QUANTITATIVE FRAMEWORK FOR PLANNING HIGHWAY BRIDGE INSPECTION AND ASSESSMENT

By

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To my loving wife Shelia

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CHAPTER I

INTRODUCTION

General

Current U. S. practice in highway bridge inspection relies on visual inspection and comparison with condition states by an inspector as the two primary components for assessment of bridge condition. This type of subjective assessment may not lead to an accurate identification of bridge condition. These current procedures utilize little quantitative data and provide little information required for use with currently available physically-based models that may be utilized for more accurate condition assessment or life prediction. This study presents methods to improve the accuracy of bridge inspection/condition assessment through the development of more objective and quantitative inspection procedures thus reducing the amount of subjectivity in visual inspection. This can be accomplished through the combination of quantitative data and models with current inspection procedures and condition states. The work presented herein provides an avenue for inspecting a chosen group of bridges primarily focusing on major deterioration mechanisms, identifying and quantifying actual deterioration using objective condition states, and utilizing this information to ascertain conditions and deterioration rates for other bridge structures.

Bridge Inspection History

In 1967, the Silver Bridge that crossed the Ohio River in Point Pleasant, West Virginia, collapsed causing 46 deaths and 9 injuries (Lichtenstein 1993). This event was directly responsible for the initiation of a massive effort in bridge safety that continues today. This effort was initiated by the U.S. Congress through the Federal-Aid Highway Act of 1968. This act required the U.S. Secretary of Transportation to provide guidelines for adequate safety inspections of bridges on the Federal-Aid system (FHWA 2002). This was to be accomplished through the development of National Bridge Inspection Standards (NBIS). This act also required that each state maintain a current inventory of all of the bridges on the Federal-aid system. The immediate response to this was the development of two programs. The programs were the Special Bridge Replacement Program and the National Bridge Inspection Program (NBIP).

The Special Bridge Replacement Program has been renamed since its inception in the late 1960's. Currently, the title of this program is the National Highway Bridge Replacement and Rehabilitation Program (NBRRP). The main purpose of this program, both now and at inception, is to provide an avenue to allocate Federal money to State Departments of Transportation for the purpose of rehabilitation or replacement of bridges that are judged to be at risk.

The NBIP was responsible for identifying bridge conditions, maintenance needs, and safety problems. This program was also responsible for mandating that State Departments of Transportation maintain bridge inspection records. Initially, this program also required regular periodic inspection and inventory of all bridges that were on the Federal-Aid system.

Later, in the 1970 Federal-Aid Highway Act, Congress mandated that all bridges on the Federal-Aid system be classified in terms of serviceability, safety, and importance to the public. Also, each bridge was to be given a priority for replacement (Galambos 1984).

The National Bridge Inspection Standards (NBIS) were created in 1971 to satisfy the requirements stipulated by congress (FHWA 2002). These standards provided the required qualifications of bridge inspectors, bridge inspection requirements, and inspection frequency requirements. These standards also recognized standard methods for evaluation and appraisal of bridge condition. In short, these standards provided guidance and regulations as to how bridges were to be inspected, inventoried, and reported on.

The Surface Transportation Assistance Act (STTA) of 1978 changed the requirements of the bridges that were to be inspected (FHWA 2002). This act now required that all bridges on public roads be inspected and inventoried. The following year the NBIS was edited to include this new requirement.

The NBIP and NBRRP programs as well as the NBIS were created to insure that bridge owners conduct regular, periodic inspection of their bridge inventories and that bridges were safe for public use. The inspection procedures recognized and developed by these initiatives mainly included the use of visual inspection techniques and were based on the state of knowledge at that time.

Since inception, periodic bridge inspection and its guidelines have experienced several changes. These changes have been due to either actual inspection experience or catastrophic failures that have occurred over the past three decades.

One example of beneficial information brought about by bridge inspection is cracking in welded plate girders (Lichtenstein 1993). Through inspections, cracking in these types of girders was realized, and is now commonly inspected and tested for. Also, this information has been propagated to the designers of bridge structures so that this type of behavior and or possible failure can be considered in the design phase. These considerations may include structure geometry or layout as well as the inclusion of fatigue in design calculations.

Two bridge failures that have impacted bridge inspection procedures are the Mianus River Bridge and the Schoharie Creek Bridge. In 1983, a 100-foot section of the Mianus River Bridge in Greenwich, Connecticut collapsed (Graybeal et. al. 2000, Galambos 1984). Three deaths and three serious injuries resulted from this collapse. The cause of this event was determined to be the failure of a hanger pin, one part of many hanger-pin connections present that supported a suspended section of the bridge. The failure of the hanger pin was attributed to poor design details and environmental corrosion forces that allowed the lateral displacement of one hanger that forced additional weight onto an adjacent hanger-pin connection. This hanger was also displaced so that it rested on a location on the pin that was more susceptible to fatigue fracture. In response, a report issued by the National Transportation Safety Board (NTSB) recommended the development of site specific inspection procedures, the development of a comprehensive integrated bridge inspection procedure, and better review of inspection reports (NTSB 1984). In addition to the recommendations made by the NTSB, the state of Connecticut initiated a massive, 10 year, road and bridge rehabilitation program (Robison 1987). This program was accompanied by large budget increases for design, construction, inspection, and development of new procedures.

In another example, several spans of a bridge over Schoharie Creek collapsed in 1987 resulting in 10 fatalities (Thornton et. al. 1988). This bridge was located on the New York State Thruway near Amsterdam, New York. The cause of this collapse was determined to be scour, or erosion of the material, beneath the spread footings that the bridge was supported by thus rendering portions of the structure unstable. Lack of adequate rip-rap was cited as one of the main contributing factors to the scour that had occurred. After this incident and other similar incidents such as the scour-related collapse of the Hatchie River Bridge in Tennessee resulting in 8 deaths, much national attention was paid to scour of bridge foundations (NTSB 1990). Several research efforts and proposed inspection improvements were completed after these collapses. Directly following the Schoharie Creek collapse, the National Bridge Inspection Program was augmented by the Federal Highway Administration (FHWA) to include a national scour-evaluation program. Later, additions to the NBIS required that all bridges be evaluated through underwater inspection at a two year interval. This interval could be lengthened if proper circumstances were documented. Also, procedures were developed for the assessment of bridge scour, and additional scour considerations were included in the design of bridges.

Current Bridge Inspection

Currently, one of the primary guidelines that is utilized for bridge inspection is a document titled "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges" (FHWA 1995). In addition to this publication, other publications including the "Bridge Inspectors Training Manual" are also utilized for procedures and standard reporting practices (FHWA 2000). These publications provide guidance and regulations on how bridges are to be inspected. This may include what bridges are to be inspected, what bridge (location, route, span length, etc.) data are needed, what components or elements of a bridge are to be inspected, how the inspection data are to be recorded, and condition rating criteria for the different elements. This document also stipulates that each bridge (with spans of 20 feet or greater) must be inspected at least every two years.

The current state of practice largely utilizes visual inspection. Although there has been an increased use of additional non-destructive techniques, the majority of the inspection still relies on visual procedures performed by the inspection team.

During inspection, each bridge is inspected by an inspection team that observes the roadway approaches, the obstacles that the bridge crosses, and the condition of the bridge itself. Items such as traffic protection components, waterways, and alignment of approaches are reviewed. However, the bridge itself is typically broken down into three main components for inspection and reporting purposes. These include the deck, the superstructure, and the substructure. Each of these components of the bridge is inspected and assigned a rating that describes its current condition. The ratings used are generally those found in the recording and coding guide (FHWA 1995). Standard reporting forms are commonly used. An example of this type of form currently used by the Tennessee Department of Transportation (TDOT) is shown in Figure 1.1.

TDOT

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

Bridge Condition Coding Form

Revised 06/15/2000

County: ______

Route: ______

Special Case: ______

County Sequence: ______

Log Mile: ______

Bridge Number: (Includes Item 5A) ______

Feature Intersected: ______

CODE ONLY THOSE VALUES WHICH HAVE CHANGED

ITEM #	DESCRIPTION	VALUE
90	INSPECTION DATE	
10	MINIMUM V.C. OVER DECK (ROADWAY + SHOULDERS)	____ FT. ____ IN.
520	MINIMUM V.C. OVER DECK (EXCLUDES SHOULDERS)	____ FT. ____ IN.
36	TRAFFIC SAFETY FEATURES: Br. Rail __ Trans. __ Appr. Rail __ Appr. Rail Ends __	
41	STRC OPEN/CLOSED/POSTED: A K P	__
58	DECK	__
59	SUPERSTRUCTURE	__
60	SUBSTRUCTURE	__
61	CHANL/CHANL PROTECTION	__
62	CULVERT AND RETAIN WALL	__
71	WATERWAY ADEQUACY	__
72	APPROACH RDWY ALIGNMENT (USE VALUES OF 3, 6, OR 8)	__
521	OVERALL CONDITION (Circle One): GOOD FAIR POOR CRITICAL	

CONDITION CODING GUIDELINES
(Values for Coding Items 58, 59, 60 and 62)

- N NOT APPLICABLE
- 9 EXCELLENT CONDITION
- 8 VERY GOOD CONDITION - NO PROBLEMS NOTED.
- 7 GOOD CONDITION - SOME MINOR PROBLEMS.
- 6 SATISFACTORY CONDITION - MINOR DETERIORATION OF STRUCTURAL ELEMENTS.
- 5 FAIR CONDITION - ALL PRIMARY STRUCTURAL ELEMENTS ARE SOUND BUT MAY HAVE MINOR SECTION LOSS, CRACKING, SPALLING OR SCOUR.
- 4 POOR CONDITION - ADVANCED SECTION LOSS, DETERIORATION, SPALLING OR SCOUR.
- 3 SERIOUS CONDITION - LOSS OF SECTION, DETERIORATION, SPALLING OR SCOUR HAVE SERIOURSLY AFFECTED PRIMARY STRUCTURAL COMPONENTS. LOCAL FAILURES ARE POSSIBLE. FATIGUE CRACKS IN STEEL OR SHEAR CRACKS IN CONCRETE MAY BE PRESENT.
- 2 CRITICAL CONDITION - ADVANCED DETERIORATION OF PRIMARY STRUCTURAL ELEMENTS. FATIGUE CRACKS IN STEEL OR SHEAR CRACKS IN CONCRETE MAY BE PRESENT OR SCOUR MAY HAVE REMOVED SUBSTRUCTURE SUPPORT. UNLESS CLOSELY MONITORED IT MAY BE NECESSARY TO CLOSE THE BRIDGE UNTIL CORRECTIVE ACTION IS TAKEN.
- 1 "IMMINENT" FAILURE CONDITION - MAJOR DETERIORATION OR SECTION LOSS PRESENT IN CRITICAL STRUCTURAL COMPONENTS OR OBVIOUS VERTICAL OR HORIZONTAL MOVEMENT AFFECTING STRUCTURAL STABILITY. BRIDGE IS CLOSED TO TRAFFIC BUT CORRECTIVE ACTION MAY PUT BACK IN LIGHT SERVICE.
- 0 FAILED CONDITION - OUT OF SERVICE AND BEYOND CORRECTIVE ACTION.

TEAM LEADER SIGNATURE ______ REVIEW DATE __/__/__

Figure 1.1 – Bridge Condition Coding Form

The inspection reports generally include maps, pictures, detailed drawings, and notes concerning the findings of the inspection. An overall rating for the bridge is provided, such as Critical, Poor, Fair, and Good. Additionally, a bridge maintenance recommendation may also be completed so that the proper maintenance can be scheduled or performed on the bridge as funds and personnel are available.

In addition to this rating, a sufficiency rating may also be calculated. This sufficiency rating is utilized to establish priority of the bridges that have been inspected and inventoried. As the sufficiency rating moves from 100 (perfect score) toward 0, the priority of the bridge increases. This rating is primarily utilized for ascertaining which bridges are eligible for repair, rehabilitation, or replacement through Federal funding. The guidelines for the calculation of the rating are provided in an appendix to the recording guide (FHWA 1995). The rating consists of the calculation of four different sufficiency rating factors including structural adequacy and safety (S_1), serviceability and functional obsolescence (S_2), essentiality for public use (S_3), and special reductions (S_4).

Use of Inspection Data

The data that is obtained through the periodic inspection of bridges is also utilized in the National Bridge Inventory (NBI) data base. This data base contains information on the entire inventory of inspected bridges in the United States. At the end of 2002, this database contained information on nearly 600,000 bridges.

The information that is collected during the routine inspections of bridges can also be used in Bridge Management Systems (BMS). Bridge management systems have been developed to perform many functions including tracking the condition changes within a selected bridge inventory, determining optimal maintenance and rehabilitation procedures, and predicting deterioration of bridge elements based on historical inspection data. The two primary systems that are currently in use are PONTIS and BRIDGIT. These systems are the product of research efforts initiated in the late 1980's by the Federal Highway Administration (FHWA) and the National Cooperative Highway Research Program (NCHRP), respectively. In a recent survey, it was noted that a majority of states used PONTIS for their bridge management system (Small et. al. 1999).

Concerns with Current Inspection Procedures

The inspection standards that were initiated in the 1960's, and edited over the last few decades have served their initial purpose. Bridges are visually inspected with a set of standard criteria and on a standard interval to insure safety (Washer 1999). Several areas of concern arise when visual inspection procedures are used. These inspections rely heavily on the engineering judgment of the individual inspector, thus rendering the process subjective and dependant on qualified personnel (Koehn and Barroeta 1991).

This type of inspection procedure also leaves opportunities for deterioration to be missed, and thus an inaccurate assessment of the structure may result. For example, during routine visual inspection, some areas of the bridge structure may be difficult or impossible to access, therefore deterioration may go unnoticed until significant damage has occurred (DeWolf et. al. 1998). Also, visual inspection may not obtain the information that is required to assess the capacity reduction of structural members. This may be the case when considering the information required (loss of steel area) to compute the load carrying capacity of reinforced concrete members with reinforcing steel subject to corrosion (Hover 1996). Therefore, these types of inspection guidelines or techniques are more prone to instigate bridge repair or rehabilitation after damage rather than aid in proactive bridge preservation.

The LTBP Program

The above information supports the need for an improved, more accurate understanding of highway bridge performance. In recognition of this, an effort to assess the long term performance of highway bridges throughout the country is being proposed by the FHWA. This effort, the Long Term Bridge Performance (LTBP) program, is aimed at the condition and performance evaluation of a representative sample of bridges through continuous monitoring and instrumentation over a minimum time span of approximately 10 to 20 years (Hooks 2003).

The LTBP program will include a sample of bridges representative of the entire bridge infrastructure in the United States (Hooks 2003). Characteristics such as bridge type, superstructure material, span length, environment, and traffic loadings are examples of the types of attributes that must be considered when defining this sample. However, this sample would not include major or specialty structures such as cable-stayed, suspension, long span steel truss and masonry arch bridges. These particular bridge types are considered outside the scope of the LTBP program due to their special nature and infrequent use.

This program will address the significant deterioration processes that lead to a reduction in performance and service life of highway bridges (Hooks 2003). Examples of these deterioration processes may include corrosion of concrete reinforcing or steel girders, fatigue loading, freeze-thaw cycles, and scour. Also, this program will address the relationship between the physical characteristics of bridges and operational performance such as the effect of lateral clearance on accident rates and traffic speed (Hooks 2003). If possible, this program will also complete forensic autopsies on bridges that are de-commissioned with the aim of determining characteristics such as load capacities, remaining service life, and usefulness of testing procedures.

Current trends and deficiencies in bridge inspection have been discussed as well as the need for in-depth investigation programs to better understand the deterioration processes resulting in structural deficiencies throughout the inventory. Considerable information is available from different sources to adequately support a portion of such programs. However, additional effort is required to refine a portion of the existing information, such as condition states, and to define protocols for efficient development and management of such programs. Five research objectives are identified that consolidate the existing information and propose procedures to help achieve a better understanding of long-term bridge deterioration.

Research Objectives

The five primary research objectives of this dissertation are as follows: (1) Development of a procedure capable of selecting a random representative sample of bridges from the national inventory; (2) Redefinition of existing condition states with quantitative treatment; (3) Identification of the major deterioration processes that limit the service life and performance of highway bridges; (4) Assessment of the current quantitative models for the deterioration mechanisms identified and identification of available methods for obtaining required data for use; and (5) Development of an inspection planning map that integrates the information in Research Objectives 1 thru 4.

To study the overall performance and deterioration of the bridge inventory, a representative sample of bridges must be identified. Due to the size and complexity of the national inventory, a statistical sampling procedure is developed in Research Objective 1 that identifies groups of similar structures based upon eight parameters that are obtained from NBI data and describe typical characteristics of each structure. The proposed procedure allows a random selection of a group of structures for inspection, monitoring, etc. Additional parameters typically correlated with bridge deterioration are also identified such as weather and environmental characteristics. These characteristics in combination with the grouping procedure provide the opportunity to select a representative sample or to select a group of structures meeting specific guidelines.

Existing condition states rely heavily data from visual inspection. Based on current practice in Tennessee, these condition states are redefined in Research Objective 2 to include more quantitative information that is readily available during the inspection process. In comparison to those currently used the proposed condition states provide more precise transition points between adjacent condition states, easier comparison between inspectors or structures, and increased communication of actual bridge condition. The proposed condition states will also improve the planning and budgeting process for repair and rehabilitation projects and aid in the determination of actual deterioration rates.

Many earlier studies (Enright and Frangopol 2000, Dunker and Rabbat 1993, Ramey and Wright 1997, etc.) identify and discuss a small subset of the deterioration mechanisms that affect bridge structures. Information on numerous deterioration processes are scattered throughout the literature. Therefore, a consolidated description of the major physical deterioration processes is completed in Objective 3. The listing identifies the deterioration symptoms of each process, discusses the underlying mechanics of each process, and provides typical preventive strategies where possible.

Many efforts have been reported on quantitative modeling of the deterioration mechanisms that affect the long-term performance of bridge structures (Liang et. al. 2002, Yun et. al. 2000, Farhey et. al. 1997, Fu and Hag-Elsafi 2000, Papadakis et. al. 1991, Eisenhauer and Russbach 2000, Annandale 2000, Chase and Gaspar 2000, Weyers et. al. 1998, Kirkpatrick et. al. 2002, Attiogbe 1996, etc.). A listing of the most notable and accepted models is not currently available. Objective 4 collects the scattered information regarding practical quantitative models for the major deterioration mechanisms. The parameters for use are identified as well as any gaps in the model inventory. Appropriate testing and inspection methods for acquiring the data required for model use are discussed. These methods are typically restricted to those that follow a formal standard or are approved for use. Ultimately, this list supports the inspection and appraisal process and allows a better understanding of the current conditions, prediction of future deterioration, estimation of service life, and identification of the information needed from the inspection process.

Finally, a planning map is developed in Objective 5 that combines the information proposed and developed throughout this study. This map provides direction on the forms of deterioration to be expected, data required for model use, and the appropriate condition states for use with typical bridge structures. Ultimately, the information contained in the planning map will improve the inspection process through a more prepared inspection team and aid in a better understanding of anticipated bridge deterioration.

Organization

Investigation and statistical stratification of the bridge inventory is discussed in Chapter II. A rational method of stratification of the inventory into groups of similar structures is proposed. The results of this method may be utilized to select random samples of bridges with varying sizes and attributes. This procedure is illustrated on a small portion of the National Bridge Inventory in Chapter II, with results from the remainder of the inventory provided in the Appendix. A method of random sampling is also discussed.

Chapter III augments the existing standard condition states through the integration of quantitative data. New condition states are developed for each major bridge component, material, and deterioration combination, with definitive, quantitative thresholds indicating transition between condition states. The condition states are limited to the material and deterioration types found in the Tennessee inventory.

Chapter IV is focuses on major deterioration mechanisms that limit the service lives of highway bridges. The deterioration mechanisms discussed are those that generally result in the damage discussed in the proposed condition states of Chapter 3. Primary deterioration mechanisms are identified and discussed for all major materials utilized in past and current bridge construction.

Chapter V investigates the quantitative models currently available for the primary deterioration mechanisms from Chapter IV. Existing models are identified along with the required parameters for use. Deterioration types with no available quantitative model are also identified. Currently approved non-destructive methods available to obtain data required to facilitate the use of models are also discussed.

Chapter VI proposes an inspection planning map for bridges chosen for long term assessment. The proposed checklists combine the information provided in Chapters II thru V to develop an inspection program and obtain the information required for long-term study and comparison of bridge structures.

Chapter VII discusses findings from the work presented in Chapters II thru VI. Possibilities of improvement on the work in this study are also briefly discussed as are recommendations of future work including implementation of the proposed procedures and condition states.

CHAPTER II

METHODOLOGY FOR SAMPLE SELECTION

Introduction

Any program focused on in-depth investigation of bridge performance throughout an inventory (national, state, etc.), such as the LTBP, requires a method of selecting a sample of bridges for study. Several key issues may be of interest when developing a program such as materials or deterioration processes of interest, appropriate assessment procedures, and possible modeling techniques. Also, the number of structures participating in the sample must be identified based on the overall goal of the program and any constraints that may be present. For this study, a sample size of 2,000 bridges was assumed based on available financial resources. Each of these issues must be addressed prior to the selection of a sample for study. Once these issues are addressed, two steps remain in the selection of particular bridges to participate in the program.

First, a representative sample of structures meeting the criteria of the program must be defined. This step is intended to insure that the distribution of structures and results of the program are generally consistent and applicable across the entire inventory. Second, the particular structures chosen for participation in the program must be selected from the initial inventory through a random process. This is required to avoid any unnecessary bias or correlation within the sample chosen. Research Objective 1 addresses both of these steps through the development of a methodology that generates an in-depth definition of the inventory and suggests a process for random sampling.

Methodology development included stratification of the inventory into distinct subgroups through the combination of statistical grouping analyses and structure specific parameters defining the physical and operational characteristics of the inventory. Parameters describing the environmental exposure characteristics of the inventory were also investigated to provide further opportunity to delineate between similar structures, add flexibility in selecting the bridge sample, and support investigation of correlations between exposure and deterioration.

Bridge Inventory Stratification

National Bridge Inventory Data

The data contained in the National Bridge Inventory at the end of 2002 was obtained from the Federal Highway Administration. Initially, this data set described nearly 600,000 public bridges with over 100 distinct parameters describing physical and operational attributes such as the year the structure was built, the average daily traffic utilizing the structure, and condition ratings of the bridge's main components including the substructure, superstructure, and deck. These parameters, listed in Table A1 of the Appendix, are typically obtained by state departments of transportation during periodic inspections that generally occur every two years, and are recorded with simple alphanumeric entries. The information provided in this data set provided the foundation for stratification of the inventory into groups of similar structures.

In particular, two of these parameters provided an opportunity to identify groups of structures that were similar in a fundamental way. These parameters were material type and structure type. The material type parameter included ten different options defining the type of material utilized for the construction of the superstructure of a particular bridge, and when necessary, the continuity of the structure at support points. These variables and representation within the bridge inventory are provided in Table 2.1.

Table 2.1: *Bridge Inventory by Material Type*

Material	NBI Code	Count	Percent
Concrete	1	164,321	27.80%
Concrete Continuous	2	75,672	12.80%
Steel	3	146,706	24.82%
Steel Continuous	4	48,121	8.14%
Prestressed Concrete	5	103,202	17.46%
Prestressed Concrete Continuous	6	17,251	2.92%
Wood	7	32,363	5.48%
Masonry	8	1,869	0.32%
Aluminum / Iron	9	1,167	0.20%
Other	0	389	0.06%

Similarly, the structure type parameter included twenty three different categories identifying the basic type of structural system utilized for the superstructure of the bridge. These categories and their use throughout the inventory are provided in Table 2.2.

The information in Tables 2.1 and 2.2 provided a logical way of dividing the inventory into smaller groups that were similar at a fundamental level. These parameters provided enough information to complete an initial analysis of the inventory and remove those basic groups of structures that were not of interest when studying long-term performance. Material and structure types representing small portions of the inventory, specialty structures, or those not anticipated to be utilized frequently in future construction were removed. The material types aluminum/iron and other as well as the

Table 2.2: *Bridge Inventory by Structure Type*

Structure Type	NBI Code	Count	Percent
Slab	1	77,616	13.13%
Stringer/Multi-beam or Girder	2	250,610	42.40%
Girder and Floor beam System	3	8,661	1.47%
Tee Beam	4	37,598	6.36%
Box Beam or Girders – Multiple	5	44,403	7.51%
Box Beam or Girders - Multiple or Spread	6	7,215	1.22%
Frame (except frame culverts)	7	4,880	0.83%
Orthotropic	8	403	0.07%
Truss – Deck	9	825	0.14%
Truss – Thru	10	14,798	2.50%
Arch – Deck	11	7,450	1.26%
Arch – Thru	12	398	0.07%
Suspension	13	98	0.02%
Stayed Girder	14	33	0.01%
Moveable – Lift	15	169	0.03%
Moveable – Bascule	16	485	0.08%
Moveable – Swing	17	238	0.04%
Tunnel	18	83	0.01%
Culvert (includes frame culverts)	19	118,144	19.99%
Mixed types	20	478	0.08%
Segmental Box Girder	21	141	0.02%
Channel Beam	22	13,439	2.27%
Other	0	2,838	0.48%

structure types orthotropic, suspension, stayed girder, moveable/lift, moveable bascule, moveable/swing, tunnel, and other were removed from the overall inventory. This reduced the inventory to 585,545 structures.

The structures remaining in the inventory were then broken down into material and structure type combinations, or subpopulations, as shown in Table A2 of the Appendix. This analysis provided an identification of the size of each subpopulation of material and structure type. As previously noted, a sample of 2,000 bridges was targeted. With a remaining viable population of 585,545 structures, approximately 1 of every 292 bridges from the remaining population would be selected as part of the sample. It was assumed that any subpopulation that contained less than 584 structures (representing less than 2 structures in the sample) would need no further stratification or grouping. Therefore, any combination containing less than 584 bridges was removed prior to additional analysis. Although not involved in further stratification analysis, these small groups of structures remain available for sampling and participation in the inspection program. This resulted in 579,531 structures for further analysis, as shown in Table 2.3.

Many of the remaining subpopulations were still too large in number to easily identify a representative sample. To further group similar subpopulation structures, additional analysis was required using the remaining parameters available for each structure. The parameters selected were considered to be those that were typically connected with long term structural performance, useful in identifying major differences between structures of the same material and structure type, and indicative of large maintenance or repair expenses. These variables were among those reported in, or easily calculated from, the NBI data. The parameters were selected through basic exploratory statistical analysis correlating variables describing each structure and those indicating structural performance as well as consultation with department of transportation personnel. A core set of eight parameters were identified to further define the remaining inventory.

This core set consisted of 4 continuous parameters and 4 non-continuous or nominal parameters. The continuous parameters included the age of the structure in years (AGE), the total length of the structure in feet (SL), the average daily truck traffic (ADTT) as a percentage of total daily traffic, and the structure age in years since major reconstruction (NEWAGE). The variable NEWAGE reverted to the value for AGE if the

Table 2.3: *Bridge Inventory by Structure and Material Type*

Main Material Type	Main Structure Type	No. of Bridges
Concrete	Slab	34,947
	Stringer/Multi-beam or Girder	10,179
	Girder or Floorbeam System	1,065
	Tee Beam	22,740
	Box Beam or Girders – Multiple	1,615
	Frame (except frame culverts)	3,448
	Arch – Deck	5,324
	Culvert (includes frame culverts)	71,581
	Channel Beam	11,890
Concrete Continuous	Slab	29,842
	Stringer/Multi-beam or Girder	2,930
	Tee Beam	6,910
	Box Beam or Girders - Multiple	4,499
	Box Beam or Girders - Single or Spread	1,078
	Frame (except frame culverts)	915
	Culvert (includes frame culverts)	28,783
Steel	Stringer/Multi-beam or Girder	109,983
	Girder or Floorbeam System	5,488
	Truss – Deck	652
	Truss – Thru	13,847
	Culvert (includes frame culverts)	13,244
Steel Continuous	Stringer/Multi-beam or Girder	45,149
	Girder or Floorbeam System	1,573
Prestressed Concrete	Slab	8,876
	Stringer/Multi-beam or Girder	43,815
	Tee Beam	7,244
	Box Beam or Girders - Multiple	34,433
	Box Beam or Girders - Single or Spread	3,562
	Culvert (includes frame culverts)	3,140
	Channel Beam	1,506
Prestressed Concrete Continuous	Stringer/Multi-beam or Girder	10,818
	Tee Beam	647
	Box Beam or Girders - Multiple	3,328
	Box Beam or Girders - Single or Spread	2,040
Wood or Timber	Slab	3,456
	Stringer/Multi-beam or Girder	27,695
Masonry	Arch – Deck	1,289

structure had not undergone a major reconstruction during its service life.

The four non-continuous, or nominal variables included the design load (DL) utilized for the original design of the structure, the deck structure type (DST) that was utilized, the type of wearing surface (TOWS) used on the bridge deck, and the type of deck protection (DP) that was utilized. Tables 2.4 and 2.5 illustrate the different types of each non-continuous variable as well as the entry code utilized in the NBI data set.

Table 2.4: *NBI Design Load and Deck Structure Type Categories*

NBI Entry	Design Load	Deck Structure Type
1	H 10	Concrete Cast - in – Place
2	H 15	Concrete Precast Panels
3	HS 15	Open Grating
4	H 20	Closed Grating
5	HS 20	Steel Plate (includes orthotropic)
6	HS 20+Mod	Corrugated Steel
7	Pedestrian	Aluminum
8	Railroad	Wood or Timber
9	HS 25	Other
N	---	Not Applicable

Table 2.5: *NBI Type of Wearing Surface and Deck Protection Categories*

NBI Entry	Type of Wearing Surface	Deck Protection
1	Monolithic Concrete (concurrently placed with deck)	Epoxy Coated Reinforcing
2	Integral Concrete (non-modified layer of concrete added)	Galvanized Reinforcing
3	Latex concrete or similar additive	Other Coated Reinforcing
4	Low Slump Concrete	Cathodic Protection
5	Epoxy Overlay	---
6	Bituminous	Polymer Impregnated
7	Wood or Timber	Internally Sealed
8	Gravel	Unknown
9	Other	Other
0	None	None
N	Not applicable	Not Applicable

The NBI data available for the remaining subpopulations of bridge structures was reduced to this core set of variables. Several avenues were investigated on treatment of observations with missing data including removal of observations with missing data, removal of variables with missing data, and various imputation methods. The most practical method of addressing this type of data irregularity, with consideration given to sample size, was found to be removal of records with missing data (Hair et. al. 1998). Therefore, all bridge records that contained missing or invalid entries for any one of these parameters were purged resulting in a data set with similar information on all structures remaining in the analysis. This reduction resulted in a data set containing information on 569,631 structures, with subgroups of structures as indicated in Table 2.6. Comparison of Tables 2.3 and 2.6 identified 9,900 records, or approximately 1.7 percent, with missing data, and these were removed from further analysis. Subsequent to analysis, these structures may remain available for sampling and participation in the inspection program.

A brief statistical analysis of the continuous and nominal parameters was completed for each subpopulation to identify the distribution of each core parameter within each subpopulation of structures. Results from this analysis are provided in Tables A3 and A4 of the Appendix. This analysis considered all remaining structures with the exception that the analysis for NEWAGE considered only reconstructed bridges.

Subsequently, each of the non-continuous parameters was converted to a set of nominal indicator variables. For example, the parameter DL was converted to 10 indicator variables. The sequence of these variables was chosen to match the data entry process for NBI data such that an entry of “1” for design load in NBI data correlates with the new variable DL1. After this conversion to indicator variables was completed, this

Table 2.6: *Bridge Inventory by Structure and Material Type*

Main Material Type	Main Structure Type	No. of Bridges
Concrete	Slab	34,393
	Stringer/Multi-beam or Girder	10,135
	Girder or Floorbeam System	1,042
	Tee Beam	22,507
	Box Beam or Girders – Multiple	1,578
	Frame (except frame culverts)	3,119
	Arch – Deck	4,951
	Culvert (includes frame culverts)	71,015
	Channel Beam	11,884
Concrete Continuous	Slab	29,643
	Stringer/Multi-beam or Girder	2,894
	Tee Beam	6,840
	Box Beam or Girders – Multiple	4,475
	Box Beam or Girders - Single or Spread	1,075
	Frame (except frame culverts)	847
	Culvert (includes frame culverts)	28,598
Steel	Stringer/Multi-beam or Girder	106,452
	Girder or Floorbeam System	5,176
	Truss – Deck	633
	Truss – Thru	13,546
	Culvert (includes frame culverts)	12,590
Steel Continuous	Stringer/Multi-beam or Girder	44,676
	Girder or Floorbeam System	1,549
Prestressed Concrete	Slab	8,741
	Stringer/Multi-beam or Girder	43,553
	Tee Beam	7,184
	Box Beam or Girders – Multiple	34,132
	Box Beam or Girders - Single or Spread	3,545
	Culvert (includes frame culverts)	3,131
	Channel Beam	1,485
Prestressed Concrete Continuous	Stringer/Multi-beam or Girder	10,760
	Tee Beam	640
	Box Beam or Girders – Multiple	3,306
	Box Beam or Girders - Single or Spread	2,029
Wood or Timber	Slab	3,367
	Stringer/Multi-beam or Girder	27,018
Masonry	Arch – Deck	1,122

variable now had an entry of either 0 indicating that the design load was not H 10 or an entry of 1 indicating that the design load was in fact H 10. This same process was followed for all of the non-continuous variables. This was accomplished in order to simplify the analysis and provide variables that essentially related a yes or no pertaining to a particular variable during the analysis. Although simplifying the analysis, this process expanded the overall number of parameters utilized. Through the increase in number of parameters, the results of the analyses were understood and compared with greater ease.

The NBI inventory was reduced to those structures and material combinations large enough to be of interest in the LTBP program. As previously mentioned several of these combinations contained less than 584 structures and required no further stratification. Due to the size and complexity of the remaining combinations, additional analyses were required to provide further grouping and simplify the selection procedure.

Stratification with Statistical Methods

Three different techniques were investigated for use in further dividing the remaining inventory including factor analysis, correspondence analysis, and latent class cluster analysis. Factor analysis can be utilized for identification of structure in data through summarization and reduction of data. Correspondence analysis is a compositional technique that is generally used for dimensional reduction and perceptual mapping. Finally, latent class cluster analysis classifies observations into groups or clusters based on a vector of parameters describing the observations of interest. The similarities that are identified are beyond those easily identified through cursory inspection of data.

While each of the investigated methods was thought to be somewhat useful, latent class cluster analysis was chosen as the technique that best suited the grouping objective. The primary reason for this selection was the superior ability of latent class cluster modeling to effectively manage the use of both continuous and nominal variables in the same data set and analysis.

Latent Class Cluster Analysis

The latent class cluster analysis allows the classification of observations, or structures, into groups or clusters based on a multivariate dependent variable consisting of several parameters defining characteristics of interest for each bridge structure. The number and statistical characteristics of the groups into which these structures are classified are assumed to be "latent" or unknown a priori (Vermunt and Magidson 2002, Chaney et. al. 2006).

The Latent Class Cluster Model

For a J component dependent variable $\underline{y}_i = (y_{i1}, \ldots, y_{iJ})$, we find J clusters by maximizing the J-variate likelihood for N observations,

$$\mathbf{L} = \prod_{i=1}^{N} \sum_{k=1}^{K} \mathbf{p}(\mathbf{k} \mid \mathbf{z}_i)\ \mathbf{f}_k(\mathbf{y}_i \mid \mathbf{z}_i, \Theta^{(k)}), \qquad \text{Equation 2.1}$$

where $p(k|\underline{z}_i)$ is the probability that an observation with covariate vector $\underline{z}_i$ is in cluster k, k=1,…,K; and $f_k(\underline{y}_i|\underline{z}_i,\underline{\Theta}^{(k)})$ is the J-variate density within cluster k, with parameters $\underline{\Theta}^{(k)}$. Generally one assumes some form of local independence (conditional on an observation being in a particular cluster). In the most extreme case the J components of $\underline{y}_i$ are completely independent when it is in cluster k,

$$\mathbf{f_k\,(y_i \mid z_i, \Theta^{(k)}) = \prod_{j=1}^{J} f_{kj}(y_{ij} \mid z_i, \theta_j^{(k)})}, \qquad \text{Equation 2.2}$$

where the parameters $\theta_j^{(k)}$ for the univariate density f_{kj} will generally consist of a varying number of components depending on the mathematical form of the density f_{kj} (Vermut and Magidson 2002).

Based on the analysis of bivariate residuals from an initial fit of Equation 2.2, we also consider less extreme forms of local independence where only L subgroups, $\underline{\mathbf{y}}_{\mathbf{i}}^{(\ell)}$, of the J components are independent, i.e., the subgroups $\underline{\mathbf{y}}_{\mathbf{i}}^{(\ell)}$, $\ell = \mathbf{1,...,L,}$ consist of multivariate, and possibly univariate, mutually exclusive subgroups of the original J components, such that:

$$(\underline{\mathbf{y}}_{\mathbf{i}}^{(1)}, ..., \underline{\mathbf{y}}_{\mathbf{i}}^{(L)}) = (\mathbf{y}_{i1}, ..., \mathbf{y}_{iJ}).$$

In this case the J clusters are found by maximizing the likelihood in Equation 2.1, with

$$\mathbf{f_k\,(y_i \mid z_i, \Theta^{(k)}) = \prod_{\ell=1}^{L} f_{k\ell}\,(y_i^{(\ell)} \mid z_i, \theta_\ell^{(k)}\,)}\,. \qquad \text{Equation 2.3}$$

If the subgroup of components $\underline{\mathbf{y}}_{\mathbf{i}}^{(\ell)}$ are continuous, we will generally assume $\mathbf{f}_{\mathbf{k}\ell}$ is normal or multivariate normal, and if $\underline{\mathbf{y}}_{\mathbf{i}}^{(\ell)}$ consists of nominal (or ordinal) components, then $\mathbf{f}_{\mathbf{k}\ell}$ is either a multinomial distribution, if there is only one component in $\underline{\mathbf{y}}_{\mathbf{i}}^{(\ell)}$, or a restricted joint multinomial distribution if there is more than one component. In this way, each of the L subgroups, $\underline{\mathbf{y}}_{\mathbf{i}}^{(\ell)}$, of the original components of $\underline{y}_i$, consists of exclusively continuous or exclusively nominal (or ordinal) components. Dependence between continuous and nominal (or ordinal) components of $\underline{y}_i$ is introduced by adding the non-continuous variables to the group of covariates $\underline{z}_i$. The need for such direct effects is also deduced by analyzing preliminary fit of Equation 2.2 and subsequent fits of Equation 2.3.

Analysis

Latent class cluster models were developed from the data set containing the four continuous and four non-continuous characteristics previously described. Prior to implementing the analysis, it was assumed that no cluster would be accepted that represented less than 1 bridge in the sample, indicating that a cluster of less than 292 structures would not be accepted. Additionally, only the nominal parameters (DL1, DST1, etc.) that represented a portion of the inventory relating to at least 1 structure in the sample to be chosen were included, thus initially reducing the size of the data set used for each analysis of a particular material and structure type combination.

To begin the analysis, a two-cluster model was estimated. This model was used to determine the significance of the variables that remained in the data set as well as to identify the magnitude of the residuals of different pairs of variables. The next step was to estimate additional models, using only variables that were significant at the 0.05 level in the previous two cluster model. Additional models with increasing numbers of clusters were estimated until minimization of the Bayesian Information Criterion occurred, subject to the constraint on minimum cluster size (Schwarz 1978, Woodroofe 1982). This procedure was followed for each of the remaining structure and material type combinations.

Analysis Results

General results pertaining to all material and structure types are discussed in this chapter, with complete results provided in the Appendix. Specific results for small portions of the analysis are provided in the following text for illustration and discussion purposes.

Table A5 in the Appendix tabulates the optimal number of clusters identified for each material and structure type combination. This table also indicates the percentage of each combination population within a given cluster. Generally, an increase in the initial population results in an increase in the number of clusters in the optimal solution. Optimal solutions across the forty combinations analyzed ranged from 2 to 15 clusters. Eight of the analyses resulted in one cluster solutions (i.e. Steel Truss-Deck bridges) typically indicating that the size of the second cluster was below the assumed constraint. Optimal solutions for the prestressed concrete continuous combinations are provided in Table 2.7. Solutions of one to four clusters were optimal subject to the given constraints. As previously discussed, the stringer/multi-beam or girder combination contained a larger initial population and therefore required more clusters to obtain an optimal solution.

Table 2.7: *Prestressed Concrete Continuous Cluster Characteristics*

Structure Type	Cluster			
	1	2	3	4
Stringer/Multi-beam or Girder	0.502	0.376	0.069	0.053
Tee Beam	No Clusters Required			
Box Beam or Girders – Multiple	0.871	0.129	---	---
Box Beam or Girders – Single or Spread	0.856	0.145	---	---

The results in Table A5 also indicate that the percentages of the combination within each cluster range from a minimum of 0.05 percent to a maximum of 91.4 percent through the forty combinations analyzed without considering the 1 cluster solutions. Similarly, Table 2.7 indicates this information for the prestressed concrete analyses. Here, approximately 50.2% of the stringer/multi-beam or girder combination is contained in cluster 1. As the number of clusters increases, a trend becomes evident that a small number clusters represent a large portion of the combination with each of the remaining clusters representing only a small portion of the combination. Within the data structure, the few highly populated clusters may represent the most general stratification within the combination and the less populated clusters may represent smaller subsets of structures with very particular similarities. This possible relationship may help in the selection of structures to include in a sample. In example, if a program is only interested in the most typical structures, then sampling may be accomplished from the few largest clusters. However, if the program is concerned with a particular subset of structures, sampling may be directed to the appropriate cluster(s). Due to the constraints placed on the analysis, the results of the more populated combinations will typically reveal more and smaller groups of structures thus possibly resulting in more precise stratification of the combination. The same could be accomplished on the smaller combinations with a slight change in constraints used. In review of Table 2.7, this structure becomes visible in each of the combinations, and in particular, the stringer/multi-beam or girder combination. As shown, approximately 88 percent of the combination is contained by clusters 1 and 2 with the remaining 12 percent in clusters 3 and 4.

Results indicating the within cluster distribution of the nominal parameters used for analysis of each combination are provided in Table A6 of the appendix. These results indicate which of the nominal parameters were utilized in the final analysis of each combination. These results may also indicate the most prevalent nominal characteristics with a given cluster, and may be used to identify clusters with a particularly high or low likelihood of a particular parameter of interest.

The within cluster distribution of the nominal parameters used in the analysis for material type prestressed concrete continuous and structure type box beam or girder – single or spread, are provided in Table 2.8. These results indicate that the only nominal parameters remaining in the final analysis were DL5, DL6, DST1, DST2, and TOWS1. For example, structures in Cluster 1 have a greater likelihood of utilizing a type of wearing surface TOWS1 than the other types of wearing surfaces. These results provide insight into the characteristics within each cluster and may support more suitable selection of the clusters to include in a program.

Table 2.8: *Nominal Parameter Distribution within Cluster*

Parameter	Indicator	Cluster	
---	---	1	2
DL5	0	0.34	0.49
	1	0.65	0.50
DL6	0	0.86	0.69
	1	0.13	0.30
DST1	0	0.24	0.07
	1	0.75	0.92
DST2	0	0.76	0.93
	1	0.23	0.06
TOWS1	0	0.14	0.24
	1	0.85	0.75

Similarly, the nominal parameter distributions across cluster for each of the completed analyses are provided in Table A7 of the Appendix. These results may aid in the selection of clusters or structures that represent a portion of the combination with typical characteristics of interest (DST1, DL5, etc.). The results for the same prestressed concrete example are provided in Table 2.9. These results indicate the distribution of structures across clusters based on a given nominal parameter. Therefore, of the structures indicated as being designed with DL5, 89 percent are in cluster 1 and the remaining 11 percent are contained in cluster 2.

The results provided in Tables 2.8, 2.9, A6, and A7 only represent percentages within and across each cluster. These percentages are relative to both the population size and distribution of nominal parameters throughout each combination as provided in Table A3. Integration of the data in Table A3 with the nominal parameter results may provide additional insight into the analysis and ultimately improve the selection procedure. Subsequent to this integration, characteristics of interest may be more easily identified throughout the clusters thus resulting in more efficient sampling.

Table 2.9: *Nominal Parameter Distribution across Cluster*

Parameter	Indicator	Cluster	
---	---	1	2
DL5	0	0.80	0.20
	1	0.89	0.11
DL6	0	0.88	0.12
	1	0.72	0.28
DST1	0	0.95	0.05
	1	0.83	0.17
DST2	0	0.83	0.17
	1	0.96	0.04
TOWS1	0	0.78	0.22
	1	0.87	0.13

The average values for each continuous parameter remaining in the final analysis of each combination are provided in Table A8 of the Appendix. In addition to identifying the continuous parameters that remained in the final analysis, these results indicate possible differences between clusters and may aid in identifying clusters with average continuous characteristics of interest. Although considerable uncertainty may result from these basic analysis results, these results may direct additional study or investigation toward the correct clusters prior to sampling. The average value of the four continuous parameters within each cluster for the prestressed concrete example are provided in Table 2.10 A portion of the results indicate that on average, structures with higher average daily truck traffic are present in cluster 2. Therefore, if high average daily traffic is of interest, a program may concentrate on this cluster rather than Cluster 1. However, to better understand and aid in the utilization of these results, this information may need to be integrated with that provided in the remainder of the Appendix and compared with the characteristics of the entire combination.

Table 2.10: *Continuous Parameter Average within Clusters*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
1	14.17	614.53	7.14	14.17
2	29.26	2024.53	13.63	11.50

Finally, the results indicating the distribution of each continuous parameter across each cluster and within several different ranges are provided in Table A9 of the Appendix. These results help to identify how each parameter is distributed and if used in combination with the results in Table A8, help concentrate the sampling procedure on the best clusters for a given program. The results for the prestressed example are provided in Table 2.11. In example, 92 percent of the structures 0 to 7 years old are present in cluster 1. This information helps provide a more clear understanding of the structures that populate each cluster. This information may be utilized on specialized studies and may help reduce the inventory to only the clusters of interest.

Each of the different results reported may be of help in studying the bridge population and development of an inspection program. These results may aid in investigation of specific groups of structures or the entire inventory. More insight into an inventory and thus more applicable selection of structures for inspection may be achieved if the different results for each combination are used together. These results may simply indicate that particular clusters should be removed from the inventory prior to sampling or that additional study may be required to develop a more thorough understanding of a particular portion of the inventory.

Table 2.11: *Continuous Parameter Distribution across Clusters*

Parameter	Range	Cluster	
---	---	1	2
AGE (years)	0 - 7	0.92	0.08
	8-12	0.94	0.06
	13 - 16	0.90	0.10
	17 - 23	0.94	0.06
	24 - 99	0.55	0.45
SL (meters x 10)	64 - 360	0.87	0.13
	361 - 465	0.89	0.11
	466 - 606	0.93	0.07
	607 - 914	0.91	0.09
	917 - 2e+004	0.68	0.32
ADTT (%)	0 - 2	0.96	0.04
	3-4	0.87	0.13
	5-8	0.86	0.14
	9-12	0.83	0.17
	13 - 70	0.75	0.25
NEWAGE (years)	0 - 6	0.83	0.17
	7-11	0.79	0.21
	12-14	0.86	0.14
	15 - 19	0.87	0.13
	20 - 82	0.93	0.07

Environmental Exposure Parameters

In addition to the information available from the NBI data set, additional data sources were investigated to provide a more suitable definition of the bridge sample. National department of transportation personnel were consulted to identify additional parameters that would be helpful in identifying bridges that are subjected to different exposure conditions and that are also associated with deterioration of bridge structures.

The additional parameters investigated included three weather related parameters including exposure to freeze and thaw cycles, daily temperature ranges, and frequency of snowfall as well as exposure to saltwater or coastal environments. The usefulness of these types of data has been shown through previous research efforts (Chase et. al. 1999).

Daily Weather Station Data

To investigate the new parameters of freeze thaw cycles, daily temperature range, and snowfall frequency, historical weather data was acquired from the National Oceanic and Atmospheric Administration (NOAA) for 1062 weather stations (NOAA 1999). This data included information on daily climatic activity including maximum and minimum temperature readings and snowfall amounts. In addition to describing the weather characteristics at each weather station, this data set also included latitude, longitude, and elevation of each station. The data set provided information concerning each station for extended periods of time, with the most recently added stations dating to 1948. The 1,062 stations represented in this data set were chosen by NOAA to provide appropriate spatial representation of the contiguous 48 states.

Data for these weather stations was obtained in standard text format and separated into 48 subsets of data, each containing records for the population of weather stations for a given state. Initially, each of the subsets of data was converted to a file type that could be easily augmented and utilized to search the data provided. Subsequent to this conversion, each data set was separated into files representing each of the 1062 weather stations. Finally, each of these datasets was further separated into subsets containing only information pertaining to daily temperature records or snowfall amounts. Although the data files obtained from NOAA were subjected to considerable quality control measures prior to being obtained, each of the files were searched for values that were erroneous or appeared to be errors such as negative snowfall amounts. Each of the entries that appeared to be in error was removed from the data files prior to completion of any analysis. Subsequent to the purge of questionable data, these data files were utilized in the following analyses.

Freeze-Thaw Activity

Freeze-thaw cycles have been documented as a serious deterioration mechanism that can affect many types of bridge materials. To gain a better understanding of the freeze thaw potential at each weather station, the data sets for daily temperature were analyzed to identify the tendency at each station location to undergo freeze thaw cycles. This analysis considered a freeze-thaw cycle as a day with maximum and minimum daily temperatures above and below freezing, respectively. Each data file was analyzed to identify the total number of days with a freeze-thaw cycle as well as the total number of days on record for each given station. The results from this analysis were then used to calculate a freeze thaw ratio (FTR) for each station, which was the ratio of freeze-thaw days to days on record. This factor simply identifies the historical presence of freeze-thaw cycles in ambient air temperature at each given station location, and is not intended as a true measure of the freezing and thawing of an actual structure at the same site. However, this factor can provide useful information that can be utilized to categorize locations or structures as having similar freeze thaw exposure. The results of this analysis range form a minimum of 0.00053 to a maximum of 0.66136, with results for each station provided in Table A10 in the appendix. A small sample of the results is provided in Table 2.12.

Daily Temperature Variation

The daily temperature files were also analyzed to provide a general idea of the temperature range that a given station location experienced on an average day. This particular exposure was of interest due to the correlation between thermal movement and deterioration of bridge structures. The average daily temperature range (ADTR), in degrees Fahrenheit, for each station was calculated by determining the range in temperature for each day on record and averaging over the total number of days on record. The results for this analysis indicate minimum and maximum ADTR's of 11.6 and 39.7 degrees Fahrenheit, respectively. A small sample of the results is provided in Table 2.12 with full results for each weather station provided in Table A10 of the Appendix. Similar to the analysis for the FTF, the results for ADTR are indicative only of the average ambient temperature extremes at a given weather station on a daily basis and does not indicate the thermal gradient that the structure may experience, but does provide an avenue to identify structures or locations with similar exposure severities.

Snowfall Frequency

The final analysis completed using the weather station data was concerned with calculating a snowfall ratio (SFR), which identified the historical likelihood of a station location to experience measurable snowfall. This particular form of environmental exposure was of interest due to the link between snowfall, use of de-icing salts, and bridge deterioration. Use of de-icing salts was investigated and data was not available to quantify the frequency and magnitude of its use across a significant portion of the bridge inventory. Therefore, the frequency of snowfall was selected as a substitute for salt usage to provide an avenue, when combined with other site specific parameters such as ADT, to associate structures with different levels of salt usage.

The computation of the SFF for each station simply involved calculating the ratio of days with measurable snowfall to the number of days on record. The results of this analysis ranged from a minimum of 0.0 to a maximum of 0.28. Similar to previous results, the results of the SFF analysis are provided in Table A10 in the Appendix. Results from a sample of weather stations are provided in Table 2.12.

Table 2.12: *Weather Station Characteristics*

Station No.	Latitude	Longitude	Elevation	FTR	ADTR	SFR
---	(deg)	(deg)	(ft)	---	(deg F)	---
1	31.07	-87.05	85	0.12027	26.348	0.00022
2	30.55	-87.89	23	0.04854	20.366	0.00000
3	32.71	-87.59	220	0.09672	22.929	0.00110
4	31.95	-86.32	594	0.09258	22.777	0.00052
5	34.76	-87.62	536	0.13840	21.403	0.00512
6	34.17	-86.82	800	0.19362	25.152	0.00371
7	34.69	-86.05	615	0.18545	24.790	0.00216
8	32.42	-87.00	147	0.07213	22.401	0.00034
9	33.44	-86.10	555	0.14243	24.632	0.00105
10	31.92	-87.74	405	0.10307	23.473	0.00065

Correlation with NBI Data

The analyses completed with data from weather stations have indicated results that are accurate at each specific station location. However, for use with data contained in the NBI, a link was required to associate each particular bridge, or groups of bridges, to the analysis results.

Initially, relation of each bridge to a particular weather station was investigated using the latitude and longitude parameter that may be reported for each bridge structure tracked through NBI data. Through inspection of NBI data and review of previously completed research studies (Chase et. al. 1999), this avenue of association was not deemed appropriate due to the low number of entries for latitude and longitude contained in the NBI data set.

However, one data entry that is recorded in NBI data and typically available for each structure was the state and county Federal Information Processing Standards (FIPS) codes. Therefore, to facilitate the integration of the results of the weather data analyses and NBI data, a FTF, ADTR, and SFF was associated with each county within the contiguous states. This was accomplished by relating each county to the nearest weather station. Therefore, each county was associated with the closest weather station, and thus the analyses results for that particular station. From this, each bridge could be associated with the results of the weather data analyses.

Although this relationship does not provide a completely accurate picture for each county, and does not provide results that are completely accurate for each specific bridge location, it does provide a general relationship throughout the country and can be utilized in identifying general regions or categories for freezing and thawing activity, daily temperature ranges, and snowfall frequency. A portion of the results of this mapping exercise are provided in Table 2.13 with full results in Table A11 of the appendix.

Coastal Exposure

Due to the correlation between saltwater exposure and deterioration of bridge materials including concrete and steel, each county within the contiguous states that bordered saltwater was identified. This identification was accomplished through the use of a geographic information system software application. In addition to graphical representation, each of the counties with coastal exposure was also identified by their respective state and county FIPS, and thus each bridge can be associated with an exposure condition. A sample of this information as well as the information relating counties to specific weather stations is provided in Table 2.13. The total results from this analysis are provided in Table A11 of the Appendix.

Table 2.13: *County Data*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
		Alabama Counties			
1	Autauga	32.52	-86.58	8	No
3	Baldwin	30.59	-87.75	2	Yes
5	Barbour	31.86	-85.33	12	No
7	Bibb	33.04	-87.12	3	No
9	Blount	33.98	-86.55	6	No
11	Bullock	32.10	-85.70	12	No
13	Butler	31.74	-86.66	4	No
15	Calhoun	33.74	-85.82	9	No

A sample of counties from Alabama is provided in Table 2.13. As shown, each county is mapped to the nearest weather station. Also, each county is identified as a coastal or non-coastal county. In example, Baldwin County is mapped to weather station 2 and is identified as a coastal area. The identification of counties with coastal exposure provided an opportunity to identify bridges that may be exposed or in close proximity to salt water. Similar to the data from the weather data analyses, this mapping of data provided information that will allow investigation of the effect of one or more exposure conditions through study of similar groups of structures with opposite exposure conditions.

Sampling

Integration of the latent class cluster analysis results with any additional considerations, such as environmental exposure, will result in the identification of a sampling inventory. If all remaining program considerations (sample size, etc.) have been addressed, sampling may be completed in a random manner. This process will result in a sample that generally represents those bridges remaining in the sample inventory. This process must generally take place separately in each cluster to be included in the program. The process generally involves several steps including; (1) the assignment of a numbering scheme to the sampling inventory; (2) generation of random numbers; and (3) the relation of the random numbers to the sample inventory to identify the selected structures.

In order to achieve the proper representation within each cluster, the structures must be arranged in ascending order based on original age. Next, the population of structures must be stratified into segments of equal size representing groups of structures adjacent in the numbering scheme. Therefore, each segment will contain structures of similar age. This will help insure that equal representation throughout the cluster is achieved. The selection of number of strata may vary depending on the size of the population and the size of the sample required. In no case should the number of segments be larger than the sample size required.

Each of the structures remaining in each segment of population N may be assigned a number from 1 to N. Therefore, the newest bridge within a given segment will be assigned as Bridge #1 and the oldest bridge as Bridge #N. In combinations of considerable size, multiple structures will be of the same age. In this instance, all bridges of the same age will be sequentially numbered with no additional consideration given to the order of the structures. In example, if three bridge have the same age and are found the be the newest structures in the segment of interest, the corresponding assignments will be Bridge #1, Bridge #2, and Bridge #3.

Uniform random numbers can then be generated ranging from zero to one. The quantity of random numbers generated should equal the size of the sample required. Subsequent to the generation, each of the random numbers must be multiplied by the actual size of the segment, N, with the results rounded to the nearest whole number. Only bridges with identification numbers matching these random numbers will be selected for the program sample. This process is illustrated on a small example inventory in Table 2.14.

The example in Table 2.14 illustrates the random selection process for a sample of nine structures from an original population of 30 bridges. As shown, the bridges were listed in order from least to greatest age and stratified into 3 segments. Based on this configuration, 3 structures were to be chosen from each of the segments. Therefore, three uniform random numbers were generated for each segment and subsequently related to the size of the sample for each segment. The bridges were numbered sequentially one

Table 2.14: *Example Random Number Generation and Sample Selection*

Uniform Random No. (URN)	Extrapolation (URN * N)	Numbered Segment ---	Age (years)	
0.33175	3	Bridge #1	1	
		Bridge #2	3	
0.65215	7	Bridge #3	5	
		Bridge #4	6	
0.86362	9	Bridge #5	6	
		Bridge #6	8	Segment #1
		Bridge #7	12	
		Bridge #8	13	
		Bridge #9	15	
		Bridge #10	18	
0.18274	2	Bridge #1	19	
		Bridge #2	20	
0.63521	6	Bridge #3	20	
		Bridge #4	22	
0.98547	10	Bridge #5	24	
		Bridge #6	27	Segment #2
		Bridge #7	29	
		Bridge #8	29	
		Bridge #9	33	
		Bridge #10	37	
0.22481	2	Bridge #1	41	
		Bridge #2	43	
0.57823	6	Bridge #3	44	
		Bridge #4	46	
0.88341	9	Bridge #5	47	Segment #3
		Bridge #6	47	
		Bridge #7	49	
		Bridge #8	53	
		Bridge #9	57	
		Bridge #10	63	

thru ten in each segment and the bridges to be included in the sample are identified. As shown, the first random number of 0.33175 resulted in a rounded number of 3 for a ten structure segment. This resulted in bridge number 3 being chosen for the sample. As indicated in this example, bridge numbers seven and nine would also be chosen for the sample from segment 1. Similar procedure is followed for the remaining segments. Although this is a very simple example of the process, similar steps could be followed for inventories of any size.

Summary

Investigation and analysis of the bridge inventory was completed to identify the structure and material type combinations that would be of interest when studying long-term performance of highway bridges. Basic exploratory investigation was first performed to reduce the overall inventory to only those structures of interest. Several statistical modeling techniques were investigated for use in further stratification of the inventory to more precise groups of similar structures. Ultimately, latent class cluster analysis was chosen for this procedure. Thorough this analysis technique, groups of similar structures were identified that may aid in the selection of a representative group of structures to be studied. Also, several environmental parameters defining the likelihood of geographic related characteristics such as freeze-thaw events and coastal exposure were developed and related to the bridge inventory.

Subsequent to the selection of bridges to be inspected, criteria for inspection and condition assessment must be identified. Chapter III addresses the condition assessment criteria through proposing condition states that consider specific forms and magnitudes of deterioration. These condition states seek to improve assessment through increasing the amount of objective considerations and reducing the subjectivity of the process. The proposed condition states may be used in conjunction with the procedure developed in this chapter for an in-depth program, or used during routine inspection.

CHAPTER III

PROPOSED CONDITION STATES

Motivation

Current bridge inspection methods rely heavily on subjective assessment based on visual inspection and comparison with pre-defined condition states (Chajes et. al. 2000). These condition states, or definitions of bridge condition, are generally quite broad and do not provide a definitive identification of the current condition of the bridge and the type of deterioration that is present. Also, these condition states do not allow for utilization of the different types of quantitative information that may be obtained during inspection of a bridge structure. Therefore, this chapter, related to Research Objective 2, addresses the inadequacies of the current condition states through the development of the proposed, more quantitative and precise condition states aimed at more objective and comparable assessment of bridge condition.

Background Information

In regard to current condition states, at least one research study has identified the need for condition states to be quantifiable to provide a more accurate assessment of the structure at hand (Phares et. al. 2001). The need exists for inspectors to have the capability of identifying actual amounts of damage or change in damage from prior inspections or initial construction conditions. Also, current condition states do not provide opportunity for integration of quantitative data such as that obtained from testing and or monitoring of a structure. Improper identification of the condition rating of the bridge, or components thereof, has been associated with compromising public safety, inefficient allocation of public funds, and major difficulties with heavy truck traffic (Chajes et. al. 2000).

Several studies have noted that the current system of visual inspection relies on the inspector's subjective assessment of bridge condition at the time of inspection. Additionally, the reliability of inspectors choosing the correct condition state has been investigated through actual inspection and condition assessment of structures with known deterioration. This study revealed that routine inspections and condition assessments are completed with significant variability and that typically an average of four different condition ratings were given for the same component. This study also found that inspectors participating in the study successfully identified large widespread deficiencies such as corrosion or section loss on steel girders but rarely identified deficiencies that would typically call for more in-depth inspections such as fatigue cracks in steel girders. Inspectors also found difficulty locating and estimating areas of concrete bridge decks experiencing delamination (Graybeal et. al. 2001, Phares et. al. 2000, Phares et. al. 2001).

These studies have shown that the reliability of the condition ratings assigned during routine visual inspections, as well as the results from in-depth inspections, are not providing accurate assessments of current bridge condition and or deterioration and that the current condition state definitions do not provide adequate opportunity for inspectors to properly classify each of the bridge components. Proper identification and assessment of bridge deterioration is a major key to assuring bridge safety for the public that utilize them.

Non-destructive evaluation techniques (other than visual inspection) are being increasingly utilized in bridge inspection (Rolander et. al. 2001). Integration of these techniques supports more accurate identification and assessment of bridge deterioration. However, to improve the inspection process, the understanding of actual bridge condition, and the link between inspection results and planning or modeling, the condition states must be organized in a manner that accepts quantitative data.

An earlier study has investigated the use of condition states that integrated different or additional inspection and testing procedures as the elements transition from one condition state to the next (Hearn and Shim 1998). This study was primarily focused on the integration of non-destructive testing methods into bridge inspection, condition states, and bridge management systems. This was accomplished through the development of augmented condition states.

An additional study was interested in the inspection of highway bridges using segmental inspection, a technique breaks each component into several segments rather than evaluating the component as a whole (Hearn 1999). This study suggested that more information may be obtained about the deterioration patterns of a given bridge through this type of inspection, as well as relative and causative deterioration among groups of elements. This type of inspection may also provide more repeatable results, calculation of quantities, more accurate location of deterioration for future inspection and repair considerations, aid in selection of repair options, and the ability to track the effect of repairs through the remaining life of the bridge. In addition to these advantages, this type of inspection may allow better communication between administrative and field personnel responsible for inventory, assessment and repair of bridges.

Current Condition States

The most recent edition of the "Recording and Coding Guide" identifies two different sets of condition states for the individual characteristics of a typical bridge structure that may be of interest, a set of ratings for use in the appraisal of the entire bridge, and an additional set of ratings concerned with the vulnerability of the bridge due to scour (FHWA 1995). Generally, as is the case in Tennessee, bridge inspectors utilize these condition state definitions during the inspection and appraisal process as do many research studies concerned with bridge inspection, deterioration or modeling (Mauch and Madanat 2001, Dunker and Rabbat 1995, Chase and Gaspar 2000, Graybeal et. al. 2002, Phares et. al. 2001).

The most frequently utilized set of condition states is shown in Table 3.1. These condition states are utilized when assessing the deck, superstructure, and substructure of a typical bridge. As shown, these condition states identify, in general terms, the amount of degradation present thus providing an opportunity for the inspector to match the actual condition of the bridge to the condition state that is most similar.

These condition states provide the inspector the opportunity to classify each bridge component or characteristic based upon a short, non-quantitative definition. As previously discussed, these definitions are quite subjective and do not provide many distinct transition points between the different ratings. Also, when considering a component or characteristic of interest, the inspector must generalize the rating for the entire component. In example, a few specific portions of a bridge deck may be in very poor condition, while the rest of the deck is in satisfactory condition. In this instance, the inspector must combine, or average, these characteristics to obtain a single condition

Table 3.1: *Condition States for Deck, Superstructure, and Substructure*

Code	Description
N	Not Applicable
9	Excellent Condition
8	Very Good Condition – no problems noted
7	Good Condition – some minor problems
6	Satisfactory Condition – structural elements show some minor deterioration
5	Fair Condition – all primary structural elements are sound but may have minor section loss, cracking, spalling or scour
4	Poor Condition – *advanced* section loss, deterioration, spalling or scour
3	Serious Condition – loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	Critical Condition – advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
1	Imminent Failure Condition – major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put back in light service.
0	Failed Condition – out of service – beyond corrective action.

rating. Inspection results obtained utilizing these condition states provide little information that can be utilized in calculation of load capacities or identification of actual repair requirements.

Proposed Condition States

The proposed condition states were developed through augmentation of the existing condition states in Table 3.1 and are intended for use during visual bridge inspections. Augmentation accomplished two main goals including the integration of quantitative data into the rating procedure and the provision of definitive transition points between adjacent condition states. These condition states are typically compatible with segmental inspection and allow more objective comparison of inspection results completed by different personnel or from different structures. In conjunction with notes, sketches, and measurements taken during field inspection, the proposed condition states will help provide a more clear understanding of the actual condition of the structure and improved information to support repair planning and load capacity analysis.

The proposed condition states represent the typical types of deterioration found during routine visual inspection of highway bridges throughout the Tennessee bridge inventory. Development of the proposed condition states was limited to the Tennessee inventory due to the availability of reliable sources with in-depth knowledge of bridge inspection and deterioration. Additional condition states may be developed for bridge deterioration found in other inventories as experience and acceptable sources are available.

Augmentation was accomplished through study of inspection reports generated utilizing visual inspection and consultation with TDOT personnel responsible for bridge inspection and repair planning. Transition between adjacent condition states was defined based upon historical application throughout the Tennessee inventory. Specific quantitative transition points between states were chosen based on experience and the amount of deterioration thought to be representative of the current condition state definition. Therefore, these quantitative transition points do not represent an exact relationship between a type of deterioration and a quantified reduction in the structural capacity of the component in question.

Many of the proposed condition states rely upon measurements taken or estimated in the field during inspection. The transition pointes utilized by many of the condition states require quantitative measurement such as percent of deck area or superstructure component in question. Although these transitions are exact in nature in the proposed condition states, the actual measurement must typically be estimated by the inspection team. However, careful estimation and partitioning of the component of interest will provide results deemed accurate enough to be utilized with the proposed condition states. Several of the proposed condition states will not require estimations because assessment may be based upon true or false indications such as the presence of cracks or indication of efflorescence.

The proposed condition states are similar to currently used condition states in that the deck, superstructure, and substructure are all assessed independently such that a poor assessment of a particular component does not result in lower assessments for all components. In contrast to existing condition states, the augmented condition states include separate condition states for each different type of deterioration typically found during visual inspection of structures representing significant portions of the bridge inventory in Tennessee. Therefore, for a given combination of bridge component and material type, several different condition states were developed, each representing one of the major forms of deterioration typically present. During typical inspection, each portion of the structure will be assessed using the applicable set of proposed condition states, with the final assessment equal to the minimum rating identified for each particular component.

Bridge Decks

The distribution of deck types throughout the Tennessee bridge inventory is provided in Table 3.2, with approximately sixty percent of the inventory constructed utilizing concrete cast–in–place decks. Due to the frequency of use of this particular bridge deck type, proposed condition states were developed only for concrete cast-in-place decks.

Table 3.2: *Bridge Deck Types in Tennessee*

Deck Type	Count	% of Inventory
Concrete Cast - in – Place	11,670	60.24
Concrete Precast panels	1,798	9.28
Open Grating	15	0.08
Closed Grating	1	0.01
Steel Plate (includes orthotropic)	40	0.21
Corrugated Steel	303	1.56
Aluminum	7	0.04
Wood or Timber	732	3.78
Other	1,185	6.12
Not Applicable	3,621	18.69

Six major types of deterioration were identified as the typical reasons resulting in degradation of the deck and subsequent reduction in performance capacity. These included partial depth deterioration, full depth deterioration, scaling, structural cracks, non-structural cracks, and chloride contamination. New condition states were created for each identified type of deterioration. Typical assessment is based upon the percentage of deck area (entire deck or segment) deteriorated with assessment of chloride contamination based upon the maximum contamination identified throughout the entire deck or particular segment.

Partial Depth Deterioration

Partial depth deterioration reaches a maximum depth equal to the either layer of reinforcing steel when compared to the respective nearest face of the deck. This type of deterioration represents a structural concern due to loss of section and opportunity for additional deterioration to occur if not repaired. Delamination, spalling, and exposed reinforcing steel are indicative of partial depth deterioration. The mechanisms at work causing partial depth deterioration may include corrosion of reinforcing steel, overstress from traffic loading, and environmental loading such as frost action. Poor quality control during initial construction may also play a role in this form of deterioration. The proposed condition states for partial depth deterioration are shown in Table 3.3.

Table 3.3: *Proposed Deck Condition States for Partial Depth Deterioration*

Code	NBI Description	% Deck /Segment Area
N	Not Applicable	Not Applicable
9	Excellent	None Allowed
8	Very Good	None Allowed
7	Good	None Allowed
6	Satisfactory	< 5%
5	Fair	5% to 20 %
4	Poor	20% to 50%
3	Serious	> 50%
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Failed

Partial depth deterioration is not allowed in condition states 9 thru 7 and alone cannot reduce the assessment to ratings below 3. Condition states 6 thru 3 represent different levels of deterioration ranging from less than five percent to greater than fifty percent of deck area, respectively.

