------|--------|--------|--------|
| Survey Rank | M&M4 ◇ | MNT5 □ | MNT4 △ | MNT7 X |
| 6 | N/A | 2.11 | 2.12 | 2.12 |
| 9 | N/A | 2.05 | 2.07 | 2.06 |

FIGURE 3-3 Comparison with EMS Survey for Dauphin County

The initial investigation of tables 3-5, 3-6 and 3-7 and figures 3-1, 3-2 and 3-3 indicated the necessity for further investigation of several of the bridge rankings.

The Cumberland County PennDOT results, table 3-5 and figure 3-1, shows that none of the methods gave similar results for the bridge ranked fourth by the survey. Upon investigation of the database, it was discovered that the file for that bridge had not been updated since the completion of the highway. The bridge record had an ADT of zero but the PennDOT survey was based on the four lane highway being open to traffic. Therefore, any rankings based on this bridge's database information would rank the bridge far below its actual importance. This discovery reinforced the researchers' opinion that requesting more BMS data than currently required would increase the BMS work load for each state and be met with resistance.

The Dauphin County PennDOT results, table 3-6 and figure 3-2, shows that none of the methods gave similar results for the bridges ranked 10th and 17th by the survey. The bridge ranked 10th by PennDOT is a railroad bridge crossing a 2 lane highway. The bridge ranked 17th by PennDOT is a rural 2 lane, 15.5 m (51') bridge crossing a stream.

The Dauphin County EMS results, table 3-7 and figure 3-3, shows that none of the methods gave similar results for the bridges ranked 6th through 12th by the survey. These bridges are rural routes providing access to small towns. Several of the typical characteristics of these bridges are as follows:

- ADT < 8900
- 2 lane bridges
- Stream crossing
- Average bridge length of 29 m (95 ft)

While the variation of the methods made attempts to increase the importance of routes similar to the ones described above, further increasing the correlation with these routes was not possible without sacrificing the importance of highway and interstate bridges with high traffic volumes.

After further comparison of M&M4, MNT4, MNT5, and MNT7, two methods were selected for the final comparison. The M&M4 method was selected because it resulted in the best correlation with the EMS Survey and the lowest standard deviation in both PennDOT Surveys. In addition, M&M4 was retained because it was a variation of the IDOT method unlike the other three. Since it was not known if a Montana or IDOT variation was the best method for a statewide database, a minimum of one variation of each was included for further comparison. Both the MNT5 and MNT7 methods compared better with the PennDOT Surveys than the M&M4 Method. The results between the MNT5 and MNT7 were similar for the three final comparison rankings. However, the MNT5 equation was preferred because the ADT reference value was the average ADT value.

The M&M4 and MNT5 methods were then used with the NYSDOT database to investigate their functionality with a different and larger database. Before the NYSDOT database investigation began, it was discovered that the maximum bridge length and average ADT used in MNT5 may not be appropriate due to the large differences encountered in a large database. The maximum bridge length of 12 558 m (41,200') in that database was of particular concern considering the original Montana method used a reference value of 305 m (1000'). The maximum bridge length is defined in the National Bridge Inventory Database as the distance from abutment joint to abutment joint. This length can be substantial as seen in the NYSDOT database. Therefore, a third modified method, MNT5M, was used. This method investigated a maximum bridge length reference value of 1610 m (5280'). It was decided not to alter the ADT reference value at this time.

The distribution of importance values is based on the number of bridges in the importance value percentile obtained by using the following equation:

$$\text{Importance Value Percentile} = (\text{Actual Value} - \text{Value}_{\min}) / (\text{Value}_{\max} - \text{Value}_{\min}) * 100$$

where:

Actual Value = importance value being investigated

Value_{max} = maximum importance value calculated in the database

Value_{min} = minimum importance value calculated in the database

After ranking the database with the three methods, the distribution of importance values were graphed in figure 3-4. The results from the original Montana and IDOT methods were included in the plot as a comparison to the original importance value distribution. As discussed in section 2, an effective importance method would limit the amount of interpretation of the results. If the bridge importance values are distributed evenly, there are no large groupings of bridges that require interpretation of results. This becomes more crucial as the importance of the structures increase. Therefore, an ideal distribution of structural importance would be as the importance value percentile increases, the number of bridges would decrease. This results in the most distinction where structural importance has the greatest affect in the design and retrofiting specifications, among "critical" and "essential" bridges.

It was determined that MNT5 and MNT5M produced similar results. However, MNT5 gave results with a more even distribution of bridge importance (see figure 3-4). Therefore, a maximum bridge length reference value was deemed unnecessary. MNT5 also produced a more even distribution than M&M4.

Based on this portion of study, MNT5 provides one of the most accurate importance rankings when compared to the five comparison rankings while giving the best distribution of importance. Therefore, MNT5 was selected as the importance ranking method. MNT5 considers the following bridge management data:

Route Carried

- Route type
- ADT
- Average ADT of bridges in database
- Detour length
- Bridge length
- Maximum bridge length in database
- Rail traffic

Route Crossed

- Route type
- ADT
- Rail crossing
- Water crossing

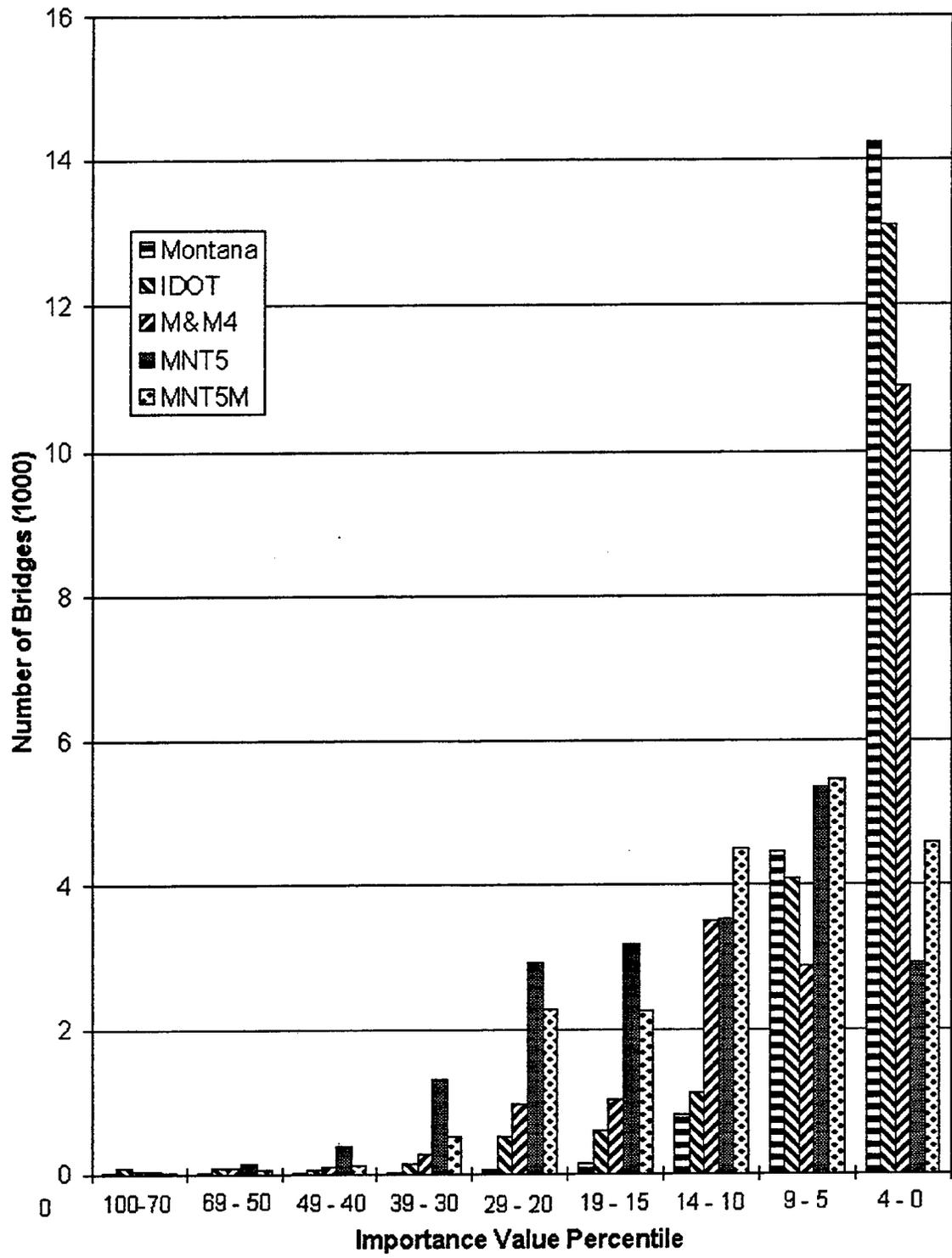


FIGURE 3-4 Distribution of NYSDOT Bridges by Importance Values

3.4 Importance Classification

Based on the analysis of the results discussed above, it is concluded that the MNT5 equation can then be used in the importance classification of bridges.

The next issue considered was the number of importance designations to be used in the in design specifications. The AASHTO "Standard Specification for Highway Bridges" currently uses two importance classifications, "essential" and "other". The "AASHTO LRFD Bridges Design Specification" uses three importance classifications, "critical", "essential", and "other". Further analysis of the PennDOT and NYSDOT BMS databases provided insight to this issue.

The MNT5 importance values versus the bridge rank percentile graphs for the Cumberland County, Dauphin County, and NYSDOT databases are shown in figures 3-5, 3-6, 3-7, respectively. The bridge rank percentile is based on the number of bridges with a lower importance ranking than the bridge being considered and can be obtained with the following equation:

$$\text{Bridge Rank Percentile} = \frac{\text{total number of bridges} - \text{current bridge rank}}{\text{total number of bridges}} * 100$$

If the importance value curves have significant extended changes in slope at specific rank percentiles, then that percentile may be interpreted as a change in the trend of bridge importance. These changes are considered as groups or classifications of bridges with similar structural importance.

Cumberland County importance values, shown in figure 3-5, have trend change points at approximately the 97th and 60th bridge rank percentiles. Dauphin County importance values, figure 3-6, have trend change points at approximately the 97th and 65th percentiles. NYSDOT importance values, figure 3-7, have trend change points at approximately the 95th and 70th percentile. All three databases showed three significant changes in the importance value trends. Therefore, the use of three bridge classifications, as used in the AASHTO LRFD Specification, corresponds better to these results. Most bridge classifications will be made using a state database instead of a county database. Therefore, more emphasis was placed on the NYSDOT results. Based solely on the NYSDOT results, the bridge importance classification divisions would be at the 95th and 70th bridge rank percentiles. The 95th percentile lower limit for "critical" bridges is considered acceptable because the lower limit for the smaller databases is the 97th percentile. However, the 70th percentile lower limit for "essential" bridges is too high when compared with the smaller databases. The smallest database, Cumberland County, has a limit of 60th percentile. The lower limit of 65th percentile for "essential" bridges is chosen because it is in agreement with the Dauphin County data and conservative when compared to the NYSDOT data.

In summary, three bridge importance classifications are indicated, designated herein following the LRFD terminology as "critical", "essential", and "other". The results of this study suggest that these classifications be divided by the 95th and 65th bridge rank percentiles.

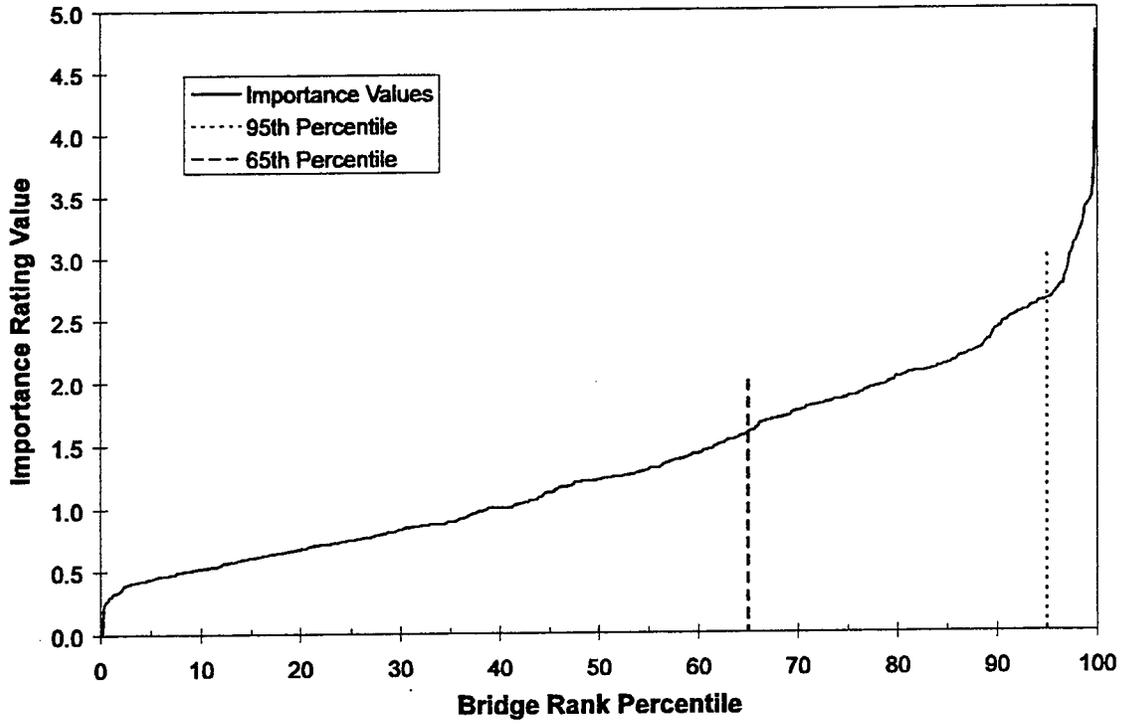


FIGURE 3-5 Cumberland County Importance Value Distribution

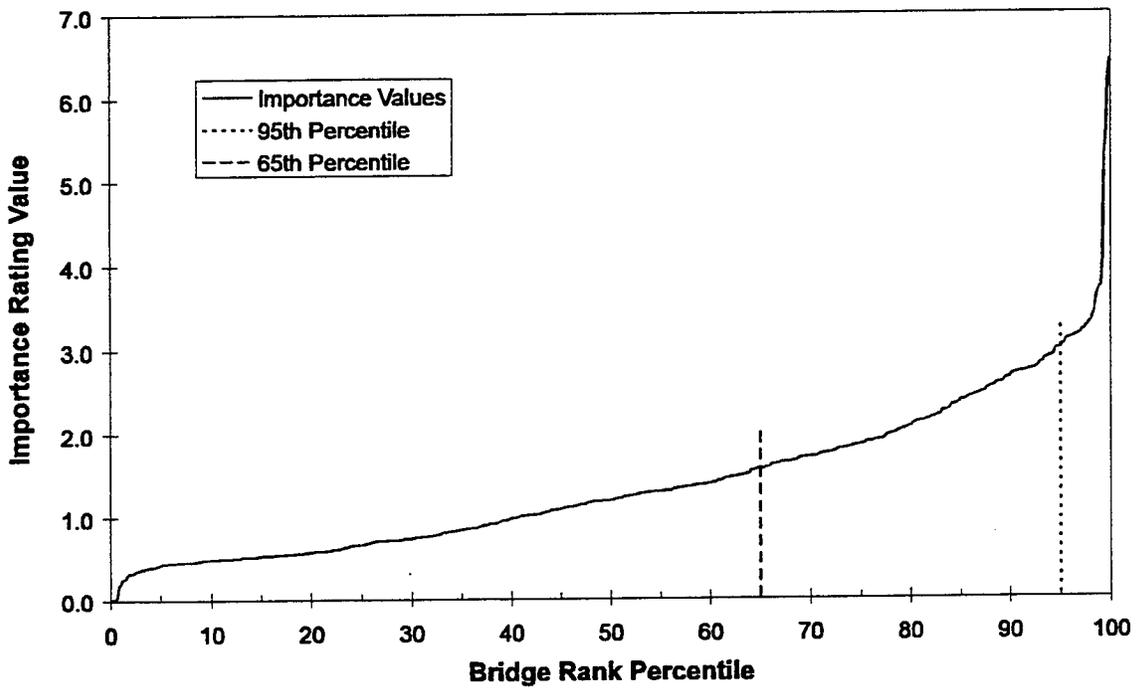


FIGURE 3-6 Dauphin County Importance Value Distribution

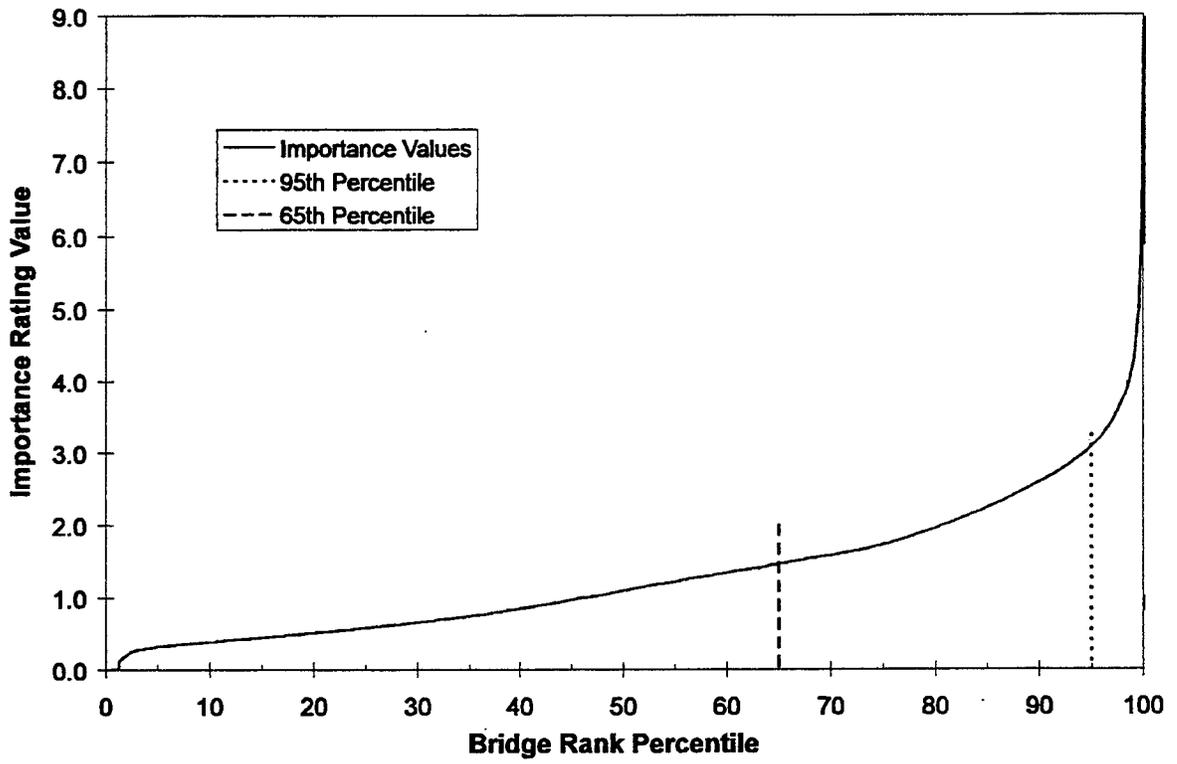


FIGURE 3-7 NYSDOT Importance Value Distribution

SECTION 4

REVIEW OF PROPOSED IMPORTANCE METHOD BY SELECTED STATES

Based on comments received from the NCEER Highway Project advisory committee in 1996, a survey on the recommended importance equation, MNT5, was sent to twenty states and one city. The survey included the following major items:

- Explanation of research task objectives,
- Questions regarding what method the agency currently uses to determine importance (if any),
- Questions regarding this task's proposed importance method,
- EXCEL spreadsheet macro to calculate the importance ranking using bridge management data.

A copy of the survey letter is provided in Appendix D. Table 4-1 provides a list of the states and city that were surveyed and their responses. New York City was included in the survey due to its large traffic volumes and number of bridges. However, New York City did not respond to the survey.

In general, the states responded positively to the MNT5 proposal. Based on the state comments, MNT5 was further modified and renamed MNT5R. The major state concerns are described and the corresponding equation modifications are discussed below.

Some of the comments from the states conflicted with one another as might be expected. For example, consider those received on the river crossing factor. Montana stated that river crossings were not making a large enough contribution to bridge importance. Their rationale was that construction costs for river crossings are much higher. Therefore, these bridges should be considered more important. Washington stated that the possibility of loss of life on a waterway was much less than on a roadway below the structure during a damaging earthquake. Therefore, the roadway crossing should be considered more important. Based on these conflicting responses, the MNT5 equation was not revised. The river crossing issue was considered a compromise between the two importance issues, cost of replacement and loss of life.

Montana and Alaska stated that the spread of the importance values, C , was not large enough. The equation was not modified based on these comments because this was believed to be more of a cosmetic issue. In the case of NYSDOT, the database contains 19,740 bridges. The distribution of the importance values are shown in figure 3-7. The bridges classified as "critical" and "essential" have a larger distribution of importance values. Importance will play a larger factor in the retrofitting or design scheme for "critical" and "essential" bridges. The importance values for "other" bridges are closer together. However, "other" bridges should not be retrofitted based solely upon importance. These structures will tend to be controlled by seismic vulnerability, retrofitting costs, and rehabilitation scheduling, none of which were considered in this task. Therefore, the smaller difference in the importance values is not significant. If a state believes that a larger spread is necessary, it could increase all of the RT values or use a percentage of C_{max} . The values, as presented, are giving relative importance and exact numbers are not as critical.

TABLE 4-1 Summary of Survey Responses

| Agency | Yes | No | Comments |
|------------------|-----|----|--|
| Alaska | X | | Ran macro and completed survey forms. |
| Arizona | | X | |
| California | | X | Called and asked questions, but never received a response. |
| Connecticut | X | | Completed survey forms, but did not run macro. No plans for changing current method of ranking bridges. |
| Hawaii | | X | |
| Idaho | | X | |
| Illinois | X | | Completed survey forms, but did not run macro. No plans for changing current method of ranking bridges. |
| Iowa | X | | Seismic Cat. A; therefore seismic retrofits not applicable |
| Kentucky | | X | |
| Missouri | | X | |
| Montana | X | | Ran macro and completed survey forms. |
| Nevada | | X | |
| New York - City | | X | Called and asked questions, but never received a response. |
| New York - State | X | | Completed survey forms, but did not run macro. No plans for changing current method of ranking bridges. |
| Oregon | X | | Completed survey forms, but did not run macro. No plans for changing current method of ranking bridges. |
| Pennsylvania | | X | |
| South Carolina | X | | Ran macro and completed survey forms. |
| Tennessee | | X | |
| Utah | | X | |
| Washington | X | | Ran macro and completed survey forms. |
| Wyoming | X | | Ran macro and completed survey forms. |

No = did not return the survey

Most of the states responded that the addition of railway considerations was an important factor in the importance issue. Some of the states had previously based railway bridge importance on ADT = 0. However, South Carolina and Wyoming stated that too much emphasis was being placed on

the railroads. In response to the railway concerns, the coefficients RT_{carry} and N_{carry} were revised to 0.9 and 0.8, respectively. This results in a 72% reduction in the "carry" factor of MNT5 for bridges carrying railways. Therefore the final recommended equation, MNT5R, is as follows:

$$C = \text{bridge importance value} \\ = [RT_{carry}(DL_{carry} * N_{carry})] + 0.6(RT_{cross} * N_{cross}) + 0.34[(ADT_{carry}/Ave ADT)L]^{0.25} + RV_{cross}$$

where:

"carry" indicates the critical route on the bridge;

"cross" indicates the critical route under the bridge;

RT_{carry} = Factor for nature of route:

= 1.1 for Interstate Route or Principal Artery,

= 0.9 for all other routes and railroad bridges;

DL_{carry} = Factor representing criticality of detour length:

= 1.2 for Detour Lengths > 155 km,

= 1.0 for 80 km < Detour Lengths ≤ 155 km,

= 0.9 for 15 km < Detour Lengths ≤ 80 km,

= 0.8 for 5 km < Detour Lengths ≤ 15 km,

= 0.7 for Detour Lengths ≤ 5 km,

= 1.0 for bridges carrying railroads;

N_{carry} = Factor representing criticality of traffic congestion:

= $(ADT_{carry}/Ave ADT)^{0.25}$,

= 0.8 for bridges carrying railroads;

ADT_{carry} = Average Daily Traffic on the bridge;

L = Bridge length(m);

RT_{cross} = Factor for nature of route:

= 0.8 for all routes and structures,

= 0.0 for no route or structure under the bridge;

N_{cross} = Factor representing criticality of traffic congestion:

= $(ADT_{cross}/Ave ADT)^{0.25}$,

RV_{cross} = Ratio of bridge length to longest bridge in the database:

= L/L_{max} ;

Ave ADT = Average ADT_{carry} in the classification database;

L_{max} = Maximum bridge length(m) in the classification database.