Full Depth Deterioration

Full depth deterioration is defined as deterioration of the deck that penetrates to a level extending beyond either layer of reinforcing steel resulting in deterioration of a majority of or the entire depth of the deck. The deterioration mechanisms for full depth deterioration are similar to that of partial depth deterioration only differing in the extent to which the deck is damaged. The proposed condition states are shown in Table 3.4.

Table 3.4: *Proposed Deck Condition States for Full Depth Deterioration*

Code	NBI Description	% Deck /Segment Area
N	Not Applicable	Not Applicable
9	Excellent	None Allowed
8	Very Good	None Allowed
7	Good	None Allowed
6	Satisfactory	None Allowed
5	Fair	< 15%
4	Poor	15% to 50%
3	Serious	50% to 75%
2	Critical	>75%
1	Imminent Failure	>75% in Critical Area
0	Failed	Failed

Due to the loss of capacity associated with full depth deterioration, condition states 9 thru 6 do not allow full depth deterioration. Condition states 5 thru 2 represent full depth deterioration from less than fifteen percent to greater than seventy five percent of deck area. Decks with greater than seventy five percent deterioration in critical areas such as maximum positive moment regions are assessed with condition state 1.

Scaling

Scaling generally deteriorates the top of a concrete bridge deck. This particular deterioration mechanism by itself is typically not a structural concern however it may provide an additional opportunity for other forms of deterioration to initiate or accelerate. Scaling may also result in decreased functionality of the deck through reduced ride quality. The proposed condition states developed for scaling of concrete bridge decks are provided in Table 3.5.

Table 3.5: *Proposed Deck Condition States for Scaling*

Code	NBI Description	% Deck /Segment Area
N	Not Applicable	Not Applicable
9	Excellent	No Scaling Allowed
8	Very Good	No Scaling Allowed
7	Good	< 2%
6	Satisfactory	2% to 25%
5	Fair	25% to 50%
4	Poor	> 50%
3	Serious	Not Applicable
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Not Applicable

Condition states 9 and 8 do not allow scaling, and due to the non-structural nature of this type of deterioration, scaling alone cannot reduce the assessment of the deck below a rating of 4. Condition states 7 thru 4 represent different levels of deterioration ranging from less than two percent to more than fifty percent of deck area affected, respectively, with states 6 and 5 representing intermediate levels of deterioration.

Structural Cracks

Tension and shear cracks in concrete bridge decks are typically considered structural cracks. Shear cracks are typically found near points of support and typically run diagonally across the section affected, whereas tensile cracks are typically found in areas of maximum flexure such as locations where maximum positive and negative moment occur. These cracks are typically caused by dead and live loads, and in extreme cases, are a result of restricted thermal movement. During deck inspection, cracks with a width of one sixteenth of an inch or greater are considered structural in nature. Cracks may be evident due to corrosion stains and efflorescence.

When inspecting for cracks, either structural or non-structural, use of segmental inspection may be advantageous due to the possible difficulty in identifying percentages of deck deteriorated due to cracking. The deck may be broken into segments and each segment rated based purely on the existence of cracks. Results from all of the segments can be combined to gain an overall picture of the entire deck. Selection of the appropriate segment size and layout are important as is the use of the same combination during future inspections to facilitate an improved understanding of the change in deterioration from one inspection or repair to the next. The proposed condition states for structural cracks are shown in Table 3.6. Due to the serious nature of this type of deterioration, structural cracks cannot be present in condition states above 5. Ratings of 5, 4, and 3 indicate less than five percent, five to fifty percent, and more than fifty percent of the deck deteriorated by structural cracks. Condition states below 3 are not utilized.

Table 3.6: *Proposed Deck Condition States for Structural Cracks*

Code	NBI Description	% Deck /Segment Area
N	Not Applicable	Not Applicable
9	Excellent	None Allowed
8	Very Good	None Allowed
7	Good	None Allowed
6	Satisfactory	None Allowed
5	Fair	< 5%
4	Poor	5% to 50%
3	Serious	> 50%
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Failed

Non-Structural Cracks

Non-structural cracks are typically initiated by stresses due to temperature and shrinkage. These cracks are fairly common in reinforced concrete bridge decks, and alone do not represent a great risk to the structure. However, similar to structural cracks, these cracks may allow the intrusion of elements such as water and or chloride that can initiate and accelerate deterioration. Non-structural cracks are typically identified through visual inspection and may be present on the top or bottom surface of the bridge deck. Map cracking is one example of non-structural cracking. The proposed condition states for non-structural cracks are provided in Table 3.7.

Condition states 8 and above do not allow non-structural cracks and due to the non-structural nature of these cracks, states 4 and below are not utilized. Decks are assessed condition states 7, 6, and 5 when non-structural cracks are present ranging from less than ten percent, ten to fifty percent, and greater than fifty percent of deck area.

Table 3.7: *Proposed Deck Condition States for Non-Structural Cracks*

Code	NBI Description	% Deck /Segment Area
N	Not Applicable	Not Applicable
9	Excellent	None Allowed
8	Very Good	None Allowed
7	Good	<10%
6	Satisfactory	10% to 50%
5	Fair	> 50%
4	Poor	Not Applicable
3	Serious	Not Applicable
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Failed

Chloride Contamination

Chloride contamination has been identified as a major factor in concrete bridge deck deterioration. The presence of chlorides in the bridge deck does not represent deterioration or damage, but does indicate that favorable conditions exist for deterioration to begin. Regardless of the source, a threshold contamination level of one to two pounds of chloride per cubic yard of concrete has been linked to the initiation of corrosion.

Typical bridge inspection in Tennessee requires a bridge deck survey that includes the identification of the chloride concentration present at a depth equal to the top layer of reinforcing steel. The condition states proposed for this predictor of deterioration are shown in Table 3.8, which identifies a transition from a rating of 5 to 4 as the chloride level reaches two pounds per cubic yard. This rating will generally support (will not increase or decrease) other ratings identified during an inspection unless the chloride level is found to be above the threshold level with all other ratings remaining at 6 or above. In this instance the chloride level would reduce the overall rating to a 5. Otherwise, the final assessment of the structure will be the minimum of the other five condition states.

Table 3.8: *Proposed Deck Condition States for Chloride Contamination*

Code	NBI Description	Entire Deck
N	Not Applicable	Not Applicable
9	Excellent	< 2lbs/cubic yard
8	Very Good	< 2lbs/ cubic yard
7	Good	< 2lbs/ cubic yard
6	Satisfactory	< 2lbs/ cubic yard
5	Fair	> 2lbs/ cubic yard
4	Poor	> 2lbs/ cubic yard
3	Serious	> 2lbs/ cubic yard
2	Critical	> 2lbs/ cubic yard
1	Imminent Failure	> 2lbs/ cubic yard
0	Failed	Failed

Superstructures

Similar to decks, the material type of the superstructure was focused upon for the development of augmented condition states due to the correlation of deterioration and material type. The distribution of superstructures by material type throughout the Tennessee bridge inventory is shown in Table 3.9.

Table 3.9 indicates that approximately ninety eight percent of the Tennessee inventory is represented by superstructures of concrete, steel, or prestressed concrete, either in simple or continuous spans. Section loss was found to be a common form of deterioration for each of the three material types. Reduction in assessment of steel superstructures was also due to surface corrosion and fatigue cracks, concrete superstructures were found susceptible to shear and tensile cracks, and prestressed concrete superstructures were found to have shear cracks and exposed tendons.

Table 3.9: *Superstructures by Material Type in Tennessee*

Material Type	Count	%
Concrete	3594	18.55
Concrete Continuous	8224	42.45
Steel	2028	10.47
Steel Continuous	944	4.87
Prestressed Concrete	1979	10.22
Prestressed Concrete Continuous	2161	11.16
Wood or Timber	417	2.15
Masonry	13	0.07
Aluminum, Wrought Iron, or Cast Iron	3	0.02
Other	9	0.05

Surface Corrosion – Steel Superstructures

Surface corrosion of steel superstructures represents initial corrosion that deteriorates only the surface of the structural member and may penetrate any protective coating such as paint. This type of deterioration may not present as an immediate structural concern but does indicate the initiation of the corrosion process that can cause significant damage and reduction in structural capacity. Similar to several of the condition states for decks, segmental inspection may be of use when inspecting superstructures, and involve separating main and secondary members and dividing main members into multiple segments. The condition states proposed for surface corrosion of steel superstructures are provided in Table 3.10.

Table 3.10: *Proposed Steel Superstructure Condition States for Surface Corrosion*

Code	NBI Description	% of Structure/Segment
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	Weathering/No Corrosion
6	Satisfactory	Less than 5% with corrosion
5	Fair	5% to 50% with corrosion
4	Poor	> 50% with corrosion
3	Serious	Not Applicable
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Not Applicable

Condition states 9 and 8 do not allow surface corrosion, and states 3 and below are not used. Condition state 7 represents structures where weathering or fading of the protective system is apparent but corrosion is not visible. Condition states 6 thru 4 represent structures with increasing amounts of surface corrosion ranging from less than five percent to greater than fifty percent of the superstructure surface area, respectively.

Section Loss – Steel Superstructures

Section loss in steel superstructures typically represents progressive deterioration that initiates in surface corrosion. Section loss is defined as the percentage reduction, in thickness of material, as compared to initial construction. The numeric value reported for section loss represents the worst location identified on the given superstructure or segment thereof. In contrast to surface corrosion, section loss is a structural concern due to the gradual loss of structural capacity. Harsh environmental conditions and exposure to de-icing salts may initiate or accelerate section loss. When assessing a steel superstructure for section loss, the location of section loss is also of importance. The proposed condition states for section loss of steel superstructures are provided in Table 3.11.

Section loss identified through visual inspection is not allowed in condition states 9 thru 6, with up to two percent section loss allowed in condition state 5. Condition states 4 and 3 allow progressively larger amounts of section loss to maximums of forty and eighty percent, respectively. Condition state 2 allows from eighty to one hundred percent section loss in non-critical areas. Finally, condition state 1 is assessed when one hundred percent section loss is found in a critical area, such as a bearing point or location of maximum stress or moment, or when visible distortion of the member is evident.

Table 3.11: *Proposed Steel Superstructure Condition States for Section Loss*

Code	NBI Description	% of Entire Structure/Segment
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	up to 10%
4	Poor	10% to 40%
3	Serious	40% to 80 %
2	Critical	80% to 100% non critical areas
1	Imminent Failure	100% critical area or distortion
0	Failed	Not Applicable

Fatigue Cracks – Steel Superstructures

Fatigue cracks in steel superstructures have been indicated as an important deterioration and failure mechanism. Structures susceptible to catastrophic failure due to fracture of a single member are defined as fracture critical. Condition states were developed for three different cases when fatigue cracks are of interest. These include superstructures that are non-fracture critical, secondary members such as cross members, and fracture critical superstructures. The proposed condition states for fatigue cracks were developed to identify the presence, magnitude, and location of cracking and to indicate that immediate additional inspection and repair may be needed. The relative risk of fatigue cracks, regardless of the member or structure type, results in low assessments when any cracks are found.

Non-fracture critical steel superstructures are typically those with three or more longitudinal girders. Fatigue cracks on this type of structure are important to note, monitor, and repair, but are not as significant as cracks found on a fracture critical structure. The proposed condition states for this type of deterioration are shown in Table 3.12.

As shown in Table 3.12, identification of any fatigue cracking reduces the assessment of a structure to a condition state 3, with growth of cracks or direction change from a previous inspection reducing the rating to condition state 2. Finally, if a fatigue crack is identified in or reaching the flange of a girder, which is typically indicative of a higher risk of failure, the assessment drops to a condition state 1.

Table 3.12: *Proposed Steel Superstructure Condition States for Fatigue Cracks in Non-Fracture Critical Structures*

Code	NBI Description	Fatigue Cracks
N	Not Applicable	Not Applicable
9	Excellent	No fatigue cracks
8	Very Good	No fatigue cracks
7	Good	No fatigue cracks
6	Satisfactory	No fatigue cracks
5	Fair	No fatigue cracks
4	Poor	No fatigue cracks
3	Serious	Any cracks detected
2	Critical	Growth of cracks and or direction change
1	Imminent Failure	Cracks in or reach flange
0	Failed	Not Applicable

Secondary members of steel superstructures are typically those other than the longitudinal girders such as diaphragm and cross members. Cracks in these types of members are important, but not an immediate concern because significant failure of the structure is not probable when a secondary member fails alone. The condition states developed for fatigue cracks in secondary members are provided in Table 3.13.

Table 3.13: *Proposed Steel Superstructure Condition States for Fatigue Cracks in Secondary Members*

Code	NBI Description	Fatigue Cracks
N	Not Applicable	Not Applicable
9	Excellent	No fatigue cracks
8	Very Good	No fatigue cracks
7	Good	No fatigue cracks
6	Satisfactory	No fatigue cracks
5	Fair	Any Cracks
4	Poor	Growth of Crack Toward Primary Member
3	Serious	Crack Reaches Primary Member
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Not Applicable

Cracking in secondary members is not allowed in states 9 thru 6 and alone cannot reduce a structure's assessment to a rating of 2 or 1. Condition state 5 is used for assessment when any cracks are found and condition state 4 is assessed when crack growth toward a primary member is evident. Due to the risk of a crack continuing from one member to another, condition state 3 is assessed when a secondary member crack reaches a primary member.

Fatigue cracks in fracture critical structures represent a significant failure possibility when compared to their non-fracture critical counterparts. Any indication of cracking in this type of structure is of serious concern and drastically reduces the assessment of the structure. The proposed condition ratings are provided in Table 3.14. Conditions states 9 thru 3 do not allow cracks. Any horizontal cracks reduce the assessment to a rating of 2 and horizontal cracks that turn vertical or any vertical cracks reduce the assessment to a rating of 1.

Table 3.14: *Proposed Steel Superstructure Condition States for Fatigue Cracks in Fracture Critical Structures*

Code	NBI Description	Fatigue Cracks
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	None
4	Poor	None
3	Serious	None
2	Critical	Horizontal Cracks
1	Imminent Failure	Horizontal Cracks turn Vertical/Vertical Cracks
0	Failed	Not Applicable

Section Loss – Concrete Superstructures

Section loss of concrete superstructures is defined as the loss of concrete typically to a depth equal to the outermost layer of reinforcing steel. Similar to partial and full depth deterioration of concrete bridge decks, this type of deterioration may be indicative of several underlying forms of deterioration including overstress, frost action, and corrosion of reinforcing steel. In addition to the deterioration evident through inspection, this type of deterioration provides an opportunity for deterioration to accelerate or begin. The condition states developed for section loss in concrete superstructures are provided in Table 3.15.

Condition states 9 thru 6 do not allow section loss and a structure cannot be assessed a condition state 1 due solely to section loss. Condition states 5 thru 2 allow increasing amounts of section loss from less than ten to greater than thirty percent, respectively. The considerable reduction in assessment due to larger percentages of section loss is due to the loss of structural capacity, magnitude of failure possible, and possible additional deterioration when considering superstructure components.

Table 3.15: *Proposed Concrete Superstructure Condition States for Section Loss*

Code	NBI Description	% of Entire Structure/Segment
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	Up to 10% with section loss
4	Poor	10% to 20% with section loss
3	Serious	20% to 30% with section loss
2	Critical	30% or more with section loss
1	Imminent Failure	Not Applicable
0	Failed	Not Applicable

Flexure and Shear Cracks – Concrete Superstructures

Flexure and shear cracks on concrete superstructures are similar to those found on concrete bridge decks. These types of cracks do not necessarily represent an immediate structural concern, but do indicate deterioration substantial enough to reduce the assessment of a structure into lower condition ratings. These cracks may be a result of dead and live load, but may also be a result of restricted movement. The condition states developed for this type of deterioration are provided in Table 3.16. The assessment of these types of cracks in concrete members relies upon identification of cracks/efflorescence only, and not quantitative measurement due to the difficulty in measuring cracks. The existence of cracks is represents enough information to reduce the assessment and possible require further investigation to identify causes of the cracks.

Table 3.16: *Proposed Concrete Superstructure Condition States for Flexure and Shear Cracks*

Code	NBI Description	Entire Structure/Segment
N	Not Applicable	Not applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	Any shear or flexure cracks
4	Poor	Cracks with efflorescence/corrosion staining
3	Serious	Not applicable
2	Critical	Not applicable
1	Imminent Failure	Not applicable
0	Failed	Not applicable

Condition states 9 thru 6 do not allow structural cracking and condition state 5 is utilized for assessment for structures with any evidence of flexure or shear cracks. Assessments of superstructures are reduced to condition state 4 if cracking is present with evidence of efflorescence or corrosion staining due to the additional deterioration that has taken place. Condition states 3 and below are not utilized.

Section Loss - Prestressed Concrete Superstructures

Section loss of prestressed concrete is a result of deterioration due generally to delamination and spalling resulting from corrosion of reinforcing steel and overstress. This form of deterioration may be more serious on prestressed structures due to the failure mechanisms associated with pre-stressing tendons, especially when exposed to harsh environmental conditions, deicing salts, and chemicals. The proposed condition states developed for this form of deterioration are provided in Table 3.17.

Condition states 9 thru 7 do not allow section loss, condition states 6 thru 2 allow increasing amounts of deterioration ranging from less than two percent to greater than 30 percent of the superstructure affected by section loss, and condition state 1 is not utilized.

Table 3.17: *Proposed Prestressed Concrete Superstructure Condition States for Section Loss*

Code	NBI Description	% of Structure/Segment
N	Not Applicable	Not Applicable
9	Excellent	None Allowed
8	Very Good	None Allowed
7	Good	None Allowed
6	Satisfactory	< 2%
5	Fair	2% to 10%
4	Poor	10% to 20%
3	Serious	20% to 30%
2	Critical	>30%
1	Imminent Failure	Not Applicable
0	Failed	Out of service

Exposed Tendons – Prestressed Concrete Superstructures

Tendons may become exposed due to several different mechanisms, particularly from impact damage. Exposed tendons on prestressed concrete superstructures represent a considerable risk to a bridge structure due to the loss of structural capacity, environmental exposure, and reduced protection from additional impact damage. The proposed condition states for tendon exposure are provided in Table 3.18.

Table 3.18: *Proposed Prestressed Concrete Superstructure Condition States for Tendon Exposure*

Code	NBI Description	Prestresssing Tendons
N	Not Applicable	Not Applicable
9	Excellent	No Tendons Visible
8	Very Good	No Tendons Visible
7	Good	No Tendons Visible
6	Satisfactory	No Tendons Visible
5	Fair	No Tendons Visible
4	Poor	Tendons Visible
3	Serious	< 10% Exposed
2	Critical	< 25% Exposed/<10% Severed
1	Imminent Failure	>25% Exposed/>10% Severed
0	Failed	Out of service

Any visible tendons reduces the assessment of the superstructure to a condition state 4 and condition state 3 allows up to ten percent of tendons to be exposed. Condition state 2 allows up to twenty five percent of the tendons to be exposed and up to ten percent of the tendons to be severed. Finally, condition state 1 allows more than twenty five percent of tendons to be exposed and more than ten percent to be severed.

Shear Cracks – Prestressed Concrete Superstructures

Shear cracks represent the majority of cracks found on prestressed superstructures within the Tennessee bridge inventory. These cracks typically present near supports where shear is greatest. The condition states proposed for shear cracks in prestressed superstructures are provided in Table 3.19.

Table 3.19: *Proposed Prestressed Concrete Superstructure Condition States for Shear Cracks*

Code	NBI Description	Entire Structure/Segment
N	Not Applicable	Not Applicable
9	Excellent	None Allowed
8	Very Good	None Allowed
7	Good	None Allowed
6	Satisfactory	None Allowed
5	Fair	Any Cracks
4	Poor	Wider than Hairline or Top to Bottom
3	Serious	Growth compared to previous inspection
2	Critical	Any Slippage
1	Imminent Failure	Not Applicable
0	Failed	Out of service

Condition states 9 thru 6 do not allow shear cracks and structures with any shear cracks are assessed with condition state 5. Condition state 4 is utilized when shear cracks run from top to bottom of the superstructure component or when the width of the crack is considered greater than hairline. Crack growth when compared to previous inspection results reduces the rating of a structure to a condition state 3. Due to the reduction in structural integrity associated with the movement of shear cracks, any slippage of a shear crack places a structure in condition state 2, and condition state 1 is not utilized.

Substructures

Several different types of substructures have been utilized in bridge construction in Tennessee including columns, bents, and piers typically constructed of reinforced concrete. These substructures are typically supported by foundations including spread footings founded on solid rock, concrete piles, and steel piles. Types of deterioration typically noticed are section loss of substructure components and changes in exposure due to dynamic sub-grade conditions. New condition ratings were created for pile, substructure, and spread footing exposure, change in cross section of streambed, and section loss of substructure, steel piles, and concrete piles.

Substructure/Pile Exposure

Substructure and pile exposure refers to the distance from a reference point to the point at which a pile, group of piles, or other substructure components become exposed or are above ground level. This rating identifies changes in the amount of pile/substructure embedment, generally due to scour, and is to be compared to a similar measurement recorded immediately following construction. The proposed condition state is provided in Table 3.20. Ratings 6 and above are utilized when exposure does not increase by more than one foot or one percent from original measurements and a substructure transitions to a rating of 5 if such a change occurs. This rating is intended to identify the need for an in-depth inspection to determine the stability of the structure and causes for change. Condition states 4 and below are not utilized.

Table 3.20: *Proposed Substructure Condition States for Substructure/Pile Exposure*

Code	NBI Description	Entire Substructure/Segment
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	greater than 1’ or 5%
4	Poor	Not Applicable
3	Serious	Not Applicable
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Out of service

Change in Cross Section

Change in cross section refers to changes that are identified in the cross section through the water way beneath a structure. Typical types of changes include lateral movement and increases in the depth of the channel, typically referred to as shifts and deepening, respectively. The proposed rating is provided in Table 3.21 and provides for general identification of changes in the cross section. This is typically utilized to identify locations where scour may be active and is typically compared to an original cross section recorded during construction. Ratings 5 thru 3 are utilized to identify different magnitudes of changes in the cross section while rating 6 and above are utilized for structures with negligible change in cross section and ratings 2 and below are not used.

Table 3.21: *Proposed Substructure Condition States for Change in Cross Section*

Code	NBI Description	Entire Cross Section
N	Not Applicable	Not Applicable
9	Excellent	No Change
8	Very Good	No Change
7	Good	No Change
6	Satisfactory	No Change
5	Fair	up to 12” change (shift or deepening)
4	Poor	from 12” to 24” change (shift or deepening)
3	Serious	greater than 24” change (shift or deepening)
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Out of service

Spread Footing Exposure

Spread footing exposure refers to the portion of the footing that is exposed, or not beneath cover any longer, and is intended to identify changes in the conditions surrounding each particular foundation. The proposed condition ratings are provided in Table 3.22. As indicated, spread footings that are not exposed, or are covered are rated at states 6 or above and those that are completely exposed are rated at condition state 3 due to the likelihood of scouring conditions. Intermediate levels of exposure are indicated by states 5 and 4. A substructure cannot be rated below 3 solely for spread footing exposure.

Concrete Section Loss

Section loss of concrete substructures generally refers to delamination and spalling of concrete columns, piers, and bents. The proposed condition states are shown

Table 3.22: *Proposed Substructure Condition States for Spread Footing Exposure*

Code	NBI Description	Entire Foundation /Segment
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	Top of Footing Exposed
4	Poor	Exposure between Top and Bottom of Footing
3	Serious	Bottom of Footing Exposed
2	Critical	Not Applicable
1	Imminent Failure	Not Applicable
0	Failed	Out of service

in Table 3.23, where ratings are based on the percentage of the substructure component experiencing section loss. Ratings 7 and above do not allow section loss and rating 6 provides transition allowing evidence of corrosion and efflorescence without section loss. Components experiencing increasing amounts of section loss or spalling to a depth equal to the first layer of reinforcing steel are assessed with ratings 5 thru 2, and ratings below 2 are not utilized.

Steel Pile Section Loss

Section loss of steel piles is a form of deterioration that cannot be verified on every structure due to the exposure conditions present. However, on structures where steel piles are exposed, the section loss present should be determined. Similar to steel superstructures, steel pile section loss refers to the percentage material lost compared to initial conditions and is measured as the worst condition found on a particular

Table 3.23: *Proposed Substructure Condition States for Concrete Section Loss*

Code	NBI Description	Entire Substructure/Segment
N	Not Applicable	Not applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	Staining from reinforcing corrosion of efflorescence
5	Fair	Any delamination or spalling back to reinforcing
4	Poor	Up to 25% with spalling/delamination back to reinforcing
3	Serious	More than 25%/less than 50% with spalling/delamination to reinforcing
2	Critical	greater than 50% with spalling/delamination back to reinforcing
1	Imminent Failure	Not Applicable
0	Failed	Not applicable

component. The major contributor to section loss of steel piles is corrosion. The proposed condition state for this form of deterioration is provided in Table 3.24. Ratings above 5 do not allow section loss with ratings 5 and below allowing increasing amounts of deterioration. Condition state 2 is utilized when 80 to 100 percent section loss is found on a single pile, and condition state 1 is utilized when this same condition holds true on multiple piles or any distortion is evident.

Concrete Pile Section Loss

Similar to deterioration found with steel piles, section loss of concrete piles is only verified when exposure conditions allow. Section loss of concrete piles refers to the percentage of section removed due to mechanisms such as corrosion and scour. The proposed condition states for section loss of concrete piles are provided in Table 3.25.

Table 3.24: *Proposed Substructure Condition States for Steel Pile Section Loss*

Code	NBI Description	Spalling/Section Loss
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	Up to 10%
4	Poor	10% to 40%
3	Serious	40% to 80%
2	Critical	80% to 100% (single pile only)
1	Imminent Failure	80 to 100% (multiple piles) or distortion
0	Failed	Not Applicable

Table 3.25: *Proposed Substructure Condition States for Concrete Pile Section Loss*

Code	NBI Description	Spalling/Section Loss
N	Not Applicable	Not Applicable
9	Excellent	None
8	Very Good	None
7	Good	None
6	Satisfactory	None
5	Fair	Any Noticeable Section Loss
4	Poor	Up to 25%
3	Serious	25% to 50%
2	Critical	Greater than 50% (single pile only)
1	Imminent Failure	Greater than 50% (multiple piles) distortion
0	Failed	Not Applicable

As indicated, section loss is not allowed in ratings 9 thru 6, and condition state 5 is utilized when any section loss is noted. Condition states 4 and 3 allow up to twenty five and fifty percent section loss, respectively. Condition states 2 is assessed when section loss exceeding fifty percent is identified on a single pile, and condition state 1 is used in cases where multiple piles have experienced section loss of greater than fifty percent or if any distortion or slippage has occurred.

Summary

Condition states were proposed in this chapter for each major type of deterioration mechanism found to reduce condition ratings for bridges visually inspected throughout the Tennessee bridge inventory. The proposed condition states are specific to the particular component and material type and type deterioration in question. For a given structure and material combination, each condition state will be assessed, with the overall assessment equal to the lowest single assessments. The proposed condition states allow the integration of quantitative data into the inspection process and the use of segmental inspection. The proposed condition states were developed to improve repair planning, monitoring of specific conditions or repairs, and communication of actual field conditions between field and administrative personnel.

Chapter IV discusses the major deterioration mechanisms that result in the damage assessed through the proposed condition states developed in this chapter. Major deterioration mechanisms are identified for each material type. The combination of the information presented in Chapters III and IV may improve the inspection team's fundamental understanding of bridge deterioration, and ultimately improve the quality of bridge inspection and assessment.

CHAPTER IV

DETERIORATION MECHANISMS

Introduction

Deterioration mechanisms that reduce the service lives of highway bridges vary considerably ranging from decay of timber to corrosion of steel. This chapter, related to Research Objective 3, seeks to identify these major deterioration mechanisms. Typically each mechanism is associated with particular material types, with the exception of foundation scour, and have therefore been identified in a similar manner. These deterioration mechanisms are those that might be of interest in and in-depth program, such as the LTBP, that may be developed through use of the procedures illustrated in Chapter II. Also, these mechanisms may typically result in the deterioration that may be assessed through use of the proposed condition states in Chapter III. In this chapter, deterioration mechanisms are identified for the major material types prevalent throughout the bridge inventory including wood or timber, steel, and concrete.

Wood or Timber

Bridges constructed with timber or wood superstructures represent between five and six percent of the bridge inventory. Fungal decay, insect attack, and marine borer attack have been identified as the primary deterioration mechanisms resulting in timber bridge repair and replacement (Tuor et. al. 1995, Ryall 2001).

Microscopically, typical timber is composed of three main constituents including cellulose, hemi-cellulose, and lignin, as well as a wide range of extraneous materials (Desch 1968, Rayner and Boddy 1988). Cellulose acts as the fiber in timber and lignin behaves as cement binding the fibers together providing strength and flexibility. Lignin generally constitutes up to one-third the volume of a particular wood, with the remaining volume consisting of cellulose or hemi-cellulose.

Within a given sample of timber, two distinctly different types of wood exist including sapwood and heartwood. Sapwood is the outer layer of the tree participating in growth and generally contains higher moisture contents and is typically less durable compared to more mature heartwood or wood coming from the center of the tree. Sapwood and heartwood generally achieve similar strength and composition properties (Desch 1968). Some timbers contain natural extractives of an oily or solid nature that are toxic and thus render the wood unsuitable for insect or fungi growth. These toxic extractives provide a natural resistance to deterioration resulting in certain species of timber being considered naturally durable (Rayner and Boddy 1988, Desch 1968).

Historically, many species of timber have been used for bridge construction including western red cedar, larch, various species of pine, and red and white oak. More recently, bridges have been constructed of Douglas fir or southern pine due to their availability. Use of heartwood has declined in recent years, with increasing amounts of timber coming from small second growth trees containing increasing amounts of less durable sapwood (Desch 1968).

Fungal Decay

The leading cause of timber bridge replacement is deterioration, or decay, due to growth of fungi. Decay is a natural process caused when fungi feed on timber members (Ryall 2001). Most fungi that decay timber bridge structures result from mushroom or conk seeds. These seeds reach structures by several means of dispersal including air currents, water, animals, and insects (Goodell et. al. 2003, Rayner and Boddy 1988).

Fungal decomposition has historically been grouped by the characteristics of the wood during degradation. However, decay generally becomes visible after damage has already occurred. Relatively few of the over one million types of fungi have the capability to degrade wood (Goodell et. al. 2003, Desch 1968). The two basic groups of decay that have been found to deteriorate timber bridge structures are white and brown rot, which represent two fundamentally different biochemical processes (Tuor et. al. 1995, Rayner and Boddy 1988). Regardless of decay type, percentage of weight loss is the most common rate of decay index. However, information such as initial weight and volume may be difficult to obtain accurately and the amount of decay is typically underestimated (Rayner and Boddy 1988).

White rot typically decays wood leaving it bleached, stringy, spongy, and more fragile as the wood deteriorates. Naturally occurring white rot is more prone to occur in areas where ambient temperatures are cooler. White rots involve degradation of all the major structural and chemical components or the wood, including cellulose and lignin. The white color results from the fast decay of the lignin that exposes the slower decaying white cellulose (Goodell et. al. 2003, Rayner and Boddy 1988). Although more forms of white rot exist when compared to brown rot, white rots represent a minor portion of decay found on timber bridges due to their attraction to deciduous timber that is infrequently utilized in construction of highway bridge superstructures.

Brown rot feeds mainly on the carbohydrate components, or cellulose, leaving the lignin as a framework. Brown rot is naturally more active in warmer climates. Brown rots usually result in brown discoloration of the wood, accompanied at late stages by cubical cracking and acquisition of a friable consistency (Rayner and Boddy 1988, Desch 1968). Although brown rot represents only a small portion of the numerous forms of wood decay, it represents a major portion of the decay on timber bridges due to its natural selection of conifers such as southern pine. Brown rot is typically associated with rapid strength loss. Loss of mass may lag behind loss of strength at the early stages of decay, possibly resulting in up to a 70 percent loss in modulus of elasticity before decay becomes readily visible (Goodell et. al. 2003).

Four conditions are required to support growth of fungi causing white and brown rot including food supply, adequate moisture, suitable temperature, and oxygen supply. Timber bridges typically provide the required food source, and oxygen is also typically available unless the timber utilized is submerged in water or saturated soil (Desch 1968).

Fungi need at least twenty percent moisture to infect, grow, and remain active in timber (Desch 1968). At moisture levels of twenty percent or more, fungi grow, but prosper at higher levels with optimal growth occurring between forty and sixty percent. Snow, rain, and other exposure conditions are the primary sources of moisture naturally available. Maintenance of suitable moisture content occurs in typical areas of timber bridges. These areas are particularly susceptible to fungal decay and include splices, members in contact with the ground, and areas where water and debris can accumulate such as expansion joints and bottom chord members of truss bridges. Additionally, natural defects in wood including shakes or splits provide opportunistic moisture storage that may support growth of fungi (Ryall 2001).

Fungi grow in temperatures between thirty-two and ninety degrees Fahrenheit, with optimal growing temperatures ranging from sixty-five to eighty degrees Fahrenheit (Desch 1968). Fungi remain dormant in temperatures below freezing, and are quite inactive below forty and above ninety degrees Fahrenheit. Fungi typically do not survive in temperatures above one hundred and twenty degrees Fahrenheit, such as those reached during a kiln drying process.

Insect and Marine Borer Attack

Insects and marine borers are the second largest contributor to timber bridge deterioration. Insects include carpenter ants, caddis flies, and powder post or lyctus beetles and marine borers include mollusk and crustacean borers. Although well known for destruction of wood, termites have not been recognized as a serious problem in timber bridges (FHWA 2000).

Typical deterioration resulting from insects is often referred to as worm. Insects tunnel in timber and reduce the strength properties of the member (Desch 1968). In some circumstances, insects create networks of tunnels rendering the timber member useless. Evidence of this type of deterioration includes holes on the surface of the wood member above ground or water level (Ryall 2001, Desch 1968).

Carpenter ants are large black ants that destroy soft or already decayed wood for shelter, but do not utilize wood as a food source. Typically, deterioration due to carpenter ants can be identified by the presence of piles of sawdust at the base of the member in question. Similarly, powder post or lyctus beetles hollow out the inside of timber members but also use wood as a source of food, leaving the surface of the timber with small holes. Caddis flies are insects found in fresh and sometimes brackish water. These flies typically attack piles located in water and are particularly attracted to timber that is weakened due to previous deterioration. Typically, these organisms utilize timber for shelter only (FHWA 2000).

Marine borers are found in salt and brackish water only. These borers can cause severe damage to timber members in the area between high and low water levels. In some instances, these organisms have completely consumed piles in just a few months. The two main forms of marine borers are mollusk borers, commonly referred to as shipworms, and crustacean borers that are commonly referred to as gribbles (FHWA 2000).

Shipworms are the most serious enemy of marine timber installations. These organisms enter through the surface of the wood and deteriorate the timber through mechanical excavation and ingestion (FHWA 2000). Shipworms attack timber members for shelter and utilize the wood as a primary food source (Rayner and Boddy 1988, Lopez-Anito et. al. 2004). These organisms occur in all oceans, but most generally in shallow waters from tropical to temperate climates and can withstand broad fluctuations in temperature, salinity, and oxygen. Shipworms can survive out of water for several hours such as seen with tidal activity. Typically, ship worms maintain only a small hole in the exterior surface of the timber to obtain nourishment from seawater, resulting in a difficult deterioration to identify during visual inspection (Rayner and Boddy 1988, FHWA 2000).

Gribbles can cause major economic damage and severe reduction in the service life of timber structures. These marine borers attack timber structures in costal regions through shallow burrows and use the wood for both food and shelter (Rayner and Boddy 1988). The timber remaining over the shallow burrows is removed or scoured away due to tidal or wave activity, resulting in a thinning of the timber thus forcing the gribble to bore deeper. Typically, damage is greater in the tidal zone. Deterioration due to gribbles is progressive in nature, and easily detected through visual inspection due to an hourglass shaped burrow (Lopez-Anito et. al. 2004, FHWA 2000).

Inspection of Timber Bridges

Common forms of damage found during inspection of timber bridges includes that from fungi, insects, weathering, crushing, and natural defects such as checks or splits. Both visual and physical techniques are utilized during the inspection process. Deterioration identified through visual inspection may include crushing, fungal decay, and natural defects (FHWA 2000).

Physical inspection techniques may include testing of material for moisture content, probing, and ultrasonic testing. These typically may be utilized to identify conditions suitable for presence and growth of fungi and to determine loss of mass in deteriorated wood. Typical locations of interest include areas of high shear and tension, bearing points, connections, areas of insect infestation, and areas subject to some form of drainage (FHWA 2000).

Steel

Bridges with superstructures constructed of steel, using either simple or continuous spans, represent approximately one-third of the entire national bridge inventory. Major causes of steel bridge deterioration include corrosion and fatigue cracking (Ramey 1997). In particular, fatigue cracking represents such a substantial risk of catastrophic failure that special inspections are performed on fracture critical structures to identify serious deterioration before problems arise (Lovejoy 2003).

Corrosion

Corrosion is the most common and recognizable form of deterioration affecting steel bridge members (Ryall 2001). Historically, steel bridges considered structurally deficient have primarily been deteriorated due to corrosion. Generally, corrosion of steel bridge members results in section loss and reduced load capacity (Chang 2000).

Many different forms of corrosion degrade steel members including atmospheric (environmental), stress, stray current, bacteriological, and fretting corrosion. However, atmospheric and stress corrosion are the most frequent and serious when considering highway bridges (FHWA 2000). Corrosion, regardless of type, ranges in severity from minor surface corrosion to complete section removal (Ryall 2001). Numerous preventive strategies are utilized on steel bridge members including cathodic protection and protective coatings such as paint.

Corrosion of steel is an electrochemical reaction between a metal and the environment. The metal experiencing corrosive activity is generally deteriorated due to chemical changes resulting from the oxidation of iron atoms (Tonias 1995). General requirements for corrosion to begin and continue include an anode, cathode, oxygen, and an electrolyte or moisture (Ghosh 2000).

The surfaces of steel members are irregular due to a non-homogenous chemical composition and stress points from applied load during fabrication or service duty. These irregular areas, or anodes, represent areas that are more easily oxidized. During the corrosion process, iron atoms in these areas release two electrons, or negative ions, to form Fe^{2+} as depicted in Equation 4.1. The two electrons flow through the steel or base material to the cathodic region and react with oxygen to form hydroxide as depicted in Equation 4.2 (Zundahl 1993).

$$Fe \rightarrow Fe^{2+} + 2e^{-} \qquad \text{Equation 4.1}$$

$$O_2 + 2H_2O + 4e^{-} \rightarrow 4OH^{-} \qquad \text{Equation 4.2}$$

The remaining Fe^{2+} ions travel to the cathodic region through a conductive solution of water and acidic materials present on the surface of the steel member, commonly referred to as an electrolyte. In the cathodic region these ions react with oxygen to form hydrated iron oxide (Fe_2O_3), or rust, as depicted in Equation 4.3 (Zundahl 1993). Typically, hydrated iron oxide is colored from brown to yellow, with a common color of reddish brown (Ghosh 2000, Zundahl 1993).

$$4Fe^{2+} + O_2 + (4+2n)H_2O \rightarrow Fe_2O_3 \cdot nH_2O + 8H^{+} \qquad \text{Equation 4.3}$$

The flow of ions to the cathode results in the removal of material and development of pits at the anode (Ghosh 2000, Zundahl 1993). The rust many times appears in areas different than that of base material removal, with the electrolyte acting as a bridge between the different regions. Due to an increase in the conduction properties of the electrolyte, exposure to salts and chlorides typically correlate with an increase in the magnitude or rate of corrosion (Zundahl 1993). This is particularly evident in northern states where considerable amounts of de-icing salts are used or coastal regions where bridge structures are exposed to salt water (FHWA 2000, Tonias 1995, Ramey 1997). Other parameters contributing to accelerated corrosion are exposure to frequent rainfall and cycles of wetting and drying. High humidity may also provide the needed moisture for formation of the electrolyte thus explaining the difference in corrosion potential in geographic regions with extremely high and low humidity (Zundahl 1993, Ramey 1997, FHWA 2000).

Additional factors affecting the susceptibility of steel bridge structures to corrosion include foreign matter (litter, highway debris, bird droppings, etc.) on bridge members and faulty expansion joints that allow contaminated water and debris to accumulate. These factors support the formation of the required electrolyte and may allow the electrolyte to be sustained for longer periods of time (Tonias 1995, Tuor et. al. 1995).

In corrosive environments, members subject to high tensile stresses may suffer fracture due to stress corrosion. In conjunction with a reduction of cross sectional area of a member due to atmospheric corrosion, an increase in the tensile stress may occur (Agerskov and Nielson 1999). Due to this increase in tensile stress, additional surface area of the steel member is exposed. This area is then subject to corrosion that may further reduce the cross sectional area of the member, ultimately resulting in an additional increase in the tensile stresses present. This cycle may lead ultimately to fracture of the member (Tonias 1995). This type of distress is found in specific locations such as eye bars and pins in suspension and cable stayed bridges (Agerskov and Nielson 1999).

Fatigue

Recent studies have indicated that eighty to ninety percent of structural steel failures are related to fatigue, a significant cause of damage to steel highway bridges (Nishikawa et. al. 1998, Cheung and Li 2003). Although corrosion in a more prevalent form of steel deterioration, fatigue typically represents a greater risk of failure. Permanent structural change, or failure, of structural members resulting from repeated cycles of loading and unloading is referred to as fatigue (Chung et. al. 2006, Agerskov and Nielson 1999). As a result of these repeated load cycles, cracks may initiate and grow, resulting in failures at stresses well below those at failure when considering static load only (FHWA 2000, McCormac 1995). In contrast to average building structures, service conditions of highway bridges typically include high levels of load cycles, or load reversal, requiring consideration of fatigue during the design and inspection process (Chotackai and Bowman 2006).

Fatigue cracking and subsequent failure has occurred in several bridge structures around the nation resulting in catastrophic failure such as that experienced with the Silver bridge collapse. Failures of this type have resulted in improved inspection and design provisions (FHWA 2000). However, current codes and specifications normally incorporate simple linear damage rules, such as Miner's summation shown in Equation 4.4, where N_i and n_i represent the number of cycles to failure and actual number of cycles at a given stress level, respectively. Partial damage is assumed to occur at each random stress level, with total failure reached when the sum of damage increments at different stress levels equals or exceeds unity (Fisher 1984).

$$\sum \frac{n_i}{N_i} = 1 \qquad \text{Equation 4.4}$$

Current codes and models also rely on the results of constant amplitude fatigue tests or S-N curves. These curves simply provide an estimation, based on experimental results, of the number of cycles (N) expected to induce failure for a given stress level (S). One problem with these standard methods of investigation and life prediction is that the structural loads from traffic and the frequencies with which they occur are random, and do not have constant amplitude or frequency like those used to construct the typical S-N curve (Dicleli and Bruneau 1995, Szerszen and Nowak 2000). Therefore, these curves must be factored to account for a wide range of structural conditions and loadings (Lovejoy 2003). Although past experiments have supported Miner's summation as an adequate model not affected by sequence of stress application, the process neglects the random nature of highway loading and material durability (Dicleli and Bruneau 1995).

Although bridges are regularly inspected, fatigue cracking is a difficult deterioration mechanism to properly identify using visual inspection, thus requiring use of advanced inspection techniques (Washer 1999). Fatigue cracks in steel members usually occur at or near stress concentrations such as holes, notches, sudden changes in cross section, sharp corners, and flaws present in the base material. In particular, fatigue failure is prevalent at locations of welded connections such as those present at intersection of flanges and webs of plate girders, web stiffeners, and steel girder to diaphragm connections (Ramey 1997). Many factors specific to highway bridges lead to the development of fatigue cracks including the frequency of truck traffic, age or load history of the bridge, type of detail, quality of fabricated detail, material fracture toughness, weld quality, and ambient temperature (FHWA 2000).

In particular, several studies have indicated that exposure to overload from heavy truck traffic may not impart major damage immediately, but may result in a faster rate of fatigue damage accumulation (Fisher 1984, Mohammadi and Polepeddi 2000). Additional studies have identified that interaction of fatigue with other deterioration mechanisms such as long-term exposure to environmental corrosion may result in a possible reduction of the number of cycles to failure (Ghosh 2000, Zuraski and Johnson 1990).

Inspection and Assessment of Steel Bridges

Surface rust, section loss, fatigue cracking, impact damage, and failure of any protective coating represent a portion of the forms of damage of interest when inspecting steel bridge components (most typically superstructures). Both visual and physical inspection techniques may be utilized during inspection of steel bridges. Visual inspection is generally used to identify damage such as corrosion and some fatigue cracks depending on the size of crack and proximity of the inspector to the member in question (FHWA 2000).

Physical methods may be required to further investigate concerns identified through visual inspection or look for damage typically not detectable through visual inspection. Examples of interest include presence or extent of cracking and amount of section loss resulting from corrosion. Examples of available techniques include magnetic particle, dye penetrant, and ultrasonic testing. Typical areas of interest on steel superstructures include locations of high stress, bearing locations, expansion joints, areas subject to runoff or trapped water, and fatigue prone details (FHWA 2000).

Steel superstructure components may be assessed through the use of the proposed condition states in Tables 3.10 thru 3.14. Condition states are proposed for surface corrosion and section loss resulting form the corrosion process. Cracks resulting from fatigue may be assessed on primary non-fracture critical members, primary fracture critical members, and secondary members. Also, section loss and distortion of steel piles may be assessed through the use of the proposed condition state in Table 3.25.

Models for estimation and prediction of corrosion and fatigue are discussed in Chapter V along with the parameters, both field and laboratory, that are required for their use. Methods of obtaining these parameters as well as possible non-destructive methods of obtaining the information required for assessment when using the proposed condition states are also discussed. Chapter VI illustrates possible avenues for identification and integration of these mechanisms into the selection process at the initiation of an inspection program. Chapter VI also illustrates the development of inspection maps for use by the inspection team to insure that the proper data are gathered and appropriate deterioration mechanisms and testing techniques are reviewed prior to implementation of the program.

Concrete and Prestressed Concrete

Approximately sixty-one percent of all superstructures and ninety percent of all bridge decks throughout the inventory are constructed utilizing conventional reinforced or prestressed concrete. Although design and construction of superstructures and decks made with each of these types of concrete are considerably different, the deterioration mechanisms resulting in repair and replacement are very similar.

Two primary mechanisms deteriorate concrete bridges including frost action and corrosion of reinforcing steel (Park 1984). Conditions that may aggravate the deterioration produced by these mechanisms include heavy use of deicing salts, and poor construction quality or design practice (Ropke 1982). These deterioration mechanisms reduce the structural integrity of the member with common symptoms including scaling, delamination, section loss, and cracking (Raina 1996).

Scaling is defined as the removal, through flaking or disintegration, of the surface of a concrete member, eventually exposing the coarse aggregate. This type of deterioration is particularly prone to occur on reinforced concrete bridge decks due to their exposure to harsh conditions (ACI 1966). Scaling can be divided into different categories of severity including light, moderate, and severe. Light scaling generally removes only a small portion, up to approximately one eighth of an inch, of the top surface of the concrete member without exposing any coarse aggregate. Moderate scaling may remove between one and three eights of an inch of surface paste or mortar with the possibility of some coarse aggregate exposure. Severe scaling includes deterioration up to an inch in depth, and generally exposes coarse aggregate. In most general cases, scaling may begin in small areas, but may extend over time to cover large areas or entire members (Mehta 1986, FHWA 2000).

Delamination of concrete is defined as the separation of concrete into layers, typically parallel with the surface of the member. This effect generally occurs at a depth equal to that of the reinforcing steel. Typically, areas of delamination are identified during inspection through a hollow sound when tapped with a hammer. When the areas subject to delamination completely separate from the member leaving a depression, and possibly exposed reinforcing steel, spalling has occurred. Spalls are found through visual inspection, and generally classified as small and large. Small spalls are less than one inch deep and six inches in diameter and large spalls are more than one inch deep or six inches in diameter.

Frost Action

Frost action is defined as deterioration of moist materials through cycles of freezing and thawing (Ramachandran and Beaudoin 2001). Deterioration due to frost action is the most detrimental environmental effect on concrete structures (Orchard 1979). Both aggregates and hardened cement paste are porous materials that absorb available moisture, and are therefore susceptible to frost action (Mindess and Young 1981). The water to cement ratio, generally a direct comparison to porosity, may play an important role in the durability of a particular concrete when exposed to frost action (Ryall 2001).

Approximately seventy five percent of a typical Portland cement is comprised of Dicalcium ($2CaO{\cdot}SiO_2$) and Tricalcium ($3CaO{\cdot}SiO_2$) silicate. As shown in Equations 4.5

and 4.6, these compounds react with water during cement hydration to form calcium silicate hydrate ($3CaO\cdot 2SiO_2$) and calcium hydroxide ($CaO\cdot H_2O$), primary components of cement paste. Calcium silicate hydrate is primarily responsible for the engineering properties of concrete, most notably strength. This compound is a poorly crystalline and highly variable material consisting of thin layers or sheets of calcium silicate with calcium ions and water in between. During hydration, capillary pores or cavities are also formed in the calcium silicate hydrate representing voids in which water can be stored and behave like bulk water (PCA 2002, Mindess and Young 1981).

$$2(2CaO\cdot SiO_2)+9H_2O \rightarrow 3CaO\cdot 2SiO_2\cdot 8H_2O + CaO\cdot H_2O \qquad \text{Equation 4.5}$$

$$2(3CaO\cdot SiO_2)+11H_2O \rightarrow 3CaO\cdot 2SiO_2\cdot 8H_2O + 3(CaO\cdot H_2O) \qquad \text{Equation 4.6}$$

During frost action, temperatures drop to a required level to begin transforming water absorbed into the void system of the concrete into ice crystals (Mindess and Young 1981, ACI 1966). This transformation of water to ice represents an expansion of approximately nine percent. As a result of the expansion during ice formation, pressure is exerted forcing the pores in the cement paste and aggregates to dilate. This dilation leads to internal stresses and micro cracking. Additional cracking may occur as subsequent freeze thaw events occur.

Generally bridge deterioration due to frost action is easily identified during visual inspection, and is typically most prevalent on reinforced concrete bridge decks. In comparison to other bridge members, the deck is relatively thin with large surface area exposed to the environment, resulting in an increased likelihood of frost action. Typical symptoms include scaling, spalling, and cracking.

In addition to the pressures exerted due purely to the expansion of ice crystals, three other processes are thought to play a major role in frost action damage including hydraulic and osmotic pressure and desorption (Mindess and Young 1981).

The nine percent expansion experienced as ice crystals are developed results not only in micro cracks, but also in disrupting hydraulic pressure (Mindess and Young 1981, Orchard 1979). Due to this expansion, the remaining unfrozen water is forced into a smaller volume thus producing increased hydraulic pressure. This pressure can be relieved through several means including release to the surface of the concrete or into unfrozen or empty cavities.

However, these opportunities for pressure release must be extremely close to the pore experiencing the hydraulic pressure. If the pressure is not released, further dilation of the capillary pore will develop. The tensile stresses caused by this dilatation, in combination with similar stresses caused by adjacent pores expanding in a similar manner, may eventually reach levels large enough to induce further micro cracking in the concrete (Mindess and Young 1981, ACI 1966). Typically, partially dry concrete will not experience hydraulic pressure from freezing due to the availability of empty voids to accommodate movement of water under pressure.

Aggregates, similar to cement paste, may experience hydraulic pressure and the amount of damage is directly related to the amount of absorbed water and the pore structure of the aggregate (Mindess and Young, 1981). Soft limestone and porous aggregates may be affected but hard aggregates such as flint, gravels, and granite are typically not susceptible to frost damage (Orchard 1979).

The solution present in capillary pores is not pure water, and typically contains several impurities including alkalis, calcium hydroxide, and chlorides. During the freezing process, ice crystals nucleate from the capillary solution. This process generally results in a steadily increasing concentration of solute in the liquid adjacent to the freezing site (Mindess and Young 1981).

Through osmosis, water from nearby unfrozen paste is spontaneously drawn to the location with a higher solute concentration in order to achieve equilibrium. This movement of water in response to increasing solute concentrations generates osmotic pressure that further dilates the capillary pores where ice crystals have already formed. Similar to hydraulic pressure, osmotic pressure may cause additional cracking to occur (Mindess and Young 1981).

The chemical potential of the frozen water is substantially different that that of unfrozen, or super-cooled, water at other locations. This results in a reduced vapor pressure at the location of freezing, and thus the effective relative humidity at the freeze site is lowered. Movement or desorption of water from unfrozen pores or paste will occur between these two differing sites until equilibrium is reached, thus resulting in a similar effect to that of osmotic pressure (Mindess and Young 1981).

Entraining air in concrete is the common method that is utilized to prevent damage due to frost action. The entrained air provides empty space to allow expansion and water movement during a freeze event. This void space virtually eliminates the harmful pressures that deteriorate concrete due to frost action (Mindess and Young 1981).

Corrosion of Reinforcing Steel

Corrosion of reinforcing steel is a primary deterioration mechanism of reinforced concrete, representing the most serious durability issue, and results in a majority of damage to concrete structures (Orchard 1979, Ramachandran and Beaudoin 2001, and Page et. al. 1996). Corrosion of the reinforcing steel ultimately reduces the strength, structural integrity, and functionality of the structure (ACI 1968, Ramachandran and Beaudoin 2001). In particular, bridge deck deterioration due to corrosion of reinforcing steel is considered one of the most acute durability problems throughout the inventory (Mindess and Young 1981).

Common symptoms of reinforcement corrosion include delamination, section loss, cracking, and staining. These symptoms are typically a result of the expansive nature of the corrosion process. The rust produced by corrosion of reinforcing steel occupies up to four times more volume than the material that was removed thus causing distress in the concrete (PCA 2002, ACI 1968, Mallett 1994, Orchard 1979, Mindess and Young 1981, Raina 1996). Cracks in concrete may result from a layer of corrosion one tenth of a millimeter thick (Ramachandran and Beaudoin 2001).

Corrosion of reinforcing steel follows the same general principles as corrosion of structural steel. Through an electrochemical process, anodes and cathodes are created and the flow of ions through an electrolytic substance causes corrosion. In concrete, the anode and cathodes typically represent areas with different impurity levels in the base metal, residual strains, or concentrations of oxygen or electrolytes in contact with metal (Mindess and Young 1981).

Oxygen typically reaches the reinforcing steel through several means including diffusion through the concrete, cracks, or a combination of both (ACI 1968). Oxygen is also supplied through splash from traffic or sea mist each of which includes dissolved oxygen. Concretes completed and continuously submerged in water are generally not susceptible to corrosion deterioration due to the lack of oxygen present to support the process (Ramachandran and Beaudoin 2001, Levitt 1982). Generally, the corrosion process is controlled by the diffusion of oxygen through the concrete (Ramachandran and Beaudoin 2001).

Similar to oxygen, water generally reaches the reinforcing steel through diffusion or cracks present in the concrete. Water acts as the electrolyte needed for galvanic action, and therefore, permanently dry concrete will not support corrosion (ACI 1968, Ropke 1982). Typically, the wider and deeper the crack, the more susceptible concrete is to deleterious elements. The ability of oxygen and moisture to reach reinforcing steel is also dependent upon the initial quality of the concrete including the density, compaction, and thickness of cover (Orchard 1979, Mindess and Young 1981). Reduction in the permeability of concrete will reduce the amount of oxygen and water available to the corrosion process (ACI 1968).

In comparison to steel, concrete construction involves several inherent properties that typically protect embedded reinforcing steel from both corrosion and the environment. As concrete hydrates and cures around reinforcing steel, the alkalinity in the cement paste causes a thin layer or oxide film to form of the surface of the steel (ACI

1968, Ramachandran and Beaudoin 2001, Mindess and Young 1981, Raina 1996). The film renders the reinforcing steel passive, with Ph ranging from 9.5 to 13 (Ramachandran and Beaudoin 2001). This protective film is considered very stable while it remains in a high alkaline environment with decreasing stability as the alkalinity is lowered to Ph levels ranging from 9 to 11 (Levitt 1982, ACI 1968). Chloride contamination and carbonation are the most common reasons for the passive layer to deteriorate (Raina 1996).

One mechanism that lowers the level alkalinity at the reinforcing steel is carbonation. The initial stage of carbonation is the intrusion or diffusion of carbon dioxide from the atmosphere into the concrete (ACI 1968, Ramachandran and Beaudoin 2001). This may take place through cracks in the concrete or through naturally occurring pores in the cement paste. Once present, carbon dioxide reacts with soluble products in the pore solution such as calcium hydroxide, a typical hydration by-product, which maintains a high Ph level in the cement paste (ACI 1968, Ramachandran and Beaudoin 2001). This reaction results in the formation of insoluble calcium carbonate that precipitates on the walls and in the cavities of the pores. The transition of calcium hydroxide to calcium carbonate results in a reduction of the alkalinity in the area of the carbonation to a Ph level of 8 or 9, below its normal value of approximately 13 (Levitt 1982, Raina 1996).

Several factors affect the rate and presence of carbonation including the permeability of the concrete and presence of cracks. Also, maximum carbonation will occur between fifty and seventy percent relative humidity (ACI 1968, Ramachandran and Beaudoin 2001, Mallett 1994). However, for carbonation to participate in the initiation of corrosion, it must take place at or near the reinforcing steel. Two particulars instances where this is found include older bridges or those with inadequate level or quality of concrete cover (Mallett 1994). Typically, well cured, quality concrete with a low water to cement ratio or low permeability are subject to very shallow carbonation. The presence of cracks can increase the presence and magnitude of carbonation, especially at the level of reinforcing steel. Fully carbonated concrete in the area of the reinforcing steel may not be subject to corrosion without oxygen and moisture (Mindess and Young 1981).

The presence of chloride ions in concrete can also reduce the stability of the protective film rendering it less passive and thus more subject to corrosion (ACI 1968). Common sources of chloride include calcium chloride in accelerating admixtures, deicing salts and sea water (Orchard 1979, Mallett 1994, Mindess and Young 1981, ACI 1968). These chlorides may be directly applied to the concrete bridge member, such as de-icing salts on bridge decks, or indirectly as result of leaking deck joints or water proofing, splash from traffic, and from sea spray (Mallett 1994, ACI 1968).

Chlorides typically reach the concrete surrounding the reinforcement through two main mechanisms. First, chloride present on the surface of the member or in solution in the pores may diffuse into the concrete (Mindess and Young 1981, Page et. al. 1996). This process is typically quite slow and thought to follow Fick's second law of diffusion. The parameters that effect the diffusion are the concentration of chloride present and the permeability of the concrete. The second main transport mechanism of chloride to the reinforcing steel is through cracks present in the concrete that may be a result of temperature and shrinkage, frost action, or overstress (Mindess and Young 1981).

Regardless of the transport mechanism involved, chloride will build up over time, and may eventually reach a critical level where the level of alkalinity at the reinforcing steel is diminished enough to allow the corrosion process to begin. Typical critical chloride concentrations required to reduce the high alkalinity are between one and two pounds per cubic yard of concrete, but ultimately dependent upon the or actual alkalinity present at the interface of the concrete and reinforcing steel (Mindess and Young 1981). This process not only reduces the Ph in the vicinity of the reinforcing steel, but also may increase the electrical conductance of the electrolyte possibly allowing the corrosion rate to increase (Ramachandran and Beaudoin 2001). Chloride contamination may also result in concrete that retains more moisture resulting in a more conducive environment for damage due to frost action or corrosion (Mehta 1986).

Several preventive methods are commonly utilized to prevent or slow the corrosion process. Included in these are coating the reinforcing steel with protective coatings such as epoxy, utilizing reinforcing of high performance metals such as stainless steel, using concrete designed to be less permeable, and application of a protective overlay coating to stop penetration of water and chlorides.

Inspection and Assessment of Concrete Bridges

Damage that is typically of interest when inspecting concrete bridge components includes cracking, delamination, spalling, scaling, collision damage, corrosion of reinforcing steel, etc. Inspection of concrete bridge components (substructures, superstructures, decks) may involve both visual and physical techniques. Visual techniques may typically identify general surface symptoms of deterioration such as cracking, spalling, corrosion staining, etc. Physical techniques may be utilized to provide a more in-depth understanding of concerns identified in visual inspection or to investigate those items not suitable for visual techniques. These may include extent of delamination, chloride contamination, and corrosion of reinforcing steel. A portion of the physical techniques involved are quite simple such as a chain drag for delamination or taking cores for strength or chloride contamination testing. More sophisticated tests include ground penetrating radar, ultrasonic testing, and acoustic wave velocity measurements (FHWA 2000).

Although types of deterioration and procedures of investigation may vary depending on the type of component in question, general areas of interest are similar on most structures. The areas will typically be investigated on all structures, and include areas of high shear or tension, expansion joints, bearing points, drainage areas, and areas of collision damage or previous repairs (FHWA 2000).

Within an inspection program, the assessment of the condition of concrete bridge components may typically be completed through the use of the proposed condition states illustrated in Chapter III. The proposed condition states for concrete bridge decks are provided in Tables 3.3 thru 3.8 and address partial and full depth deterioration, structural and non-structural cracks, scaling, and chloride contamination. Conventional concrete superstructures may be assessed for section loss and cracking through use of the proposed condition states in Tables 3.15 and 3.16. Prestressed superstructures may be addressed through use of the proposed condition states provided in Tables 3.17 thru 3.19 for section loss, shear cracks, and exposed tendons. Finally, concrete substructures and concrete piles are assessed for section loss through use of the proposed condition states provided in Tables 3.23 and 3.24. These forms of deterioration are directly related to one or more of the deterioration mechanisms discussed in this chapter.

Mathematical models, and the required supporting information, for estimation or prediction of these mechanisms are discussed in Chapter V. Mechanisms discussed include corrosion, frost action, and chloride contamination. Available methods of measurement of the required parameters are also provided where applicable. Methods of identification and integration of the mechanisms into an inspection program are illustrated in Chapter VI through the development of inspection planning maps.

Foundation Scour

Scour is defined as the removal of material adjacent to foundation elements, such as piers and abutments, due to the flow of water resulting from natural, man made, or flood conditions, resulting in increased exposure of the element effected (Umbrell et. al. 1998). Scour can be cyclic in nature and maximum scour will generally occur during flood conditions with some refilling after flow subsides. Flow of water causing scour may be unidirectional such as in a river or multidirectional such as tidal activity (FHWA 2001). Foundation scour has been identified as the most common cause of bridge failure, most typically during flood events (Cardoso and Bettes 1999). Approximately sixty-nine percent of the bridges in the national bridge inventory span water in some manner. Additionally, approximately fourteen percent of the bridges in the inventory have been identified as vulnerable to scour (Stein et al. 1999).

The type of material that is present in the stream bed is one of the main factors that determine the transport or scour characteristics of a particular stream or river.

Generally, when stream beds are subjected to the same flow rate under the same conditions, the rate of scour will be dependent upon the type of material present (FHWA 2001). Scour of very hard, resilient materials such as granite may occur over centuries whereas scour of loose material such as sand may require only several hours given appropriate flow conditions (Umbrell et. al. 1998).

Two different transport characteristics are involved in scour including clear water and live bed scour. Live bed sour occurs when the bed material upstream of the bridge is transported downstream due to flow conditions causing scour. Conversely, clear water scour occurs when no transport or movement of material from upstream is involved (Lim and Cheng 1998, FHWA 2001).

Total scour is a result of the cumulative effect of three independent scour components. These components include channel gradation (aggregation and degradation of stream bed), general scour including contraction scour, and local scour that occurs at piers or abutments (Johnson and Niezgoda 2004, FHWA 2001).

Channel Gradation

Channel gradation is typically naturally occurring and generally occurs longitudinally along the stream bed. Although naturally occurring, manmade activity, such as structures, channel modification, or urbanization, may accelerate the removal of material (Johnson and Niezgoda 2004).

Two distinct forms of gradation exist including aggradation and degradation. Aggradation is the progressive buildup of material along the downstream longitudinal profile of a streambed due to removal of upstream sediment. Conversely, degradation is the progressive removal or scouring of streambed material due to the flow of water over a long channel length, thus changing or lowering the profile (FHWA 2001).

<u>*General Scour*</u>

General scour includes two primary components, general scour and contraction scour. General scour may lower the channel in either a non uniform or uniform manner, and generally occurs in areas where the flow pattern is forced to change direction, such as bends in a river. The nature of general scour is different from that of degradation due to its cyclic nature and reliance upon flood conditions to occur (FHWA 2001).

Contraction scour generally occurs in areas the flow channel is restricted or contracted, resulting in a smaller area through which the flow must pass (Umbrell et. al. 1998). Restrictions in flow may occur through natural means such as berms created through sediment deposit, ice formation or jams, and growth of vegetation, or as a result of manmade construction such as bridge piers or abutments, roadway approaches in flood plains, and pressure flow during flood events (Johnson and Niezgoda 2004, FHWA 2001). The reduction in the area results in a corresponding increase in velocity of flow, transport capacity, and shear stresses present at the streambed. Contraction scour will occur as the velocity induced through a restriction reach the critical velocity of the material on the streambed (Johnson and Niezgoda 2004). Scour will continue until the velocity reduces below the critical velocity and equilibrium is reached (Umbrell et. al. 1998). Several factors influence the reduction in velocity including an increase in the area constricted resulting in a larger area for the flow to pass and the reduction of flow as flood conditions pass. However, when considering tidal exposures, flow velocities do not necessarily decrease as scour occurs (FHWA 2001).

Local scour

Local scour is the most detrimental of scour activities for bridge elements, and involves the removal of material directly adjacent to a pier or abutment, resulting in an abrupt decrease in streambed elevation (Johnson and Niezgoda 2004). This type of scour is caused by the alteration or obstruction of flow caused by the foundation element, resulting in vortices. Vortices result from the accumulation of water on the upstream side of the foundation element, causing an acceleration of the flow around the upstream side of the obstruction. The action of the vortex removes streambed material from the base of the obstruction, resulting in a scour hole directly adjacent to the obstruction. As the size of the scour hole increases, the disrupting vortex decreases. This process results in the transport of streambed material away from the obstruction until equilibrium is reached (FHWA, 2001). Several factors are involved in the development of local scour including flow attack angle, size, shape, and orientation of foundation element, depth and velocity of flow, sediment size, gradation, and type, and angle of return to main channel (Johnson and Niezgoda 2004, FHWA 2001). Local scour can occur in clear water or live bed scour conditions. The local scour hole reaches equilibrium faster in live bed than clear water conditions (Lim and Cheng 1998). Undermining of foundation elements is the typical failure mechanism resulting from local scour with pile exposure an additional concern. Each of these concerns is typically addressed during the design process (Martin-Vide 1998).

Scour Mitigation

Mitigation of scour at bridge foundations has become a very important consideration over the past several decades as a result of bridge failures (Johnson et. al. 2001). Several types of countermeasures exist to prevent or control scour including armor, hydraulic controls, and grade controls (Johnson and Niezgoda 2004). Prevention of scour can be achieved through the use of countermeasures in the correct manner, but may accelerate scouring if inappropriately applied. Countermeasures are dependent upon identification of the basic cause of scour for a particular location. Identification of scour before major material removal occurs is the key to prevention of failure, and accessibility to problem areas is a common problem when installing new countermeasures at an existing bridge location (Ramey and Wright 1997).

Armor is the most common countermeasure providing protection by withstanding high velocities and shear stresses (Johnson et. al. 2001). Riprap is the most common form of armor, with other forms including grout filled bags, foundation extensions, concrete aprons, and precast concrete units, each of which provides armor against erosive forces. Riprap, the most common armor, may fail for several reason including stones entrained with flow, winnowing, edge failure, and bed form erosion through live scour conditions (Lauchlan and Melville 2001). Although frequently used as a method to reduce scour, armor does not reduce vortices as found in local scour nor do they redirect flow. Armor may also exacerbate scour conditions through the restriction of flow and increase in velocity (Johnson and Niezgoda 2004).

Hydraulic control involves the installation of devices that break up the flow above piers or abutments, reducing vortices and high velocities that cause scour. These devices typically realign flow to prevent local and contraction scour near foundation elements. Hydraulic control devices include sacrificial piles, circular shields, bend away weirs, and stone sills (Johnson and Niezgoda 2004).

Common forms of grade controls include guide banks, earthen banks covered with riprap, or large floodplains that help to provide smooth transition of flow through bridge openings and reduction in turbulence. Also, vanes, cross vanes and weirs are utilized to provide grade control on degrading stream beds, and help to moves any scour activity to the middle of the channel. Finally, in extreme cases, channel realignment may be necessary to improve flow and bank conditions (Johnson and Niezgoda 2004).

Inspection and Assessment of Scour

Inspection for scour near bridge foundations generally focuses on three major aspects including identification of critical damage, determining current conditions, and quantification of changes in streambed conditions. Current conditions may include the type of streambed material, current scour evident at or near bridge foundations, and debris buildup. Measurement of current conditions helps to identify the presence of scour and in present, any changes near bridge components that have occurred between inspections (FHWA 2000).

Inspection and assessment of bridge sites for scour change or damage may be accomplished through the use of the proposed condition states provided in tables 3.20 thru 3.22. These condition states allow assessment of bridge sites for changes in exposure of spread footings, substructures, and piles, as well as changes in the depth, width, or location of the channel. Use of underwater inspection techniques may be required for determination of changes in exposure on the substructure and foundation elements and in some cases, the streambed itself (DeVault 2000, Collins 1987). Exposure and streambed conditions may also be accomplished through techniques such as fathometer or ground penetrating radar. Through use of a boat, this equipment may be used to determine an estimated depth from the water surface to the streambed or foundation element. Finally, measurements required for the assessment of scour may be taken directly through the use of a surveyor's rod when shallow water exists. These measurements will be completed in a similar manner for both new and existing structures. However, on new structures, care must be taken to insure that the conditions recorded are those after final construction is complete. Regardless of measurement type, care must also be taken to appropriately identify the elevation of the water surface on the day of inspection. This will help insure that accurate comparison can be made from one inspection to the next.

Chapter V focuses on the next step in the development of a quantitative inspection approach for scour. It discusses mathematical models for predicting several different forms of scour that occur at or near bridge foundations. The parameters for use of these models are also identified. A method of integration of the proposed condition states, identified deterioration, and mathematical models into an inspection program is provided in Chapter VI. This process will aid in the inspection team's understanding of the process and information to be recorded during inspection. Although not directly illustrated on a scour example, with careful consideration the method may generally apply to all forms of deterioration.