Illinois and Washington disagreed with the omission of the emergency route. As mentioned previously, the test databases from New York and Pennsylvania do not have this information. Therefore, it is suggested that if a state has this data, that state could increase C by 10% for a specified emergency route. This modification is included as commentary in the draft proposals of the specifications in order to allow individual states with specified emergency routes some freedom in adjusting the importance they want to assign to their emergency routes (see section 5). An example of a modified importance equation would be as follows:

$$C = ER * \{[(RT_{carry})(DL_{carry} * N_{carry})] + 0.6(RT_{cross} * N_{cross}) + \\ 0.34[(ADT_{carry}/Ave ADT)(L)]^{0.25} + RV_{cross}\}$$

where:

ER = 1.1 for confirmed emergency route
1.0 for others

Other variables are defined in the MNT5R method given above.

As shown in table 4-1, several of the responses from the states indicated that they were satisfied with their current method for evaluating importance and were unlikely to change. However, the recommended method will still be of value to agencies that have not finalized their bridge seismic screening and evaluation process.

SECTION 5 PROPOSED IMPORTANCE METHOD IN DESIGN AND RETROFIT SPECIFICATIONS

In section 3, a bridge importance classification system was proposed based on data from the NBI database. After evaluating comments received from several states, refinements to the proposed importance classification system were developed as documented in section 4. This section provides recommendations for implementing the proposed importance classification system into seismic design and retrofitting specifications. This implementation is based on inserting the proposed importance classification system into the specifications without changing the basic seismic design philosophies within each of the specifications.

5.1 The AASHTO "Standard Specifications for Highway Bridges", Division I-A

5.1.1 Abstract

The current AASHTO "Standard Specifications for Highway Bridges", Division I-A (from hence forth this specification will be referred to as Division I-A) provides for an Importance Classification with two categories:

- essential bridges and
- other bridges.

The commentary to Division I-A suggests items which should be considered when determining the classification. However, the Division I-A does not provide a method to formally categorize a bridge.

Section 3.4 suggests that an Importance Classification with three categories as given in the "AASHTO LRFD Bridge Design Specifications" should be used:

- critical bridges,
- essential bridges and
- other bridges.

In addition to the change from two to three Importance Classification categories, a method to determine the bridge classification category is included in the recommended revision. The recommended Importance Classifications are based on the bridge importance rank percentile.

In the determination of the Seismic Performance Category (SPC) the Division I-A specification only makes a distinction between "essential" and "other" bridges in regions with an acceleration coefficient, A , greater than 0.29. In order to make a distinction between the three proposed categories in Division I-A with respect to SPC, a classification coefficient, I_c , is assigned to each of the Importance Classification categories. The classification coefficients were developed such that the new minimum design requirements would not be less than previous requirements. The product, $A \cdot I_c$, is then compared to the previous limits for the acceleration coefficient, A . A maximum limit is placed on this product for "other" bridges to insure that the minimum seismic design requirements are not increased from the current Division I-A requirements for "other" bridges.

5.1.2 Recommended Specification Revision

The bold text given below is the suggested revision of Division I-A Sections 3.3 and 3.4 in SI units; Appendix E provides the suggested revision of Division I-A Sections 3.3 and 3.4 in customary U.S. units.

3.3 IMPORTANCE CLASSIFICATION

An Importance Classification (I_c) shall be assigned for all bridges for the purpose of determining the Seismic Performance Category (SPC) in Article 3.4 as follows:

$I_c = 1.2$ for **"critical" bridges**: those bridges which are required to remain functional for all traffic after an earthquake of the same magnitude as the design earthquake and provide at least a minimum level of functionality for emergency vehicles or for security/defense purposes immediately after a large earthquake, e.g., 2500 year return period event.

$I_c = 1.1$ for **"essential" bridges**: those bridges which are required to provide at least a minimum level of functionality for emergency vehicles or for security/defense purposes after an earthquake of the same magnitude as the design earthquake.

$I_c = 1.0$ for **"other" bridges**: all other bridges

The Importance Classification shall include Social/Survival and Security/Defense considerations. If the recommended classification method is used, these requirements shall be considered to be fulfilled. Factors such as socioeconomic or emergency route considerations may also be considered as deemed appropriate by the owner. A methodology for including emergency routes in the determination of structural importance is described in the commentary. Additional owner specified socioeconomic factors can be implemented similar to emergency routes or by the use of additional or modified RT_{carry} and/or RT_{cross} factors. The addition and/or modification of "RT" factors is preferred for socioeconomic factors because it will increase only the importance contribution of the route being considered. The emergency route method given in the commentary increases the contribution of all importance considerations as apposed to only the route being considered i.e., route carried, route crossed, river crossing, etc.

If the owner has a method to classify bridges as "critical", "essential" or "other" bridges, it may be used in lieu of the provisions specified herein. However, if the owner does not have an importance classification system in place, bridges may be classified using the following equation which is based on data from the National Bridge Inventory (NBI) Database:

$$C = \text{Bridge importance value} \\ = [RT_{carry}(DL_{carry} * N_{carry})] + 0.6(RT_{cross} * N_{cross}) + 0.34[(ADT_{carry}/\text{Ave ADT})L]^{0.25} +$$

RV_{cross}

where:

"carry" indicates the critical route on the bridge;

"cross" indicates the critical route under the bridge;

RT_{carry} = Factor for nature of route:
= 1.1 for Interstate Route or Principal Artery,
= 0.9 for all other routes and for railroad bridges;

DL_{carry} = Factor representing criticality of detour length:
= 1.2 for Detour Lengths > 155 km,
= 1.0 for 80 km < Detour Lengths ≤ 155 km,
= 0.9 for 15 km < Detour Lengths ≤ 80 km,
= 0.8 for 5 km < Detour Lengths ≤ 15 km,
= 0.7 for Detour Lengths ≤ 5 km,
= 1.0 for bridges carrying railroads;

N_{carry} = Factor representing criticality of traffic congestion:
= (ADT_{carry}/Ave ADT)^{0.25},
= 0.8 for bridges carrying railroads;

ADT_{carry} = Average Daily Traffic on the bridge;

L = Bridge length(m);

RT_{cross} = Factor for nature of route:
= 0.8 for all routes,
= 0.0 for no route under the bridge;

N_{cross} = Factor representing criticality of traffic congestion:
= (ADT_{cross}/Ave ADT)^{0.25};

RV_{cross} = Ratio of bridge length to longest bridge in the database:
= L/L_{max};

Ave ADT = Average ADT_{carry} in the classification database;

L_{max} = Maximum bridge length(m) in the classification database.

All bridges shall be ranked in order of importance, with the maximum importance value (C_{max}) being the most critical bridge in the classification database. After the bridges are ranked in order of importance, the bridge rank percentile shall be determined. Bridge

rank percentile is the percentage of bridges ranked lower than the bridge being considered and can be obtained by using the following equation:

$$\text{Bridge Rank Percentile} = (\text{total number of bridges} - \text{current bridge rank}) / (\text{total number of bridges}) * 100$$

These rank percentiles shall be used to determine the Importance Classifications:

"critical" bridges are those bridges in the 95th percentile or higher,

"essential" bridges are those bridges ranked in or above the 65th but below the 95th percentile,

"other" bridges are those bridges ranked below the 65th percentile.

DIVISION I-A COMMENTARY: C3.3

The importance rankings for the complete database are required for this importance classification method. Once the importance rankings have been developed, they may be used without recalculating them as long as the NBI Records are not revised. The Engineer shall then only be required to calculate the Importance Value, C, for new structures and determine their Importance Classification in the established rankings. For a new structure, an estimated ADT at the time of opening should be used in the calculation of the importance value, not the design ADT which is usually taken as a projected 20-year ADT. A projected ADT would not be comparable to existing structures with an established ADT and therefore skews the results towards all new structures having higher importance rankings.

If a state has confirmed emergency routes, the importance value, C, could be increased by 10% for that route. This is not included in the design specifications in order to allow individual states with specified emergency routes some freedom in adjusting the importance they want to assign to their emergency routes. An example of a modified importance equation would be as follows:

$$C = ER * \{ [(RT_{\text{carry}})(DL_{\text{carry}} * N_{\text{carry}})] + 0.6(RT_{\text{cross}} * N_{\text{cross}}) + 0.34[(ADT_{\text{carry}}/\text{Ave ADT})(L)]^{0.25} + RV_{\text{cross}} \}$$

where:

ER = 1.1 for confirmed emergency route
1.0 for others

If an owner has a method to rank bridges for seismic importance but does not have a method to assign the "critical", "essential", and "other" classifications, the bridge rank percentiles in the design specification may be used with the existing seismic importance

rankings to determine the Importance Classifications.

3.4 SEISMIC PERFORMANCE CATEGORIES

Each bridge shall be assigned to one of four Seismic Performance Categories (SPC), A through D, based on the Acceleration Coefficient, A , and the Importance Classification (I_c), as shown in Table 3.4. Minimum analysis and design requirements are governed by the SPC.

The product of the Acceleration Coefficient, A , and the Importance Classification, I_c , is only used to determine the SPC of a structure. The actual Acceleration Coefficient, A , shall be used in all other calculations.

TABLE 3.4 Seismic Performance Category (SPC)

| SPC | Range of $I_c A$ |
|---|--------------------------|
| *A | $I_c A \leq 0.09$ |
| B | $0.09 < I_c A \leq 0.19$ |
| C | $0.19 < I_c A \leq 0.29$ |
| **D | $0.29 < I_c A$ |
| * For "critical" bridges ($I_c = 1.2$), $I_c A > 0.09$ | |
| ** For "other" bridges ($I_c = 1.0$), $I_c A \leq 0.29$ | |

DIVISION I-A COMMENTARY: C3.4

The product $I_c A$ has a maximum value of 0.29 for "other" bridges. This maximum value is used to prevent an "other" bridge from being assigned to SPC D. This corresponds to the requirements of the AASHTO Sixteenth Edition of the Standard Specification of Highway Bridges, Division I-A.

The product $I_c A$ has a minimum value of 0.09 for "critical" bridges. This minimum value is used to prevent a "critical" bridge from being assigned to SPC A.

5.2 "AASHTO LRFD Bridge Design Specifications"

5.2.1 Abstract

The "AASHTO LRFD Bridge Design Specifications" (from hence forth, this specification will be

referred to as LRFD) provides for an Importance Classification with three categories:

- critical bridges,
- essential bridges and
- other bridges.

The LRFD Specification suggests items which should be considered when determining the classification. However, the specification does not provide a method to categorize a bridge. The proposed LRFD revision, given in the next subsection, has a recommended method for categorizing bridges. The recommended Importance Classifications are based on the bridge's importance rank percentile.

The specification specifies a response modification factor, R, based on the Importance Classification. Therefore, the design applications of the Importance Classifications are already included in the specifications.

5.2.2 Recommended Specification Revision

The bold text given below is the suggested revision to LRFD Sections 3.10.3, C3.10.3 and 4.7.4.3.1 for SI units; Appendix F provides the suggested revision of LRFD Sections 3.10.3 and C3.10.3 in customary U.S. units. If these articles are adopted, new definitions and references must be added to the notation and reference lists in LRFD Section 3.

3.10.3 Importance Categories

For the purpose of Article 3.10, the Owner shall classify bridges into one of three importance categories taken as:

- **critical bridges,**
- **essential bridges, or**
- **other bridges.**

The basis of classification shall include social/survival and security/defense requirements. Use of Equation 1 shall be considered as satisfying these requirements. Additional socioeconomic or emergency route considerations as deemed appropriate by the owner may be included in establishing Importance Classifications.

C3.10.3

"Essential" bridges are generally those that should, as a minimum, be open to emergency vehicles and for security/defense purposes immediately after the design earthquake, i.e., a 475-year return period event. However, some bridges must remain open to all traffic after the design earthquake and be usable by emergency vehicles and for security/defense purposes immediately after a large earthquake, e.g., a 2,500-year return period event. These should be regarded as "critical" bridges.

The addition and/or modification of "RT" factors is preferred for socioeconomic factors because it will increase only the importance contribution of the route being considered. The emergency route method given below increases the contribution of all importance considerations as apposed to only the route being considered i.e., route

Additional owner specified socioeconomic factors may also be implemented similar to emergency routes or by the use of additional or modified RT_{carry} and/or RT_{cross} factors. When classifying a bridge, consideration should be given to possible future changes in conditions and requirements.

Other owner approved methods to classify bridges as "critical", "essential" or "other" bridges may be used. Where such owner approved methods do not exist, importance classifications may be determined as specified herein based on data from the National Bridge Inventory (NBI) Records:

C = bridge importance value

$$= [RT_{carry}(DL_{carry}N_{carry})] + 0.6(RT_{carry}N_{cross}) + 0.34 \left[\left(\frac{ADT_{carry}}{AveADT} \right) L \right]^{0.25} + RV_{cross} \quad (3.10.3-1)$$

where:

"carry" indicates the critical route on the bridge;

"cross" indicates the critical route under the bridge;

RT_{carry} = Factor for nature of route:
 = 1.1 for Interstate Route or Principal Artery,
 = 0.9 for all other routes including railroads;

DL_{carry} = Factor representing criticality of detour length:
 = 1.2 for Detour Lengths > 155 km,
 = 1.0 for 80 km < Detour Lengths ≤ 155 km,
 = 0.9 for 15 km < Detour Lengths

carried, route crossed, river crossing, etc.

If a state has confirmed emergency routes, the importance value, **C**, could be increased by 10% for that route. This is not included in the design specifications in order to allow individual states with specified emergency routes some freedom in adjusting the importance they want to assign to their emergency routes. An example of a modified importance equation is:

C = bridge importance value

$$= ER [[RT_{carry}(DL_{carry}N_{carry})] + 0.6(RT_{carry}N_{cross}) + 0.34 \left[\left(\frac{ADT_{carry}}{AveADT} \right) L \right]^{0.25} + RV_{cross}]$$

(C3.10.3-1)

where:

ER = 1.1 for confirmed emergency route
 1.0 for others

- ≤ 80 km,
 - = 0.8 for 5 km < Detour Lengths ≤ 15 km,
 - = 0.7 for Detour Lengths ≤ 5 km,
 - = 1.0 for bridges carrying railroads;
- N_{carry} = Factor representing criticality of traffic congestion:
 - = $(\text{ADT}_{\text{carry}}/\text{Ave ADT})^{0.25}$,
 - = 0.8 for bridges carrying railroads;
- $\text{ADT}_{\text{carry}}$ = Average Daily Traffic on the bridge;
- L = Bridge length(m);
- RT_{cross} = Factor for nature of route:
 - = 0.8 for all routes,
 - = 0.0 for no route under the bridge;
- N_{cross} = Factor representing criticality of traffic congestion:
 - = $(\text{ADT}_{\text{cross}}/\text{Ave ADT})^{0.25}$;
- RV_{cross} = Ratio of bridge length to longest bridge in the database:
 - = L/L_{max} ;
- Ave ADT= Average $\text{ADT}_{\text{carry}}$ in the classification database;
- L_{max} = Maximum bridge length(m) in the classification database.

All of the bridges shall be ranked in order of importance, with the maximum importance value (C_{max}) being the most critical bridge in the classification database. After the bridges are ranked in order of importance, the bridge rank percentile shall be determined as:

$$\text{Bridge Rank Percentile} = \frac{\text{(total number of bridges - current bridge rank)}}{\text{(total number of$$

The importance rankings for the complete database are required for this importance classification method to be used. Once the importance rankings for the complete database have been developed, they may be used without recalculating them as long as the NBI Records are not revised. The Engineer shall then only be required to calculate the Importance Value, C , for new structures and determine their

bridges)*100

(3.10.3-2)

These rank percentiles shall be used to determine the Importance Classifications:

"critical" bridges are those bridges in the 95th percentile or higher,

"essential" bridges are those bridges ranked in or above the 65th but below the 95th percentile,

"other" bridges are those bridges ranked below the 65th percentile.

Importance Classification in the established rankings. For a new structure, an estimated ADT at the time of opening should be used in the calculation of the importance value, not the design ADT which is usually taken as a projected 20-year ADT. A projected ADT would not be comparable to existing structures with an established ADT and therefore skews the results towards all new structures having higher importance rankings.

Bridge rank percentile is the percentage of bridges ranked lower than the bridge being considered. If an owner has a method to rank bridges for seismic importance but does not have a method to assign the importance classifications, the bridge rank percentiles may be used with the existing seismic importance rankings to determine the importance classifications.

4.7.4.3.1 Selection of Method (insert before Table 1)

When determining the minimum analysis requirements from Table 1, the bridge importance categories as defined in Article 3.10.3 shall be used.

5.3 The FHWA "Seismic Retrofitting Manual for Highway Bridges"

5.3.1 Abstract

Like Division I-A, the current FHWA "Seismic Retrofitting Manual for Highway Bridges" (from hence forth referred to as Seismic Retrofitting Manual) provides for a Importance Classification which has two categories:

- essential bridges and
- standard bridges.

However, the Seismic Retrofitting Manual uses this classification to determine the Seismic Performance Category (SPC) differently than does Division I-A. This is because Division I-A made no allowance for the structure importance for bridges with acceleration coefficients less than 0.29. The recommended revision to Division I-A as presented in section 5.1.2 includes three categories, i.e. "critical", "essential", and "other", and makes a distinction between them. The recommended revisions for the Seismic Retrofitting Manual will include the same three importance categories.

However, the SPC will be determined similarly to the way the Seismic Retrofitting Manual currently requires. The only distinction with regards to SPC between the current Seismic Retrofitting Manual and the recommended revision is the addition of "critical" classification. As proposed, "critical" bridges will be required to be retrofitted to the "essential" bridges. Thus at this time, the "critical" classification is more of a consistency revision to correspond to the use of three classifications in the "AASHTO LRFD Bridge Design Specifications" and the recommended revisions to the AASHTO "Standard Specification for Highway Bridges, Division I-A". The distinctions between retrofitting requirements for "critical" and "essential" bridges can be revised as future research deems necessary.

The Seismic Retrofitting Manual recommends the use of a Priority Index which is a function of importance, structural vulnerability and seismicity, but this manual does not specify how that functionality should be established. Based on the proposed importance equation, it is anticipated that there will be a wide distribution of importance values. The use of a summation equation to combine importance, structural vulnerability and seismicity into a composite index, "Priority Index", would cause the structure importance to have a large affect on this index. Therefore, importance coefficients were developed so the Priority Index could be the product of importance, structural vulnerability and seismicity coefficients. Numerous importance coefficients to be used in the Priority Index product were investigated using the NYSDOT database (see table 5-1). The coefficients considered were:

- C1 - classification coefficients,
"critical", "essential", and "other", $C_{if} = I_c = 1.2, 1.1, 1.0$, respectively;
- C2 - linear function of importance rank, $C_{if} = (\# \text{ of bridges} - \text{rank}) / \# \text{ of bridges}$;
- C3 - linear function of the importance values, $C_{if} = C_i$;
- C4 - exponential function of the importance value, $C_{if} = C_i^{0.5}$;
- C4a - exponential function of the importance value, $C_{if} = C_i^{0.25}$;
- C5 - percentage of importance value, $C_{if} = C_i^{0.5} / (C_{\max} - C_{\min})^{0.5}$;
- C5a - percentage of importance value, $C_{if} = C_i^{0.5} / (C_{\max} - C_{\min})^{0.5} \geq 0.5$;
- C5b - percentage of importance value, $C_{if} = C_i^{0.25} / (C_{\max} - C_{\min})^{0.25}$;
- C5c - percentage of importance value, $C_{if} = C_i^{0.25} / (C_{\max} - C_{\min})^{0.25} \geq 0.5$;
- C6 - percentage of importance rank, $C_{if} = (\# \text{ of bridges} - \text{rank})^{0.5} / (\# \text{ of bridges})^{0.5}$;
- C6a - percentage of importance rank, $C_{if} = (\# \text{ of bridges} - \text{rank})^{0.5} / (\# \text{ of bridges})^{0.5} \geq 0.5$;
- C6b - percentage of importance rank, $C_{if} = (\# \text{ of bridges} - \text{rank})^{0.25} / (\# \text{ of bridges})^{0.25}$;
- C6c - percentage of importance rank, $C_{if} = (\# \text{ of bridges} - \text{rank})^{0.25} / (\# \text{ of bridges})^{0.25} \geq 0.5$;

where:

I_c is the importance classification coefficient in the proposed revision of Division I-A

C is the importance value in the proposed revision of Division I-A

TABLE 5-1 Importance Coefficients

| Importance Coefficient | Coefficient Data | | | |
|------------------------|------------------|------|-------|----------|
| | max | min | Ave | Std. Dev |
| C1 | 1.20 | 1.00 | 1.040 | 0.058 |
| C2 | 1.00 | 0.00 | 0.500 | 0.289 |
| C3 | 8.77 | 0.00 | 1.297 | 0.927 |
| C4 | 2.96 | 0.00 | 1.069 | 0.392 |
| C4a | 1.72 | 0.00 | 1.014 | 0.204 |
| C5 | 1.00 | 0.00 | 0.361 | 0.132 |
| C5a | 1.00 | 0.50 | 0.512 | 0.040 |
| C5b | 1.00 | 0.00 | 0.589 | 0.118 |
| C5c | 1.00 | 0.50 | 0.603 | 0.093 |
| C6 | 1.00 | 0.00 | 0.667 | 0.236 |
| C6a | 1.00 | 0.00 | 0.800 | 0.163 |
| C6b | 1.00 | 0.50 | 0.806 | 0.148 |
| C6c | 1.00 | 0.50 | 0.708 | 0.172 |

The importance coefficients, C1, C2, C3, C4, and C4a, had a large variation in values. Coefficients with a large variation in value would cause structural importance to dominate the Priority Index and therefore, these coefficients were not selected. A minimum coefficient limit of 0.50 was selected to prevent highly vulnerable structures with low importance from being neglected. The importance coefficients, C5, C5b, C6, and C6b, were not considered for final recommendation because they did not have a minimum value. The C6a and C6c coefficients had an average value close to the median value. An average coefficient close to the median value would not allow a significant distinction among the three importance classifications so these coefficients were disregarded. The C5a coefficient had an average value only 2% greater than the minimum coefficient. This would result in very minor distinctions among all bridges with the exception of "critical" bridges. The C5c coefficient had an average value 20% greater than the minimum. This would allow some distinction among "other" bridges while giving greater importance to "critical" and "essential" bridges. Therefore, the final recommended importance coefficient is the C5c coefficient.

5.3.2 Recommended Manual Revision

The bold text given below the is suggested revision to the FHWA "Seismic Retrofitting Manual for Highway Bridges", Publication No. FHWA-RD-94-052 (May 1995), sections 1.5 and 2.3.2. Since these sections do not have units of measure contained within them it, both the metric and customary U.S.

units versions would be identical.

1.5 BRIDGE CLASSIFICATION

Before seismic retrofitting can be undertaken for a group of bridges, they must first be classified according to their Seismic Performance Category (SPC). As noted in section 1.3, the SPC is determined by a combination of seismic hazard and structure importance.

Seismic hazard is reflected in the Acceleration Coefficient (A) values that are assigned to all locations covered by the AASHTO Specifications. When multiplied by the acceleration due to gravity (g), the product (A*g) represents the likely peak horizontal ground acceleration that will occur due to an earthquake sometime within a 475-year period. More rigorously, this acceleration has a 10 percent probability of being exceeded within a 50-year time frame.

Bridge importance is not so readily quantified. The determination of the Importance Classification of a bridge is necessarily subjective and consideration should be given to societal/survival and security/defense requirements.

The societal/survival evaluation addresses a number of socio-economical needs and includes, for example, the need for access for emergency relief and recovery operations immediately following an earthquake.

Security/defense requirements may be evaluated using the 1973 Federal-aid Highway Act, which required that a plan for defense highways be developed by each State. The defense highway network provides connecting routes to military installations, industries and resources not covered by the Federal-aid primary routes.

Three Importance Classifications are specified: "critical", "essential", and "other". These classifications are defined in the AASHTO "Standard Specifications for Highway Bridges", Division I-A, section 3.3. If the owner has a method to classify bridges as "critical", "essential", or "other" bridges, it may be used in lieu of the provisions referenced herein. However, if the owner does not have an importance classification system in place, a recommended method is given in Division I-A, section 3.3. If the classifications are determined as specified in Division I-A, the societal/survival and security/defense requirements can be considered fulfilled.

Based on the above considerations for seismic hazard and importance, four Seismic Importance Categories are defined as shown in table 1.

Table 1. Seismic performance category.

| Acceleration Coefficient | Importance Classification | | |
|--------------------------|---------------------------|-----------|-------|
| | Critical | Essential | Other |
| $A \leq 0.09$ | B | B | A |
| $0.09 < A \leq 0.19$ | C | C | B |
| $0.19 < A \leq 0.29$ | C | C | C |
| $0.29 < A$ | D | D | C |

The bridge SPC is assigned differently from AASHTO Specifications for new design. In view of the high cost of retrofiting, it is important to be able to distinguish between "critical" or "essential" and "other" structures; this is especially so in low-to-moderate seismic zones. Such a distinction also enables a more rational allowance to be made for the nature of the seismic hazard in the Central and Eastern United States where the maximum credible earthquake is expected to be significantly larger than the "design" earthquake (475-year event). This implies that if a "critical" bridge in the East is to remain fully operational following a large earthquake, it will need to be retrofitted to a standard higher than that required by the specification for new construction. This observation is reflected in the SPC assignment for "critical" and "essential" bridges in table 1.

2.3.2 CALCULATION OF PRIORITY INDEX

Once a rank has been calculated for each bridge based on equation 2-2, the bridges may be listed in numerical order of decreasing rank. This order is then modified to include such factors as bridge importance, network redundancy, nonseismic deficiencies, remaining useful life and any other factor deemed necessary by the owner.

Guidance on assigning importance is given in Division I-A and some discussion of network redundancy and nonseismic rehabilitation was provided in section 1.6 (and figures 4 and 5) under the Heading, "Preliminary Screening". If a bridge is part of a highly redundant highway network with alternative bridges or routes, the likelihood that these alternate facilities may also be damaged must be considered. If, for example, an overpass can be bypassed by using the on- and off-ramps, then a relatively convenient detour may be nearby, provided these access ramps remain operational. If, on the otherhand, the structure in question is a critical river crossing, the nearest detour may be kilometers away, but the possibility of it also being damaged may not be so great. Nevertheless, the higher priority should be given to the river crossing because of lack of alternate routes. In general, it is difficult to develop a single number by which to scale the seismic rank (equation 2-2) to obtain the priority index. However, unless the owner is willing to reorder the rank to

include the importance issue by some subjective means using a combination of engineering and societal judgement, then some type of numerical equation is necessary to determine the priority index. With a large number of bridges, even a simplistic numerical equation will be of great benefit in determining the priority index. Therefore, if the owner implements the importance method from Division I-A to calculate the Priority Index (P), the following method should be used:

$$P = R * C_{if}$$

where:

R = bridge rank (section 2.3.1)

$$C_{if} = \frac{C_i^{0.25}}{(C_{max} - C_{min})^{0.25}} \geq 0.50$$

C_i = importance value for the bridge being considered (Division I-A)

C_{max} = maximum importance value in the classification database

C_{min} = minimum importance value in the classification database

If the owner does not implement the importance method from Division I-A, a similar equation could be used.

SECTION 6 CONCLUSIONS AND RECOMMENDATIONS

The three major results of this project are:

- Development of an importance ranking method which is based on existing NBI data.
- Development of suggested revisions to the AASHTO "Standard Specification for Highway Bridges", Division I-A, "AASHTO LRFD Bridge Design Specifications" and the FHWA "Seismic Retrofitting Manual for Highway Bridges" to specifically include importance in seismic design procedures.
- Allowance for existing importance ranking methods to be used with the suggested revisions to the specifications given above.

The Importance method developed from this study is simplistic in nature when compared with the research done by others which use a network approach and Geographic Information System (GIS) data. However, the method from this report works with the state's existing NBI data and does not require the collection of new data. During this research, several data entry errors and omissions were discovered in the test databases. Rapid growth in ADT and bridge rehabilitations makes maintaining the NBI Records difficult. The requirement of additional data would only increase the cost of maintaining bridge inventory records.

The method proposed herein fills a need for states in low and moderate seismic zones to develop an importance ranking method with minimal effort or cost. When GIS based network analysis become readily available and cost effective, engineers can then implement more advanced systems for determining importance rankings.

SECTION 7
REFERENCES

AASHTO (1996), Standard Specification for Highway Bridges, Sixteenth Edition, Washington, D.C.

AASHTO (1994), AASHTO LRFD Bridge Design Specifications, First Edition, Washington, D.C.

FHWA (1995), Seismic Retrofitting Manual for Highway Bridges, Publication No. FHWA-RD-94-052

**APPENDIX A
EXISTING IMPORTANCE METHODS**

The importance methods provided in this appendix are given in customary U.S. Units.

Babaei and Hawkins '91: Washington DOT

CRITICALITY FACTOR, C

$$C = \frac{[(RN_{carry})(DL_{carry} \times N_{carry})] + [UT_{carry}]}{(2/3)[(RN_{cross})(DL_{cross} \times N_{cross})] + (1/4)[(ADT_{carry}/30,000)(L)]^{0.25}}$$

RN_{carry} = factor for the nature of the route

RN_{carry} = 1.0; interstate route, principal artery, or confirmed emergency route
= 0.8; all other routes

DL_{carry} = factor representing criticality of detour length
= 1.00; When detour length > 10 mi
= 0.80; When detour length is 3 to 10 mi
= 0.75; When detour length < 3 mi

N_{carry} = factor representing criticality of detour due to traffic congestion
= $ADT_{carry}/30,000]^{0.25} \geq 1$

ADT_{carry} = average daily traffic of the route

UT_{carry} = factor representing utility lines
= 1; bridge carrying a confirmed essential utility line
= 0; all other bridges

RN_{cross} = factor representing the nature of the route
= 1.0; confirmed emergency route
= 0.8; all other routes
= 0.0; no route under the bridge

DL_{cross} = factor representing criticality of detour length

- = 1.00; when detour length > 10 miles
- = 0.80; when detour length is 3 to 10 miles
- = 0.75; when detour length < 3 mi

N_{cross} = factor representing criticality of detour due to traffic congestion
 = $ADT_{cross}/30,000]^{0.25} >=1$

ADT_{cross} = average daily traffic

L = length of the bridge in ft.

Modified Babaei and Hawkins: Adjust reference ADT from 30,000 to 6,000

CRITICALITY FACTOR, C

$$C = \frac{[(RN_{carry})(DL_{carry} \times N_{carry})] + [UT_{carry}] + (2/3)[(RN_{cross})(DL_{cross} \times N_{cross})] + (1/4)[(ADT_{carry}/6,000)(L)]^{0.25}}{}$$

RN_{carry} = factor for the nature of the route

RN_{carry} = 1.0; interstate route, principal artery, or confirmed emergency route
 = 0.8; all other routes

DL_{carry} = factor representing criticality of detour length

- = 1.00; When detour length > 10 mi
- = 0.80; When detour length is 3 to 10 mi
- = 0.75; When detour length < 3 mi

N_{carry} = factor representing criticality of detour due to traffic congestion
 = $ADT_{carry}/6,000]^{0.25} >=1$

ADT_{carry} = average daily traffic of the route

UT_{carry} = factor representing utility lines

- = 1; bridge carrying a confirmed essential utility line
- = 0; all other bridges

RN_{cross} = factor representing the nature of the route

- = 1.0; confirmed emergency route
- = 0.8; all other routes
- = 0.0; no route under the bridge

DL_{cross} = factor representing criticality of detour length

- = 1.00; when detour length > 10 miles
- = 0.80; when detour length is 3 to 10 miles
- = 0.75; when detour length < 3 mi

N_{cross} = factor representing criticality of detour due to traffic congestion
 = $ADT_{cross}/6,000]^{0.25} >=1$

ADT_{cross} = average daily traffic
 L = length of the bridge in ft.

Buckle '95; New York DOT

Please note that for comparison studies, only the equation was used.

A bridge is defined as "critical" if any one of the following conditions exist:

1. Bridge is designated as a critical facility
2. Bridge carries a defense highway
3. Bridge is located on the national network for trucks
4. The index (i) is greater than or equal to 2.5

Where:

$$I = 1 + \frac{FADT}{15,000} + \frac{N}{10} + \frac{DL}{20} + \frac{FC}{2}$$

FADT = future average daily traffic
 N = number of utilities carried
 DL = detour length (miles)
 FC = functional classification

Modified Buckle '95: Replace FADT with ADT

$$I = 1 + \frac{ADT}{15,000} + \frac{N}{10} + \frac{DL}{20} + \frac{FC}{2}$$

ADT = average daily traffic
 N = number of utilities carried
 DL = detour length (miles)
 FC = functional classification

Caltrans Method

Impact = .28 * (Value from a curve based on ADT on the structure)
 +.12 * (Value from a curve based on ADT under or over the structure)
 +.14 * (Value from a line normalized to 100 miles based on detour length)
 +.15 * (Leased Air Space Residential, Office; 1 = present, 0 = else)
 +.07 * (Leased Air Space Parking, Storage; 1 = present, 0 = else)
 +.07 * (Route Type on Bridge;
 1.0 = interstate, 0.8 = US, State route or street, 0.7 = RR, 0.5 = federal funded County route or city street, 0.2 = nonfederal funded County route or city street, 0.0 = federal land, State land, other)

+0.07 * (Facility Crossed; use categories from route type on bridge)
 +.10 * (Critical Utility; 1 = present, 0 = else)

Montana

$$C = [(RT_{carry})(DL_{carry} * N_{carry})] + (2/3)[(RT_{cross})(DL_{cross} * N_{cross})] + (1/4)[(ADT_{carry}/6,000)(L)]^{0.25} + RV_{cross}$$

where:

$N_i = (ADT_i/6000)^{0.25}$
 $DL_i =$ Detour Length Coefficient
 $RV_{cross} = L/1000$ for river crossings
 $RT_{carry} = 1.0$ or 0.8
 $RT_{cross} = 1.0$ or 0.8

Nevada

$$I = RT + T + Det + Ut + Def + RR$$

Type of route, RT :

The sum of RT for the routes on and under the bridge
 Interstate, RT = 3 Primary Route, RT = 2
 Secondary route, RT = 1 Others, RT = 0
 Urban Routes are classified as primary or secondary

Traffic count, T :

Sum of the value of T for routes on and under the bridge

$$T = \frac{\sqrt{ADT}}{100} \left[1 + \frac{\sqrt{(LW)(N)}}{300} \right]$$

where:

$ADT \leq 90,000$
 $LW =$ bridge length for route on the bridge
 and bridge width for route under the bridge
 $N =$ number of lanes on or under the bridge

Detour length, Det:

One tenth of the sum of the detour for both routes on and under the bridge. $Det \leq 2$

Utilities on the bridge, Ut :

1.0 if utilities exist on the bridge, otherwise = 0.0

Defense classification, Def :

1.0 if the route on or under the bridge is designated as part of the strategic Highway Network, otherwise = 0

Rail roads :

1.5 if railroad exists on or under the bridge, otherwise = 0.0

South Carolina

Importance Rating, IR:

All bridges will be classified as IC = II except in the following cases where the bridges will be classified as IC = I:

- (a) Bridges on or passing over an interstate highway
- (b) Bridges on designated truck network or defense highway
- (c) Bridges necessary to provide access to emergency services, power plants and water treatment plants.

Bridges classified as IC = I, will have an initial value of IR = 6. This value will be increased or decreased based on the factors below, but will not be taken less than 6 or greater than 10:

- | | |
|--|----|
| 1. Bridge over water | +1 |
| 2. Bridge carries interstate | +1 |
| 3. Bridge over interstate | +1 |
| 4. Interchange allows traffic to bypass bridge | -1 |
| 5. 5000 < ADT < 10,000 | +1 |
| 6. 10,000 < ADT < 20,000 | +2 |
| 7. ADT > 20,000 | +3 |
| 8. Bridge deck surface area > 12,000 SF | +1 |

Bridges classified as IC = II, will have an initial value of IR = 0. This value will be increased or decreased based on the factors below, but will not be taken less than 0 or greater than 5:

- | | |
|-----------------------------|----|
| 1. Bridge over water | +1 |
| 2. 50 < ADT < 200 | +1 |
| 3. 200 < ADT < 500 | +2 |
| 4. ADT > 500 | +3 |
| 5. Detour length > 10 miles | +1 |

Modified South Carolina

For the South Carolina method given above, deleted the maximum values of 10 and 5 placed on IC=I and IC=II, respectively.

Missouri

Importance factor = $[(3+1_1) \times n_1 \times SF_1 + (3+1_2) \times n_2 \times SF_2] \times P + RC + Det$

where:

l_1, l_2 : Length of bridge and length along intersecting roadway under the bridge, respectively. Both are in 100 ft.

n_1, n_2 : Number of lanes on and under the bridge, respectively.

SF_1, SF_2 : Spacing factor based on ADT on and under the bridge, respectively. Values of SF are calculated based on the ADT as follows:

| <u>ADT</u> | <u>Vehicle spacing</u> | <u>SF</u> |
|------------------|------------------------|-----------|
| < 5,000 | 500 ft. | 0.20 |
| 5,000 - 20,000 | 300 ft. | 0.33 |
| 20,000 - 50,000 | 200 ft. | 0.50 |
| 50,000 - 100,000 | 100 ft. | 1.00 |
| > 100,000 | 50 ft. | 2.00 |

P : Route priority factor = 1.2 for priority 1 routes
1.0 for priority 2 routes

RC : Route continuity factor =
2.0 for bridges needed for completing a route, otherwise = 0.0. RC is ignored in the preliminary screening and will be considered only in the final screening.

Det : Detour length factor = 1.0 for detour length \geq 5 miles, otherwise = 0

Modified Missouri

For the Missouri method given above, set the maximum bridge length = 5280'.

IDOT

I = 0.69*Vehicles Impacted + 0.15*Emergency Route + 0.10*Detour +
0.05*Defense Route + 0.01*Utilities

where:

Vehicles Impacted = $(ADT_{on}(Length_{bridge} + 236) + ADT_{under}(Deck\ width + 236))/5,068,800$
Emergency Route was not used in this equation.

Detour = $(ADT_{on} * detour\ length_{on})/100,000 + 0.39 * (ADT_{under} * detour\ length_{under})/100,000$
+ $15 * I_{NW} + 5 * I_{RR}$

I_{NW} = 1 if bridge is over navigable water

I_{RR} = 1 if bridge is over railroad

Defense Route = 0.8 for priority route on bridge

= 0.2 for priority route under bridge

= 0.7 for secondary route on bridge

= 0.1 for secondary route under bridge

= 0 for non-defense route

Utilities = 1 if utilities on bridge

APPENDIX B

PENNDOT IMPORTANCE SURVEY

July 2, 1996

Mr. John Rautzahn, P. E., Assistant District Engineer, Design
Pennsylvania Department of Transportation
Engineering District 8-0
2140 Herr Street
Harrisburg, Pennsylvania 17103-2699

RE: NCEER HIGHWAY PROJECT, DTFH61-92-C-00112
Evaluation of Structure Importance
Bridge Importance in Dauphin and Cumberland Counties

JN1525

Dear Mr. Rautzahn:

Modjeski and Masters, Inc. has been working on a seismic research project which is investigating the importance rating for bridges. This project is with the National Center for Earthquake Engineering Research. In prioritization of bridges for seismic retrofits, importance is one factor in the prioritization equation (see attached copy of flowchart from the Seismic Retrofit Manual).

Modjeski and Masters, Inc. has been reviewing 12 importance equations developed by individuals and States. Most of these equations are designed to work with data from bridge management systems (BMS). Mr. Hal Rogers, an Assistant Chief Bridge Engineer with PennDOT, has provided us with BMS data for Dauphin and Cumberland Counties in order to review these equations.

We are asking if several of the District 8-0 employees could list what, in their opinion, are the top 20 most important State or local bridges in Dauphin and Cumberland Counties (each County separately). The lists supplied by your employees would then be compared with results which were obtained from the importance equations. Mr. Rogers informed me of his conversation with you on Friday, June 28, 1996. Mr. Rogers indicated your willingness to help with this study. Mr. Rogers also stated that you had discussed allowing County Managers, traffic personnel, maintenance personnel, bridge personnel or whoever else you believe is appropriate complete the forms.

In our definition of "importance", the most important bridges would be ones which if they were out of service would cause the most disruption to the community and/or public service. In our definition of "importance", a bridge's need of repair or replacement is not a rating factor (i.e. we are not looking for the maintenance or replacement priority list).

We would appreciate obtaining these lists from your employees by July 18, 1996, so that we can incorporate them into our ongoing study. In order to expedite the process, we expect the forms to be filled out by hand (i.e. not typed). After we have processed these lists, we can setup a

Mr. John Rautzahn

-2-

July 2, 1996

meeting to discuss our comparison of your results and our equations. At the end of the project, we will provide you with a copy of the final report.

Enclosed are eight sets of list forms and instructions for your employees, if you need more let us know.

If you have any questions, please call me or Mr. Andrew L. Thomas.

Thank you for your time and consideration on this matter.

Very truly yours,

SCOTT R. ESHENAUR,
Associate

SRE:rsb

encl.
as

cc: Mr. Hal Rogers, PennDOT, Central Office (w/encl)

INSTRUCTIONS FOR COMPLETING FORMS

Modjeski and Masters, Inc. has been working on a seismic research project which is investigating the importance rating for bridges. This project is with the National Center for Earthquake Engineering Research. In prioritization of bridges for seismic retrofits, importance is one factor in the prioritization equation.

Modjeski and Masters, Inc. has been reviewing 12 importance equations developed by individuals and states. Most of these equations are designed to work with data from bridge management systems(BMS).

We are asking that you list what in your opinion are the top twenty most important state or local bridges in Dauphin and Cumberland Counties (each county separately, see attached sheets). If possible, please rank these top twenty bridges with number one being the most important and number twenty being the least important of the top twenty. These lists will then be compared with results which were obtained from the importance equations.

In our definition of Importance, the most important bridges would be ones which if they were out of service would cause the most disruption to the community and/or public services. In our definition of Importance, a bridge's need of repair or replacement is not a rating factor (i.e. we are not looking for the maintenance or replacement priority list.).

We would appreciate obtaining these lists from you by July 18, 1996 so that we can incorporate them into our on going study. In order to expedite the process, we expect the forms to be fill out by hand (i.e. not typed). Please return the completed lists in the attached stamped envelope.

If you have any questions concerning these lists, please call Mr. Andy Thomas or Mr. Scott Eshenaur of Modjeski and Masters at 717-790-9565.

Thank you for your time and consideration on this matter.

PennDOT SURVEY

Most Important State or Local Bridges in Dauphin County

Unit: _____ Title: _____ Name(optional): _____

| Rank | Name of Bridge or Route Carried | State or Local | Feature Crossed (Route, river, RR, etc) | Township (if known) | Reason of Importance * |
|------|---------------------------------|----------------|---|---------------------|------------------------|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20 | | | | | |

* The reasons for bridge importance ranking is helpful but not required. The reverse side may be used for any additional comments.

Note: Forms may be handwritten.

**APPENDIX C
COMPARISON RESULTS**

| Babaei and Hawkins Results for Dauphin County | | | | | | | | | | | | |
|---|---------------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| B&H RANK | Structure ID Number | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 2200830420000 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 2230160010000 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 3 | 2200810652000 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 4 | 22008304203326 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 5 | 22301400300190 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 6 | 22301200300000 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 | |
| 7 | 22002200500208 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | |
| 8 | 22301200100000 | 10 | 186 | 198 | 97 | 12 | 226 | 347 | 347 | 32 | 27 | |
| 9 | 22032201700000 | 9 | 88 | 120 | 59 | 30 | 198 | 98 | 70 | 47 | 31 | |
| 10 | 22301200800233 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 | |
| 11 | 22002204200000 | 8 | 94 | 103 | 2 | 28 | 9 | 14 | 34 | 26 | 54 | |
| 12 | 22302200200250 | 13 | 133 | 157 | 37 | 39 | 79 | 451 | 451 | 53 | 103 | |
| 13 | 22008304300800 | 15 | 396 | 408 | 9 | 54 | 26 | 53 | 100 | 6 | 44 | |
| 14 | 22707699024676 | 21 | 81 | 81 | 16 | 69 | 21 | 113 | 75 | 62 | 108 | |
| 15 | 22301701102199 | 16 | 232 | 251 | 11 | 52 | 39 | 107 | 117 | 48 | 106 | |
| 16 | 22008304340000 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 17 | 22300900101034 | 18 | 125 | 128 | 26 | 50 | 126 | 446 | 446 | 92 | 134 | |
| 18 | 22003900201278 | 17 | 183 | 212 | 25 | 53 | 84 | 405 | 405 | 61 | 144 | |
| 19 | 22300700600000 | 22 | 284 | 248 | 5 | 68 | 27 | 103 | 115 | 40 | 62 | |
| 20 | 22301300200377 | 23 | 235 | 256 | 6 | 72 | 31 | 105 | 116 | 54 | 66 | |
| | average= | 11.2 | 140.0 | 148.4 | 26.1 | 29.2 | 63.0 | 178.6 | 178.4 | 34.7 | 47.5 | Tot. ave |
| | | | | | | | | | | | | 86.7 |

Modified Babaei and Hawkins Results for Dauphin County

| Mod B&H RANK | Structure ID Number | B & H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
|--------------|---------------------|------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|-------|
| 1 | 22008304200000 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22301600100000 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 3 | 22008106520000 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 4 | 22008304203326 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 5 | 22301400300190 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 6 | 22008304340000 | 16 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 7 | 22301200300000 | 6 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 | |
| 8 | 22002204200000 | 11 | 94 | 103 | 2 | 28 | 9 | 14 | 34 | 26 | 54 | |
| 9 | 22032201700000 | 9 | 88 | 120 | 59 | 30 | 198 | 98 | 70 | 47 | 31 | |
| 10 | 22301200100000 | 8 | 186 | 198 | 97 | 12 | 226 | 347 | 347 | 32 | 27 | |
| 11 | 22301200800233 | 10 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 | |
| 12 | 22002200500208 | 7 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | |
| 13 | 22302200200250 | 12 | 133 | 157 | 37 | 39 | 79 | 451 | 451 | 53 | 103 | |
| 14 | 22008304601012 | 39 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 | |
| 15 | 22008304300800 | 13 | 396 | 408 | 9 | 54 | 26 | 53 | 100 | 6 | 44 | |
| 16 | 22301701102199 | 15 | 232 | 251 | 11 | 52 | 39 | 107 | 117 | 48 | 106 | |
| 17 | 22003900201278 | 18 | 183 | 212 | 25 | 53 | 84 | 405 | 405 | 61 | 144 | |
| 18 | 22300900101034 | 17 | 125 | 128 | 26 | 50 | 126 | 446 | 446 | 92 | 134 | |
| 19 | 22008304611029 | 50 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 | |
| 20 | 22008106601047 | 34 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| | | average = | 14.0 | 127.8 | 32.5 | 21.0 | 62.3 | 169.7 | 168.8 | 30.3 | 37.8 | |
| | | | | | | | | | | | Tot. ave | 78.10 |