Summary

The major underlying mechanisms causing deterioration on bridge structures have been identified and discussed in this chapter for each main material type utilized throughout the national bridge inventory. Also, general inspection requirements and procedures were briefly discussed. Different deterioration mechanisms are applicable to different materials. Although materials and methods have changed considerably over the past few decades, the types of deterioration found to reduce the service lives of highway bridges have remained consistent. This fact supports the need for improvement in inspection procedures, improved deterioration models, and the proposed condition states discussed in Chapter III. A more clear understanding of the condition of the structure and the rate of deterioration can be achieved if these major forms deterioration mechanisms are investigated and monitored appropriately through routine inspection.

Chapter V investigates the currently available practical models for the estimation and or prediction of the different deterioration mechanisms discussed throughout this chapter. The parameters for use of these models are also identified, along with typical methods of obtaining data for use. Such information enhances the ability of the inspection team to understand the processes at work and develop a quantitative approach to bridge inspection.

CHAPTER V

DETERIORATION MODELS

Introduction

This chapter is related to Research Objective 4, and discusses procedures to include numerical models in the development of an inspection program. These models are required to properly understand bridge deterioration, determine inspection frequencies, and possibly estimate the useful remaining life of a structure. Available models describing or estimating the deterioration mechanisms identified in Chapter IV are discussed here. Different testing methods for obtaining the information required for model implementation are also identified.

Wood of Timber

The major forms of deterioration effecting timber or wood bridges were defined in Chapter IV as fungal decay, insect attack, and marine borer attack. Considerable research has been accomplished on each of these deterioration mechanisms. However, no acceptable models are available to predict or estimate the amount of damage on timber bridge structures. Two primary protocols exist to reasonably anticipate the presence or possible initiation of deterioration. These include monitoring the required conditions for survival of fungi and evidence from prior inspection results.

The conditions required for survival of fungi responsible for decay were discussed in detail in Chapter IV, and included suitable moisture, oxygen, and temperature. Also, specific areas of a typical bridge and specific types of exposure were identified as more susceptible to attack from these mechanisms as well as insects and marine borers. Estimation or prediction of damage must incorporate this information along with data from previous inspections and any preventive maintenance accomplished in order to be as accurate as possible. Typical identification of damage during inspection includes visual inspection and most typically sounding, viewing cores, and mechanical probing. This latter method is the most frequently used, is subjective in nature, and many times does not identify early damage. Methods of additional investigation to ascertain the extent of damage include loss of mass tests, investigation of the mechanical properties of the wood, immunodiagnosis, and near infrared spectroscopy (Goodell et. al. 2003).

Loss of mass is a test that may indicate that deterioration is present, or the amount of additional deterioration relative to earlier inspection results. This test is particularly difficult due to variability in the moisture content of samples selected. The loss of mass test is generally considered to be accurate within two to three percent. However, mechanisms such as brown rot may impart major damage with only a two or three percent loss of mass. The inherent variability of this test presents problems in field measurement and identification of initial damage (Goodell et. al. 2003).

Mechanical properties of wood members subject to deterioration can be tracked to identify changes in the extent of deterioration. Compression, bending, and torsion strength are the most utilized for these tests in laboratory and field measurements. Additionally, permeability may be periodically checked as an increase in permeability is typically associated with deterioration (Goodell et. al. 2003).

Through the use of antibodies, immunodiagnosis was found to be one acceptable method if identifying the presence of detrimental fungi in wood or timber samples. This process is typically very sensitive and can identify even incipient stages of decay. This test method does not have the ability to identify the different levels of decay, or magnitude of progression from one inspection to the next. It is typically recommended to be used in conjunction with other tests that identify magnitude of actual decay such as compression and bending stiffness tests (Goodell et. al. 2003).

Finally, near infrared (NIR) spectroscopy has been identified as one test procedure that has been successful in identifying and quantifying deterioration in wood samples. The process, along with statistical analysis has been successful in the identification of the loss of mass and compression strength in wood samples (Goodell et. al. 2003).

Steel

Corrosion and fatigue were identified in Chapter IV as the two major forms of deterioration resulting in reduced assessments of steel bridges. Many research studies have investigated and modeled these mechanisms (Cheung and Li 2003, Dadson et. al. 2002, Farhey et. al. 1997, Szerszen and Nowak 1999, Vasudevan et. al. 2001, Zuraski et. al. 1990). Many of these models are quite specific to particular environmental and geometric conditions. Presented here are models developed for general conditions and adaptable to conditions for specific locations, owners, or inventori*es.*

Corrosion

As discussed in Chapter IV, corrosion of steel girders, beams, and cross members ranges from surface corrosion to section loss. Many factors are relevant when considering the process of corrosion of these members, including physical characteristics of the steel, natural environmental constraints such as temperature, moisture from rain, snow, and relative humidity, and applied factors such as salts and chemicals. Review of literature found that no satisfactory model currently exists that includes all of the factors involved.

One model was identified through several studies that predicted the time variant corrosion loss of the steel member based on observed corrosion characteristics (Frangopol and Hendawi 1994, Kayser and Nowak 1989, Akgul and Frangopol 2004). This model is typically developed by fitting corrosion data to a power function as shown in Equation 5.1, where C is the average corrosion depth (μm) and t is exposure time (years). The coefficient A is the corrosion depth at one year and exponent B is the slope of the logarithmic plot of Equation 5.1. Reported values of A and B for carbon steel range from 8 μm to 45 μm and from 0.23 to 0.76, respectively (Kayser and Nowak 1989). Based on this relationship, the depth of corrosion can be estimated and used for other calculations such as capacity analysis, estimation of remaining useful life, and time until repair is necessary.

$$C = At^{B} \qquad \text{Equation 5.1}$$

The process of corrosion of steel bridge members is based on several parameters that contain considerable uncertainty. In response to this uncertainty, at least one study has quantified the variability of the parameters required for use of Equation 5.1 (Albrecht and Naeemi 1984). This study reported findings for the parameters A and B that included their mean, standard deviation, and correlation values. These characteristics of corrosion may be utilized to incorporate a portion of the uncertainty present when estimating corrosion activity.

The parameters required for use of Equation 5.1 can be obtained through literature or estimated from an actual, or similar, sample of the steel used for a particular bridge or group of bridges within an inventory. However, the more closely the sample represents the material and environmental conditions that correspond with the structure under investigation, the more accurate the prediction of corrosion depth will be.

During inspection, information can be gathered on specific structures that may enable more accurate use of Equation 5.1. Quantitative measurements such as actual corrosion can be monitored, and over the course of several inspections, the growth of corrosion depth can be monitored and correlated to in-service conditions. Several different measurement techniques exist for identifying the depth of corrosion, and most generally involve determining the thickness of remaining base metal with depth of corrosion extrapolated from this measurement. When both sides of the member are accessible, direct measurements of material thickness may be completed through use of calipers. Ultrasonic measurement may also be used, and only requires that one side of the member be accessible (Yoshida and Asano 2003).

Actual information for a specified bridge will provide the opportunity to refine the parameters A and B for a specific steel and the appropriate environmental conditions. Also, information gathered over several inspection cycles or from similar structures may also support the development of statistical estimates of the uncertainties for each of the measured quantities. This information can be utilized for the specific bridge, or group of bridges that are constructed of similar steel and in similar regions with consistent environmental conditions.

Fatigue

Numerous studies have been reported concerning the fatigue and fracture of steel bridge girders (Agerskov and Nielson 1999, Dicleli and Bruneau 1885). Current AASHTO guidelines require that existing steel bridges be evaluated for fatigue life based upon a method that employs standard S-N curves. These curves are empirical in nature, do not follow a fracture mechanics approach to the problem, and must be factored for different loading conditions. This analysis technique is typically conservative with results indicating that the fatigue life of many of the currently functional structures may have already been surpassed.

Generally, the study of fatigue and fracture involves three phases including the initiation of the crack, the stable growth of the crack, and the rapid unstable growth of the crack just prior to failure. Typically, the second phase is of interest in the inspection and maintenance of bridge structures.

One research study has investigated the development of a fracture mechanics approach to the estimation of fatigue life, or the number of load cycles required to grow a macroflaw to a specified size (Lovejoy 2003). Macroflaws include weld defects and metal forming flaws. Macroflaws may not be present in new bridge members or may result from the growth of microflaws such as grain boundaries and inclusions in the material. This research study was particularly interested in the fatigue life of steel girders when subjected to heavy truck loading. The method developed utilizes principles from linear elastic fracture mechanics (LEFM). Although most failures of steel bridges may occur in a ductile manner, LEFM was utilized for simplification of the procedure and should result in conservative estimates of fatigue life.

This method assumes that an initial crack or flaw is present with subsequent growth until a critical crack size is reached. Once the critical crack size is reached, further crack growth is rapid and unpredictable resulting in the failure of the element. The critical crack size (a_{crit}) can be calculated using Equation 5.2 (Lovejoy 2003). Here, the critical crack size is based upon the critical stress intensity factor (K_c), the stress normal to the crack (σ), and the form factor (f).

$$a_{crit} = \frac{1}{\pi}\left(\frac{K_c}{f\sigma}\right)^2 \qquad \text{Equation 5.2}$$

The critical stress intensity factor may vary between different structures based partly on temperature, type of steel, load rate, presence of corrosion, and stress field. Two primary methods were identified to classify the critical stress intensity factor of steel samples including ASTM A673 and ASTM A813 (Lovejoy 2003). The former uses CVN testing and the latter of the two test methods utilizes compact tension (CT) specimens. Typical values for the critical stress intensity factor range from 44 MPa-$m^{1/2}$ to 220 MPa-$m^{1/2}$ depending on the ductility of the steel utilized (Lovejoy 2003).

Three different methods can be utilized to determine the stress normal to the crack. The first method is calculation of the stress on a structure specific basis. Second, the normal stress can be estimated using a percentage of the yield stress of the material or based on maximum allowable design stresses, both of which rely on the typical design and operating process within a given bridge inventory. Third, the actual value of the stress may be measured through instrumentation of a structure of interest. Typical values identified range from 113 to 190 MPa (Lovejoy 2003). Structure specific factors must also be incorporated into this analysis such as location of interest and additional post-construction loadings such as overlays.

The form factor generally accounts for the geometry of the two-dimensional crack that is formed. Three general cases are typically presented including a through crack in the middle of a plate, an edge crack, and a surface crack. The form factor may range from 0.75 to 1.5. Typical edge cracks have a form factor approximately 1.12 and through cracks a value of 1.0 (Lovejoy 2003). Values for this factor can typically be determined through literature review and may be standardized for typical application within a given inventory. Due to the low stresses and high toughness of typical bridge steel currently used, exact calculation of the form factor may not be required.

Fatigue crack growth characteristics under live loads can be described by the Paris Equation (Equation 5.3). Here, the growth rate of the crack (a) with respect to the number of cycles (N) is a function of the range in stress intensity (ΔK) and two material constants A and m. The material constants A and m are typically determined through experimental laboratory tests, with typical results for bridge steels of 6.87×10^{-12} and 3.0, respectively.

$$\frac{da}{dN} = A(\Delta K)^m \qquad \text{Equation 5.3}$$

Equation 5.4 describes the stress intensity range (ΔK) as a function of current crack length (a), the form factor (f), and the range in stress ($\Delta\sigma$) normal to the crack. Measurements of normal stresses have indicated ranges from 7 to 70 MPa, depending upon the influence of heavy truck traffic on a particular bridge (Lovejoy 2003). The stress range will ultimately be based upon the structure and loading in question. The location of the crack under investigation is also generally very important, especially if near a connection or other stress concentration.

$$\Delta K = f\sqrt{\pi}\Delta\sigma\sqrt{a} \qquad \text{Equation 5.4}$$

Although an initial flaw may be present, growth of the crack may not occur if the stress intensity range, ΔK, does not reach a threshold value (ΔK_{th}). The threshold value may be dependent on several factors, most notably the ratio of the minimum (σ_{min}) to maximum (σ_{max}) stress that is applied to the crack area. Typical values reported for ΔK_{th} for typical bridge steels range from 3.3 to 11.0 MPa-m$^{1/2}$ (Lovejoy 2003).

Integrating Equation 5.3 from the initial crack length (a_i) to the final crack length (a_f) is illustrated Equation 5.5. Here, the number of cycles required can be calculated if the stress range and form factor are assumed constant, with the stress intensity range changing with the length of crack (Lovejoy 2003). The live load stress range on a typical bridge can vary considerably, and can be reduced to an equivalent constant stress range through Miner's Summation. For small members, the live load stress range may need to be adjusted during analysis due to the large change in effective stress and area of the member available to resist load.

$$N = \int dN = \int_{a_i}^{a_f} \frac{da}{A(\Delta K)^m} \qquad \text{Equation 5.5}$$

Finally, the time (T) to reach a critical crack size can be determined through Equation 5.6 (Lovejoy 2003). Implementation of this equation requires an appropriate final crack size to be chosen, such as a percentage of the critical crack size. This will vary depending on the structure type and general policy set forth by the bridge owner. Two typical methods can be used to set the final crack size. The first method sets the final crack size at the minimum that can be identified by the non-destructive methods typically utilized by the owner. The second method assumes the final crack size as a fraction of the critical size (i.e. $a_f = 1/3\ a_{crit}$) resulting in an estimated remaining fatigue life when the specified crack size is reached. The numerator of Equation 5.6 can be calculated using Equation 5.5 and the average daily truck traffic (ADTT) can be measured through traffic counts or estimated based on growth profiles and previous analysis. The number of significant stress cycles per truck passage (C) must be approximated through structural analysis or obtained through measurement of actual stresses during the in-service conditions of the structure. The result of Equation 5.6 can be used to schedule the next inspection of the bridge and to monitor the existence or growth of cracks.

$$T = \frac{N_{a_i}^{a_f}}{365(ADTT)(C)} \qquad \text{Equation 5.6}$$

Identification and measurement of cracks in field situations may be completed utilizing several different techniques including dye penetrant testing, magnetic particle testing, ultrasonic testing, and radiographic examination. Dye penetrant testing involves subjecting the cleaned surface of the bridge member to a dye. The dye is allowed to penetrate into surface cracks or defects and is then cleaned from the surface of the member. A developer of high absorbent property is then applied, and any remaining dye in cracks or defects bleeds onto the developer and identifies the location of cracks. The resulting cracks are then investigated through magnification. This particular method is considered very suitable for use on actual bridges (Ghosh 2000).

Magnetic particle testing involves the application of a magnetic field on the member to be tested and then subjecting the area to a fine iron powder. If a crack exists, the magnetic field along the crack is disturbed and the cracks become readily visible. This method of detection may identify both surface and subsurface cracks, and is suitable for both field and laboratory use (Ghosh 2000).

Ultrasonic testing is generally utilized to identify the presence of cracks or defects in welds and plate laminations. A high frequency sound beam is introduced into the member through the use of a transducer. The sound beam travels through the member and when it reaches a crack, reflects back to the instrument where it is identified. This method may be used when only one side of the member is accessible, and requires specialized training for proper interpretation of the results from the test. This method is utilized to identify the presence of surface and subsurface cracks, and is also quite suitable for field investigation (Ghosh 2000).

Radiographic examination is capable of identifying surface and subsurface defects. This process consists of passing X-rays through a member and developing an image on a photosensitive film that is placed behind the member. Therefore, both sides of the member must be accessible during the testing of the member. Cracks in the steel member will allow more radiation to pass resulting in identification on the resulting image. Areas of sound steel will show up as light areas and areas with cracks or defects will appear as dark or shaded regions. This particular method requires appropriately trained personnel to complete the test and requires additional safety precautions (Ghosh 2000).

Concrete and Prestressed Concrete

Corrosion of reinforcing steel, frost action, and chloride contamination were identified in Chapter IV as the major deterioration mechanisms associated with concrete bridges. Many different proposed methods are available to estimate and predict corrosion, cracking, and chloride contamination (Liang et. al. 2002, Kirkpatrick et. al. 2002, Enright and Frangopol 1999, Weyers et. al. 1998, Boothby and Laman 1999, Attiogbe 1996, Frangopol et. al. 1997). The models presented here are those considered to be those useful in inspection and analysis of in-service structures. Applicable models to estimate scaling were not identified and one basic laboratory procedure was identified to estimate the general durability of concrete exposed to frost action.

Corrosion

One particular method for estimation of corrosion and subsequent cracking proposed by Liu and Weyers is discussed here as a reasonable technique that has proven to yield accurate results when compared to laboratory testing (Page et. al. 1996). Several steps are included in the calculation of possible cracking in concrete due to corrosion. The first of which is determination of the corrosion rate. The corrosion rate is typically measured through field or laboratory tests. Several test methods are available for the determination of the rate of corrosion including loss of mass tests and of interest here, the Linear Polarization Technique (Berke et. al. 1996, Carino 1999, Rucchini 1993, Law et. al. 2000).

Two typical applications of the Linear Polarization Technique are the K. C. Clears 3LP and the Geoscia Geocor techniques. Each of these techniques utilizes the Stearn Query equation (Equation 5.7) to determine a corrosion current density as a function of the polarization resistance. Here, β_z and β_c are the anodic and cathodic Tafel slopes and R_p is the polarization resistance. The method typically involves a large range of anodic and cathodic potential polarization that is applied to a working electrode. The results of the test are generally reported as a plot of potential versus current density. This is typically referred to as a Tafel plot. The straight portions of this curve follow the Tafel relationship with the respective slopes referred to as the anodic and cathodic Tafel slopes. Typical values for the polarization resistance vary dependent upon the type of device used for testing and utilize specific calculations to estimate the corrosion rate. When using the Geocor technique, values for polarization resistance have been reported between 70 $k\Omega m^2$ and 143 $k\Omega m^2$ corresponding to corrosion rates of 0.187 $\mu A/m^2$ to 1.192 $\mu A/m^2$. When using the Geocor test, four different corrosion regions are identified with transition points including 1.17 $\mu A/m^2$, 5.85 $\mu A/m^2$, and 11.7 $\mu A/m^2$. Corrosion rates less than 1.17 $\mu A/m^2$ and greater than 11.7 $\mu A/m^2$ represent passive and high corrosion regions respectively, with low and moderate regions in between (Page et. al. 1996, Ramachandran and Beaudoin 2001, Law et. al 1999).

$$I_{corr} = \frac{(\beta_a \beta_c)}{2.3R_p(\beta_a + \beta_c)} \qquad \text{Equation 5.7}$$

Corrosion rate has been found to be a function of the temperature at the time of measurement. A measured corrosion rate can be converted to an actual corrosion rate for a given temperature through Equation 5.8 (Page et. al. 1996). In particular, an accepted method is to convert the corrosion rate to the annual average temperature for the site in question. Here, I_{corr} is the equivalent corrosion rate, I_m is the measured corrosion rate at temperature T_m, and T_{corr} is the average annual temperature. The annual average temperature at a bridge site may vary considerably depending on the location of interest. This information may be measured on site or estimated from analyses such as those in Chapter II.

$$i_{corr} = i_m \text{ x } 2^{(T_{corr} - T_m)/10} \qquad \text{Equation 5.8}$$

The next step in the procedure is the determination of the critical weight of rust products (Page et. al. 1996). As reinforcing steel corrodes resulting in formation of rust, the rust products represent a greater volume than the base material replaced. The critical amount of corrosion products is the amount that is required to produce cracking in reinforced concrete. This critical weight of corrosion product is a function of cover depth (L), reinforcing steel size (D), spacing (S), concrete including tensile strength (f_1), and bar hole flexibility (δ_{pp}). Each of these factors is easily identified with the exception of δ_{pp} which must be calculated based on the poisons ratio, modulus of elasticity, and creep characteristics of the concrete in question (Bazant 1979). Equations 5.9 thru 5.11 represent the relationship between these parameters and the critical weight of rust products. As shown, this equation can be altered for two different types of cracking including inclined cracking that results in spalling (Equation 5.11a) and parallel cracking that results in delamination (Equation 5.11b). ΔD is the increase in the diameter and is derived from the Bazant Equation (Bazant 1979).

$$W_{cr-rust} = k\Delta D \qquad \text{Equation 5.9}$$

$$k = (\tfrac{1}{2})(1/\rho_{rust} - \alpha/\rho_{steel})^{-1} \qquad \text{Equation 5.10}$$

$$\Delta D = 2f_1(L/D)\delta_{pp} \text{ (inclined cracking or spalling)} \qquad \text{Equation 5.11a}$$

$$\Delta D = 2f_1(S/D-1)\delta_{pp} \text{ (cover peeling of delamination)} \qquad \text{Equation 5.11b}$$

As corrosion products are generated, the rate of additional formation of corrosion products decreases as a function of the thickness of rust due to the inverse relation of diffusion and rust thickness as indicated in Equation 5.12 (Page et. al. 1996). Integrating Equation 5.12 yields Equation 5.13, with K_p (Equation 5.14) defined by in terms of the measured corrosion rate I_{corr}. Through these equations, the time required to cracking can be derived as Equation 5.15, with T_{corr} representing the elapsed time until corrosion cracking occurs.

$$dW_{rust} / dt = k_p / W_{rust} \qquad \text{Equation 5.12}$$

$$W_{rust}^2 = 2k_p t_{corr} \qquad \text{Equation 5.13}$$

$$K_p = (1/\alpha)9.11i_{corr} \qquad \text{Equation 5.14}$$

$$t_{corrt} = W_{corr-rust}^2 / 2k_p \qquad \text{Equation 5.15}$$

Chloride Contamination

Chloride contamination has been correlated with corrosion of reinforcing steel. As previously noted, a threshold level of approximately two pounds per cubic yard of concrete is required to reduce the alkalinity in the area surrounding the reinforcing steel to a level where corrosion may begin. Chloride may reach the level of reinforcing steel through several processes, in particular diffusion through the pores of the concrete.

Many literature sources have indicated that the diffusion process typically follows Fick's second law of diffusion as indicated in Equation 5.16 (Mindess and Young 1981, Ramachandran and Beaudoin 2001, Page et. al. 1996, Nokken et. al. 2006, Chatterji 1995). When considering chloride, C represents chloride concentration, K_d is a concrete diffusion coefficient, t is time and x is the depth from the surface of the material to a point of interest such as reinforcing steel. Typical values for the diffusion coefficient range from 10.6 x $10^{-9}cm^2/sec$ to 11.8 x $10^{-9}cm^2/sec$. Values for lightweight concrete are approximately twice that of normal weight concrete (Sugiyama et. al. 1996).

$$\frac{\partial C}{\partial t} = K_d \frac{\partial^2 C}{\partial x^2} \qquad \text{Equation 5.16}$$

The solution of this equation for a concrete member with finite dimensions is provided in Equation 5.17 (Mindess and Young 1981, Ramachandran and Beaudoin 2001, Page et. al. 1996, Nokken et. al. 2006, Chatterji 1995). Through this equation, the chloride concentration at time t and depth x can be predicted based on the initial chloride concentration C_0. Typical values for actual initial chloride concentration have ranged from 1.2 kg/m^3 to 8.2 kg/m^3 (Stewart and Rosowsky 1998).

$$C(x,t) = C_0\left[1 - \mathrm{erf}\left(\frac{x}{2\sqrt{K_d t}}\right)\right] \qquad \text{Equation 5.17}$$

In order to use the equation developed from Fick's second law, a diffusion coefficient must be known for the concrete sample in question. Many test methods exist for the determination of the diffusion coefficient. However, only the methods with ASTM or AASHTO approval are identified and discussed. Two major forms of diffusion tests are typically considered including immersion or ponding tests and electric field migration tests (Ramachandran and Beaudoin 2001).

Ponding and immersions tests typically require that one surface of the specimen be subjected to a specified chloride concentration. This technique insures that the chloride movement is unidirectional so to better understand the diffusion properties of the sample. Samples are subjected to the chloride solution for a specified period of time, and concentrations are measured at different distances from the surface of the specimen. These measurements can be used to determine the contamination profile or the penetration depth. The penetration depth and profile can be used to calculate the diffusion coefficient using Equation 5.17 or 5.18 (Ramachandran and Beaudoin 2001).

$$X_d = 4\sqrt{K_d t} \qquad \text{Equation 5.18}$$

The approved Method following this process is AASHTO T259-80. Several parameters of particular interest on this test are that the sample must be saturated prior to test to avoid measuring both diffusion and absorption. Also, the solution that the sample is exposed to must remain available and not evaporate during the test to insure a constant supply of chloride and reduce the variability of the test. Containment of the liquid is achieved by a dyke placed around the top of a cylindrical specimen. The specimen is subjected to the test for 90 days. After testing and determination of the concentration at various depths of the sample, the results are plotted as concentration versus depth, with the area under the curve representing total chloride contamination (Ramachandran and Beaudoin 2001).

The rapid chloride permeability test is one form of an electric field migration test, and is described by Standard test methods AAASHTO T277 and ASTM C 1209-94. This test is typically completed through the use of a migration cell. Initially, the specimen is soaked in a vacuum for eighteen hours and enclosed in two chambers with specific concentrations of sodium chloride and sodium hydroxide. An electric field of sixty volts is applied across the electrodes in each chamber for six hours. The current passing the specimen is recorded as a function of time. The area under the time current plot represents the total charge, or movement of ions, that occurs during the test. This test provides an indirect measurement of the chloride diffusion coefficient and is typically correlated with other test results. General ranges for high, moderate, and low permeability are available for correlation, but estimation of the actual coefficient may be difficult utilizing this technique (Ramachandran and Beaudoin 2001).

Scaling

No acceptable physical models were found to adequately predict the mechanism of scaling. To date, a full understanding of the mechanism resulting in scaling behavior is not available (Cantin and Pigeon 1996). Generally, scaling is considered to be a result of the use of de-icing salts or chemicals. Heat consumption and osmosis may be the two main processes at work resulting in the scaling mechanism (Mindess and Young 1981).

The process that occurs as de-icing salts or chemicals melt snow or ice involves heat consumption. During this process, the concrete directly beneath the surface may be exposed to a rapid drop in temperature. This drop in temperature may result in damage or cracking from freezing of the concrete or from thermal differentials between surface and subsequent levels of concrete. Additional water may become available during this process and may lead to formation of ice lenses near the surface that may result in additional cracking or damage.

After heavy or repeated cycles of de-icing salt application, concentration of the salts or chemicals may build up in areas below the surface of the concrete member. As rainwater or melted snow and ice accumulate on the surface of the member, the process of osmosis may occur. Through osmosis, equilibrium of the concentrations at the surface and below the surface may occur. During this process, water must flow through the concrete. This flow of water may result in disrupting hydraulic pressures on the cement paste resulting in micro-cracking and subsequent scaling of surface material.

Although appropriate models for scaling are not yet available, several characteristics of concrete and placement techniques are typically associated with the mechanism. Included are the use and presence of de-icing salts, over vibration, toweling the concrete too early and long, plastic shrinkage cracks, and excessive bleeding. Each of these characteristics may lead to a weak layer of paste at or just beneath the surface of the concrete. This layer may also include micro cracks or channels to transport salts, water, and chemicals below the surface of the concrete member resulting in damage (Mindess and Young 2003).

Frost Action

As discussed in Chapter IV, frost action involves several processes including expansion as a result of ice formation, hydraulic pressure, osmotic pressure, and desorption. Several test methods exist for the investigation of freeze thaw resistance of concrete. These include ASTM C 666 and C 671. Typically these tests subject test specimens to cycles of freezing and thawing. Progressive deterioration is monitored through loss of weight, strength, dynamic modulus of elasticity, and length change of the specimen (Mindess and Young 2003).

ASTM C 666 describes a standard test method for exposing test specimens to a series of freeze and thaw cycles every two to five hours. Freezing is completed in saturated or dry conditions and thawing is always completed in a saturated condition. Specifications are provided on the rate of thawing of the specimen, and the process continues for three hundred cycles or until a forty percent reduction of the original dynamic modulus of elasticity is reached. At completion, a durability factor can be calculated as indicated in Equation 5.19. This equation relates the durability factor to P, the percentage of the initial dynamic modulus of elasticity after N cycles. No definitive values of the durability factor have been identified as acceptable or unacceptable (Mindess and Young 2003).

$$\text{Durability Factor} = \frac{P \times N}{300} \qquad \text{Equation 5.19}$$

However, a value of forty or less generally correlates with poor performance as does a value of sixty percent or above with satisfactory performance. One major problem with ASTM C 666 is the error introduced due to the difference between the high freezing rate of the test and that typically found in service conditions (Mindess and Young 2003).

ASTM C 671 provides test procedures similar to that of C 666 except that the freezing is accomplished over a two week period and thawing is accomplished in a rapid manner. Damage is measured as a change in length. The test is continued until a required number of cycles are met or until a critical dilation is reached that corresponds with sharp changes in the rate of deterioration. This particular test allows the user to approximate the curing and exposure conditions to most nearly match those found during in-service conditions (Mindess and Young 2003).

Each of the tests provides some insight into the freeze-thaw durability of a particular concrete mix. However, results form tests and those from actual in-service exposure vary considerably due to conditions that cannot be replicated in a laboratory setting. These may include degree of saturation of concrete, freezing rate, and actual curing.

Foundation Scour

Chapter IV identified that several scour components work independently and result in an accumulative effect of foundation scour. Computations and estimation of the different scour components typically involves the use of computer models for simulation and consideration of all of the possible alternatives that exist at a given site. Several models for estimation of the scour components have been identified through available literature (Eisenhauer and Rossbach 1999, Johnson and Simon 1997, Annandale 1999, Richardson and Panchang 1998, Johnson and Dock 1998). The different scour components discussed here include clear water, live bed, and pressure flow contraction scour and local scour at piers. Regardless of computation method, much field data concerning the channel, streambed, and structure are required for accurate estimation. This information can be gathered prior to design, during construction, and during inspection. Some of the parameters might change over time and may need to be re-evaluated throughout the life of the structure.

Critical Velocity

Regardless of the scour component of interest, the critical velocity (V_c) in ft/sec is the velocity above which bed material of diameter (D) and smaller may be transported by flow. The calculation of critical velocity follows Equation 5.20 and is a function of a constant K_u (11.7 for English units and 6.19 for SI units), the average depth of flow upstream of the bridge (y), and the particle size (D) under consideration. When critical velocity is greater than the actual velocity, clear water scour may occur and when the critical velocity is less than the actual velocity, live bed scour will occur (FHWA 2001).

$$V_c = K_u y^{\frac{1}{6}} D^{\frac{1}{3}} \qquad \text{Equation 5.20}$$

Live Bed Contraction Scour

The result of live bed contraction scour can be estimated using Equation 5.21 (FHWA 2001). Here, the average depth in feet in the contracted section (y_2) is a function of the average depth in the upstream channel (y_1), the ratio of the flow in the contracted (Q_2) and upstream (Q_1) channels, and the ratio of the bottom widths of the channel in the upstream (W_1) and contracted (W_2) portions under consideration. The estimation of live bed contraction scour also involves the exponent K_1 that is based on the results from Equation 5.22 (FHWA 2001). Here, g is the acceleration of gravity, and S_1 is the slope of the energy grade line in the main cannel, and w is the fall velocity of the D_{50} bed material. D_{50} represents the particle size with fifty percent of the bed material larger or smaller in size. This can typically be estimated through the use of a sieve analysis. The value for ω is available in chart form through review of current literature. Results from Equation 5.22 below 0.5 are assigned a value of 0.59, values between 0.5 and 2.0 are assigned a value of 0.64, and values greater than 2.0 are assigned a value of 0.69 for use in Equation 5.21.

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}}\left(\frac{W_1}{W_2}\right)^{k_1} \qquad \text{Equation 5.21}$$

$$K_1 = \frac{(g y_1 S_1)^{\frac{1}{2}}}{\omega} \qquad \text{Equation 5.22}$$

Clear water contraction scour

Estimation of clear water contraction scour may be completed through the use of Equation 5.23. Here, the average equilibrium depth in the contracted section (y_2) is estimated as a function of the flow through the bridge (Q), the diameter of the smallest non-transportable particle (D_m), the bottom width of the contracted section less the pier width (W), and a constant coefficient K_u (0.025 for SI units and 0.0077 for English units).

If several layers of different materials are present at the scour site, this analysis may be completed in sequential form to accommodate differing particle sizes as additional scour occurs (FHWA 2001).

$$y_2 = \left[\frac{K_u Q^2}{D_m^{2/3} W^2}\right]^{3/7} \qquad \text{Equation 5.23}$$

<u>*Contraction Scour for Pressure Flow*</u>

In some instances, flooding may result in pressure around bridge substructures. This occurs when flooding results in flow that reaches or passes the level of the superstructure above the normal channel levels. Estimation of contraction scour resulting from a pressure flow situation follows Equation 5.24. Here, scour is a function of the depth of flow upstream of the ridge (y_1), the distance from the lowest chord of the bridge to the average elevation of the streambed before scour, the average velocities of flow through bridge opening before scour, and the critical velocity of the D_{50} bed material in the opening (FHWA 2001).

$$\frac{y_s}{y_1} = -5.08 + 1.27\left(\frac{y_1}{H_b}\right) + 4.44\left(\frac{H_b}{y_1}\right) + 0.19\left(\frac{V_a}{V_c}\right) \qquad \text{Equation 5.24}$$

<u>*Local Scour at Piers*</u>

Live bed and clear water scour may both be estimated through use of Equation 5.25 (FHWA 2001). Here, the scour depth (y_s) is a function of four coefficients (K_1, K_2,

K_3, and K_4), the flow depth directly upstream of the pier (Y_1), the pier width (a), and the Froude number directly upstream of the pier. The four coefficients represent corrections for the pier nose shape, the angle of attack of the flow, bed conditions, and for armoring provided by bed material size, respectively. These coefficients are available through current literature. The Froude Number may be calculated through Equation 5.26 as a function of the average velocity directly upstream of the pier (V_1), the acceleration of gravity (g), and the depth of flow upstream of the pier (Y_1).

$$\frac{y_s}{a} = 20K_1K_2K_3K_4\left(\frac{y_1}{a}\right)^{0.35} Fr_1^{0.43} \qquad \text{Equation 5.25}$$

$$Fr_1 = \frac{V_1}{gy_1} \qquad \text{Equation 5.26}$$

Summary

This chapter identified available practical estimation models for the major deterioration mechanisms resulting in damage of highway bridges. These models represent the link between visual inspection and estimation of deterioration or remaining useful life. Although not a comprehensive listing of available proposed models, the models discussed here represent those practical enough to use throughout the inspection and planning process. Also, possible methods of obtaining the required data for use of the models were identified and briefly discussed including procedures, application, and limitations. Chapter VI integrates the information discussed in Chapters II thru V to properly prepare the inspection team and efficiently plan the inspection process.

CHAPTER VI

INSPECTION PROGRAM PLANNING

Introduction

Any bridge inspection program, whether routine or designed to investigate a specific interest, must be appropriately planned prior to implementation. Many previous studies have investigated the development of management programs with specific aims, integration of non-destructive methods, mechanical models, and statistics into the program protocols, and development of improved data acquisition methods for use during inspection (Rens et. al. 2005, Sunkpho and Garrett 2003, Sunkpho et. al. 2005, Lounis and Madanat 2002, DeWolf 1998, Thompson et. al. 2003, Elzarka 1999, Hearn and Shim 1998). The main focus of Research Objective 5 is discussed here, and includes the identification and integration of information discussed in Chapters II thru V that support the development of a quantitative inspection program.

In addition to identification of the overall goal of an inspection program, the process for developing a bridge inspection program must involve four additional components. These components include; (1) the identification of the structures to be inspected; (2) identification of the types of deterioration anticipated; (3) the basic information that should be recorded during inspection and standards that each structure is to be assessed against; and (4) an understanding of the quantitative models available to estimate deterioration or determine inspection frequencies. Information supporting these components was presented in Chapters II thru V.

Selection of Structures

Selection of the structures to be included in an inspection program must be accomplished to best support the overall objective of the program. Ultimate success of any in-depth inspection program relies upon many factors, but particularly the correct selection of structures for study. Selection may range in complexity from an entire inventory, such as that of a municipality or state, to a very specific subset of an inventory required for investigation of a specific deterioration process or environmental exposure. Selection of the latter case may be accomplished through use of the procedure presented in Chapter II.

The proposed procedure reduced an initial inventory of structures into subgroups of bridges constructed with specific material and structure type combinations. These combinations were further stratified through latent class cluster analysis based upon a set of eight variables describing the physical and functional attributes of the structures. The resulting clusters represent groups or subsets of bridges more similar than just material and structure type. The procedure proposed in Chapter II was illustrated on a majority of the National Bridge Inventory, but could be implemented on an inventory of any size and complexity and dependent any set of desired characteristics. The results from this analysis may provide suitable insight into an inventory such that structures deemed suitable for inspection and comparison within the guidelines of the program can be identified.

In many instances, in-depth investigation of a smaller subset of structures may be of interest when studying a particular deterioration mechanism, construction type, or some combination thereof. The resulting clusters from the proposed analysis may provide identification of these smaller subsets of structures. Another possible situation may involve the investigation of a specific exposure condition on a particular subset of bridges. The results from the analysis discussed in Chapter II may be used to aid in a final selection of bridges for study through an elimination procedure that identifies only the structures that meet specified exposure criteria such a coastal exposure or a likelihood of frost action. In-depth investigation of entire subsets such as these may not be possible due to the number of bridges remaining or availability of qualified personnel or funding required for completion of the study. In this instance, a representative sample of structures may need to be selected, with the results possibly extrapolated to the remaining structures.

Each of the resulting clusters from the proposed analysis procedure represented a percentage of the initial material and structure type population. If a known number of structures with similar material and structure types are to be included in an inspection program, the selection of structures can follow the distribution of the structures throughout the different clusters. For example, an in-depth program may be interested in bridges with a material type of steel and structure type of stringer/multi-beam or girder constructed in a simple span manner. The results for this analysis indicate an optimal solution of fifteen clusters and a total population of 106,552 bridges. If a sample of five hundred bridges is to be selected for in-depth investigation, the distribution of the structures may follow the cluster percentages as shown in Table 6.1. Therefore, the percent of the sample per cluster is identical to the percent of the population per cluster.

Table 6.1: *Example Selection Based on Cluster Probabilities*

Cluster	% of Population	Inventory Structures	Sample Structures
1	25.43	27,170	127
2	24.56	26,145	123
3	8.21	8,740	41
4	7.98	8,495	40
5	7.84	8,346	39
6	3.97	4,226	20
7	3.89	4,141	20
8	2.64	2,810	12
9	2.57	2,736	13
10	2.52	2,683	13
11	2.44	2,597	12
12	2.28	2,427	11
13	2.24	2,385	11
14	1.97	2,097	10
15	1.46	1,554	7

As discussed in Chapter II, additional parameters may be of interest. These parameters may be of particular interest in specific programs, but not in all routine inspections. The remaining structures can be again stratified to only include or exclude structures with specified characteristics such as high or low likelihood of frost action. Subsequent to this stratification, the inventory from which the sample is taken may be considered complete and the distribution of the sample can follow the same process as the previous example.

The general process is illustrated in Figure 6.1. In this example, the inspection program is interested in the deterioration rates of simple span steel stringer/multi beam or girder bridges with concrete decks located in coastal areas. The steps illustrated in Figure 6.1 could possibly be completed in a different order with the same end result. The process described begins with the entire inventory and works to the final sample inventory where sampling may begin. This assumes that the cluster analysis is completed

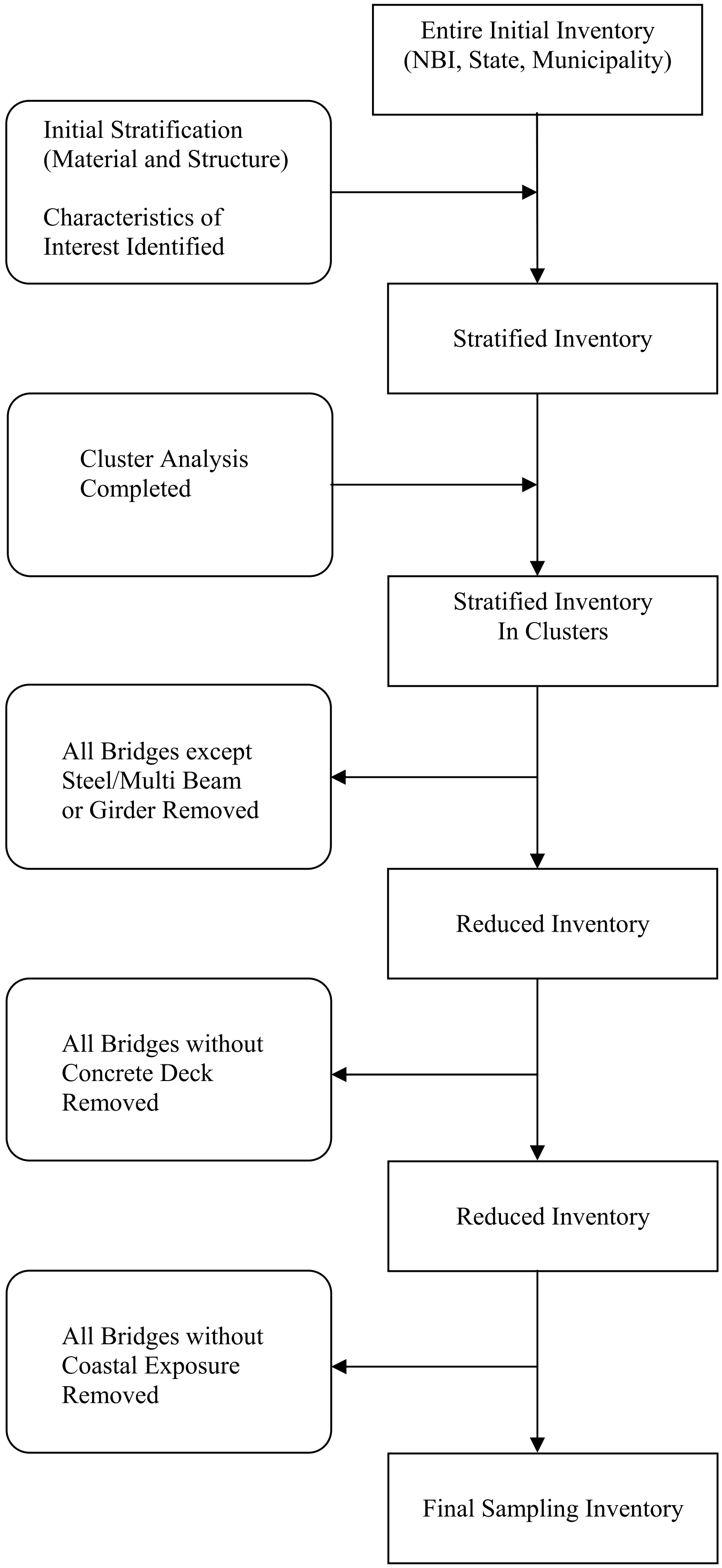

Figure 6.1: *Example of Sampling Inventory Preparation*

before the direction of the program is known. If the overall purpose of the program is known prior to the analysis, the first few steps may be omitted.

If all considerations have been addressed during the identification of the sampling inventory, sampling may be completed in a random manner following a process similar to that discussed in Chapter II.

Standard Deterioration and Assessment

The standard forms of deterioration may be identified before or after the selection of the sample depending upon the type of program to be implemented. If the sample is to be concerned with a specific type of material or deterioration process, the types of deterioration to be investigated can be listed before or after selection. However, if the characteristics of the final sample are not known prior to the selection, identification may need to be completed after selection in complete.

Identification of the forms of deterioration will basically involve identifying the material types of the selected sample and the corresponding deterioration mechanisms as identified in Chapter IV. Also, if the structure or structures of interest cross a waterway, then scour may need to be included as a deterioration mechanism.

This process is illustrated in Figures 6.2 thru 6.4 on the previous example of steel bridges. Several requirements exist including the basic deterioration processes of interest when considering steel bridges, identifying the typical forms of deterioration and available condition states for assessment, the typical information that is required during an inspection, and avenues for obtaining the information required. Figure 6.2 shows a very basic identification of the deterioration processes typically resulting in damage to steel bridge superstructures including corrosion and fatigue. Although a simple procedure when considering a program where only steel superstructures are of interest, the process gains considerable complexity when considering a sample with a wide range of materials and exposures, such as the entire inventory of a state or municipality.

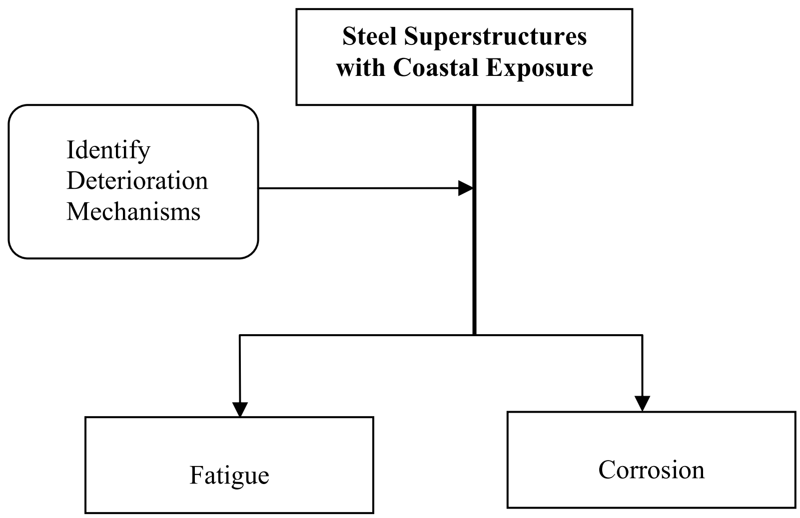

Figure 6.2: *Deterioration Processes for Steel Superstructures*

Subsequent to the identification of the major deterioration processes, the available condition states, information of interest for assessment, and method of measurement must be identified. This process is illustrated for the steel superstructure example in Figures 6.3 and 6.4.

Figure 6.3 identifies that condition states are available for two forms of deterioration resulting form general corrosion. These include surface corrosion and section loss. Surface corrosion can be assessed based on the condition of any protective coating and amount of the beam or girder with surface corrosion. These forms of deterioration are typically estimated through visual inspection. Section loss typically requires measurements of the reduction of thickness, identification of the location of measurement, and is completed using calipers or ultrasonic thickness measurement.

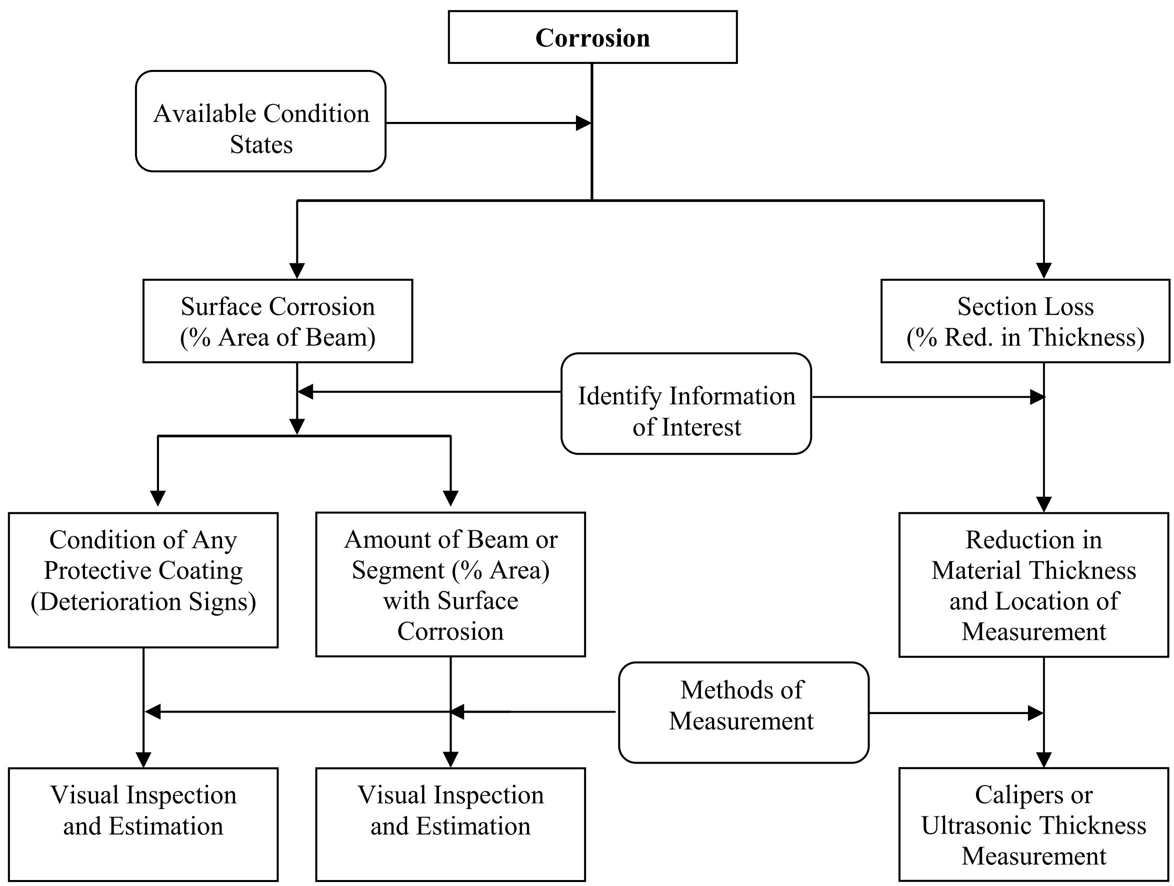

Figure 6.3: *Corrosion Assessment for Steel Superstructures*

Figure 6.4 illustrates this same process for fatigue of steel superstructures. Fatigue cracks are the typical form of deterioration and condition states are available for assessment for fatigue cracks in non-fracture critical members, fracture critical members, and secondary members. Typical identification includes the presence, growth, and location of cracks. Methods of investigation include visual inspection, dye penetrant testing, magnetic particle testing, ultrasonic testing, and radiographic examination.

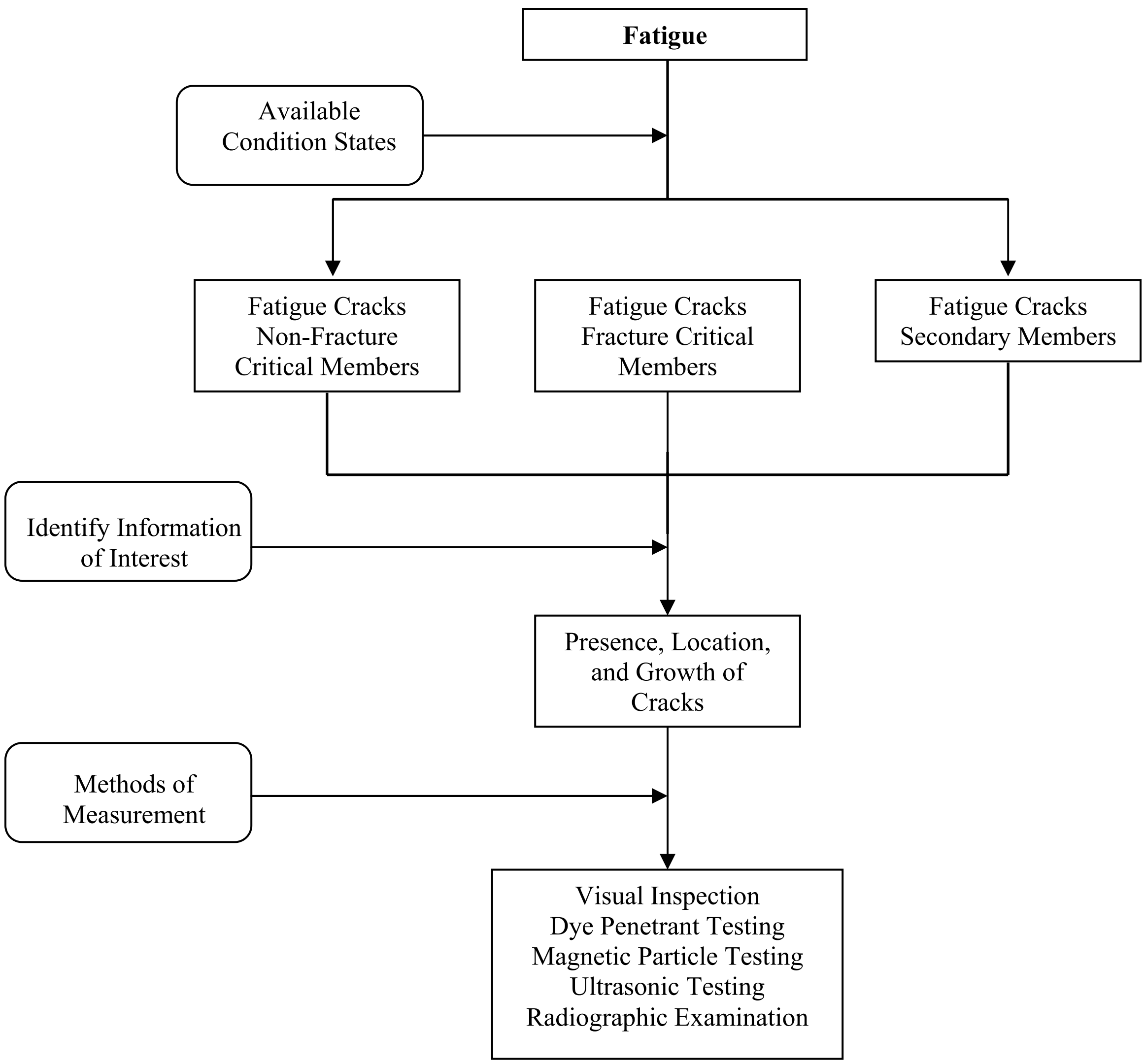

Figure 6.4: *Fatigue Assessment for Steel Superstructures*

Information similar to that provided in Figure 6.2 thru 6.4 may be gathered at the beginning of any inspection program. Accumulation of information prior to inspection may be of great value to both the success of the program and efficiency and accuracy of inspection results. Through this process, the inspection team will better understand the types of deterioration to expect and have a better appreciation of the processes at work and the information that is anticipated from the inspection. Also, this provides some insight into the type of equipment and measurement techniques that may be required for a given structure. Several different sets of information similar to that discussed will be required on a typical bridge. These might include information for the deck, superstructure, substructure, and possibly scour related items depending on the structure or structures in question.

Identification of Models Available

Subsequent to the identification of the deterioration mechanisms at work for a given subset of a bridge inventory, the models available for their prediction or estimation may need to be identified dependent upon the aim of the inspection program. Currently available practical models were discussed in Chapter V. Identification of these models will provide additional insight into the information that may need to be recorded during the inspection process, allow the calculation or estimation of past or future deterioration, and determination of inspection frequencies.

Similar to the process for constructing Figure 6.2 thru 6.4, quantitative models may be identified as well as the information required for their use. In contrast to the information provided in Figures 6.2 thru 6.4, this information may not be needed in all inspection programs or at all times. The process of identifying the available models is valuable in educating the inspection team of the underlying processes, regardless of use within a given program. This process is illustrated in Figures 6.5 and 6.6 for the steel superstructure example.

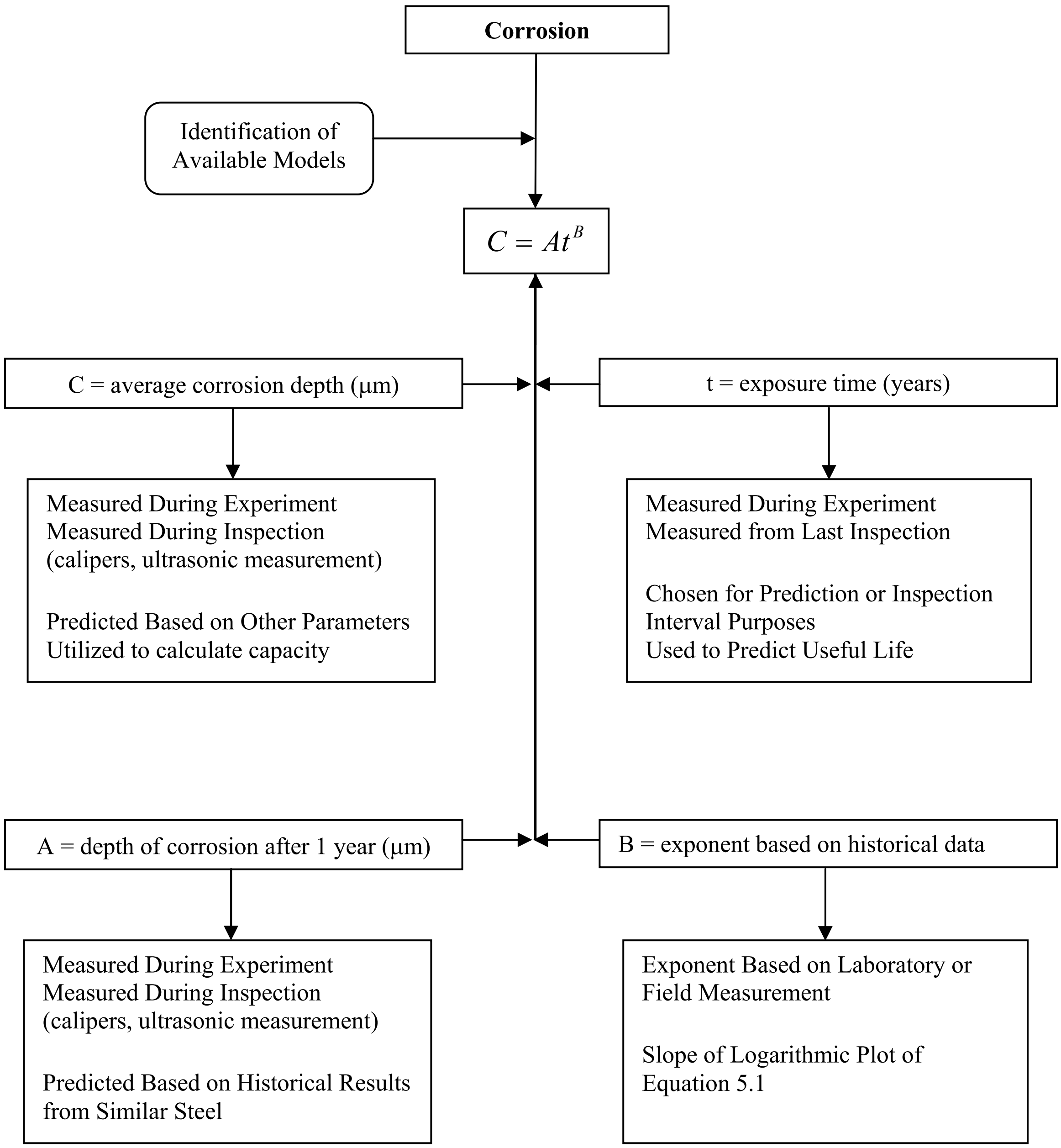

Figure 6.5: *Models for Corrosion of Steel Superstructures*

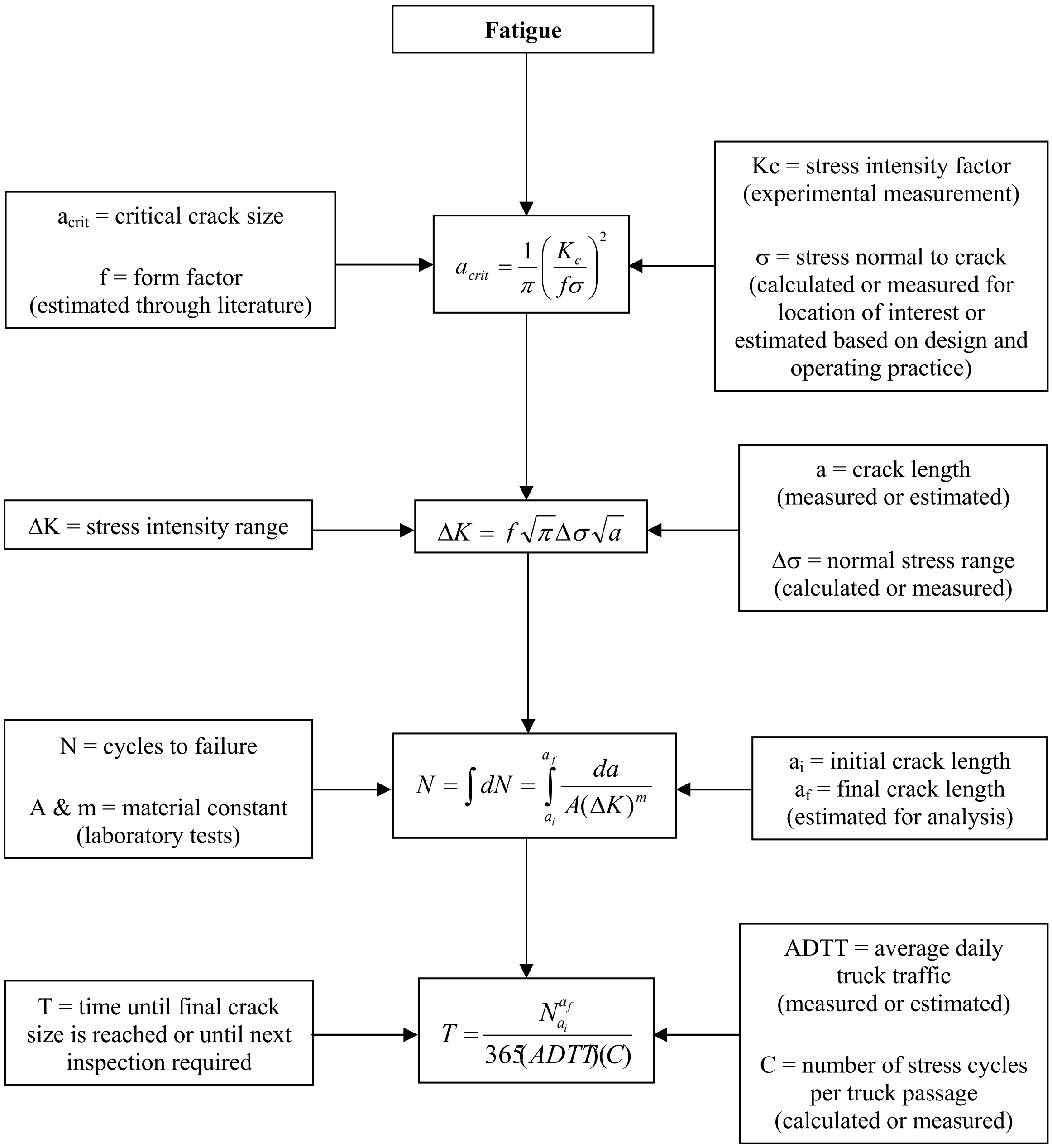

Figure 6.6: *Models for Fatigue of Steel Superstructures*

Figure 6.5 illustrates the models identified in Chapter V to be practical in the estimation or prediction of corrosion of steel superstructures. The model and parameters are identified. Methods of obtaining values for each parameter are also identified. Similarly, Figure 6.6 identifies these same characteristics for the model discussed in Chapter V concerning fatigue cracks. This model may be used to estimate or predict crack lengths, crack growth, or determine an appropriate inspection cycle. These figures are one example of research that can be accomplished prior to inspection to help insure that adequate information is recorded during inspection to support further analysis including calculation of structural capacity.

Summary

Planning an inspection program involves several different steps including selection of structures to be included, identifying the deterioration types and assessment standards, and identifying available practical models of deterioration and prediction. This process generally needs to be completed prior to implementation of a program. Through the process, several advantages may be achieved including education of the inspection team, identification of required resources prior to implementation, and planning the inspection process to achieve the desired results in an efficient and accurate manner. One example of the planning process was presented for steel superstructures, which would only represent a small portion of that required for a comprehensive program. Generally, careful planning and investigation is required prior to implementation of any inspection program to achieve desired results. The results of the process, such as provided in Figures 6.3 thru 6.4, may be of help both in the management of the program and useful in including in an inspection package for field use and scheduling of resources.

CHAPTER VII

CONCLUSIONS

Findings

Through investigation and completion of the cluster analysis, considerable insight into the characteristics of the national inventory was gained. This type of analysis proved to be useful in addressing data sets with different types of parameters (continuous, nominal, etc.). The results of the analyses provide a logical method of stratifying an inventory and identifying structures with similar characteristics, and may be of use when selecting a representative sample needed for programs such as the LTBP.

The latent class cluster analysis process was found to be quite cumbersome and computationally intensive when applied to the national inventory. However, as the number of clusters increased for a given analysis, more understanding of the data structure became evident thus justifying the effort. Care should be taken to evaluate any procedure, and parameters included, prior to implementation on any large scale inventory.

Environmental exposure characteristics that were investigated proved to be useful in identifying structures with specific exposure conditions and further describing the inventory. These characteristics were found to be easily integrated with the cluster analysis results and bridge inventory data, and may be useful when studying specific forms of deterioration.

The proposed condition states provide an avenue to integrate more quantitative information into the inspection process. The number of states proposed indicates the number of different forms of deterioration throughout the inventory, and supports the need for such development.

Investigation of the forms of deterioration and models to estimate or predict deterioration found an overwhelming volume of information. Considerable effort was required to identify models practical enough to use throughout an inspection program. The magnitude of information found supports the need and interest in a better understanding of bridge performance.

Finally, when selecting analysis, modeling, and data acquisition procedures, care must be taken to insure that the inspection program manager (state, municipality, etc) has the resources (personnel, financial, etc.) for implementation. Implementation of the program must be considered at the beginning and throughout the entire process of developing a bridge inspection program.

Future Work

Two areas of future work became evident through completion of this research effort. These included further improvement of the condition states and implementation of the proposed methods into an actual bridge inspection practice.

The proposed condition states augmented the existing condition states through the integration of quantitative treatment. This integration typically involved identifying appropriate amounts of specific forms of deterioration and relating this to the different ratings. Therefore, damage is estimated based on inference from observed conditions, and no true consideration is given to actual reduction in capacity or the underlying process causing the damage. Including correlations between loss of structural capacity and condition ratings will ultimately yield an inspection process that evaluates structures based on actual condition rather than observed condition. In this regard, many recent advances in structural health monitoring techniques including detection of faults and damage and the development of algorithms to identify damage may be integrated into bridge assessment. Techniques such as these will help move bridge inspection, assessment, and management to a proactive mode rather than a reactive mode.

Second, use of the proposed methods on a small sample of bridges within an existing program may allow the validation of the procedures developed. This will also allow the calibration of the suggested models and identification of improvements that are needed. This integration will provide opportunity to utilize the selection procedure with a specific purpose, identify any unforeseen problems, and improve the process to provide a better sampling mechanism. Use of the proposed conditions states by the inspection team will identify any improvement in understanding of bridge condition if results from existing and proposed condition states are compared. This will also identify needed improvement in the proposed condition states. Finally, use of the models to verify or estimate damage on current and past inspections may provide insight into the usefulness of such models in bridge inspection and assessment.