Buckle Results for Dauphin County

| Buckle RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-------------|---------------------|------------|--------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304340000 | 16 | 6 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 2 | 22008304340713 | 78 | 52 | 24 | 10 | 40 | 32 | 55 | 51 | 12 | 35 |
| 3 | 22008304203326 | 4 | 4 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22008304200000 | 1 | 1 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 5 | 22008304900000 | 90 | 59 | 9 | 13 | 43 | 35 | 73 | 61 | 37 | 45 |
| 6 | 22008304840608 | 111 | 86 | 10 | 27 | 74 | 43 | 72 | 60 | 50 | 61 |
| 7 | 22008304700976 | 83 | 57 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 8 | 22008304741403 | 89 | 61 | 12 | 32 | 84 | 55 | 69 | 58 | 18 | 52 |
| 9 | 22008304840463 | 131 | 113 | 14 | 63 | 105 | 157 | 71 | 24 | 71 | 28 |
| 10 | 22008304501003 | 45 | 25 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 11 | 22008304440634 | 44 | 24 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 12 | 22008304501664 | 104 | 77 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 13 | 22008304540221 | 125 | 68 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 |
| 14 | 22008304801909 | 112 | 89 | 17 | 40 | 97 | 69 | 70 | 59 | 33 | 78 |
| 15 | 22008304600107 | 151 | 140 | 15 | 66 | 127 | 155 | 60 | 21 | 29 | 33 |
| 16 | 22008107401223 | 110 | 83 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 17 | 22008304641054 | 75 | 35 | 21 | 23 | 29 | 34 | 64 | 55 | 24 | 42 |
| 18 | 22008304641712 | 136 | 95 | 22 | 14 | 55 | 23 | 65 | 3 | 72 | 16 |
| 19 | 22008304641936 | 68 | 27 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 |
| 20 | 22008107041120 | 147 | 128 | 24 | 82 | 118 | 115 | 32 | 7 | 57 | 36 |
| | | average = | 86.0 | 12.9 | 29.1 | 58.2 | 54.9 | 59.4 | 34.0 | 32.9 | 27.4 |
| | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | 45.60 |

| Modified Buckle Results for Dauphin County | | | | | | | | | | | | |
|--|---------------------|------------|--------------|-------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| Mod Buckle RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22008304203326 | 4 | 4 | 3 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 3 | 22008304340000 | 16 | 6 | 1 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 4 | 22008304340713 | 78 | 52 | 2 | 10 | 40 | 32 | 55 | 51 | 12 | 35 | |
| 5 | 22008304440634 | 44 | 24 | 11 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 6 | 22008304501003 | 45 | 25 | 10 | 22 | 33 | 46 | 57 | 18 | 19 | 6 | |
| 7 | 22008304501664 | 104 | 77 | 12 | 42 | 90 | 98 | 58 | 19 | 65 | 14 | |
| 8 | 22008106641980 | 154 | 141 | 28 | 46 | 142 | 162 | 21 | 5 | 10 | 25 | |
| 9 | 22008304900000 | 90 | 59 | 5 | 13 | 43 | 35 | 73 | 61 | 37 | 45 | |
| 10 | 22008304840608 | 111 | 86 | 6 | 27 | 74 | 43 | 72 | 60 | 50 | 61 | |
| 11 | 22008304700976 | 83 | 57 | 7 | 31 | 75 | 52 | 68 | 23 | 16 | 13 | |
| 12 | 22008304741403 | 89 | 61 | 8 | 32 | 84 | 55 | 69 | 58 | 18 | 52 | |
| 13 | 22008304540221 | 125 | 68 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 | |
| 14 | 22008304840463 | 131 | 113 | 9 | 63 | 105 | 157 | 71 | 24 | 71 | 28 | |
| 15 | 22008304600107 | 151 | 140 | 15 | 66 | 127 | 155 | 60 | 21 | 29 | 33 | |
| 16 | 22008106520000 | 3 | 3 | 23 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 17 | 22008304801909 | 112 | 89 | 14 | 40 | 97 | 69 | 70 | 59 | 33 | 78 | |
| 18 | 22008107401223 | 110 | 83 | 16 | 71 | 94 | 100 | 35 | 10 | 46 | 18 | |
| 19 | 22008107502454 | 146 | 126 | 55 | 72 | 115 | 104 | 38 | 11 | 59 | 30 | |
| 20 | 22008107342707 | 144 | 120 | 56 | 76 | 111 | 109 | 34 | 9 | 56 | 29 | Tot. ave |
| | average = | 87.1 | 66.8 | 14.9 | 32.8 | 65.6 | 64.5 | 53.5 | 29.4 | 30.2 | 25.0 | 47.0 |

Caltrans Results for Dauphin County

| Caltrans RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|---------------|---------------------|------------|--------------|-------------|-----------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 22002204200000 | 11 | 8 | 94 | 103 | 28 | 9 | 14 | 34 | 26 | 54 |
| 3 | 22008304340000 | 16 | 6 | 1 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 4 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 2 | 52 | 17 | 3 | 3 |
| 5 | 22300700600000 | 19 | 22 | 284 | 248 | 68 | 27 | 103 | 115 | 40 | 62 |
| 6 | 22301300200377 | 20 | 23 | 235 | 256 | 72 | 31 | 105 | 116 | 54 | 66 |
| 7 | 22008304540221 | 125 | 68 | 13 | 13 | 51 | 25 | 59 | 20 | 42 | 12 |
| 8 | 22301600100000 | 2 | 2 | 22 | 60 | 3 | 15 | 106 | 72 | 5 | 4 |
| 9 | 22008304300800 | 13 | 15 | 396 | 408 | 54 | 26 | 53 | 100 | 6 | 44 |
| 10 | 22008304340713 | 78 | 52 | 2 | 24 | 40 | 32 | 55 | 51 | 12 | 35 |
| 11 | 22301701102199 | 15 | 16 | 232 | 251 | 52 | 39 | 107 | 117 | 48 | 106 |
| 12 | 22008304440634 | 44 | 24 | 11 | 5 | 15 | 37 | 56 | 52 | 30 | 10 |
| 13 | 22008304900000 | 90 | 59 | 5 | 9 | 43 | 35 | 73 | 61 | 37 | 45 |
| 14 | 22008304641712 | 136 | 95 | 18 | 22 | 55 | 23 | 65 | 3 | 72 | 16 |
| 15 | 22302600700560 | 31 | 43 | 269 | 266 | 104 | 48 | 166 | 166 | 69 | 135 |
| 16 | 22707699024676 | 14 | 21 | 81 | 81 | 69 | 21 | 113 | 75 | 62 | 108 |
| 17 | 22008106520000 | 3 | 3 | 23 | 16 | 1 | 3 | 16 | 4 | 2 | 2 |
| 18 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 14 | 66 | 56 | 28 | 39 |
| 19 | 22301400300190 | 5 | 5 | 159 | 172 | 5 | 18 | 352 | 352 | 15 | 8 |
| 20 | 22028300040000 | 35 | 47 | 93 | 105 | 106 | 51 | 79 | 65 | 154 | 158 |
| average = | | 36.5 | 27.1 | 98.2 | 103.4 | 40.0 | 23.1 | 87.3 | 77.1 | 35.5 | 45.7 |
| | | | | | | | | | | Tot. ave | 57.37 |

| Montana Results for Dauphin County | | | | | | | | | | | | |
|------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|-------------|---------|-------------|---------------|-----------|----------|
| Montana RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 3 | 16 | 4 | 2 | 2 | |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 1 | 51 | 16 | 1 | 1 | |
| 3 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 15 | 106 | 72 | 5 | 4 | |
| 4 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 5 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 18 | 352 | 352 | 15 | 8 | |
| 6 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 40 | 349 | 349 | 38 | 19 | |
| 7 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 145 | 1 | 82 | 34 | 15 | |
| 8 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 203 | 348 | 348 | 11 | 9 | |
| 9 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 4 | 54 | 50 | 4 | 5 | |
| 10 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 44 | 3 | 84 | 76 | 17 | |
| 11 | 22002200511275 | 42 | 40 | 147 | 149 | 146 | 45 | 5 | 86 | 79 | 23 | |
| 12 | 22301200100000 | 8 | 10 | 186 | 198 | 97 | 226 | 347 | 347 | 32 | 27 | |
| 13 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 8 | 61 | 22 | 22 | 11 | |
| 14 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 28 | 19 | 38 | 8 | 7 | |
| 15 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 37 | 56 | 52 | 30 | 10 | |
| 16 | 22303400100000 | 53 | 99 | 482 | 479 | 284 | 388 | 452 | 452 | 606 | 170 | |
| 17 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 29 | 63 | 54 | 39 | 24 | |
| 18 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 14 | 66 | 56 | 28 | 39 | |
| 19 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 107 | 2 | 83 | 93 | 20 | |
| 20 | 22002200510165 | 61 | 56 | 146 | 148 | 263 | 154 | 4 | 85 | 94 | 34 | |
| | average = | 28.1 | 22.8 | 112.9 | 118.8 | 78.1 | 75.6 | 120.4 | 132.5 | 61.0 | 22.4 | Tot. ave |
| | | | | | | | | | | | | 77.24 |

Nevada Results for Dauphin County

| Nevada RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 51 | 16 | 1 | 1 |
| 2 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 52 | 17 | 3 | 3 |
| 3 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 16 | 4 | 2 | 2 |
| 4 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 54 | 50 | 4 | 5 |
| 5 | 22008305011814 | 79 | 33 | 60 | 63 | 41 | 24 | 76 | 25 | 68 | 53 |
| 6 | 22008106940918 | 95 | 53 | 73 | 71 | 47 | 38 | 27 | 6 | 91 | 65 |
| 7 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 30 | 2 | 80 | 26 |
| 8 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 61 | 22 | 22 | 11 |
| 9 | 22002204200000 | 11 | 8 | 94 | 103 | 2 | 28 | 14 | 34 | 26 | 54 |
| 10 | 22707699024738 | 133 | 106 | 185 | 104 | 69 | 57 | 116 | 77 | 74 | 109 |
| 11 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 90 | 13 | 21 |
| 12 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 13 | 92 | 14 | 22 |
| 13 | 22028300241975 | 86 | 44 | 71 | 75 | 53 | 32 | 82 | 28 | 89 | 70 |
| 14 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 66 | 56 | 28 | 39 |
| 15 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 106 | 72 | 5 | 4 |
| 16 | 22030000100964 | 77 | 32 | 86 | 59 | 33 | 31 | 85 | 67 | 20 | 43 |
| 17 | 22028300252054 | 92 | 55 | 83 | 80 | 55 | 41 | 84 | 30 | 110 | 85 |
| 18 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 352 | 352 | 15 | 8 |
| 19 | 22301900201401 | 60 | 26 | 150 | 156 | 49 | 25 | 108 | 118 | 25 | 73 |
| 20 | 22028300251756 | 105 | 72 | 68 | 70 | 64 | 48 | 83 | 29 | 238 | 100 |
| | average = | 59.4 | 34.1 | 74.8 | 72.1 | 33.0 | 25.0 | 74.4 | 59.4 | 46.4 | 39.7 |
| | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | 51.81 |

| Missouri Results for Dauphin County | | | | | | | | | | | | |
|-------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|-----------|----------|
| Missouri RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | IDOT RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | |
| 4 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 5 | |
| 5 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 4 | |
| 6 | 22008304300800 | 13 | 15 | 396 | 408 | 9 | 54 | 26 | 53 | 100 | 44 | |
| 7 | 22800300200760 | 206 | 195 | 263 | 242 | 90 | 193 | 53 | 173 | 173 | 124 | |
| 8 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 7 | |
| 9 | 22302100100000 | 142 | 129 | 316 | 304 | 79 | 42 | 63 | 151 | 151 | 38 | |
| 10 | 22008106641980 | 154 | 141 | 28 | 8 | 46 | 142 | 162 | 21 | 5 | 25 | |
| 11 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 9 | |
| 12 | 22008304340713 | 78 | 52 | 2 | 24 | 10 | 40 | 32 | 55 | 51 | 35 | |
| 13 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 21 | |
| 14 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 22 | |
| 15 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 8 | |
| 16 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 13 | |
| 17 | 22300600600000 | 129 | 98 | 401 | 298 | 81 | 67 | 75 | 101 | 113 | 140 | |
| 18 | 22008304741403 | 89 | 61 | 8 | 12 | 32 | 84 | 55 | 69 | 58 | 52 | |
| 19 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 6 | |
| 20 | 22030000100964 | 77 | 32 | 86 | 59 | 33 | 31 | 16 | 85 | 67 | 43 | Tot. ave |
| | average = | 60.6 | 45.5 | 109.4 | 102.9 | 35.0 | 42.5 | 43.9 | 92.8 | 91.9 | 30.1 | 65.44 |

| IDOT Results for Dauphin County | | | | | | | | | | | | |
|---------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|----------|
| IDOT RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | |
| 6 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | |
| 8 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | |
| 9 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | |
| 10 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | |
| 11 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | |
| 12 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | |
| 13 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | |
| 14 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | |
| 15 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | |
| 16 | 22008304641712 | 136 | 95 | 18 | 22 | 14 | 55 | 23 | 65 | 3 | 72 | |
| 17 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | |
| 18 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | |
| 19 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | |
| 20 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | Tot. ave |
| | average = | 44.2 | 30.5 | 64.8 | 69.6 | 44.0 | 25.7 | 50.0 | 90.6 | 83.1 | 30.1 | 53.25 |

PennDOT Survey Results for Dauphin County

| PennDOT RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
|--------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|------------------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 3 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | |
| 4 | 22707699024665 | 143 | 139 | 82 | 89 | 119 | 73 | 70 | 112 | 74 | 84 | 99 | |
| 5 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 6 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 | |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 8 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 9 | 22032201700000 | 9 | 9 | 88 | 120 | 59 | 30 | 198 | 98 | 70 | 47 | 31 | |
| 10 | 22300901900601 | 513 | 511 | 407 | 402 | 293 | 480 | 185 | 558 | 558 | 234 | 558 | |
| 11 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 12 | 22002202310000 | 103 | 97 | 136 | 129 | 203 | 56 | 158 | 134 | 134 | 192 | 87 | |
| 13 | 22008304340713 | 78 | 52 | 2 | 4 | 10 | 40 | 32 | 55 | 51 | 12 | 35 | |
| 14 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 | |
| 15 | 22008106851552 | 96 | 70 | 53 | 56 | 65 | 46 | 47 | 26 | 44 | 44 | 83 | |
| 16 | 22028300252054 | 92 | 55 | 83 | 80 | 55 | 41 | 17 | 84 | 30 | 110 | 85 | |
| 17 | 22022501301860 | 214 | 228 | 197 | 211 | 287 | 225 | 310 | 193 | 193 | 262 | 172 | |
| 18 | 22002200900000 | 97 | 75 | 98 | 102 | 99 | 49 | 86 | 6 | 87 | 112 | 77 | |
| 19 | 22008106940918 | 95 | 53 | 73 | 71 | 47 | 38 | 6 | 27 | 6 | 91 | 65 | |
| 20 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 | |
| 21 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 | |
| | average = | 79.3 | 67.0 | 96.0 | 99.5 | 77.5 | 56.7 | 73.2 | 113.2 | 113.2 | 66.8 | 66.9 | Tot. ave 78.7 |

| EMS Survey Results for Dauphin County | | | | | | | | | | | | | |
|---------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|-------|
| EMS RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 2 | 22302100100000 | 142 | 129 | 316 | 304 | 79 | 42 | 63 | 151 | 151 | 9 | 38 | |
| 3 | 22032200600000 | 132 | 132 | 161 | 177 | 139 | 71 | 87 | 150 | 150 | 138 | 225 | |
| 4 | 22002201802643 | 220 | 223 | 188 | 201 | 173 | 116 | 112 | 132 | 132 | 224 | 236 | |
| 5 | 22002200900000 | 97 | 75 | 98 | 102 | 99 | 49 | 86 | 6 | 87 | 112 | 77 | |
| 6 | 22014700401898 | 179 | 235 | 346 | 342 | 372 | 295 | 276 | 164 | 164 | 337 | 98 | |
| 7 | 22014702200000 | 248 | 250 | 288 | 265 | 302 | 236 | 335 | 230 | 230 | 261 | 177 | |
| 8 | 22014703100842 | 183 | 215 | 356 | 387 | 367 | 201 | 309 | 141 | 141 | 284 | 88 | |
| 9 | 22020900700000 | 300 | 313 | 312 | 335 | 335 | 297 | 359 | 234 | 234 | 270 | 231 | |
| 10 | 22020901401722 | 271 | 281 | 364 | 341 | 358 | 253 | 349 | 237 | 237 | 332 | 240 | |
| 11 | 22020902600000 | 201 | 230 | 297 | 261 | 309 | 218 | 327 | 191 | 191 | 248 | 185 | |
| 12 | 22020903200000 | 212 | 241 | 281 | 293 | 325 | 234 | 336 | 192 | 192 | 251 | 210 | |
| 13 | 22008106851552 | 96 | 70 | 53 | 56 | 65 | 46 | 47 | 26 | 44 | 44 | 83 | |
| 14 | 22008106940918 | 95 | 53 | 73 | 71 | 47 | 38 | 6 | 27 | 6 | 91 | 65 | |
| 15 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 | |
| 16 | 22032201700000 | 9 | 9 | 88 | 120 | 59 | 30 | 198 | 98 | 70 | 47 | 31 | |
| 17 | 22032202901298 | 229 | 212 | 189 | 164 | 259 | 206 | 260 | 259 | 259 | 231 | 138 | |
| 18 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 19 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | |
| 20 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| | average = | 133.3 | 135.0 | 182.9 | 184.9 | 171.4 | 118.5 | 164.2 | 123.7 | 124.3 | 150.1 | 108.0 | 141.6 |

Babaei and Hawkins Results for Cumberland County

| B & H RANK | Structure ID Number | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|------------|---------------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21001501700863 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 2 | 21001107400000 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 3 | 21058101300000 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 4 | 21001109800000 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 5 | 21203500500000 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 6 | 21707699021516 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| 7 | 21001501501530 | 6 | 10 | 17 | 12 | 44 | 131 | 12 | 69 | 23 | 99 |
| 8 | 21001108900000 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 9 | 21058100501728 | 8 | 251 | 60 | 41 | 61 | 179 | 389 | 389 | 20 | 441 |
| 10 | 21707699023945 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | 12 |
| 11 | 21101500100878 | 19 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 |
| 12 | 21707699021226 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 |
| 13 | 21008105140000 | 17 | 90 | 108 | 24 | 26 | 16 | 65 | 100 | 33 | 83 |
| 14 | 21008105150413 | 13 | 87 | 100 | 19 | 24 | 15 | 67 | 101 | 34 | 84 |
| 15 | 21008104540557 | 18 | 124 | 65 | 16 | 30 | 27 | 44 | 22 | 31 | 72 |
| 16 | 21707699022854 | 25 | 72 | 72 | 46 | 21 | 31 | 118 | 123 | 68 | 61 |
| 17 | 21011400601951 | 24 | 109 | 130 | 121 | 48 | 221 | 82 | 103 | 53 | 56 |
| 18 | 21058100600203 | 22 | 252 | 61 | 42 | 82 | 181 | 390 | 390 | 65 | 466 |
| 19 | 21707699022662 | 21 | 70 | 82 | 14 | 29 | 10 | 115 | 122 | 54 | 78 |
| 20 | 21001108701474 | 34 | 167 | 185 | 130 | 69 | 177 | 5 | 63 | 188 | 31 |
| 21 | 21001108711456 | 36 | 159 | 171 | 131 | 70 | 178 | 6 | 64 | 189 | 32 |
| 22 | 21094405801144 | 20 | 307 | 334 | 13 | 32 | 32 | 136 | 136 | 5 | 71 |
| 23 | 21707699022130 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 |
| 24 | 21008104650367 | 12 | 97 | 56 | 9 | 22 | 12 | 49 | 26 | 27 | 70 |
| 25 | 21707699023627 | 11 | 67 | 77 | 8 | 19 | 8 | 126 | 57 | 14 | 60 |
| | average = | 15.4 | 110.3 | 97.6 | 44.8 | 37.4 | 72.4 | 107.1 | 108.6 | 50.0 | 76.6 |
| | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | 72.0 |

Modified Babaci and Hawkins Results for Cumberland County

| Mod B&H RANK | Structure ID Number | B & H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|--------------|---------------------|------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21001107400000 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 3 | 21001501700863 | 1 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 4 | 21203500500000 | 5 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 5 | 21001109800000 | 4 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 6 | 21001501501530 | 7 | 10 | 17 | 12 | 44 | 131 | 12 | 69 | 23 | 99 |
| 7 | 21008304140000 | 68 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 8 | 21058100501728 | 9 | 251 | 60 | 41 | 61 | 179 | 389 | 389 | 20 | 441 |
| 9 | 21001108900000 | 8 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 10 | 21707699021516 | 6 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| 11 | 21707699023627 | 25 | 67 | 77 | 8 | 19 | 8 | 126 | 57 | 14 | 60 |
| 12 | 21008104650367 | 24 | 97 | 56 | 9 | 22 | 12 | 49 | 26 | 27 | 70 |
| 13 | 21008105150413 | 14 | 87 | 100 | 19 | 24 | 15 | 67 | 101 | 34 | 84 |
| 14 | 21707699023945 | 10 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | 12 |
| 15 | 21001107600000 | 96 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 16 | 21008104640250 | 26 | 36 | 58 | 11 | 27 | 13 | 46 | 24 | 56 | 73 |
| 17 | 21008105140000 | 13 | 90 | 108 | 24 | 26 | 16 | 65 | 100 | 33 | 83 |
| 18 | 21008104540557 | 15 | 124 | 65 | 16 | 30 | 27 | 44 | 22 | 31 | 72 |
| 19 | 21101500100878 | 11 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 |
| 20 | 21094405801144 | 22 | 307 | 334 | 13 | 32 | 32 | 136 | 136 | 5 | 71 |
| 21 | 21707699022662 | 19 | 70 | 82 | 14 | 29 | 10 | 115 | 122 | 54 | 78 |
| 22 | 21058100600203 | 18 | 252 | 61 | 42 | 82 | 181 | 390 | 390 | 65 | 466 |
| 23 | 21707699021226 | 12 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 |
| 24 | 21011400601951 | 17 | 109 | 130 | 121 | 48 | 221 | 82 | 103 | 53 | 56 |
| 25 | 21707699022854 | 16 | 72 | 72 | 46 | 21 | 31 | 118 | 123 | 68 | 61 |
| | average = | 98.2 | 85.0 | 31.7 | 28.6 | 57.6 | 109.8 | 107.1 | 33.1 | 76.3 | 62.73 |
| | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | 69.00 |

Buckle Results for Cumberland County

| Buckle RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-------------|---------------------|------------|--------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21008304160483 | 103 | 44 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 2 | 21058101300000 | 3 | 1 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 3 | 21058101200000 | 197 | 113 | 3 | 77 | 63 | 187 | 85 | 40 | 22 | 16 |
| 4 | 21058101401063 | 112 | 28 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 5 | 21008304140000 | 68 | 7 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 6 | 21008304041288 | 123 | 33 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 7 | 21001107400000 | 2 | 2 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 8 | 21001501700863 | 1 | 3 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 9 | 21001501700000 | 122 | 31 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 10 | 21001501501530 | 7 | 6 | 17 | 12 | 44 | 131 | 12 | 69 | 23 | 99 |
| 11 | 21793551010007 | 152 | 208 | 9 | 79 | 533 | 237 | 499 | 499 | 423 | 213 |
| 12 | 21793563040401 | 149 | 206 | 10 | 80 | 529 | 236 | 500 | 500 | 308 | 216 |
| 13 | 21001501401561 | 219 | 138 | 18 | 182 | 76 | 212 | 11 | 19 | 99 | 59 |
| 14 | 21008105100858 | 255 | 186 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 |
| 15 | 21001108002039 | 58 | 49 | 26 | 30 | 111 | 185 | 382 | 382 | 25 | 281 |
| 16 | 21710230005051 | 102 | 146 | 13 | 7 | 201 | 180 | 431 | 431 | 209 | 484 |
| 17 | 21720303624001 | 147 | 200 | 14 | 45 | 524 | 235 | 477 | 477 | 304 | 208 |
| 18 | 21721803934011 | 405 | 465 | 15 | 175 | 523 | 287 | 496 | 496 | 420 | 429 |
| 19 | 21001500700490 | 258 | 187 | 20 | 201 | 132 | 218 | 229 | 229 | 107 | 62 |
| 20 | 21008103341044 | 235 | 170 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 |
| 21 | 21008103540769 | 233 | 169 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 |
| 22 | 21008105702531 | 224 | 143 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 |
| 23 | 21008105541172 | 229 | 152 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 |
| 24 | 21008105601972 | 234 | 160 | 25 | 196 | 126 | 175 | 71 | 11 | 80 | 33 |
| 25 | 21001107600000 | 96 | 15 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| | | average = | 114.5 | 14.2 | 82.3 | 140.8 | 127.0 | 166.0 | 155.2 | 99.0 | 91.4 |
| | | | 149.4 | | | | | | | | Tot. ave |
| | | | | | | | | | | | 113.97 |

Modified Buckle Results for Cumberland County

| Mod Buckle RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------------|---------------------|------------|--------------|-------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21008304160483 | 103 | 44 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 2 | 21008304140000 | 68 | 7 | 5 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21058101200000 | 197 | 113 | 3 | 77 | 63 | 187 | 85 | 40 | 22 | 16 |
| 4 | 21058101300000 | 3 | 1 | 2 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 5 | 21058101401063 | 112 | 28 | 4 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 6 | 21001501700863 | 1 | 3 | 8 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 7 | 21008106101223 | 237 | 165 | 38 | 120 | 105 | 170 | 77 | 15 | 11 | 10 |
| 8 | 21001501700000 | 122 | 31 | 9 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 9 | 21793551010007 | 152 | 208 | 11 | 79 | 533 | 237 | 499 | 499 | 423 | 213 |
| 10 | 21793563040401 | 149 | 206 | 12 | 80 | 529 | 236 | 500 | 500 | 308 | 216 |
| 11 | 21008304041288 | 123 | 33 | 6 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 12 | 21008105702531 | 224 | 143 | 22 | 134 | 81 | 106 | 72 | 12 | 73 | 11 |
| 13 | 21710230005051 | 102 | 146 | 16 | 7 | 201 | 180 | 431 | 431 | 209 | 484 |
| 14 | 21720303624001 | 147 | 200 | 17 | 45 | 524 | 235 | 477 | 477 | 304 | 208 |
| 15 | 21721803934011 | 405 | 465 | 18 | 175 | 523 | 287 | 496 | 496 | 420 | 429 |
| 16 | 21001107400000 | 2 | 2 | 7 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 17 | 21001501501530 | 7 | 6 | 10 | 12 | 44 | 131 | 12 | 69 | 23 | 99 |
| 18 | 21001501401561 | 219 | 138 | 13 | 182 | 76 | 212 | 11 | 19 | 99 | 59 |
| 19 | 21008105100858 | 255 | 186 | 14 | 160 | 131 | 176 | 61 | 7 | 77 | 19 |
| 20 | 21001500700490 | 258 | 187 | 19 | 201 | 132 | 218 | 229 | 229 | 107 | 62 |
| 21 | 21008103341044 | 235 | 170 | 20 | 186 | 137 | 143 | 25 | 3 | 76 | 27 |
| 22 | 21008103540769 | 233 | 169 | 21 | 187 | 133 | 144 | 26 | 4 | 75 | 28 |
| 23 | 21001500601043 | 160 | 70 | 77 | 90 | 13 | 156 | 383 | 383 | 26 | 104 |
| 24 | 21008105541172 | 229 | 152 | 23 | 195 | 122 | 174 | 70 | 10 | 78 | 29 |
| 25 | 21008105601972 | 234 | 160 | 24 | 196 | 126 | 175 | 71 | 11 | 80 | 33 |
| | average = | 159.1 | 121.3 | 16.0 | 88.9 | 140.9 | 132.2 | 163.8 | 150.4 | 99.1 | 84.5 |
| | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | 115.6 |

Caltrans Results for Cumberland County

| Caltrans RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
|---------------|---------------------|------------|--------------|-------------|-----------------|--------------|-------------|---------|-------------|---------------|-----------|-------|
| 1 | 21008304140000 | 68 | 7 | 5 | 2 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 2 | 21203500500000 | 5 | 4 | 136 | 154 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 3 | 21008304160483 | 103 | 44 | 1 | 1 | 17 | 6 | 80 | 17 | 2 | 6 | |
| 4 | 21001501700863 | 1 | 3 | 8 | 6 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 5 | 21001107400000 | 2 | 2 | 7 | 16 | 8 | 9 | 133 | 133 | 19 | 17 | |
| 6 | 21001109800000 | 4 | 5 | 174 | 212 | 12 | 3 | 8 | 66 | 7 | 14 | |
| 7 | 21710230005051 | 102 | 146 | 16 | 13 | 201 | 180 | 431 | 431 | 209 | 484 | |
| 8 | 21707699023627 | 25 | 11 | 67 | 77 | 19 | 8 | 126 | 57 | 14 | 60 | |
| 9 | 21008104650367 | 24 | 12 | 97 | 56 | 22 | 12 | 49 | 26 | 27 | 70 | |
| 10 | 21058101300000 | 3 | 1 | 2 | 4 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 11 | 21008104640250 | 26 | 16 | 36 | 58 | 27 | 13 | 46 | 24 | 56 | 73 | |
| 12 | 21001501501530 | 7 | 6 | 10 | 17 | 44 | 131 | 12 | 69 | 23 | 99 | |
| 13 | 21094405801144 | 22 | 20 | 307 | 334 | 32 | 32 | 136 | 136 | 5 | 71 | |
| 14 | 21707699022662 | 19 | 21 | 70 | 82 | 29 | 10 | 115 | 122 | 54 | 78 | |
| 15 | 21001107600000 | 96 | 15 | 25 | 35 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 16 | 21008104540557 | 15 | 18 | 124 | 65 | 30 | 27 | 44 | 22 | 31 | 72 | |
| 17 | 21707699022631 | 32 | 29 | 193 | 132 | 49 | 7 | 114 | 52 | 55 | 88 | |
| 18 | 21058101401063 | 112 | 28 | 4 | 5 | 4 | 29 | 87 | 106 | 13 | 7 | |
| 19 | 21008105150413 | 14 | 13 | 87 | 100 | 24 | 15 | 67 | 101 | 34 | 84 | |
| 20 | 21707699020543 | 31 | 38 | 39 | 42 | 85 | 20 | 90 | 109 | 89 | 109 | |
| 21 | 21707699020625 | 38 | 46 | 42 | 45 | 108 | 23 | 93 | 110 | 93 | 112 | |
| 22 | 21707699023606 | 30 | 43 | 145 | 131 | 47 | 4 | 125 | 128 | 30 | 97 | |
| 23 | 21001501001113 | 72 | 78 | 165 | 165 | 160 | 18 | 145 | 145 | 29 | 67 | |
| 24 | 21008105140000 | 13 | 17 | 90 | 108 | 26 | 16 | 65 | 100 | 33 | 83 | |
| 25 | 21008105111172 | 65 | 67 | 56 | 64 | 77 | 42 | 64 | 33 | 162 | 129 | |
| average = | | 37.2 | 27.6 | 76.2 | 77.0 | 41.6 | 26.2 | 97.3 | 96.8 | 40.7 | 73.4 | |
| | | | | | | | | | | | Tot. ave | 59.40 |

Montana Results for Cumberland County

| Montana RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|--------------|---------------------|------------|--------------|-------------|-----------------|---------------|-------------|---------|-------------|---------------|-----------|
| 1 | 2105810130000 | 3 | 1 | 2 | 4 | 10 | 5 | 86 | 105 | 1 | 1 |
| 2 | 2100830414000 | 68 | 7 | 5 | 2 | 1 | 1 | 79 | 16 | 3 | 2 |
| 3 | 2100110760000 | 96 | 15 | 25 | 35 | 15 | 11 | 134 | 134 | 10 | 4 |
| 4 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 29 | 87 | 106 | 13 | 7 |
| 5 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 30 | 14 | 71 | 15 | 5 |
| 6 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 39 | 13 | 70 | 8 | 13 |
| 7 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 19 | 78 | 38 | 6 | 15 |
| 8 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 9 | 133 | 133 | 19 | 17 |
| 9 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 2 | 89 | 108 | 4 | 3 |
| 10 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 58 | 50 | 6 | 98 | 8 |
| 11 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 60 | 47 | 5 | 97 | 9 |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 3 | 8 | 66 | 7 | 14 |
| 13 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 156 | 383 | 383 | 26 | 104 |
| 14 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 9 | 67 | 9 | 23 |
| 15 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 52 | 7 | 65 | 24 | 46 |
| 16 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 59 | 81 | 102 | 16 | 75 |
| 17 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 6 | 80 | 17 | 2 | 6 |
| 18 | 21101500100878 | 11 | 19 | 231 | 175 | 59 | 203 | 309 | 309 | 72 | 48 |
| 19 | 21707699023627 | 25 | 11 | 67 | 77 | 8 | 8 | 126 | 57 | 14 | 60 |
| 20 | 21203500501906 | 27 | 27 | 134 | 152 | 58 | 90 | 408 | 408 | 239 | 245 |
| 21 | 21707699022854 | 16 | 25 | 72 | 72 | 46 | 31 | 118 | 123 | 68 | 61 |
| 22 | 21008104650367 | 24 | 12 | 97 | 56 | 9 | 12 | 49 | 26 | 27 | 70 |
| 23 | 21001107200000 | 218 | 115 | 27 | 31 | 123 | 62 | 131 | 131 | 35 | 66 |
| 24 | 21008105150413 | 14 | 13 | 87 | 100 | 19 | 15 | 67 | 101 | 34 | 84 |
| 25 | 21001107010000 | 210 | 108 | 78 | 122 | 148 | 38 | 144 | 144 | 90 | 82 |
| | average = | 81.1 | 37.8 | 80.5 | 77.8 | 49.5 | 40.5 | 109.2 | 111.6 | 37.5 | 42.7 |
| | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | 66.83 |

Nevada Results for Cumberland County

| Nevada RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
|-------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|---------|-------------|---------------|-----------|-------|
| 1 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 79 | 16 | 3 | 2 | |
| 2 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 89 | 108 | 4 | 3 | |
| 3 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 8 | 66 | 7 | 14 | |
| 4 | 21707699023606 | 30 | 43 | 145 | 131 | 22 | 47 | 125 | 128 | 30 | 97 | |
| 5 | 21581013000000 | 3 | 1 | 2 | 4 | 10 | 1 | 86 | 105 | 1 | 1 | |
| 6 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 80 | 17 | 2 | 6 | |
| 7 | 21707699022631 | 32 | 29 | 193 | 132 | 17 | 49 | 114 | 52 | 55 | 88 | |
| 8 | 21707699023627 | 25 | 11 | 67 | 77 | 8 | 19 | 126 | 57 | 14 | 60 | |
| 9 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 133 | 133 | 19 | 17 | |
| 10 | 21707699022662 | 19 | 21 | 70 | 82 | 14 | 29 | 115 | 122 | 54 | 78 | |
| 11 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 134 | 134 | 10 | 4 | |
| 12 | 21008104650367 | 24 | 12 | 97 | 56 | 9 | 22 | 49 | 26 | 27 | 70 | |
| 13 | 21008104640250 | 26 | 16 | 36 | 58 | 11 | 27 | 46 | 24 | 56 | 73 | |
| 14 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 9 | 67 | 9 | 23 | |
| 15 | 21008105150413 | 14 | 13 | 87 | 100 | 19 | 24 | 67 | 101 | 34 | 84 | |
| 16 | 21008105140000 | 13 | 17 | 90 | 108 | 24 | 26 | 65 | 100 | 33 | 83 | |
| 17 | 21008105100190 | 195 | 142 | 63 | 99 | 128 | 46 | 60 | 32 | 71 | 119 | |
| 18 | 21001501001113 | 72 | 78 | 165 | 165 | 23 | 160 | 145 | 145 | 29 | 67 | |
| 19 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 78 | 38 | 6 | 15 | |
| 20 | 21707699020543 | 31 | 38 | 39 | 42 | 20 | 85 | 90 | 109 | 89 | 109 | |
| 21 | 21707699023261 | 29 | 26 | 233 | 243 | 29 | 36 | 122 | 125 | 103 | 458 | |
| 22 | 21008103540163 | 89 | 97 | 358 | 355 | 54 | 202 | 149 | 149 | 57 | 472 | |
| 23 | 21707699020625 | 38 | 46 | 42 | 45 | 21 | 108 | 93 | 110 | 93 | 112 | |
| 24 | 21707699021869 | 40 | 48 | 48 | 53 | 52 | 109 | 107 | 116 | 95 | 114 | |
| 25 | 21707699020736 | 39 | 47 | 50 | 46 | 51 | 112 | 94 | 111 | 94 | 113 | |
| | ave = | 50.8 | 34.8 | 93.8 | 100.4 | 27.4 | 47.0 | 90.5 | 87.6 | 39.8 | 91.3 | |
| | | | | | | | | | | | Tot. ave | 66.35 |

Missouri Results for Cumberland County

| Missouri RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | IDOT RANK |
|---------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 |
| 2 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 6 |
| 3 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 2 |
| 4 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 3 |
| 5 | 21094405801144 | 22 | 20 | 307 | 334 | 13 | 32 | 32 | 136 | 136 | 71 |
| 6 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 15 |
| 7 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 14 |
| 8 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 13 |
| 9 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 23 |
| 10 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 4 |
| 11 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 10 |
| 12 | 21202800200646 | 231 | 131 | 155 | 168 | 118 | 40 | 63 | 88 | 107 | 98 |
| 13 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 7 |
| 14 | 21707699023627 | 25 | 11 | 67 | 77 | 8 | 19 | 8 | 126 | 57 | 60 |
| 15 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 5 |
| 16 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 75 |
| 17 | 21707699023945 | 10 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 12 |
| 18 | 21202100400904 | 230 | 163 | 321 | 269 | 164 | 53 | 172 | 406 | 406 | 229 |
| 19 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 17 |
| 20 | 21058100501728 | 9 | 8 | 251 | 60 | 41 | 61 | 179 | 389 | 389 | 441 |
| 21 | 21101900300000 | 263 | 210 | 369 | 364 | 211 | 93 | 89 | 161 | 161 | 460 |
| 22 | 21058101200000 | 197 | 113 | 3 | 3 | 77 | 63 | 187 | 85 | 40 | 16 |
| 23 | 21001501501530 | 7 | 6 | 10 | 17 | 12 | 44 | 131 | 12 | 69 | 99 |
| 24 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 46 |
| 25 | 21001108002039 | 58 | 49 | 15 | 26 | 30 | 111 | 185 | 382 | 382 | 281 |
| | average = | 90.8 | 49.4 | 107.3 | 98.5 | 51.7 | 31.3 | 64.9 | 115.5 | 115.1 | 80.3 |
| | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | 80.48 |

IDOT Results for Cumberland County

| IDOT RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-------|
| 1 | 2105810130000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | |
| 2 | 2100830414000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | |
| 3 | 2120350050000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | |
| 4 | 2100110760000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | |
| 5 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | |
| 6 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | |
| 7 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | |
| 8 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | |
| 9 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | |
| 10 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | |
| 11 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | |
| 12 | 21707699023945 | 10 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | |
| 13 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | |
| 14 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | |
| 15 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | |
| 16 | 21058101200000 | 197 | 113 | 3 | 3 | 77 | 63 | 187 | 85 | 40 | 22 | |
| 17 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | |
| 18 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | |
| 19 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | |
| 20 | 21008105512143 | 182 | 111 | 102 | 111 | 287 | 39 | 189 | 69 | 35 | 168 | |
| 21 | 21008102742185 | 225 | 150 | 51 | 28 | 220 | 83 | 164 | 17 | 2 | 64 | |
| 22 | 21008105502205 | 185 | 119 | 110 | 120 | 293 | 45 | 190 | 68 | 34 | 167 | |
| 23 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | |
| 24 | 21008102601335 | 232 | 158 | 114 | 27 | 219 | 90 | 165 | 15 | 1 | 66 | |
| 25 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | |
| | ave = | 115.9 | 65.6 | 50.6 | 52.9 | 92.4 | 36.9 | 75.4 | 68.2 | 48.0 | 45.2 | |
| | | | | | | | | | | | Tot. ave | 65.11 |

PennDOT Survey Results for Cumberland County

| PennDOT RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|--------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21008105502205 | 185 | 119 | 110 | 120 | 293 | 45 | 190 | 68 | 34 | 167 | 22 |
| 2 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 3 | 21008105100190 | 195 | 142 | 63 | 99 | 128 | 46 | 17 | 60 | 32 | 71 | 119 |
| 4 | 21058100301760 | 199 | 280 | 360 | 356 | 221 | 421 | 411 | 504 | 504 | 151 | 200 |
| 5 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 6 | 21001108701474 | 20 | 34 | 167 | 185 | 130 | 69 | 177 | 5 | 63 | 188 | 31 |
| 7 | 21008104840101 | 220 | 159 | 62 | 98 | 158 | 54 | 80 | 56 | 96 | 36 | 140 |
| 8 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 9 | 21008104800066 | 215 | 149 | 53 | 81 | 145 | 51 | 86 | 54 | 30 | 37 | 127 |
| 10 | 21101500100878 | 11 | 19 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 |
| 11 | 21008105140000 | 13 | 17 | 90 | 108 | 24 | 26 | 16 | 65 | 100 | 33 | 83 |
| 12 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 13 | 21008104640250 | 26 | 16 | 36 | 58 | 11 | 27 | 13 | 46 | 24 | 56 | 73 |
| 14 | 21203500500133 | 50 | 58 | 125 | 142 | 60 | 42 | 93 | 138 | 138 | 283 | 68 |
| 15 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| 16 | 21008105110135 | 190 | 123 | 60 | 67 | 129 | 116 | 28 | 63 | 8 | 79 | 149 |
| 17 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 18 | 21011400601951 | 17 | 24 | 109 | 130 | 121 | 48 | 221 | 82 | 103 | 53 | 56 |
| 19 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 20 | 21008104850246 | 217 | 151 | 65 | 97 | 149 | 52 | 78 | 57 | 97 | 70 | 128 |
| 21 | 21008104902459 | 236 | 196 | 118 | 134 | 224 | 59 | 129 | 58 | 98 | 220 | 102 |
| | average = | 105.5 | 75.7 | 91.5 | 104.1 | 96.3 | 55.6 | 89.8 | 100.7 | 102.0 | 77.9 | 68.0 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 83.8 |

| MIDOT Survey Results for Dauphin County | | | | | | | | | | | | | |
|---|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| MIDOT RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buekle RANK | Mod Buekle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 6 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 | |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 8 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 9 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 | |
| 10 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 | |
| 11 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 | |
| 12 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 | |
| 13 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 | |
| 14 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 15 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 | |
| 16 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 | |
| 17 | 22008304641712 | 136 | 95 | 18 | 22 | 14 | 55 | 23 | 65 | 3 | 72 | 16 | |
| 18 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | 17 | |
| 19 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 | |
| 20 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | |
| | average = | 53.0 | 36.7 | 57.3 | 59.4 | 44.7 | 29.3 | 48.3 | 74.7 | 65.8 | 32.2 | 10.9 | Tot. ave |
| | | | | | | | | | | | | | 46.55 |

M&M1 Survey Results for Dauphin County

| M&M1 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 6 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 7 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 |
| 8 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 9 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 10 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 11 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 12 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 13 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 |
| 14 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 15 | 22008304641712 | 136 | 95 | 18 | 22 | 14 | 55 | 23 | 65 | 3 | 72 | 16 |
| 16 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 17 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 |
| 18 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | 17 |
| 19 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 |
| 20 | 22002200511275 | 42 | 40 | 147 | 149 | 146 | 11 | 45 | 5 | 86 | 79 | 23 |
| | average = | 60.2 | 43.9 | 55.7 | 57.9 | 50.3 | 34.6 | 45.2 | 56.4 | 52.1 | 37.5 | 12.5 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 46.0 |

| M&M2 Survey Results for Dauphin County | | | | | | | | | | | | | |
|--|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M2 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 6 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 | |
| 7 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 | |
| 8 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 | |
| 9 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 10 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 | |
| 11 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 | |
| 12 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 13 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 | |
| 14 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 15 | 22008304641712 | 136 | 95 | 18 | 22 | 14 | 55 | 23 | 65 | 3 | 72 | 16 | |
| 16 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 | |
| 17 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | 17 | |
| 18 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 | |
| 19 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | |
| 20 | 22002200511275 | 42 | 40 | 147 | 149 | 146 | 11 | 45 | 5 | 86 | 79 | 23 | |
| | average = | 53.2 | 38.0 | 61.8 | 63.7 | 50.1 | 29.2 | 50.2 | 71.9 | 69.0 | 35.1 | 11.5 | Tot. ave |
| | | | | | | | | | | | | | 48.5 |

M&M3 Survey Results for Dauphin County

| M&M3 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 6 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 7 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 8 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 9 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 10 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 |
| 11 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 |
| 12 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 13 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 |
| 14 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 |
| 15 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | 17 |
| 16 | 22030000710851 | 106 | 110 | 145 | 150 | 217 | 27 | 119 | 88 | 103 | 144 | 40 |
| 17 | 22002200511275 | 42 | 40 | 147 | 149 | 146 | 11 | 45 | 5 | 86 | 79 | 23 |
| 18 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 |
| 19 | 22008304641712 | 136 | 95 | 18 | 22 | 14 | 55 | 23 | 65 | 3 | 72 | 16 |
| 20 | 22008107041120 | 147 | 128 | 20 | 24 | 82 | 118 | 115 | 32 | 7 | 57 | 36 |
| | average = | 75.3 | 59.3 | 64.9 | 64.9 | 65.4 | 45.5 | 58.9 | 57.6 | 51.1 | 48.2 | 16.7 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 55.2 |

| M&M4 Survey Results for Dauphin County | | | | | | | | | | | | | |
|--|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M4 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 6 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 7 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 8 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 | |
| 9 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 | |
| 10 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 | |
| 11 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 12 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 | |
| 13 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 | |
| 14 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 | |
| 15 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 | |
| 16 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 | |
| 17 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 | |
| 18 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 | |
| 19 | 22030000710851 | 106 | 110 | 145 | 150 | 217 | 27 | 119 | 88 | 103 | 144 | 40 | |
| 20 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 | Tot. ave |
| | average = | 67.8 | 49.0 | 55.5 | 56.0 | 50.4 | 38.9 | 46.8 | 59.9 | 54.0 | 32.8 | 14.3 | 47.8 |

M&M5 Survey Results for Dauphin County

| M&M5 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 7 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 8 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 9 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 10 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 11 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 12 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 13 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 |
| 14 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 |
| 15 | 22030000710851 | 106 | 110 | 145 | 150 | 217 | 27 | 119 | 88 | 103 | 144 | 40 |
| 16 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 |
| 17 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 18 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 19 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 20 | 22030000700795 | 114 | 131 | 156 | 166 | 228 | 36 | 132 | 87 | 102 | 143 | 49 |
| | average = | 64.1 | 48.9 | 59.3 | 60.6 | 59.4 | 36.8 | 53.1 | 62.8 | 59.0 | 36.0 | 15.5 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 50.5 |

M&M6 Survey Results for Dauphin County

| M&M6 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 2200830420000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 2200810652000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 2230160010000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 2200830434000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 7 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 8 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 9 | 2200110010000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 10 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 11 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 12 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 13 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 |
| 14 | 22030000710851 | 106 | 110 | 145 | 150 | 217 | 27 | 119 | 88 | 103 | 144 | 40 |
| 15 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 |
| 16 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 17 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 18 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 19 | 22030000700795 | 114 | 131 | 156 | 166 | 228 | 36 | 132 | 87 | 102 | 143 | 49 |
| 20 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 |
| | average = | 58.2 | 46.1 | 65.8 | 67.0 | 62.8 | 35.2 | 57.2 | 59.9 | 62.2 | 38.5 | 15.9 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 51.7 |

| M&M4a Survey Results for Dauphin County | | | | | | | | | | | | | |
|---|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M4a RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 6 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 7 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 | |
| 8 | 220081066601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 9 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 | |
| 10 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 | |
| 11 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 | |
| 12 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 | |
| 13 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 | |
| 14 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 | |
| 15 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 | |
| 16 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 17 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 | |
| 18 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 | |
| 19 | 22008304900000 | 90 | 59 | 5 | 9 | 13 | 43 | 35 | 73 | 61 | 37 | 45 | |
| 20 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 | Tot. ave |
| | average = | 67.0 | 46.5 | 48.5 | 48.9 | 40.2 | 39.7 | 42.6 | 59.2 | 51.9 | 27.5 | 14.6 | 44.2 |

| M&M4b Survey Results for Dauphin County | | | | | | | | | | | | | |
|---|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M4b RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 6 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 7 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 8 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 | |
| 9 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 | |
| 10 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 11 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 | |
| 12 | 22030000710851 | 106 | 110 | 145 | 150 | 217 | 27 | 119 | 88 | 103 | 144 | 40 | |
| 13 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 | |
| 14 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 | |
| 15 | 22030000700795 | 114 | 131 | 156 | 166 | 228 | 36 | 132 | 87 | 102 | 143 | 49 | |
| 16 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 | |
| 17 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 | |
| 18 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 | |
| 19 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 | |
| 20 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | Tot. ave |
| | average = | 67.6 | 53.3 | 57.6 | 58.8 | 61.1 | 39.5 | 57.6 | 63.2 | 54.2 | 43.3 | 15.6 | 52.0 |

M&M4c Survey Results for Dauphin County

| M&M4c RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 7 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 8 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 9 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 10 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 11 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 12 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 13 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 |
| 14 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 15 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 |
| 16 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 17 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 |
| 18 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 19 | 22008304900000 | 90 | 59 | 5 | 9 | 13 | 43 | 35 | 73 | 61 | 37 | 45 |
| 20 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 |
| | average = | 67.0 | 46.5 | 48.5 | 48.9 | 40.2 | 39.7 | 42.6 | 59.2 | 51.9 | 27.5 | 14.6 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 44.2 |