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APPENDIX

Table A1: *National Bridge Inventory Parameters*

State Code	Navigation Control	Type of Work
Structure Number	Navigation Vertical Clearance	Type of Work Proposed
Inventory Route	Navigation Horizontal Clearance	Work Done By
Record Type	Structure Open/Posted/Closed	Length Of Structure Improvement
Route Signing Prefix	Type Of Service	Inspection Date
Designated Level of Service	Type of Service On Bridge	Designated Inspection Frequency
Route Number	Type of Service Under Bridge	Critical Feature Inspection
Directional Suffix	Structure Type, Main	Fracture Critical Details
Highway Agency District	Kind of Material/Design	Underwater Inspection
County (Parish) Code	Type of Design/Construction	Other Special Inspection
Place Code	Structure Type, Approach Spans	Critical Feature Inspection Dates
Features Intersected	Kind of Material/Design	Fracture Critical Details Date
Features Intersected	Type of Design/Construction	Underwater Inspection Date
Critical Facility Indicator	Number Of Spans In Main Unit	Other Special Inspection Date
Facility Carried By Structure	Number Of Approach Spans	Bridge Improvement Cost
Location	Inventory Rte Total Horz. Clear.	Roadway Improvement Cost
Inv Rte, Min Vert. Clear	Length Of Maximum Span	Total Project Cost
Kilometerpoint	Structure Length	Year Of Imp. Cost Estimate
Base Highway Network	Curb/Sidewalk Widths	Border Bridge
Inventory Route	Left Curb/Sidewalk Width	Neighboring State Code
LRS Inventory Route	Right Curb/Sidewalk Width	Percent Responsibility
Subroute Number	Bridge Roadway Width C-To-C	Border Bridge Structure Number
Latitude	Deck Width, Out-To-Out	STRAHNET Highway Desig.
Longitude	Min Vert Clear Over Bridge Road	Parallel Structure Designation
Bypass/Detour Length	Minimum Vertical Under.	Direction Of Traffic
Toll	Reference Feature	Temporary Structure Designation
Maintenance Responsibility	Minimum Vertical Under.	Highway System/Inventory Route
Owner	Min Lateral Under On Right	Federal Lands Highways
Functional Class/Inv Rte.	Reference Feature	Year Reconstructed
Year Built	Minimum Lateral Under	Deck Structure Type
Lanes On/Under Structure	Min Lateral Under On Left	Wearing Surface/Prot Sys
Lanes On Structure	Deck	Type of Wearing Surface
Lanes Under Structure	Superstructure	Type of Membrane
Average Daily Traffic	Substructure	Deck Protection
Year Of ADT	Channel/Channel Protection	Average Daily Truck Traffic
Design Load	Culverts	Designated National Network
Approach Roadway Width	Method Used/Operating Rating	Pier/Abutment Protection
Bridge Median	Operating Rating	NBIS Bridge Length
Skew	Method Used/Inventory Rating	Scour Critical Bridges
Structure Flared	Inventory Rating	Future Average Daily Traffic
Traffic Safety Features	Structural Evaluation	Year of Future Avg. Daily Traffic
Bridge Railings	Deck Geometry	Minimum Navigation Vert Clear
Transitions	Underclear, Vertical & Horizontal	Vertical Lift Bridge
Approach Guardrail	Bridge Posting	Status
Approach Guardrail Ends	Waterway Adequacy	Asterisk Field in SR
Historical significance	Approach Roadway Alignment	Sufficiency Rating

Table A2: Structure and Material Type Combinaitons

Main Structure Type	No. of Bridges	% of Inventory
Concrete		
Slab	34,947	5.911
Stringer/Multi-beam or Girder	10,179	1.722
Girder and Floorbeam System	1,065	0.18
Tee Beam	22,740	3.846
Box Beam or Girders – Multiple	1,615	0.273
Box Beam or Girders - Single or Spread	223	0.038
Frame (except frame culverts)	3,448	0.583
Truss – Deck	5	0.001
Truss – Thru	11	0.002
Arch – Deck	5,324	0.901
Arch – Thru	162	0.027
Culvert (includes frame culverts)	71,581	12.107
Mixed Types	218	0.037
Segmental Box Girder	10	0.002
Channel Beam	11,890	2.011
Concrete Continuous		
Slab	29,842	5.047
Stringer/Multi-beam or Girder	2,930	0.496
Girder and Floorbeam System	262	0.044
Tee Beam	6,910	1.169
Box Beam or Girders – Multiple	4,499	0.761
Box Beam or Girders - Single or Spread	1,078	0.182
Frame (except frame culverts)	915	0.155
Truss – Deck	6	0.001
Truss – Thru	4	0.001
Arch – Deck	254	0.043
Arch – Thru	17	0.003
Culvert (includes frame culverts)	28,783	4.868
Mixed Types	72	0.012
Segmental Box Girder	8	0.001
Channel Beam	22	0.004
Steel		
Slab	185	0.031
Stringer/Multi-beam or Girder	109,983	18.603
Girder and Floorbeam System	5,488	0.928
Tee Beam	8	0.001
Box Beam or Girders – Multiple	207	0.035
Box Beam or Girders - Single or Spread	92	0.016
Frame (except frame culverts)	103	0.017
Truss – Deck	652	0.11
Truss – Thru	13,847	2.342
Arch – Deck	416	0.07
Arch – Thru	142	0.024

Table A2 Continued: Structure and Material Type Combinaitons

Main Structure Type	No. of Bridges	% of Inventory
Culvert (includes frame culverts)	13,244	2.24
Mixed Types	98	0.017
Segmental Box Girder	1	0
Channel Beam	3	0.001
Steel Continuous		
Slab	55	0.009
Stringer/Multi-beam or Girder	45,149	7.637
Girder and Floorbeam System	1,573	0.266
Tee Beam	10	0.002
Box Beam or Girders – Multiple	276	0.047
Box Beam or Girders - Single or Spread	214	0.036
Frame (except frame culverts)	147	0.025
Truss – Deck	135	0.023
Truss – Thru	269	0.045
Arch – Deck	9	0.002
Arch – Thru	29	0.005
Culvert (includes frame culverts)	55	0.009
Mixed Types	0	0
Segmental Box Girder	11	0.002
Channel Beam	1	0
Prestressed Concrete		
Slab	8,876	1.501
Stringer/Multi-beam or Girder	43,815	7.411
Girder and Floorbeam System	132	0.022
Tee Beam	7,244	1.225
Box Beam or Girders – Multiple	34,433	5.824
Box Beam or Girders - Single or Spread	3,562	0.602
Frame (except frame culverts)	39	0.007
Truss – Deck	0	0
Truss – Thru	1	0
Arch – Deck	73	0.012
Arch – Thru	5	0.001
Culvert (includes frame culverts)	3,140	0.531
Mixed Types	24	0.004
Segmental Box Girder	3	0.002
Channel Beam	1,506	0.255
Prestressed Concrete Continuous		
Slab	236	0.04
Stringer/Multi-beam or Girder	10,818	1.83
Girder and Floorbeam System	21	0.004
Tee Beam	647	0.109
Box Beam or Girders – Multiple	3,328	0.563
Box Beam or Girders - Single or Spread	2,040	0.345

Table A2 Continued: Structure and Material Type Combinaitons

Main Structure Type	No. of Bridges	% of Inventory
Frame (except frame culverts)	7	0.001
Truss – Deck	0	0
Truss – Thru	0	0
Arch – Deck	2	0
Arch – Thru	0	0
Culvert (includes frame culverts)	7	0.001
Mixed Types	0	0
Segmental Box Girder	108	0.018
Channel Beam	13	0.002
Wood or Timber		
Slab	3,456	0.585
Stringer/Multi-beam or Girder	27,695	4.684
Girder and Floorbeam System	107	0.018
Tee Beam	28	0.005
Box Beam or Girders – Multiple	41	0.007
Box Beam or Girders – Single or Spread	6	0.001
Frame (except frame culverts)	219	0.037
Truss – Deck	20	0.003
Truss – Thru	414	0.07
Arch – Deck	9	0.002
Arch – Thru	31	0.005
Culvert (includes frame culverts)	138	0.023
Mixed Types	14	0.002
Segmental Box Girder	0	0
Channel Beam	1	0
Masonry		
Slab	21	0.004
Stringer/Multi-beam or Girder	11	0.002
Girder and Floorbeam System	0	0
Tee Beam	6	0.001
Box Beam or Girders – Multiple	0	0
Box Beam or Girders - Single or Spread	0	0
Frame (except frame culverts)	2	0
Truss – Deck	0	0
Truss – Thru	0	0
Arch – Deck	1,289	0.218
Arch – Thru	9	0.002
Culvert (includes frame culverts)	485	0.082
Mixed Types	41	0.007
Segmental Box Girder	0	0
Channel Beam	0	0

Table A3: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Concrete - Slab		
Number of Bridges	34393	34393	34393	3617
Minimum	0	26	0	0
Maximum	172	10973	98	89
Mean	42.61	216.6	6.09	27.45
Standard Deviation	23.3	254.98	7.5	17.49
25th Percentile	25	85	0	12.75
50th Percentile	41	137	5	27
75th Percentile	62	274	10	41
		Concrete Continuous - Slab		
Number of Bridges	29643	29643	29643	3578
Minimum	0	61	0	0
Maximum	132	20184	99	82
Mean	34.26	336.72	9.99	19.83
Standard Deviation	19.54	322.8	10.51	13.79
25th Percentile	19	216	2	10
50th Percentile	35	302	8	16
75th Percentile	45	387	14	29
		Prestressed Concrete - Slab		
Number of Bridges	8741	8741	8741	795
Minimum	0	48	0	1
Maximum	152	45315	90	76
Mean	25.12	244.93	5.65	15.52
Standard Deviation	18.04	537.2	5.95	10.83
25th Percentile	12	113	1	7
50th Percentile	23	173	5	14
75th Percentile	34	305	8	22
		Wood or Timber - Slab		
Number of Bridges	3367	3367	3367	292
Minimum	1	37	0	1
Maximum	102	2140	60	56
Mean	27.55	157.37	2.68	15.84
Standard Deviation	18.6	104.25	4.96	11.51
25th Percentile	13	80	0	7.5
50th Percentile	24	130	0	12
75th Percentile	38	201	5	20

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Concrete - Stringer/Multi-beam or Girder		
Number of Bridges	10135	10135	10135	1034
Minimum	0	57	0	1
Maximum	152	61896	83	82
Mean	39.86	441.49	9.91	22.7
Standard Deviation	21.69	908.15	10.55	15.23
25th Percentile	25	149	0	12
50th Percentile	39	305	8	18
75th Percentile	49	488	15	32
		Concrete Continuous - Stringer/Multi-beam or Girder		
Number of Bridges	2894	2894	2894	529
Minimum	0	64	0	1
Maximum	152	6801	75	88
Mean	51.9	447.72	7.87	21.07
Standard Deviation	21.83	430.17	8.53	17.25
25th Percentile	39	162	0	8
50th Percentile	46	366	5	16
75th Percentile	71	588	10	29
		Steel - Stringer/Multi-beam or Girder		
Number of Bridges	106452	106452	106452	19401
Minimum	0	24	0	0
Maximum	192	154881	99	97
Mean	44.2	349.23	5.76	21.43
Standard Deviation	23.28	1123.27	6.66	14.33
25th Percentile	28	98	0	11
50th Percentile	42	164	4	18
75th Percentile	62	387	10	29
		Steel Continuous - Stringer/Multi-beam or Girder		
Number of Bridges	44676	44676	44676	9371
Minimum	0	43	0	0
Maximu	166	121091	95	77
Mean	33.94	1013.06	9.46	14.8
Standard Deviation	16.51	1679.68	9.14	10.26
25th Percentile	24	472	3	8
50th Percentile	34	692	8	14
75th Percentile	43	1000	13	19

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Prestressed Concrete - Stringer/Multi-beam or Girder		
Number of Bridges	43553	43553	43553	3466
Minimum	0	61	0	0
Maximum	127	233824	95	66
Mean	23.73	820.78	9.15	13.71
Standard Deviation	14.02	2626.04	9.05	9.01
25th Percentile	12	332	3	7
50th Percentile	24	542	7	12
75th Percentile	34	808	13	19
		Prestressed Concrete Contimuous - Stringer/Multi-beam or Girder		
Number of Bridges	10760	10760	10760	740
Minimum	0	73	0	0
Maximum	102	83768	99	69
Mean	17.77	983.24	9.91	10.49
Standard Deviation	12.51	2300.13	8.34	7.07
25th Percentile	8	491	5	5
50th Percentile	16	642.5	9	10
75th Percentile	26	905	13	14
		Wood or Timber - Stringer/Multi-beam or Girder		
Number of Bridges	27018	27018	27018	3886
Minimum	0	34	0	0
Maximum	172	8784	90	66
Mean	44.28	163.48	4.35	22
Standard Deviation	20.68	164.45	8.38	13.99
25th Percentile	31	91	0	11
50th Percentile	44	122	0	19
75th Percentile	58	183	6	31
		Concrete - Girder or Floorbeam System		
Number of Bridges	1042	1042	1042	98
Minimum	1	67	0	2
Maximum	102	4542	58	81
Mean	62.25	289.3	5.06	33.03
Standard Deviation	23.77	392.16	6.94	20.51
25th Percentile	47	106	0	17
50th Percentile	71	158	2	32
75th Percentile	79	320	8	47

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Steel - Girder or Floorbeam System		
Number of Bridges	5176	5176	5176	1202
Minimum	0	61	0	0
Maximum	170	32812	90	103
Mean	56.67	563.63	4.77	23.68
Standard Deviation	24.39	1440.14	6.16	15.76
25th Percentile	39	131	0	13
50th Percentile	61	207.5	3	20
75th Percentile	72	390	8	32
		Steel Continuous - Girder or Floorbeam System		
Number of Bridges	1549	1549	1549	386
Minimum	1	73	0	1
Maximum	152	384216	50	80
Mean	40.67	3018.28	9.26	18.44
Standard Deviation	17.32	14303.99	8.68	11.95
25th Percentile	29	613	2	10
50th Percentile	40	1353	7	16
75th Percentile	48	2777	13	23
		Concrete - Tee Beam		
Number of Bridges	22507	22507	22507	4537
Minimum	0	57	0	1
Maximum	152	73490	95	85
Mean	55.77	367.79	8.55	34.21
Standard Deviation	19.42	768.48	7.47	16.6
25th Percentile	43	122	3	20
50th Percentile	60	262	7	37
75th Percentile	72	457	10	46
		Concrete Continuous - Tee Beam		
Number of Bridges	6840	6840	6840	1000
Minimum	1	67	0	0
Maximum	152	13216	60	73
Mean	43.9	606	10.78	23.01
Standard Deviation	15.01	536.44	10.79	15.13
25th Percentile	35	354	3	11
50th Percentile	41	491.5	8	19
75th Percentile	48	719	15	32

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
			Prestressed Concrete - Tee Beam	
Number of Bridges	7184	7184	7184	472
Minimum	0	61	0	1
Maximum	102	60344	80	48
Mean	23.71	274.45	6.96	18.37
Standard Deviation	14.86	1050.28	8.17	10.2
25th Percentile	14	119.5	0	10
50th Percentile	22	171	4	18
75th Percentile	31	308	10	25.5
			Prestressed Concrete Continuous - Tee Beam	
Number of Bridges	640	640	640	38
Minimum	0	76	0	0
Maximum	102	15697	57	34
Mean	18.49	641.03	9.16	13.82
Standard Deviation	16.2	827.36	7.65	8.32
25th Percentile	9	335	4.5	9
50th Percentile	16	460	10	15
75th Percentile	23	669	10	18
			Concrete Continuous- Box Beam or Girders - Multiple	
Number of Bridges	4475	4475	4475	450
Minimum	1	79	0	1
Maximum	102	65800	90	47
Mean	33.9	1024.28	7.96	17.51
Standard Deviation	9.58	1692.84	8.99	10.73
25th Percentile	30	549	2	8
50th Percentile	35	719	5	15
75th Percentile	39	1012	10	27
			Prestressed Concrete- Box Beam or Girders - Multiple	
Number of Bridges	34132	34132	34132	3633
Minimum	0	40	0	0
Maximum	170	24940	99	100
Mean	24.29	261.04	4.61	17.22
Standard Deviation	20.06	374.98	6.09	10.02
25th Percentile	11	128	0	9
50th Percentile	19	185	3	17
75th Percentile	32	297	7	23

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
Prestressed Concrete Continuous- Box Beam or Girders - Multiple				
Number of Bridges	3306	3306	3306	246
Minimum	0	98	0	1
Maximum	102	26700	95	42
Mean	19.15	1253.19	6.1	13.36
Standard Deviation	13.88	1872.58	6.85	7.85
25th Percentile	9	530	2	8
50th Percentile	16	780	5	13
75th Percentile	28	1173	9	19
Concrete Continuous - Box Beam or Girders - Single or Spread				
Number of Bridges	1075	1075	1075	161
Minimum	0	98	0	2
Maximum	87	33245	80	40
Mean	34.18	1072.44	9.74	16.03
Standard Deviation	10.55	1488.73	7.87	7.53
25th Percentile	29	625.75	5	11
50th Percentile	36	788	10	16
75th Percentile	41	1108.25	11	18
Prestressed Concrete - Box Beam or Girders - Single or Spread				
Number of Bridges	3545	3545	3545	504
Minimum	0	67	0	0
Maximum	155	10973	80	45
Mean	23.28	362.68	9.42	11.76
Standard Deviation	16.29	484.46	9.56	7.6
25th Percentile	10	158.75	3	5
50th Percentile	21	259	7	11
75th Percentile	35	430	12	17
Prestressed Concrete Continuous - Box Beam or Girders - Single or Spread				
Number of Bridges	2029	2029	2029	173
Minimum	0	64	0	1
Maximum	99	24643	70	1224
Mean	16.35	818.29	8.07	17.67
Standard Deviation	11.43	1242.2	7.61	92.47
25th Percentile	9	384	3	7
50th Percentile	14	527	6	9
75th Percentile	21	799.25	10	15

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Concrete - Frame (except frame culverts)		
Number of Bridges	3119	3119	3119	340
Minimum	0	43	0	0
Maximum	109	30016	72	1525
Mean	35.19	157.24	7.41	26.58
Standard Deviation	23.15	593.05	8.16	82.85
25th Percentile	11	79	2	10
50th Percentile	40	104	5	20
75th Percentile	52	170	10	32
		Concrete Continuous - Frame (except frame culverts)		
Number of Bridges	847	847	847	100
Minimum	1	61	0	1
Maximum	102	2770	40	6626
Mean	43.28	319.76	4.33	85.84
Standard Deviation	15.01	197.82	6.3	660.86
25th Percentile	35	189.75	0	7
50th Percentile	44	305	1	13.5
75th Percentile	50	398.25	7	31.5
		Steel - Truss – Deck		
Number of Bridges	633	633	633	211
Minimum	0	72	0	1
Maximum	154	45415	99	1927
Mean	60.96	1586.96	6.71	30.31
Standard Deviation	25.01	3022.48	9.42	131.95
25th Percentile	45	235	0	12
50th Percentile	63	524	5	18
75th Percentile	74	1704	9	28.75
		Steel - Truss – Thru		
Number of Bridges	13546	13546	13546	3051
Minimum	0	67	0	0
Maximum	170	65060	90	98
Mean	73.48	562.74	5.29	26.33
Standard Deviation	23.3	1601.91	7.11	17.77
25th Percentile	64	186	0	13
50th Percentile	75	277	2	22
75th Percentile	92	454	10	38

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Concrete - Arch - Deck		
Number of Bridges	4951	4951	4951	1101
Minimum	0	61	0	0
Maximum	175	91827	98	90
Mean	73.73	367.93	5.03	31.78
Standard Deviation	19.7	1465.95	4.98	19.33
25th Percentile	67	107	1	16
50th Percentile	77	168	5	30
75th Percentile	86	309.5	8	45
		Masonry - Arch - Deck		
Number of Bridges	1122	1122	1122	317
Minimum	33	56	0	1
Maximum	201	3277	60	104
Mean	101.78	185.3	3.95	43.46
Standard Deviation	29.53	225.4	4.6	26.97
25th Percentile	82	85	0	21
50th Percentile	100	122	3	42
75th Percentile	112	201	6	67.25
		Concrete - Culvert (includes frame culverts)		
Number of Bridges	71015	71015	71015	9617
Minimum	0	30	0	0
Maximum	160	3188	99	82
Mean	37.58	104.63	9.54	26.64
Standard Deviation	21.42	64.24	9.83	15.39
25th Percentile	19	73	1	14
50th Percentile	38	91	8	26
75th Percentile	52	116	15	39
		Concrete Continuous - Culvert (includes frame culverts)		
Number of Bridges	28598	28598	28598	2559
Minimum	0	34	0	1
Maximum	102	5593	99	77
Mean	36.36	107.3	8.82	26.51
Standard Deviation	20.99	66.09	8.99	15.02
25th Percentile	18	76	2	14
50th Percentile	36	94	7	26
75th Percentile	50	122	12	37

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Steel - Culvert (includes frame culverts)		
Number of Bridges	12590	12590	12590	393
Minimum	0	24	0	0
Maximum	102	1658	90	64
Mean	25.91	95.77	5.06	18.55
Standard Deviation	17.23	50.79	6.49	12.44
25th Percentile	14	70	0	9
50th Percentile	23	83	4	16
75th Percentile	34	106	7	26
		Prestressed Concrete - Culvert (includes frame culverts)		
Number of Bridges	3131	3131	3131	69
Minimum	0	34	0	1
Maximum	152	7327	56	41
Mean	15.08	104.39	1.22	11.57
Standard Deviation	9.28	133.12	3.86	6.88
25th Percentile	7	80	0	6
50th Percentile	15	92	0	11
75th Percentile	23	118	0	15
		Masonry - Culvert (includes frame culverts)		
Number of Bridges	474	474	474	53
Minimum	2	61	0	4
Maximum	161	1247	50	101
Mean	67.38	98.37	5.26	37.32
Standard Deviation	15.32	68.09	7.47	20.92
25th Percentile	62	73	0	20.75
50th Percentile	65	85	1	41
75th Percentile	70	107	9	47.5
		Concrete - Channel Beam		
Number of Bridges	11884	11884	11884	569
Minimum	0	61	0	1
Maximum	122	5154	70	60
Mean	27.7	217.85	4.21	21.08
Standard Deviation	16.39	173.65	5.14	12.6
25th Percentile	15	116	0	10
50th Percentile	28	174	2	22
75th Percentile	38	283	8	30

Table A3 - Continued: *Sub-Population Continuous Parameter Statistics*

	Age (years)	Structure Length (meters x 10)	Average Daily Truck Traffic (%)	Reconstructed Age (years)
		Prestressed Concrete - Channel Beam		
Number of Bridges	1485	1485	1485	81
Minimum	1	61	0	4
Maximum	146	1463	90	42
Mean	32.87	193.42	4.44	20.57
Standard Deviation	12.41	131.06	5.99	9.8
25th Percentile	27	98	0	11
50th Percentile	34	162	5	21
75th Percentile	38	247	6	27.25

Table A4: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
		Concrete - Slab		
1	3,195	26,225	11,123	1,919
2	7,321	6,603	474	12
3	1,020	2	91	4
4	3,451	4	79	2
5	10,699	4	52	---
6	1,400	7	16,166	27
7	0	0	50	9
8	14	56	1,300	7,577
9	249	247	729	190
0	7,044	---	4,106	24,009
N	---	1,245	223	644
		Concrete Continuous - Slab		
1	463	29,081	14,467	3,648
2	3,040	132	1,011	18
3	714	0	1,265	5
4	4,381	0	1,641	69
5	13,105	0	126	---
6	3,788	4	8,068	59
7	2	0	17	7
8	2	22	814	2,886
9	587	126	744	139
0	3,561	---	1,399	22,599
N	---	278	91	213
		Prestressed Concrete - Slab		
1	25	3,216	1,760	799
2	281	3,351	105	70
3	430	4	34	3
4	867	0	12	1
5	4,241	1	8	---
6	1,721	5	6,373	5
7	2	1	9	21
8	1	21	65	1,268
9	566	1,621	48	17
0	607	---	305	6,211
N	---	521	22	346
		Wood or Timber - Slab		
1	30	74	63	30
2	255	13	0	0
3	13	1	0	0

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
4	520	0	0	2
5	1,646	1	0	---
6	158	3	2,405	0
7	0	6	327	31
8	1	2,764	502	101
9	112	9	15	96
0	632	---	53	1,799
N	---	496	2	1,308
		Concrete - Stringer/Multi-beam or Girder		
1	173	9,004	4,579	198
2	2,149	619	67	1
3	157	0	135	2
4	1,839	0	23	4
5	3,818	1	9	---
6	145	6	4,326	47
7	0	1	16	6
8	0	29	341	4,830
9	73	99	345	141
0	1,781	---	235	4,820
N	---	376	59	86
		Concrete Continuous - Stringer/Multi-beam or Girder		
1	28	2,743	997	87
2	684	24	27	2
3	63	1	291	0
4	201	7	16	0
5	1,013	1	2	---
6	148	2	1,357	2
7	0	0	7	0
8	2	6	52	195
9	28	42	23	12
0	727	---	110	2,580
N	---	68	12	16
		Steel - Stringer/Multi-beam or Girder		
1	4,116	70,668	33,749	7,245
2	11,660	547	3,251	179
3	2,032	1,544	2,729	52
4	9,877	791	453	47
5	23,329	455	334	---
6	10,042	7,283	37,333	78
7	8	93	10,992	154
8	40	22,240	8,312	8,765

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
9	1,617	1,489	2,909	435
0	43,731	---	6,158	87,883
N	---	1,342	232	1,614
		Steel Continuous - Stringer/Multi-beam or Girder		
1	560	41,563	20,473	11,071
2	4,481	348	3,553	118
3	1,150	157	3,393	26
4	4,445	68	2,007	87
5	19,436	72	229	---
6	8,979	689	9,767	118
7	2	10	677	25
8	6	1,278	482	5,289
9	1,603	263	2,389	351
0	4,014	---	1,663	26,726
N	---	228	43	865
		Prestressed Concrete - Stringer/Multi-beam or Girder		
1	112	39,372	27,428	7,552
2	2,199	3,102	489	100
3	1,042	4	918	15
4	2,792	9	820	26
5	27,190	5	172	---
6	6,779	22	8,261	135
7	1	2	41	13
8	5	67	172	9,890
9	2,011	565	404	642
0	1,422	---	4,663	23,193
N	---	405	185	1,987
		Prestressed Concrete Contimuous - Stringer/Multi-beam or Girder		
1	14	9,498	7,531	a
2	221	1,137	266	6
3	21	1	310	0
4	448	2	329	8
5	7,402	4	23	---
6	1,655	7	1,371	11
7	1	0	3	3
8	0	17	3	717
9	845	34	43	29
0	153	---	852	5,326
N	---	60	29	44

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
		Wood or Timber - Stringer/Multi-beam or Girder		
1	4,052	2,364	1,335	11
2	3,380	50	4	1
3	308	24	3	3
4	1,225	3	5	0
5	1,960	25	2	---
6	122	215	7,899	8
7	2	47	9,994	57
8	8	24,048	4,799	2,027
9	147	86	1,878	158
0	15,814	---	1,039	24,024
N	---	156	60	729
		Concrete - Girder or Floorbeam System		
1	24	937	428	15
2	231	67	13	0
3	41	2	2	0
4	124	0	2	0
5	140	0	6	---
6	45	3	417	0
7	0	0	3	1
8	0	4	135	39
9	7	18	22	5
0	430	---	10	702
N	---	11	4	280
		Steel - Girder or Floorbeam System		
1	233	2,709	1,040	331
2	478	15	215	8
3	65	165	120	5
4	495	58	39	2
5	852	72	9	---
6	197	296	1,911	4
7	2	6	831	4
8	11	1,615	332	264
9	38	184	363	27
0	2,805	---	301	4,478
N	---	56	15	53
		Steel Continuous - Girder or Floorbeam System		
1	58	1,375	748	236
2	156	6	33	2
3	38	16	162	0

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
4	150	5	76	0
5	734	2	8	---
6	201	18	329	15
7	0	1	27	0
8	1	103	14	171
9	35	7	24	3
0	176	---	125	1,102
N	---	16	3	20
		Concrete - Tee Beam		
1	395	21,202	6,182	364
2	7,787	699	237	10
3	1,370	1	978	13
4	3,149	2	386	7
5	4,803	3	48	---
6	1,383	3	13,396	92
7	2	0	11	10
8	4	27	240	4,111
9	23	149	173	152
0	3,591	---	763	17,555
N	---	421	93	193
		Concrete Continuous - Tee Beam		
1	25	6,692	2,694	198
2	879	29	117	2
3	233	0	518	0
4	886	1	299	11
5	3,262	0	23	---
6	937	2	2,614	31
7	2	0	1	2
8	0	1	24	485
9	14	39	58	27
0	602	---	487	6,071
N	---	76	5	13
		Prestressed Concrete - Tee Beam		
1	20	3,508	3,265	730
2	539	2,279	89	24
3	164	3	9	4
4	844	1	18	2
5	3,601	1	3	---
6	293	3	2,225	3
7	1	0	17	1
8	1	13	628	267

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
9	231	794	34	7
0	1,490	---	654	5,893
N	---	582	242	253
		Prestressed Concrete Continuous - Tee Beam		
1	9	443	456	292
2	22	147	11	0
3	13	1	7	0
4	86	0	16	0
5	338	0	0	---
6	108	1	85	0
7	0	0	0	1
8	0	0	1	17
9	18	45	4	1
0	46	---	54	326
N	---	3	6	3
		Concrete Continuous- Box Beam or Girders - Multiple		
1	0	4,404	2,711	141
2	116	21	37	0
3	22	0	75	2
4	209	0	214	8
5	3,062	1	15	---
6	981	0	855	12
7	0	1	1	0
8	1	2	2	128
9	21	13	22	3
0	63	---	539	4,136
N	---	33	4	45
		Prestressed Concrete- Box Beam or Girders - Multiple		
1	41	14,611	12,846	5,138
2	498	13,758	912	70
3	945	3	357	25
4	1,590	4	40	11
5	19,651	4	50	---
6	4,986	18	17,779	128
7	0	0	16	81
8	2	49	221	3,761
9	3,704	2,809	1,038	411
0	2,715	---	527	22,917
N	---	2,876	346	1,590

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
Prestressed Concrete Continuous- Box Beam or Girders - Multiple				
1	2	3,095	2,066	552
2	14	116	88	1
3	6	0	78	3
4	34	0	1	4
5	1,326	1	10	---
6	1,715	0	611	5
7	1	0	2	1
8	1	1	0	77
9	164	31	40	12
0	43	---	405	2,589
N	---	62	5	62
Concrete Continuous - Box Beam or Girders - Single or Spread				
1	3	1,063	575	71
2	33	4	15	0
3	61	0	103	0
4	104	0	56	53
5	539	0	14	---
6	305	0	261	5
7	0	0	0	0
8	0	0	0	47
9	5	6	0	1
0	25	---	50	896
N	---	2	1	2
Prestressed Concrete - Box Beam or Girders - Single or Spread				
1	7	3,006	2,536	1,427
2	33	432	59	24
3	8	2	247	5
4	197	31	5	3
5	1,900	1	0	---
6	550	3	596	32
7	0	0	3	1
8	1	9	18	147
9	637	42	4	4
0	212	---	63	1,890
N	---	19	14	12
Prestressed Concrete Continuous - Box Beam or Girders - Single or Spread				
1	3	1,582	1,713	1,079
2	14	420	36	2
3	6	0	53	2

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
4	109	8	15	0
5	1,291	0	2	---
6	321	3	174	0
7	1	0	2	0
8	0	0	14	63
9	242	12	3	4
0	42	---	10	870
N	---	4	7	9
		Concrete - Frame (except frame culverts)		
1	2	2,072	446	276
2	313	180	29	5
3	83	0	38	4
4	429	0	9	3
5	1,312	0	2	---
6	384	2	2,283	6
7	1	0	1	1
8	1	0	51	139
9	272	44	40	31
0	322	---	40	1,998
N	---	821	180	656
		Concrete Continuous - Frame (except frame culverts)		
1	4	684	106	35
2	67	5	13	0
3	13	0	11	0
4	155	0	9	3
5	323	0	7	---
6	53	0	396	0
7	0	0	0	0
8	1	0	14	59
9	3	13	9	0
0	228	---	254	618
N	---	145	28	132
		Steel - Truss – Deck		
1	13	336	149	52
2	126	1	23	1
3	21	25	24	0
4	72	12	13	0
5	176	7	7	---
6	31	93	257	4
7	0	1	84	1
8	1	149	14	51

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
9	2	7	30	6
0	191	---	29	507
N	---	2	3	11
		Steel - Truss – Thru		
1	633	4,998	2,792	375
2	1,738	23	228	30
3	222	380	106	2
4	684	160	37	5
5	982	104	39	---
6	153	1,192	3,448	5
7	0	21	4,619	24
8	6	6,260	925	910
9	88	317	627	111
0	9,040	---	676	11,733
N	---	91	49	351
		Concrete - Arch - Deck		
1	105	2,019	439	149
2	736	25	50	0
3	84	0	30	1
4	666	0	9	0
5	607	0	5	---
6	135	4	2,636	4
7	0	0	5	0
8	2	10	250	243
9	47	230	86	16
0	2,569	---	48	2,648
N	---	2,663	1,393	1,890
		Masonry - Arch - Deck		
1	14	106	24	4
2	134	1	4	0
3	10	0	0	0
4	58	3	0	0
5	64	0	0	---
6	5	0	451	1
7	0	0	0	0
8	0	0	123	29
9	3	167	64	5
0	834	---	4	518
N	---	845	452	565

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
		Concrete - Culvert (includes frame culverts)		
1	582	19,382	3,889	408
2	13,489	218	37	2
3	861	2	15	4
4	11,110	2	12	0
5	29,769	5	19	---
6	5,854	23	19,116	68
7	7	2	39	5
8	16	48	1,526	10,483
9	907	344	510	347
0	8,420	---	318	15,485
N		50,989	45,534	44,213
		Concrete Continuous - Culvert (includes frame culverts)		
1	1,163	10,093	2,898	1,088
2	4,722	39	17	1
3	214	0	0	1
4	2,446	0	30	0
5	13,462	1	1	---
6	2,759	2	6,092	0
7	5	1	8	0
8	2	11	2,870	356
9	37	471	328	17
0	3,788	---	743	10,693
N	---	17,980	15,611	16,442
		Steel - Culvert (includes frame culverts)		
1	63	217	175	8
2	1,484	3	1	0
3	82	0	0	0
4	1,298	0	1	0
5	3,695	11	0	---
6	2,653	139	1,747	0
7	0	2	21	1
8	24	36	603	179
9	135	105	121	13
0	3,156	---	155	2,080
N	---	12,077	9,766	10,309
		Prestressed Concrete - Culvert (includes frame culverts)		
1	0	20	73	6
2	3	9	0	1
3	0	0	0	0

Table A4 - Continued: *Sub-Population Nominal Parameter Statistics*

NBI Category	Design Load	Deck Structure Type	Type of Wearing Surface	Deck Protection
4	7	0	0	0
5	2,116	0	0	---
6	47	0	894	0
7	0	0	1	1
8	0	3	2,081	3
9	934	3	0	0
0	24	---	3	30
N	---	3,096	79	3,090
		Concrete - Channel Beam		
1	221	1,385	5,965	41
2	5,400	9,090	73	2
3	615	2	2	0
4	574	0	10	1
5	2,909	1	0	---
6	53	1	4,134	2
7	0	2	12	12
8	0	22	398	177
9	15	1,022	190	15
0	2,097	---	775	11,301
N	---	359	325	333
		Prestressed Concrete - Channel Beam		
1	276	871	335	26
2	299	146	5	0
3	25	0	0	1
4	200	0	0	0
5	445	0	0	---
6	11	0	842	0
7	0	0	0	1
8	0	1	12	101
9	5	297	134	0
0	224	---	154	1,328
N	---	170	3	28

Table A5: *Material and Structure Type Cluster Percentages*

Structure Type	Cluster														
---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Concrete															
Slab	0.173	0.158	0.157	0.113	0.094	0.074	0.056	0.045	0.043	0.024	0.020	0.019	0.017	0.009	---
Stringer/Multi-beam or Girder	0.223	0.223	0.211	0.210	0.038	0.034	0.031	0.030	---	---	---	---	---	---	---
Girder and Floorbeam System	No Clusters Required														
Tee Beam	0.413	0.209	0.124	0.113	0.049	0.044	0.030	0.018	---	---	---	---	---	---	---
Box Beam or Girders – Multiple	No Clusters Required														
Frame (except frame culverts)	0.695	0.176	0.130	---	---	---	---	---	---	---	---	---	---	---	---
Arch – Deck	0.438	0.282	0.167	0.114	---	---	---	---	---	---	---	---	---	---	---
Culvert (includes frame culverts)	0.385	0.095	0.077	0.067	0.056	0.053	0.047	0.041	0.038	0.037	0.033	0.026	0.025	0.011	0.010
Channel Beam	0.325	0.186	0.166	0.145	0.103	0.050	0.025	---	---	---	---	---	---	---	---
Concrete Continuous															
Slab	0.248	0.159	0.152	0.124	0.100	0.055	0.045	0.041	0.034	0.017	0.015	0.011	---	---	---
Stringer/Multi-beam or Girder	0.272	0.236	0.224	0.150	0.118	---	---	---	---	---	---	---	---	---	---
Tee Beam	0.390	0.226	0.129	0.105	0.076	0.074	---	---	---	---	---	---	---	---	---
Box Beam or Girders – Multiple	0.443	0.442	0.116	---	---	---	---	---	---	---	---	---	---	---	---
Box Beam or Girders – Single or Spread	No Clusters Required														
Frame (except frame culverts)	0.523	0.477	---	---	---	---	---	---	---	---	---	---	---	---	---
Culvert (includes frame culverts)	0.265	0.237	0.139	0.138	0.109	0.067	0.031	0.014	---	---	---	---	---	---	---
Steel															
Stringer/Multi-beam or Girder	0.254	0.246	0.082	0.080	0.078	0.040	0.039	0.026	0.026	0.025	0.024	0.023	0.022	0.020	0.015
Girder and Floorbeam System	0.384	0.320	0.153	0.143	---	---	---	---	---	---	---	---	---	---	---
Truss-Deck	No Clusters Required														
Truss - Thru	0.212	0.144	0.144	0.133	0.121	0.068	0.059	0.058	0.034	0.027	---	---	---	---	---
Arch Deck	No Clusters Required														

Table A5 - Continued: *Material and Structure Type Cluster Percentages*

Structure Type	Cluster														
---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Culvert	0.518	0.286	0.123	0.042	0.031	---	---	---	---	---	---	---	---	---	---
Steel Continuous															
Stringer/Multi-beam or Girder	0.311	0.123	0.117	0.088	0.073	0.053	0.052	0.037	0.035	0.032	0.022	0.021	0.020	0.009	0.008
Girder and Floorbeam System	0.729	0.271	---	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete															
Slab	0.518	0.286	0.123	0.042	0.031	---	---	---	---	---	---	---	---	---	---
Stringer/Multi-beam or Girder	0.507	0.184	0.147	0.059	0.043	0.033	0.020	0.007	---	---	---	---	---	---	---
Tee Beam	0.918	0.082	---	---	---	---	---	---	---	---	---	---	---	---	---
Box Beam or Girders – Multiple	0.314	0.217	0.087	0.073	0.063	0.053	0.053	0.036	0.035	0.025	0.023	0.016	0.005	---	---
Box Beam or Girders – Single or Spread	0.468	0.374	0.159	---	---	---	---	---	---	---	---	---	---	---	---
Culvert (includes frame culverts)	0.603	0.267	0.131	---	---	---	---	---	---	---	---	---	---	---	---
Channel Beam	0.914	0.086	---	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete Continuous															
Stringer/Multi-beam or Girder	0.502	0.376	0.069	0.053	---	---	---	---	---	---	---	---	---	---	---
Tee Beam	No Clusters Required														
Box Beam or Girders – Multiple	0.871	0.129	---	---	---	---	---	---	---	---	---	---	---	---	---
Box Beam or Girders – Single or Spread	0.856	0.145	---	---	---	---	---	---	---	---	---	---	---	---	---
Wood or Timber															
Slab	0.532	0.368	0.100	---	---	---	---	---	---	---	---	---	---	---	---
Stringer/Multi-beam or Girder	0.402	0.172	0.136	0.075	0.068	0.063	0.059	0.025	---	---	---	---	---	---	---
Truss – Thru	No Clusters Required														

Table A5 - Continued: *Material and Structure Type Cluster Percentages*

Structure Type	Cluster														
---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Masonry															
Arch – Deck	0.693	0.307	---	---	---	---	---	---	---	---	---	---	---	---	---
Culvert (includes frame culverts)	No Clusters Required														

Table A6: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
									Concrete - Slab							
DL1	0	0.94	0.97	0.95	0.98	0.90	0.33	1.00	1.00	0.98	0.96	0.97	0.99	0.99	0.21	---
	1	0.06	0.03	0.05	0.02	0.10	0.67	0.00	0.00	0.02	0.04	0.03	0.01	0.01	0.79	---
DL2	0	0.88	0.73	0.76	0.75	0.62	0.74	1.00	1.00	0.82	0.69	0.60	0.93	0.89	0.82	---
	1	0.12	0.27	0.24	0.25	0.38	0.26	0.00	0.00	0.18	0.31	0.40	0.07	0.11	0.18	---
DL3	0	0.95	0.97	0.96	0.94	0.97	0.99	1.00	1.00	0.96	0.97	0.99	1.00	0.98	1.00	---
	1	0.05	0.03	0.04	0.06	0.03	0.01	0.00	0.00	0.04	0.03	0.01	0.00	0.02	0.00	---
DL4	0	0.91	0.93	0.88	0.87	0.84	1.00	1.00	0.97	0.87	0.83	0.55	0.75	0.91	0.97	---
	1	0.09	0.07	0.12	0.13	0.16	0.00	0.00	0.03	0.13	0.17	0.45	0.25	0.09	0.03	---
DL5	0	0.43	0.54	0.92	0.63	0.81	0.96	1.00	0.27	0.80	0.73	0.94	0.65	0.49	1.00	---
	1	0.57	0.46	0.08	0.37	0.19	0.04	0.00	0.73	0.20	0.27	0.06	0.35	0.51	0.00	---
DL6	0	0.98	0.94	0.98	0.92	0.98	1.00	1.00	0.85	0.96	0.95	1.00	0.94	0.81	1.00	---
	1	0.02	0.06	0.02	0.08	0.02	0.00	0.00	0.15	0.04	0.05	0.00	0.06	0.19	0.00	---
DL9	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.97	1.00	1.00	0.98	0.98	1.00	---
	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.03	0.00	0.00	0.02	0.02	0.00	---
DL0	0	0.91	0.91	0.54	0.90	0.89	0.98	0.00	0.98	0.65	0.85	0.95	0.77	0.96	0.99	---
	1	0.09	0.09	0.46	0.10	0.11	0.02	1.00	0.02	0.35	0.15	0.05	0.23	0.04	0.01	---
DST1	0	0.31	0.26	0.01	0.14	0.06	1.00	0.06	0.04	0.20	0.17	0.00	0.98	0.14	1.00	---
	1	0.69	0.74	0.99	0.86	0.94	0.00	0.94	0.96	0.80	0.83	1.00	0.02	0.86	0.00	---
DST2	0	0.75	0.75	1.00	0.87	0.94	0.00	1.00	0.98	0.96	0.86	1.00	1.00	0.94	0.00	---
	1	0.25	0.25	0.00	0.14	0.06	1.00	0.00	0.02	0.04	0.14	0.00	0.00	0.06	1.00	---
DSTN	0	0.96	1.00	1.00	1.00	1.00	1.00	0.96	0.99	0.85	1.00	1.00	0.02	0.94	1.00	---
	1	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.15	0.00	0.00	0.98	0.06	0.00	---
TOWS1	0	0.60	0.98	0.91	0.00	0.65	0.80	0.77	0.18	0.81	0.76	0.95	0.89	0.53	0.85	---
	1	0.40	0.02	0.09	1.00	0.35	0.20	0.23	0.82	0.19	0.24	0.05	0.11	0.47	0.15	---
TOWS2	0	0.99	0.99	0.98	1.00	1.00	1.00	0.98	0.94	0.98	0.99	1.00	0.99	0.93	1.00	---
	1	0.01	0.01	0.02	0.00	0.00	0.00	0.02	0.06	0.02	0.01	0.00	0.01	0.07	0.00	---
TOWS6	0	0.76	0.46	0.25	1.00	0.40	0.20	0.62	0.95	0.31	0.36	0.06	0.33	0.80	0.16	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.24	0.54	0.75	0.00	0.60	0.80	0.38	0.05	0.69	0.64	0.94	0.67	0.20	0.84	---
TOWS8	0	0.96	0.99	0.93	1.00	0.99	1.00	0.71	1.00	0.96	1.00	1.00	0.99	1.00	1.00	---
	1	0.04	0.01	0.07	0.00	0.01	0.00	0.29	0.00	0.04	0.00	0.00	0.01	0.00	0.00	---
TOWS9	0	0.96	0.98	0.97	1.00	0.97	1.00	0.94	1.00	0.99	0.98	0.99	0.99	0.97	1.00	---
	1	0.04	0.02	0.03	0.00	0.03	0.00	0.06	0.00	0.01	0.02	0.01	0.01	0.03	0.00	---
TOWS0	0	0.74	0.61	0.98	1.00	0.99	1.00	0.99	0.94	0.98	0.94	1.00	1.00	0.84	1.00	---
	1	0.26	0.39	0.02	0.00	0.01	0.00	0.01	0.06	0.02	0.06	0.00	0.00	0.16	0.00	---
TOWSN	0	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.99	1.00	1.00	0.81	0.96	1.00	---
	1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.19	0.04	0.00	---
DP1	0	0.98	1.00	1.00	1.00	0.97	1.00	1.00	0.08	0.92	1.00	1.00	0.99	0.81	1.00	---
	1	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.92	0.08	0.00	0.00	0.01	0.19	0.00	---
DP8	0	0.88	1.00	1.00	1.00	0.09	0.00	0.89	0.95	0.97	1.00	0.04	0.99	0.82	0.00	---
	1	0.12	0.00	0.00	0.00	0.91	1.00	0.11	0.05	0.03	0.00	0.96	0.01	0.18	1.00	---
DP9	0	1.00	1.00	1.00	1.00	0.97	1.00	0.99	0.99	0.99	1.00	0.96	1.00	0.99	1.00	---
	1	0.00	0.00	0.00	0.00	0.03	0.00	0.01	0.01	0.01	0.00	0.04	0.00	0.01	0.00	---
DP0	0	0.15	0.00	0.00	0.00	1.00	1.00	0.14	1.00	0.21	0.00	1.00	0.48	0.46	1.00	---
	1	0.85	1.00	1.00	1.00	0.00	0.00	0.86	0.00	0.79	1.00	0.00	0.52	0.54	0.00	---
DPN	0	0.99	1.00	1.00	1.00	0.98	1.00	0.98	0.99	0.92	1.00	1.00	0.54	0.92	1.00	---
	1	0.01	0.00	0.00	0.00	0.02	0.00	0.02	0.01	0.08	0.00	0.00	0.46	0.08	0.00	---
Concrete - Stringer/Mulit-beam or girder																
DL1	0	0.99	0.98	1.00	0.96	0.96	1.00	0.99	0.97	---	---	---	---	---	---	---
	1	0.01	0.02	0.00	0.04	0.04	0.00	0.01	0.03	---	---	---	---	---	---	---
DL2	0	0.80	0.87	0.67	0.79	0.87	0.79	0.90	0.73	---	---	---	---	---	---	---
	1	0.20	0.13	0.33	0.21	0.13	0.21	0.10	0.27	---	---	---	---	---	---	---
DL3	0	0.98	0.99	1.00	0.96	0.99	1.00	0.98	0.98	---	---	---	---	---	---	---
	1	0.02	0.01	0.00	0.04	0.01	0.00	0.02	0.02	---	---	---	---	---	---	---
DL4	0	0.82	0.89	0.71	0.89	0.91	0.52	0.78	0.77	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.18	0.11	0.29	0.11	0.09	0.48	0.22	0.23	---	---	---	---	---	---	---
DL5	0	0.50	0.62	0.65	0.75	0.47	0.71	0.49	0.76	---	---	---	---	---	---	---
	1	0.50	0.38	0.35	0.25	0.53	0.29	0.51	0.24	---	---	---	---	---	---	---
DL6	0	0.98	0.99	1.00	0.99	0.93	0.99	0.93	1.00	---	---	---	---	---	---	---
	1	0.02	0.01	0.00	0.01	0.07	0.01	0.07	0.00	---	---	---	---	---	---	---
DL0	0	0.94	0.66	0.98	0.66	0.88	0.99	0.96	0.79	---	---	---	---	---	---	---
	1	0.06	0.34	0.02	0.34	0.12	0.01	0.04	0.21	---	---	---	---	---	---	---
DST1	0	0.02	0.23	0.01	0.20	0.08	0.00	0.01	0.30	---	---	---	---	---	---	---
	1	0.98	0.77	0.99	0.80	0.92	1.00	0.99	0.70	---	---	---	---	---	---	---
DST2	0	0.99	0.91	0.99	0.84	0.94	1.00	0.99	0.92	---	---	---	---	---	---	---
	1	0.01	0.09	0.01	0.16	0.06	0.00	0.01	0.08	---	---	---	---	---	---	---
DSTN	0	1.00	0.88	1.00	0.97	1.00	1.00	1.00	0.81	---	---	---	---	---	---	---
	1	0.00	0.12	0.00	0.03	0.00	0.00	0.00	0.19	---	---	---	---	---	---	---
TOWS1	0	0.04	0.39	1.00	0.72	0.55	0.80	0.59	0.82	---	---	---	---	---	---	---
	1	0.96	0.61	0.00	0.28	0.45	0.20	0.41	0.18	---	---	---	---	---	---	---
TOWS6	0	1.00	0.75	0.04	0.50	0.80	0.22	0.69	0.32	---	---	---	---	---	---	---
	1	0.00	0.25	0.96	0.50	0.20	0.78	0.31	0.68	---	---	---	---	---	---	---
TOWS8	0	1.00	0.93	1.00	0.93	0.99	1.00	1.00	0.97	---	---	---	---	---	---	---
	1	0.00	0.07	0.00	0.07	0.01	0.00	0.00	0.03	---	---	---	---	---	---	---
TOWS0	0	1.00	0.97	1.00	0.94	0.98	1.00	0.87	0.99	---	---	---	---	---	---	---
	1	0.00	0.03	0.00	0.06	0.02	0.00	0.13	0.01	---	---	---	---	---	---	---
DP1	0	0.95	0.99	1.00	1.00	0.94	1.00	0.94	1.00	---	---	---	---	---	---	---
	1	0.05	0.01	0.00	0.00	0.06	0.00	0.06	0.00	---	---	---	---	---	---	---
DP8	0	0.32	0.66	0.09	1.00	0.77	0.03	0.52	0.98	---	---	---	---	---	---	---
	1	0.68	0.34	0.91	0.00	0.23	0.97	0.48	0.02	---	---	---	---	---	---	---
DP0	0	0.76	0.39	0.95	0.02	0.31	0.98	0.56	0.04	---	---	---	---	---	---	---
	1	0.24	0.61	0.05	0.98	0.69	0.02	0.44	0.96	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							Concrete - Tee Beam									
DL1	0	0.97	0.98	0.99	0.99	1.00	0.99	1.00	0.99	---	---	---	---	---	---	---
	1	0.03	0.02	0.01	0.01	0.00	0.01	0.00	0.01	---	---	---	---	---	---	---
DL2	0	0.64	0.68	0.66	0.63	0.51	0.77	0.78	0.81	---	---	---	---	---	---	---
	1	0.36	0.32	0.34	0.37	0.49	0.23	0.22	0.19	---	---	---	---	---	---	---
DL3	0	0.94	0.98	0.87	0.96	0.99	0.89	0.94	0.79	---	---	---	---	---	---	---
	1	0.06	0.02	0.13	0.04	0.01	0.11	0.06	0.21	---	---	---	---	---	---	---
DL4	0	0.88	0.86	0.91	0.82	0.52	0.94	0.90	0.92	---	---	---	---	---	---	---
	1	0.12	0.14	0.09	0.18	0.48	0.06	0.10	0.08	---	---	---	---	---	---	---
DL5	0	0.74	0.91	0.76	0.79	0.98	0.60	0.56	0.78	---	---	---	---	---	---	---
	1	0.26	0.09	0.24	0.21	0.02	0.40	0.44	0.22	---	---	---	---	---	---	---
DL6	0	0.93	0.98	0.86	0.97	1.00	0.98	0.89	0.80	---	---	---	---	---	---	---
	1	0.07	0.02	0.14	0.03	0.00	0.02	0.11	0.20	---	---	---	---	---	---	---
DL0	0	0.90	0.61	0.96	0.84	0.99	0.83	0.94	0.91	---	---	---	---	---	---	---
	1	0.10	0.39	0.04	0.16	0.01	0.17	0.06	0.09	---	---	---	---	---	---	---
DST1	0	0.00	0.02	0.00	0.05	0.00	1.00	0.08	0.01	---	---	---	---	---	---	---
	1	1.00	0.98	1.00	0.95	1.00	0.00	0.92	0.99	---	---	---	---	---	---	---
DST2	0	1.00	1.00	1.00	0.98	1.00	0.37	0.97	0.99	---	---	---	---	---	---	---
	1	0.00	0.00	0.00	0.02	0.00	0.63	0.03	0.01	---	---	---	---	---	---	---
DST9	0	1.00	1.00	1.00	0.99	1.00	0.88	0.99	1.00	---	---	---	---	---	---	---
	1	0.00	0.00	0.00	0.01	0.00	0.12	0.01	0.00	---	---	---	---	---	---	---
DSTN	0	1.00	0.98	1.00	0.97	1.00	0.76	0.96	1.00	---	---	---	---	---	---	---
	1	0.00	0.02	0.00	0.03	0.00	0.24	0.04	0.00	---	---	---	---	---	---	---
TOWS1	0	0.64	1.00	0.37	0.92	1.00	0.54	0.53	0.67	---	---	---	---	---	---	---
	1	0.36	0.00	0.63	0.08	0.00	0.46	0.47	0.33	---	---	---	---	---	---	---
TOWS4	0	0.97	1.00	0.97	0.99	1.00	1.00	0.97	1.00	---	---	---	---	---	---	---
	1	0.03	0.00	0.03	0.01	0.00	0.00	0.03	0.00	---	---	---	---	---	---	---
TOWS6	0	0.56	0.04	0.72	0.16	0.00	0.68	0.68	0.36	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.44	0.96	0.28	0.84	1.00	0.32	0.32	0.64	---	---	---	---	---	---	---
TOWS8	0	0.99	0.98	1.00	0.99	1.00	0.96	1.00	1.00	---	---	---	---	---	---	---
	1	0.01	0.02	0.00	0.01	0.00	0.04	0.00	0.00	---	---	---	---	---	---	---
TOWS0	0	0.94	1.00	0.99	0.99	1.00	0.92	0.93	1.00	---	---	---	---	---	---	---
	1	0.06	0.00	0.01	0.01	0.00	0.08	0.07	0.00	---	---	---	---	---	---	---
DP1	0	1.00	1.00	0.94	1.00	1.00	0.98	0.77	1.00	---	---	---	---	---	---	---
	1	0.00	0.00	0.06	0.00	0.00	0.02	0.23	0.00	---	---	---	---	---	---	---
DP8	0	1.00	0.93	0.15	1.00	0.18	0.97	0.89	0.01	---	---	---	---	---	---	---
	1	0.00	0.07	0.85	0.00	0.82	0.03	0.11	0.99	---	---	---	---	---	---	---
DP9	0	1.00	1.00	0.97	1.00	0.97	0.99	1.00	1.00	---	---	---	---	---	---	---
	1	0.00	0.00	0.03	0.00	0.03	0.01	0.00	0.00	---	---	---	---	---	---	---
DP0	0	0.00	0.08	1.00	0.00	0.86	0.16	0.41	1.00	---	---	---	---	---	---	---
	1	1.00	0.92	0.00	1.00	0.14	0.84	0.59	0.00	---	---	---	---	---	---	---
DPN	0	1.00	1.00	0.98	1.00	1.00	0.90	0.96	1.00	---	---	---	---	---	---	---
	1	0.00	0.00	0.02	0.00	0.00	0.10	0.04	0.00	---	---	---	---	---	---	---
Concrete - Frame (except for culverts)																
DL2	0	0.88	0.99	0.91	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.01	0.09	---	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.92	0.74	0.74	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.08	0.26	0.26	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.54	0.71	0.58	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.46	0.29	0.42	---	---	---	---	---	---	---	---	---	---	---	---
DL9	0	0.94	0.77	0.98	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.06	0.23	0.02	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.18	1.00	0.28	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.82	0.00	0.72	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.92	1.00	0.99	---	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.08	0.00	0.01	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.92	0.00	0.74	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.08	1.00	0.26	---	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.83	0.95	0.86	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.17	0.05	0.14	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.25	0.37	0.26	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.75	0.64	0.74	---	---	---	---	---	---	---	---	---	---	---	---
TOWSN	0	1.00	0.71	0.97	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.29	0.03	---	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.88	1.00	0.96	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.00	0.04	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.20	1.00	0.36	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.80	0.00	0.64	---	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.99	0.00	0.79	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.01	1.00	0.21	---	---	---	---	---	---	---	---	---	---	---	---
								Concrete - Arch- Deck								
DL2	0	0.82	0.92	0.81	0.88	---	---	---	---	---	---	---	---	---	---	---
	1	0.18	0.08	0.19	0.12	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.89	0.90	0.77	0.82	---	---	---	---	---	---	---	---	---	---	---
	1	0.11	0.10	0.23	0.18	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.90	0.95	0.80	0.75	---	---	---	---	---	---	---	---	---	---	---
	1	0.10	0.05	0.20	0.25	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.47	0.28	0.71	0.70	---	---	---	---	---	---	---	---	---	---	---
	1	0.53	0.72	0.29	0.30	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.41	0.98	0.16	0.99	---	---	---	---	---	---	---	---	---	---	---
	1	0.59	0.02	0.84	0.01	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.68	0.03	0.91	0.03	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.32	0.97	0.09	0.97	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.90	1.00	0.76	0.97	---	---	---	---	---	---	---	---	---	---	---
	1	0.10	0.00	0.24	0.03	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.27	0.83	0.37	0.46	---	---	---	---	---	---	---	---	---	---	---
	1	0.73	0.17	0.63	0.54	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.90	0.98	0.99	0.99	---	---	---	---	---	---	---	---	---	---	---
	1	0.10	0.02	0.01	0.01	---	---	---	---	---	---	---	---	---	---	---
TOWSN	0	0.98	0.20	0.99	0.60	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.80	0.01	0.40	---	---	---	---	---	---	---	---	---	---	---
DP8	0	0.92	1.00	0.92	0.98	---	---	---	---	---	---	---	---	---	---	---
	1	0.08	0.00	0.08	0.02	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.12	1.00	0.27	0.76	---	---	---	---	---	---	---	---	---	---	---
	1	0.88	0.00	0.73	0.24	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.98	0.00	0.96	0.28	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	1.00	0.04	0.72	---	---	---	---	---	---	---	---	---	---	---
Concrete - Culvert (includes frame culverts)																
DL1	0	0.99	0.99	0.98	0.99	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
	1	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
DL2	0	0.79	0.92	0.74	0.85	0.95	0.79	0.61	0.96	0.97	0.55	0.79	0.94	0.68	0.91	0.85
	1	0.21	0.08	0.26	0.15	0.05	0.21	0.39	0.04	0.03	0.45	0.21	0.06	0.32	0.09	0.15
DL3	0	0.99	0.99	0.98	0.99	0.97	1.00	0.99	1.00	1.00	0.99	0.99	1.00	1.00	1.00	0.99
	1	0.01	0.01	0.02	0.01	0.03	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01
DL4	0	0.86	0.91	0.89	0.82	0.95	0.61	0.80	0.98	0.82	0.63	0.65	0.91	0.82	0.96	0.82
	1	0.14	0.09	0.11	0.18	0.05	0.39	0.20	0.02	0.18	0.37	0.35	0.09	0.18	0.04	0.18
DL5	0	0.63	0.52	0.64	0.61	0.42	0.66	0.78	0.12	0.35	0.89	0.66	0.38	0.55	0.23	0.61
	1	0.37	0.48	0.36	0.39	0.58	0.34	0.22	0.88	0.65	0.11	0.34	0.62	0.45	0.77	0.39
DL6	0	0.85	0.98	0.95	0.94	0.95	1.00	0.97	0.96	0.90	1.00	0.95	0.93	0.99	0.95	0.96

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.15	0.02	0.05	0.06	0.05	0.00	0.03	0.04	0.10	0.00	0.05	0.07	0.01	0.05	0.04
DL9	0	0.99	0.98	0.96	1.00	0.96	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.99	1.00	1.00
	1	0.01	0.02	0.04	0.01	0.04	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.01
DL0	0	0.91	0.70	0.87	0.81	0.81	0.95	0.86	0.99	0.97	0.94	0.97	0.87	0.98	0.96	0.78
	1	0.09	0.30	0.13	0.19	0.19	0.05	0.14	0.01	0.03	0.06	0.03	0.13	0.02	0.04	0.22
DST1	0	1.00	0.34	1.00	0.03	1.00	0.00	1.00	1.00	1.00	0.03	0.88	0.22	0.04	1.00	0.29
	1	0.00	0.66	0.00	0.97	0.00	1.00	0.00	0.00	0.00	0.97	0.12	0.78	0.96	0.00	0.71
DST2	0	1.00	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.99	1.00	1.00
	1	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00
DST9	0	1.00	0.98	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	1.00	0.98
	1	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.00	0.02
DSTN	0	0.00	0.70	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.98	0.14	0.85	1.00	0.00	0.74
	1	1.00	0.30	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.02	0.86	0.15	0.00	1.00	0.26
TOWS1	0	1.00	0.80	0.90	0.81	1.00	1.00	0.99	1.00	1.00	1.00	1.00	0.62	1.00	0.99	0.60
	1	0.00	0.20	0.10	0.19	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.38	0.00	0.01	0.40
TOWS6	0	1.00	0.56	0.19	0.27	1.00	0.00	0.89	1.00	1.00	0.00	1.00	0.50	1.00	0.84	0.54
	1	0.00	0.44	0.81	0.73	0.00	1.00	0.11	0.00	0.00	1.00	0.00	0.50	0.00	0.16	0.46
TOWS8	0	1.00	0.83	0.97	0.97	1.00	1.00	0.99	1.00	1.00	1.00	1.00	0.97	1.00	0.99	0.97
	1	0.00	0.17	0.03	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.01	0.03
TOWS9	0	1.00	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.97
	1	0.00	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.03
TOWS0	0	1.00	0.99	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.98	0.99
	1	0.00	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.01
TOWSN	0	0.00	0.86	0.99	0.99	0.00	1.00	0.13	0.00	0.00	1.00	0.00	0.98	0.00	0.21	0.93
	1	1.00	0.14	0.01	0.01	1.00	0.00	0.87	1.00	1.00	0.00	1.00	0.02	1.00	0.79	0.07
DP1	0	1.00	0.99	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	1.00	0.99
	1	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.01
DP8	0	1.00	0.67	0.74	1.00	1.00	0.05	1.00	1.00	1.00	0.26	1.00	0.48	1.00	1.00	0.54
	1	0.00	0.33	0.26	0.00	0.00	0.95	0.00	0.00	0.00	0.74	0.00	0.52	0.00	0.00	0.46