M&M4d Survey Results for Dauphin County

| M&M4d RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 8 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 9 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 10 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 11 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 12 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 13 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 14 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 15 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 |
| 16 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 17 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 |
| 18 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 |
| 19 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 |
| 20 | 22030000710851 | 106 | 110 | 145 | 150 | 217 | 27 | 119 | 88 | 103 | 144 | 40 |
| | average = | 67.8 | 49.0 | 55.5 | 56.0 | 50.4 | 38.9 | 46.8 | 59.9 | 54.0 | 32.8 | 14.3 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 47.8 |

M&M4e Survey Results for Dauphin County

| M&M4e RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 2 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 7 | 2200830440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 8 | 22008304501003 | 45 | 25 | 10 | 6 | 22 | 33 | 46 | 57 | 18 | 19 | 6 |
| 9 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 10 | 22008304700976 | 83 | 57 | 7 | 11 | 31 | 75 | 52 | 68 | 23 | 16 | 13 |
| 11 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 12 | 22008107401223 | 110 | 83 | 16 | 18 | 71 | 94 | 100 | 35 | 10 | 46 | 18 |
| 13 | 22008304501664 | 104 | 77 | 12 | 7 | 42 | 90 | 98 | 58 | 19 | 65 | 14 |
| 14 | 22008107502454 | 146 | 126 | 55 | 19 | 72 | 115 | 104 | 38 | 11 | 59 | 30 |
| 15 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 16 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 17 | 22008304540221 | 125 | 68 | 13 | 13 | 7 | 51 | 25 | 59 | 20 | 42 | 12 |
| 18 | 22008106951752 | 187 | 134 | 80 | 73 | 48 | 78 | 7 | 30 | 2 | 80 | 26 |
| 19 | 22030000710851 | 106 | 110 | 145 | 150 | 217 | 27 | 119 | 88 | 103 | 144 | 40 |
| 20 | 22008107342707 | 144 | 120 | 56 | 20 | 76 | 111 | 109 | 34 | 9 | 56 | 29 |
| | average = | 67.8 | 49.0 | 55.5 | 56.0 | 50.4 | 38.9 | 46.8 | 59.9 | 54.0 | 32.8 | 14.3 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 47.8 |

| PennDOT Survey Results for Dauphin County | | | | | | | | | | | | | |
|---|---------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|
| PennDOT RANK | Structure ID Number | MIDOT RANK | M&M1 RANK | M&M2 RANK | M&M3 RANK | M&M4 RANK | M&M5 RANK | M&M6 RANK | M&M4a RANK | M&M4b RANK | M&M4c RANK | M&M4d RANK | M&M4e RANK |
| 1 | 22008304200000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 22008106520000 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 22002200500208 | 20 | 17 | 19 | 11 | 22 | 21 | 20 | 21 | 20 | 21 | 21 | 22 |
| 4 | 22707699024665 | 87 | 81 | 91 | 97 | 44 | 43 | 41 | 56 | 43 | 56 | 47 | 44 |
| 5 | 22301600100000 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 6 | 22301200300000 | 15 | 25 | 18 | 31 | 46 | 70 | 67 | 63 | 39 | 63 | 52 | 48 |
| 7 | 22008106601047 | 7 | 11 | 9 | 38 | 6 | 6 | 6 | 8 | 6 | 8 | 7 | 6 |
| 8 | 22008304340000 | 5 | 6 | 5 | 41 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 9 | 22032201700000 | 54 | 55 | 51 | 58 | 90 | 105 | 104 | 97 | 86 | 97 | 94 | 90 |
| 10 | 22300901900601 | 554 | 509 | 512 | 518 | 196 | 224 | 222 | 201 | 194 | 198 | 198 | 196 |
| 11 | 22301400300190 | 14 | 12 | 12 | 12 | 11 | 17 | 16 | 16 | 10 | 16 | 11 | 11 |
| 12 | 22002202310000 | 80 | 82 | 83 | 159 | 60 | 57 | 56 | 81 | 49 | 81 | 62 | 60 |
| 13 | 22008304340713 | 39 | 68 | 62 | 162 | 53 | 49 | 47 | 47 | 57 | 47 | 50 | 53 |
| 14 | 22002202911867 | 33 | 37 | 33 | 148 | 16 | 19 | 18 | 10 | 24 | 10 | 14 | 16 |
| 15 | 22008106851552 | 86 | 96 | 92 | 436 | 96 | 90 | 89 | 77 | 94 | 77 | 91 | 93 |
| 16 | 22028300252054 | 85 | 94 | 81 | 446 | 101 | 102 | 101 | 93 | 92 | 92 | 100 | 101 |
| 17 | 22022501301860 | 181 | 141 | 157 | 98 | 198 | 226 | 223 | 188 | 208 | 189 | 201 | 198 |
| 18 | 22002200900000 | 71 | 72 | 76 | 62 | 32 | 30 | 28 | 28 | 33 | 29 | 31 | 32 |
| 19 | 22008106940918 | 72 | 75 | 74 | 427 | 63 | 73 | 68 | 45 | 69 | 46 | 59 | 63 |
| 20 | 22008304601012 | 13 | 34 | 21 | 73 | 26 | 31 | 29 | 25 | 25 | 25 | 25 | 26 |
| 21 | 22008304611029 | 38 | 63 | 49 | 424 | 58 | 55 | 54 | 62 | 55 | 62 | 58 | 58 |
| | average = | 69.6 | 70.7 | 69.1 | 154.7 | 53.8 | 58.6 | 57.2 | 53.8 | 53.1 | 53.8 | 54.0 | 53.8 |

EMS Survey Results for Dauphin County

| EMS RANK | Structure ID Number | MIDOT RANK | M&M1 RANK | M&M2 RANK | M&M3 RANK | M&M4 RANK | M&M5 RANK | M&M6 RANK | M&M4a RANK | M&M4b RANK | M&M4c RANK | M&M4d RANK | M&M4e RANK |
|----------|---------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|
| 1 | 22008106520000 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 2 | 22302100100000 | 55 | 45 | 45 | 60 | 40 | 36 | 38 | 39 | 52 | 38 | 39 | 40 |
| 3 | 22032200600000 | 515 | 516 | 544 | 461 | 130 | 156 | 152 | 134 | 128 | 134 | 132 | 130 |
| 4 | 22002201802643 | 157 | 483 | 286 | 474 | 141 | 126 | 123 | 133 | 146 | 133 | 141 | 141 |
| 5 | 22002200900000 | 71 | 72 | 76 | 62 | 32 | 30 | 28 | 28 | 33 | 29 | 31 | 32 |
| 6 | 22014700401898 | 77 | 67 | 71 | 59 | 99 | 95 | 95 | 116 | 88 | 116 | 101 | 99 |
| 7 | 22014702200000 | 193 | 149 | 165 | 109 | 223 | 240 | 237 | 216 | 228 | 214 | 223 | 224 |
| 8 | 22014703100842 | 70 | 60 | 67 | 55 | 91 | 89 | 87 | 110 | 82 | 110 | 95 | 91 |
| 9 | 22020900700000 | 245 | 202 | 220 | 151 | 274 | 282 | 280 | 270 | 280 | 270 | 273 | 275 |
| 10 | 22020901401722 | 251 | 209 | 228 | 166 | 290 | 297 | 296 | 278 | 294 | 278 | 294 | 290 |
| 11 | 22020902600000 | 198 | 152 | 172 | 111 | 233 | 246 | 243 | 217 | 235 | 218 | 230 | 233 |
| 12 | 22020903200000 | 230 | 180 | 200 | 131 | 251 | 262 | 260 | 251 | 256 | 251 | 252 | 251 |
| 13 | 22008106851552 | 86 | 96 | 92 | 436 | 96 | 90 | 89 | 77 | 94 | 77 | 91 | 93 |
| 14 | 22008106940918 | 72 | 75 | 74 | 427 | 63 | 73 | 68 | 45 | 69 | 46 | 59 | 63 |
| 15 | 22008304601012 | 13 | 34 | 21 | 73 | 26 | 31 | 29 | 25 | 25 | 25 | 25 | 26 |
| 16 | 22032201700000 | 54 | 55 | 51 | 58 | 90 | 105 | 104 | 97 | 86 | 97 | 94 | 90 |
| 17 | 22032202901298 | 146 | 120 | 125 | 79 | 164 | 193 | 188 | 160 | 165 | 161 | 162 | 161 |
| 18 | 22008304200000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 19 | 22002200500208 | 20 | 17 | 19 | 11 | 22 | 21 | 20 | 21 | 20 | 21 | 21 | 22 |
| 20 | 22301600100000 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | average = | 123.0 | 127.0 | 123.2 | 146.5 | 113.6 | 119.0 | 117.2 | 111.2 | 114.4 | 111.3 | 113.5 | 113.4 |

| MIDOT Results for Cumberland County | | | | | | | | | | | | | |
|-------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| MIDOT RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 3 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 4 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 5 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 6 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 7 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 8 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 | |
| 9 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 | |
| 10 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 | |
| 11 | 21707699023945 | 10 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | 12 | |
| 12 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 | |
| 13 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 | |
| 14 | 21008105512143 | 182 | 111 | 102 | 111 | 287 | 39 | 189 | 69 | 35 | 168 | 20 | |
| 15 | 21008102601335 | 232 | 158 | 114 | 27 | 219 | 90 | 165 | 15 | 1 | 66 | 24 | |
| 16 | 21008102742185 | 225 | 150 | 51 | 28 | 220 | 83 | 164 | 17 | 2 | 64 | 21 | |
| 17 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 | |
| 18 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 | |
| 19 | 21008105502205 | 185 | 119 | 110 | 120 | 293 | 45 | 190 | 68 | 34 | 167 | 22 | |
| 20 | 21707699022130 | 23 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 | Tot. ave |
| | average = | 116.1 | 70.6 | 45.4 | 42.2 | 107.1 | 46.5 | 84.0 | 74.3 | 41.9 | 59.4 | 12.7 | 63.63 |

M&M1 Results for Cumberland County

| M&M1 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 3 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 4 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 |
| 5 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 |
| 6 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 7 | 21707699023945 | 10 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | 12 |
| 8 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| 9 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 |
| 10 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 |
| 11 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 |
| 12 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 |
| 13 | 21008102742185 | 225 | 150 | 51 | 28 | 220 | 83 | 164 | 17 | 2 | 64 | 21 |
| 14 | 21707699022130 | 23 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 |
| 15 | 21008102601335 | 232 | 158 | 114 | 27 | 219 | 90 | 165 | 15 | 1 | 66 | 24 |
| 16 | 21707699021183 | 28 | 35 | 44 | 48 | 84 | 123 | 65 | 99 | 45 | 131 | 30 |
| 17 | 21707699020569 | 36 | 42 | 40 | 43 | 81 | 139 | 67 | 91 | 41 | 137 | 34 |
| 18 | 21707699020618 | 33 | 40 | 41 | 44 | 82 | 134 | 68 | 92 | 42 | 134 | 35 |
| 19 | 21707699020871 | 34 | 41 | 43 | 47 | 83 | 135 | 69 | 95 | 43 | 136 | 36 |
| 20 | 21707699021475 | 37 | 45 | 46 | 51 | 87 | 145 | 70 | 104 | 48 | 140 | 37 |
| | average = | 113.7 | 81.5 | 38.8 | 34.4 | 115.5 | 87.7 | 92.5 | 73.9 | 28.0 | 81.9 | 20.7 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 69.84 |

| M&M2 Results for Cumberland County | | | | | | | | | | | | | |
|------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|------------------|
| M&M2 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 3 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 4 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 5 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 | |
| 6 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 | |
| 7 | 21707699023945 | 10 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | 12 | |
| 8 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 | |
| 9 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 10 | 21008105512143 | 182 | 111 | 102 | 111 | 287 | 39 | 189 | 69 | 35 | 168 | 20 | |
| 11 | 21008102742185 | 225 | 150 | 51 | 28 | 220 | 83 | 164 | 17 | 2 | 64 | 21 | |
| 12 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 | |
| 13 | 21008102601335 | 232 | 158 | 114 | 27 | 219 | 90 | 165 | 15 | 1 | 66 | 24 | |
| 14 | 21008105502205 | 185 | 119 | 110 | 120 | 293 | 45 | 190 | 68 | 34 | 167 | 22 | |
| 15 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 | |
| 16 | 21707699022130 | 23 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 | |
| 17 | 21707699021183 | 28 | 35 | 44 | 48 | 84 | 123 | 65 | 99 | 45 | 131 | 30 | |
| 18 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 19 | 21707699020569 | 36 | 42 | 40 | 43 | 81 | 139 | 67 | 91 | 41 | 137 | 34 | |
| 20 | 21707699020618 | 33 | 40 | 41 | 44 | 82 | 134 | 68 | 92 | 42 | 134 | 35 | |
| | average = | 105.4 | 72.1 | 50.1 | 46.9 | 117.6 | 65.1 | 91.7 | 73.4 | 35.5 | 78.2 | 16.8 | Tot. ave 68.4 |

M&M3 Results for Cumberland County

| M&M3 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 3 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 4 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 |
| 5 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 |
| 6 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 |
| 7 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 |
| 8 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| 9 | 21707699023945 | 10 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | 12 |
| 10 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 |
| 11 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 |
| 12 | 21707699021183 | 28 | 35 | 44 | 48 | 84 | 123 | 65 | 99 | 45 | 131 | 30 |
| 13 | 21707699022130 | 23 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 |
| 14 | 21707699020569 | 36 | 42 | 40 | 43 | 81 | 139 | 67 | 91 | 41 | 137 | 34 |
| 15 | 21707699020618 | 33 | 40 | 41 | 44 | 82 | 134 | 68 | 92 | 42 | 134 | 35 |
| 16 | 21707699020871 | 34 | 41 | 43 | 47 | 83 | 135 | 69 | 95 | 43 | 136 | 36 |
| 17 | 21707699021475 | 37 | 45 | 46 | 51 | 87 | 145 | 70 | 104 | 48 | 140 | 37 |
| 18 | 21008102742185 | 225 | 150 | 51 | 28 | 220 | 83 | 164 | 17 | 2 | 64 | 21 |
| 19 | 21707699021297 | 51 | 63 | 34 | 50 | 86 | 171 | 71 | 102 | 47 | 147 | 39 |
| 20 | 21008102601335 | 232 | 158 | 114 | 27 | 219 | 90 | 165 | 15 | 1 | 66 | 24 |
| | average = | 112.9 | 84.3 | 40.3 | 36.8 | 119.7 | 96.2 | 96.0 | 75.0 | 29.5 | 89.1 | 22.5 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 72.9 |

| M&M4 Results for Cumberland County | | | | | | | | | | | | | |
|------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M4 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 3 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 4 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 5 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 6 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 7 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 8 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 | |
| 9 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 | |
| 10 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 | |
| 11 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 | |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 | |
| 13 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 | |
| 14 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 | |
| 15 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 | |
| 16 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 | |
| 17 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 | |
| 18 | 21008105541172 | 229 | 152 | 23 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 | |
| 19 | 21008105601972 | 234 | 160 | 24 | 25 | 196 | 126 | 175 | 71 | 11 | 80 | 33 | |
| 20 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 | Tot. ave |
| | average = | 114.9 | 73.5 | 40.6 | 43.3 | 86.4 | 53.1 | 72.5 | 66.7 | 44.2 | 46.2 | 15.8 | 59.7 |

M&M5 Results for Cumberland County

| M&M5 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 4 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 5 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 6 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 7 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 8 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 |
| 9 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 |
| 10 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 |
| 11 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 |
| 12 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 13 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 |
| 14 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| 15 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 16 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 17 | 21008105541172 | 229 | 152 | 23 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 |
| 18 | 21008105601972 | 234 | 160 | 24 | 25 | 196 | 126 | 175 | 71 | 11 | 80 | 33 |
| 19 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 |
| 20 | 21707699022130 | 23 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 |
| | average = | 110.9 | 72.8 | 43.0 | 45.9 | 90.7 | 58.1 | 75.5 | 68.1 | 45.9 | 52.5 | 16.8 |
| | | | | | | | | | | | Tot. ave | 61.8 |

| M&M6 Results for Cumberland County | | | | | | | | | | | | | |
|------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M6 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 3 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 4 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 5 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 6 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 7 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 8 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 | |
| 9 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 | |
| 10 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 | |
| 11 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 | |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 | |
| 13 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 | |
| 14 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 | |
| 15 | 21707699022130 | 23 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 | |
| 16 | 21707699020569 | 36 | 42 | 40 | 43 | 81 | 139 | 67 | 91 | 41 | 137 | 34 | |
| 17 | 21707699020618 | 33 | 40 | 41 | 44 | 82 | 134 | 68 | 92 | 42 | 134 | 35 | |
| 18 | 21707699020871 | 34 | 41 | 43 | 47 | 83 | 135 | 69 | 95 | 43 | 136 | 36 | |
| 19 | 21707699021183 | 28 | 35 | 44 | 48 | 84 | 123 | 65 | 99 | 45 | 131 | 30 | |
| 20 | 21707699021297 | 51 | 63 | 34 | 50 | 86 | 171 | 71 | 102 | 47 | 147 | 39 | |
| | average = | 60.7 | 42.0 | 48.0 | 52.0 | 65.3 | 60.8 | 51.9 | 79.4 | 55.0 | 67.4 | 18.7 | Tot. ave |
| | | | | | | | | | | | | | 54.6 |

| M&M4a Results for Cumberland County | | | | | | | | | | | | | |
|-------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M4a RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 3 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 4 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 5 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 6 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 | |
| 7 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 | |
| 8 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 | |
| 9 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 10 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 | |
| 11 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 12 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 | |
| 13 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 | |
| 14 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 | |
| 15 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 | |
| 16 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 | |
| 17 | 21008105541172 | 229 | 152 | 23 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 | |
| 18 | 21008105601972 | 234 | 160 | 24 | 25 | 196 | 126 | 175 | 71 | 11 | 80 | 33 | |
| 19 | 21058101200000 | 197 | 113 | 3 | 3 | 77 | 63 | 187 | 85 | 40 | 22 | 16 | |
| 20 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 | Tot. ave |
| | average = | 131.3 | 81.3 | 42.1 | 48.9 | 89.5 | 52.3 | 76.8 | 66.1 | 44.0 | 41.2 | 14.2 | 62.5 |

| M&M4b Results for Cumberland County | | | | | | | | | | | | | |
|-------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M4b RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 3 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 4 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 5 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 6 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 7 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 8 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 | |
| 9 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 | |
| 10 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 | |
| 11 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 | |
| 12 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 | |
| 13 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 | |
| 14 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 | |
| 15 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 | |
| 16 | 21707699021226 | 12 | 23 | 45 | 49 | 85 | 79 | 64 | 100 | 46 | 106 | 25 | |
| 17 | 21707699023945 | 10 | 14 | 69 | 79 | 107 | 43 | 127 | 128 | 18 | 17 | 12 | |
| 18 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 | |
| 19 | 21707699022130 | 23 | 30 | 49 | 54 | 89 | 117 | 66 | 108 | 51 | 128 | 26 | |
| 20 | 21008105541172 | 229 | 152 | 23 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 | Tot. ave |
| | average = | 104.8 | 67.6 | 45.0 | 47.9 | 86.1 | 54.4 | 73.0 | 68.3 | 40.4 | 48.5 | 15.2 | 59.2 |

M&M4c Results for Cumberland County

| M&M4c RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 3 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 4 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 5 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 |
| 6 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 |
| 7 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 |
| 8 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 9 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 10 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 11 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 |
| 12 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 13 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 14 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 15 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| 16 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 |
| 17 | 21058101200000 | 197 | 113 | 3 | 3 | 77 | 63 | 187 | 85 | 40 | 22 | 16 |
| 18 | 21008105541172 | 229 | 152 | 23 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 |
| 19 | 21008105601972 | 234 | 160 | 24 | 25 | 196 | 126 | 175 | 71 | 11 | 80 | 33 |
| 20 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| | average = | 131.3 | 81.3 | 42.1 | 48.9 | 89.5 | 52.3 | 76.8 | 66.1 | 44.0 | 41.2 | 14.2 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 62.5 |

| M&M4d Results for Cumberland County | | | | | | | | | | | | | |
|-------------------------------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| M&M4d RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 3 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 4 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 5 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 6 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 | |
| 7 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 | |
| 8 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 | |
| 9 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 | |
| 10 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 | |
| 11 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 12 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 | |
| 13 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 14 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 | |
| 15 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 | |
| 16 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 | |
| 17 | 21008105541172 | 229 | 152 | 23 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 | |
| 18 | 21008105601972 | 234 | 160 | 24 | 25 | 196 | 126 | 175 | 71 | 11 | 80 | 33 | |
| 19 | 21058101200000 | 197 | 113 | 3 | 3 | 77 | 63 | 187 | 85 | 40 | 22 | 16 | |
| 20 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 | Tot. ave |
| | average = | 131.3 | 81.3 | 42.1 | 48.9 | 89.5 | 52.3 | 76.8 | 66.1 | 44.0 | 41.2 | 14.2 | 62.5 |

M&M4e Results for Cumberland County

| M&M4e RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|------------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 4 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 5 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 6 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 7 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 8 | 21008106101223 | 237 | 165 | 38 | 7 | 120 | 105 | 170 | 77 | 15 | 11 | 10 |
| 9 | 21008103341044 | 235 | 170 | 20 | 21 | 186 | 137 | 143 | 25 | 3 | 76 | 27 |
| 10 | 21008103540769 | 233 | 169 | 21 | 22 | 187 | 133 | 144 | 26 | 4 | 75 | 28 |
| 11 | 21008105702531 | 224 | 143 | 22 | 12 | 134 | 81 | 106 | 72 | 12 | 73 | 11 |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 13 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 14 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 15 | 21008105100858 | 255 | 186 | 14 | 19 | 160 | 131 | 176 | 61 | 7 | 77 | 19 |
| 16 | 21008105541172 | 229 | 152 | 23 | 24 | 195 | 122 | 174 | 70 | 10 | 78 | 29 |
| 17 | 21008105601972 | 234 | 160 | 24 | 25 | 196 | 126 | 175 | 71 | 11 | 80 | 33 |
| 18 | 21707699021516 | 6 | 10 | 47 | 52 | 88 | 55 | 61 | 105 | 49 | 67 | 18 |
| 19 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 20 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| | average = | 121.8 | 76.1 | 48.7 | 55.0 | 87.8 | 49.9 | 70.0 | 62.2 | 45.2 | 41.3 | 15.7 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 61.2 |

PennDOT Survey Results for Cumberland County

| PennDOT RANK | Structure ID Number | MIDOT RANK | M&M1 RANK | M&M2 RANK | M&M3 RANK | M&M4 RANK | M&M5 RANK | M&M6 RANK | M&M4a RANK | M&M4b RANK | M&M4c RANK | M&M4d RANK | M&M4e RANK |
|--------------|---------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|
| 1 | 21008105502205 | 19 | 23 | 14 | 31 | 49 | 48 | 44 | 54 | 45 | 61 | 54 | 50 |
| 2 | 21001107600000 | 6 | 48 | 31 | 209 | 7 | 7 | 7 | 4 | 7 | 4 | 4 | 7 |
| 3 | 21008105100190 | 93 | 398 | 205 | 401 | 100 | 114 | 114 | 111 | 96 | 116 | 113 | 105 |
| 4 | 21058100301760 | 209 | 137 | 147 | 137 | 249 | 263 | 256 | 283 | 237 | 306 | 288 | 267 |
| 5 | 21008304041288 | 43 | 61 | 53 | 374 | 55 | 55 | 53 | 53 | 59 | 52 | 53 | 54 |
| 6 | 21001108701474 | 27 | 27 | 23 | 24 | 38 | 37 | 34 | 42 | 36 | 46 | 42 | 39 |
| 7 | 21008104840101 | 109 | 413 | 318 | 417 | 118 | 110 | 110 | 122 | 115 | 127 | 123 | 120 |
| 8 | 21001109800000 | 33 | 54 | 50 | 369 | 12 | 16 | 12 | 10 | 14 | 8 | 9 | 12 |
| 9 | 21008104800066 | 102 | 408 | 246 | 414 | 117 | 109 | 109 | 128 | 114 | 133 | 129 | 121 |
| 10 | 21101500100878 | 60 | 55 | 58 | 48 | 86 | 96 | 92 | 93 | 76 | 94 | 93 | 89 |
| 11 | 21008105140000 | 79 | 220 | 95 | 392 | 85 | 79 | 75 | 87 | 78 | 89 | 86 | 85 |
| 12 | 21001501700000 | 41 | 58 | 52 | 372 | 51 | 50 | 48 | 45 | 53 | 43 | 45 | 49 |
| 13 | 21008104640250 | 73 | 203 | 89 | 391 | 79 | 72 | 67 | 86 | 74 | 91 | 89 | 82 |
| 14 | 21203500500133 | 61 | 68 | 67 | 201 | 43 | 42 | 39 | 46 | 40 | 50 | 48 | 45 |
| 15 | 21707699021516 | 12 | 8 | 8 | 8 | 15 | 14 | 10 | 20 | 13 | 20 | 20 | 18 |
| 16 | 21008105110135 | 99 | 402 | 226 | 408 | 123 | 133 | 133 | 139 | 111 | 149 | 145 | 129 |
| 17 | 21008304140000 | 2 | 6 | 2 | 50 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 |
| 18 | 21011400601951 | 66 | 57 | 60 | 49 | 74 | 91 | 87 | 79 | 75 | 78 | 79 | 78 |
| 19 | 21001107400000 | 40 | 49 | 51 | 73 | 17 | 15 | 11 | 13 | 31 | 9 | 10 | 13 |
| 20 | 21008104850246 | 103 | 411 | 270 | 415 | 112 | 104 | 102 | 118 | 110 | 124 | 120 | 116 |
| 21 | 21008104902459 | 81 | 82 | 83 | 370 | 58 | 58 | 56 | 65 | 57 | 77 | 70 | 61 |
| | average = | 64.7 | 151.8 | 102.3 | 245.4 | 71.0 | 72.1 | 69.6 | 76.2 | 68.7 | 80.0 | 77.3 | 73.4 |

MNTI Survey Results for Dauphin County

| MNTI RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 3 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 4 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 5 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 6 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 |
| 7 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 8 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 |
| 9 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | 17 |
| 10 | 22002200511275 | 42 | 40 | 147 | 149 | 146 | 11 | 45 | 5 | 86 | 79 | 23 |
| 11 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 12 | 22301200100000 | 8 | 10 | 186 | 198 | 97 | 12 | 226 | 347 | 347 | 32 | 27 |
| 13 | 22303400100000 | 53 | 99 | 482 | 479 | 284 | 16 | 388 | 452 | 452 | 606 | 170 |
| 14 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 15 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 |
| 16 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 17 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 |
| 18 | 22002200510165 | 61 | 56 | 146 | 148 | 263 | 20 | 154 | 4 | 85 | 94 | 34 |
| 19 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 |
| 20 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 |
| | average = | 28.1 | 22.8 | 112.9 | 118.8 | 78.1 | 10.5 | 75.6 | 120.4 | 132.5 | 61.0 | 22.4 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 71.2 |

| MNT2 Survey Results for Dauphin County | | | | | | | | | | | | | |
|--|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| MNT2 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 3 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 4 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 5 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 6 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 | |
| 7 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 | |
| 8 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 | |
| 9 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | 17 | |
| 10 | 22002200511275 | 42 | 40 | 147 | 149 | 146 | 11 | 45 | 5 | 86 | 79 | 23 | |
| 11 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 12 | 22301200100000 | 8 | 10 | 186 | 198 | 97 | 12 | 226 | 347 | 347 | 32 | 27 | |
| 13 | 22303400100000 | 53 | 99 | 482 | 479 | 284 | 16 | 388 | 452 | 452 | 606 | 170 | |
| 14 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 15 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 | |
| 16 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 17 | 22002200500208 | 7 | 12 | 142 | 140 | 74 | 19 | 107 | 2 | 83 | 93 | 20 | |
| 18 | 22002200510165 | 61 | 56 | 146 | 148 | 263 | 20 | 154 | 4 | 85 | 94 | 34 | |
| 19 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 | |
| 20 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 | |
| | average = | 28.1 | 22.8 | 112.9 | 118.8 | 78.1 | 10.5 | 75.6 | 120.4 | 132.5 | 61.0 | 22.4 | Tot. ave |
| | | | | | | | | | | | | | 71.2 |

MNT3 Survey Results for Dauphin County

| MNT3 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 8 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 |
| 9 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 10 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 |
| 11 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 |
| 12 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 13 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 14 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 15 | 22032200420865 | 66 | 30 | 178 | 200 | 85 | 23 | 30 | 95 | 108 | 27 | 47 |
| 16 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 |
| 17 | 22301900201401 | 60 | 26 | 150 | 156 | 49 | 25 | 19 | 108 | 118 | 25 | 73 |
| 18 | 22008305011814 | 79 | 33 | 60 | 63 | 41 | 24 | 5 | 76 | 25 | 68 | 53 |
| 19 | 22301000610730 | 80 | 34 | 119 | 132 | 29 | 26 | 22 | 104 | 71 | 41 | 63 |
| 20 | 22002204200000 | 11 | 8 | 94 | 103 | 2 | 28 | 9 | 14 | 34 | 26 | 54 |
| | average = | 38.4 | 19.1 | 84.1 | 94.1 | 39.0 | 14.2 | 22.6 | 83.4 | 85.1 | 22.2 | 24.1 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 47.8 |

| MNT4 Survey Results for Dauphin County | | | | | | | | | | | | | |
|--|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| MNT4 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 | |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 | |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 | |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 | |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 | |
| 6 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 | |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 | |
| 8 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 | |
| 9 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 | |
| 10 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 | |
| 11 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 | |
| 12 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 | |
| 13 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 | |
| 14 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 | |
| 15 | 22008305011814 | 79 | 33 | 60 | 63 | 41 | 24 | 5 | 76 | 25 | 68 | 53 | |
| 16 | 22301900201401 | 60 | 26 | 150 | 156 | 49 | 25 | 19 | 108 | 118 | 25 | 73 | |
| 17 | 22032200420865 | 66 | 30 | 178 | 200 | 85 | 23 | 30 | 95 | 108 | 27 | 47 | |
| 18 | 22301000610730 | 80 | 34 | 119 | 132 | 29 | 26 | 22 | 104 | 71 | 41 | 63 | |
| 19 | 22002204200000 | 11 | 8 | 94 | 103 | 2 | 28 | 9 | 14 | 34 | 26 | 54 | |
| 20 | 22008304641054 | 75 | 35 | 17 | 21 | 23 | 29 | 34 | 64 | 55 | 24 | 42 | |
| | average = | 41.7 | 20.3 | 73.4 | 81.3 | 38.4 | 15.3 | 22.3 | 69.1 | 70.4 | 21.5 | 25.2 | Tot. ave |
| | | | | | | | | | | | | | 43.5 |

MNT5 Survey Results for Dauphin County

| MNT5 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 8 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 |
| 9 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 10 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 |
| 11 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 |
| 12 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 13 | 22008304641054 | 75 | 35 | 17 | 21 | 23 | 29 | 34 | 64 | 55 | 24 | 42 |
| 14 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 15 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 16 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 |
| 17 | 22008305011814 | 79 | 33 | 60 | 63 | 41 | 24 | 5 | 76 | 25 | 68 | 53 |
| 18 | 22032200420865 | 66 | 30 | 178 | 200 | 85 | 23 | 30 | 95 | 108 | 27 | 47 |
| 19 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 |
| 20 | 22301900201401 | 60 | 26 | 150 | 156 | 49 | 25 | 19 | 108 | 118 | 25 | 73 |
| | average = | 37.9 | 19.1 | 83.2 | 90.2 | 42.0 | 13.3 | 32.9 | 98.1 | 100.0 | 20.6 | 20.8 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 50.7 |

| MNT6 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 8 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 |
| 9 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 10 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 |
| 11 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 |
| 12 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 13 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 14 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 15 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 |
| 16 | 22008304641054 | 75 | 35 | 17 | 21 | 23 | 29 | 34 | 64 | 55 | 24 | 42 |
| 17 | 22008305011814 | 79 | 33 | 60 | 63 | 41 | 24 | 5 | 76 | 25 | 68 | 53 |
| 18 | 22032200420865 | 66 | 30 | 178 | 200 | 85 | 23 | 30 | 95 | 108 | 27 | 47 |
| 19 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 |
| 20 | 22301900201401 | 60 | 26 | 150 | 156 | 49 | 25 | 19 | 108 | 118 | 25 | 73 |
| | average = | 37.9 | 19.1 | 83.2 | 90.2 | 42.0 | 13.3 | 32.9 | 98.1 | 100.0 | 20.6 | 20.8 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 50.7 |

MNT7 Survey Results for Dauphin County

| MNT7 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 22008106520000 | 3 | 3 | 23 | 16 | 17 | 1 | 3 | 16 | 4 | 2 | 2 |
| 2 | 22008304200000 | 1 | 1 | 4 | 1 | 1 | 2 | 1 | 51 | 16 | 1 | 1 |
| 3 | 22008304203326 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 52 | 17 | 3 | 3 |
| 4 | 22301600100000 | 2 | 2 | 22 | 60 | 8 | 3 | 15 | 106 | 72 | 5 | 4 |
| 5 | 22008304340000 | 16 | 6 | 1 | 3 | 3 | 9 | 4 | 54 | 50 | 4 | 5 |
| 6 | 22301400300190 | 5 | 5 | 159 | 172 | 19 | 5 | 18 | 352 | 352 | 15 | 8 |
| 7 | 22008106601047 | 34 | 20 | 25 | 47 | 57 | 14 | 28 | 19 | 38 | 8 | 7 |
| 8 | 22008304440634 | 44 | 24 | 11 | 5 | 12 | 15 | 37 | 56 | 52 | 30 | 10 |
| 9 | 22008304601012 | 39 | 14 | 57 | 62 | 39 | 13 | 8 | 61 | 22 | 22 | 11 |
| 10 | 22008304611029 | 50 | 19 | 58 | 64 | 60 | 17 | 29 | 63 | 54 | 39 | 24 |
| 11 | 22008304641936 | 68 | 27 | 19 | 23 | 18 | 18 | 14 | 66 | 56 | 28 | 39 |
| 12 | 22001100100000 | 71 | 58 | 211 | 247 | 212 | 7 | 145 | 1 | 82 | 34 | 15 |
| 13 | 22301200300000 | 6 | 7 | 177 | 135 | 68 | 8 | 203 | 348 | 348 | 11 | 9 |
| 14 | 22008304641054 | 75 | 35 | 17 | 21 | 23 | 29 | 34 | 64 | 55 | 24 | 42 |
| 15 | 22301200800233 | 10 | 11 | 231 | 277 | 34 | 6 | 40 | 349 | 349 | 38 | 19 |
| 16 | 22002202901786 | 62 | 28 | 128 | 124 | 44 | 21 | 11 | 11 | 90 | 13 | 21 |
| 17 | 22002202911867 | 63 | 29 | 129 | 125 | 45 | 22 | 12 | 13 | 92 | 14 | 22 |
| 18 | 22008305011814 | 79 | 33 | 60 | 63 | 41 | 24 | 5 | 76 | 25 | 68 | 53 |
| 19 | 22032200420865 | 66 | 30 | 178 | 200 | 85 | 23 | 30 | 95 | 108 | 27 | 47 |
| 20 | 22002200501317 | 38 | 38 | 154 | 147 | 145 | 10 | 44 | 3 | 84 | 76 | 17 |
| | average = | 36.8 | 19.7 | 83.4 | 89.7 | 46.8 | 12.6 | 34.2 | 92.8 | 98.3 | 23.1 | 18.0 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 50.5 |

| PennDOT Survey Results for Dauphin County | | | | | | | | | | |
|---|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--|--|
| PennDOT RANK | Structure ID Number | MNT1 RANK | MNT2 RANK | MNT3 RANK | MNT4 RANK | MNT5 RANK | MNT6 RANK | MNT7 RANK | | |
| 1 | 22008304200000 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | |
| 2 | 22008106520000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| 3 | 22002200500208 | 17 | 17 | 64 | 64 | 54 | 57 | 53 | | |
| 4 | 22707699024665 | 73 | 73 | 71 | 71 | 63 | 68 | 63 | | |
| 5 | 22301600100000 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | | |
| 6 | 22301200300000 | 8 | 8 | 22 | 22 | 16 | 15 | 13 | | |
| 7 | 22008106601047 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | | |
| 8 | 22008304340000 | 11 | 11 | 5 | 5 | 5 | 5 | 5 | | |
| 9 | 22032201700000 | 24 | 24 | 45 | 43 | 37 | 37 | 37 | | |
| 10 | 22300901900601 | 482 | 279 | 267 | 260 | 223 | 278 | 223 | | |
| 11 | 22301400300190 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | | |
| 12 | 22002202310000 | 56 | 56 | 49 | 49 | 44 | 46 | 44 | | |
| 13 | 22008304340713 | 41 | 41 | 31 | 31 | 28 | 31 | 28 | | |
| 14 | 22002202911867 | 22 | 22 | 13 | 13 | 15 | 14 | 17 | | |
| 15 | 22008106851552 | 46 | 46 | 37 | 37 | 35 | 36 | 35 | | |
| 16 | 22028300252054 | 42 | 42 | 32 | 33 | 36 | 34 | 36 | | |
| 17 | 22022501301860 | 233 | 227 | 233 | 228 | 227 | 224 | 227 | | |
| 18 | 22002200900000 | 49 | 49 | 40 | 40 | 38 | 39 | 38 | | |
| 19 | 22008106940918 | 38 | 38 | 28 | 28 | 32 | 29 | 32 | | |
| 20 | 22008304601012 | 15 | 15 | 8 | 8 | 8 | 8 | 9 | | |
| 21 | 22008304611029 | 19 | 19 | 10 | 10 | 10 | 10 | 10 | | |
| | average = | 57.2 | 47.2 | 46.4 | 45.8 | 42.4 | 45.3 | 42.4 | | |

EMS Survey Results for Dauphin County

| EMS RANK | Structure ID Number | MNT1 RANK | MNT2 RANK | MNT3 RANK | MNT4 RANK | MNT5 RANK | MNT6 RANK | MNT7 RANK |
|----------|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | 22008106520000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 22302100100000 | 39 | 39 | 78 | 82 | 95 | 86 | 86 |
| 3 | 22032200600000 | 71 | 71 | 69 | 70 | 62 | 67 | 67 |
| 4 | 22002201802643 | 119 | 119 | 113 | 115 | 119 | 120 | 120 |
| 5 | 22002200900000 | 49 | 49 | 40 | 40 | 38 | 39 | 38 |
| 6 | 22014700401898 | 295 | 319 | 322 | 323 | 323 | 321 | 321 |
| 7 | 22014702200000 | 236 | 243 | 247 | 241 | 239 | 233 | 233 |
| 8 | 22014703100842 | 195 | 195 | 219 | 217 | 216 | 207 | 207 |
| 9 | 22020900700000 | 297 | 321 | 318 | 317 | 316 | 314 | 314 |
| 10 | 22020901401722 | 254 | 264 | 276 | 279 | 268 | 268 | 268 |
| 11 | 22020902600000 | 219 | 223 | 229 | 227 | 226 | 223 | 223 |
| 12 | 22020903200000 | 232 | 236 | 248 | 247 | 243 | 235 | 235 |
| 13 | 22008106851552 | 46 | 46 | 37 | 37 | 35 | 36 | 35 |
| 14 | 22008106940918 | 38 | 38 | 28 | 28 | 32 | 29 | 32 |
| 15 | 22008304601012 | 15 | 15 | 8 | 8 | 8 | 8 | 9 |
| 16 | 22032201700000 | 24 | 24 | 45 | 43 | 37 | 37 | 37 |
| 17 | 22032202901298 | 208 | 209 | 204 | 199 | 197 | 194 | 194 |
| 18 | 22008304200000 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 19 | 22002200500208 | 17 | 17 | 64 | 64 | 54 | 57 | 53 |
| 20 | 22301600100000 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |
| | average = | 118.0 | 121.7 | 127.6 | 127.2 | 125.8 | 124.1 | 124.0 |

| MNT1 Survey Results for Cumberland County | | | | | | | | | | | | | |
|---|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|----------|
| MNT1 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK | |
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 | |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 | |
| 3 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 | |
| 4 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 | |
| 5 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 | |
| 6 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 | |
| 7 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 | |
| 8 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 | |
| 9 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 | |
| 10 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 | |
| 11 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 | |
| 12 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 13 | 156 | 383 | 383 | 26 | 104 | |
| 13 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 | |
| 14 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 | |
| 15 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 | |
| 16 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 | |
| 17 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 16 | 75 | |
| 18 | 21101500100878 | 11 | 19 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 | |
| 19 | 21001107200000 | 218 | 115 | 27 | 31 | 123 | 23 | 62 | 131 | 131 | 35 | 66 | |
| 20 | 21203500501906 | 27 | 27 | 134 | 152 | 58 | 20 | 90 | 408 | 408 | 239 | 245 | Tot. ave |
| | average = | 87.0 | 38.8 | 80.6 | 75.9 | 50.4 | 10.7 | 45.4 | 111.3 | 117.0 | 35.2 | 35.6 | 62.5 |

MNT2 Survey Results for Cumberland County

| MNT2 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 4 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 5 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 6 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 7 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 8 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 9 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 10 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 11 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 13 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| 14 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 13 | 156 | 383 | 383 | 26 | 104 |
| 15 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 16 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 16 | 75 |
| 17 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 18 | 21101500100878 | 11 | 19 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 |
| 19 | 21707699023627 | 25 | 11 | 67 | 77 | 8 | 19 | 8 | 126 | 57 | 14 | 60 |
| 20 | 21008104650367 | 24 | 12 | 97 | 56 | 9 | 22 | 12 | 49 | 26 | 27 | 70 |
| | average = | 77.2 | 32.9 | 80.8 | 73.4 | 42.2 | 10.6 | 38.8 | 93.1 | 94.2 | 23.6 | 26.5 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 53.9 |

MNT3 Survey Results for Cumberland County

| MNT3 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 4 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 5 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 6 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 7 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 8 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 9 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 10 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 11 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 13 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| 14 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 13 | 156 | 383 | 383 | 26 | 104 |
| 15 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 16 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 17 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 16 | 75 |
| 18 | 21707699023627 | 25 | 11 | 67 | 77 | 8 | 19 | 8 | 126 | 57 | 14 | 60 |
| 19 | 21203500501906 | 27 | 27 | 134 | 152 | 58 | 20 | 90 | 408 | 408 | 239 | 245 |
| 20 | 21707699022854 | 16 | 25 | 72 | 72 | 46 | 21 | 31 | 118 | 123 | 68 | 61 |
| | average = | 77.6 | 33.9 | 74.7 | 73.1 | 44.0 | 10.7 | 34.1 | 101.5 | 104.0 | 34.0 | 35.9 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 56.7 |

MNT4 Survey Results for Cumberland County

| MNT4 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 4 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 5 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 6 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 7 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 8 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 9 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 10 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 11 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 13 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 13 | 156 | 383 | 383 | 26 | 104 |
| 14 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| 15 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 16 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 17 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 16 | 75 |
| 18 | 21707699023627 | 25 | 11 | 67 | 77 | 8 | 19 | 8 | 126 | 57 | 14 | 60 |
| 19 | 21001107200000 | 218 | 115 | 27 | 31 | 123 | 23 | 62 | 131 | 131 | 35 | 66 |
| 20 | 21008104650367 | 24 | 12 | 97 | 56 | 9 | 22 | 12 | 49 | 26 | 27 | 70 |
| | average = | 87.5 | 37.7 | 70.6 | 66.2 | 45.4 | 10.9 | 31.8 | 84.2 | 85.3 | 21.7 | 27.4 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 51.7 |

MNT5 Survey Results for Cumberland County

| MNT5 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 4 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 5 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 6 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 7 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 8 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 9 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 10 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 11 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 12 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 13 | 156 | 383 | 383 | 26 | 104 |
| 13 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 14 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 15 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| 16 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 17 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 16 | 75 |
| 18 | 21001107200000 | 218 | 115 | 27 | 31 | 123 | 23 | 62 | 131 | 131 | 35 | 66 |
| 19 | 21101500100878 | 11 | 19 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 |
| 20 | 21008104540557 | 15 | 18 | 124 | 65 | 16 | 30 | 27 | 44 | 22 | 31 | 72 |
| | average = | 86.4 | 38.4 | 80.1 | 71.6 | 48.3 | 11.2 | 42.3 | 93.1 | 97.7 | 24.8 | 26.9 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 56.4 |

MNT6 Survey Results for Cumberland County

| MNT6 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 4 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 5 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 6 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 7 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 8 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 9 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 10 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 11 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 12 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 13 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 14 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 13 | 156 | 383 | 383 | 26 | 104 |
| 15 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 16 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| 17 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 16 | 75 |
| 18 | 21203500501906 | 27 | 27 | 134 | 152 | 58 | 20 | 90 | 408 | 408 | 239 | 245 |
| 19 | 21101500100878 | 11 | 19 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 |
| 20 | 21707699022854 | 16 | 25 | 72 | 72 | 46 | 21 | 31 | 118 | 123 | 68 | 61 |
| | average = | 76.9 | 34.3 | 82.9 | 78.0 | 46.6 | 10.6 | 43.9 | 110.7 | 116.6 | 36.9 | 35.3 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 61.1 |

MNT7 Survey Results for Cumberland County

| MNT7 RANK | Structure ID Number | B & H RANK | Mod B&H RANK | Buckle RANK | Mod Buckle RANK | Caltrans RANK | Montana RANK | Nevada RANK | SC RANK | Mod SC RANK | Missouri RANK | IDOT RANK |
|-----------|---------------------|------------|--------------|-------------|-----------------|---------------|--------------|-------------|---------|-------------|---------------|-----------|
| 1 | 21058101300000 | 3 | 1 | 2 | 4 | 10 | 1 | 5 | 86 | 105 | 1 | 1 |
| 2 | 21008304140000 | 68 | 7 | 5 | 2 | 1 | 2 | 1 | 79 | 16 | 3 | 2 |
| 3 | 21001107600000 | 96 | 15 | 25 | 35 | 15 | 3 | 11 | 134 | 134 | 10 | 4 |
| 4 | 21058101401063 | 112 | 28 | 4 | 5 | 18 | 4 | 29 | 87 | 106 | 13 | 7 |
| 5 | 21001501700863 | 1 | 3 | 8 | 6 | 4 | 5 | 30 | 14 | 71 | 15 | 5 |
| 6 | 21001501700000 | 122 | 31 | 9 | 8 | 27 | 6 | 39 | 13 | 70 | 8 | 13 |
| 7 | 21008304041288 | 123 | 33 | 6 | 11 | 28 | 7 | 19 | 78 | 38 | 6 | 15 |
| 8 | 21001107400000 | 2 | 2 | 7 | 16 | 5 | 8 | 9 | 133 | 133 | 19 | 17 |
| 9 | 21008104651675 | 169 | 99 | 32 | 37 | 139 | 10 | 58 | 50 | 6 | 98 | 8 |
| 10 | 21008104641546 | 174 | 102 | 33 | 41 | 147 | 11 | 60 | 47 | 5 | 97 | 9 |
| 11 | 21203500500000 | 5 | 4 | 136 | 154 | 2 | 9 | 2 | 89 | 108 | 4 | 3 |
| 12 | 21001500601043 | 160 | 70 | 77 | 23 | 90 | 13 | 156 | 383 | 383 | 26 | 104 |
| 13 | 21008304160483 | 103 | 44 | 1 | 1 | 3 | 17 | 6 | 80 | 17 | 2 | 6 |
| 14 | 21001109800000 | 4 | 5 | 174 | 212 | 6 | 12 | 3 | 8 | 66 | 7 | 14 |
| 15 | 21001108900000 | 8 | 9 | 135 | 126 | 44 | 15 | 52 | 7 | 65 | 24 | 46 |
| 16 | 21001109810485 | 150 | 75 | 207 | 284 | 114 | 14 | 14 | 9 | 67 | 9 | 23 |
| 17 | 21011400400000 | 183 | 87 | 359 | 195 | 115 | 16 | 59 | 81 | 102 | 16 | 75 |
| 18 | 21101500100878 | 11 | 19 | 231 | 175 | 59 | 18 | 203 | 309 | 309 | 72 | 48 |
| 19 | 21001107200000 | 218 | 115 | 27 | 31 | 123 | 23 | 62 | 131 | 131 | 35 | 66 |
| 20 | 21203500501906 | 27 | 27 | 134 | 152 | 58 | 20 | 90 | 408 | 408 | 239 | 245 |
| | average = | 87.0 | 38.8 | 80.6 | 75.9 | 50.4 | 10.7 | 45.4 | 111.3 | 117.0 | 35.2 | 35.6 |
| | | | | | | | | | | | | Tot. ave |
| | | | | | | | | | | | | 62.5 |

PennDOT Survey Results for Cumberland County

| PennDOT RANK | Structure ID Number | MNT1 RANK | MNT2 RANK | MNT3 RANK | MNT4 RANK | MNT5 RANK | MNT6 RANK | MNT7 RANK |
|--------------|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | 21008105502205 | 121 | 41 | 52 | 52 | 42 | 47 | 44 |
| 2 | 21001107600000 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 | 21008105100190 | 112 | 45 | 43 | 43 | 51 | 46 | 50 |
| 4 | 21058100301760 | 170 | 409 | 479 | 484 | 497 | 484 | 484 |
| 5 | 21008304041288 | 7 | 7 | 7 | 8 | 7 | 8 | 7 |
| 6 | 21001108701474 | 27 | 68 | 72 | 72 | 64 | 66 | 66 |
| 7 | 21008104840101 | 107 | 56 | 54 | 51 | 50 | 55 | 52 |
| 8 | 21001109800000 | 14 | 12 | 12 | 12 | 14 | 12 | 14 |
| 9 | 21008104800066 | 105 | 50 | 47 | 46 | 46 | 49 | 45 |
| 10 | 21101500100878 | 18 | 18 | 26 | 24 | 19 | 19 | 18 |
| 11 | 21008105140000 | 117 | 25 | 25 | 28 | 31 | 27 | 32 |
| 12 | 21001501700000 | 6 | 5 | 6 | 6 | 5 | 6 | 6 |
| 13 | 21008104640250 | 97 | 27 | 27 | 22 | 29 | 26 | 29 |
| 14 | 21203500500133 | 312 | 47 | 41 | 42 | 43 | 39 | 41 |
| 15 | 21707699021516 | 405 | 55 | 57 | 57 | 47 | 51 | 47 |
| 16 | 21008105110135 | 115 | 119 | 117 | 118 | 106 | 112 | 110 |
| 17 | 21008304140000 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 18 | 21011400601951 | 139 | 48 | 56 | 56 | 45 | 50 | 46 |
| 19 | 21001107400000 | 8 | 8 | 8 | 7 | 8 | 7 | 8 |
| 20 | 21008104850246 | 109 | 51 | 48 | 47 | 48 | 53 | 48 |
| 21 | 21008104902459 | 110 | 59 | 59 | 59 | 58 | 57 | 58 |
| | average = | 100.2 | 55.0 | 59.1 | 59.0 | 57.9 | 58.0 | 57.6 |

APPENDIX D

IMPORTANCE METHOD, MNT5, SURVEY

RE: NCEER HIGHWAY PROJECT, DTFH61-92-C-00112
Evaluation of Structure Importance

Dear Sir/Madam:

Modjeski and Masters, Inc. has been working on a seismic research project which is investigating the importance rating for bridges. This project is with the National Center for Earthquake Engineering Research. In prioritization of bridges for seismic retrofits, importance is one factor in the prioritization equation (see attached flowchart from Seismic Retrofitting Manual for Highway Bridges Pub. No. FHWA-RD-94-052, May 1995).