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DP9	0	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.97	1.00	0.98	1.00	1.00	0.98
	1	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.03	0.00	0.02	0.00	0.00	0.02
DP0	0	1.00	0.50	0.58	0.00	1.00	1.00	1.00	0.00	0.99	0.77	1.00	0.74	1.00	0.00	0.59
	1	0.00	0.50	0.42	1.00	0.00	0.00	0.00	1.00	0.01	0.23	0.00	0.26	0.00	1.00	0.41
DPN	0	0.00	0.85	0.70	1.00	0.00	1.00	0.00	1.00	0.01	1.00	0.00	0.92	0.00	1.00	0.91
	1	1.00	0.15	0.30	0.00	1.00	0.00	1.00	0.00	0.99	0.00	1.00	0.08	1.00	0.00	0.09
Concrete - Channel Beam																
DL1	0	1.00	1.00	0.98	0.99	0.91	0.96	1.00	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.02	0.01	0.09	0.04	0.00	---	---	---	---	---	---	---	---
DL2	0	0.56	0.23	0.63	0.73	0.49	0.74	0.88	---	---	---	---	---	---	---	---
	1	0.44	0.77	0.37	0.27	0.51	0.26	0.12	---	---	---	---	---	---	---	---
DL3	0	0.97	0.98	0.94	0.84	0.98	0.98	0.99	---	---	---	---	---	---	---	---
	1	0.03	0.02	0.06	0.16	0.02	0.02	0.01	---	---	---	---	---	---	---	---
DL4	0	0.97	0.99	0.92	0.97	0.94	0.86	0.76	---	---	---	---	---	---	---	---
	1	0.03	0.01	0.08	0.03	0.06	0.14	0.24	---	---	---	---	---	---	---	---
DL5	0	0.70	0.81	0.67	0.76	0.90	0.75	0.99	---	---	---	---	---	---	---	---
	1	0.30	0.19	0.33	0.24	0.10	0.25	0.01	---	---	---	---	---	---	---	---
DL0	0	0.81	0.99	0.88	0.71	0.78	0.72	0.39	---	---	---	---	---	---	---	---
	1	0.19	0.01	0.12	0.29	0.22	0.28	0.62	---	---	---	---	---	---	---	---
DST1	0	0.91	0.97	0.78	1.00	0.63	0.84	1.00	---	---	---	---	---	---	---	---
	1	0.09	0.03	0.22	0.00	0.37	0.16	0.00	---	---	---	---	---	---	---	---
DST2	0	0.09	0.04	0.33	0.00	1.00	0.30	1.00	---	---	---	---	---	---	---	---
	1	0.91	0.96	0.67	1.00	0.00	0.70	0.00	---	---	---	---	---	---	---	---
DST9	0	1.00	1.00	0.90	1.00	0.39	0.91	1.00	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.10	0.00	0.61	0.09	0.00	---	---	---	---	---	---	---	---
DSTN	0	1.00	1.00	0.99	1.00	0.99	0.95	0.00	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.01	0.00	0.01	0.05	1.00	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TOWS1	0	0.13	0.40	0.49	1.00	1.00	0.56	1.00	---	---	---	---	---	---	---	---
	1	0.87	0.60	0.51	0.00	0.00	0.44	0.00	---	---	---	---	---	---	---	---
TOWS6	0	1.00	0.70	0.69	0.19	0.00	0.61	1.00	---	---	---	---	---	---	---	---
	1	0.00	0.30	0.31	0.81	1.00	0.39	0.00	---	---	---	---	---	---	---	---
TOWS8	0	0.98	0.99	0.96	0.89	1.00	0.96	1.00	---	---	---	---	---	---	---	---
	1	0.02	0.01	0.04	0.11	0.00	0.04	0.00	---	---	---	---	---	---	---	---
TOWS9	0	0.99	1.00	0.98	0.95	1.00	0.97	1.00	---	---	---	---	---	---	---	---
	1	0.01	0.00	0.02	0.05	0.00	0.03	0.00	---	---	---	---	---	---	---	---
TOWS0	0	0.92	0.91	0.89	0.99	1.00	0.95	1.00	---	---	---	---	---	---	---	---
	1	0.08	0.09	0.11	0.01	0.00	0.05	0.00	---	---	---	---	---	---	---	---
DP8	0	1.00	1.00	0.92	1.00	1.00	0.97	1.00	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.08	0.00	0.00	0.03	0.00	---	---	---	---	---	---	---	---
DP0	0	0.01	0.00	0.10	0.00	0.00	0.08	1.00	---	---	---	---	---	---	---	---
	1	0.99	1.00	0.90	1.00	1.00	0.92	0.00	---	---	---	---	---	---	---	---
DPN	0	1.00	1.00	1.00	1.00	1.00	0.97	0.00	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.00	0.00	0.00	0.03	1.00	---	---	---	---	---	---	---	---
Concrete Continuous - Slab																
DL1	0	0.98	1.00	1.00	1.00	0.92	0.99	1.00	1.00	0.98	1.00	0.99	1.00	---	---	---
	1	0.02	0.00	0.00	0.00	0.08	0.01	0.00	0.00	0.02	0.00	0.01	0.00	---	---	---
DL2	0	0.85	1.00	0.80	1.00	0.86	0.86	0.99	0.95	0.80	0.84	0.98	1.00	---	---	---
	1	0.15	0.00	0.20	0.00	0.14	0.14	0.01	0.05	0.20	0.16	0.02	0.00	---	---	---
DL3	0	0.96	1.00	0.93	1.00	0.99	0.99	1.00	0.99	0.95	0.99	1.00	1.00	---	---	---
	1	0.04	0.00	0.07	0.00	0.01	0.01	0.00	0.01	0.05	0.01	0.00	0.00	---	---	---
DL4	0	0.85	1.00	0.53	0.97	0.98	0.77	0.95	0.90	0.85	0.47	0.94	1.00	---	---	---
	1	0.15	0.00	0.47	0.03	0.02	0.23	0.05	0.10	0.15	0.53	0.06	0.00	---	---	---
DL5	0	0.63	0.00	1.00	0.28	0.94	0.47	0.43	0.62	0.51	0.79	0.51	1.00	---	---	---
	1	0.37	1.00	0.00	0.72	0.06	0.53	0.57	0.38	0.49	0.21	0.49	0.00	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL6	0	0.76	1.00	0.89	0.86	1.00	0.99	0.64	0.71	0.97	0.94	0.68	1.00	---	---	---
	1	0.24	0.00	0.11	0.14	0.00	0.01	0.36	0.29	0.03	0.06	0.32	0.00	---	---	---
DL9	0	1.00	1.00	0.99	0.89	1.00	1.00	1.00	0.93	1.00	0.99	0.91	1.00	---	---	---
	1	0.00	0.00	0.01	0.11	0.00	0.00	0.00	0.07	0.00	0.01	0.09	0.00	---	---	---
DL0	0	0.97	1.00	0.87	0.99	0.31	0.92	0.99	0.89	0.95	0.98	0.99	0.00	---	---	---
	1	0.03	0.00	0.13	0.01	0.69	0.08	0.01	0.11	0.05	0.02	0.01	1.00	---	---	---
DSTN	0	0.99	1.00	1.00	1.00	0.98	1.00	0.99	0.93	0.98	0.99	0.99	1.00	---	---	---
	1	0.01	0.00	0.00	0.00	0.02	0.00	0.01	0.07	0.02	0.01	0.01	0.00	---	---	---
TOWS1	0	0.94	0.22	0.00	0.15	0.78	0.52	0.88	0.65	0.70	0.79	0.42	0.71	---	---	---
	1	0.06	0.78	1.00	0.85	0.22	0.48	0.12	0.35	0.30	0.21	0.58	0.29	---	---	---
TOWS2	0	0.96	0.96	1.00	0.91	1.00	0.99	0.96	0.98	0.99	0.99	0.77	1.00	---	---	---
	1	0.04	0.04	0.00	0.09	0.00	0.01	0.04	0.02	0.01	0.01	0.23	0.00	---	---	---
TOWS6	0	0.43	0.99	1.00	0.98	0.51	0.51	0.82	0.79	0.52	0.31	0.99	0.43	---	---	---
	1	0.57	0.01	0.00	0.02	0.49	0.49	0.19	0.21	0.48	0.69	0.01	0.57	---	---	---
TOWS8	0	0.99	0.99	1.00	0.99	0.78	1.00	1.00	1.00	1.00	1.00	1.00	0.90	---	---	---
	1	0.01	0.01	0.00	0.01	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.10	---	---	---
TOWS9	0	0.92	1.00	1.00	1.00	0.97	0.99	0.98	0.99	0.98	0.98	0.98	1.00	---	---	---
	1	0.08	0.00	0.00	0.00	0.03	0.01	0.02	0.01	0.02	0.02	0.02	0.00	---	---	---
TOWS0	0	0.95	0.90	1.00	0.98	0.98	1.00	0.96	0.71	0.97	0.99	1.00	0.98	---	---	---
	1	0.05	0.10	0.00	0.02	0.02	0.00	0.04	0.29	0.03	0.01	0.00	0.02	---	---	---
DP1	0	1.00	1.00	1.00	0.16	1.00	1.00	1.00	0.92	1.00	0.97	0.01	1.00	---	---	---
	1	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.08	0.00	0.03	0.99	0.00	---	---	---
DP8	0	1.00	1.00	1.00	0.86	0.91	0.00	0.97	0.93	0.99	0.29	1.00	0.93	---	---	---
	1	0.00	0.00	0.00	0.14	0.09	1.00	0.03	0.07	0.01	0.71	0.00	0.07	---	---	---
DP9	0	0.99	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.99	0.97	1.00	1.00	---	---	---
	1	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.03	0.00	0.00	---	---	---
DP0	0	0.01	0.00	0.00	1.00	0.10	1.00	0.08	0.26	0.04	0.79	1.00	0.08	---	---	---
	1	0.99	1.00	1.00	0.00	0.90	0.00	0.92	0.74	0.96	0.21	0.00	0.92	---	---	---
DPN	0	1.00	1.00	1.00	0.98	0.99	1.00	1.00	0.92	0.99	0.99	1.00	1.00	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.08	0.02	0.01	0.00	0.00	---	---	---
DST1	0	0.01	0.01	0.01	0.03	0.04	0.00	0.01	0.08	0.03	0.02	0.02	0.00	---	---	---
	1	0.99	0.99	0.99	0.97	0.96	1.00	0.99	0.92	0.97	0.98	0.98	1.00	---	---	---
Concrete Continuous - Stringer/Mulit-beam or girder																
DL2	0	0.61	0.67	0.77	1.00	1.00	---	---	---	---	---	---	---	---	---	---
	1	0.39	0.33	0.23	0.00	0.00	---	---	---	---	---	---	---	---	---	---
DL4	0	0.95	0.86	0.92	1.00	0.97	---	---	---	---	---	---	---	---	---	---
	1	0.05	0.14	0.08	0.00	0.03	---	---	---	---	---	---	---	---	---	---
DL5	0	0.91	1.00	0.54	0.01	0.37	---	---	---	---	---	---	---	---	---	---
	1	0.09	0.00	0.46	0.99	0.63	---	---	---	---	---	---	---	---	---	---
DL6	0	1.00	0.99	0.94	1.00	0.71	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.01	0.06	0.00	0.29	---	---	---	---	---	---	---	---	---	---
DL0	0	0.57	0.53	0.91	1.00	0.97	---	---	---	---	---	---	---	---	---	---
	1	0.43	0.47	0.09	0.00	0.03	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.51	1.00	0.18	1.00	0.77	---	---	---	---	---	---	---	---	---	---
	1	0.49	0.00	0.82	0.00	0.23	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.62	0.05	0.95	0.18	0.95	---	---	---	---	---	---	---	---	---	---
	1	0.38	0.95	0.05	0.82	0.05	---	---	---	---	---	---	---	---	---	---
Concrete Continuous - Tee Beam																
DL2	0	0.97	0.80	0.67	0.86	0.99	0.80	---	---	---	---	---	---	---	---	---
	1	0.03	0.20	0.33	0.14	0.01	0.20	---	---	---	---	---	---	---	---	---
DL3	0	0.98	0.95	0.94	0.99	0.99	0.94	---	---	---	---	---	---	---	---	---
	1	0.02	0.05	0.06	0.01	0.01	0.06	---	---	---	---	---	---	---	---	---
DL5	0	0.41	0.46	0.99	0.50	0.31	0.75	---	---	---	---	---	---	---	---	---
	1	0.59	0.54	0.01	0.50	0.69	0.25	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL6	0	0.75	0.97	1.00	0.92	0.75	0.94	---	---	---	---	---	---	---	---	---
	1	0.25	0.03	0.00	0.08	0.25	0.06	---	---	---	---	---	---	---	---	---
DL0	0	1.00	0.97	0.55	0.98	1.00	0.76	---	---	---	---	---	---	---	---	---
	1	0.00	0.03	0.45	0.02	0.00	0.24	---	---	---	---	---	---	---	---	---
TOWS1	0	0.90	0.00	0.87	0.43	0.56	0.77	---	---	---	---	---	---	---	---	---
	1	0.10	1.00	0.13	0.57	0.44	0.23	---	---	---	---	---	---	---	---	---
TOWS3	0	0.85	1.00	0.99	0.89	0.95	0.98	---	---	---	---	---	---	---	---	---
	1	0.15	0.00	0.01	0.11	0.05	0.02	---	---	---	---	---	---	---	---	---
TOWS4	0	0.92	1.00	0.99	0.94	0.92	0.98	---	---	---	---	---	---	---	---	---
	1	0.08	0.00	0.01	0.06	0.08	0.02	---	---	---	---	---	---	---	---	---
TOWS6	0	0.51	1.00	0.22	0.82	0.66	0.38	---	---	---	---	---	---	---	---	---
	1	0.49	0.00	0.78	0.18	0.34	0.62	---	---	---	---	---	---	---	---	---
TOWS0	0	0.86	1.00	0.96	0.97	0.96	0.95	---	---	---	---	---	---	---	---	---
	1	0.14	0.00	0.04	0.03	0.04	0.05	---	---	---	---	---	---	---	---	---
DP1	0	1.00	1.00	1.00	0.83	0.89	0.96	---	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.00	0.17	0.11	0.04	---	---	---	---	---	---	---	---	---
DP8	0	1.00	1.00	0.92	0.52	0.95	0.91	---	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.08	0.48	0.05	0.09	---	---	---	---	---	---	---	---	---
DP0	0	0.01	0.01	0.08	0.69	0.17	0.14	---	---	---	---	---	---	---	---	---
	1	0.99	0.99	0.92	0.31	0.83	0.86	---	---	---	---	---	---	---	---	---
Concrete Continuous - Box Beam or Girders - Multiple																
DL4	0	1.00	0.90	0.98	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.10	0.02	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.03	0.61	0.30	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.97	0.39	0.70	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	1.00	0.57	0.74	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.43	0.26	---	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DST1	0	0.01	0.02	0.02	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.99	0.98	0.98	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.86	0.76	0.82	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.14	0.24	0.18	---	---	---	---	---	---	---	---	---	---	---	---
TOWS0	0	0.90	0.85	0.91	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.10	0.15	0.09	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.05	0.10	0.07	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.95	0.90	0.93	---	---	---	---	---	---	---	---	---	---	---	---
Concrete Continuous - Frame (except for culverts)																
DL4	0	0.78	0.86	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.22	0.14	---	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.54	0.71	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.46	0.29	---	---	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.92	0.52	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.08	0.48	---	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.68	0.99	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.32	0.01	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.35	0.74	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.65	0.26	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS0	0	0.98	0.39	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.61	---	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.51	0.01	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.49	0.99	---	---	---	---	---	---	---	---	---	---	---	---	---
Concrete Continuous - Culvert (includes frame culverts)																
DL1	0	0.86	1.00	0.98	1.00	1.00	0.99	1.00	0.96	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.14	0.00	0.02	0.00	0.00	0.01	0.00	0.04	---	---	---	---	---	---	---
DL2	0	0.74	1.00	0.71	0.76	1.00	0.83	0.83	0.56	---	---	---	---	---	---	---
	1	0.26	0.00	0.29	0.24	0.00	0.17	0.17	0.44	---	---	---	---	---	---	---
DL4	0	0.88	1.00	0.88	0.82	1.00	0.90	0.90	0.91	---	---	---	---	---	---	---
	1	0.12	0.00	0.12	0.18	0.00	0.10	0.10	0.09	---	---	---	---	---	---	---
DL5	0	1.00	0.00	0.70	0.82	0.00	0.39	0.47	0.98	---	---	---	---	---	---	---
	1	0.00	1.00	0.30	0.18	1.00	0.61	0.53	0.02	---	---	---	---	---	---	---
DL6	0	0.69	1.00	0.95	0.99	1.00	0.92	0.95	0.90	---	---	---	---	---	---	---
	1	0.31	0.00	0.05	0.01	0.00	0.08	0.05	0.10	---	---	---	---	---	---	---
DL0	0	0.84	1.00	0.80	0.62	1.00	0.97	0.87	0.72	---	---	---	---	---	---	---
	1	0.16	0.00	0.20	0.38	0.00	0.03	0.13	0.28	---	---	---	---	---	---	---
DST1	0	0.99	0.99	0.26	0.26	0.00	1.00	0.28	0.01	---	---	---	---	---	---	---
	1	0.01	0.01	0.74	0.74	1.00	0.00	0.72	0.99	---	---	---	---	---	---	---
DST9	0	1.00	1.00	0.97	0.92	1.00	1.00	0.98	0.99	---	---	---	---	---	---	---
	1	0.00	0.00	0.03	0.08	0.00	0.00	0.02	0.01	---	---	---	---	---	---	---
DSTN	0	0.01	0.01	0.77	0.82	1.00	0.00	0.75	1.00	---	---	---	---	---	---	---
	1	0.99	0.99	0.23	0.18	0.00	1.00	0.25	0.00	---	---	---	---	---	---	---
TOWS1	0	1.00	1.00	0.92	0.89	0.44	1.00	0.88	0.29	---	---	---	---	---	---	---
	1	0.00	0.00	0.08	0.11	0.56	0.00	0.12	0.71	---	---	---	---	---	---	---
TOWS6	0	0.98	0.98	0.22	0.75	0.66	0.99	0.35	0.92	---	---	---	---	---	---	---
	1	0.02	0.02	0.78	0.25	0.34	0.01	0.65	0.08	---	---	---	---	---	---	---
TOWS8	0	1.00	1.00	0.93	0.46	0.91	1.00	0.93	0.79	---	---	---	---	---	---	---
	1	0.00	0.00	0.07	0.54	0.09	0.00	0.07	0.21	---	---	---	---	---	---	---
TOWS9	0	1.00	1.00	0.99	0.93	1.00	1.00	0.99	1.00	---	---	---	---	---	---	---
	1	0.00	0.00	0.01	0.07	0.00	0.00	0.01	0.00	---	---	---	---	---	---	---
TOWS0	0	0.95	0.98	0.97	0.99	0.99	0.97	0.99	1.00	---	---	---	---	---	---	---
	1	0.05	0.02	0.03	0.01	0.01	0.03	0.01	0.00	---	---	---	---	---	---	---
TOWSN	0	0.08	0.04	0.98	0.98	1.00	0.05	0.87	1.00	---	---	---	---	---	---	---
	1	0.92	0.96	0.02	0.02	0.00	0.95	0.13	0.00	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DP0	0	1.00	1.00	0.05	0.04	0.36	1.00	0.19	0.11	---	---	---	---	---	---	---
	1	0.00	0.00	0.95	0.96	0.64	0.00	0.81	0.89	---	---	---	---	---	---	---
DPN	0	0.00	0.01	0.99	0.99	1.00	0.00	0.85	0.99	---	---	---	---	---	---	---
	1	1.00	0.99	0.01	0.01	0.00	1.00	0.15	0.01	---	---	---	---	---	---	---
Steel - Stringer/Mulit-beam or girder																
DL1	0	0.96	0.94	0.93	0.98	1.00	0.98	0.97	1.00	1.00	0.97	1.00	0.95	0.95	0.97	0.99
	1	0.04	0.06	0.08	0.02	0.00	0.02	0.03	0.00	0.00	0.03	0.00	0.05	0.05	0.03	0.00
DL2	0	0.93	0.87	0.95	0.90	1.00	0.93	0.92	0.99	0.00	0.87	0.96	0.86	0.93	0.71	0.93
	1	0.07	0.13	0.05	0.10	0.00	0.07	0.08	0.02	1.00	0.13	0.04	0.14	0.07	0.29	0.07
DL3	0	0.99	0.96	0.99	0.97	1.00	0.98	0.98	0.99	1.00	0.98	0.99	0.99	0.99	0.98	0.98
	1	0.01	0.04	0.01	0.03	0.00	0.02	0.02	0.01	0.00	0.02	0.01	0.01	0.01	0.02	0.02
DL4	0	0.93	0.85	0.97	0.87	1.00	0.91	0.92	0.90	1.00	0.86	0.90	0.88	0.95	0.74	0.91
	1	0.07	0.15	0.03	0.13	0.00	0.09	0.08	0.10	0.00	0.14	0.10	0.13	0.05	0.26	0.09
DL5	0	0.88	0.64	0.92	0.64	1.00	0.76	0.87	0.50	1.00	0.82	0.45	0.88	0.89	0.83	0.40
	1	0.12	0.36	0.08	0.36	0.00	0.24	0.14	0.50	0.00	0.18	0.55	0.12	0.11	0.17	0.60
DL6	0	0.98	0.80	0.98	0.76	1.00	0.98	0.98	0.63	1.00	0.98	0.83	0.98	0.99	0.95	0.83
	1	0.02	0.20	0.02	0.23	0.00	0.02	0.02	0.37	0.00	0.02	0.17	0.02	0.01	0.05	0.17
DL9	0	0.99	0.99	1.00	0.90	1.00	0.99	1.00	1.00	1.00	0.99	0.90	0.99	0.99	0.98	0.98
	1	0.00	0.01	0.00	0.10	0.00	0.01	0.00	0.01	0.00	0.01	0.09	0.01	0.01	0.02	0.01
DL0	0	0.34	0.95	0.27	0.97	0.00	0.47	0.37	1.00	1.00	0.53	0.96	0.47	0.30	0.84	0.98
	1	0.66	0.05	0.73	0.03	1.00	0.52	0.63	0.00	0.00	0.47	0.04	0.53	0.70	0.16	0.02
DST1	0	0.55	0.02	1.00	0.02	0.00	1.00	0.70	0.00	0.00	0.57	0.01	0.01	1.00	0.19	0.03
	1	0.45	0.98	0.00	0.98	1.00	0.00	0.30	1.00	1.00	0.43	0.99	0.99	0.00	0.81	0.97
DST3	0	0.98	1.00	1.00	1.00	1.00	0.87	0.96	1.00	1.00	1.00	1.00	1.00	0.87	0.99	1.00
	1	0.02	0.00	0.00	0.00	0.00	0.13	0.04	0.00	0.00	0.00	0.00	0.00	0.13	0.01	0.00
DST4	0	1.00	1.00	1.00	1.00	1.00	0.91	0.99	1.00	1.00	0.94	1.00	0.99	0.99	0.99	0.99
	1	0.00	0.00	0.00	0.00	0.00	0.09	0.01	0.00	0.00	0.06	0.00	0.01	0.01	0.01	0.01

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DST5	0	0.99	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00
	1	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
DST6	0	0.89	1.00	1.00	1.00	1.00	0.35	0.85	1.00	1.00	0.74	1.00	1.00	0.94	0.94	1.00
	1	0.11	0.00	0.00	0.00	0.00	0.65	0.15	0.00	0.00	0.26	0.00	0.00	0.06	0.06	0.00
DST8	0	0.67	1.00	0.00	1.00	1.00	1.00	0.57	1.00	1.00	0.78	1.00	1.00	0.23	0.95	1.00
	1	0.33	0.00	1.00	0.00	0.00	0.00	0.43	0.00	0.00	0.22	0.00	0.00	0.77	0.05	0.00
DST9	0	0.96	1.00	1.00	1.00	1.00	0.95	0.98	1.00	1.00	0.99	1.00	1.00	0.99	0.98	0.99
	1	0.04	0.00	0.00	0.00	0.00	0.05	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.02	0.01
DSTN	0	0.96	1.00	1.00	1.00	1.00	0.98	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	1	0.04	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
TOWS1	0	0.70	0.55	1.00	0.49	0.62	0.97	0.83	0.70	0.71	1.00	0.54	0.49	0.99	0.79	0.48
	1	0.30	0.45	0.00	0.51	0.38	0.03	0.17	0.30	0.29	0.00	0.46	0.51	0.01	0.21	0.52
TOWS2	0	0.99	0.97	1.00	0.87	1.00	1.00	0.99	0.95	0.98	1.00	0.78	0.97	1.00	0.98	0.93
	1	0.01	0.03	0.00	0.13	0.00	0.00	0.01	0.05	0.02	0.00	0.22	0.03	0.00	0.02	0.07
TOWS3	0	1.00	0.95	1.00	0.96	1.00	1.00	1.00	0.78	1.00	1.00	0.94	0.99	1.00	0.99	0.93
	1	0.00	0.05	0.00	0.04	0.00	0.00	0.00	0.23	0.00	0.00	0.06	0.01	0.00	0.01	0.07
TOWS4	0	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.97	0.99	1.00	1.00	0.97	1.00	0.99	0.99
	1	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.03	0.00	0.02	0.01
TOWS5	0	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	1	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
TOWS6	0	0.74	0.65	0.60	0.75	0.66	0.32	0.65	0.64	0.40	0.00	0.76	0.79	0.86	0.36	0.79
	1	0.26	0.35	0.40	0.25	0.34	0.68	0.35	0.36	0.60	1.00	0.24	0.22	0.14	0.64	0.21
TOWS7	0	0.81	1.00	0.59	1.00	1.00	0.99	0.77	1.00	1.00	1.00	1.00	1.00	0.50	0.98	1.00
	1	0.19	0.00	0.41	0.00	0.00	0.01	0.23	0.00	0.00	0.00	0.00	0.00	0.50	0.02	0.00
TOWS8	0	0.83	0.99	0.87	1.00	0.90	0.91	0.88	1.00	0.96	1.00	1.00	0.93	0.86	0.98	1.00
	1	0.17	0.01	0.13	0.00	0.10	0.09	0.12	0.00	0.04	0.00	0.00	0.07	0.14	0.02	0.00
TOWS9	0	0.96	0.99	0.98	0.99	0.98	0.90	0.94	0.99	0.98	1.00	1.00	0.99	0.89	0.98	0.99
	1	0.04	0.01	0.02	0.01	0.02	0.10	0.06	0.01	0.02	0.00	0.00	0.01	0.10	0.02	0.01
TOWSN	0	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.99

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
DP1	0	0.99	1.00	1.00	0.51	1.00	1.00	0.99	1.00	1.00	1.00	0.00	1.00	1.00	0.97	0.86
	1	0.01	0.00	0.00	0.49	0.00	0.00	0.01	0.00	0.00	0.00	1.00	0.00	0.00	0.03	0.13
DP2	0	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.99	0.99
	1	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
DP7	0	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00
	1	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
DP8	0	0.90	1.00	0.99	0.55	0.95	0.98	0.93	0.91	1.00	0.97	1.00	1.00	0.99	0.58	0.82
	1	0.10	0.00	0.01	0.45	0.05	0.02	0.07	0.09	0.00	0.03	0.00	0.00	0.01	0.42	0.18
DP0	0	0.15	0.00	0.02	1.00	0.05	0.04	0.14	0.11	0.00	0.04	1.00	0.00	0.05	0.51	0.34
	1	0.85	1.00	0.98	0.00	0.95	0.96	0.86	0.89	1.00	0.96	0.00	1.00	0.95	0.49	0.66
DPN	0	0.96	1.00	1.00	0.97	1.00	0.99	0.95	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.98
	1	0.03	0.00	0.00	0.03	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01
								Steel - Girder or Floorbeam System								
DL2	0	0.88	0.94	0.89	0.92	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.06	0.11	0.08	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.88	0.97	0.85	0.87	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.03	0.15	0.13	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.86	0.95	0.86	0.50	---	---	---	---	---	---	---	---	---	---	---
	1	0.14	0.05	0.14	0.50	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.97	1.00	0.99	0.84	---	---	---	---	---	---	---	---	---	---	---
	1	0.03	0.00	0.01	0.16	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.49	0.21	0.47	0.91	---	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.79	0.53	0.09	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.41	0.72	0.53	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.59	0.28	0.47	0.95	---	---	---	---	---	---	---	---	---	---	---
DST3	0	0.97	0.97	0.94	0.99	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.03	0.03	0.07	0.01	---	---	---	---	---	---	---	---	---	---	---
DST6	0	0.95	0.93	0.91	1.00	---	---	---	---	---	---	---	---	---	---	---
	1	0.05	0.07	0.09	0.00	---	---	---	---	---	---	---	---	---	---	---
DST8	0	0.72	0.51	0.70	0.99	---	---	---	---	---	---	---	---	---	---	---
	1	0.28	0.49	0.30	0.01	---	---	---	---	---	---	---	---	---	---	---
DST9	0	0.99	0.92	0.98	1.00	---	---	---	---	---	---	---	---	---	---	---
	1	0.01	0.08	0.02	0.00	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.82	0.81	0.84	0.68	---	---	---	---	---	---	---	---	---	---	---
	1	0.18	0.19	0.16	0.32	---	---	---	---	---	---	---	---	---	---	---
TOWS2	0	0.98	0.99	0.97	0.83	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.01	0.03	0.17	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.50	0.79	0.55	0.72	---	---	---	---	---	---	---	---	---	---	---
	1	0.50	0.21	0.45	0.28	---	---	---	---	---	---	---	---	---	---	---
TOWS7	0	0.89	0.70	0.87	1.00	---	---	---	---	---	---	---	---	---	---	---
	1	0.11	0.30	0.13	0.00	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.98	0.85	0.96	0.99	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.15	0.04	0.01	---	---	---	---	---	---	---	---	---	---	---
TOWS9	0	0.94	0.91	0.91	0.96	---	---	---	---	---	---	---	---	---	---	---
	1	0.06	0.09	0.09	0.04	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.98	1.00	0.96	0.67	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.00	0.04	0.33	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.09	0.07	0.10	0.43	---	---	---	---	---	---	---	---	---	---	---
	1	0.91	0.93	0.90	0.57	---	---	---	---	---	---	---	---	---	---	---
								Steel - Truss-Thru								
DL1	0	0.94	0.88	1.00	1.00	0.94	0.95	0.94	0.98	0.98	0.97	---	---	---	---	---
	1	0.06	0.12	0.00	0.00	0.06	0.05	0.06	0.02	0.02	0.03	---	---	---	---	---
DL2	0	0.91	0.52	1.00	1.00	0.97	0.91	0.91	0.79	0.83	0.76	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.09	0.48	0.00	0.00	0.03	0.09	0.09	0.21	0.17	0.24	---	---	---	---	---
DL3	0	0.98	0.96	1.00	1.00	1.00	0.97	0.98	0.99	0.93	0.96	---	---	---	---	---
	1	0.02	0.04	0.00	0.00	0.00	0.03	0.02	0.01	0.07	0.04	---	---	---	---	---
DL4	0	0.97	0.88	1.00	1.00	1.00	0.93	0.98	0.79	0.91	0.83	---	---	---	---	---
	1	0.03	0.12	0.00	0.00	0.00	0.07	0.02	0.21	0.09	0.17	---	---	---	---	---
DL5	0	0.92	0.89	1.00	1.00	0.98	0.95	0.97	0.82	0.61	0.74	---	---	---	---	---
	1	0.08	0.11	0.00	0.00	0.02	0.05	0.03	0.18	0.39	0.26	---	---	---	---	---
DL6	0	0.98	0.99	1.00	1.00	1.00	0.99	0.99	0.98	0.93	0.95	---	---	---	---	---
	1	0.02	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.07	0.05	---	---	---	---	---
DL0	0	0.31	0.90	0.00	0.00	0.12	0.30	0.23	0.67	0.85	0.79	---	---	---	---	---
	1	0.69	0.10	1.00	1.00	0.88	0.70	0.77	0.33	0.15	0.21	---	---	---	---	---
DST1	0	0.57	0.21	1.00	0.40	1.00	0.84	0.98	0.11	1.00	0.29	---	---	---	---	---
	1	0.43	0.79	0.00	0.60	0.00	0.16	0.02	0.89	0.00	0.71	---	---	---	---	---
DST4	0	1.00	0.98	1.00	0.99	1.00	0.98	0.99	0.95	0.98	0.93	---	---	---	---	---
	1	0.00	0.02	0.00	0.01	0.00	0.02	0.01	0.05	0.02	0.07	---	---	---	---	---
DST6	0	0.86	0.95	1.00	0.94	1.00	0.82	0.92	0.99	0.31	0.95	---	---	---	---	---
	1	0.14	0.05	0.00	0.06	0.00	0.18	0.08	0.01	0.69	0.05	---	---	---	---	---
DST8	0	0.72	0.91	0.00	0.73	0.01	0.48	0.24	1.00	0.80	0.93	---	---	---	---	---
	1	0.28	0.09	1.00	0.27	0.99	0.52	0.76	0.00	0.20	0.07	---	---	---	---	---
DST9	0	0.91	1.00	1.00	0.99	1.00	0.98	0.99	0.99	0.98	0.98	---	---	---	---	---
	1	0.09	0.00	0.00	0.01	0.00	0.02	0.01	0.01	0.02	0.02	---	---	---	---	---
TOWS1	0	0.69	0.66	1.00	0.68	1.00	0.87	0.99	0.47	1.00	0.59	---	---	---	---	---
	1	0.31	0.34	0.00	0.32	0.00	0.13	0.01	0.53	0.00	0.41	---	---	---	---	---
TOWS2	0	0.99	0.97	1.00	0.99	1.00	0.99	1.00	0.88	0.99	0.94	---	---	---	---	---
	1	0.01	0.03	0.00	0.01	0.00	0.01	0.00	0.12	0.01	0.06	---	---	---	---	---
TOWS6	0	0.69	0.54	1.00	0.73	1.00	0.67	0.80	0.78	0.08	0.71	---	---	---	---	---
	1	0.31	0.46	0.00	0.27	0.00	0.33	0.20	0.22	0.92	0.29	---	---	---	---	---
TOWS7	0	0.90	0.99	0.00	0.99	0.00	0.68	0.48	1.00	1.00	0.97	---	---	---	---	---
	1	0.10	0.01	1.00	0.01	1.00	0.32	0.52	0.00	0.00	0.03	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TOWS8	0	0.85	0.98	1.00	0.81	1.00	0.95	0.92	0.99	1.00	1.00	---	---	---	---	---
	1	0.15	0.02	0.00	0.19	0.00	0.05	0.08	0.01	0.00	0.00	---	---	---	---	---
TOWS0	0	0.96	0.96	1.00	0.85	1.00	0.91	0.91	0.98	1.00	0.94	---	---	---	---	---
	1	0.04	0.04	0.00	0.15	0.00	0.09	0.09	0.02	0.00	0.06	---	---	---	---	---
DP1	0	1.00	0.96	1.00	1.00	1.00	1.00	1.00	0.73	1.00	0.83	---	---	---	---	---
	1	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.17	---	---	---	---	---
	0	0.91	0.88	0.90	0.98	0.99	0.95	0.99	0.94	0.97	0.89	---	---	---	---	---
	1	0.09	0.12	0.10	0.02	0.01	0.05	0.02	0.06	0.03	0.11	---	---	---	---	---
DP0	0	0.17	0.20	0.13	0.03	0.02	0.13	0.04	0.36	0.08	0.35	---	---	---	---	---
	1	0.83	0.80	0.87	0.97	0.98	0.87	0.96	0.64	0.92	0.65	---	---	---	---	---
Steel - Culvert (includes frame culverts)																
DL2	0	0.87	0.87	0.93	0.94	0.90	---	---	---	---	---	---	---	---	---	---
	1	0.13	0.13	0.07	0.06	0.10	---	---	---	---	---	---	---	---	---	---
DL5	0	0.78	0.66	0.59	0.52	0.71	---	---	---	---	---	---	---	---	---	---
	1	0.22	0.34	0.41	0.48	0.29	---	---	---	---	---	---	---	---	---	---
DL6	0	0.71	0.85	0.89	0.91	0.94	---	---	---	---	---	---	---	---	---	---
	1	0.29	0.15	0.11	0.09	0.06	---	---	---	---	---	---	---	---	---	---
DL0	0	0.76	0.75	0.76	0.75	0.59	---	---	---	---	---	---	---	---	---	---
	1	0.24	0.25	0.24	0.25	0.41	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.00	0.06	0.14	0.06	0.08	---	---	---	---	---	---	---	---	---	---
	1	1.00	0.94	0.86	0.94	0.92	---	---	---	---	---	---	---	---	---	---
TOWS6	0	1.00	0.83	0.34	0.93	0.81	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.17	0.66	0.07	0.19	---	---	---	---	---	---	---	---	---	---
TOWSN	0	0.01	0.35	0.85	0.16	0.30	---	---	---	---	---	---	---	---	---	---
	1	0.99	0.65	0.15	0.84	0.70	---	---	---	---	---	---	---	---	---	---
DP0	0	1.00	0.69	0.46	0.87	0.84	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.00	0.31	0.54	0.13	0.16	---	---	---	---	---	---	---	---	---	---
DPN	0	0.00	0.33	0.61	0.15	0.17	---	---	---	---	---	---	---	---	---	---
	1	1.00	0.67	0.39	0.85	0.83	---	---	---	---	---	---	---	---	---	---
Steel Continuous - Stringer/Mulit-beam or girder																
DL1	0	0.98	1.00	0.98	1.00	0.99	1.00	0.97	0.97	1.00	1.00	1.00	1.00	0.96	0.99	0.98
	1	0.02	0.00	0.02	0.00	0.01	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.04	0.01	0.02
DL2	0	0.83	0.90	0.81	1.00	0.92	1.00	0.98	0.96	1.00	0.96	1.00	1.00	0.91	0.86	0.93
	1	0.17	0.10	0.19	0.00	0.08	0.00	0.02	0.04	0.00	0.04	0.00	0.00	0.09	0.14	0.07
DL3	0	0.95	0.97	0.97	1.00	0.99	1.00	1.00	0.99	1.00	1.00	1.00	1.00	0.98	0.99	0.98
	1	0.05	0.03	0.03	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.02	0.01	0.02
DL4	0	0.87	0.84	0.85	0.99	0.89	1.00	0.97	0.92	1.00	0.86	1.00	1.00	0.94	0.60	0.86
	1	0.13	0.16	0.15	0.01	0.11	0.00	0.03	0.08	0.00	0.14	0.00	0.00	0.06	0.40	0.14
DL5	0	0.56	0.54	0.73	0.79	0.51	0.00	0.59	1.00	0.00	0.56	1.00	0.00	0.91	0.61	0.46
	1	0.44	0.46	0.27	0.21	0.49	1.00	0.41	0.00	1.00	0.44	0.00	1.00	0.09	0.39	0.55
DL6	0	0.86	0.81	0.96	0.50	0.72	1.00	0.51	0.28	1.00	0.71	1.00	1.00	0.98	0.95	0.85
	1	0.14	0.19	0.04	0.50	0.28	0.00	0.49	0.72	0.00	0.29	0.00	0.00	0.02	0.05	0.15
DL9	0	0.99	0.97	0.99	0.74	0.99	1.00	0.99	0.90	1.00	0.96	1.00	1.00	1.00	1.00	0.98
	1	0.01	0.03	0.01	0.26	0.01	0.00	0.01	0.10	0.00	0.04	0.00	0.00	0.00	0.00	0.02
DL0	0	0.96	0.98	0.71	0.99	0.99	1.00	0.99	0.98	1.00	0.97	0.00	1.00	0.32	1.00	0.97
	1	0.04	0.02	0.29	0.01	0.01	0.00	0.01	0.02	0.00	0.03	1.00	0.00	0.68	0.00	0.03
DST1	0	0.03	0.03	0.22	0.02	0.01	0.05	0.00	0.01	0.01	0.02	0.54	0.00	0.55	0.00	0.06
	1	0.97	0.97	0.78	0.98	0.99	0.95	1.00	0.99	0.99	0.98	0.46	1.00	0.45	1.00	0.94
DST2	0	1.00	0.99	1.00	0.98	1.00	0.95	1.00	1.00	0.99	0.99	0.99	1.00	0.99	1.00	0.98
	1	0.00	0.01	0.00	0.02	0.00	0.05	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.02
DST3	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.97	1.00	1.00
	1	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.03	0.00	0.00
DST6	0	0.99	1.00	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	0.83	1.00	0.99

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.01	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.17	0.00	0.01
DST9	0	1.00	0.99	0.98	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	1.00	0.99	1.00	0.98
	1	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.02
DSTN	0	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00
	1	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
TOWS1	0	0.58	0.48	0.52	0.55	0.80	0.00	0.88	0.47	0.35	0.40	0.82	0.00	0.77	1.00	0.54
	1	0.42	0.52	0.48	0.45	0.20	1.00	0.12	0.53	0.65	0.60	0.18	1.00	0.23	0.00	0.46
TOWS2	0	0.96	0.97	0.94	0.69	0.94	1.00	0.98	0.65	0.78	0.93	1.00	1.00	0.99	1.00	0.99
	1	0.04	0.03	0.06	0.31	0.06	0.00	0.02	0.35	0.22	0.07	0.00	0.00	0.01	0.00	0.01
TOWS3	0	0.93	0.96	0.96	0.94	0.71	1.00	0.74	0.96	0.97	0.91	1.00	1.00	1.00	1.00	0.90
	1	0.07	0.04	0.04	0.06	0.29	0.00	0.26	0.04	0.03	0.09	0.00	0.00	0.00	0.00	0.10
TOWS4	0	0.94	0.96	0.99	1.00	0.83	1.00	0.92	1.00	0.99	0.94	1.00	1.00	1.00	1.00	0.94
	1	0.06	0.04	0.01	0.00	0.17	0.00	0.08	0.00	0.01	0.06	0.00	0.00	0.00	0.00	0.06
TOWS5	0	0.99	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00
	1	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
TOWS6	0	0.72	0.71	0.81	0.95	0.78	1.00	0.72	0.93	0.92	0.88	0.49	1.00	0.58	0.00	0.74
	1	0.28	0.29	0.19	0.05	0.22	0.00	0.28	0.07	0.08	0.12	0.51	0.00	0.42	1.00	0.26
TOWS9	0	0.93	0.97	0.93	0.99	0.95	1.00	0.81	1.00	0.99	0.97	0.91	1.00	0.94	1.00	0.98
	1	0.07	0.03	0.07	0.01	0.05	0.00	0.19	0.00	0.01	0.03	0.09	0.00	0.06	0.00	0.02
TOWS0	0	0.95	0.96	0.98	0.90	0.99	1.00	0.96	0.99	0.99	0.97	0.95	1.00	0.98	1.00	0.92
	1	0.05	0.04	0.02	0.10	0.01	0.00	0.04	0.01	0.01	0.03	0.05	0.00	0.02	0.00	0.08
DP1	0	1.00	0.85	0.97	0.01	1.00	0.00	0.98	0.01	0.00	0.68	1.00	0.93	1.00	1.00	0.86
	1	0.00	0.16	0.03	0.99	0.00	1.00	0.02	0.99	1.00	0.32	0.00	0.07	0.00	0.00	0.14
DP8	0	1.00	0.54	0.82	1.00	1.00	1.00	0.94	1.00	1.00	0.77	0.90	0.35	0.78	0.05	0.79
	1	0.00	0.46	0.18	0.00	0.00	0.00	0.06	0.00	0.00	0.23	0.10	0.65	0.22	0.95	0.21
DP0	0	0.00	0.70	0.30	1.00	0.01	1.00	0.11	1.00	1.00	0.65	0.11	1.00	0.25	1.00	0.37
	1	1.00	0.30	0.70	0.00	0.99	0.00	0.89	0.00	0.00	0.35	0.89	0.00	0.75	0.00	0.63
DPN	0	1.00	0.96	0.93	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.80	0.99	1.00	1.00
	1	0.00	0.04	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.20	0.01	0.00	0.00

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Steel Continuous - Girder or Floorbeam System																
DL2	0	0.88	0.94	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.54	0.48	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.46	0.52	---	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.89	0.81	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.11	0.19	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS3	0	0.92	0.83	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.08	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.91	0.69	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.09	0.31	---	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Slab																
DL2	0	0.96	0.97	1.00	0.96	0.99	---	---	---	---	---	---	---	---	---	---
	1	0.04	0.03	0.00	0.04	0.01	---	---	---	---	---	---	---	---	---	---
DL3	0	0.99	0.97	0.78	0.98	0.97	---	---	---	---	---	---	---	---	---	---
	1	0.01	0.03	0.22	0.02	0.03	---	---	---	---	---	---	---	---	---	---
DL4	0	0.89	0.86	1.00	0.88	0.95	---	---	---	---	---	---	---	---	---	---
	1	0.11	0.14	0.00	0.12	0.05	---	---	---	---	---	---	---	---	---	---
DL5	0	0.42	0.43	1.00	0.48	0.38	---	---	---	---	---	---	---	---	---	---
	1	0.58	0.57	0.00	0.52	0.62	---	---	---	---	---	---	---	---	---	---
DL6	0	0.91	0.90	0.25	0.90	0.84	---	---	---	---	---	---	---	---	---	---
	1	0.09	0.10	0.75	0.10	0.16	---	---	---	---	---	---	---	---	---	---
DL9	0	0.92	0.95	1.00	0.92	0.93	---	---	---	---	---	---	---	---	---	---
	1	0.08	0.05	0.00	0.08	0.07	---	---	---	---	---	---	---	---	---	---
DL0	0	0.93	0.93	0.98	0.88	0.94	---	---	---	---	---	---	---	---	---	---
	1	0.07	0.07	0.02	0.12	0.06	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DST1	0	0.87	0.40	0.00	0.77	0.68	---	---	---	---	---	---	---	---	---	---
	1	0.13	0.60	1.00	0.23	0.32	---	---	---	---	---	---	---	---	---	---
DST2	0	0.49	0.74	1.00	0.51	0.46	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.26	0.00	0.49	0.54	---	---	---	---	---	---	---	---	---	---
DST9	0	0.71	0.93	1.00	0.84	0.86	---	---	---	---	---	---	---	---	---	---
	1	0.29	0.07	0.00	0.16	0.14	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.93	0.94	1.00	0.88	0.99	---	---	---	---	---	---	---	---	---	---
	1	0.07	0.06	0.00	0.12	0.01	---	---	---	---	---	---	---	---	---	---
TOWS1	0	1.00	0.03	1.00	0.83	0.79	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.97	0.00	0.17	0.21	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.09	1.00	0.01	0.27	0.31	---	---	---	---	---	---	---	---	---	---
	1	0.91	0.00	0.99	0.73	0.69	---	---	---	---	---	---	---	---	---	---
DP1	0	0.91	0.86	1.00	0.81	0.94	---	---	---	---	---	---	---	---	---	---
	1	0.09	0.14	0.00	0.19	0.06	---	---	---	---	---	---	---	---	---	---
DP8	0	0.82	0.81	1.00	0.89	0.90	---	---	---	---	---	---	---	---	---	---
	1	0.18	0.19	0.00	0.11	0.10	---	---	---	---	---	---	---	---	---	---
DP0	0	0.31	0.44	0.00	0.40	0.18	---	---	---	---	---	---	---	---	---	---
	1	0.69	0.56	1.00	0.60	0.82	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Stringer/Mulit-beam or girder																
DL2	0	0.95	0.90	1.00	0.99	0.99	0.89	1.00	0.98	---	---	---	---	---	---	---
	1	0.05	0.10	0.00	0.01	0.01	0.11	0.00	0.02	---	---	---	---	---	---	---
DL3	0	0.96	0.98	1.00	0.99	1.00	0.98	1.00	1.00	---	---	---	---	---	---	---
	1	0.04	0.02	0.00	0.01	0.00	0.02	0.00	0.00	---	---	---	---	---	---	---
DL4	0	0.94	0.99	0.99	0.98	0.96	0.86	0.00	0.95	---	---	---	---	---	---	---
	1	0.06	0.01	0.01	0.02	0.04	0.14	1.00	0.05	---	---	---	---	---	---	---
DL5	0	0.39	0.25	0.43	0.24	0.48	0.48	1.00	0.26	---	---	---	---	---	---	---
	1	0.62	0.75	0.57	0.76	0.52	0.52	0.00	0.74	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL6	0	0.82	0.93	0.84	0.85	0.60	0.94	1.00	0.84	---	---	---	---	---	---	---
	1	0.18	0.07	0.16	0.15	0.40	0.06	0.00	0.16	---	---	---	---	---	---	---
DL9	0	0.99	1.00	0.76	0.97	0.99	0.93	1.00	0.99	---	---	---	---	---	---	---
	1	0.01	0.00	0.24	0.03	0.01	0.07	0.00	0.01	---	---	---	---	---	---	---
DL0	0	0.96	0.97	0.98	0.99	0.99	0.93	1.00	0.99	---	---	---	---	---	---	---
	1	0.04	0.03	0.02	0.01	0.01	0.07	0.00	0.01	---	---	---	---	---	---	---
DST1	0	0.09	0.16	0.06	0.08	0.01	0.18	0.05	0.06	---	---	---	---	---	---	---
	1	0.91	0.84	0.94	0.92	0.99	0.82	0.95	0.94	---	---	---	---	---	---	---
DST9	0	0.98	1.00	0.99	1.00	1.00	0.96	1.00	1.00	---	---	---	---	---	---	---
	1	0.02	0.00	0.01	0.00	0.00	0.04	0.00	0.00	---	---	---	---	---	---	---
TOWS1	0	0.43	0.32	0.11	0.33	0.66	0.42	0.57	0.51	---	---	---	---	---	---	---
	1	0.57	0.68	0.89	0.67	0.34	0.58	0.43	0.49	---	---	---	---	---	---	---
TOWS2	0	0.99	1.00	0.99	0.99	0.97	0.98	1.00	1.00	---	---	---	---	---	---	---
	1	0.01	0.00	0.01	0.01	0.03	0.02	0.00	0.00	---	---	---	---	---	---	---
TOWS3	0	0.98	1.00	0.98	0.99	0.84	0.98	1.00	0.96	---	---	---	---	---	---	---
	1	0.02	0.00	0.02	0.01	0.16	0.02	0.00	0.04	---	---	---	---	---	---	---
TOWS4	0	0.98	0.99	1.00	0.99	0.91	0.99	1.00	0.97	---	---	---	---	---	---	---
	1	0.02	0.01	0.00	0.01	0.09	0.01	0.00	0.03	---	---	---	---	---	---	---
TOWS6	0	0.81	0.71	0.95	0.91	0.84	0.67	0.48	0.83	---	---	---	---	---	---	---
	1	0.19	0.29	0.05	0.09	0.16	0.33	0.52	0.17	---	---	---	---	---	---	---
TOWS9	0	0.99	0.99	1.00	0.99	1.00	0.99	0.99	0.97	---	---	---	---	---	---	---
	1	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.03	---	---	---	---	---	---	---
TOWS0	0	0.84	1.00	0.98	0.82	0.78	0.98	0.99	0.78	---	---	---	---	---	---	---
	1	0.16	0.00	0.02	0.18	0.22	0.02	0.01	0.22	---	---	---	---	---	---	---
DP1	0	1.00	1.00	0.00	0.85	0.83	0.78	1.00	0.92	---	---	---	---	---	---	---
	1	0.00	0.00	1.00	0.15	0.17	0.22	0.00	0.08	---	---	---	---	---	---	---
DP8	0	1.00	0.00	1.00	0.71	0.95	0.74	0.36	0.68	---	---	---	---	---	---	---
	1	0.00	1.00	0.00	0.29	0.05	0.26	0.64	0.32	---	---	---	---	---	---	---
DP0	0	0.11	1.00	1.00	0.48	0.24	0.59	1.00	0.43	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.89	0.00	0.00	0.52	0.76	0.41	0.00	0.57	---	---	---	---	---	---	---
DPN	0	0.93	1.00	1.00	0.99	0.99	0.92	0.71	0.98	---	---	---	---	---	---	---
	1	0.07	0.00	0.00	0.01	0.01	0.08	0.29	0.02	---	---	---	---	---	---	---
Prestressed Concrete - Tee Beam																
DL2	0	0.93	0.90	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.07	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
DL3	0	0.98	0.96	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.88	0.92	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.49	0.55	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.45	---	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.96	0.94	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.04	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.68	0.75	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.32	0.25	---	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.92	0.94	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.08	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.70	0.64	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.31	0.36	---	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Box Beam or Girders - Multiple																
DL2	0	0.99	0.98	0.98	1.00	0.99	0.96	1.00	0.98	0.98	0.99	0.98	0.99	0.97	---	---
	1	0.01	0.02	0.02	0.00	0.01	0.04	0.00	0.02	0.02	0.01	0.02	0.01	0.03	---	---
DL3	0	0.96	0.96	1.00	1.00	0.95	0.98	1.00	0.95	0.98	0.98	0.99	0.98	0.99	---	---
	1	0.04	0.04	0.00	0.00	0.06	0.02	0.00	0.05	0.02	0.02	0.01	0.02	0.01	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL4	0	0.97	0.93	0.92	1.00	0.99	0.95	1.00	0.95	0.87	0.92	0.95	0.97	0.90	---	---
	1	0.03	0.07	0.08	0.00	0.01	0.05	0.00	0.05	0.13	0.08	0.05	0.03	0.10	---	---
DL5	0	0.40	0.29	0.22	1.00	0.20	0.48	0.89	0.30	0.51	0.48	0.34	0.49	0.62	---	---
	1	0.60	0.71	0.78	0.00	0.80	0.52	0.11	0.70	0.49	0.52	0.66	0.51	0.38	---	---
DL6	0	0.90	0.96	0.99	0.00	0.98	0.81	0.97	0.88	0.93	0.90	0.80	0.73	0.93	---	---
	1	0.10	0.04	0.01	1.00	0.02	0.19	0.03	0.12	0.07	0.10	0.20	0.27	0.07	---	---
DL9	0	0.87	0.98	0.95	1.00	0.99	0.98	0.19	0.98	0.80	0.92	0.96	0.91	0.71	---	---
	1	0.13	0.02	0.05	0.00	0.01	0.02	0.81	0.02	0.20	0.08	0.04	0.09	0.29	---	---
DL0	0	0.92	0.90	0.95	1.00	0.91	0.84	0.95	0.98	0.91	0.82	0.97	0.94	0.88	---	---
	1	0.08	0.10	0.05	0.00	0.09	0.16	0.05	0.02	0.09	0.18	0.03	0.06	0.12	---	---
DST1	0	0.63	0.73	0.07	0.00	1.00	0.56	0.60	0.54	0.99	0.38	0.42	0.34	1.00	---	---
	1	0.37	0.27	0.93	1.00	0.00	0.44	0.40	0.46	0.01	0.62	0.58	0.66	0.00	---	---
DST2	0	0.47	0.46	1.00	1.00	0.00	0.61	0.95	0.67	0.99	0.68	0.67	0.74	1.00	---	---
	1	0.53	0.54	0.00	0.00	1.00	0.39	0.05	0.33	0.01	0.32	0.33	0.27	0.00	---	---
DST9	0	0.95	0.90	0.94	1.00	1.00	0.91	0.47	0.87	0.99	0.95	0.95	0.98	0.99	---	---
	1	0.05	0.10	0.06	0.00	0.00	0.09	0.53	0.13	0.01	0.05	0.05	0.02	0.01	---	---
DSTN	0	0.95	0.91	1.00	1.00	1.00	0.93	0.99	0.93	0.02	0.99	0.97	0.95	0.01	---	---
	1	0.06	0.09	0.01	0.00	0.00	0.07	0.01	0.07	0.98	0.01	0.03	0.05	0.99	---	---
TOWS1	0	0.48	1.00	0.10	0.73	0.30	1.00	0.48	1.00	0.67	0.46	0.68	0.36	0.72	---	---
	1	0.52	0.00	0.90	0.27	0.70	0.00	0.52	0.00	0.33	0.54	0.32	0.64	0.28	---	---
TOWS2	0	0.99	1.00	0.97	0.95	0.93	1.00	0.95	1.00	0.92	0.85	0.94	0.96	0.92	---	---
	1	0.01	0.00	0.03	0.05	0.07	0.00	0.05	0.00	0.08	0.15	0.06	0.04	0.08	---	---
TOWS3	0	1.00	1.00	0.98	0.99	1.00	1.00	0.99	1.00	1.00	0.87	0.88	0.95	1.00	---	---
	1	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.13	0.12	0.05	0.00	---	---
TOWS6	0	0.60	0.00	1.00	0.40	1.00	0.00	0.66	0.00	0.66	1.00	0.52	0.88	0.49	---	---
	1	0.40	1.00	0.00	0.60	0.00	1.00	0.34	1.00	0.34	0.00	0.48	0.12	0.51	---	---
TOWS8	0	0.99	1.00	1.00	1.00	0.96	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	---	---
	1	0.01	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	---	---
TOWS9	0	0.96	1.00	0.98	0.98	0.85	1.00	1.00	1.00	0.99	0.92	0.99	0.93	0.98	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.04	0.00	0.02	0.02	0.15	0.00	0.00	0.00	0.01	0.08	0.01	0.07	0.02	---	---
TOWSN	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.76	1.00	1.00	0.98	0.88	---	---
	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.02	0.12	---	---
DP1	0	0.88	0.96	0.82	0.81	0.96	0.93	0.05	0.96	1.00	0.64	0.81	0.81	1.00	---	---
	1	0.12	0.04	0.18	0.19	0.04	0.07	0.95	0.04	0.00	0.36	0.19	0.19	0.00	---	---
DP9	0	0.99	0.99	1.00	0.97	0.99	0.97	0.99	0.98	1.00	0.98	0.99	1.00	1.00	---	---
	1	0.01	0.01	0.00	0.03	0.01	0.03	0.01	0.02	0.00	0.02	0.01	0.00	0.00	---	---
DP0	0	0.28	0.16	0.42	0.29	0.13	0.17	0.99	0.30	1.00	0.44	0.33	0.48	1.00	---	---
	1	0.72	0.84	0.58	0.71	0.87	0.83	0.01	0.70	0.00	0.56	0.67	0.52	0.00	---	---
DPN	0	0.99	1.00	1.00	1.00	0.99	1.00	1.00	0.99	0.00	1.00	0.99	0.94	0.05	---	---
	1	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	1.00	0.00	0.01	0.06	0.95	---	---
							Prestressed Concrete - Box Beam or Girders - Single or Spread									
DL4	0	0.91	0.98	0.95	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.09	0.02	0.05	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.34	0.57	0.58	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.66	0.43	0.42	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.81	0.94	0.72	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.19	0.06	0.28	---	---	---	---	---	---	---	---	---	---	---	---
DL9	0	0.99	0.61	0.82	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.01	0.39	0.18	---	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.96	0.91	0.95	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.04	0.09	0.05	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.08	0.28	0.06	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.92	0.72	0.94	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.94	0.76	0.96	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.06	0.24	0.04	---	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.40	0.10	0.40	---	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.60	0.90	0.61	---	---	---	---	---	---	---	---	---	---	---	---
TOWS3	0	0.93	1.00	0.78	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.07	0.00	0.22	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.74	0.93	0.87	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.26	0.07	0.13	---	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.95	0.19	0.50	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.05	0.81	0.50	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.14	0.84	0.55	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.87	0.16	0.45	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Culvert (includes frame culverts)																
DL5	0	0.01	1.00	0.40	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.99	0.00	0.60	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.00	0.01	0.04	---	---	---	---	---	---	---	---	---	---	---	---
	1	1.00	0.99	0.96	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.77	0.77	0.32	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.23	0.23	0.68	---	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.24	0.25	0.96	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.76	0.75	0.04	---	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.01	0.00	0.07	---	---	---	---	---	---	---	---	---	---	---	---
	1	1.00	1.00	0.93	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Channel Beam																
DL5	0	0.71	0.55	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.29	0.45	---	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.40	0.56	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.60	0.44	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TOWS1	0	0.79	0.64	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.21	0.36	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.42	0.62	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.58	0.38	---	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete Continuous - Stringer/Mulit-beam or girder																
DL2	0	0.96	1.00	0.98	1.00	---	---	---	---	---	---	---	---	---	---	---
	1	0.04	0.00	0.02	0.00	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.94	0.98	0.96	0.99	---	---	---	---	---	---	---	---	---	---	---
	1	0.06	0.02	0.04	0.01	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.29	0.34	0.30	0.32	---	---	---	---	---	---	---	---	---	---	---
	1	0.71	0.66	0.70	0.68	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.86	0.85	0.79	0.80	---	---	---	---	---	---	---	---	---	---	---
	1	0.14	0.15	0.21	0.20	---	---	---	---	---	---	---	---	---	---	---
DL9	0	0.98	0.84	0.99	0.90	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.16	0.01	0.10	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.98	0.99	0.99	0.99	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.01	0.01	0.01	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.08	0.19	0.05	0.08	---	---	---	---	---	---	---	---	---	---	---
	1	0.92	0.81	0.95	0.92	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.41	0.11	0.46	0.41	---	---	---	---	---	---	---	---	---	---	---
	1	0.59	0.89	0.54	0.59	---	---	---	---	---	---	---	---	---	---	---
TOWS3	0	0.98	0.98	0.86	0.98	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.02	0.14	0.02	---	---	---	---	---	---	---	---	---	---	---
TOWS4	0	0.96	1.00	0.85	0.98	---	---	---	---	---	---	---	---	---	---	---
	1	0.04	0.00	0.15	0.02	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.81	0.95	0.89	0.90	---	---	---	---	---	---	---	---	---	---	---
	1	0.19	0.05	0.11	0.10	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TOWS0	0	0.88	0.99	0.99	0.78	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.01	0.02	0.23	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.99	0.00	0.58	0.65	---	---	---	---	---	---	---	---	---	---	---
	1	0.01	1.00	0.42	0.35	---	---	---	---	---	---	---	---	---	---	---
DP8	0	0.88	1.00	0.97	0.89	---	---	---	---	---	---	---	---	---	---	---
	1	0.12	0.00	0.03	0.11	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.14	1.00	0.47	0.49	---	---	---	---	---	---	---	---	---	---	---
	1	0.86	0.00	0.53	0.52	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete Continuous - Box Beam or Girders - Single or Spread																
DL5	0	0.34	0.50	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.66	0.50	---	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.87	0.69	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.13	0.31	---	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.25	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.75	0.93	---	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.77	0.94	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.23	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.14	0.24	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.86	0.76	---	---	---	---	---	---	---	---	---	---	---	---	---
Wood or Timber - Slab																
DL2	0	0.89	0.98	0.93	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.11	0.02	0.07	---	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.80	0.90	0.87	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.20	0.10	0.13	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.57	0.39	0.63	---	---	---	---	---	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.43	0.61	0.37	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.97	0.94	0.92	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.03	0.06	0.08	---	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.80	0.84	0.78	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.20	0.16	0.22	---	---	---	---	---	---	---	---	---	---	---	---
DST8	0	0.22	0.10	0.25	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.78	0.90	0.75	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.81	0.93	0.83	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.19	0.07	0.17	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.36	0.18	0.31	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.64	0.82	0.69	---	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.77	0.97	0.87	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.23	0.03	0.13	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.65	0.24	0.34	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.35	0.76	0.66	---	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.39	0.89	0.73	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.61	0.11	0.27	---	---	---	---	---	---	---	---	---	---	---	---
Wood or Timber - Stringer/Mulit-beam or girder																
DL2	0	0.92	0.94	0.66	0.95	0.84	0.80	0.94	0.76	---	---	---	---	---	---	---
	1	0.08	0.06	0.34	0.05	0.16	0.20	0.06	0.24	---	---	---	---	---	---	---
DL3	0	1.00	0.99	0.96	1.00	0.98	0.99	1.00	0.97	---	---	---	---	---	---	---
	1	0.00	0.01	0.04	0.00	0.02	0.01	0.00	0.03	---	---	---	---	---	---	---
DL4	0	0.94	0.98	0.96	0.95	0.97	0.97	0.94	0.96	---	---	---	---	---	---	---
	1	0.06	0.02	0.04	0.05	0.03	0.03	0.06	0.04	---	---	---	---	---	---	---
DL5	0	0.91	0.95	0.89	0.97	0.94	0.98	0.92	0.94	---	---	---	---	---	---	---
	1	0.09	0.05	0.11	0.03	0.06	0.02	0.08	0.06	---	---	---	---	---	---	---
DL9	0	1.00	1.00	0.99	0.99	0.99	1.00	0.99	0.99	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	---	---	---	---	---	---	---
DL0	0	0.47	0.22	0.71	0.18	0.34	0.38	0.29	0.50	---	---	---	---	---	---	---
	1	0.53	0.78	0.29	0.82	0.66	0.62	0.71	0.50	---	---	---	---	---	---	---
DST1	0	0.97	1.00	1.00	0.98	1.00	0.00	0.99	0.49	---	---	---	---	---	---	---
	1	0.03	0.00	0.00	0.02	0.00	1.00	0.01	0.51	---	---	---	---	---	---	---
DST6	0	0.99	1.00	0.98	1.00	1.00	1.00	0.99	0.93	---	---	---	---	---	---	---
	1	0.01	0.00	0.02	0.00	0.00	0.00	0.01	0.07	---	---	---	---	---	---	---
DST8	0	0.05	0.01	0.04	0.02	0.00	1.00	0.04	0.61	---	---	---	---	---	---	---
	1	0.95	0.99	0.96	0.98	1.00	0.00	0.96	0.39	---	---	---	---	---	---	---
TOWS1	0	0.99	0.99	1.00	1.00	1.00	0.40	0.99	0.80	---	---	---	---	---	---	---
	1	0.01	0.01	0.00	0.00	0.00	0.60	0.01	0.20	---	---	---	---	---	---	---
TOWS6	0	0.81	1.00	0.03	0.70	0.78	0.65	0.86	0.40	---	---	---	---	---	---	---
	1	0.19	0.00	0.97	0.30	0.22	0.35	0.14	0.60	---	---	---	---	---	---	---
TOWS7	0	0.61	0.42	0.98	0.50	0.50	1.00	0.41	0.88	---	---	---	---	---	---	---
	1	0.39	0.58	0.02	0.50	0.50	0.00	0.59	0.12	---	---	---	---	---	---	---
TOWS8	0	0.78	0.70	1.00	0.83	0.80	1.00	0.85	0.97	---	---	---	---	---	---	---
	1	0.22	0.30	0.00	0.17	0.20	0.00	0.15	0.03	---	---	---	---	---	---	---
TOWS9	0	0.89	0.92	1.00	0.99	0.96	1.00	0.91	0.99	---	---	---	---	---	---	---
	1	0.11	0.08	0.00	0.01	0.04	0.00	0.09	0.01	---	---	---	---	---	---	---
TOWS0	0	0.94	0.96	1.00	1.00	0.97	0.97	0.98	0.96	---	---	---	---	---	---	---
	1	0.06	0.04	0.00	0.00	0.03	0.03	0.02	0.04	---	---	---	---	---	---	---
DP8	0	1.00	0.98	0.96	0.28	0.99	0.95	0.89	0.96	---	---	---	---	---	---	---
	1	0.00	0.02	0.04	0.72	0.01	0.05	0.11	0.04	---	---	---	---	---	---	---
DP9	0	1.00	1.00	0.99	0.96	0.99	1.00	0.99	0.99	---	---	---	---	---	---	---
	1	0.00	0.00	0.01	0.04	0.01	0.00	0.01	0.01	---	---	---	---	---	---	---
DP0	0	0.00	0.03	0.08	1.00	0.03	0.09	0.17	0.09	---	---	---	---	---	---	---
	1	1.00	0.97	0.92	0.00	0.97	0.91	0.83	0.91	---	---	---	---	---	---	---
DPN	0	1.00	0.99	0.97	0.78	1.00	0.97	0.97	0.96	---	---	---	---	---	---	---
	1	0.00	0.01	0.03	0.22	0.00	0.04	0.03	0.04	---	---	---	---	---	---	---

Table A6 Continued: *Nominal Parameter Distribution Within Cluster*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							Masonry - Arch-Deck									
DST9	0	0.82	0.91	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.18	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.63	0.52	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.37	0.48	---	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.51	0.60	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.49	0.40	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A7: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
									Concrete - Slab							
DL1	0	0.18	0.17	0.16	0.12	0.09	0.03	0.06	0.05	0.05	0.03	0.02	0.02	0.02	0.00	---
	1	0.11	0.05	0.08	0.02	0.10	0.53	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.08	---
DL2	0	0.19	0.15	0.15	0.11	0.07	0.07	0.07	0.06	0.04	0.02	0.02	0.02	0.02	0.01	---
	1	0.10	0.20	0.18	0.13	0.17	0.09	0.00	0.00	0.04	0.04	0.04	0.01	0.01	0.01	---
DL3	0	0.17	0.16	0.16	0.11	0.09	0.08	0.06	0.05	0.04	0.02	0.02	0.02	0.02	0.01	---
	1	0.26	0.14	0.19	0.21	0.09	0.02	0.00	0.00	0.05	0.02	0.00	0.00	0.01	0.00	---
DL4	0	0.18	0.16	0.15	0.11	0.09	0.08	0.06	0.05	0.04	0.02	0.01	0.02	0.02	0.01	---
	1	0.15	0.11	0.18	0.14	0.15	0.00	0.00	0.01	0.06	0.04	0.09	0.05	0.01	0.00	---
DL5	0	0.11	0.12	0.21	0.10	0.11	0.10	0.08	0.02	0.05	0.03	0.03	0.02	0.01	0.01	---
	1	0.32	0.23	0.04	0.13	0.06	0.01	0.00	0.11	0.03	0.02	0.00	0.02	0.03	0.00	---
DL6	0	0.18	0.15	0.16	0.11	0.10	0.08	0.06	0.04	0.04	0.02	0.02	0.02	0.01	0.01	---
	1	0.09	0.23	0.09	0.22	0.04	0.00	0.00	0.17	0.04	0.03	0.00	0.03	0.08	0.00	---
DL9	0	0.17	0.16	0.16	0.11	0.09	0.07	0.06	0.04	0.04	0.02	0.02	0.02	0.02	0.01	---
	1	0.07	0.06	0.04	0.04	0.03	0.00	0.00	0.43	0.20	0.00	0.00	0.06	0.05	0.00	---
DL0	0	0.20	0.18	0.11	0.13	0.10	0.09	0.00	0.06	0.03	0.03	0.02	0.02	0.02	0.01	---
	1	0.07	0.07	0.35	0.05	0.05	0.01	0.27	0.00	0.07	0.02	0.00	0.02	0.00	0.00	---
DST1	0	0.22	0.17	0.00	0.07	0.03	0.31	0.01	0.01	0.04	0.02	0.00	0.08	0.01	0.04	---
	1	0.16	0.15	0.20	0.13	0.12	0.00	0.07	0.06	0.04	0.03	0.03	0.00	0.02	0.00	---
DST2	0	0.16	0.15	0.19	0.12	0.11	0.00	0.07	0.05	0.05	0.03	0.03	0.02	0.02	0.00	---
	1	0.22	0.20	0.00	0.08	0.03	0.38	0.00	0.01	0.01	0.02	0.00	0.00	0.01	0.05	---
DSTN	0	0.17	0.16	0.16	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.00	0.02	0.01	---
	1	0.18	0.01	0.00	0.01	0.01	0.00	0.06	0.02	0.17	0.00	0.00	0.51	0.03	0.00	---
TOWS1	0	0.15	0.23	0.21	0.00	0.09	0.09	0.06	0.01	0.05	0.03	0.03	0.02	0.01	0.01	---
	1	0.21	0.01	0.05	0.35	0.10	0.05	0.04	0.11	0.03	0.02	0.00	0.01	0.02	0.00	---
TOWS2	0	0.17	0.16	0.15	0.11	0.09	0.07	0.06	0.04	0.04	0.02	0.02	0.02	0.02	0.01	---
	1	0.15	0.09	0.27	0.00	0.03	0.00	0.07	0.19	0.07	0.02	0.00	0.02	0.09	0.00	---
TOWS6	0	0.25	0.14	0.07	0.21	0.07	0.03	0.07	0.08	0.03	0.02	0.00	0.01	0.02	0.00	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.09	0.18	0.25	0.00	0.12	0.13	0.05	0.01	0.06	0.03	0.04	0.03	0.01	0.02	---
TOWS8	0	0.17	0.16	0.15	0.12	0.10	0.08	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.01	---
	1	0.20	0.03	0.27	0.00	0.01	0.00	0.43	0.00	0.04	0.00	0.00	0.00	0.00	0.00	---
TOWS9	0	0.17	0.16	0.16	0.12	0.09	0.08	0.05	0.05	0.04	0.02	0.02	0.02	0.02	0.01	---
	1	0.30	0.13	0.21	0.00	0.11	0.00	0.16	0.01	0.02	0.02	0.01	0.01	0.02	0.00	---
TOWS0	0	0.14	0.11	0.17	0.13	0.11	0.08	0.06	0.05	0.05	0.03	0.02	0.02	0.02	0.01	---
	1	0.38	0.52	0.03	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.02	0.00	---
TOWSN	0	0.17	0.16	0.16	0.11	0.09	0.07	0.06	0.05	0.04	0.02	0.02	0.02	0.02	0.01	---
	1	0.10	0.00	0.01	0.00	0.03	0.00	0.10	0.00	0.08	0.00	0.00	0.55	0.11	0.00	---
DP1	0	0.18	0.17	0.17	0.12	0.10	0.08	0.06	0.00	0.04	0.03	0.02	0.02	0.01	0.01	---
	1	0.07	0.00	0.00	0.00	0.06	0.00	0.00	0.75	0.06	0.00	0.00	0.00	0.06	0.00	---
DP8	0	0.20	0.20	0.20	0.14	0.01	0.00	0.06	0.05	0.05	0.03	0.00	0.02	0.02	0.00	---
	1	0.09	0.00	0.00	0.00	0.39	0.33	0.03	0.01	0.01	0.00	0.09	0.00	0.01	0.04	---
DP9	0	0.17	0.16	0.16	0.11	0.09	0.07	0.06	0.04	0.04	0.02	0.02	0.02	0.02	0.01	---
	1	0.10	0.00	0.00	0.00	0.51	0.00	0.09	0.07	0.06	0.00	0.14	0.01	0.02	0.00	---
DP0	0	0.09	0.00	0.00	0.00	0.31	0.24	0.03	0.15	0.03	0.00	0.07	0.03	0.03	0.03	---
	1	0.21	0.23	0.22	0.16	0.00	0.00	0.07	0.00	0.05	0.03	0.00	0.01	0.01	0.00	---
DPN	0	0.17	0.16	0.16	0.12	0.09	0.08	0.06	0.05	0.04	0.02	0.02	0.01	0.02	0.01	---
	1	0.06	0.00	0.00	0.00	0.11	0.00	0.07	0.03	0.19	0.00	0.00	0.46	0.07	0.00	---
								Concrete Continuous - Slab								
DL1	0	0.25	0.16	0.15	0.13	0.09	0.06	0.05	0.04	0.03	0.02	0.01	0.01	---	---	---
	1	0.34	0.00	0.04	0.01	0.52	0.03	0.00	0.00	0.05	0.00	0.01	0.00	---	---	---
DL2	0	0.24	0.18	0.13	0.14	0.10	0.05	0.05	0.04	0.03	0.02	0.02	0.01	---	---	---
	1	0.36	0.00	0.30	0.00	0.14	0.08	0.00	0.02	0.07	0.03	0.00	0.00	---	---	---
DL3	0	0.24	0.16	0.14	0.13	0.10	0.06	0.05	0.04	0.03	0.02	0.02	0.01	---	---	---
	1	0.40	0.00	0.45	0.00	0.03	0.02	0.00	0.01	0.07	0.01	0.00	0.00	---	---	---
DL4	0	0.25	0.19	0.09	0.14	0.11	0.05	0.05	0.04	0.03	0.01	0.02	0.01	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.25	0.00	0.48	0.02	0.01	0.08	0.02	0.03	0.03	0.06	0.01	0.00	---	---	---
DL5	0	0.28	0.00	0.27	0.06	0.17	0.05	0.03	0.05	0.03	0.02	0.01	0.02	---	---	---
	1	0.21	0.36	0.00	0.20	0.01	0.07	0.06	0.03	0.04	0.01	0.02	0.00	---	---	---
DL6	0	0.22	0.18	0.15	0.12	0.11	0.06	0.03	0.03	0.04	0.02	0.01	0.01	---	---	---
	1	0.46	0.00	0.13	0.13	0.00	0.01	0.13	0.09	0.01	0.01	0.04	0.00	---	---	---
DL9	0	0.25	0.16	0.15	0.11	0.10	0.06	0.05	0.04	0.03	0.02	0.01	0.01	---	---	---
	1	0.05	0.00	0.06	0.67	0.00	0.00	0.01	0.14	0.01	0.00	0.07	0.00	---	---	---
DL0	0	0.27	0.18	0.15	0.14	0.04	0.06	0.05	0.04	0.04	0.02	0.02	0.00	---	---	---
	1	0.07	0.00	0.16	0.01	0.57	0.03	0.00	0.04	0.01	0.00	0.00	0.09	---	---	---
DSTN	0	0.25	0.16	0.15	0.13	0.10	0.06	0.05	0.04	0.03	0.02	0.01	0.01	---	---	---
	1	0.26	0.00	0.01	0.05	0.25	0.00	0.04	0.29	0.06	0.02	0.02	0.00	---	---	---
TOWS1	0	0.46	0.07	0.00	0.04	0.15	0.06	0.08	0.05	0.05	0.03	0.01	0.02	---	---	---
	1	0.03	0.25	0.31	0.22	0.04	0.05	0.01	0.03	0.02	0.01	0.02	0.01	---	---	---
TOWS2	0	0.25	0.16	0.16	0.12	0.10	0.06	0.05	0.04	0.04	0.02	0.01	0.01	---	---	---
	1	0.28	0.17	0.00	0.33	0.01	0.01	0.05	0.03	0.01	0.01	0.10	0.00	---	---	---
TOWS6	0	0.15	0.22	0.21	0.17	0.07	0.04	0.05	0.04	0.02	0.01	0.02	0.01	---	---	---
	1	0.52	0.00	0.00	0.01	0.18	0.10	0.03	0.03	0.06	0.04	0.00	0.02	---	---	---
TOWS8	0	0.25	0.16	0.16	0.13	0.08	0.06	0.05	0.04	0.04	0.02	0.02	0.01	---	---	---
	1	0.06	0.04	0.00	0.06	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.04	---	---	---
TOWS9	0	0.24	0.16	0.16	0.13	0.10	0.06	0.05	0.04	0.03	0.02	0.01	0.01	---	---	---
	1	0.75	0.01	0.00	0.00	0.11	0.02	0.04	0.01	0.02	0.02	0.01	0.00	---	---	---
TOWS0	0	0.25	0.15	0.16	0.13	0.10	0.06	0.05	0.03	0.03	0.02	0.02	0.01	---	---	---
	1	0.27	0.33	0.00	0.04	0.03	0.00	0.04	0.25	0.02	0.00	0.00	0.00	---	---	---
DP1	0	0.28	0.18	0.17	0.02	0.11	0.06	0.05	0.04	0.04	0.02	0.00	0.01	---	---	---
	1	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.03	0.00	0.00	0.12	0.00	---	---	---
DP8	0	0.28	0.18	0.17	0.12	0.10	0.00	0.05	0.04	0.04	0.01	0.02	0.01	---	---	---
	1	0.00	0.00	0.00	0.17	0.09	0.56	0.01	0.03	0.00	0.13	0.00	0.01	---	---	---
DP9	0	0.25	0.16	0.15	0.12	0.10	0.05	0.05	0.04	0.03	0.02	0.01	0.01	---	---	---
	1	0.47	0.00	0.01	0.06	0.05	0.00	0.10	0.16	0.05	0.11	0.00	0.00	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DP0	0	0.01	0.00	0.00	0.52	0.04	0.23	0.02	0.04	0.01	0.06	0.06	0.00	---	---	---
	1	0.32	0.21	0.20	0.00	0.12	0.00	0.05	0.04	0.04	0.00	0.00	0.01	---	---	---
DPN	0	0.25	0.16	0.15	0.12	0.10	0.06	0.05	0.04	0.03	0.02	0.01	0.01	---	---	---
	1	0.00	0.00	0.00	0.28	0.16	0.00	0.03	0.45	0.07	0.02	0.00	0.00	---	---	---
DST1	0	0.18	0.06	0.11	0.17	0.19	0.00	0.03	0.17	0.05	0.02	0.01	0.00	---	---	---
	1	0.25	0.16	0.15	0.12	0.10	0.06	0.05	0.04	0.03	0.02	0.01	0.01			
Prestressed Concrete - Slab																
DL2	0	0.53	0.18	0.16	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.68	0.17	0.02	0.12	0.01	---	---	---	---	---	---	---	---	---	---
DL3	0	0.55	0.19	0.13	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.14	0.11	0.71	0.03	0.02	---	---	---	---	---	---	---	---	---	---
DL4	0	0.53	0.17	0.17	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.61	0.26	0.00	0.11	0.02	---	---	---	---	---	---	---	---	---	---
DL5	0	0.43	0.15	0.30	0.09	0.03	---	---	---	---	---	---	---	---	---	---
	1	0.64	0.22	0.00	0.10	0.05	---	---	---	---	---	---	---	---	---	---
DL6	0	0.61	0.21	0.05	0.10	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.24	0.09	0.59	0.05	0.03	---	---	---	---	---	---	---	---	---	---
DL9	0	0.52	0.19	0.17	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.70	0.15	0.00	0.11	0.04	---	---	---	---	---	---	---	---	---	---
DL0	0	0.53	0.18	0.16	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.57	0.19	0.05	0.16	0.03	---	---	---	---	---	---	---	---	---	---
DST1	0	0.73	0.12	0.00	0.11	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.19	0.30	0.42	0.06	0.03	---	---	---	---	---	---	---	---	---	---
DST2	0	0.43	0.22	0.25	0.08	0.03	---	---	---	---	---	---	---	---	---	---
	1	0.71	0.13	0.00	0.12	0.05	---	---	---	---	---	---	---	---	---	---
DST9	0	0.47	0.21	0.19	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.83	0.07	0.00	0.08	0.03	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DSTN	0	0.53	0.18	0.17	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.62	0.20	0.00	0.18	0.00	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.67	0.01	0.19	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.88	0.00	0.08	0.04	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.18	0.68	0.00	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.66	0.00	0.21	0.09	0.03	---	---	---	---	---	---	---	---	---	---
DP1	0	0.54	0.17	0.17	0.08	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.28	0.00	0.19	0.02	---	---	---	---	---	---	---	---	---	---
DP8	0	0.51	0.17	0.18	0.09	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.66	0.25	0.00	0.07	0.02	---	---	---	---	---	---	---	---	---	---
DP0	0	0.57	0.28	0.00	0.13	0.02	---	---	---	---	---	---	---	---	---	---
	1	0.52	0.14	0.22	0.08	0.04	---	---	---	---	---	---	---	---	---	---
Wood or Timber - Slab																
DL2	0	0.51	0.39	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.80	0.11	0.09	---	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.51	0.39	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.67	0.24	0.08	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.60	0.28	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.46	0.46	0.08	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.54	0.36	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.33	0.49	0.18	---	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.52	0.38	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.58	0.31	0.12	---	---	---	---	---	---	---	---	---	---	---	---
DST8	0	0.65	0.20	0.14	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.40	0.09	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.50	0.40	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.70	0.18	0.11	---	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TOWS6	0	0.67	0.23	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.48	0.42	0.10	---	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.48	0.42	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.83	0.08	0.08	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.74	0.19	0.07	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.35	0.53	0.12	---	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.34	0.54	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.83	0.10	0.07	---	---	---	---	---	---	---	---	---	---	---	---
Concrete - Stringer/Mulit-beam or girder																
DL1	0	0.22	0.22	0.21	0.21	0.04	0.03	0.03	0.03	---	---	---	---	---	---	---
	1	0.15	0.20	0.04	0.45	0.09	0.00	0.01	0.06	---	---	---	---	---	---	---
DL2	0	0.23	0.25	0.18	0.21	0.04	0.03	0.04	0.03	---	---	---	---	---	---	---
	1	0.21	0.14	0.33	0.21	0.02	0.03	0.02	0.04	---	---	---	---	---	---	---
DL3	0	0.22	0.23	0.21	0.20	0.04	0.03	0.03	0.03	---	---	---	---	---	---	---
	1	0.22	0.10	0.06	0.50	0.03	0.01	0.05	0.04	---	---	---	---	---	---	---
DL4	0	0.22	0.24	0.18	0.23	0.04	0.02	0.03	0.03	---	---	---	---	---	---	---
	1	0.22	0.13	0.34	0.12	0.02	0.09	0.04	0.04	---	---	---	---	---	---	---
DL5	0	0.18	0.22	0.22	0.25	0.03	0.04	0.02	0.04	---	---	---	---	---	---	---
	1	0.30	0.22	0.20	0.14	0.05	0.03	0.04	0.02	---	---	---	---	---	---	---
DL6	0	0.22	0.22	0.21	0.21	0.04	0.03	0.03	0.03	---	---	---	---	---	---	---
	1	0.27	0.15	0.02	0.21	0.19	0.01	0.14	0.01	---	---	---	---	---	---	---
DL0	0	0.25	0.18	0.25	0.17	0.04	0.04	0.04	0.03	---	---	---	---	---	---	---
	1	0.08	0.43	0.02	0.40	0.03	0.00	0.01	0.04	---	---	---	---	---	---	---
DST1	0	0.03	0.47	0.01	0.38	0.03	0.00	0.00	0.08	---	---	---	---	---	---	---
	1	0.25	0.19	0.24	0.19	0.04	0.04	0.03	0.02	---	---	---	---	---	---	---
DST2	0	0.23	0.22	0.22	0.19	0.04	0.04	0.03	0.03	---	---	---	---	---	---	---
	1	0.05	0.31	0.02	0.54	0.04	0.00	0.00	0.04	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DSTN	0	0.23	0.20	0.22	0.21	0.04	0.04	0.03	0.03	---	---	---	---	---	---	---
	1	0.00	0.69	0.00	0.15	0.00	0.00	0.00	0.15	---	---	---	---	---	---	---
TOWS1	0	0.02	0.16	0.38	0.27	0.04	0.05	0.03	0.05	---	---	---	---	---	---	---
	1	0.48	0.30	0.00	0.13	0.04	0.01	0.03	0.01	---	---	---	---	---	---	---
TOWS6	0	0.39	0.29	0.01	0.18	0.05	0.01	0.04	0.02	---	---	---	---	---	---	---
	1	0.00	0.13	0.48	0.24	0.02	0.06	0.02	0.05	---	---	---	---	---	---	---
TOWS8	0	0.23	0.21	0.22	0.20	0.04	0.04	0.03	0.03	---	---	---	---	---	---	---
	1	0.01	0.49	0.00	0.46	0.01	0.00	0.00	0.03	---	---	---	---	---	---	---
TOWS0	0	0.23	0.22	0.22	0.20	0.04	0.04	0.03	0.03	---	---	---	---	---	---	---
	1	0.00	0.25	0.00	0.53	0.04	0.00	0.17	0.02	---	---	---	---	---	---	---
DP1	0	0.22	0.22	0.21	0.21	0.04	0.03	0.03	0.03	---	---	---	---	---	---	---
	1	0.56	0.16	0.03	0.04	0.11	0.00	0.10	0.00	---	---	---	---	---	---	---
DP8	0	0.14	0.28	0.04	0.40	0.06	0.00	0.03	0.06	---	---	---	---	---	---	---
	1	0.32	0.16	0.40	0.00	0.02	0.07	0.03	0.00	---	---	---	---	---	---	---
DP0	0	0.32	0.17	0.38	0.01	0.02	0.06	0.03	0.00	---	---	---	---	---	---	---
	1	0.11	0.29	0.02	0.43	0.06	0.00	0.03	0.06	---	---	---	---	---	---	---
Concrete Continuous - Stringer/Mulit-beam or girder																
DL2	0	0.22	0.21	0.23	0.20	0.15	---	---	---	---	---	---	---	---	---	---
	1	0.45	0.33	0.22	0.00	0.00	---	---	---	---	---	---	---	---	---	---
DL4	0	0.28	0.22	0.22	0.16	0.12	---	---	---	---	---	---	---	---	---	---
	1	0.21	0.48	0.26	0.00	0.05	---	---	---	---	---	---	---	---	---	---
DL5	0	0.38	0.36	0.18	0.00	0.07	---	---	---	---	---	---	---	---	---	---
	1	0.07	0.00	0.30	0.42	0.21	---	---	---	---	---	---	---	---	---	---
DL6	0	0.29	0.25	0.22	0.16	0.09	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.04	0.26	0.00	0.67	---	---	---	---	---	---	---	---	---	---
DL0	0	0.21	0.17	0.27	0.20	0.15	---	---	---	---	---	---	---	---	---	---
	1	0.47	0.44	0.08	0.00	0.01	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TOWS1	0	0.21	0.36	0.06	0.23	0.14	---	---	---	---	---	---	---	---	---	---
	1	0.39	0.00	0.53	0.00	0.08	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.32	0.02	0.40	0.05	0.21	---	---	---	---	---	---	---	---	---	---
	1	0.22	0.48	0.03	0.26	0.01	---	---	---	---	---	---	---	---	---	---
Steel - Stringer/Mulit-beam or girder																
DL1	0	0.25	0.24	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
	1	0.26	0.38	0.16	0.05	0.00	0.02	0.03	0.00	0.00	0.02	0.00	0.03	0.03	0.02	0.00
DL2	0	0.26	0.24	0.09	0.08	0.09	0.04	0.04	0.03	0.00	0.02	0.03	0.02	0.02	0.02	0.02
	1	0.17	0.28	0.04	0.07	0.00	0.03	0.03	0.00	0.23	0.03	0.01	0.03	0.01	0.05	0.01
DL3	0	0.26	0.24	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.14	0.53	0.03	0.11	0.00	0.05	0.04	0.01	0.00	0.03	0.01	0.01	0.01	0.02	0.01
DL4	0	0.26	0.23	0.09	0.08	0.09	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01
	1	0.19	0.39	0.03	0.11	0.00	0.04	0.03	0.03	0.00	0.04	0.03	0.03	0.01	0.06	0.01
DL5	0	0.29	0.20	0.10	0.07	0.10	0.04	0.04	0.02	0.03	0.03	0.01	0.03	0.03	0.02	0.01
	1	0.14	0.41	0.03	0.13	0.00	0.04	0.02	0.06	0.00	0.02	0.06	0.01	0.01	0.02	0.04
DL6	0	0.28	0.22	0.09	0.07	0.09	0.04	0.04	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.05	0.52	0.02	0.20	0.00	0.01	0.01	0.10	0.00	0.01	0.04	0.00	0.00	0.01	0.03
DL9	0	0.26	0.25	0.08	0.07	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.08	0.12	0.02	0.50	0.00	0.02	0.01	0.01	0.00	0.02	0.15	0.01	0.01	0.03	0.01
DL0	0	0.15	0.39	0.04	0.13	0.00	0.03	0.02	0.04	0.04	0.02	0.04	0.02	0.01	0.03	0.02
	1	0.41	0.03	0.15	0.01	0.19	0.05	0.06	0.00	0.00	0.03	0.00	0.03	0.04	0.01	0.00
DST1	0	0.42	0.01	0.24	0.00	0.00	0.12	0.08	0.00	0.00	0.04	0.00	0.00	0.07	0.01	0.00
	1	0.17	0.36	0.00	0.12	0.12	0.00	0.02	0.04	0.04	0.02	0.04	0.03	0.00	0.02	0.02
DST3	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.26	0.03	0.00	0.00	0.00	0.36	0.12	0.00	0.00	0.00	0.00	0.00	0.21	0.01	0.00
DST4	0	0.26	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01
	1	0.13	0.03	0.00	0.01	0.00	0.47	0.07	0.00	0.00	0.19	0.00	0.02	0.03	0.04	0.01

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DST5	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.46	0.00	0.00	0.00	0.00	0.39	0.05	0.00	0.00	0.04	0.00	0.00	0.02	0.02	0.00
DST6	0	0.24	0.26	0.09	0.09	0.08	0.01	0.04	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.02
	1	0.40	0.01	0.00	0.00	0.00	0.38	0.08	0.00	0.00	0.10	0.00	0.00	0.02	0.02	0.00
DST8	0	0.21	0.31	0.00	0.10	0.10	0.05	0.03	0.03	0.03	0.02	0.03	0.03	0.01	0.02	0.02
	1	0.41	0.01	0.39	0.00	0.00	0.00	0.08	0.00	0.00	0.03	0.00	0.00	0.08	0.01	0.00
DST9	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.66	0.06	0.00	0.02	0.00	0.14	0.05	0.00	0.00	0.01	0.01	0.00	0.01	0.03	0.01
DSTN	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.79	0.01	0.00	0.00	0.00	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
TOWS1	0	0.26	0.20	0.12	0.06	0.07	0.06	0.05	0.03	0.03	0.04	0.02	0.02	0.03	0.02	0.01
	1	0.24	0.35	0.00	0.13	0.10	0.00	0.02	0.03	0.02	0.00	0.04	0.04	0.00	0.01	0.02
TOWS2	0	0.26	0.24	0.08	0.07	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.06	0.28	0.00	0.33	0.01	0.01	0.02	0.04	0.01	0.00	0.17	0.03	0.00	0.01	0.03
TOWS3	0	0.26	0.24	0.08	0.08	0.08	0.04	0.04	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.00	0.53	0.00	0.12	0.00	0.00	0.00	0.23	0.00	0.00	0.06	0.01	0.00	0.01	0.04
TOWS4	0	0.26	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.06	0.31	0.00	0.07	0.00	0.00	0.00	0.22	0.06	0.00	0.02	0.16	0.00	0.08	0.04
TOWS5	0	0.26	0.24	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.03	0.77	0.01	0.10	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.04
TOWS6	0	0.29	0.25	0.08	0.09	0.08	0.02	0.04	0.03	0.02	0.00	0.03	0.03	0.03	0.01	0.02
	1	0.19	0.24	0.09	0.06	0.08	0.08	0.04	0.03	0.04	0.07	0.02	0.01	0.01	0.04	0.01
TOWS7	0	0.23	0.27	0.05	0.09	0.09	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.01	0.02	0.02
	1	0.47	0.00	0.33	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00
TOWS8	0	0.23	0.26	0.08	0.09	0.08	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
	1	0.55	0.02	0.14	0.00	0.10	0.05	0.06	0.00	0.01	0.00	0.00	0.02	0.04	0.01	0.00
TOWS9	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.01
	1	0.37	0.11	0.07	0.02	0.06	0.15	0.09	0.01	0.02	0.00	0.00	0.01	0.08	0.02	0.00
TOWSN	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.34	0.05	0.01	0.13	0.01	0.18	0.11	0.00	0.01	0.00	0.00	0.00	0.07	0.06	0.03
DP1	0	0.27	0.26	0.09	0.04	0.08	0.04	0.04	0.03	0.03	0.03	0.00	0.02	0.02	0.02	0.01
	1	0.02	0.00	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.01	0.03
DP2	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.26	0.00	0.00	0.31	0.00	0.06	0.12	0.08	0.00	0.02	0.00	0.00	0.00	0.10	0.05
DP7	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.14	0.00	0.40	0.10	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.32	0.01	0.00
DP8	0	0.25	0.27	0.09	0.05	0.08	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01
	1	0.30	0.00	0.01	0.43	0.04	0.01	0.03	0.03	0.00	0.01	0.00	0.00	0.00	0.10	0.03
DP0	0	0.21	0.00	0.01	0.46	0.02	0.01	0.03	0.02	0.00	0.01	0.14	0.00	0.01	0.06	0.03
	1	0.26	0.30	0.10	0.00	0.09	0.05	0.04	0.03	0.03	0.03	0.00	0.03	0.03	0.01	0.01
DPN	0	0.25	0.25	0.08	0.08	0.08	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01
	1	0.59	0.00	0.02	0.15	0.02	0.03	0.14	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01
Steel Continuous - Stringer/Mulit-beam or girder																
DL1	0	0.31	0.12	0.12	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.38	0.04	0.22	0.00	0.07	0.00	0.11	0.09	0.00	0.00	0.00	0.00	0.06	0.01	0.01
DL2	0	0.29	0.12	0.11	0.10	0.07	0.06	0.06	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.53	0.12	0.22	0.00	0.06	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.02	0.01	0.01
DL3	0	0.30	0.12	0.12	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.62	0.14	0.15	0.00	0.03	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.02	0.00	0.01
DL4	0	0.30	0.11	0.11	0.10	0.07	0.06	0.06	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.39	0.20	0.17	0.01	0.08	0.00	0.01	0.03	0.00	0.04	0.00	0.00	0.01	0.03	0.01
DL5	0	0.31	0.12	0.15	0.12	0.07	0.00	0.05	0.07	0.00	0.03	0.04	0.00	0.03	0.01	0.01
	1	0.32	0.13	0.07	0.04	0.08	0.12	0.05	0.00	0.08	0.03	0.00	0.05	0.00	0.01	0.01
DL6	0	0.33	0.12	0.14	0.05	0.07	0.07	0.03	0.01	0.04	0.03	0.03	0.03	0.02	0.01	0.01
	1	0.22	0.12	0.03	0.22	0.10	0.00	0.13	0.13	0.00	0.05	0.00	0.00	0.00	0.00	0.01
DL9	0	0.32	0.12	0.12	0.07	0.07	0.05	0.05	0.03	0.04	0.03	0.02	0.02	0.02	0.01	0.01

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.07	0.10	0.02	0.63	0.01	0.00	0.02	0.10	0.00	0.04	0.00	0.00	0.00	0.00	0.00
DL0	0	0.33	0.13	0.09	0.10	0.08	0.06	0.06	0.04	0.04	0.03	0.00	0.02	0.01	0.01	0.01
	1	0.14	0.03	0.38	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.25	0.00	0.15	0.00	0.00
DST1	0	0.13	0.05	0.38	0.03	0.01	0.04	0.00	0.00	0.01	0.01	0.17	0.00	0.16	0.00	0.01
	1	0.32	0.13	0.10	0.09	0.08	0.05	0.06	0.04	0.04	0.03	0.01	0.02	0.01	0.01	0.01
DST2	0	0.31	0.12	0.12	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.06	0.21	0.05	0.23	0.00	0.31	0.00	0.01	0.03	0.03	0.02	0.00	0.02	0.00	0.02
DST3	0	0.31	0.12	0.12	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.15	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.19	0.00	0.00
DST6	0	0.31	0.12	0.11	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.14	0.03	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.22	0.00	0.00
DST9	0	0.31	0.12	0.12	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.20	0.11	0.44	0.01	0.05	0.03	0.00	0.02	0.03	0.03	0.04	0.00	0.03	0.00	0.03
DSTN	0	0.31	0.12	0.12	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.40	0.11	0.37	0.00	0.06	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.02	0.00	0.00
TOWS1	0	0.33	0.11	0.11	0.09	0.11	0.00	0.08	0.03	0.02	0.02	0.03	0.00	0.03	0.02	0.01
	1	0.28	0.14	0.12	0.09	0.03	0.11	0.01	0.04	0.05	0.04	0.01	0.05	0.01	0.00	0.01
TOWS2	0	0.32	0.13	0.12	0.07	0.07	0.06	0.06	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.16	0.05	0.09	0.34	0.05	0.00	0.01	0.16	0.10	0.03	0.00	0.00	0.00	0.00	0.00
TOWS3	0	0.31	0.13	0.12	0.09	0.06	0.06	0.04	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.27	0.06	0.06	0.07	0.28	0.00	0.18	0.02	0.01	0.04	0.00	0.00	0.00	0.00	0.01
TOWS4	0	0.30	0.12	0.12	0.09	0.06	0.06	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.45	0.10	0.03	0.00	0.27	0.00	0.10	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.01
TOWS5	0	0.31	0.12	0.12	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.48	0.09	0.10	0.13	0.04	0.00	0.09	0.02	0.01	0.04	0.00	0.00	0.01	0.00	0.00
TOWS6	0	0.29	0.11	0.12	0.11	0.07	0.07	0.05	0.04	0.04	0.04	0.01	0.03	0.02	0.00	0.01
	1	0.40	0.16	0.10	0.02	0.07	0.00	0.07	0.01	0.01	0.02	0.05	0.00	0.04	0.04	0.01
TOWS9	0	0.30	0.13	0.12	0.09	0.07	0.06	0.04	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.42	0.07	0.15	0.02	0.07	0.00	0.19	0.00	0.00	0.02	0.04	0.00	0.02	0.00	0.00

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TOWS0	0	0.31	0.12	0.12	0.08	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.39	0.13	0.07	0.24	0.02	0.00	0.05	0.01	0.01	0.02	0.03	0.00	0.01	0.00	0.02
DP1	0	0.41	0.14	0.15	0.00	0.10	0.00	0.07	0.00	0.00	0.03	0.03	0.03	0.03	0.01	0.01
	1	0.00	0.08	0.01	0.35	0.00	0.21	0.01	0.15	0.14	0.04	0.00	0.01	0.00	0.00	0.00
DP8	0	0.35	0.08	0.11	0.10	0.08	0.06	0.06	0.04	0.04	0.03	0.02	0.01	0.02	0.00	0.01
	1	0.00	0.48	0.18	0.00	0.00	0.00	0.03	0.00	0.00	0.06	0.02	0.12	0.04	0.07	0.01
DP0	0	0.00	0.21	0.09	0.22	0.00	0.13	0.01	0.09	0.09	0.05	0.01	0.05	0.01	0.02	0.01
	1	0.52	0.06	0.14	0.00	0.12	0.00	0.08	0.00	0.00	0.02	0.03	0.00	0.03	0.00	0.01
DPN	0	0.32	0.12	0.11	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	1	0.00	0.24	0.45	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.22	0.01	0.00	0.00
Prestressed Concrete - Stringer/Mulit-beam or girder																
DL2	0	0.51	0.17	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.52	0.37	0.01	0.01	0.01	0.07	0.00	0.00	---	---	---	---	---	---	---
DL3	0	0.50	0.18	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.79	0.16	0.01	0.02	0.00	0.03	0.00	0.00	---	---	---	---	---	---	---
DL4	0	0.51	0.19	0.16	0.06	0.04	0.03	0.00	0.01	---	---	---	---	---	---	---
	1	0.49	0.04	0.03	0.02	0.03	0.07	0.32	0.01	---	---	---	---	---	---	---
DL5	0	0.52	0.12	0.17	0.04	0.05	0.04	0.05	0.00	---	---	---	---	---	---	---
	1	0.50	0.22	0.14	0.07	0.04	0.03	0.00	0.01	---	---	---	---	---	---	---
DL6	0	0.49	0.20	0.15	0.06	0.03	0.04	0.02	0.01	---	---	---	---	---	---	---
	1	0.58	0.08	0.15	0.06	0.11	0.01	0.00	0.01	---	---	---	---	---	---	---
DL9	0	0.52	0.19	0.12	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.14	0.01	0.75	0.04	0.01	0.05	0.00	0.00	---	---	---	---	---	---	---
DL0	0	0.50	0.18	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.64	0.18	0.08	0.02	0.01	0.07	0.00	0.00	---	---	---	---	---	---	---
DST1	0	0.46	0.31	0.09	0.05	0.01	0.06	0.01	0.00	---	---	---	---	---	---	---
	1	0.51	0.17	0.15	0.06	0.05	0.03	0.02	0.01	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DST9	0	0.50	0.19	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.71	0.01	0.16	0.02	0.00	0.09	0.00	0.00	---	---	---	---	---	---	---
TOWS1	0	0.59	0.16	0.04	0.05	0.08	0.04	0.03	0.01	---	---	---	---	---	---	---
	1	0.46	0.20	0.21	0.06	0.02	0.03	0.01	0.01	---	---	---	---	---	---	---
TOWS2	0	0.51	0.19	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.58	0.03	0.19	0.04	0.10	0.05	0.00	0.00	---	---	---	---	---	---	---
TOWS3	0	0.51	0.19	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.44	0.03	0.14	0.03	0.32	0.03	0.00	0.01	---	---	---	---	---	---	---
TOWS4	0	0.51	0.19	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.58	0.11	0.04	0.04	0.20	0.03	0.00	0.01	---	---	---	---	---	---	---
TOWS6	0	0.51	0.16	0.17	0.07	0.04	0.03	0.01	0.01	---	---	---	---	---	---	---
	1	0.50	0.28	0.04	0.03	0.04	0.06	0.06	0.01	---	---	---	---	---	---	---
TOWS9	0	0.51	0.18	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.60	0.20	0.02	0.07	0.02	0.05	0.03	0.02	---	---	---	---	---	---	---
TOWS0	0	0.48	0.21	0.16	0.05	0.04	0.04	0.02	0.01	---	---	---	---	---	---	---
	1	0.76	0.00	0.03	0.10	0.09	0.01	0.00	0.01	---	---	---	---	---	---	---
DP1	0	0.61	0.22	0.00	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.01	0.00	0.85	0.05	0.04	0.04	0.00	0.00	---	---	---	---	---	---	---
DP8	0	0.66	0.00	0.19	0.05	0.05	0.03	0.01	0.01	---	---	---	---	---	---	---
	1	0.00	0.81	0.00	0.08	0.01	0.04	0.06	0.01	---	---	---	---	---	---	---
DP0	0	0.12	0.39	0.31	0.06	0.02	0.04	0.04	0.01	---	---	---	---	---	---	---
	1	0.85	0.00	0.00	0.06	0.06	0.03	0.00	0.01	---	---	---	---	---	---	---
DPN	0	0.49	0.19	0.15	0.06	0.04	0.03	0.02	0.01	---	---	---	---	---	---	---
	1	0.79	0.00	0.00	0.01	0.01	0.05	0.13	0.00	---	---	---	---	---	---	---
Prestressed Concrete Continuous - Stringer/Mulit-beam or girder																
DL2	0	0.49	0.38	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.86	0.07	0.07	0.00	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL4	0	0.49	0.39	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.77	0.15	0.06	0.01	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.46	0.42	0.07	0.06	---	---	---	---	---	---	---	---	---	---	---
	1	0.52	0.36	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.51	0.38	0.06	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.47	0.37	0.09	0.07	---	---	---	---	---	---	---	---	---	---	---
DL9	0	0.53	0.34	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.14	0.78	0.01	0.07	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.50	0.38	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.68	0.22	0.07	0.03	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.34	0.60	0.03	0.03	---	---	---	---	---	---	---	---	---	---	---
	1	0.52	0.35	0.07	0.06	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.68	0.14	0.10	0.07	---	---	---	---	---	---	---	---	---	---	---
	1	0.42	0.48	0.05	0.04	---	---	---	---	---	---	---	---	---	---	---
TOWS3	0	0.51	0.38	0.06	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.40	0.24	0.34	0.03	---	---	---	---	---	---	---	---	---	---	---
TOWS4	0	0.50	0.39	0.06	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.61	0.01	0.33	0.04	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.47	0.41	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.74	0.16	0.06	0.04	---	---	---	---	---	---	---	---	---	---	---
TOWS0	0	0.48	0.40	0.07	0.04	---	---	---	---	---	---	---	---	---	---	---
	1	0.78	0.06	0.01	0.15	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.87	0.00	0.07	0.06	---	---	---	---	---	---	---	---	---	---	---
	1	0.01	0.88	0.07	0.04	---	---	---	---	---	---	---	---	---	---	---
DP8	0	0.48	0.40	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.88	0.00	0.03	0.09	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.14	0.74	0.06	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.87	0.00	0.07	0.06	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							Wood or Timber - Stringer/Mulit-beam or girder									
DL2	0	0.42	0.18	0.10	0.08	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.24	0.09	0.37	0.03	0.09	0.10	0.03	0.05	---	---	---	---	---	---	---
DL3	0	0.41	0.17	0.13	0.08	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.11	0.09	0.49	0.02	0.13	0.08	0.02	0.07	---	---	---	---	---	---	---
DL4	0	0.40	0.18	0.14	0.07	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.53	0.06	0.13	0.09	0.04	0.04	0.08	0.02	---	---	---	---	---	---	---
DL5	0	0.40	0.18	0.13	0.08	0.07	0.07	0.06	0.02	---	---	---	---	---	---	---
	1	0.48	0.12	0.20	0.03	0.06	0.02	0.06	0.02	---	---	---	---	---	---	---
DL9	0	0.40	0.17	0.14	0.07	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.24	0.06	0.34	0.09	0.15	0.00	0.07	0.05	---	---	---	---	---	---	---
DL0	0	0.46	0.09	0.23	0.03	0.06	0.06	0.04	0.03	---	---	---	---	---	---	---
	1	0.36	0.23	0.07	0.10	0.08	0.07	0.07	0.02	---	---	---	---	---	---	---
DST1	0	0.43	0.19	0.15	0.08	0.07	0.00	0.06	0.01	---	---	---	---	---	---	---
	1	0.12	0.00	0.00	0.01	0.00	0.72	0.01	0.14	---	---	---	---	---	---	---
DST6	0	0.40	0.17	0.13	0.08	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.28	0.10	0.28	0.01	0.00	0.00	0.11	0.22	---	---	---	---	---	---	---
DST8	0	0.18	0.02	0.05	0.02	0.00	0.58	0.02	0.14	---	---	---	---	---	---	---
	1	0.43	0.19	0.15	0.08	0.08	0.00	0.06	0.01	---	---	---	---	---	---	---
TOWS1	0	0.42	0.18	0.14	0.08	0.07	0.03	0.06	0.02	---	---	---	---	---	---	---
	1	0.09	0.02	0.01	0.01	0.00	0.77	0.01	0.10	---	---	---	---	---	---	---
TOWS6	0	0.46	0.24	0.01	0.07	0.08	0.06	0.07	0.01	---	---	---	---	---	---	---
	1	0.27	0.00	0.45	0.08	0.05	0.08	0.03	0.05	---	---	---	---	---	---	---
TOWS7	0	0.39	0.12	0.21	0.06	0.05	0.10	0.04	0.03	---	---	---	---	---	---	---
	1	0.43	0.27	0.01	0.10	0.09	0.00	0.09	0.01	---	---	---	---	---	---	---
TOWS8	0	0.38	0.15	0.17	0.08	0.07	0.08	0.06	0.03	---	---	---	---	---	---	---
	1	0.50	0.29	0.00	0.07	0.08	0.00	0.05	0.00	---	---	---	---	---	---	---
TOWS9	0	0.38	0.17	0.15	0.08	0.07	0.07	0.06	0.03	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.66	0.20	0.01	0.01	0.04	0.00	0.07	0.00	---	---	---	---	---	---	---
TOWS0	0	0.39	0.17	0.14	0.08	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.64	0.17	0.02	0.01	0.06	0.05	0.03	0.02	---	---	---	---	---	---	---
DP8	0	0.43	0.18	0.14	0.02	0.07	0.06	0.06	0.03	---	---	---	---	---	---	---
	1	0.00	0.04	0.08	0.72	0.01	0.04	0.09	0.01	---	---	---	---	---	---	---
DP9	0	0.40	0.17	0.14	0.07	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.00	0.13	0.14	0.51	0.08	0.00	0.11	0.03	---	---	---	---	---	---	---
DP0	0	0.00	0.05	0.10	0.68	0.02	0.05	0.09	0.02	---	---	---	---	---	---	---
	1	0.45	0.19	0.14	0.00	0.07	0.06	0.06	0.03	---	---	---	---	---	---	---
DPN	0	0.41	0.18	0.14	0.06	0.07	0.06	0.06	0.02	---	---	---	---	---	---	---
	1	0.00	0.05	0.15	0.60	0.01	0.08	0.07	0.03	---	---	---	---	---	---	---
Steel - Girder or Floorbeam System																
DL2	0	0.37	0.33	0.15	0.15	---	---	---	---	---	---	---	---	---	---	---
	1	0.50	0.19	0.19	0.12	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.37	0.34	0.14	0.14	---	---	---	---	---	---	---	---	---	---	---
	1	0.48	0.09	0.24	0.19	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.39	0.36	0.16	0.09	---	---	---	---	---	---	---	---	---	---	---
	1	0.33	0.11	0.13	0.43	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.39	0.33	0.16	0.13	---	---	---	---	---	---	---	---	---	---	---
	1	0.33	0.02	0.04	0.60	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.41	0.15	0.16	0.28	---	---	---	---	---	---	---	---	---	---	---
	1	0.36	0.46	0.15	0.02	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.33	0.48	0.17	0.01	---	---	---	---	---	---	---	---	---	---	---
	1	0.43	0.17	0.14	0.26	---	---	---	---	---	---	---	---	---	---	---
DST3	0	0.38	0.32	0.15	0.15	---	---	---	---	---	---	---	---	---	---	---
	1	0.39	0.27	0.31	0.03	---	---	---	---	---	---	---	---	---	---	---
DST6	0	0.39	0.31	0.15	0.15	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.33	0.41	0.25	0.01	---	---	---	---	---	---	---	---	---	---	---
DST8	0	0.40	0.24	0.15	0.21	---	---	---	---	---	---	---	---	---	---	---
	1	0.35	0.50	0.15	0.00	---	---	---	---	---	---	---	---	---	---	---
DST9	0	0.39	0.30	0.16	0.15	---	---	---	---	---	---	---	---	---	---	---
	1	0.15	0.76	0.09	0.00	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.39	0.33	0.16	0.12	---	---	---	---	---	---	---	---	---	---	---
	1	0.35	0.30	0.12	0.23	---	---	---	---	---	---	---	---	---	---	---
TOWS2	0	0.39	0.33	0.15	0.12	---	---	---	---	---	---	---	---	---	---	---
	1	0.22	0.09	0.11	0.58	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.30	0.40	0.13	0.16	---	---	---	---	---	---	---	---	---	---	---
	1	0.52	0.18	0.18	0.11	---	---	---	---	---	---	---	---	---	---	---
TOWS7	0	0.41	0.27	0.16	0.17	---	---	---	---	---	---	---	---	---	---	---
	1	0.27	0.61	0.12	0.00	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.40	0.29	0.16	0.15	---	---	---	---	---	---	---	---	---	---	---
	1	0.14	0.75	0.08	0.02	---	---	---	---	---	---	---	---	---	---	---
TOWS9	0	0.39	0.31	0.15	0.15	---	---	---	---	---	---	---	---	---	---	---
	1	0.31	0.42	0.19	0.07	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.40	0.34	0.16	0.10	---	---	---	---	---	---	---	---	---	---	---
	1	0.14	0.01	0.10	0.74	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.26	0.17	0.12	0.45	---	---	---	---	---	---	---	---	---	---	---
	1	0.40	0.34	0.16	0.09	---	---	---	---	---	---	---	---	---	---	---
		Steel Continuous - Girder or Floorbeam System														
DL2	0	0.72	0.28	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.84	0.16	---	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.75	0.25	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.70	0.30	---	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.75	0.25	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.60	0.40	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS3	0	0.75	0.25	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.57	0.43	---	---	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.78	0.22	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.45	0.55	---	---	---	---	---	---	---	---	---	---	---	---	---
Concrete - Tee Beam																
DL1	0	0.41	0.21	0.12	0.11	0.05	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.60	0.25	0.07	0.04	0.00	0.02	0.01	0.01	---	---	---	---	---	---	---
DL2	0	0.40	0.22	0.12	0.11	0.04	0.05	0.04	0.02	---	---	---	---	---	---	---
	1	0.43	0.19	0.12	0.12	0.07	0.03	0.02	0.01	---	---	---	---	---	---	---
DL3	0	0.41	0.22	0.11	0.11	0.05	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.39	0.08	0.27	0.08	0.01	0.08	0.03	0.06	---	---	---	---	---	---	---
DL4	0	0.42	0.21	0.13	0.11	0.03	0.05	0.03	0.02	---	---	---	---	---	---	---
	1	0.35	0.21	0.08	0.15	0.17	0.02	0.02	0.01	---	---	---	---	---	---	---
DL5	0	0.39	0.24	0.12	0.11	0.06	0.03	0.02	0.02	---	---	---	---	---	---	---
	1	0.50	0.09	0.14	0.11	0.01	0.08	0.06	0.02	---	---	---	---	---	---	---
DL6	0	0.41	0.22	0.11	0.12	0.05	0.05	0.03	0.02	---	---	---	---	---	---	---
	1	0.49	0.05	0.29	0.05	0.00	0.02	0.05	0.06	---	---	---	---	---	---	---
DL0	0	0.44	0.15	0.14	0.11	0.06	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.27	0.51	0.03	0.11	0.00	0.05	0.01	0.01	---	---	---	---	---	---	---
DST1	0	0.01	0.08	0.00	0.10	0.00	0.76	0.04	0.00	---	---	---	---	---	---	---
	1	0.44	0.22	0.13	0.11	0.05	0.00	0.03	0.02	---	---	---	---	---	---	---
DST2	0	0.43	0.22	0.13	0.11	0.05	0.02	0.03	0.02	---	---	---	---	---	---	---
	1	0.00	0.00	0.01	0.06	0.00	0.90	0.03	0.01	---	---	---	---	---	---	---
DST9	0	0.42	0.21	0.12	0.11	0.05	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.02	0.07	0.00	0.09	0.00	0.77	0.05	0.00	---	---	---	---	---	---	---
DSTN	0	0.42	0.21	0.13	0.11	0.05	0.03	0.03	0.02	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.01	0.21	0.00	0.16	0.00	0.56	0.06	0.00	---	---	---	---	---	---	---
TOWS1	0	0.37	0.29	0.06	0.14	0.07	0.03	0.02	0.02	---	---	---	---	---	---	---
	1	0.54	0.00	0.29	0.03	0.00	0.07	0.05	0.02	---	---	---	---	---	---	---
TOWS4	0	0.41	0.21	0.12	0.11	0.05	0.05	0.03	0.02	---	---	---	---	---	---	---
	1	0.66	0.00	0.19	0.10	0.00	0.00	0.06	0.01	---	---	---	---	---	---	---
TOWS6	0	0.57	0.02	0.22	0.04	0.00	0.07	0.05	0.02	---	---	---	---	---	---	---
	1	0.31	0.34	0.06	0.16	0.08	0.02	0.02	0.02	---	---	---	---	---	---	---
TOWS8	0	0.41	0.21	0.13	0.11	0.05	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.27	0.44	0.02	0.07	0.00	0.18	0.01	0.01	---	---	---	---	---	---	---
TOWS0	0	0.40	0.22	0.13	0.12	0.05	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.77	0.01	0.02	0.04	0.00	0.10	0.06	0.00	---	---	---	---	---	---	---
DP1	0	0.42	0.21	0.12	0.11	0.05	0.04	0.02	0.02	---	---	---	---	---	---	---
	1	0.00	0.01	0.49	0.00	0.01	0.06	0.43	0.00	---	---	---	---	---	---	---
DP8	0	0.51	0.24	0.02	0.14	0.01	0.05	0.03	0.00	---	---	---	---	---	---	---
	1	0.00	0.08	0.58	0.00	0.22	0.01	0.02	0.10	---	---	---	---	---	---	---
DP9	0	0.42	0.21	0.12	0.11	0.05	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.00	0.12	0.59	0.00	0.25	0.04	0.01	0.00	---	---	---	---	---	---	---
DP0	0	0.00	0.07	0.56	0.00	0.19	0.03	0.05	0.08	---	---	---	---	---	---	---
	1	0.53	0.25	0.00	0.14	0.01	0.05	0.02	0.00	---	---	---	---	---	---	---
DPN	0	0.42	0.21	0.12	0.11	0.05	0.04	0.03	0.02	---	---	---	---	---	---	---
	1	0.00	0.04	0.32	0.00	0.01	0.49	0.13	0.00	---	---	---	---	---	---	---
							Concrete Continuous - Tee Beam									
DL2	0	0.44	0.21	0.10	0.10	0.09	0.07	---	---	---	---	---	---	---	---	---
	1	0.08	0.36	0.33	0.12	0.00	0.12	---	---	---	---	---	---	---	---	---
DL3	0	0.40	0.22	0.12	0.11	0.08	0.07	---	---	---	---	---	---	---	---	---
	1	0.23	0.35	0.23	0.04	0.02	0.12	---	---	---	---	---	---	---	---	---
DL5	0	0.31	0.20	0.24	0.10	0.05	0.11	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.48	0.25	0.00	0.11	0.11	0.04	---	---	---	---	---	---	---	---	---
DL6	0	0.34	0.25	0.15	0.11	0.07	0.08	---	---	---	---	---	---	---	---	---
	1	0.71	0.06	0.00	0.06	0.14	0.03	---	---	---	---	---	---	---	---	---
DL0	0	0.43	0.24	0.08	0.11	0.08	0.06	---	---	---	---	---	---	---	---	---
	1	0.02	0.08	0.66	0.03	0.00	0.21	---	---	---	---	---	---	---	---	---
TOWS1	0	0.58	0.00	0.18	0.07	0.07	0.09	---	---	---	---	---	---	---	---	---
	1	0.10	0.57	0.04	0.15	0.09	0.04	---	---	---	---	---	---	---	---	---
TOWS3	0	0.36	0.24	0.14	0.10	0.08	0.08	---	---	---	---	---	---	---	---	---
	1	0.77	0.00	0.02	0.15	0.05	0.02	---	---	---	---	---	---	---	---	---
TOWS4	0	0.38	0.24	0.13	0.10	0.07	0.08	---	---	---	---	---	---	---	---	---
	1	0.69	0.00	0.02	0.13	0.14	0.03	---	---	---	---	---	---	---	---	---
TOWS6	0	0.32	0.37	0.05	0.14	0.08	0.05	---	---	---	---	---	---	---	---	---
	1	0.50	0.00	0.26	0.05	0.07	0.12	---	---	---	---	---	---	---	---	---
TOWS0	0	0.36	0.24	0.13	0.11	0.08	0.08	---	---	---	---	---	---	---	---	---
	1	0.79	0.00	0.07	0.05	0.04	0.05	---	---	---	---	---	---	---	---	---
DP1	0	0.40	0.23	0.13	0.09	0.07	0.07	---	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.00	0.61	0.29	0.11	---	---	---	---	---	---	---	---	---
DP8	0	0.42	0.24	0.13	0.06	0.08	0.07	---	---	---	---	---	---	---	---	---
	1	0.00	0.00	0.14	0.72	0.05	0.09	---	---	---	---	---	---	---	---	---
DP0	0	0.03	0.02	0.09	0.65	0.12	0.09	---	---	---	---	---	---	---	---	---
	1	0.44	0.25	0.13	0.04	0.07	0.07	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Tee Beam																
DL2	0	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.89	0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
DL3	0	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.84	0.16	---	---	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.91	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.91	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.89	0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.91	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
Concrete Continuous - Box Beam or Girders - Multiple																
DL4	0	0.465	0.417	0.118	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.04	0.85	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.63	0.25	0.12	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.57	0.32	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.86	0.14	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.25	0.58	0.17	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.45	0.44	0.11	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.47	0.41	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.33	0.56	0.11	---	---	---	---	---	---	---	---	---	---	---	---
TOWS0	0	0.46	0.43	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.35	0.56	0.08	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.31	0.57	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.45	0.43	0.12	---	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
								Prestressed Concrete - Box Beam or Girders - Multiple								
DL2	0	0.32	0.22	0.09	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.00	---	---
	1	0.23	0.29	0.12	0.00	0.02	0.15	0.01	0.05	0.04	0.03	0.04	0.01	0.01	---	---
DL3	0	0.31	0.22	0.09	0.08	0.06	0.05	0.05	0.03	0.04	0.03	0.02	0.02	0.01	---	---
	1	0.43	0.28	0.01	0.00	0.12	0.03	0.00	0.07	0.02	0.02	0.01	0.01	0.00	---	---
DL4	0	0.32	0.21	0.08	0.08	0.06	0.05	0.06	0.04	0.03	0.02	0.02	0.02	0.00	---	---
	1	0.23	0.32	0.15	0.00	0.02	0.05	0.00	0.04	0.09	0.04	0.03	0.01	0.01	---	---
DL5	0	0.29	0.15	0.05	0.17	0.03	0.06	0.11	0.02	0.04	0.03	0.02	0.02	0.01	---	---
	1	0.33	0.27	0.12	0.00	0.09	0.05	0.01	0.04	0.03	0.02	0.03	0.01	0.00	---	---
DL6	0	0.33	0.24	0.10	0.00	0.07	0.05	0.06	0.04	0.04	0.03	0.02	0.01	0.01	---	---
	1	0.22	0.06	0.01	0.50	0.01	0.07	0.01	0.03	0.02	0.02	0.03	0.03	0.00	---	---
DL9	0	0.31	0.24	0.09	0.08	0.07	0.06	0.01	0.04	0.03	0.03	0.03	0.02	0.00	---	---
	1	0.38	0.04	0.04	0.00	0.00	0.01	0.40	0.01	0.06	0.02	0.01	0.01	0.01	---	---
DL0	0	0.31	0.21	0.09	0.08	0.06	0.05	0.06	0.04	0.03	0.02	0.02	0.02	0.00	---	---
	1	0.32	0.28	0.06	0.00	0.07	0.11	0.03	0.01	0.04	0.06	0.01	0.01	0.01	---	---
DST1	0	0.35	0.28	0.01	0.00	0.11	0.05	0.06	0.03	0.06	0.02	0.02	0.01	0.01	---	---
	1	0.27	0.14	0.19	0.17	0.00	0.06	0.05	0.04	0.00	0.04	0.03	0.02	0.00	---	---
DST2	0	0.25	0.17	0.14	0.12	0.00	0.05	0.08	0.04	0.06	0.03	0.03	0.02	0.01	---	---
	1	0.41	0.29	0.00	0.00	0.16	0.05	0.01	0.03	0.00	0.02	0.02	0.01	0.00	---	---
DST9	0	0.33	0.21	0.09	0.08	0.07	0.05	0.03	0.03	0.04	0.03	0.02	0.02	0.01	---	---
	1	0.18	0.26	0.06	0.00	0.00	0.06	0.34	0.06	0.00	0.02	0.02	0.00	0.00	---	---
DSTN	0	0.32	0.22	0.09	0.08	0.07	0.05	0.06	0.04	0.00	0.03	0.02	0.02	0.00	---	---
	1	0.20	0.23	0.01	0.00	0.00	0.04	0.01	0.03	0.40	0.00	0.01	0.01	0.06	---	---
TOWS1	0	0.24	0.35	0.01	0.09	0.03	0.09	0.04	0.06	0.04	0.02	0.03	0.01	0.01	---	---
	1	0.43	0.00	0.21	0.05	0.12	0.00	0.07	0.00	0.03	0.04	0.02	0.03	0.00	---	---
TOWS2	0	0.32	0.22	0.09	0.07	0.06	0.05	0.05	0.04	0.03	0.02	0.02	0.02	0.00	---	---
	1	0.15	0.00	0.09	0.15	0.16	0.00	0.11	0.00	0.11	0.14	0.05	0.03	0.01	---	---
TOWS3	0	0.32	0.22	0.09	0.07	0.06	0.05	0.05	0.04	0.04	0.02	0.02	0.02	0.01	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.05	0.00	0.14	0.07	0.02	0.00	0.07	0.00	0.01	0.32	0.26	0.07	0.00	---	---
TOWS6	0	0.39	0.00	0.18	0.06	0.13	0.00	0.07	0.00	0.05	0.05	0.03	0.03	0.01	---	---
	1	0.24	0.42	0.00	0.09	0.00	0.10	0.04	0.07	0.02	0.00	0.02	0.00	0.00	---	---
TOWS8	0	0.31	0.22	0.09	0.07	0.06	0.05	0.05	0.04	0.03	0.02	0.02	0.02	0.01	---	---
	1	0.37	0.02	0.04	0.00	0.42	0.00	0.00	0.00	0.00	0.14	0.00	0.01	0.00	---	---
TOWS9	0	0.31	0.22	0.09	0.07	0.06	0.05	0.05	0.04	0.04	0.02	0.02	0.02	0.01	---	---
	1	0.46	0.00	0.06	0.05	0.31	0.00	0.00	0.00	0.01	0.07	0.01	0.03	0.00	---	---
TOWSN	0	0.32	0.22	0.09	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.00	---	---
	1	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.04	0.06	---	---
DP1	0	0.32	0.25	0.08	0.07	0.07	0.06	0.00	0.04	0.04	0.02	0.02	0.02	0.01	---	---
	1	0.26	0.05	0.10	0.09	0.02	0.03	0.34	0.01	0.00	0.06	0.03	0.02	0.00	---	---
DP9	0	0.31	0.22	0.09	0.07	0.06	0.05	0.05	0.04	0.04	0.02	0.02	0.02	0.01	---	---
	1	0.28	0.20	0.02	0.20	0.04	0.12	0.04	0.05	0.00	0.03	0.02	0.00	0.00	---	---
DP0	0	0.27	0.11	0.11	0.06	0.03	0.03	0.16	0.03	0.11	0.03	0.02	0.02	0.02	---	---
	1	0.34	0.27	0.07	0.08	0.08	0.07	0.00	0.04	0.00	0.02	0.02	0.01	0.00	---	---
DPN	0	0.32	0.23	0.09	0.08	0.07	0.06	0.06	0.04	0.00	0.03	0.02	0.02	0.00	---	---
	1	0.10	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.75	0.00	0.00	0.02	0.10	---	---
Prestressed Concrete - Box Beam or Girders - Single or Spread																
DL4	0	0.45	0.39	0.16	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.75	0.12	0.13	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.34	0.46	0.20	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.58	0.30	0.12	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.45	0.42	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.56	0.15	0.29	---	---	---	---	---	---	---	---	---	---	---	---
DL9	0	0.57	0.28	0.16	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.82	0.16	---	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.48	0.36	0.16	---	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.32	0.56	0.13	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.25	0.69	0.06	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.32	0.18	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.50	0.32	0.17	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.21	0.74	0.05	---	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.65	0.13	0.22	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.39	0.47	0.13	---	---	---	---	---	---	---	---	---	---	---	---
TOWS3	0	0.47	0.40	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.47	0.02	0.51	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.41	0.42	0.17	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.74	0.14	0.12	---	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.75	0.12	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.05	0.75	0.20	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.14	0.68	0.19	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.76	0.11	0.13	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete Continuous - Box Beam or Girders - Single or Spread																
DL5	0	0.80	0.20	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.89	0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
DL6	0	0.88	0.12	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.72	0.28	---	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.95	0.05	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.83	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.83	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.78	0.22	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Concrete - Frame (except for culverts)														
DL2	0	0.68	0.19	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.86	0.02	0.12	---	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.74	0.15	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.43	0.33	0.24	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.65	0.22	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.75	0.12	0.13	---	---	---	---	---	---	---	---	---	---	---	---
DL9	0	0.71	0.15	0.14	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.46	0.03	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.37	0.52	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.86	0.00	0.14	---	---	---	---	---	---	---	---	---	---	---	---
DST2	0	0.68	0.19	0.14	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.98	0.00	0.02	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.87	0.00	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.21	0.67	0.13	---	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.68	0.19	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.81	0.07	0.13	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.64	0.24	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.72	0.15	0.13	---	---	---	---	---	---	---	---	---	---	---	---
TOWSN	0	0.73	0.13	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.06	0.89	0.06	---	---	---	---	---	---	---	---	---	---	---	---
DP1	0	0.67	0.19	0.14	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.94	0.00	0.06	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.38	0.49	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.87	0.00	0.13	---	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.87	0.00	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.04	0.83	0.13	---	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Concrete Continuous - Frame (except for culverts)																
DL4	0	0.50	0.50	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.63	0.37	---	---	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.45	0.55	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.64	0.36	---	---	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.66	0.34	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.16	0.84	---	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.43	0.57	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.97	0.03	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.34	0.66	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.73	0.27	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS0	0	0.73	0.27	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.03	0.97	---	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.98	0.02	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.35	0.65	---	---	---	---	---	---	---	---	---	---	---	---	---
Steel - Truss-Thru																
DL1	0	0.21	0.13	0.15	0.14	0.12	0.07	0.06	0.06	0.03	0.03	---	---	---	---	---
	1	0.28	0.36	0.00	0.00	0.16	0.07	0.08	0.03	0.02	0.02	---	---	---	---	---
DL2	0	0.22	0.09	0.17	0.15	0.13	0.07	0.06	0.05	0.03	0.02	---	---	---	---	---
	1	0.15	0.55	0.00	0.00	0.02	0.05	0.04	0.09	0.05	0.05	---	---	---	---	---
DL3	0	0.21	0.14	0.15	0.14	0.12	0.07	0.06	0.06	0.03	0.03	---	---	---	---	---
	1	0.25	0.31	0.00	0.00	0.03	0.11	0.06	0.04	0.14	0.06	---	---	---	---	---
DL4	0	0.22	0.13	0.15	0.14	0.13	0.07	0.06	0.05	0.03	0.02	---	---	---	---	---
	1	0.14	0.34	0.00	0.00	0.01	0.10	0.02	0.24	0.06	0.09	---	---	---	---	---
DL5	0	0.21	0.14	0.16	0.14	0.13	0.07	0.06	0.05	0.02	0.02	---	---	---	---	---
	1	0.24	0.22	0.00	0.00	0.04	0.05	0.03	0.14	0.18	0.10	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL6	0	0.21	0.14	0.15	0.13	0.12	0.07	0.06	0.06	0.03	0.03	---	---	---	---	---
	1	0.31	0.17	0.00	0.00	0.02	0.04	0.03	0.11	0.20	0.13	---	---	---	---	---
DL0	0	0.20	0.39	0.00	0.00	0.04	0.06	0.04	0.12	0.09	0.06	---	---	---	---	---
	1	0.22	0.02	0.22	0.20	0.16	0.07	0.07	0.03	0.01	0.01	---	---	---	---	---
DST1	0	0.19	0.05	0.23	0.08	0.19	0.09	0.09	0.01	0.05	0.01	---	---	---	---	---
	1	0.25	0.31	0.00	0.22	0.00	0.03	0.00	0.14	0.00	0.05	---	---	---	---	---
DST4	0	0.21	0.14	0.15	0.13	0.12	0.07	0.06	0.06	0.03	0.03	---	---	---	---	---
	1	0.06	0.27	0.00	0.06	0.00	0.12	0.04	0.22	0.06	0.16	---	---	---	---	---
DST6	0	0.20	0.15	0.16	0.14	0.13	0.06	0.06	0.06	0.01	0.03	---	---	---	---	---
	1	0.34	0.08	0.00	0.10	0.00	0.14	0.05	0.00	0.26	0.02	---	---	---	---	---
DST8	0	0.28	0.25	0.00	0.18	0.00	0.06	0.03	0.11	0.05	0.05	---	---	---	---	---
	1	0.13	0.03	0.31	0.08	0.26	0.08	0.10	0.00	0.01	0.00	---	---	---	---	---
DST9	0	0.20	0.15	0.15	0.14	0.12	0.07	0.06	0.06	0.03	0.03	---	---	---	---	---
	1	0.79	0.02	0.00	0.05	0.01	0.04	0.02	0.01	0.03	0.02	---	---	---	---	---
TOWS1	0	0.18	0.12	0.18	0.12	0.15	0.07	0.07	0.03	0.04	0.02	---	---	---	---	---
	1	0.32	0.23	0.00	0.20	0.00	0.04	0.00	0.15	0.00	0.05	---	---	---	---	---
TOWS2	0	0.21	0.14	0.15	0.14	0.12	0.07	0.06	0.05	0.03	0.03	---	---	---	---	---
	1	0.11	0.28	0.00	0.04	0.00	0.05	0.00	0.41	0.02	0.09	---	---	---	---	---
TOWS6	0	0.20	0.10	0.19	0.13	0.16	0.06	0.06	0.06	0.00	0.03	---	---	---	---	---
	1	0.26	0.26	0.00	0.14	0.00	0.09	0.05	0.05	0.12	0.03	---	---	---	---	---
TOWS7	0	0.29	0.22	0.00	0.20	0.00	0.07	0.04	0.09	0.05	0.04	---	---	---	---	---
	1	0.06	0.00	0.42	0.00	0.35	0.06	0.09	0.00	0.00	0.00	---	---	---	---	---
TOWS8	0	0.19	0.15	0.15	0.12	0.13	0.07	0.06	0.06	0.04	0.03	---	---	---	---	---
	1	0.46	0.05	0.00	0.36	0.00	0.05	0.07	0.01	0.00	0.00	---	---	---	---	---
TOWS0	0	0.21	0.15	0.15	0.12	0.13	0.06	0.06	0.06	0.04	0.03	---	---	---	---	---
	1	0.19	0.13	0.00	0.39	0.00	0.12	0.11	0.03	0.00	0.03	---	---	---	---	---
DP1	0	0.22	0.14	0.15	0.14	0.12	0.07	0.06	0.04	0.03	0.02	---	---	---	---	---
	1	0.04	0.22	0.01	0.00	0.00	0.01	0.00	0.56	0.00	0.17	---	---	---	---	---
DP8	0	0.21	0.14	0.14	0.14	0.13	0.07	0.06	0.06	0.04	0.03	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.30	0.27	0.21	0.05	0.01	0.05	0.01	0.05	0.01	0.04	---	---	---	---	---
DP0	0	0.27	0.21	0.14	0.03	0.02	0.06	0.02	0.16	0.02	0.07	---	---	---	---	---
	1	0.20	0.13	0.14	0.15	0.14	0.07	0.07	0.04	0.04	0.02	---	---	---	---	---
Concrete - Arch- Deck																
DL2	0	0.42	0.30	0.16	0.12	---	---	---	---	---	---	---	---	---	---	---
	1	0.54	0.15	0.21	0.09	---	---	---	---	---	---	---	---	---	---	---
DL4	0	0.45	0.29	0.15	0.11	---	---	---	---	---	---	---	---	---	---	---
	1	0.35	0.21	0.28	0.16	---	---	---	---	---	---	---	---	---	---	---
DL5	0	0.45	0.30	0.15	0.10	---	---	---	---	---	---	---	---	---	---	---
	1	0.37	0.12	0.27	0.24	---	---	---	---	---	---	---	---	---	---	---
DL0	0	0.42	0.16	0.25	0.17	---	---	---	---	---	---	---	---	---	---	---
	1	0.45	0.39	0.09	0.07	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.30	0.47	0.04	0.19	---	---	---	---	---	---	---	---	---	---	---
	1	0.64	0.02	0.34	0.00	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.65	0.02	0.33	0.01	---	---	---	---	---	---	---	---	---	---	---
	1	0.26	0.51	0.03	0.21	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.43	0.31	0.14	0.12	---	---	---	---	---	---	---	---	---	---	---
	1	0.51	0.01	0.45	0.04	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.26	0.50	0.13	0.11	---	---	---	---	---	---	---	---	---	---	---
	1	0.60	0.09	0.20	0.12	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.42	0.29	0.17	0.12	---	---	---	---	---	---	---	---	---	---	---
	1	0.84	0.11	0.03	0.02	---	---	---	---	---	---	---	---	---	---	---
TOWSN	0	0.60	0.08	0.23	0.09	---	---	---	---	---	---	---	---	---	---	---
	1	0.02	0.80	0.01	0.16	---	---	---	---	---	---	---	---	---	---	---
DP8	0	0.43	0.30	0.16	0.12	---	---	---	---	---	---	---	---	---	---	---
	1	0.68	0.00	0.28	0.04	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.11	0.61	0.10	0.19	---	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.72	0.00	0.23	0.05	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.69	0.00	0.26	0.05	---	---	---	---	---	---	---	---	---	---	---
	1	0.03	0.74	0.02	0.22	---	---	---	---	---	---	---	---	---	---	---
Masonry - Arch-Deck																
DST9	0	0.67	0.33	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.82	0.18	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.73	0.27	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.63	0.37	---	---	---	---	---	---	---	---	---	---	---	---	---
DP0	0	0.66	0.34	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.73	0.27	---	---	---	---	---	---	---	---	---	---	---	---	---
Concrete - Culvert (includes frame culverts)																
DL1	0	0.39	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.01
	1	0.38	0.13	0.19	0.08	0.06	0.03	0.05	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.01
DL2	0	0.37	0.11	0.07	0.07	0.07	0.05	0.04	0.05	0.05	0.03	0.03	0.03	0.02	0.01	0.01
	1	0.43	0.04	0.11	0.05	0.02	0.06	0.10	0.01	0.01	0.09	0.04	0.01	0.04	0.01	0.01
DL3	0	0.38	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.01	0.01
	1	0.47	0.11	0.11	0.07	0.13	0.00	0.04	0.01	0.01	0.02	0.03	0.01	0.00	0.00	0.01
DL4	0	0.39	0.10	0.08	0.07	0.06	0.04	0.04	0.05	0.04	0.03	0.02	0.03	0.02	0.01	0.01
	1	0.34	0.05	0.06	0.08	0.02	0.13	0.06	0.01	0.04	0.09	0.07	0.02	0.03	0.00	0.01
DL5	0	0.42	0.09	0.08	0.07	0.04	0.06	0.06	0.01	0.02	0.06	0.04	0.02	0.02	0.00	0.01
	1	0.34	0.11	0.07	0.06	0.08	0.04	0.02	0.09	0.06	0.01	0.03	0.04	0.03	0.02	0.01
DL6	0	0.36	0.10	0.08	0.07	0.06	0.06	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.01	0.01
	1	0.71	0.02	0.05	0.05	0.03	0.00	0.02	0.02	0.05	0.00	0.02	0.02	0.00	0.01	0.01
DL9	0	0.39	0.09	0.07	0.07	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.01
	1	0.34	0.13	0.25	0.03	0.16	0.00	0.01	0.00	0.01	0.00	0.00	0.05	0.02	0.00	0.00

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL0	0	0.40	0.08	0.08	0.06	0.05	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.01	0.01
	1	0.30	0.24	0.09	0.11	0.09	0.02	0.06	0.00	0.01	0.02	0.01	0.03	0.00	0.00	0.02
DST1	0	0.53	0.04	0.11	0.00	0.08	0.00	0.06	0.06	0.05	0.00	0.04	0.01	0.00	0.01	0.00
	1	0.00	0.23	0.00	0.24	0.00	0.19	0.00	0.00	0.00	0.13	0.01	0.08	0.09	0.00	0.03
DST2	0	0.39	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.01
	1	0.00	0.31	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.35	0.07	0.00	0.01
DST9	0	0.39	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.01
	1	0.00	0.43	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.12	0.14	0.00	0.04
DSTN	0	0.00	0.24	0.00	0.24	0.00	0.19	0.00	0.00	0.00	0.13	0.02	0.08	0.09	0.00	0.03
	1	0.54	0.04	0.11	0.00	0.08	0.00	0.06	0.06	0.05	0.00	0.04	0.01	0.00	0.01	0.00
TOWS1	0	0.41	0.08	0.07	0.06	0.06	0.06	0.05	0.04	0.04	0.04	0.03	0.02	0.03	0.01	0.01
	1	0.00	0.35	0.15	0.24	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.07
TOWS6	0	0.53	0.07	0.02	0.02	0.08	0.00	0.06	0.06	0.05	0.00	0.04	0.02	0.03	0.01	0.01
	1	0.00	0.16	0.23	0.18	0.00	0.20	0.02	0.00	0.00	0.14	0.00	0.05	0.00	0.01	0.02
TOWS8	0	0.39	0.08	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.01	0.01
	1	0.00	0.73	0.09	0.11	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.01
TOWS9	0	0.39	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.01	0.01
	1	0.00	0.46	0.24	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.04
TOWS0	0	0.39	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.01
	1	0.00	0.18	0.44	0.19	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.11	0.00	0.05	0.02
TOWSN	0	0.00	0.23	0.21	0.19	0.00	0.15	0.02	0.00	0.00	0.10	0.00	0.07	0.00	0.01	0.03
	1	0.60	0.02	0.00	0.00	0.09	0.00	0.06	0.06	0.06	0.00	0.05	0.00	0.04	0.01	0.00
DP1	0	0.39	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.02	0.02	0.01	0.01
	1	0.00	0.16	0.23	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.58	0.00	0.00	0.02
DP8	0	0.45	0.07	0.07	0.08	0.07	0.00	0.05	0.05	0.04	0.01	0.04	0.01	0.03	0.01	0.01
	1	0.00	0.21	0.13	0.00	0.00	0.34	0.00	0.00	0.00	0.19	0.00	0.09	0.00	0.00	0.03
DP9	0	0.39	0.10	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.01
	1	0.00	0.06	0.06	0.00	0.00	0.49	0.00	0.00	0.03	0.24	0.00	0.09	0.00	0.00	0.03
DP0	0	0.49	0.06	0.06	0.00	0.07	0.07	0.06	0.00	0.05	0.04	0.04	0.02	0.03	0.00	0.01

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.00	0.22	0.15	0.31	0.00	0.00	0.00	0.19	0.00	0.04	0.00	0.03	0.00	0.05	0.02
DPN	0	0.00	0.21	0.14	0.18	0.00	0.14	0.00	0.11	0.00	0.10	0.00	0.06	0.00	0.03	0.02
	1	0.62	0.02	0.04	0.00	0.09	0.00	0.07	0.00	0.06	0.00	0.05	0.00	0.04	0.00	0.00
Concrete Continuous - Culvert (includes frame culverts)																
DL1	0	0.24	0.25	0.14	0.14	0.11	0.07	0.03	0.01	---	---	---	---	---	---	---
	1	0.89	0.00	0.07	0.01	0.00	0.01	0.00	0.01	---	---	---	---	---	---	---
DL2	0	0.24	0.28	0.12	0.12	0.13	0.07	0.03	0.01	---	---	---	---	---	---	---
	1	0.41	0.00	0.25	0.20	0.00	0.07	0.03	0.04	---	---	---	---	---	---	---
DL4	0	0.25	0.26	0.13	0.12	0.12	0.07	0.03	0.01	---	---	---	---	---	---	---
	1	0.38	0.00	0.20	0.29	0.00	0.08	0.04	0.02	---	---	---	---	---	---	---
DL5	0	0.50	0.00	0.18	0.21	0.00	0.05	0.03	0.03	---	---	---	---	---	---	---
	1	0.00	0.50	0.09	0.05	0.23	0.09	0.03	0.00	---	---	---	---	---	---	---
DL6	0	0.20	0.26	0.15	0.15	0.12	0.07	0.03	0.01	---	---	---	---	---	---	---
	1	0.84	0.00	0.07	0.01	0.00	0.05	0.02	0.01	---	---	---	---	---	---	---
DL0	0	0.26	0.27	0.13	0.10	0.13	0.08	0.03	0.01	---	---	---	---	---	---	---
	1	0.32	0.00	0.21	0.39	0.00	0.02	0.03	0.03	---	---	---	---	---	---	---
DST1	0	0.41	0.36	0.06	0.06	0.00	0.10	0.01	0.00	---	---	---	---	---	---	---
	1	0.00	0.01	0.29	0.29	0.31	0.00	0.06	0.04	---	---	---	---	---	---	---
DST9	0	0.27	0.24	0.14	0.13	0.11	0.07	0.03	0.01	---	---	---	---	---	---	---
	1	0.00	0.00	0.28	0.68	0.00	0.00	0.04	0.00	---	---	---	---	---	---	---
DSTN	0	0.00	0.01	0.29	0.30	0.29	0.00	0.06	0.04	---	---	---	---	---	---	---
	1	0.42	0.37	0.05	0.04	0.00	0.11	0.01	0.00	---	---	---	---	---	---	---
TOWS1	0	0.29	0.26	0.14	0.14	0.05	0.07	0.03	0.00	---	---	---	---	---	---	---
	1	0.00	0.00	0.11	0.15	0.60	0.00	0.04	0.10	---	---	---	---	---	---	---
TOWS6	0	0.33	0.29	0.04	0.13	0.09	0.08	0.01	0.02	---	---	---	---	---	---	---
	1	0.02	0.03	0.51	0.16	0.18	0.00	0.09	0.00	---	---	---	---	---	---	---
TOWS8	0	0.29	0.26	0.14	0.07	0.11	0.07	0.03	0.01	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.01	0.00	0.10	0.74	0.09	0.00	0.02	0.03	---	---	---	---	---	---	---
TOWS9	0	0.27	0.24	0.14	0.13	0.11	0.07	0.03	0.01	---	---	---	---	---	---	---
	1	0.00	0.00	0.12	0.84	0.02	0.00	0.02	0.00	---	---	---	---	---	---	---
TOWS0	0	0.26	0.24	0.14	0.14	0.11	0.07	0.03	0.01	---	---	---	---	---	---	---
	1	0.53	0.15	0.14	0.04	0.03	0.09	0.02	0.00	---	---	---	---	---	---	---
TOWSN	0	0.04	0.02	0.30	0.30	0.24	0.01	0.06	0.03	---	---	---	---	---	---	---
	1	0.45	0.42	0.01	0.01	0.00	0.12	0.01	0.00	---	---	---	---	---	---	---
DP0	0	0.42	0.38	0.01	0.01	0.06	0.11	0.01	0.00	---	---	---	---	---	---	---
	1	0.00	0.00	0.35	0.36	0.19	0.00	0.07	0.03	---	---	---	---	---	---	---
DPN	0	0.00	0.00	0.32	0.32	0.26	0.00	0.06	0.03	---	---	---	---	---	---	---
	1	0.46	0.41	0.00	0.00	0.00	0.12	0.01	0.00	---	---	---	---	---	---	---
Steel - Culvert (includes frame culverts)																
DL2	0	0.51	0.28	0.13	0.04	0.03	---	---	---	---	---	---	---	---	---	---
	1	0.56	0.32	0.07	0.02	0.03	---	---	---	---	---	---	---	---	---	---
DL5	0	0.57	0.27	0.10	0.03	0.03	---	---	---	---	---	---	---	---	---	---
	1	0.40	0.33	0.17	0.07	0.03	---	---	---	---	---	---	---	---	---	---
DL6	0	0.47	0.31	0.14	0.05	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.70	0.21	0.07	0.02	0.01	---	---	---	---	---	---	---	---	---	---
DL0	0	0.52	0.28	0.13	0.04	0.02	---	---	---	---	---	---	---	---	---	---
	1	0.50	0.29	0.12	0.04	0.05	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.04	0.41	0.43	0.06	0.06	---	---	---	---	---	---	---	---	---	---
	1	0.54	0.28	0.11	0.04	0.03	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.60	0.27	0.05	0.05	0.03	---	---	---	---	---	---	---	---	---	---
	1	0.00	0.35	0.58	0.02	0.04	---	---	---	---	---	---	---	---	---	---
TOWSN	0	0.02	0.44	0.46	0.03	0.04	---	---	---	---	---	---	---	---	---	---
	1	0.66	0.24	0.02	0.05	0.03	---	---	---	---	---	---	---	---	---	---
DP0	0	0.62	0.24	0.07	0.04	0.03	---	---	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.00	0.53	0.41	0.03	0.03	---	---	---	---	---	---	---	---	---	---
DPN	0	0.00	0.52	0.41	0.03	0.03	---	---	---	---	---	---	---	---	---	---
	1	0.63	0.23	0.06	0.04	0.03	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Culvert (includes frame culverts)																
DL5	0	0.02	0.82	0.16	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.88	0.00	0.12	---	---	---	---	---	---	---	---	---	---	---	---
DSTN	0	0.24	0.32	0.43	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.61	0.27	0.13	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.65	0.29	0.06	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.48	0.21	0.31	---	---	---	---	---	---	---	---	---	---	---	---
TOWS8	0	0.42	0.20	0.37	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.69	0.30	0.01	---	---	---	---	---	---	---	---	---	---	---	---
DPN	0	0.23	0.06	0.71	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.61	0.27	0.12	---	---	---	---	---	---	---	---	---	---	---	---
Concrete - Channel Beam																
DL1	0	0.33	0.19	0.17	0.15	0.10	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.08	0.03	0.21	0.08	0.50	0.10	0.00	---	---	---	---	---	---	---	---
DL2	0	0.34	0.08	0.19	0.19	0.09	0.07	0.04	---	---	---	---	---	---	---	---
	1	0.31	0.32	0.13	0.09	0.11	0.03	0.01	---	---	---	---	---	---	---	---
DL3	0	0.33	0.19	0.16	0.13	0.11	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.20	0.08	0.20	0.45	0.04	0.02	0.00	---	---	---	---	---	---	---	---
DL4	0	0.33	0.19	0.16	0.15	0.10	0.05	0.02	---	---	---	---	---	---	---	---
	1	0.21	0.03	0.29	0.08	0.12	0.14	0.13	---	---	---	---	---	---	---	---
DL5	0	0.30	0.20	0.15	0.15	0.12	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.40	0.14	0.22	0.14	0.04	0.05	0.00	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DL0	0	0.32	0.22	0.18	0.13	0.10	0.04	0.01	---	---	---	---	---	---	---	---
	1	0.35	0.01	0.11	0.24	0.13	0.08	0.09	---	---	---	---	---	---	---	---
DST1	0	0.34	0.20	0.15	0.16	0.07	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.24	0.05	0.31	0.00	0.33	0.07	0.00	---	---	---	---	---	---	---	---
DST2	0	0.13	0.03	0.23	0.00	0.44	0.06	0.11	---	---	---	---	---	---	---	---
	1	0.39	0.23	0.14	0.19	0.00	0.05	0.00	---	---	---	---	---	---	---	---
DST9	0	0.35	0.20	0.16	0.16	0.04	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.01	0.01	0.20	0.00	0.73	0.05	0.00	---	---	---	---	---	---	---	---
DSTN	0	0.33	0.19	0.17	0.15	0.11	0.05	0.00	---	---	---	---	---	---	---	---
	1	0.02	0.00	0.05	0.00	0.04	0.08	0.82	---	---	---	---	---	---	---	---
TOWS1	0	0.08	0.15	0.16	0.29	0.21	0.06	0.05	---	---	---	---	---	---	---	---
	1	0.57	0.22	0.17	0.00	0.00	0.04	0.00	---	---	---	---	---	---	---	---
TOWS6	0	0.50	0.20	0.18	0.04	0.00	0.05	0.04	---	---	---	---	---	---	---	---
	1	0.00	0.16	0.15	0.34	0.30	0.06	0.00	---	---	---	---	---	---	---	---
TOWS8	0	0.33	0.19	0.16	0.13	0.11	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.24	0.03	0.20	0.47	0.00	0.05	0.00	---	---	---	---	---	---	---	---
TOWS9	0	0.33	0.19	0.17	0.14	0.10	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.22	0.01	0.18	0.49	0.00	0.09	0.00	---	---	---	---	---	---	---	---
TOWS0	0	0.32	0.18	0.16	0.15	0.11	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.42	0.25	0.27	0.03	0.00	0.03	0.00	---	---	---	---	---	---	---	---
DP8	0	0.33	0.19	0.16	0.15	0.10	0.05	0.03	---	---	---	---	---	---	---	---
	1	0.04	0.00	0.88	0.00	0.00	0.08	0.00	---	---	---	---	---	---	---	---
DP0	0	0.05	0.00	0.35	0.01	0.00	0.08	0.50	---	---	---	---	---	---	---	---
	1	0.34	0.20	0.16	0.15	0.11	0.05	0.00	---	---	---	---	---	---	---	---
DPN	0	0.33	0.19	0.17	0.15	0.11	0.05	0.00	---	---	---	---	---	---	---	---
	1	0.03	0.00	0.02	0.00	0.00	0.06	0.88	---	---	---	---	---	---	---	---