Modjeski and Masters, Inc. reviewed 12 importance equations developed by States and/or individuals. Most of these equations are designed to work with data from bridge management systems(BMS). After analyzing the results of these methods from several test databases, Modjeski and Masters has selected one modified method, MNT5, for further analysis.

We are asking if you and/or several of your employees could review the method we are currently recommending as summarized in the attachments to this letter. If someone else in your organization would be better suited to respond to this letter, please pass it on to them. We have included a diskette with an EXCEL Macro that could be used with your BMS Data. We are interested in how the MNT5 method will work with different databases and your opinions on the methods results. We have enclosed a response form in order for you to provide your comments.

Enclosed is a diskette with an EXCEL file. The file includes the MNT5 Macro and a portion of one of our test databases. This will show an example of how the macro works with BMS data. We have also enclosed instructions on how to setup and use the MNT5 Macro.

If you have any questions, please call me or Mr. Andrew L. Thomas.

We would appreciate it if you could return your response to us by February 28, 1997.

Thank you for your time and consideration on this matter.

Very truly yours,

SCOTT R. ESHENAUER,
Associate

Modjeski and Masters, Inc.

**Evaluation of Structure Importance
(Task 112-D-2(B))
(FHWA Contract DTFH61-92-C-00112)**

The overall objective of Task 112-D-2 is to identify, assess and develop improvements to existing methodologies for defining structure importance, and to provide recommended definitions of importance and classification systems based on importance.

Modjeski and Masters is currently recommending using a modification of the Montana method, MNT5. From our test data and surveys, we feel it provides the most accurate importance ranking while giving the best distribution of importance. MNT5 considers the following Bridge Management Data:

Route Carried

- Route Type
- ADT
- Average ADT
- Detour
- Bridge Length
- Maximum Bridge Length
- Rail Traffic

Route Crossed

- Route Type
- ADT
- Rail Traffic
- Water Crossing

The MNT5 equation is defined below:

MNT5 Equation:

$$C = [(RT_{carry})(DL_{carry} * N_{carry})] + (2/3)[(RT_{cross})(0.9 * N_{cross})] + (1/4)[(ADT_{carry}/Ave ADT)(L)]^{0.25} + RV_{cross}$$

where:

$$N_{carry} = (ADT_{carry}/Ave ADT)^{0.25} \text{ for route being considered} \\ = 1 \text{ for bridges carrying railroads}$$

$$N_{cross} = (ADT_{cross}/Ave ADT)^{0.25} \text{ for route being considered}$$

DL_{carry} = Detour Length Coefficient for route on the structure

RV_{cross} = L/L_{max} for river crossings

RT_{carry} = 1.1 for Principal Arterial Routes on the structure

= 1.0 for railroads on the structure

= 0.9 for all other structures

$RT_{cross} = 0.9$ for Principal Arterial Routes under the structure
 $= 0.9$ for railroads under the structure
 $= 0.8$ for all other structures

The following is instructions on the use of the importance equation currently being recommended by Modjeski and Masters. The various bridge inventory items are being referenced from "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges" dated December 1988. The required inventory items are as follows:

- Item 5 - Inventory Route
- Item 26 - Functional Classification
- Item 29 - Average Daily Traffic
- Item 19 - Bypass, Detour Length
- Item 49 - Structure Length
- Item 42 - Type of Service

Item 5 is required in order to determine if the route is on or under the structure being considered. Items 26, 29 and 42 are required for both routes on and under the structure.

An average ADT, Item 29, for routes on the structure must be determined to be used as the reference value in the calculation of N_r . The maximum bridge length, Item 49, must be determined for the RV_{cross} reference value. The actual values from Items 29 and 49 will be used in the calculation of a structures importance.

The Functional Classification, Item 26, is to be used to determine the RT_{carry} and the RT_{cross} coefficients. For the route on the structure, RT_{carry} shall be used as 1.1 when Item 26 = 1, 2, 11, 12 or 14. Otherwise, RT_{carry} shall be 0.9. For the route under the structure, RT_{cross} shall be 0.9 or 0.8 respectively.

The Detour Length in miles, Item 19, is to be used to determine DL_{carry} . DL_{carry} shall be determined as follows:

| | |
|--------------------------|--------------------|
| Detour length > 98; | $DL_{carry} = 1.2$ |
| 50 < Detour length ≤ 98; | $DL_{carry} = 1.0$ |
| 10 < Detour length ≤ 50; | $DL_{carry} = 0.9$ |
| 3 < Detour length ≤ 10; | $DL_{carry} = 0.8$ |
| 0 < Detour length ≤ 3; | $DL_{carry} = 0.7$ |

Item 42, Type of Service, is used to determine several variables including the variables listed above. To describe the use of this Inventory Item, we will use "?" as a wildcard. If Item 42 equals 2? or 4?, the structure carries rail traffic. If Item 42 equals ?2, ?4, ?7, ?8, the structure crosses a railroad. If Item 42 equals ?5, ?6, ?7, ?8, or ?9, the structure crosses water. This information shall be used as follows:

If railroad on structure: $N_{carry} = 1.0$, $DL_{carry} = 1.0$, $RT_{carry} = 1.0$
 If railroad under structure: $ADT_{cross} = \text{ave. ADT}$, $RT_{cross} = 0.9$
 If water under structure: $RV_{cross} = \text{Structure Length}/\text{max. Length}$

Modjeski and Masters, Inc.

Instructions for EXCEL Macro, MNT5

The diskette included with this survey contains an EXCEL Version 5.0 File. This file includes a copy of the test macro for the proposed Importance Calculation method and a test input file as an example. The test file includes 300 bridges. The test file run should take approximately 2 minutes to run.

These instructions will aid in applying the MNT5 Macro to your Bridge Management System (BMS) database. When possible, we suggest using a sub-set of your entire database as a first trial. A first trial of several hundred bridges instead of several thousand bridges would be much simpler. The first step in applying MNT5 is to setup the input file. The example input file has extra database fields not required by the MNT5 Macro. The data fields being used from the input file are highlighted in red. The National Inventory Items corresponding to the required fields are listed in the previous general information sheets.

All required fields need to be filled in the correct columns for both routes on and under the structure being considered in order for the macro to run properly. Columns between the required fields may be left blank. The method used to import the data fields into EXCEL will depend on the Database Software. EXCEL will accept Dbase, various spreadsheets or text files. The maximum number of rows in EXCEL is 16384, so if there are more records than this 2 runs will be required to calculate importance of all bridges. Also note that if an input file uses all 16384 rows, the macro run could take several hours to run.

Once the input file has been completed, several minor modifications to the macro are needed. These modifications will customize the results to be specific to your database. The modifications are to be made on lines 10, 20, 30, 40 and 50 of the MNT5 Macro. On Line 10 the "j" range must be changed to reflect the maximum number of records for 1 structure in the input record. On Lines 20, 40 and 50 the average ADT must replace the 10402 value. The average ADT should be based for routes on the structures only. Finally, on Line 30 the maximum structure length should replace the 5188 value.

One modification must be made to the equation in the MNT5 sheet. The average ADT value should replace the 10402 value in the equation. A copy of the equation used in the MNT5 sheet is at the bottom of the Macro sheet.

After these modification have been made, the MNT5 Macro is ready to run. After the run is complete, the results can be exported to a database for faster ranking of the results.

If there are any questions, please feel free to call Mr. Andrew L. Thomas at (717) 790-9565.

**Evaluation of Structure Importance
RESPONSE FORM**

Please Return Form to:
ATTN: Andrew L. Thomas
Modjeski and Masters, Inc.
P.O. BOX 2345
Harrisburg, PA 17105

State: _____ Name (optional): _____

Position: _____ Telephone (optional): _____

May we contact you for additional information? _____

Does your organization presently have an importance ranking system? _____

If yes, please describe it: _____

Database Information:

Number of Bridges: _____

Software: _____ Is software Windows compatible? _____

Maximum Bridge Length: _____

Average ADT: _____

Macro Information:

Do you have Excel Version 5 (or later version)? _____

If yes, did the MNT5 macro run? _____

What, if any, problems occurred setting up the input file? _____

What, if any, problems occurred exporting the results? _____

Results Information:

Were the bridge(s) you expected most important ranked that way? _____

Do you have a current listing of importance ranking of bridges? _____

If yes, Did the MNT5 Equation produce similar results? _____

What, if any, type of bridge (i.e. railroad, interstate, rural) was ranked too high? _____

What, if any, type of bridge (i.e. railroad, interstate, rural) was ranked too low? _____

On a scale of one to ten with ten being the best, your rank of this importance method is _____

Would this importance method meet your needs? _____ Why or why not? _____

Would you consider using this importance method instead of what you are presently using? _____ Why or Why not? _____

Additional Comments: _____

Note: If needed, attach extra sheets for any additional or continued comments.

APPENDIX E
PROPOSED REVISIONS TO DIVISION I-A SECTIONS 3.3
AND 3.4 WITH CUSTOMARY U.S. UNITS

This appendix provides the suggested revision of Division I-A Sections 3.3 and 3.4 in customary U.S. units.

3.3 IMPORTANCE CLASSIFICATION

An Importance Classification (I_c) shall be assigned for all bridges for the purpose of determining the Seismic Performance Category (SPC) in Article 3.4 as follows:

$I_c = 1.2$ for "critical" bridges: those bridges which are required to remain functional for all traffic after an earthquake of the same magnitude as the design earthquake and provide at least a minimum level of functionality for emergency vehicles or for security/defense purposes immediately after a large earthquake, e.g., 2500 year return period event.

$I_c = 1.1$ for "essential" bridges: those bridges which are required to provide at least a minimum level of functionality for emergency vehicles or for security/defense purposes after an earthquake of the same magnitude as the design earthquake.

$I_c = 1.0$ for "other" bridges: all other bridges

The Importance Classification shall include Social/Survival and Security/Defense considerations. If the recommended classification method is used, these requirements shall be considered to be fulfilled. Factors such as socioeconomic or emergency route considerations may also be considered as deemed appropriate by the owner. A methodology for including emergency routes in the determination of structural importance is described in the commentary. Additional owner specified socioeconomic factors can be implemented similar to emergency routes or by the use of additional or modified RT_{carry} and/or RT_{cross} factors. The addition and/or modification of "RT" factors is preferred for socioeconomic factors because it will increase only the importance contribution of the route being considered. The emergency route method given in the commentary increases the contribution of all importance considerations as apposed to only the route being considered i.e., route carried, route crossed, river crossing, etc.

If the owner has a method to classify bridges as "critical", "essential" or "other" bridges, it may be used in lieu of the provisions specified herein. However, if the owner does not have an importance classification system in place, bridges may be classified using the following equation which is based on data from the National Bridge Inventory (NBI) Database:

$$C = \text{Bridge importance value} \\ = [RT_{carry}(DL_{carry} * N_{carry})] + 0.6(RT_{cross} * N_{cross}) + 0.25[(ADT_{carry}/\text{Ave ADT})L]^{0.25} + RV_{cross}$$

where:

"carry" indicates the critical route on the bridge;

"cross" indicates the critical route under the bridge;

RT_{carry} = Factor for nature of route:
= 1.1 for Interstate Route or Principal Artery,
= 0.9 for all other routes and for railroad bridges;

DL_{carry} = Factor representing criticality of detour length:
= 1.2 for Detour Lengths > 98 mi,
= 1.0 for 50 mi < Detour Lengths \leq 98 mi,
= 0.9 for 10 mi < Detour Lengths \leq 50 mi,
= 0.8 for 3 mi < Detour Lengths \leq 10 mi,
= 0.7 for Detour Lengths \leq 3 mi,
= 1.0 for bridges carrying railroads;

N_{carry} = Factor representing criticality of traffic congestion:
= $(ADT_{carry}/Ave ADT)^{0.25}$,
= 0.8 for bridges carrying railroads;

ADT_{carry} = Average Daily Traffic on the bridge;

L = Bridge length(ft);

RT_{cross} = Factor for nature of route:
= 0.8 for all routes,
= 0.0 for no route under the bridge;

N_{cross} = Factor representing criticality of traffic congestion:
= $(ADT_{cross}/Ave ADT)^{0.25}$,

RV_{cross} = Ratio of bridge length to longest bridge in the database:
= L/L_{max} ;

Ave ADT = Average ADT_{carry} in the classification database;

L_{max} = Maximum bridge length(ft) in the classification database.

All bridges shall be ranked in order of importance, with the maximum importance value (C_{max}) being the most critical bridge in the classification database. After the bridges are ranked in order of importance, the bridge rank percentile shall be determined. Bridge rank percentile is the percentage of bridges ranked lower than the bridge being considered and can be obtained by using the following equation:

$$\text{Bridge Rank Percentile} = \frac{(\text{total number of bridges} - \text{current bridge rank})}{(\text{total number of bridges})} * 100$$

These rank percentiles shall be used to determine the Importance Classifications:

"critical" bridges are those bridges in the 95th percentile or higher,

"essential" bridges are those bridges ranked in or above the 65th but below the 95th percentile,

"other" bridges are those bridges ranked below the 65th percentile.

DIVISION I-A COMMENTARY: C3.3

The importance rankings for the complete database are required for this importance classification method. Once the importance rankings have been developed, they may be used without recalculating them as long as the NBI Records are not revised. The Engineer shall then only be required to calculate the Importance Value, C, for new structures and determine their Importance Classification in the established rankings. For a new structure, an estimated ADT at the time of opening should be used in the calculation of the importance value, not the design ADT which is usually taken as a projected 20-year ADT. A projected ADT would not be comparable to existing structures with an established ADT and therefore skews the results towards all new structures having higher importance rankings.

If a state has confirmed emergency routes, the importance value, C, could be increased by 10% for that route. This is not included in the design specifications in order to allow individual states with specified emergency routes some freedom in adjusting the importance they want to assign to their emergency routes. An example of a modified importance equation would be as follows:

$$C = ER * \{ [(RT_{carry})(DL_{carry} * N_{carry})] + 0.6(RT_{cross} * N_{cross}) + 0.25[(ADT_{carry}/Ave ADT)(L)]^{0.25} + RV_{cross} \}$$

where:

ER = 1.1 for confirmed emergency route
1.0 for others

If an owner has a method to rank bridges for seismic importance but does not have a method to assign the "critical", "essential", and "other" classifications, the bridge rank percentiles in the design specification may be used with the existing seismic importance rankings to determine the Importance Classifications.

3.4 SEISMIC PERFORMANCE CATEGORIES

Each bridge shall be assigned to one of four Seismic Performance Categories (SPC), A through D, based on the Acceleration Coefficient, A, and the Importance Classification (I_C), as shown in Table 3.4. Minimum analysis and design requirements are governed by the SPC.

The product of the Acceleration Coefficient, A, and the Importance Classification, I_C is only used to determine the SPC of a structure. The actual Acceleration Coefficient, A, shall be used in all other calculations.

TABLE 3.4 Seismic Performance Category (SPC)

| SPC | Range of $I_c A$ |
|---|--------------------------|
| *A | $I_c A \leq 0.09$ |
| B | $0.09 < I_c A \leq 0.19$ |
| C | $0.19 < I_c A \leq 0.29$ |
| **D | $0.29 < I_c A$ |
| * For "critical" bridges ($I_c = 1.2$), $I_c A > 0.09$ ** For "other" bridges ($I_c = 1.0$), $I_c A \leq 0.29$ | |

DIVISION I-A COMMENTARY: C3.4

The product $I_c A$ has a maximum value of 0.29 for "other" bridges. This maximum value is used to prevent an "other" bridge from being assigned to SPC D. This corresponds to the requirements of the AASHTO Sixteenth Edition of the Standard Specification of Highway Bridges, Division I-A.

The product $I_c A$ has a minimum value of 0.09 for "critical" bridges. This minimum value is used to prevent a "critical" bridge from being assigned to SPC A.

APPENDIX F
PROPOSED REVISIONS TO LRFD SECTIONS 3.10.3
AND C3.10.3 WITH CUSTOMARY U.S UNITS

This appendix provides the suggested revision of LRFD Sections 3.10.3 and C3.10.3 in customary U.S. units. If these articles are adopted, new definitions and references must be added to the notation and reference lists in LRFD Section 3.

3.10.3 Importance Categories

For the purpose of Article 3.10, the Owner shall classify bridges into one of three importance categories taken as:

- critical bridges,
- essential bridges, or
- other bridges.

The basis of classification shall include social/survival and security/defense requirements. Use of Equation 1 shall be considered as satisfying these requirements. Additional socioeconomic or emergency route considerations as deemed appropriate by the owner may be included in establishing Importance Classifications. Additional owner specified socioeconomic factors may also be implemented similar to emergency routes or by the use of additional or modified RT_{carry} and/or RT_{cross} factors. When classifying a bridge, consideration should be given to possible future changes in conditions and requirements.

Other owner approved methods to classify bridges as "critical", "essential" or "other" bridges may be used. Where such owner approved methods do not exist, importance classifications may be determined as specified herein based on data from the National Bridge Inventory (NBI) Records:

C = bridge importance value

C3.10.3

"Essential" bridges are generally those that should, as a minimum, be open to emergency vehicles and for security/defense purposes immediately after the design earthquake, i.e., a 475-year return period event. However, some bridges must remain open to all traffic after the design earthquake and be usable by emergency vehicles and for security/defense purposes immediately after a large earthquake, e.g., a 2,500-year return period event. These should be regarded as "critical" bridges.

The addition and/or modification of "RT" factors is preferred for socioeconomic factors because it will increase only the importance contribution of the route being considered. The emergency route method given below increases the contribution of all importance considerations as apposed to only the route being considered i.e., route carried, route crossed, river crossing, etc.

If a state has confirmed emergency routes, the importance value, C, could be increased by 10% for that route. This is not included in the design specifications in order to allow individual states with specified emergency routes some freedom in adjusting the importance they want to assign to their emergency routes. An example of a modified importance equation is:

C = bridge importance value

$$\begin{aligned}
&= [RT_{carry}(DL_{carry}N_{carry})] + 0.6(RT_{carry}N_{cross}) \\
&\quad + 0.25 \left[\left(\frac{ADT_{carry}}{AveADT} \right) L \right]^{0.25} + RV_{cross}
\end{aligned}
\tag{3.10.3-1}$$

where:

"carry" indicates the critical route on the bridge;

"cross" indicates the critical route under the bridge;

RT_{carry} = Factor for nature of route:
= 1.1 for Interstate Route or Principal Artery,
= 0.9 for all other routes including railroads;

DL_{carry} = Factor representing criticality of detour length:
= 1.2 for Detour Lengths > 98 mi,
= 1.0 for 50 mi < Detour Lengths ≤ 98 mi,
= 0.9 for 10 mi < Detour Lengths ≤ 50 mi,
= 0.8 for 3 mi < Detour Lengths ≤ 10 mi,
= 0.7 for Detour Lengths ≤ 3 mi,
= 1.0 for bridges carrying railroads;

N_{carry} = Factor representing criticality of traffic congestion:
= (ADT_{carry}/Ave ADT)^{0.25},
= 0.8 for bridges carrying railroads;

ADT_{carry} = Average Daily Traffic on the bridge;

L = Bridge length(ft);

RT_{cross} = Factor for nature of route:
= 0.8 for all routes,
= 0.0 for no route under the bridge;

N_{cross} = Factor representing criticality of traffic congestion:
= (ADT_{cross}/Ave ADT)^{0.25};

$$\begin{aligned}
&= ER[[RT_{carry}(DL_{carry}N_{carry})] + 0.6(RT_{carry}N_{cross}) \\
&\quad + 0.25 \left[\left(\frac{ADT_{carry}}{AveADT} \right) L \right]^{0.25} + RV_{cross}]
\end{aligned}
\tag{C3.10.3-1}$$

where:

ER = 1.1 for confirmed emergency route
1.0 for others

RV_{cross} = Ratio of bridge length to longest bridge in the database:
= L/L_{max} ;

Ave ADT= Average ADT_{carry} in the classification database;

L_{max} = Maximum bridge length(ft) in the classification database.

All of the bridges shall be ranked in order of importance, with the maximum importance value (C_{max}) being the most critical bridge in the classification database. After the bridges are ranked in order of importance, the bridge rank percentile shall be determined as:

$$\begin{aligned} \text{Bridge Rank Percentile} &= \\ &= (\text{total number of bridges} - \text{current bridge rank}) / (\text{total number of bridges}) * 100 \end{aligned} \quad (3.10.3-2)$$

These rank percentiles shall be used to determine the Importance Classifications:

"critical" bridges are those bridges in the 95th percentile or higher,

"essential" bridges are those bridges ranked in or above the 65th but below the 95th percentile,

"other" bridges are those bridges ranked below the 65th percentile.

4.7.4.3.1 Selection of Method (insert before Table 1)

When determining the minimum analysis requirements from Table 1, the bridge importance categories as defined in Article 3.10.3 shall be used.

The importance rankings for the complete database are required for this importance classification method to be used. Once the importance rankings for the complete database have been developed, they may be used without recalculating them as long as the NBI Records are not revised. The Engineer shall then only be required to calculate the Importance Value, C, for new structures and determine their Importance Classification in the established rankings. For a new structure, an estimated ADT at the time of opening should be used in the calculation of the importance value, not the design ADT which is usually taken as a projected 20-year ADT. A projected ADT would not be comparable to existing structures with an established ADT and therefore skews the results towards all new structures having higher importance rankings.

Bridge rank percentile is the percentage of bridges ranked lower than the bridge being considered. If an owner has a method to rank bridges for seismic importance but does not have a method to assign the importance classifications, the bridge rank percentiles may be used with the existing seismic importance rankings to determine the importance classifications.

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