Table A7 Continued: *Nominal Parameter Distribution Across Clusters*

Parameter	Indicator	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Prestressed Concrete - Channel Beam																
DL5	0	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
DST1	0	0.88	0.12	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS1	0	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.86	0.14	---	---	---	---	---	---	---	---	---	---	---	---	---
TOWS6	0	0.88	0.12	---	---	---	---	---	---	---	---	---	---	---	---	---
	1	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A8: *Continuous Parameter Average Within Cluster*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
		Concrete - Slab		
1	31.36	194.01	0.00	31.36
2	35.27	306.66	10.89	35.27
3	60.51	87.57	6.13	60.51
4	30.76	295.38	6.39	30.76
5	43.52	303.21	10.63	43.52
6	34.85	181.63	4.60	34.85
7	69.63	87.27	0.00	69.63
8	9.27	122.03	4.17	9.27
9	71.44	82.02	5.38	29.62
10	59.80	196.80	8.65	29.81
11	62.50	302.99	14.39	33.96
12	50.83	86.06	7.17	50.82
13	38.82	1065.69	15.14	21.22
14	38.71	206.78	5.24	8.12
		Concrete Continuous - Slab		
1	38.72	314.58	15.45	38.72
2	21.54	337.76	6.70	21.54
3	28.59	320.55	7.33	28.59
4	11.06	321.86	7.35	11.06
5	63.26	123.10	3.54	63.26
6	38.73	373.70	14.39	38.73
7	38.47	364.85	15.66	13.58
8	25.29	813.94	10.16	25.29
9	60.42	271.89	8.74	26.57
10	50.35	1074.21	14.08	25.29
11	44.62	331.18	13.86	9.16
12	68.70	131.53	5.09	32.56
		Prestressed Concrete - Slab		
1	24.21	196.95	5.42	24.21
2	19.64	182.09	3.63	19.64
3	15.23	330.48	5.84	15.23
4	59.15	204.82	5.72	15.52
5	23.38	992.31	18.13	23.38
		Wood or Timber - Slab		
1	28.72	164.13	0.00	28.72
2	18.33	142.45	5.71	18.33
3	55.37	176.35	5.82	17.55

Table A8 - Continued: *Continuous Parameter Average Within Cluster*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
		Concrete - Stringer/Mulit-beam or girder		
1	27.76	503.96	12.30	27.76
2	41.08	236.38	0.00	41.08
3	37.66	479.03	18.08	37.66
4	48.05	205.58	8.59	48.05
5	50.00	390.31	9.37	18.00
6	43.80	877.20	16.64	19.01
7	31.16	2707.29	14.62	31.16
	70.53	112.27	5.68	32.91
		Concrete Continuous - Stringer/Mulit-beam or girder		
1	0.00	50.06	---	---
2	7.47	66.25	---	---
3	13.30	39.34	---	---
4	14.78	43.76	---	---
5	7.71	11.73	---	---
		Steel - Stringer/Mulit-beam or girder		
1	42.35	128.59	0.00	42.35
2	38.88	521.22	7.73	38.88
3	44.22	143.27	7.67	44.22
4	28.66	493.11	8.50	28.66
5	47.21	127.44	7.48	47.21
6	33.82	154.88	6.74	33.82
7	67.88	116.20	0.00	22.10
8	41.70	584.20	8.81	16.59
9	59.24	180.44	8.62	59.24
10	64.18	112.15	6.08	27.73
11	52.00	435.74	8.54	11.91
12	68.48	183.98	7.96	24.67
13	64.24	162.08	8.33	19.63
14	60.25	463.95	19.26	32.28
15	39.64	4542.34	9.65	29.26
		Steel Continuous - Stringer/Mulit-beam or girder		
1	35.62	742.37	8.99	35.62
2	32.07	2424.92	10.02	32.07
3	34.16	542.68	0.00	34.16
4	11.53	912.01	8.22	11.53
5	41.72	685.82	10.44	15.93
6	14.08	955.20	7.99	14.08
7	35.22	677.06	30.04	35.22

Table A8 - Continued: *Continuous Parameter Average Within Cluster*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
8	42.95	667.85	12.46	9.40
9	46.19	648.17	12.72	11.31
10	45.55	1674.06	15.06	14.00
11	44.21	171.68	4.69	44.21
12	30.80	717.29	10.64	30.80
13	61.65	189.86	3.20	21.46
14	49.06	915.24	14.22	22.57
15	43.81	9799.31	9.30	26.61
Prestressed Concrete - Stringer/Mulit-beam or girder				
1	25.37	542.17	8.30	25.37
2	21.18	676.17	10.92	21.18
3	11.05	516.88	8.83	11.05
4	19.87	3293.32	9.73	19.87
5	37.46	573.32	13.42	12.07
6	49.59	588.16	6.58	15.90
7	36.04	571.97	7.33	36.04
8	30.79	14282.00	17.81	15.33
Prestressed Concrete Continuous - Stringer/Mulit-beam or girder				
1	20.84	702.69	10.28	---
2	10.27	741.49	8.89	---
3	39.83	813.80	11.40	---
4	13.50	5570.54	11.65	---
Wood or Timber - Stringer/Mulit-beam or girder				
1	42.27	140.04	0.00	42.27
2	42.76	137.37	10.35	42.76
3	43.95	215.26	7.68	43.95
4	35.20	150.52	0.00	35.20
5	55.54	141.30	13.32	20.61
6	44.96	208.33	4.95	44.96
7	55.56	129.81	0.00	19.94
8	57.19	510.95	12.38	35.21
Steel - Girder or Floorbeam System				
1	54.50	326.60	6.99	54.50
2	53.44	175.60	0.00	53.44
3	73.33	242.64	4.31	25.19
4	51.93	2411.11	9.94	27.85

Table A8 - Continued: *Continuous Parameter Average Within Cluster*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
		Steel Continuous - Girder or Floorbeam System		
1	37.43	2017.61	8.82	37.43
2	49.39	5710.82	10.45	19.35
		Concrete - Tee Beam		
1	49.71	396.91	9.09	49.71
2	68.31	117.86	5.78	68.31
3	43.00	511.01	9.24	43.00
4	71.21	230.63	7.49	36.24
5	70.77	516.56	15.48	38.93
6	33.28	202.65	5.44	33.28
7	54.51	1587.70	14.59	26.56
8	56.92	455.58	8.75	28.41
		Concrete Continuous - Tee Beam		
1	38.01	514.20	16.39	38.01
2	38.45	598.39	5.17	38.45
3	65.21	357.38	4.97	65.21
4	37.71	978.13	10.02	37.71
5	41.50	534.83	12.04	16.30
6	65.82	1089.86	8.21	30.88
		Prestressed Concrete - Tee Beam		
1	21.49	226.30	---	21.49
2	48.52	811.25	---	19.21
		Concrete Continuous - Box Beam or Girders - Multiple		
1	35.63	702.51	4.59	35.63
2	30.96	1077.97	11.50	30.96
3	38.56	2053.13	7.32	19.35
		Prestressed Concrete - Box Beam or Girders - Multiple		
1	17.74	206.96	0.00	17.74
2	24.97	197.20	5.58	24.97
3	21.51	336.41	6.67	21.51
4	13.26	258.76	7.21	13.26
5	16.35	224.49	4.87	16.35
6	71.53	152.06	4.37	18.29
7	8.51	196.06	6.24	8.51
8	24.55	554.34	14.60	24.55

Table A8 - Continued: *Continuous Parameter Average Within Cluster*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
9	20.31	244.36	6.57	20.31
10	65.71	157.56	5.08	16.10
11	51.79	570.87	12.84	16.62
12	24.62	1616.52	13.46	24.62
13	68.21	205.57	5.62	14.08
		Prestressed Concrete - Box Beam or Girders - Single or Spread		
1	27.73	360.14	10.69	27.73
2	9.10	259.00	5.87	9.10
3	43.51	613.61	14.04	12.45
		Prestressed Concrete Continuous - Box Beam or Girders - Single or Spread		
1	14.17	614.53	7.14	14.17
2	29.26	2024.53	13.63	11.50
		Concrete - Frame (except for culverts)		
1	31.77	121.28	---	31.77
2	35.70	150.47	---	35.70
3	52.85	359.22	---	25.40
		Concrete Continuous - Frame (except for culverts)		
1	---	---	8.29	---
2	---	---	0.00	---
		Steel - Truss-Thru		
1	69.84	269.28	0.00	69.84
2	62.20	909.37	8.71	62.20
3	82.65	249.77	0.00	82.65
4	72.39	274.29	9.74	72.39
5	81.21	337.78	9.65	81.21
6	82.40	269.91	0.00	29.10
7	84.92	397.40	8.84	26.74
8	74.00	610.08	8.17	27.35
9	51.07	295.66	5.24	13.80
10	63.45	6417.65	14.67	33.87
		Concrete - Arch- Deck		
1	72.56	245.53	4.27	72.56
2	79.48	178.47	4.92	79.48
3	75.10	1141.47	6.59	34.83

Table A8 - Continued: *Continuous Parameter Average Within Cluster*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
4	61.98	176.42	5.92	31.66
		Masonry - Arch-Deck		
1	97.59	142.58	3.32	97.59
2	111.21	281.63	5.38	47.97
		Concrete - Culvert (includes frame culverts)		
1	33.36	93.74	8.44	33.36
2	33.63	97.86	0.00	33.63
3	38.97	97.26	8.10	38.97
4	38.00	98.30	9.55	38.00
5	20.39	94.31	0.00	20.39
6	41.42	104.78	15.96	41.42
7	60.83	82.69	10.26	25.91
8	43.73	104.16	12.52	43.73
9	29.06	177.56	26.12	29.06
10	62.96	110.64	17.87	30.26
11	53.90	122.66	18.66	25.22
12	25.42	191.41	12.40	25.42
13	41.26	100.21	14.64	41.26
14	59.23	96.84	12.13	24.76
15	50.98	284.60	10.18	23.80
		Concrete Continuous - Culvert (includes frame culverts)		
1	41.37	95.95	9.73	41.37
2	29.10	108.90	12.09	29.10
3	41.34	104.08	8.24	41.34
4	39.82	96.60	0.00	39.82
5	14.23	119.70	4.33	14.23
6	53.97	103.46	19.24	26.27
7	55.20	196.43	14.23	29.76
8	27.71	159.42	2.26	27.71
		Steel - Culvert (includes frame culverts)		
1	24.27	90.26	6.18	24.27
2	25.25	89.54	0.00	25.25
3	27.10	94.12	7.06	27.10
4	26.96	210.61	19.30	26.96
5	53.25	96.31	5.71	18.56

Table A8 - Continued: *Continuous Parameter Average Within Cluster*

Cluster	AGE (years)	SL (meters x 10)	ADTT (%)	NEWAGE (years)
		Prestressed Concrete - Culvert (includes frame culverts)		
1	19.09	---	0.00	---
2	5.22	---	0.00	---
3	16.73	---	9.34	---
		Concrete - Channel Beam		
1	18.99	214.74	0.34	18.99
2	24.51	242.72	8.00	24.51
3	29.94	280.93	8.88	29.94
4	31.92	163.82	1.76	31.92
5	35.69	164.28	5.78	35.69
6	56.69	260.81	4.36	21.34
7	34.67	102.49	2.74	34.67
		Prestressed Concrete - Channel Beam		
1	31.86	184.23	4.01	31.86
2	43.66	290.87	9.02	22.74

Table A9: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
								Concrete - Slab								
AGE (years)	0 - 20	0.36	0.15	0.02	0.15	0.05	0.03	0.00	0.22	0.00	0.00	0.00	0.01	0.02	0.00	---
	21 - 35	0.20	0.24	0.06	0.20	0.08	0.15	0.01	0.00	0.00	0.01	0.00	0.01	0.02	0.01	---
	36 - 46	0.11	0.26	0.10	0.15	0.11	0.15	0.01	0.00	0.01	0.02	0.01	0.02	0.02	0.03	---
	47 - 64	0.12	0.11	0.24	0.05	0.18	0.04	0.09	0.00	0.05	0.03	0.05	0.02	0.01	0.00	---
	65 - 172	0.09	0.04	0.36	0.01	0.05	0.00	0.17	0.00	0.15	0.06	0.04	0.03	0.01	0.00	---
SL (meters x 10)	26 - 79	0.13	0.04	0.39	0.04	0.04	0.00	0.15	0.02	0.12	0.01	0.01	0.05	0.00	0.00	---
	80 - 110	0.14	0.06	0.28	0.10	0.04	0.07	0.09	0.08	0.08	0.01	0.00	0.04	0.01	0.01	---
	111 - 180	0.23	0.13	0.11	0.07	0.08	0.12	0.04	0.12	0.01	0.04	0.02	0.01	0.01	0.01	---
	181 - 304	0.23	0.25	0.00	0.14	0.12	0.15	0.00	0.02	0.00	0.04	0.03	0.00	0.01	0.02	---
	305 - 1e+004	0.14	0.30	0.00	0.22	0.18	0.03	0.00	0.00	0.00	0.02	0.04	0.00	0.06	0.01	---
ADTT (%)	0 - 0	0.59	0.01	0.03	0.01	0.01	0.04	0.19	0.06	0.03	0.01	0.00	0.00	0.01	0.00	---
	1-1	0.00	0.25	0.21	0.37	0.05	0.01	0.00	0.03	0.03	0.03	0.00	0.01	0.02	0.00	---
	2-5	0.00	0.17	0.29	0.13	0.11	0.11	0.00	0.04	0.07	0.03	0.01	0.02	0.01	0.01	---
	6-10	0.00	0.15	0.22	0.12	0.12	0.16	0.00	0.05	0.05	0.03	0.02	0.04	0.01	0.02	---
	11-98	0.00	0.35	0.11	0.12	0.21	0.00	0.00	0.02	0.03	0.04	0.07	0.01	0.04	0.00	---
NEWAGE (years)	0 - 17	0.29	0.10	0.01	0.11	0.04	0.02	0.00	0.21	0.06	0.03	0.02	0.01	0.04	0.04	---
	18 - 31	0.21	0.22	0.04	0.20	0.08	0.10	0.00	0.01	0.06	0.03	0.02	0.01	0.02	0.00	---
	32 - 42	0.14	0.24	0.09	0.15	0.08	0.16	0.01	0.00	0.05	0.02	0.03	0.02	0.01	0.00	---
	43 - 61	0.08	0.19	0.18	0.10	0.21	0.09	0.04	0.00	0.04	0.03	0.02	0.02	0.01	0.00	---
	62 - 135	0.15	0.05	0.44	0.02	0.06	0.00	0.22	0.00	0.01	0.01	0.00	0.03	0.00	0.00	---
								Concrete Continuous - Slab								
AGE (years)	0 - 15	0.03	0.31	0.09	0.47	0.00	0.01	0.00	0.08	0.00	0.00	0.00	0.00	---	---	---
	16 - 29	0.15	0.25	0.35	0.15	0.01	0.04	0.01	0.03	0.00	0.00	0.00	0.00	---	---	---
	30 - 38	0.41	0.15	0.16	0.00	0.02	0.09	0.10	0.04	0.01	0.01	0.01	0.00	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	39 - 47	0.47	0.07	0.12	0.00	0.05	0.10	0.09	0.03	0.02	0.01	0.04	0.00	---	---	---
	48 - 132	0.19	0.02	0.05	0.00	0.41	0.04	0.02	0.02	0.13	0.06	0.02	0.05	---	---	---
SL (meters x 10)	61 - 193	0.17	0.08	0.08	0.05	0.44	0.03	0.02	0.02	0.06	0.01	0.01	0.05	---	---	---
	194 - 262	0.30	0.16	0.17	0.17	0.05	0.04	0.04	0.01	0.03	0.01	0.02	0.01	---	---	---
	263 - 326	0.29	0.17	0.21	0.15	0.01	0.05	0.05	0.01	0.03	0.01	0.02	0.00	---	---	---
	327 - 408	0.27	0.21	0.20	0.13	0.00	0.07	0.06	0.01	0.03	0.01	0.02	0.00	---	---	---
	409 - 2e+004	0.22	0.17	0.11	0.11	0.00	0.09	0.07	0.15	0.02	0.05	0.01	0.00	---	---	---
ADTT (%)	0 - 0	0.10	0.21	0.25	0.14	0.20	0.05	0.01	0.02	0.02	0.01	0.00	0.01	---	---	---
	1-5	0.22	0.20	0.10	0.13	0.16	0.04	0.03	0.05	0.04	0.01	0.01	0.02	---	---	---
	6-10	0.22	0.14	0.11	0.18	0.10	0.03	0.07	0.05	0.05	0.02	0.02	0.02	---	---	---
	11-15	0.22	0.17	0.26	0.10	0.01	0.08	0.05	0.04	0.03	0.02	0.02	0.00	---	---	---
	16 - 99	0.49	0.08	0.08	0.07	0.00	0.09	0.08	0.04	0.02	0.03	0.02	0.00	---	---	---
NEWAGE (years)	0 - 12	0.02	0.24	0.06	0.38	0.00	0.00	0.11	0.07	0.03	0.02	0.05	0.01	---	---	---
	13 - 24	0.08	0.21	0.24	0.22	0.00	0.02	0.10	0.03	0.04	0.02	0.02	0.01	---	---	---
	25 - 35	0.33	0.21	0.24	0.01	0.02	0.06	0.02	0.04	0.05	0.02	0.00	0.01	---	---	---
	36 - 44	0.52	0.09	0.13	0.00	0.04	0.13	0.00	0.03	0.03	0.02	0.00	0.01	---	---	---
	45 - 102	0.31	0.03	0.09	0.00	0.44	0.06	0.00	0.03	0.02	0.01	0.00	0.01	---	---	---
								Prestressed Concrete - Slab								
AGE (years)	0 - 10	0.47	0.22	0.28	0.00	0.03	---	---	---	---	---	---	---	---	---	---
	11-18	0.50	0.24	0.21	0.01	0.04	---	---	---	---	---	---	---	---	---	---
	19 - 26	0.55	0.20	0.19	0.01	0.05	---	---	---	---	---	---	---	---	---	---
	27 - 36	0.63	0.19	0.09	0.05	0.04	---	---	---	---	---	---	---	---	---	---
	37 - 152	0.51	0.07	0.01	0.38	0.03	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	48 - 101	0.62	0.23	0.02	0.12	0.01	---	---	---	---	---	---	---	---	---	---
	102 - 140	0.59	0.22	0.06	0.12	0.01	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	141 - 214	0.62	0.21	0.07	0.08	0.01	---	---	---	---	---	---	---	---	---	---
	215 - 335	0.47	0.15	0.30	0.07	0.01	---	---	---	---	---	---	---	---	---	---
	336 - 5e+004	0.37	0.10	0.33	0.07	0.14	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.48	0.40	0.05	0.06	0.01	---	---	---	---	---	---	---	---	---	---
	1-3	0.69	0.13	0.03	0.12	0.02	---	---	---	---	---	---	---	---	---	---
	4-5	0.67	0.15	0.01	0.14	0.03	---	---	---	---	---	---	---	---	---	---
	6-9	0.29	0.12	0.52	0.07	0.01	---	---	---	---	---	---	---	---	---	---
	10-90	0.66	0.12	0.02	0.09	0.11	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 8	0.39	0.19	0.25	0.15	0.02	---	---	---	---	---	---	---	---	---	---
	9-16	0.44	0.21	0.20	0.13	0.03	---	---	---	---	---	---	---	---	---	---
	17 - 24	0.51	0.18	0.18	0.08	0.05	---	---	---	---	---	---	---	---	---	---
	25 - 32	0.57	0.22	0.10	0.07	0.03	---	---	---	---	---	---	---	---	---	---
	33 - 126	0.76	0.11	0.04	0.03	0.05	---	---	---	---	---	---	---	---	---	---
							Wood or Timber - Slab									
AGE (years)	1-11	0.31	0.67	0.02	---	---	---	---	---	---	---	---	---	---	---	---
	12-19	0.44	0.54	0.02	---	---	---	---	---	---	---	---	---	---	---	---
	20 - 29	0.69	0.27	0.04	---	---	---	---	---	---	---	---	---	---	---	---
	30 - 41	0.69	0.23	0.08	---	---	---	---	---	---	---	---	---	---	---	---
	42 - 102	0.52	0.12	0.35	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	37 - 79	0.49	0.40	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	80 - 99	0.43	0.42	0.15	---	---	---	---	---	---	---	---	---	---	---	---
	100 - 157	0.46	0.42	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	158 - 232	0.60	0.35	0.06	---	---	---	---	---	---	---	---	---	---	---	---
	233 - 2140	0.67	0.26	0.07	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.93	0.00	0.07	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1-1	0.00	0.91	0.09	---	---	---	---	---	---	---	---	---	---	---	---
	2-5	0.00	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	6-60	0.00	0.78	0.22	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	1-10	0.25	0.58	0.17	---	---	---	---	---	---	---	---	---	---	---	---
	11-16	0.36	0.50	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	17 - 25	0.58	0.34	0.08	---	---	---	---	---	---	---	---	---	---	---	---
	26 - 37	0.70	0.24	0.06	---	---	---	---	---	---	---	---	---	---	---	---
	38 - 102	0.77	0.18	0.05	---	---	---	---	---	---	---	---	---	---	---	---
						Concrete - Stringer/Mulit-beam or girder										
AGE (years)	0 - 19	0.38	0.36	0.06	0.15	0.00	0.00	0.04	0.00	---	---	---	---	---	---	---
	20 - 34	0.35	0.17	0.26	0.13	0.02	0.02	0.04	0.00	---	---	---	---	---	---	---
	35 - 42	0.20	0.10	0.40	0.14	0.05	0.06	0.04	0.00	---	---	---	---	---	---	---
	43 - 55	0.17	0.09	0.30	0.26	0.06	0.08	0.02	0.02	---	---	---	---	---	---	---
	56 - 152	0.02	0.38	0.03	0.37	0.05	0.01	0.01	0.13	---	---	---	---	---	---	---
SL (meters x 10)	57 - 124	0.04	0.35	0.04	0.44	0.02	0.00	0.00	0.11	---	---	---	---	---	---	---
	125 - 271	0.14	0.33	0.11	0.32	0.04	0.01	0.00	0.05	---	---	---	---	---	---	---
	274 - 368	0.25	0.23	0.29	0.15	0.04	0.03	0.00	0.00	---	---	---	---	---	---	---
	369 - 560	0.31	0.15	0.32	0.12	0.05	0.04	0.00	0.00	---	---	---	---	---	---	---
	561 - 6e+004	0.37	0.05	0.29	0.02	0.03	0.09	0.15	0.00	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.03	0.89	0.01	0.00	0.02	0.00	0.01	0.04	---	---	---	---	---	---	---
	1-4	0.35	0.00	0.08	0.46	0.04	0.02	0.03	0.02	---	---	---	---	---	---	---
	5-10	0.27	0.00	0.18	0.36	0.07	0.03	0.03	0.06	---	---	---	---	---	---	---
	11-16	0.27	0.00	0.34	0.25	0.02	0.05	0.04	0.02	---	---	---	---	---	---	---
	17 - 83	0.28	0.00	0.48	0.08	0.03	0.07	0.06	0.00	---	---	---	---	---	---	---
NEWAGE (years)	0 - 15	0.30	0.29	0.04	0.13	0.10	0.08	0.03	0.03	---	---	---	---	---	---	---
	16 - 31	0.31	0.20	0.19	0.10	0.06	0.07	0.03	0.04	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	32 - 40	0.26	0.11	0.37	0.14	0.01	0.02	0.05	0.03	---	---	---	---	---	---	---
	41 - 50	0.19	0.09	0.40	0.24	0.01	0.00	0.03	0.03	---	---	---	---	---	---	---
	51 - 104	0.05	0.43	0.05	0.44	0.01	0.00	0.01	0.02	---	---	---	---	---	---	---
Concrete Continuous - Stringer/Mulit-beam or girder																
ADTT (%)	0 - 0	0.99	0.01	0.00	0.00	0.00	---	---	---	---	---	---	---	---	---	---
	1-4	0.00	0.48	0.29	0.14	0.09	---	---	---	---	---	---	---	---	---	---
	5-8	0.00	0.39	0.25	0.14	0.22	---	---	---	---	---	---	---	---	---	---
	9-11	0.00	0.38	0.24	0.13	0.25	---	---	---	---	---	---	---	---	---	---
	12-75	0.00	0.12	0.46	0.40	0.03	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 23	0.12	0.04	0.18	0.08	0.58	---	---	---	---	---	---	---	---	---	---
	24 - 40	0.42	0.08	0.32	0.16	0.01	---	---	---	---	---	---	---	---	---	---
	41 - 47	0.26	0.09	0.37	0.29	0.00	---	---	---	---	---	---	---	---	---	---
	48 - 71	0.21	0.41	0.21	0.17	0.00	---	---	---	---	---	---	---	---	---	---
	72 - 107	0.34	0.55	0.05	0.07	0.00	---	---	---	---	---	---	---	---	---	---
Steel - Stringer/Mulit-beam or girder																
AGE (years)	0 - 23	0.38	0.16	0.08	0.20	0.10	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	24 - 37	0.21	0.42	0.08	0.07	0.04	0.06	0.01	0.03	0.00	0.01	0.01	0.00	0.01	0.01	0.02
	38 - 47	0.16	0.37	0.08	0.07	0.04	0.03	0.02	0.08	0.02	0.02	0.05	0.01	0.02	0.01	0.02
	48 - 65	0.22	0.21	0.09	0.05	0.09	0.03	0.04	0.02	0.07	0.04	0.03	0.03	0.03	0.03	0.01
	66 - 192	0.30	0.08	0.08	0.02	0.11	0.01	0.11	0.00	0.04	0.06	0.02	0.07	0.05	0.04	0.01
SL (meters x 10)	24 - 92	0.45	0.05	0.12	0.01	0.12	0.05	0.07	0.00	0.02	0.04	0.00	0.02	0.03	0.01	0.00
	93 - 127	0.40	0.06	0.13	0.01	0.12	0.06	0.07	0.00	0.03	0.05	0.01	0.02	0.03	0.01	0.00
	128 - 219	0.30	0.14	0.10	0.05	0.12	0.06	0.05	0.01	0.05	0.03	0.03	0.03	0.03	0.01	0.00
	220 - 463	0.12	0.39	0.06	0.16	0.03	0.03	0.01	0.04	0.04	0.00	0.04	0.03	0.02	0.03	0.00

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	464 - 2e+005	0.00	0.58	0.00	0.17	0.00	0.00	0.00	0.08	0.00	0.00	0.04	0.00	0.00	0.04	0.07
ADTT (%)	0 - 0	0.81	0.04	0.00	0.01	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1-1	0.00	0.39	0.22	0.07	0.13	0.05	0.00	0.02	0.03	0.02	0.01	0.02	0.03	0.01	0.02
	2-6	0.00	0.31	0.13	0.11	0.12	0.09	0.00	0.03	0.03	0.06	0.03	0.03	0.03	0.02	0.01
	7-10	0.00	0.37	0.09	0.10	0.13	0.05	0.00	0.04	0.03	0.04	0.04	0.05	0.03	0.01	0.02
	11-99	0.00	0.32	0.12	0.15	0.07	0.03	0.00	0.05	0.05	0.01	0.04	0.02	0.04	0.07	0.03
NEWAGE (years)	0 - 15	0.24	0.09	0.05	0.13	0.08	0.04	0.07	0.06	0.00	0.04	0.09	0.04	0.05	0.02	0.02
	16 - 29	0.22	0.20	0.06	0.09	0.03	0.06	0.07	0.06	0.00	0.04	0.03	0.04	0.05	0.03	0.02
	30 - 41	0.17	0.45	0.08	0.07	0.03	0.04	0.03	0.01	0.01	0.02	0.00	0.02	0.01	0.02	0.02
	42 - 56	0.22	0.35	0.10	0.06	0.08	0.04	0.02	0.00	0.05	0.02	0.00	0.02	0.01	0.02	0.01
	57 - 192	0.42	0.14	0.12	0.04	0.16	0.02	0.00	0.00	0.08	0.01	0.00	0.00	0.00	0.01	0.00
								Steel Continuous - Stringer/Mulit-beam or girder								
AGE (years)	0 - 19	0.12	0.13	0.10	0.38	0.00	0.21	0.00	0.00	0.00	0.01	0.02	0.02	0.00	0.00	0.00
	20 - 31	0.43	0.14	0.13	0.06	0.05	0.05	0.06	0.01	0.01	0.01	0.02	0.03	0.00	0.00	0.01
	32 - 37	0.36	0.12	0.13	0.00	0.10	0.00	0.11	0.04	0.03	0.04	0.01	0.04	0.01	0.00	0.01
	38 - 45	0.32	0.13	0.11	0.00	0.11	0.00	0.07	0.08	0.07	0.04	0.02	0.02	0.01	0.02	0.01
	46 - 166	0.31	0.10	0.11	0.00	0.10	0.00	0.01	0.06	0.08	0.06	0.05	0.00	0.08	0.02	0.01
SL (meters x 10)	43 - 427	0.25	0.04	0.25	0.03	0.05	0.02	0.04	0.03	0.04	0.01	0.11	0.01	0.10	0.01	0.00
	428 - 609	0.36	0.06	0.09	0.08	0.11	0.04	0.09	0.06	0.05	0.02	0.00	0.03	0.00	0.01	0.00
	610 - 785	0.37	0.07	0.11	0.10	0.09	0.06	0.06	0.04	0.04	0.02	0.00	0.03	0.00	0.01	0.00
	786 - 1134	0.37	0.08	0.10	0.12	0.08	0.08	0.05	0.04	0.03	0.02	0.00	0.03	0.00	0.01	0.00
	1135 - 1e+005	0.20	0.38	0.03	0.10	0.03	0.07	0.02	0.01	0.01	0.10	0.00	0.01	0.00	0.01	0.03
ADTT (%)	0 - 1	0.11	0.05	0.58	0.05	0.03	0.05	0.00	0.01	0.01	0.01	0.04	0.00	0.06	0.00	0.00
	2-5	0.39	0.13	0.00	0.13	0.09	0.07	0.00	0.04	0.04	0.03	0.03	0.02	0.02	0.01	0.01
	6-9	0.40	0.17	0.00	0.12	0.07	0.06	0.01	0.04	0.03	0.03	0.03	0.03	0.02	0.01	0.01
	10-14	0.43	0.13	0.00	0.09	0.11	0.06	0.01	0.04	0.04	0.03	0.01	0.02	0.01	0.01	0.01

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	15 - 95	0.24	0.14	0.00	0.06	0.07	0.03	0.23	0.05	0.05	0.06	0.00	0.04	0.00	0.02	0.01
NEWAGE (years)	0 - 12	0.06	0.07	0.05	0.24	0.13	0.10	0.00	0.12	0.09	0.07	0.01	0.01	0.03	0.01	0.01
	13 - 22	0.11	0.08	0.08	0.16	0.15	0.14	0.01	0.06	0.08	0.07	0.01	0.01	0.03	0.01	0.01
	23 - 32	0.45	0.13	0.13	0.02	0.06	0.02	0.07	0.00	0.01	0.02	0.02	0.03	0.02	0.01	0.01
	33 - 40	0.45	0.17	0.16	0.00	0.01	0.00	0.14	0.00	0.00	0.00	0.01	0.04	0.01	0.00	0.01
	41 - 116	0.50	0.17	0.18	0.00	0.01	0.00	0.05	0.00	0.00	0.00	0.06	0.01	0.01	0.00	0.01
Prestressed Concrete - Stringer/Mulit-beam or girder																
AGE (years)	0 - 9	0.39	0.20	0.34	0.07	0.00	0.00	0.00	0.00	---	---	---	---	---	---	---
	10-18	0.40	0.21	0.31	0.08	0.00	0.01	0.00	0.00	---	---	---	---	---	---	---
	19 - 28	0.60	0.21	0.09	0.08	0.01	0.01	0.00	0.00	---	---	---	---	---	---	---
	29 - 36	0.60	0.20	0.01	0.05	0.06	0.02	0.05	0.01	---	---	---	---	---	---	---
	37 - 127	0.55	0.10	0.00	0.03	0.14	0.12	0.05	0.01	---	---	---	---	---	---	---
SL (meters x 10)	61 - 289	0.56	0.14	0.20	0.00	0.02	0.06	0.02	0.00	---	---	---	---	---	---	---
	290 - 457	0.56	0.16	0.20	0.00	0.05	0.02	0.01	0.00	---	---	---	---	---	---	---
	458 - 627	0.55	0.19	0.14	0.00	0.07	0.03	0.02	0.00	---	---	---	---	---	---	---
	628 - 906	0.54	0.23	0.12	0.00	0.05	0.03	0.03	0.00	---	---	---	---	---	---	---
	908 - 2e+005	0.31	0.22	0.08	0.29	0.02	0.03	0.01	0.03	---	---	---	---	---	---	---
ADTT (%)	0 - 1	0.54	0.18	0.14	0.04	0.02	0.04	0.04	0.00	---	---	---	---	---	---	---
	2-5	0.56	0.16	0.12	0.06	0.03	0.04	0.01	0.00	---	---	---	---	---	---	---
	6-9	0.52	0.17	0.16	0.06	0.03	0.04	0.02	0.00	---	---	---	---	---	---	---
	10-14	0.49	0.16	0.18	0.07	0.05	0.04	0.01	0.01	---	---	---	---	---	---	---
	15 - 95	0.42	0.25	0.14	0.07	0.08	0.01	0.02	0.01	---	---	---	---	---	---	---
NEWAGE (years)	0 - 8	0.34	0.18	0.30	0.06	0.08	0.05	0.00	0.01	---	---	---	---	---	---	---
	9-16	0.33	0.19	0.27	0.07	0.08	0.05	0.00	0.01	---	---	---	---	---	---	---
	17 - 25	0.50	0.18	0.16	0.07	0.05	0.04	0.00	0.01	---	---	---	---	---	---	---
	26 - 34	0.65	0.22	0.01	0.06	0.01	0.02	0.03	0.00	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	35 - 112	0.73	0.15	0.00	0.04	0.00	0.01	0.07	0.00	---	---	---	---	---	---	---
Prestressed Concrete Continuous - Stringer/Mulit-beam or girder																
AGE (years)	0 - 6	0.34	0.60	0.00	0.07	---	---	---	---	---	---	---	---	---	---	---
	7-11	0.30	0.62	0.00	0.07	---	---	---	---	---	---	---	---	---	---	---
	12-19	0.43	0.50	0.01	0.06	---	---	---	---	---	---	---	---	---	---	---
	20 - 28	0.77	0.15	0.04	0.05	---	---	---	---	---	---	---	---	---	---	---
	29 - 102	0.68	0.01	0.29	0.02	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	73 - 462	0.54	0.37	0.08	0.00	---	---	---	---	---	---	---	---	---	---	---
	463 - 581	0.52	0.40	0.07	0.00	---	---	---	---	---	---	---	---	---	---	---
	582 - 720	0.53	0.40	0.07	0.00	---	---	---	---	---	---	---	---	---	---	---
	721 - 1006	0.55	0.39	0.06	0.00	---	---	---	---	---	---	---	---	---	---	---
	1008 - 8e+004	0.36	0.32	0.06	0.26	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 3	0.51	0.38	0.05	0.06	---	---	---	---	---	---	---	---	---	---	---
	4-7	0.47	0.41	0.07	0.05	---	---	---	---	---	---	---	---	---	---	---
	8-10	0.48	0.39	0.08	0.05	---	---	---	---	---	---	---	---	---	---	---
	11-14	0.50	0.40	0.07	0.04	---	---	---	---	---	---	---	---	---	---	---
	15 - 99	0.55	0.31	0.08	0.07	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 6	0.30	0.54	0.09	0.06	---	---	---	---	---	---	---	---	---	---	---
	7-10	0.27	0.55	0.11	0.07	---	---	---	---	---	---	---	---	---	---	---
	11-17	0.37	0.49	0.09	0.05	---	---	---	---	---	---	---	---	---	---	---
	18 - 25	0.64	0.27	0.04	0.05	---	---	---	---	---	---	---	---	---	---	---
	26 - 102	0.93	0.02	0.01	0.03	---	---	---	---	---	---	---	---	---	---	---
Wood or Timber - Stringer/Mulit-beam or girder																
AGE (years)	0 - 26	0.44	0.23	0.12	0.14	0.03	0.02	0.02	0.01	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	27 - 39	0.46	0.16	0.12	0.07	0.05	0.08	0.04	0.01	---	---	---	---	---	---	---
	40 - 49	0.38	0.16	0.16	0.06	0.06	0.11	0.06	0.02	---	---	---	---	---	---	---
	50 - 62	0.37	0.17	0.15	0.06	0.09	0.06	0.08	0.03	---	---	---	---	---	---	---
	63 - 172	0.36	0.14	0.12	0.03	0.12	0.04	0.11	0.06	---	---	---	---	---	---	---
SL (meters x 10)	34 - 84	0.43	0.23	0.10	0.07	0.07	0.02	0.07	0.01	---	---	---	---	---	---	---
	85 - 109	0.47	0.17	0.07	0.08	0.07	0.04	0.08	0.01	---	---	---	---	---	---	---
	110 - 143	0.43	0.18	0.12	0.08	0.07	0.05	0.06	0.02	---	---	---	---	---	---	---
	144 - 210	0.37	0.16	0.15	0.08	0.07	0.09	0.05	0.02	---	---	---	---	---	---	---
	211 - 8784	0.30	0.12	0.24	0.06	0.05	0.11	0.04	0.07	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.72	0.00	0.01	0.14	0.00	0.02	0.11	0.01	---	---	---	---	---	---	---
	1-1	0.00	0.42	0.18	0.00	0.17	0.17	0.00	0.06	---	---	---	---	---	---	---
	2-8	0.00	0.28	0.39	0.00	0.11	0.17	0.00	0.05	---	---	---	---	---	---	---
	9-90	0.00	0.48	0.24	0.00	0.19	0.05	0.00	0.05	---	---	---	---	---	---	---
NEWAGE (years)	0 - 19	0.28	0.14	0.08	0.11	0.18	0.01	0.17	0.03	---	---	---	---	---	---	---
	20 - 33	0.39	0.18	0.10	0.07	0.10	0.05	0.08	0.03	---	---	---	---	---	---	---
	34 - 44	0.47	0.15	0.13	0.07	0.03	0.09	0.04	0.02	---	---	---	---	---	---	---
	45 - 56	0.36	0.20	0.20	0.06	0.02	0.11	0.01	0.04	---	---	---	---	---	---	---
	57 - 152	0.50	0.19	0.17	0.06	0.00	0.06	0.00	0.01	---	---	---	---	---	---	---
							Steel - Girder or Floorbeam System									
AGE (years)	0 - 35	0.43	0.38	0.03	0.16	---	---	---	---	---	---	---	---	---	---	---
	36 - 50	0.41	0.31	0.07	0.21	---	---	---	---	---	---	---	---	---	---	---
	51 - 66	0.43	0.24	0.18	0.15	---	---	---	---	---	---	---	---	---	---	---
	67 - 74	0.28	0.44	0.17	0.11	---	---	---	---	---	---	---	---	---	---	---
	75 - 170	0.37	0.22	0.32	0.09	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	61 - 122	0.33	0.53	0.13	0.00	---	---	---	---	---	---	---	---	---	---	---
	123 - 177	0.35	0.47	0.17	0.01	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	179 - 256	0.40	0.35	0.19	0.06	---	---	---	---	---	---	---	---	---	---	---
	259 - 483	0.47	0.24	0.21	0.08	---	---	---	---	---	---	---	---	---	---	---
	485 - 3e+004	0.37	0.01	0.06	0.57	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.05	0.80	0.12	0.04	---	---	---	---	---	---	---	---	---	---	---
	1-5	0.59	0.00	0.24	0.17	---	---	---	---	---	---	---	---	---	---	---
	6-9	0.62	0.00	0.16	0.22	---	---	---	---	---	---	---	---	---	---	---
	10-90	0.62	0.00	0.12	0.26	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 20	0.17	0.17	0.37	0.29	---	---	---	---	---	---	---	---	---	---	---
	21 - 36	0.30	0.24	0.23	0.23	---	---	---	---	---	---	---	---	---	---	---
	37 - 51	0.43	0.31	0.11	0.15	---	---	---	---	---	---	---	---	---	---	---
	52 - 67	0.40	0.52	0.04	0.04	---	---	---	---	---	---	---	---	---	---	---
	68 - 131	0.62	0.34	0.02	0.02	---	---	---	---	---	---	---	---	---	---	---
							Steel Continuous - Girder or Floorbeam System									
AGE (years)	1-27	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
	28 - 35	0.81	0.19	---	---	---	---	---	---	---	---	---	---	---	---	---
	36 - 43	0.61	0.39	---	---	---	---	---	---	---	---	---	---	---	---	---
	44 - 51	0.71	0.29	---	---	---	---	---	---	---	---	---	---	---	---	---
	52 - 152	0.57	0.43	---	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	73 - 512	0.79	0.21	---	---	---	---	---	---	---	---	---	---	---	---	---
	515 - 1055	0.79	0.21	---	---	---	---	---	---	---	---	---	---	---	---	---
	1061 - 1783	0.73	0.27	---	---	---	---	---	---	---	---	---	---	---	---	---
	1786 - 3365	0.71	0.29	---	---	---	---	---	---	---	---	---	---	---	---	---
	3367 - 4e+005	0.63	0.37	---	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 1	0.80	0.20	---	---	---	---	---	---	---	---	---	---	---	---	---
	2-5	0.70	0.30	---	---	---	---	---	---	---	---	---	---	---	---	---
	6-9	0.74	0.26	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	10-14	0.71	0.29	---	---	---	---	---	---	---	---	---	---	---	---	---
	15 - 50	0.69	0.31	---	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	1-17	0.34	0.66	---	---	---	---	---	---	---	---	---	---	---	---	---
	18 - 27	0.56	0.44	---	---	---	---	---	---	---	---	---	---	---	---	---
	28 - 35	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	36 - 46	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
	47 - 102	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
							Concrete - Tee Beam									
AGE (years)	0 - 39	0.53	0.01	0.25	0.01	0.00	0.15	0.03	0.02	---	---	---	---	---	---	---
	40 - 50	0.60	0.08	0.18	0.03	0.00	0.04	0.04	0.02	---	---	---	---	---	---	---
	51 - 65	0.45	0.27	0.10	0.08	0.04	0.01	0.03	0.02	---	---	---	---	---	---	---
	66 - 72	0.30	0.31	0.06	0.14	0.14	0.01	0.02	0.01	---	---	---	---	---	---	---
	73 - 152	0.19	0.37	0.03	0.28	0.08	0.00	0.03	0.02	---	---	---	---	---	---	---
SL (meters x 10)	57 - 106	0.20	0.51	0.03	0.15	0.01	0.08	0.02	0.01	---	---	---	---	---	---	---
	107 - 192	0.25	0.47	0.03	0.16	0.02	0.06	0.01	0.01	---	---	---	---	---	---	---
	195 - 329	0.54	0.06	0.13	0.12	0.05	0.05	0.01	0.02	---	---	---	---	---	---	---
	332 - 506	0.58	0.00	0.19	0.10	0.07	0.02	0.02	0.02	---	---	---	---	---	---	---
	508 - 7e+004	0.49	0.00	0.24	0.04	0.10	0.01	0.09	0.03	---	---	---	---	---	---	---
ADTT (%)	0 - 2	0.40	0.27	0.08	0.11	0.01	0.10	0.01	0.01	---	---	---	---	---	---	---
	3-6	0.33	0.26	0.14	0.13	0.04	0.05	0.03	0.03	---	---	---	---	---	---	---
	7-8	0.44	0.23	0.13	0.11	0.03	0.02	0.02	0.02	---	---	---	---	---	---	---
	9-12	0.44	0.22	0.12	0.13	0.03	0.02	0.02	0.02	---	---	---	---	---	---	---
	13 - 95	0.47	0.05	0.15	0.08	0.14	0.03	0.06	0.02	---	---	---	---	---	---	---
NEWAGE (years)	0 - 33	0.29	0.00	0.15	0.23	0.06	0.12	0.10	0.06	---	---	---	---	---	---	---
	34 - 43	0.47	0.02	0.19	0.13	0.10	0.05	0.02	0.02	---	---	---	---	---	---	---
	44 - 53	0.54	0.10	0.12	0.12	0.06	0.03	0.02	0.01	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	54 - 69	0.42	0.36	0.11	0.07	0.02	0.02	0.01	0.00	---	---	---	---	---	---	---
	70 - 102	0.35	0.56	0.06	0.02	0.00	0.01	0.00	0.00	---	---	---	---	---	---	---
						Concrete Continuous - Tee Beam										
AGE (years)	1-34	0.52	0.27	0.01	0.15	0.03	0.01	---	---	---	---	---	---	---	---	---
	35 - 38	0.50	0.28	0.01	0.10	0.09	0.02	---	---	---	---	---	---	---	---	---
	39 - 42	0.42	0.30	0.02	0.13	0.11	0.02	---	---	---	---	---	---	---	---	---
	43 - 51	0.42	0.24	0.07	0.09	0.15	0.03	---	---	---	---	---	---	---	---	---
	52 - 152	0.07	0.04	0.53	0.05	0.01	0.29	---	---	---	---	---	---	---	---	---
SL (meters x 10)	67 - 323	0.32	0.13	0.34	0.04	0.04	0.13	---	---	---	---	---	---	---	---	---
	324 - 433	0.50	0.20	0.12	0.04	0.09	0.04	---	---	---	---	---	---	---	---	---
	434 - 569	0.49	0.23	0.09	0.05	0.11	0.04	---	---	---	---	---	---	---	---	---
	570 - 768	0.40	0.31	0.06	0.12	0.09	0.02	---	---	---	---	---	---	---	---	---
	769 - 1e+004	0.24	0.26	0.03	0.28	0.05	0.13	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 2	0.19	0.38	0.21	0.11	0.03	0.08	---	---	---	---	---	---	---	---	---
	3-5	0.27	0.29	0.18	0.08	0.08	0.10	---	---	---	---	---	---	---	---	---
	6-9	0.31	0.23	0.13	0.14	0.11	0.08	---	---	---	---	---	---	---	---	---
	10-18	0.41	0.21	0.10	0.11	0.09	0.07	---	---	---	---	---	---	---	---	---
	19 - 60	0.76	0.01	0.01	0.10	0.09	0.04	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 30	0.24	0.13	0.01	0.10	0.35	0.18	---	---	---	---	---	---	---	---	---
	31 - 36	0.56	0.27	0.01	0.10	0.02	0.05	---	---	---	---	---	---	---	---	---
	37 - 40	0.49	0.34	0.01	0.13	0.00	0.03	---	---	---	---	---	---	---	---	---
	41 - 47	0.47	0.30	0.06	0.13	0.00	0.04	---	---	---	---	---	---	---	---	---
	48 - 102	0.19	0.10	0.57	0.08	0.00	0.07	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							Prestressed Concrete - Tee Beam									
AGE (years)	0 - 11	0.97	0.03	---	---	---	---	---	---	---	---	---	---	---	---	---
	12-18	0.99	0.01	---	---	---	---	---	---	---	---	---	---	---	---	---
	19 - 25	0.98	0.02	---	---	---	---	---	---	---	---	---	---	---	---	---
	26 - 33	0.95	0.05	---	---	---	---	---	---	---	---	---	---	---	---	---
	34 - 102	0.69	0.31	---	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	61 - 106	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	107 - 151	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
	152 - 213	0.95	0.05	---	---	---	---	---	---	---	---	---	---	---	---	---
	216 - 342	0.95	0.05	---	---	---	---	---	---	---	---	---	---	---	---	---
	344 - 6e+004	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 10	0.89	0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
	11-17	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	18 - 23	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	24 - 30	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
	31 - 102	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
							Concrete Continuous - Box Beam or Girders - Multiple									
AGE (years)	1-28	0.29	0.68	0.04	---	---	---	---	---	---	---	---	---	---	---	---
	29 - 33	0.42	0.51	0.07	---	---	---	---	---	---	---	---	---	---	---	---
	34 - 36	0.48	0.38	0.14	---	---	---	---	---	---	---	---	---	---	---	---
	37 - 40	0.55	0.30	0.15	---	---	---	---	---	---	---	---	---	---	---	---
	41 - 102	0.46	0.35	0.19	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	79 - 509	0.51	0.36	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	512 - 650	0.55	0.35	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	652 - 792	0.51	0.41	0.08	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	794 - 1134	0.51	0.39	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	1136 - 7e+004	0.13	0.70	0.17	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 1	0.55	0.37	0.07	---	---	---	---	---	---	---	---	---	---	---	---
	2-3	0.58	0.33	0.09	---	---	---	---	---	---	---	---	---	---	---	---
	4-6	0.519	0.332	0.149	---	---	---	---	---	---	---	---	---	---	---	---
	7-11	0.47	0.39	0.15	---	---	---	---	---	---	---	---	---	---	---	---
	12-90	0.11	0.78	0.10	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	1-24	0.12	0.51	0.38	---	---	---	---	---	---	---	---	---	---	---	---
	25 - 32	0.42	0.48	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	33 - 35	0.51	0.45	0.04	---	---	---	---	---	---	---	---	---	---	---	---
	36 - 39	0.60	0.38	0.02	---	---	---	---	---	---	---	---	---	---	---	---
	40 - 76	0.58	0.39	0.03	---	---	---	---	---	---	---	---	---	---	---	---
							Prestressed Concrete - Box Beam or Girders - Multiple									
AGE (years)	0 - 9	0.37	0.12	0.07	0.13	0.08	0.00	0.14	0.02	0.04	0.00	0.00	0.03	0.00	---	---
	10-15	0.40	0.15	0.07	0.11	0.08	0.00	0.11	0.02	0.04	0.00	0.00	0.01	0.00	---	---
	16 - 23	0.39	0.25	0.08	0.08	0.09	0.00	0.01	0.04	0.02	0.00	0.01	0.01	0.00	---	---
	24 - 35	0.29	0.31	0.16	0.04	0.05	0.01	0.00	0.06	0.03	0.01	0.02	0.02	0.00	---	---
	36 - 170	0.13	0.25	0.04	0.01	0.02	0.25	0.00	0.04	0.03	0.11	0.09	0.02	0.02	---	---
SL (meters x 10)	40 - 121	0.32	0.27	0.05	0.06	0.05	0.11	0.05	0.01	0.02	0.04	0.01	0.00	0.01	---	---
	122 - 158	0.37	0.23	0.05	0.06	0.08	0.06	0.06	0.01	0.03	0.03	0.00	0.00	0.00	---	---
	159 - 212	0.37	0.23	0.06	0.08	0.07	0.05	0.06	0.01	0.04	0.02	0.00	0.00	0.01	---	---
	213 - 340	0.31	0.23	0.09	0.07	0.06	0.04	0.07	0.02	0.06	0.02	0.01	0.01	0.01	---	---
	341 - 2e+004	0.20	0.13	0.18	0.10	0.05	0.01	0.02	0.13	0.02	0.00	0.09	0.06	0.00	---	---
ADTT (%)	0 - 0	0.87	0.00	0.01	0.01	0.00	0.04	0.02	0.01	0.01	0.02	0.01	0.01	0.00	---	---
	1-1	0.00	0.34	0.19	0.10	0.19	0.05	0.03	0.03	0.01	0.02	0.01	0.02	0.00	---	---
	2-4	0.00	0.42	0.11	0.13	0.13	0.06	0.05	0.03	0.03	0.02	0.01	0.01	0.01	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	5-8	0.00	0.35	0.12	0.10	0.11	0.07	0.09	0.02	0.06	0.03	0.02	0.01	0.01	---	---
	9-99	0.00	0.25	0.16	0.12	0.04	0.05	0.07	0.11	0.05	0.04	0.07	0.04	0.01	---	---
NEWAGE (years)	0 - 8	0.33	0.10	0.06	0.11	0.07	0.05	0.13	0.02	0.04	0.03	0.03	0.02	0.01	---	---
	9-14	0.35	0.12	0.06	0.11	0.07	0.05	0.11	0.02	0.04	0.02	0.02	0.01	0.01	---	---
	15 - 20	0.35	0.20	0.08	0.09	0.08	0.06	0.02	0.03	0.02	0.03	0.03	0.01	0.00	---	---
	21 - 29	0.30	0.28	0.11	0.04	0.06	0.06	0.00	0.05	0.02	0.04	0.03	0.01	0.00	---	---
	30 - 115	0.24	0.39	0.12	0.02	0.03	0.04	0.00	0.06	0.05	0.01	0.01	0.03	0.00	---	---
Prestressed Concrete Continuous - Box Beam or Girders - Multiple																
AGE (years)	0 - 7	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
	8-12	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	13 - 21	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	22 - 29	0.89	0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
	30 - 102	0.67	0.33	---	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	98 - 475	0.83	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
	478 - 689	0.91	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---
	692 - 893	0.95	0.05	---	---	---	---	---	---	---	---	---	---	---	---	---
	894-1361	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
	1362 - 3e+004	0.71	0.29	---	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 1	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
	2-2	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
	3-5	0.88	0.12	---	---	---	---	---	---	---	---	---	---	---	---	---
	6-9	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	10-96	0.77	0.23	---	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 7	0.88	0.12	---	---	---	---	---	---	---	---	---	---	---	---	---
	8-11	0.85	0.15	---	---	---	---	---	---	---	---	---	---	---	---	---
	12-18	0.83	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	19 - 27	0.85	0.15	---	---	---	---	---	---	---	---	---	---	---	---	---
	28 - 102	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Box Beam or Girders - Single or Spread																
AGE (years)	0 - 7	0.13	0.85	0.01	---	---	---	---	---	---	---	---	---	---	---	---
	8-15	0.19	0.79	0.02	---	---	---	---	---	---	---	---	---	---	---	---
	16 - 28	0.70	0.26	0.04	---	---	---	---	---	---	---	---	---	---	---	---
	29 - 36	0.80	0.00	0.20	---	---	---	---	---	---	---	---	---	---	---	---
	37 - 155	0.46	0.00	0.54	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	67 - 145	0.39	0.42	0.19	---	---	---	---	---	---	---	---	---	---	---	---
	146 - 213	0.41	0.51	0.09	---	---	---	---	---	---	---	---	---	---	---	---
	214 - 320	0.40	0.52	0.08	---	---	---	---	---	---	---	---	---	---	---	---
	323 - 466	0.57	0.24	0.19	---	---	---	---	---	---	---	---	---	---	---	---
	469 - 1e+004	0.56	0.18	0.25	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 2	0.42	0.50	0.08	---	---	---	---	---	---	---	---	---	---	---	---
	3-5	0.38	0.47	0.15	---	---	---	---	---	---	---	---	---	---	---	---
	6-8	0.44	0.40	0.16	---	---	---	---	---	---	---	---	---	---	---	---
	9-14	0.51	0.38	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	15 - 80	0.58	0.10	0.32	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 6	0.11	0.68	0.21	---	---	---	---	---	---	---	---	---	---	---	---
	7-12	0.10	0.69	0.22	---	---	---	---	---	---	---	---	---	---	---	---
	13 - 19	0.31	0.46	0.23	---	---	---	---	---	---	---	---	---	---	---	---
	20 - 32	0.83	0.05	0.12	---	---	---	---	---	---	---	---	---	---	---	---
	33 - 71	0.98	0.00	0.02	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Prestressed Concrete Continuous - Box Beam or Girders - Single or Spread														
AGE (years)	0 - 7	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	8-12	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
	13 - 16	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	17 - 23	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
	24 - 99	0.55	0.45	---	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	64 - 360	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
	361 - 465	0.89	0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
	466 - 606	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
	607 - 914	0.91	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---
	917 - 2e+004	0.68	0.32	---	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 2	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
	3-4	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
	5-8	0.86	0.14	---	---	---	---	---	---	---	---	---	---	---	---	---
	9-12	0.83	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
	13 - 70	0.75	0.25	---	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 6	0.83	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
	7-11	0.79	0.21	---	---	---	---	---	---	---	---	---	---	---	---	---
	12-14	0.86	0.14	---	---	---	---	---	---	---	---	---	---	---	---	---
	15 - 19	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
	20 - 82	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
		Concrete - Frame (except for culverts)														
AGE (years)	0 - 9	0.74	0.25	0.01	---	---	---	---	---	---	---	---	---	---	---	---
	10-28	0.89	0.09	0.02	---	---	---	---	---	---	---	---	---	---	---	---
	29 - 44	0.72	0.10	0.18	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	45 - 55	0.57	0.22	0.21	---	---	---	---	---	---	---	---	---	---	---	---
	56 - 109	0.53	0.22	0.25	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	43 - 76	0.84	0.09	0.07	---	---	---	---	---	---	---	---	---	---	---	---
	77 - 91	0.79	0.14	0.06	---	---	---	---	---	---	---	---	---	---	---	---
	92 - 121	0.73	0.19	0.08	---	---	---	---	---	---	---	---	---	---	---	---
	122 - 189	0.62	0.21	0.17	---	---	---	---	---	---	---	---	---	---	---	---
	190 - 3e+004	0.49	0.24	0.26	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 8	0.66	0.23	0.11	---	---	---	---	---	---	---	---	---	---	---	---
	9-19	0.74	0.10	0.16	---	---	---	---	---	---	---	---	---	---	---	---
	20 - 40	0.68	0.08	0.24	---	---	---	---	---	---	---	---	---	---	---	---
	41 - 52	0.71	0.19	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	53 - 102	0.68	0.28	0.04	---	---	---	---	---	---	---	---	---	---	---	---
						Concrete Continuous - Frame (except for culverts)										
ADTT (%)	0 - 0	0.02	0.98	---	---	---	---	---	---	---	---	---	---	---	---	---
	1-4	1.00	0.00	---	---	---	---	---	---	---	---	---	---	---	---	---
	5-8	1.00	0.00	---	---	---	---	---	---	---	---	---	---	---	---	---
	9-40	1.00	0.00	---	---	---	---	---	---	---	---	---	---	---	---	---
						Steel - Truss-Thru										
AGE (years)	0 - 58	0.25	0.24	0.05	0.15	0.08	0.04	0.03	0.02	0.10	0.05	---	---	---	---	---
	59 - 71	0.21	0.25	0.14	0.09	0.05	0.06	0.03	0.12	0.01	0.04	---	---	---	---	---
	72 - 81	0.22	0.18	0.09	0.17	0.10	0.05	0.06	0.09	0.01	0.03	---	---	---	---	---
	82 - 92	0.21	0.04	0.22	0.14	0.19	0.06	0.08	0.04	0.01	0.01	---	---	---	---	---
	93 - 170	0.17	0.03	0.21	0.11	0.17	0.13	0.11	0.03	0.03	0.01	---	---	---	---	---
SL (meters x 10)	67 - 173	0.30	0.03	0.20	0.17	0.13	0.08	0.04	0.02	0.02	0.00	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	174 - 235	0.25	0.06	0.20	0.16	0.12	0.08	0.05	0.03	0.04	0.00	---	---	---	---	---
	237 - 319	0.24	0.07	0.17	0.16	0.12	0.09	0.06	0.04	0.04	0.00	---	---	---	---	---
	320 - 524	0.19	0.13	0.12	0.13	0.15	0.07	0.08	0.07	0.05	0.00	---	---	---	---	---
	527 - 7e+004	0.07	0.42	0.03	0.05	0.09	0.01	0.07	0.13	0.01	0.12	---	---	---	---	---
ADTT (%)	0 - 0	0.48	0.02	0.33	0.00	0.01	0.15	0.00	0.01	0.01	0.00	---	---	---	---	---
	1-5	0.00	0.23	0.00	0.24	0.18	0.00	0.13	0.09	0.10	0.03	---	---	---	---	---
	6-10	0.00	0.27	0.00	0.20	0.25	0.00	0.07	0.12	0.05	0.05	---	---	---	---	---
	11-9-	0.00	0.24	0.00	0.29	0.20	0.00	0.12	0.08	0.01	0.06	---	---	---	---	---
NEWAGE (years)	0 - 30	0.11	0.05	0.01	0.03	0.02	0.19	0.18	0.19	0.16	0.07	---	---	---	---	---
	31 - 61	0.15	0.21	0.05	0.14	0.07	0.13	0.10	0.10	0.01	0.05	---	---	---	---	---
	62 - 73	0.27	0.27	0.17	0.15	0.09	0.02	0.01	0.01	0.00	0.01	---	---	---	---	---
	74 - 90	0.29	0.14	0.18	0.21	0.16	0.01	0.00	0.00	0.00	0.00	---	---	---	---	---
	91 - 131	0.23	0.04	0.31	0.15	0.26	0.00	0.00	0.00	0.00	0.00	---	---	---	---	---
								Concrete - Arch- Deck								
AGE (years)	0 - 65	0.49	0.15	0.14	0.22	---	---	---	---	---	---	---	---	---	---	---
	66 - 72	0.50	0.21	0.20	0.09	---	---	---	---	---	---	---	---	---	---	---
	73 - 80	0.41	0.30	0.22	0.07	---	---	---	---	---	---	---	---	---	---	---
	81 - 87	0.39	0.40	0.14	0.07	---	---	---	---	---	---	---	---	---	---	---
	88 - 175	0.40	0.34	0.14	0.12	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	61 - 97	0.42	0.38	0.06	0.14	---	---	---	---	---	---	---	---	---	---	---
	98 - 137	0.44	0.34	0.07	0.15	---	---	---	---	---	---	---	---	---	---	---
	140 - 201	0.48	0.33	0.09	0.10	---	---	---	---	---	---	---	---	---	---	---
	204 - 378	0.49	0.26	0.12	0.13	---	---	---	---	---	---	---	---	---	---	---
	381 - 9e+004	0.36	0.11	0.49	0.04	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.57	0.31	0.07	0.06	---	---	---	---	---	---	---	---	---	---	---
	1-3	0.47	0.24	0.17	0.11	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	4-5	0.40	0.26	0.20	0.14	---	---	---	---	---	---	---	---	---	---	---
	6-9	0.34	0.39	0.16	0.11	---	---	---	---	---	---	---	---	---	---	---
	10-98	0.37	0.22	0.25	0.16	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 37	0.13	0.01	0.52	0.35	---	---	---	---	---	---	---	---	---	---	---
	38 - 66	0.44	0.18	0.20	0.18	---	---	---	---	---	---	---	---	---	---	---
	67 - 76	0.60	0.29	0.07	0.03	---	---	---	---	---	---	---	---	---	---	---
	77 - 85	0.50	0.47	0.02	0.01	---	---	---	---	---	---	---	---	---	---	---
	86 - 161	0.52	0.46	0.02	0.00	---	---	---	---	---	---	---	---	---	---	---
Masonry - Arch-Deck																
AGE (years)	33 - 75	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
	76 - 92	0.78	0.22	---	---	---	---	---	---	---	---	---	---	---	---	---
	93 - 102	0.65	0.35	---	---	---	---	---	---	---	---	---	---	---	---	---
	103 - 121	0.64	0.36	---	---	---	---	---	---	---	---	---	---	---	---	---
	122 - 201	0.54	0.46	---	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	56 - 79	0.79	0.21	---	---	---	---	---	---	---	---	---	---	---	---	---
	81 - 106	0.78	0.22	---	---	---	---	---	---	---	---	---	---	---	---	---
	107 - 139	0.77	0.23	---	---	---	---	---	---	---	---	---	---	---	---	---
	140 - 235	0.65	0.35	---	---	---	---	---	---	---	---	---	---	---	---	---
	238 - 3277	0.47	0.53	---	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.82	0.18	---	---	---	---	---	---	---	---	---	---	---	---	---
	1-1	0.84	0.16	---	---	---	---	---	---	---	---	---	---	---	---	---
	2-4	0.60	0.40	---	---	---	---	---	---	---	---	---	---	---	---	---
	5-7	0.58	0.42	---	---	---	---	---	---	---	---	---	---	---	---	---
	8-60	0.63	0.37	---	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	1-55	0.10	0.90	---	---	---	---	---	---	---	---	---	---	---	---	---
	56 - 72	0.70	0.30	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	73 - 92	0.81	0.19	---	---	---	---	---	---	---	---	---	---	---	---	---
	93 - 104	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	105 - 201	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
						Concrete - Culvert (includes frame culverts)										
AGE (years)	0 - 15	0.44	0.13	0.08	0.06	0.14	0.02	0.00	0.02	0.04	0.00	0.00	0.05	0.01	0.00	0.00
	16 - 31	0.46	0.12	0.06	0.07	0.08	0.04	0.01	0.03	0.06	0.00	0.01	0.03	0.02	0.00	0.01
	32 - 42	0.44	0.07	0.07	0.07	0.04	0.07	0.02	0.05	0.06	0.01	0.03	0.02	0.03	0.01	0.01
	43 - 57	0.36	0.06	0.11	0.08	0.02	0.10	0.06	0.05	0.02	0.04	0.05	0.02	0.04	0.01	0.01
	58 - 160	0.22	0.10	0.08	0.06	0.01	0.04	0.14	0.05	0.01	0.13	0.07	0.01	0.02	0.03	0.02
SL (meters x 10)	30 - 69	0.42	0.11	0.07	0.06	0.07	0.05	0.08	0.03	0.02	0.03	0.02	0.01	0.01	0.01	0.01
	70 - 81	0.41	0.10	0.09	0.07	0.06	0.05	0.06	0.05	0.02	0.03	0.02	0.01	0.03	0.01	0.01
	82 - 98	0.44	0.09	0.08	0.07	0.06	0.05	0.05	0.02	0.02	0.03	0.02	0.01	0.03	0.01	0.01
	99 - 127	0.38	0.09	0.08	0.07	0.06	0.05	0.04	0.05	0.02	0.04	0.04	0.01	0.03	0.01	0.01
	128 - 3188	0.27	0.08	0.06	0.06	0.04	0.07	0.00	0.05	0.10	0.05	0.06	0.08	0.02	0.01	0.03
ADTT (%)	0 - 0	0.03	0.56	0.00	0.00	0.33	0.00	0.02	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01
	1-5	0.58	0.00	0.10	0.12	0.00	0.03	0.04	0.02	0.02	0.01	0.02	0.04	0.01	0.01	0.01
	6-9	0.56	0.00	0.16	0.05	0.00	0.05	0.06	0.00	0.02	0.02	0.03	0.02	0.03	0.00	0.01
	10-15	0.41	0.00	0.09	0.07	0.00	0.06	0.07	0.14	0.01	0.03	0.03	0.02	0.03	0.03	0.01
	16 - 99	0.28	0.00	0.03	0.07	0.00	0.12	0.05	0.01	0.13	0.11	0.09	0.04	0.06	0.00	0.01
NEWAGE (years)	0 - 13	0.37	0.11	0.07	0.05	0.12	0.02	0.06	0.02	0.03	0.04	0.04	0.05	0.01	0.02	0.02
	14 - 26	0.38	0.12	0.05	0.06	0.08	0.03	0.07	0.02	0.04	0.03	0.05	0.03	0.01	0.02	0.01
	27 - 38	0.41	0.07	0.06	0.06	0.04	0.05	0.05	0.04	0.07	0.05	0.04	0.02	0.03	0.01	0.01
	39 - 49	0.38	0.05	0.09	0.07	0.03	0.10	0.04	0.05	0.03	0.06	0.03	0.02	0.04	0.01	0.01
	50 - 160	0.38	0.13	0.13	0.10	0.02	0.07	0.02	0.08	0.01	0.01	0.00	0.01	0.03	0.00	0.00

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Concrete Continuous - Culvert (includes frame culverts)														
AGE (years)	0 - 16	0.17	0.32	0.07	0.11	0.31	0.00	0.01	0.01	---	---	---	---	---	---	---
	17 - 29	0.18	0.27	0.13	0.14	0.23	0.01	0.01	0.03	---	---	---	---	---	---	---
	30 - 41	0.26	0.32	0.15	0.13	0.01	0.08	0.03	0.01	---	---	---	---	---	---	---
	42 - 53	0.40	0.18	0.17	0.12	0.00	0.09	0.03	0.01	---	---	---	---	---	---	---
	54 - 102	0.32	0.09	0.18	0.18	0.00	0.16	0.08	0.00	---	---	---	---	---	---	---
SL (meters x 10)	34 - 70	0.33	0.23	0.13	0.16	0.04	0.08	0.02	0.01	---	---	---	---	---	---	---
	71 - 82	0.31	0.23	0.14	0.16	0.08	0.05	0.02	0.01	---	---	---	---	---	---	---
	83 - 101	0.25	0.23	0.15	0.15	0.11	0.08	0.02	0.01	---	---	---	---	---	---	---
	102 - 131	0.26	0.23	0.15	0.12	0.14	0.07	0.02	0.01	---	---	---	---	---	---	---
	132 - 5593	0.17	0.27	0.13	0.09	0.18	0.06	0.06	0.03	---	---	---	---	---	---	---
ADTT (%)	0 - 1	0.07	0.09	0.04	0.70	0.07	0.00	0.02	0.01	---	---	---	---	---	---	---
	2-5	0.15	0.22	0.22	0.00	0.32	0.02	0.03	0.05	---	---	---	---	---	---	---
	6-9	0.39	0.28	0.17	0.00	0.08	0.06	0.02	0.00	---	---	---	---	---	---	---
	10-13	0.47	0.22	0.17	0.00	0.05	0.07	0.03	0.00	---	---	---	---	---	---	---
	14 - 99	0.26	0.38	0.10	0.00	0.02	0.19	0.06	0.00	---	---	---	---	---	---	---
NEWAGE (years)	0 - 14	0.16	0.30	0.06	0.10	0.24	0.09	0.04	0.01	---	---	---	---	---	---	---
	15 - 26	0.13	0.23	0.11	0.12	0.27	0.08	0.03	0.03	---	---	---	---	---	---	---
	27 - 38	0.24	0.31	0.15	0.13	0.02	0.09	0.04	0.02	---	---	---	---	---	---	---
	39 - 49	0.41	0.20	0.16	0.12	0.00	0.05	0.04	0.01	---	---	---	---	---	---	---
	50 - 102	0.38	0.15	0.22	0.22	0.00	0.02	0.02	0.00	---	---	---	---	---	---	---
		Steel - Culvert (includes frame culverts)														
AGE (years)	0 - 11	0.52	0.34	0.10	0.04	0.00	---	---	---	---	---	---	---	---	---	---
	12-19	0.58	0.27	0.11	0.03	0.01	---	---	---	---	---	---	---	---	---	---
	20 - 26	0.55	0.28	0.12	0.04	0.01	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	27 - 38	0.50	0.27	0.16	0.05	0.03	---	---	---	---	---	---	---	---	---	---
	39 - 102	0.44	0.28	0.13	0.05	0.11	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	24 - 69	0.52	0.32	0.12	0.02	0.03	---	---	---	---	---	---	---	---	---	---
	70 - 78	0.54	0.30	0.11	0.02	0.03	---	---	---	---	---	---	---	---	---	---
	79 - 90	0.53	0.30	0.12	0.02	0.03	---	---	---	---	---	---	---	---	---	---
	91 - 112	0.55	0.27	0.14	0.02	0.03	---	---	---	---	---	---	---	---	---	---
	113 - 1658	0.46	0.25	0.13	0.13	0.04	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.01	0.95	0.00	0.01	0.03	---	---	---	---	---	---	---	---	---	---
	1-1	0.86	0.00	0.10	0.03	0.02	---	---	---	---	---	---	---	---	---	---
	2-5	0.71	0.00	0.22	0.03	0.04	---	---	---	---	---	---	---	---	---	---
	6-8	0.86	0.00	0.11	0.02	0.02	---	---	---	---	---	---	---	---	---	---
	9-90	0.58	0.00	0.24	0.13	0.05	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 11	0.49	0.32	0.10	0.04	0.05	---	---	---	---	---	---	---	---	---	---
	12-18	0.56	0.26	0.10	0.03	0.04	---	---	---	---	---	---	---	---	---	---
	19 - 26	0.54	0.27	0.12	0.04	0.03	---	---	---	---	---	---	---	---	---	---
	27 - 36	0.50	0.27	0.15	0.05	0.03	---	---	---	---	---	---	---	---	---	---
	37 - 102	0.49	0.30	0.14	0.05	0.01	---	---	---	---	---	---	---	---	---	---
Prestressed Concrete - Culvert (includes frame culverts)																
AGE (years)	0 - 5	0.05	0.81	0.13	---	---	---	---	---	---	---	---	---	---	---	---
	6-11	0.32	0.54	0.14	---	---	---	---	---	---	---	---	---	---	---	---
	12-18	0.89	0.01	0.10	---	---	---	---	---	---	---	---	---	---	---	---
	19 - 23	0.92	0.00	0.08	---	---	---	---	---	---	---	---	---	---	---	---
	24 - 152	0.81	0.00	0.19	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.69	0.31	0.00	---	---	---	---	---	---	---	---	---	---	---	---
	1-56	0.00	0.00	1.00	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							Concrete - Channel Beam									
AGE (years)	0 - 11	0.56	0.21	0.16	0.05	0.01	0.00	0.00	---	---	---	---	---	---	---	---
	12-23	0.50	0.22	0.14	0.10	0.04	0.01	0.01	---	---	---	---	---	---	---	---
	24 - 32	0.32	0.20	0.15	0.17	0.12	0.02	0.03	---	---	---	---	---	---	---	---
	33 - 40	0.16	0.19	0.17	0.23	0.16	0.03	0.05	---	---	---	---	---	---	---	---
	41 - 122	0.09	0.11	0.23	0.18	0.18	0.19	0.03	---	---	---	---	---	---	---	---
SL (meters x 10)	61 - 98	0.23	0.08	0.16	0.20	0.17	0.08	0.09	---	---	---	---	---	---	---	---
	99 - 171	0.30	0.12	0.14	0.21	0.13	0.08	0.02	---	---	---	---	---	---	---	---
	173 - 209	0.39	0.24	0.11	0.13	0.10	0.03	0.00	---	---	---	---	---	---	---	---
	210 - 290	0.37	0.26	0.14	0.13	0.07	0.02	0.00	---	---	---	---	---	---	---	---
	291 - 5154	0.33	0.23	0.28	0.06	0.06	0.05	0.00	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.71	0.00	0.04	0.15	0.02	0.03	0.06	---	---	---	---	---	---	---	---
	1-1	0.58	0.00	0.07	0.22	0.06	0.07	0.00	---	---	---	---	---	---	---	---
	2-4	0.03	0.00	0.25	0.38	0.26	0.08	0.00	---	---	---	---	---	---	---	---
	5-8	0.00	0.66	0.13	0.07	0.10	0.05	0.00	---	---	---	---	---	---	---	---
	9-70	0.00	0.00	0.64	0.00	0.26	0.06	0.04	---	---	---	---	---	---	---	---
NEWAGE (years)	0 - 11	0.52	0.20	0.15	0.05	0.01	0.07	0.00	---	---	---	---	---	---	---	---
	12-22	0.48	0.21	0.13	0.09	0.03	0.06	0.01	---	---	---	---	---	---	---	---
	23 - 31	0.32	0.21	0.14	0.16	0.09	0.06	0.02	---	---	---	---	---	---	---	---
	32 - 38	0.19	0.17	0.15	0.21	0.18	0.04	0.06	---	---	---	---	---	---	---	---
	39 - 102	0.11	0.15	0.26	0.22	0.20	0.02	0.04	---	---	---	---	---	---	---	---
							Prestressed Concrete - Channel Beam									
AGE (years)	1-25	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	26 - 31	0.94	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---
	32 - 35	0.97	0.03	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A9 - Continued: *Continuous Parameter Distribution Across Clusters*

Parameter	Range	Cluster														
---	---	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	36 - 40	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
	41 - 146	0.80	0.20	---	---	---	---	---	---	---	---	---	---	---	---	---
SL (meters x 10)	61 - 93	0.91	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---
	94 - 131	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	132 - 186	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	187 - 276	0.93	0.07	---	---	---	---	---	---	---	---	---	---	---	---	---
	277 - 1463	0.89	0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
ADTT (%)	0 - 0	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	1-1	0.87	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---
	2-5	0.92	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---
	6-6	1.00	0.00	---	---	---	---	---	---	---	---	---	---	---	---	---
	7-90	0.83	0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
NEWAGE (years)	1-24	0.77	0.23	---	---	---	---	---	---	---	---	---	---	---	---	---
	25 - 30	0.90	0.10	---	---	---	---	---	---	---	---	---	---	---	---	---
	31 - 35	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---
	36 - 38	0.99	0.01	---	---	---	---	---	---	---	---	---	---	---	---	---
	39 - 102	0.96	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---

Table A10: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
1	31.07	-87.05	85	0.12027	26.348	0.00022
2	30.55	-87.89	23	0.04854	20.366	0.00000
3	32.71	-87.59	220	0.09672	22.929	0.00110
4	31.95	-86.32	594	0.09258	22.777	0.00052
5	34.76	-87.62	536	0.13840	21.403	0.00512
6	34.17	-86.82	800	0.19362	25.152	0.00371
7	34.69	-86.05	615	0.18545	24.790	0.00216
8	32.42	-87.00	147	0.07213	22.401	0.00034
9	33.44	-86.10	555	0.14243	24.632	0.00105
10	31.92	-87.74	405	0.10307	23.473	0.00065
11	31.79	-85.95	498	0.07643	22.292	0.00054
12	32.02	-85.75	440	0.11295	23.796	0.00068
13	34.57	-85.62	1,062	0.23836	25.240	0.00920
14	32.37	-112.87	1,800	0.01073	24.872	0.00025
15	33.39	-112.59	890	0.08344	35.608	0.00000
16	34.36	-111.70	2,650	0.12442	33.396	0.00119
17	35.27	-111.74	7,347	0.61702	34.373	0.06297
18	34.91	-110.17	5,070	0.36806	34.200	0.01083
19	36.87	-111.60	3,210	0.19025	28.053	0.00344
20	33.42	-111.80	1,235	0.05767	31.786	0.00003
21	33.41	-110.89	3,560	0.08595	25.798	0.00346
22	34.22	-114.22	410	0.06841	33.283	0.00003
23	34.57	-112.44	5,205	0.39081	32.337	0.02435
24	33.67	-111.16	2,205	0.02737	26.119	0.00020
25	33.07	-111.75	1,285	0.09617	33.867	0.00009
26	34.52	-109.39	5,790	0.40390	34.530	0.02086
27	35.32	-112.89	5,250	0.41009	35.189	0.01242
28	31.70	-110.05	4,610	0.08231	27.987	0.00311
29	33.84	-109.97	5,120	0.34860	33.562	0.02002
30	33.99	-112.74	2,095	0.14664	36.022	0.00037
31	35.26	-112.19	6,750	0.41248	29.223	0.05156
32	32.62	-114.66	191	0.01842	31.796	0.00003
33	34.89	-91.19	200	0.14120	21.999	0.00453
34	35.09	-92.47	310	0.15155	23.728	0.00717
35	36.41	-90.59	300	0.17089	22.574	0.00990
36	36.42	-93.79	1,420	0.17093	21.962	0.01635
37	36.44	-94.45	1,260	0.20651	23.905	0.01343
38	36.49	-91.54	650	0.24947	26.096	0.00505
39	34.57	-94.27	1,130	0.16247	22.465	0.00396
40	35.61	-91.29	228	0.14063	21.590	0.00632
41	35.49	-93.82	390	0.17574	23.771	0.00667
42	34.22	-92.02	215	0.11002	22.247	0.00375
43	36.27	-90.97	315	0.18139	23.317	0.01013
44	33.80	-93.39	308	0.12284	23.437	0.00534
45	35.30	-93.66	500	0.14886	22.933	0.00554
46	37.87	-122.27	299	0.00185	15.133	0.00017

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
47	33.62	-114.60	268	0.03025	32.543	0.00000
48	32.96	-115.55	-100	0.02054	32.356	0.00004
49	41.54	-120.17	4,670	0.35047	26.184	0.04486
50	39.71	-121.82	185	0.08579	28.415	0.00037
51	32.61	-117.10	56	0.00188	14.988	0.00010
52	39.11	-120.95	2,410	0.08907	24.663	0.01010
53	32.99	-116.59	4,640	0.25192	26.627	0.02743
54	38.54	-121.77	60	0.05916	28.541	0.00021
55	38.34	-120.67	715	0.10016	31.671	0.00063
56	40.80	-124.17	43	0.00871	11.597	0.00103
57	34.71	-118.44	3,060	0.06027	21.059	0.00436
58	39.51	-123.79	120	0.02014	15.889	0.00000
59	36.79	-119.72	336	0.04667	26.366	0.00029
60	36.30	-119.66	245	0.07937	28.828	0.00008
61	41.80	-123.37	1,120	0.15896	30.999	0.01485
62	38.62	-122.87	108	0.04240	28.005	0.00026
63	36.80	-118.20	3,950	0.21694	30.824	0.00384
64	33.74	-116.27	-21	0.02866	30.919	0.00000
65	39.32	-120.64	5,156	0.41520	27.522	0.12455
66	36.39	-119.04	513	0.04295	27.914	0.00005
67	37.67	-121.77	480	0.06869	27.967	0.00005
68	38.12	-121.29	40	0.06451	27.795	0.00005
69	39.16	-121.60	57	0.02848	25.941	0.00005
70	37.29	-120.52	153	0.06872	29.567	0.00000
71	41.32	-122.32	3,590	0.31108	25.796	0.09152
72	38.29	-122.27	35	0.04253	25.291	0.00005
73	34.46	-119.24	750	0.06334	33.125	0.00010
74	39.76	-122.20	254	0.05967	26.615	0.00031
75	41.30	-123.54	410	0.07806	27.672	0.00532
76	34.16	-118.16	864	0.00399	25.856	0.00008
77	35.64	-120.69	700	0.15571	35.392	0.00005
78	38.27	-122.66	31	0.04966	25.494	0.00005
79	39.97	-120.95	3,408	0.40478	36.351	0.02619
80	34.05	-117.19	1,318	0.01912	28.742	0.00004
81	35.30	-120.67	315	0.00739	23.856	0.00000
82	34.42	-119.69	5	0.00504	20.889	0.00000
83	36.99	-122.02	130	0.02515	23.120	0.00000
84	38.46	-122.70	167	0.06820	27.332	0.00005
85	40.39	-120.57	4,146	0.36527	29.788	0.02638
86	39.17	-120.14	6,230	0.48079	25.545	0.10884
87	35.04	-118.75	1,425	0.05543	26.122	0.00026
88	33.74	-117.79	118	0.01681	26.091	0.00004
89	39.16	-123.20	633	0.10726	30.219	0.00031
90	38.41	-121.95	110	0.05795	28.711	0.00026
91	35.61	-119.34	345	0.06558	28.708	0.00010
92	40.74	-122.94	2,050	0.30420	33.616	0.01388

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
93	39.52	-122.30	233	0.06658	27.479	0.00083
94	37.76	-119.59	3,966	0.30114	29.070	0.03516
95	41.72	-122.64	2,625	0.33914	29.476	0.02359
96	40.01	-105.27	5,484	0.29899	26.815	0.08393
97	38.42	-105.24	5,330	0.29151	28.223	0.03648
98	39.22	-105.29	6,880	0.54042	36.185	0.05914
99	38.82	-102.35	4,250	0.35995	30.354	0.02685
100	39.26	-107.97	5,980	0.43459	31.080	0.06465
101	37.67	-106.35	7,880	0.45537	30.253	0.04706
102	39.64	-106.04	9,065	0.61261	33.989	0.14739
103	37.29	-107.89	6,600	0.48463	32.732	0.07066
104	38.49	-102.79	4,211	0.37311	31.565	0.01841
105	40.59	-105.09	5,004	0.37691	28.203	0.06575
106	40.22	-103.80	4,331	0.37457	29.399	0.02624
107	39.17	-108.75	4,480	0.41026	32.571	0.02249
108	38.54	-106.97	7,640	0.50414	36.041	0.07472
109	37.77	-107.14	9,000	0.59959	36.335	0.04891
110	38.05	-102.12	3,390	0.37187	32.286	0.02158
111	38.09	-102.62	3,627	0.36576	32.003	0.03297
112	38.07	-103.22	3,890	0.37515	34.642	0.02480
113	37.17	-105.95	7,690	0.51236	34.807	0.02637
114	38.49	-107.89	5,785	0.38075	28.825	0.03209
115	38.04	-103.70	4,170	0.38621	33.623	0.03242
116	38.09	-106.14	7,692	0.50234	33.000	0.03514
117	40.51	-106.84	6,840	0.49521	33.557	0.17129
118	37.96	-107.87	8,672	0.57211	32.478	0.14051
119	37.17	-104.49	6,030	0.34899	29.635	0.03459
120	40.07	-102.24	3,535	0.38962	32.087	0.03121
121	41.96	-73.37	550	0.33244	24.396	0.03455
122	41.80	-72.25	650	0.25056	18.971	0.04410
123	39.16	-75.52	30	0.18774	20.114	0.01533
124	38.91	-75.47	30	0.21206	21.260	0.01290
125	39.67	-75.74	90	0.23411	21.612	0.01246
126	29.74	-85.04	19	0.01593	15.411	0.00008
127	27.24	-81.85	63	0.01133	23.573	0.00000
128	27.90	-81.85	125	0.00774	21.983	0.00000
129	26.65	-80.64	15	0.00388	21.824	0.00000
130	30.74	-86.07	230	0.06672	23.743	0.00011
131	25.86	-81.39	5	0.00143	19.762	0.00000
132	29.75	-81.54	5	0.01167	20.867	0.00000
133	30.65	-81.47	13	0.02148	17.532	0.00011
134	26.11	-80.20	16	0.00053	16.145	0.00000
135	26.61	-81.87	15	0.00102	19.459	0.00000
136	27.47	-80.35	25	0.00324	17.856	0.00000
137	28.74	-82.32	40	0.02411	23.103	0.00000
138	30.19	-82.60	195	0.04143	22.854	0.00000

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
139	30.54	-83.44	180	0.04137	22.524	0.00005
140	29.20	-82.09	75	0.02500	23.355	0.00000
141	28.34	-82.27	190	0.00775	21.359	0.00005
142	30.39	-84.37	55	0.07162	23.314	0.00040
143	28.15	-82.75	8	0.00645	19.507	0.00000
144	28.62	-80.82	5	0.00877	20.941	0.00000
145	31.54	-84.14	180	0.07478	23.427	0.00015
146	31.17	-81.50	13	0.02643	19.546	0.00000
147	33.61	-83.87	770	0.13342	22.805	0.00155
148	34.55	-84.02	1,360	0.18373	22.799	0.00229
149	32.21	-83.20	400	0.08445	23.513	0.00031
150	34.30	-83.85	1,170	0.14466	21.802	0.00391
151	31.94	-81.92	170	0.06001	22.284	0.00038
152	32.27	-83.47	272	0.10859	25.167	0.00038
153	33.09	-83.25	400	0.16570	25.959	0.00113
154	32.87	-81.97	195	0.10744	25.310	0.00037
155	33.44	-84.79	920	0.13648	23.411	0.00170
156	30.80	-83.59	185	0.06466	24.203	0.00014
157	34.26	-85.16	620	0.16650	23.869	0.00275
158	32.14	-81.20	46	0.03943	18.808	0.00072
159	32.69	-84.55	730	0.12335	24.627	0.00067
160	31.50	-83.54	380	0.06472	22.294	0.00007
161	34.59	-83.32	1,019	0.12881	22.465	0.00317
162	33.42	-82.66	510	0.12420	23.244	0.00077
163	33.72	-82.72	620	0.15392	24.233	0.00032
164	31.25	-82.32	145	0.09052	26.052	0.00004
165	32.87	-85.19	575	0.14056	24.631	0.00046
166	42.96	-112.84	4,405	0.39684	29.200	0.03117
167	43.61	-115.92	3,275	0.22648	25.716	0.03669
168	44.07	-111.45	5,260	0.36676	26.488	0.13025
169	43.67	-116.69	2,370	0.31057	27.779	0.02602
170	44.57	-116.69	2,650	0.33524	28.951	0.03988
171	44.51	-114.24	5,175	0.36541	27.475	0.03109
172	42.94	-115.32	2,510	0.33813	31.238	0.01351
173	42.59	-111.74	5,550	0.36949	27.360	0.06676
174	42.61	-114.14	4,060	0.34793	26.985	0.03515
175	42.36	-114.57	4,525	0.34738	26.289	0.01876
176	42.74	-114.52	3,740	0.32922	27.743	0.02622
177	47.54	-116.12	2,320	0.30372	24.406	0.07842
178	42.12	-111.30	5,926	0.35138	26.156	0.05936
179	43.92	-113.62	5,897	0.40089	28.695	0.03298
180	46.74	-116.97	2,660	0.24800	21.424	0.06890
181	44.97	-116.29	3,870	0.49926	31.432	0.10033
182	42.24	-113.89	4,560	0.33770	25.685	0.03783
183	44.09	-116.94	2,150	0.30512	28.044	0.02421
184	49.01	-116.50	1,775	0.32859	23.551	0.04884

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
185	48.36	-116.84	2,380	0.35209	24.036	0.10701
186	48.29	-116.57	2,100	0.29337	22.199	0.08110
187	41.24	-90.74	720	0.23254	21.015	0.04035
188	37.47	-89.24	640	0.18541	21.115	0.01935
189	41.76	-88.35	640	0.24822	21.126	0.05300
190	39.29	-89.87	630	0.22142	22.081	0.02938
191	39.49	-88.17	680	0.21194	20.446	0.03323
192	40.14	-87.66	558	0.23378	21.922	0.03072
193	39.84	-89.02	620	0.22301	21.533	0.03298
194	41.84	-89.52	700	0.24229	21.260	0.04089
195	37.99	-89.20	420	0.20491	22.263	0.01618
196	41.17	-90.05	860	0.23346	21.100	0.04420
197	39.72	-90.74	700	0.21332	20.904	0.02836
198	37.74	-88.52	365	0.19256	22.656	0.01888
199	39.16	-89.49	630	0.21799	21.905	0.02311
200	40.47	-87.67	710	0.21755	20.418	0.04435
201	39.74	-90.20	610	0.23635	22.244	0.03200
202	40.59	-90.97	700	0.24197	22.027	0.03394
203	40.16	-89.41	590	0.22955	21.478	0.03500
204	42.26	-88.60	820	0.24022	21.042	0.04640
205	38.11	-88.50	480	0.20656	22.275	0.02087
206	40.91	-89.05	750	0.23733	22.081	0.03902
207	40.92	-90.64	770	0.22712	21.256	0.04341
208	41.82	-89.97	603	0.25169	21.986	0.04819
209	42.11	-89.99	640	0.26698	22.504	0.05328
210	38.36	-88.87	490	0.21624	22.120	0.02020
211	38.71	-88.07	480	0.20881	21.709	0.02520
212	41.34	-88.92	525	0.23158	21.080	0.03944
213	39.01	-87.62	520	0.21180	21.745	0.02716
214	39.39	-89.09	700	0.21271	20.749	0.03379
215	39.62	-87.70	720	0.21488	20.873	0.02982
216	40.89	-88.64	650	0.21297	20.219	0.03985
217	40.12	-90.55	660	0.22341	20.871	0.02777
218	38.17	-89.70	520	0.19427	21.769	0.02545
219	40.11	-88.24	743	0.20310	19.387	0.04800
220	41.55	-89.60	690	0.22788	20.489	0.04021
221	39.44	-90.39	580	0.23101	22.144	0.02091
222	39.44	-88.60	685	0.22003	21.352	0.03207
223	40.11	-85.72	845	0.20471	19.103	0.03346
224	41.64	-84.99	1,010	0.22719	19.252	0.06904
225	40.67	-84.95	860	0.21971	19.978	0.05417
226	39.17	-86.52	825	0.21624	21.181	0.02158
227	39.42	-85.02	760	0.27842	24.090	0.02915
228	39.87	-85.19	999	0.26349	22.484	0.04323
229	39.21	-85.92	621	0.24233	22.781	0.01993
230	40.62	-86.67	560	0.22309	21.349	0.03967

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
231	41.57	-85.84	805	0.21525	19.315	0.08348
232	39.64	-86.85	860	0.21370	20.648	0.05266
233	39.79	-85.75	865	0.22293	20.598	0.02966
234	41.55	-87.29	640	0.22905	20.529	0.04045
235	41.61	-86.72	810	0.20892	18.787	0.08997
236	38.74	-85.41	455	0.19776	21.339	0.01779
237	40.57	-85.67	790	0.23765	21.135	0.04232
238	37.96	-87.89	415	0.19142	20.612	0.01568
239	38.89	-86.55	650	0.23926	22.705	0.03294
240	38.55	-86.49	560	0.24892	23.616	0.02244
241	38.36	-87.59	480	0.19100	21.087	0.01582
242	41.07	-86.22	770	0.23993	20.734	0.03206
243	39.77	-87.24	690	0.21273	20.680	0.03145
244	38.62	-86.09	800	0.22328	22.489	0.02591
245	38.71	-85.77	550	0.23782	23.111	0.02224
246	38.99	-85.91	573	0.26083	23.228	0.01603
247	38.67	-86.80	550	0.25390	23.452	0.02729
248	38.67	-87.19	485	0.18888	20.394	0.02030
249	41.26	-87.09	655	0.25645	22.367	0.03460
250	40.01	-86.35	935	0.23880	21.508	0.04176
251	41.02	-86.59	690	0.24236	20.918	0.04588
252	41.07	-92.79	880	0.21093	20.725	0.04101
253	43.07	-94.30	1,230	0.22326	20.576	0.04730
254	41.91	-92.27	840	0.23593	21.156	0.06300
255	43.05	-92.67	1,013	0.22368	20.894	0.07389
256	40.74	-95.04	1,050	0.26161	23.042	0.03571
257	41.80	-90.27	585	0.22224	20.048	0.05051
258	43.42	-94.84	1,302	0.22334	21.320	0.04262
259	41.04	-91.95	740	0.23160	21.161	0.04298
260	42.86	-91.80	1,050	0.25362	21.735	0.05775
261	43.29	-93.64	1,300	0.21673	20.677	0.04573
262	42.51	-94.20	1,115	0.23487	21.425	0.05255
263	41.37	-93.55	940	0.23922	21.691	0.04285
264	42.52	-93.25	1,130	0.23874	21.626	0.04671
265	42.79	-96.17	1,195	0.25977	22.848	0.04218
266	41.64	-95.79	990	0.25892	23.039	0.03836
267	40.69	-94.30	1,240	0.24829	21.708	0.02896
268	40.96	-91.55	730	0.22209	20.818	0.03417
269	43.07	-92.32	1,160	0.22744	20.702	0.04811
270	43.44	-96.17	1,350	0.26230	23.074	0.04271
271	42.41	-94.62	1,210	0.24863	22.027	0.05120
272	42.64	-95.19	1,425	0.23883	21.000	0.05112
273	41.99	-92.59	890	0.24420	21.540	0.03674
274	41.29	-91.69	756	0.23031	21.226	0.03494
275	37.16	-98.09	1,340	0.22035	24.552	0.01413
276	37.21	-99.77	1,970	0.30496	29.304	0.01345

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
277	39.57	-95.12	945	0.21081	21.161	0.03272
278	37.27	-99.34	2,083	0.24261	26.068	0.02194
279	37.17	-94.85	900	0.20219	22.419	0.02460
280	37.82	-96.84	1,340	0.24064	23.871	0.01877
281	38.72	-98.24	1,530	0.28273	26.429	0.02442
282	38.86	-96.10	1,420	0.23471	22.916	0.02472
283	37.86	-94.70	845	0.19994	22.473	0.02129
284	38.87	-99.34	2,010	0.30611	27.156	0.02904
285	39.67	-95.52	1,030	0.25119	23.248	0.02202
286	37.26	-95.70	780	0.20934	23.263	0.01934
287	37.94	-101.25	2,998	0.32049	29.100	0.01955
288	38.19	-99.10	1,995	0.26407	25.748	0.02520
289	38.97	-95.27	980	0.19676	20.951	0.02744
290	39.32	-94.94	910	0.22893	22.269	0.01741
291	37.05	-100.92	2,834	0.27271	28.470	0.02321
292	39.21	-96.59	1,065	0.24982	23.976	0.02984
293	38.39	-97.67	1,495	0.23441	23.867	0.02712
294	37.29	-98.59	1,500	0.26062	27.142	0.01533
295	39.14	-97.70	1,310	0.25248	24.801	0.02548
296	39.71	-99.84	2,360	0.29918	26.811	0.03569
297	39.84	-100.52	2,540	0.35029	29.587	0.03578
298	38.89	-94.77	1,055	0.20418	20.566	0.02746
299	38.62	-95.29	900	0.22821	22.817	0.02662
300	39.74	-99.32	1,907	0.30098	27.203	0.02970
301	39.77	-101.80	3,362	0.35628	29.928	0.04543
302	38.49	-100.91	2,970	0.33092	29.306	0.03332
303	37.14	-96.19	880	0.25077	25.649	0.01659
304	39.02	-99.89	2,450	0.28553	25.667	0.02974
305	37.57	-84.30	1,070	0.18870	21.442	0.01814
306	36.97	-86.44	528	0.19113	21.981	0.01588
307	38.12	-83.55	680	0.24901	24.909	0.02097
308	38.24	-84.87	500	0.25075	23.795	0.01306
309	37.26	-85.50	590	0.24337	24.584	0.01266
310	36.84	-87.50	590	0.20907	23.147	0.01354
311	37.52	-86.30	620	0.20792	22.062	0.02339
312	36.61	-83.74	1,175	0.24135	24.801	0.01026
313	37.77	-87.16	405	0.18906	22.104	0.01382
314	38.21	-85.20	730	0.24960	23.680	0.02589
315	38.66	-84.62	940	0.21088	20.761	0.03483
316	31.32	-92.47	87	0.06048	21.596	0.00054
317	30.70	-90.54	170	0.08061	23.534	0.00046
318	32.79	-91.91	150	0.09118	22.486	0.00118
319	30.54	-91.14	64	0.04484	20.698	0.00049
320	32.52	-92.34	180	0.11628	23.820	0.00153
321	30.54	-90.12	40	0.06194	22.452	0.00038
322	30.07	-91.04	30	0.03499	21.609	0.00015

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
323	29.82	-91.55	12	0.03130	19.640	0.00010
324	29.59	-90.74	15	0.02796	19.824	0.00011
325	30.20	-92.67	25	0.03926	20.173	0.00061
326	30.20	-91.99	38	0.03329	19.870	0.00043
327	32.91	-93.69	290	0.12954	24.677	0.00259
328	31.95	-91.24	78	0.08084	22.180	0.00130
329	32.11	-91.72	80	0.08713	22.873	0.00066
330	44.92	-67.00	85	0.20280	15.199	0.09161
331	44.69	-70.16	420	0.30757	23.561	0.10851
332	44.22	-69.79	140	0.30657	22.219	0.06628
333	44.11	-70.22	180	0.22683	18.227	0.08714
334	45.66	-68.70	360	0.25658	20.608	0.08590
335	44.91	-68.67	115	0.26540	20.568	0.06682
336	43.66	-70.30	45	0.23736	17.363	0.09373
337	46.66	-68.00	599	0.24447	20.594	0.12784
338	45.89	-69.19	965	0.26230	21.432	0.11251
339	45.16	-67.41	140	0.30541	22.971	0.04370
340	39.29	-76.62	14	0.12708	16.152	0.05823
341	38.57	-76.07	5	0.18435	19.843	0.01428
342	39.22	-76.07	40	0.19603	19.791	0.02133
343	38.99	-76.95	90	0.21264	21.377	0.01872
344	38.97	-76.80	150	0.26905	24.846	0.01866
345	39.11	-76.91	400	0.18951	19.814	0.00718
346	39.27	-75.87	30	0.24098	22.122	0.01590
347	39.41	-79.41	2,420	0.29880	22.784	0.11763
348	38.69	-76.67	160	0.20727	20.767	0.01568
349	38.22	-75.69	20	0.23182	23.428	0.00608
350	38.37	-75.59	10	0.18109	20.539	0.00732
351	39.34	-76.87	460	0.25293	22.329	0.02842
352	42.39	-72.54	150	0.29016	22.159	0.05238
353	42.22	-71.12	630	0.21592	17.144	0.09900
354	42.34	-71.16	120	0.23043	19.251	0.04775
355	42.41	-71.69	398	0.27414	19.915	0.05892
356	42.29	-71.42	170	0.25247	21.143	0.04974
357	42.71	-71.17	60	0.24550	19.632	0.04377
358	41.64	-70.94	70	0.16910	15.112	0.03903
359	41.99	-70.70	45	0.26805	20.029	0.03372
360	41.91	-71.07	20	0.29649	21.578	0.03349
361	41.92	-84.02	760	0.25948	21.352	0.04865
362	42.59	-85.79	750	0.25576	20.497	0.10374
363	43.39	-84.67	760	0.25172	20.688	0.06306
364	42.30	-83.72	900	0.21643	18.637	0.10973
365	43.71	-85.49	930	0.26603	21.143	0.11135
366	45.66	-84.47	590	0.23533	18.806	0.12283
367	41.96	-85.00	984	0.24040	20.133	0.07284
368	44.29	-83.50	586	0.26955	20.230	0.06407

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
369	45.67	-86.72	745	0.19791	15.705	0.07060
370	43.69	-86.35	700	0.24412	18.823	0.11366
371	41.94	-84.64	1,080	0.25405	20.722	0.08976
372	45.79	-88.09	1,060	0.25864	22.720	0.08916
373	46.47	-90.19	1,430	0.22741	20.347	0.16890
374	42.29	-85.60	950	0.22594	20.025	0.09065
375	42.62	-82.84	580	0.20009	17.227	0.08772
376	43.59	-84.77	796	0.24827	20.439	0.03793
377	46.42	-86.67	680	0.24301	18.728	0.17811
378	46.34	-85.50	875	0.22791	18.667	0.24222
379	43.04	-84.19	740	0.24309	20.067	0.05827
380	42.41	-86.29	620	0.20847	16.398	0.07219
381	46.05	-88.62	1,560	0.28023	23.756	0.13589
382	47.30	-96.52	910	0.21782	22.541	0.04473
383	43.62	-93.42	1,230	0.20713	19.661	0.05768
384	48.72	-94.62	1,075	0.21843	23.294	0.06007
385	46.71	-92.52	1,265	0.25828	23.101	0.13537
386	46.84	-95.85	1,375	0.22661	22.659	0.06970
387	43.64	-94.47	1,187	0.19956	19.390	0.06616
388	44.67	-93.19	980	0.20810	20.163	0.05768
389	47.57	-95.74	1,310	0.22580	22.368	0.06329
390	43.71	-92.57	1,350	0.21881	20.318	0.04888
391	48.77	-96.95	810	0.20316	22.296	0.03947
392	47.22	-95.20	1,490	0.26505	24.458	0.07557
393	47.26	-94.22	1,302	0.22672	22.150	0.07981
394	45.14	-95.94	1,020	0.24337	22.671	0.06172
395	44.89	-93.22	834	0.18707	18.313	0.10946
396	44.94	-95.75	985	0.22581	21.662	0.05642
397	45.89	-93.30	1,005	0.24634	23.366	0.07581
398	45.59	-95.89	1,140	0.21656	21.364	0.09846
399	44.30	-94.45	860	0.22040	21.405	0.07650
400	46.91	-95.07	1,443	0.23332	23.094	0.07846
401	46.67	-94.12	1,250	0.24825	23.289	0.06488
402	44.02	-96.32	1,705	0.25577	23.554	0.05549
403	47.26	-93.59	1,280	0.22365	22.753	0.09264
404	48.86	-95.74	1,047	0.21979	22.698	0.05633
405	44.30	-93.97	850	0.22655	21.727	0.04440
406	46.80	-93.32	1,234	0.22812	22.546	0.09160
407	47.02	-91.67	625	0.21111	18.272	0.05454
408	47.07	-94.59	1,410	0.20585	20.398	0.07496
409	43.77	-94.17	1,110	0.22011	20.601	0.06928
410	47.44	-94.05	1,315	0.21097	22.153	0.06653
411	44.30	-92.67	985	0.24798	22.650	0.05630
412	33.84	-88.52	198	0.12672	23.056	0.00282
413	34.30	-89.99	220	0.17144	23.959	0.00155
414	30.40	-88.95	15	0.02764	16.779	0.00000

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
415	34.67	-88.57	490	0.15249	21.835	0.00472
416	31.55	-90.45	435	0.09058	23.298	0.00080
417	32.61	-90.04	228	0.12826	24.559	0.00084
418	34.21	-90.57	173	0.09844	20.917	0.00312
419	31.25	-89.84	155	0.08608	23.839	0.00042
420	34.92	-88.52	385	0.15196	23.312	0.00528
421	33.39	-91.02	132	0.09757	21.930	0.00163
422	31.32	-89.30	161	0.09112	23.458	0.00041
423	34.84	-90.00	363	0.12226	20.612	0.00486
424	33.05	-89.60	410	0.14849	24.288	0.00156
425	31.69	-89.12	225	0.09971	23.273	0.00041
426	33.14	-89.07	581	0.11834	22.211	0.00161
427	31.55	-90.10	220	0.12754	25.325	0.00061
428	33.46	-90.52	117	0.09961	21.604	0.00163
429	31.55	-91.39	195	0.07345	21.977	0.00074
430	31.97	-91.00	120	0.12836	24.601	0.00134
431	33.47	-88.79	185	0.11037	22.135	0.00189
432	34.39	-89.54	380	0.15253	22.510	0.00419
433	34.17	-89.64	376	0.16723	23.614	0.00359
434	31.11	-91.24	400	0.06877	22.666	0.00047
435	38.21	-94.04	800	0.23035	23.419	0.02257
436	39.42	-93.12	645	0.22874	21.899	0.02196
437	36.21	-89.67	280	0.14776	20.844	0.00785
438	38.41	-93.77	770	0.23364	23.334	0.01842
439	40.26	-94.69	1,108	0.23261	21.920	0.02808
440	36.59	-90.82	330	0.26431	26.551	0.01311
441	38.59	-92.19	670	0.24170	23.556	0.02263
442	37.51	-94.27	980	0.22200	22.160	0.01324
443	37.67	-92.66	1,279	0.22205	22.942	0.01896
444	39.21	-93.87	825	0.21281	21.288	0.03009
445	37.39	-93.95	1,080	0.19554	21.964	0.01895
446	37.30	-89.97	390	0.24703	24.687	0.01156
447	39.17	-91.91	770	0.24221	22.618	0.02611
448	37.16	-92.27	1,450	0.21509	22.219	0.02402
449	36.87	-94.37	1,011	0.22941	24.873	0.01399
450	37.96	-91.77	1,180	0.19560	20.836	0.02757
451	39.97	-91.89	690	0.23104	21.895	0.03561
452	40.08	-93.63	837	0.22404	21.217	0.02603
453	40.49	-93.00	1,062	0.24952	22.729	0.03128
454	38.82	-91.14	845	0.21354	21.967	0.02048
455	47.49	-112.39	4,070	0.37565	28.195	0.04835
456	45.84	-109.95	4,100	0.31866	26.929	0.04578
457	45.67	-111.05	4,856	0.33251	23.860	0.17985
458	47.22	-111.72	3,360	0.28363	26.127	0.08538
459	48.59	-109.24	2,340	0.33073	28.512	0.03991
460	47.82	-112.17	3,945	0.35190	26.857	0.05520

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
461	45.61	-107.45	3,030	0.38924	31.504	0.04861
462	48.61	-112.37	3,838	0.33318	24.370	0.13601
463	45.21	-112.64	5,228	0.41993	28.262	0.05205
464	45.89	-104.54	3,425	0.33155	25.686	0.08549
465	45.36	-111.72	4,953	0.36241	26.474	0.02992
466	46.86	-108.32	3,138	0.35331	28.372	0.06226
467	48.79	-107.47	2,600	0.29549	25.135	0.05845
468	48.51	-109.80	2,613	0.30326	26.193	0.04691
469	48.79	-114.91	3,000	0.38920	26.657	0.08241
470	47.11	-104.72	2,076	0.29596	26.445	0.05012
471	46.26	-114.16	3,529	0.33949	25.706	0.06611
472	47.39	-115.35	3,100	0.47048	29.526	0.12019
473	44.87	-111.34	6,489	0.34373	25.624	0.18342
474	46.61	-112.00	3,828	0.30309	23.169	0.11264
475	45.92	-108.25	2,990	0.36401	28.808	0.05748
476	47.32	-106.91	2,590	0.36270	30.041	0.04455
477	48.30	-114.27	2,965	0.30343	22.030	0.17906
478	48.41	-115.54	2,096	0.38054	28.442	0.12828
479	48.49	-104.45	1,952	0.29711	26.207	0.04336
480	47.05	-109.95	4,300	0.34639	24.974	0.08719
481	45.49	-111.64	4,745	0.28230	22.700	0.06405
482	46.42	-104.50	2,765	0.34682	27.732	0.04907
483	48.14	-105.16	2,000	0.29611	27.111	0.04470
484	45.19	-109.25	5,850	0.37218	24.432	0.10800
485	47.32	-114.10	2,900	0.31335	24.593	0.07145
486	47.46	-104.35	1,985	0.30009	26.339	0.08328
487	48.32	-112.25	3,805	0.34257	25.298	0.05245
488	45.30	-111.95	5,773	0.41236	26.020	0.06741
489	44.66	-111.10	6,659	0.47293	30.782	0.19094
490	41.67	-97.99	1,745	0.30852	25.763	0.03420
491	42.11	-102.91	3,994	0.36226	27.554	0.04783
492	41.05	-96.35	1,070	0.26434	23.659	0.03195
493	42.54	-98.99	2,110	0.28067	24.658	0.04161
494	40.37	-95.75	930	0.24558	23.123	0.03875
495	40.14	-99.84	2,160	0.34700	30.251	0.03220
496	41.67	-103.10	3,666	0.39733	30.991	0.04029
497	41.42	-99.69	2,500	0.33508	26.651	0.03491
498	40.62	-96.95	1,435	0.25132	22.933	0.03973
499	40.67	-100.50	2,721	0.37764	30.558	0.02905
500	41.27	-97.12	1,610	0.25603	22.338	0.04065
501	40.16	-97.17	1,430	0.26684	24.175	0.03908
502	40.64	-97.59	1,640	0.27237	24.405	0.03487
503	40.11	-98.97	1,855	0.32805	27.309	0.02420
504	40.54	-97.60	1,630	0.25496	22.811	0.03033
505	41.46	-97.77	1,590	0.29427	24.929	0.05146
506	40.94	-100.17	2,585	0.34005	27.600	0.03191

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
507	41.91	-100.32	2,705	0.34442	27.985	0.04044
508	42.69	-103.89	4,850	0.36395	26.802	0.05983
509	42.61	-97.27	1,370	0.26342	23.690	0.04800
510	40.66	-98.39	1,940	0.26935	24.085	0.03409
511	40.17	-97.59	1,480	0.27141	23.847	0.04513
512	40.44	-99.37	2,320	0.28193	24.471	0.04318
513	40.52	-101.64	3,278	0.34196	27.656	0.04483
514	41.26	-103.67	4,760	0.38583	29.012	0.05786
515	41.16	-102.64	3,832	0.37995	30.658	0.03155
516	41.29	-98.97	2,065	0.31771	26.182	0.04117
517	41.84	-97.45	1,580	0.29252	24.837	0.03527
518	40.21	-100.60	2,530	0.31993	27.546	0.03032
519	42.92	-101.69	3,250	0.33542	27.311	0.04893
520	40.52	-98.95	2,160	0.29239	25.250	0.02966
521	41.51	-98.77	1,960	0.30350	25.127	0.03089
522	42.07	-97.97	1,710	0.29599	24.546	0.05265
523	40.11	-96.16	1,185	0.25130	23.642	0.02892
524	42.07	-100.25	2,690	0.34130	27.930	0.03675
525	40.11	-98.52	1,720	0.32776	27.348	0.02639
526	41.27	-98.47	1,775	0.28547	23.820	0.01635
527	40.91	-97.10	1,480	0.24460	22.357	0.04325
528	40.67	-96.19	1,100	0.26894	24.228	0.03229
529	40.37	-96.22	1,150	0.27624	24.224	0.03825
530	41.77	-96.22	1,040	0.25296	23.088	0.03538
531	42.27	-96.87	1,390	0.27716	24.344	0.05636
532	40.87	-96.16	1,100	0.26646	23.311	0.03101
533	40.87	-97.60	1,610	0.26130	23.142	0.03905
534	39.51	-117.09	6,605	0.39370	27.139	0.09446
535	35.99	-114.85	2,525	0.02367	21.148	0.00068
536	40.84	-115.79	5,050	0.45636	32.650	0.08646
537	39.46	-118.79	3,965	0.39357	32.777	0.01231
538	40.96	-117.49	4,392	0.40073	31.606	0.01068
539	40.19	-118.47	3,975	0.38096	32.264	0.01105
540	39.41	-114.77	6,300	0.39690	27.393	0.02923
541	38.39	-118.10	4,550	0.33617	30.895	0.01497
542	39.51	-119.79	4,404	0.42580	33.577	0.04490
543	35.47	-114.92	3,540	0.06761	23.440	0.00161
544	41.12	-114.97	5,650	0.47257	31.844	0.08268
545	40.91	-117.80	4,298	0.41486	31.339	0.06211
546	44.29	-71.69	1,380	0.27422	21.401	0.10201
547	43.16	-70.95	80	0.32724	23.731	0.07345
548	45.09	-71.29	1,660	0.27665	22.058	0.21397
549	43.71	-72.29	603	0.27943	21.967	0.13109
550	42.96	-72.32	510	0.32391	24.043	0.10525
551	39.39	-74.44	10	0.15095	12.829	0.01547
552	40.91	-74.41	280	0.26913	21.152	0.01909

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
553	41.04	-74.44	760	0.30281	23.043	0.04256
554	40.57	-74.89	260	0.28381	23.144	0.03539
555	40.27	-74.57	100	0.23765	20.553	0.03427
556	39.80	-74.79	100	0.26846	23.098	0.02341
557	40.27	-74.00	30	0.19961	17.138	0.02731
558	39.97	-74.97	45	0.22567	20.871	0.01664
559	40.47	-74.44	86	0.23337	20.219	0.03691
560	40.61	-74.41	90	0.23342	20.541	0.03703
561	39.61	-74.35	20	0.24228	20.207	0.02590
562	36.84	-108.00	5,644	0.41445	33.050	0.02350
563	35.54	-104.10	4,500	0.34298	33.136	0.00968
564	32.42	-104.24	3,120	0.18902	30.296	0.00418
565	33.64	-105.89	5,405	0.32418	31.720	0.01357
566	36.92	-106.59	7,850	0.53624	32.662	0.08627
567	36.47	-104.95	6,540	0.40037	30.860	0.03258
568	36.46	-103.16	4,970	0.32304	28.621	0.03821
569	33.16	-107.19	4,576	0.18551	27.402	0.00288
570	32.80	-108.16	6,142	0.29596	29.144	0.01325
571	34.47	-104.25	4,025	0.28039	31.338	0.01143
572	32.22	-108.02	4,410	0.27089	33.536	0.00274
573	35.77	-106.69	6,262	0.37613	29.232	0.03548
574	32.62	-106.74	4,266	0.34766	37.050	0.00274
575	33.84	-108.94	7,050	0.62035	39.657	0.02001
576	32.96	-105.85	6,780	0.29564	25.913	0.01890
577	34.52	-106.25	6,520	0.39959	31.784	0.02538
578	32.39	-106.10	4,182	0.22010	32.003	0.00412
579	36.71	-105.41	8,676	0.57896	32.681	0.11975
580	35.12	-103.34	4,230	0.27010	29.956	0.01967
581	34.96	-104.69	4,620	0.27230	31.794	0.01500
582	34.09	-106.89	4,585	0.31537	33.155	0.00749
583	36.37	-104.59	5,922	0.44355	35.886	0.03134
584	35.21	-103.69	4,086	0.25841	29.660	0.01831
585	33.09	-106.05	4,430	0.19866	30.108	0.00252
586	42.76	-73.80	275	0.22217	18.916	0.09804
587	42.26	-77.79	1,770	0.28797	21.848	0.14141
588	42.11	-78.75	1,500	0.29814	22.354	0.06135
589	42.30	-78.02	1,425	0.31830	23.662	0.07548
590	42.92	-76.54	770	0.22237	17.540	0.13949
591	42.29	-75.45	994	0.29298	23.046	0.09373
592	42.99	-78.19	890	0.22348	18.754	0.11060
593	40.96	-72.30	60	0.21142	15.962	0.03538
594	43.21	-77.94	535	0.21762	18.339	0.10425
595	42.94	-78.74	705	0.18799	15.795	0.16678
596	44.57	-75.12	440	0.23734	20.172	0.13788
597	44.76	-74.22	1,060	0.25859	21.754	0.14280
598	44.89	-73.44	170	0.23842	20.657	0.06020

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
599	42.71	-74.92	1,200	0.28449	22.136	0.12416
600	42.61	-76.19	1,129	0.22384	19.636	0.11092
601	44.72	-73.72	1,340	0.22393	19.017	0.08508
602	42.57	-77.72	660	0.26097	21.690	0.09561
603	42.11	-76.80	844	0.27170	21.779	0.05640
604	42.46	-79.30	760	0.19863	17.213	0.09558
605	41.52	-73.94	275	0.25080	21.236	0.04661
606	43.05	-74.35	812	0.25015	20.219	0.09947
607	42.79	-77.62	902	0.23967	19.071	0.05864
608	43.76	-74.29	1,660	0.31290	22.864	0.05749
609	44.26	-73.99	1,940	0.29658	22.669	0.14216
610	44.76	-74.66	500	0.23581	20.301	0.12798
611	43.07	-74.87	900	0.25732	20.407	0.10770
612	43.04	-74.87	360	0.23679	20.765	0.08266
613	43.19	-78.66	520	0.22781	18.701	0.09442
614	43.80	-75.49	860	0.25638	21.198	0.14463
615	41.77	-74.16	1,245	0.21026	16.279	0.08026
616	42.86	-75.66	1,340	0.27610	21.067	0.13982
617	40.79	-73.97	130	0.14438	14.842	0.04904
618	42.54	-75.54	1,020	0.29304	22.473	0.12073
619	44.74	-75.44	280	0.23412	19.791	0.06163
620	43.47	-76.50	350	0.17522	15.133	0.16337
621	44.66	-73.47	165	0.23194	19.430	0.09240
622	41.39	-74.69	470	0.28254	22.380	0.05426
623	43.14	-77.67	600	0.20316	17.869	0.17247
624	40.99	-73.80	199	0.25526	21.513	0.03270
625	40.97	-73.10	40	0.18618	16.641	0.02557
626	43.89	-75.04	1,690	0.26227	21.100	0.18376
627	43.12	-76.12	420	0.20716	18.312	0.17101
628	44.24	-74.44	1,680	0.27747	21.975	0.14271
629	44.16	-74.91	1,510	0.28813	22.777	0.18769
630	43.97	-75.87	497	0.22078	18.416	0.12992
631	41.39	-73.97	320	0.21977	19.581	0.04325
632	35.37	-80.19	610	0.18955	24.710	0.00357
633	36.17	-81.87	3,750	0.27914	21.884	0.05104
634	35.92	-79.10	500	0.21100	24.006	0.00656
635	36.05	-76.62	20	0.12764	20.371	0.00408
636	36.32	-76.20	8	0.14303	20.912	0.00301
637	35.07	-78.87	96	0.17330	24.090	0.00257
638	35.34	-77.97	109	0.14550	23.068	0.00424
639	36.37	-78.42	480	0.23182	24.826	0.00467
640	35.34	-82.45	2,160	0.23431	23.619	0.00811
641	35.05	-83.19	3,840	0.23634	19.285	0.02231
642	35.22	-77.54	55	0.16089	23.502	0.00213
643	35.92	-81.54	1,200	0.21760	24.919	0.00579
644	36.11	-78.32	260	0.26634	27.223	0.00447

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
645	34.62	-78.99	112	0.15496	23.978	0.00312
646	35.69	-82.00	1,425	0.20519	23.966	0.00752
647	35.80	-82.67	2,000	0.25689	24.634	0.01938
648	34.97	-80.50	580	0.17722	24.249	0.00489
649	35.76	-81.69	1,160	0.22014	25.604	0.00734
650	36.52	-80.62	1,030	0.24563	25.143	0.01047
651	35.69	-80.49	700	0.17812	23.202	0.00575
652	35.52	-78.35	150	0.17794	24.557	0.00203
653	34.01	-78.02	20	0.11176	19.770	0.00054
654	35.82	-80.89	950	0.20864	24.526	0.00760
655	35.89	-77.54	35	0.17614	23.679	0.00605
656	35.49	-82.97	2,658	0.25741	25.447	0.01782
657	48.84	-100.45	1,640	0.23757	23.515	0.07493
658	48.91	-103.30	1,952	0.25874	23.935	0.05911
659	46.89	-102.80	2,460	0.32138	26.136	0.06780
660	47.36	-102.66	2,232	0.28780	24.753	0.06496
661	46.05	-100.67	1,675	0.26437	23.997	0.03724
662	46.16	-98.41	1,435	0.25727	24.160	0.05287
663	48.42	-97.42	827	0.20157	22.224	0.03428
664	47.94	-97.09	830	0.19567	21.113	0.08880
665	45.99	-102.66	2,680	0.31917	25.575	0.04164
666	47.46	-97.07	910	0.20801	22.072	0.03313
667	46.89	-98.69	1,467	0.24406	23.297	0.04902
668	48.76	-98.34	1,615	0.22931	23.397	0.08276
669	46.44	-97.69	1,110	0.25397	24.111	0.05026
670	46.80	-100.91	1,750	0.25979	23.370	0.06428
671	47.51	-97.32	935	0.22482	22.987	0.07135
672	46.39	-102.34	2,515	0.33208	26.435	0.04887
673	46.51	-99.77	1,980	0.26879	24.587	0.06195
674	46.55	-102.87	2,639	0.31478	25.490	0.05289
675	48.97	-97.24	790	0.21938	23.171	0.04336
676	46.89	-102.32	2,470	0.26518	22.607	0.10086
677	48.36	-100.41	1,480	0.26845	25.124	0.04665
678	46.32	-96.60	956	0.22712	23.014	0.05512
679	48.62	-100.30	1,460	0.26267	24.898	0.06159
680	40.82	-82.97	955	0.24565	20.716	0.05236
681	40.27	-81.00	1,260	0.22821	20.528	0.05755
682	41.05	-81.94	1,180	0.24704	21.416	0.06095
683	39.62	-82.95	673	0.22402	21.703	0.02435
684	40.26	-81.87	760	0.25994	22.564	0.04327
685	40.29	-83.07	868	0.25265	21.824	0.04104
686	41.05	-83.67	768	0.22193	19.523	0.05241
687	40.11	-84.66	1,024	0.24111	20.601	0.03540
688	39.21	-83.62	1,100	0.22227	20.491	0.03428
689	41.30	-81.16	1,230	0.22693	19.125	0.08422
690	40.66	-83.60	995	0.24248	20.878	0.03740

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
691	39.66	-81.85	660	0.27444	23.691	0.04140
692	40.55	-81.92	819	0.26027	21.930	0.03864
693	40.72	-80.91	1,145	0.28328	23.324	0.05594
694	41.27	-82.62	670	0.23929	20.603	0.04727
695	41.27	-82.22	816	0.25395	21.620	0.05861
696	39.84	-81.92	1,020	0.21834	20.261	0.04257
697	38.76	-82.89	540	0.20999	21.818	0.02688
698	41.12	-83.17	740	0.22617	19.877	0.07240
699	40.84	-83.29	854	0.22823	20.471	0.04811
700	40.11	-83.79	1,000	0.24070	21.086	0.01777
701	41.21	-80.82	900	0.26524	22.288	0.07239
702	41.52	-84.16	750	0.24319	20.785	0.06707
703	39.12	-82.99	560	0.27263	24.273	0.02632
704	40.79	-81.92	1,020	0.24160	20.709	0.08332
705	34.79	-96.69	1,015	0.14390	22.948	0.00644
706	34.59	-99.34	1,380	0.18216	27.189	0.00610
707	34.26	-95.64	520	0.16024	24.584	0.00268
708	34.21	-97.16	840	0.12008	23.171	0.00456
709	36.76	-96.00	715	0.21254	24.940	0.01380
710	36.82	-100.54	2,465	0.30071	29.606	0.01297
711	36.74	-102.49	4,145	0.32526	31.336	0.02983
712	36.84	-99.62	1,795	0.25459	29.064	0.00778
713	35.12	-98.57	1,290	0.20038	25.823	0.00941
714	36.77	-98.35	1,180	0.23567	26.163	0.01205
715	36.32	-95.59	588	0.21159	23.696	0.01215
716	34.02	-96.39	660	0.13800	23.750	0.00350
717	36.42	-97.87	1,245	0.17776	23.559	0.01270
718	35.21	-99.80	1,985	0.23299	27.974	0.01643
719	35.64	-98.32	1,595	0.17918	23.534	0.00848
720	36.61	-101.62	3,310	0.30145	30.026	0.01591
721	35.89	-97.45	1,030	0.19608	24.539	0.00893
722	35.61	-99.41	1,820	0.25990	27.845	0.00923
723	36.11	-97.84	1,150	0.19192	24.128	0.01054
724	35.01	-99.05	1,552	0.18965	24.251	0.01011
725	35.09	-96.41	860	0.15134	22.981	0.00717
726	36.87	-101.22	2,995	0.29750	29.611	0.02154
727	34.01	-95.52	570	0.12535	23.404	0.00424
728	36.72	-97.80	1,045	0.22385	25.684	0.01019
729	36.91	-102.97	4,350	0.33118	31.376	0.03402
730	35.86	-97.91	1,100	0.20050	25.029	0.01088
731	34.62	-98.45	1,150	0.16794	24.811	0.00460
732	34.84	-99.44	1,520	0.20312	28.406	0.00584
733	35.51	-96.99	925	0.19189	23.882	0.00688
734	36.89	-94.89	805	0.20779	23.752	0.00801
735	35.77	-95.34	583	0.15862	22.232	0.00851
736	36.24	-99.17	1,865	0.24688	26.344	0.01654

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
737	36.89	-97.05	1,140	0.19482	23.189	0.01012
738	36.12	-98.32	1,210	0.21010	26.286	0.00699
739	35.44	-96.30	935	0.14077	22.254	0.00766
740	35.62	-96.02	647	0.19466	24.790	0.00765
741	34.74	-97.29	940	0.17736	25.434	0.00796
742	36.67	-96.35	835	0.21549	24.642	0.01254
743	36.29	-97.30	1,025	0.18730	24.117	0.00873
744	36.12	-97.10	895	0.20219	23.799	0.01283
745	35.94	-94.97	850	0.19589	23.776	0.00807
746	34.17	-98.00	875	0.14985	25.681	0.00635
747	35.52	-98.70	1,635	0.18868	24.703	0.01128
748	35.49	-95.20	550	0.19449	24.061	0.00759
749	42.22	-122.72	1,750	0.23086	26.028	0.01187
750	44.07	-121.29	3,660	0.42493	28.013	0.05204
751	42.04	-124.25	46	0.00951	15.531	0.00075
752	44.41	-122.49	860	0.18020	22.921	0.01482
753	45.24	-120.19	2,861	0.29890	23.812	0.04187
754	44.64	-123.20	225	0.11067	20.930	0.00969
755	43.79	-123.07	650	0.15086	23.985	0.00861
756	42.91	-122.14	6,475	0.43592	21.048	0.27775
757	42.94	-117.34	4,225	0.46033	32.588	0.03161
758	43.67	-123.32	292	0.09625	23.632	0.00316
759	45.46	-121.14	1,330	0.30029	26.445	0.02827
760	45.54	-123.10	180	0.13625	21.966	0.01234
761	43.39	-121.20	4,609	0.66136	35.897	0.05928
762	42.44	-123.35	925	0.17839	28.023	0.00642
763	45.46	-122.16	748	0.08997	19.081	0.01862
764	45.37	-119.55	1,885	0.22034	23.921	0.03028
765	45.82	-119.27	640	0.22459	25.545	0.01762
766	45.69	-121.52	500	0.18161	21.156	0.03672
767	42.21	-121.79	4,098	0.35891	25.819	0.05388
768	42.22	-120.37	4,778	0.38511	26.279	0.07815
769	44.19	-122.12	1,478	0.23398	27.179	0.02452
770	45.22	-123.17	155	0.12627	22.732	0.00784
771	45.96	-118.42	970	0.14265	22.124	0.01594
772	45.49	-120.72	1,870	0.24104	22.043	0.03131
773	44.64	-124.05	122	0.04020	13.935	0.00183
774	43.42	-124.25	6	0.02630	14.342	0.00186
775	42.71	-120.54	4,360	0.37332	28.125	0.02213
776	45.49	-118.82	1,720	0.23820	26.585	0.02563
777	44.36	-120.91	2,840	0.47007	32.254	0.02491
778	42.74	-122.52	2,482	0.32082	28.951	0.05077
779	42.96	-123.35	680	0.08877	23.568	0.00993
780	45.12	-122.07	1,120	0.12750	19.559	0.02873
781	45.46	-123.87	10	0.11547	17.363	0.00409
782	45.22	-117.89	2,765	0.28876	24.390	0.05606

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
783	43.99	-117.25	2,240	0.32643	28.659	0.02008
784	45.57	-117.54	2,923	0.39003	28.371	0.06068
785	40.66	-75.44	387	0.23734	19.712	0.05182
786	39.94	-77.64	640	0.25069	21.025	0.03932
787	41.39	-79.82	990	0.27437	22.590	0.07605
788	41.02	-75.91	1,900	0.24007	18.181	0.06693
789	41.42	-80.37	1,130	0.26957	23.095	0.09406
790	40.22	-76.85	340	0.19463	18.162	0.05236
791	40.34	-78.92	1,214	0.23075	21.856	0.08272
792	41.84	-75.87	1,560	0.26573	20.043	0.12091
793	41.02	-80.37	825	0.27368	23.206	0.07369
794	40.80	-75.62	410	0.26119	20.868	0.03876
795	41.42	-78.75	1,360	0.32457	24.445	0.08980
796	40.80	-77.87	1,170	0.23320	19.228	0.07849
797	41.01	-75.19	480	0.29972	23.670	0.05131
798	41.76	-76.42	750	0.28468	22.150	0.07110
799	39.92	-79.72	956	0.24399	21.963	0.04837
800	41.86	-79.16	1,210	0.25818	21.101	0.12058
801	39.97	-75.64	450	0.23683	21.221	0.02218
802	39.92	-76.75	390	0.26953	23.418	0.03130
803	41.17	-71.59	110	0.15597	12.453	0.03540
804	41.49	-71.54	100	0.29655	20.881	0.04295
805	33.61	-81.69	400	0.12376	24.587	0.00063
806	34.54	-82.67	800	0.13477	22.953	0.00227
807	32.39	-80.77	20	0.05279	19.949	0.00040
808	33.37	-81.32	324	0.10627	24.254	0.00081
809	34.09	-82.59	530	0.15611	24.369	0.00154
810	34.26	-80.66	140	0.19520	24.958	0.00078
811	32.79	-79.94	10	0.02225	14.010	0.00084
812	34.71	-79.89	140	0.17259	24.823	0.00250
813	34.69	-82.82	819	0.16580	23.861	0.00450
814	33.99	-81.02	242	0.07938	21.762	0.00183
815	33.84	-79.05	20	0.10440	22.756	0.00142
816	34.30	-79.89	150	0.12473	23.654	0.00078
817	33.36	-79.25	10	0.07503	21.115	0.00033
818	34.17	-82.20	615	0.17605	24.322	0.00233
819	34.55	-80.59	500	0.17050	24.121	0.00137
820	33.66	-79.82	60	0.13921	25.017	0.00152
821	34.51	-82.04	589	0.17958	25.089	0.00292
822	34.21	-81.42	711	0.10897	22.251	0.00290
823	34.29	-81.62	476	0.15580	24.934	0.00228
824	33.99	-81.77	480	0.17447	25.662	0.00166
825	34.64	-81.52	520	0.15360	23.520	0.00481
826	32.99	-80.19	35	0.10938	23.003	0.00047
827	33.94	-80.35	177	0.13032	24.282	0.00037
828	34.76	-83.09	980	0.19251	24.827	0.00372

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
829	34.37	-81.09	560	0.14226	22.869	0.00190
830	34.94	-81.04	690	0.13336	21.748	0.00378
831	32.69	-80.85	25	0.10317	25.106	0.00024
832	45.46	-98.44	1,296	0.25410	23.707	0.08682
833	43.51	-99.07	1,680	0.28760	25.428	0.04549
834	43.66	-97.79	1,350	0.25313	23.135	0.04251
835	43.30	-96.67	1,345	0.26643	24.090	0.04615
836	44.89	-97.74	1,780	0.25315	23.116	0.06102
837	43.97	-101.87	2,414	0.35481	29.377	0.04735
838	45.05	-101.60	2,370	0.29679	25.804	0.04925
839	45.79	-99.64	1,870	0.27318	24.649	0.05555
840	45.04	-99.14	1,570	0.27291	24.501	0.03494
841	44.04	-98.07	1,231	0.29335	25.958	0.03976
842	44.07	-99.07	1,720	0.28384	25.895	0.03841
843	44.52	-99.47	1,890	0.27795	25.102	0.04350
844	43.44	-103.47	3,560	0.38248	29.571	0.04730
845	44.02	-97.52	1,560	0.24981	23.219	0.03314
846	43.92	-99.87	1,700	0.30922	27.202	0.04208
847	45.16	-98.50	1,290	0.28331	25.521	0.04752
848	43.24	-97.59	1,324	0.26719	24.717	0.06063
849	45.21	-96.64	1,160	0.24628	23.022	0.04901
850	43.89	-100.70	2,320	0.28919	25.523	0.03856
851	44.39	-100.29	1,726	0.26487	24.070	0.07644
852	44.12	-103.29	3,450	0.30807	24.910	0.07116
853	42.76	-96.92	1,190	0.27651	24.723	0.03994
854	44.92	-97.16	1,746	0.24256	21.993	0.07661
855	43.51	-100.49	2,180	0.30491	26.787	0.02922
856	36.55	-87.37	382	0.20021	23.564	0.01122
857	35.01	-84.39	1,535	0.24665	25.730	0.00642
858	35.57	-89.67	310	0.15060	21.552	0.00722
859	36.02	-85.14	1,810	0.22854	22.626	0.02338
860	36.07	-87.39	780	0.19047	22.872	0.00954
861	36.49	-87.85	475	0.20782	23.358	0.01229
862	35.62	-88.84	400	0.16615	22.205	0.00624
863	35.46	-86.80	787	0.20672	23.782	0.00768
864	35.69	-85.80	940	0.17473	22.449	0.01087
865	35.92	-86.37	550	0.19560	23.520	0.00695
866	35.99	-83.20	1,036	0.22153	24.867	0.01124
867	36.42	-82.99	1,355	0.21160	23.878	0.01049
868	35.36	-86.20	1,048	0.17880	22.631	0.00723
869	36.41	-89.05	350	0.19341	22.454	0.01212
870	35.30	-87.77	750	0.24512	26.126	0.00876
871	32.74	-99.29	1,420	0.13657	27.110	0.00411
872	27.74	-98.07	201	0.01827	22.732	0.00020
873	30.37	-103.67	4,480	0.13611	28.152	0.00361
874	31.74	-99.99	1,755	0.13106	27.364	0.00250

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No.	Latitude	Longitude	Elevation	FTR	ADTR	SFR
---	(deg)	(deg)	(ft)	---	(deg F)	---
875	30.99	-103.75	3,220	0.14881	31.390	0.00487
876	28.45	-97.70	255	0.02796	22.324	0.00019
877	30.11	-98.42	1,370	0.10448	25.508	0.00099
878	29.80	-98.72	1,422	0.09255	24.478	0.00102
879	30.17	-96.41	313	0.04219	21.745	0.00069
880	31.72	-99.00	1,385	0.12564	25.939	0.00239
881	33.64	-95.04	435	0.12873	23.892	0.00230
882	27.77	-97.50	41	0.01156	18.656	0.00034
883	32.09	-96.47	425	0.08309	22.849	0.00152
884	33.66	-101.25	3,010	0.22051	28.062	0.01049
885	29.05	-96.24	70	0.02679	21.046	0.00024
886	32.11	-98.34	1,502	0.10612	24.227	0.00460
887	28.70	-100.49	805	0.03787	25.310	0.00073
888	31.80	-106.41	3,918	0.13840	27.464	0.00841
889	28.04	-99.42	590	0.03160	26.501	0.00037
890	27.24	-98.14	120	0.02090	24.317	0.00015
891	29.67	-97.12	520	0.03653	21.828	0.00059
892	30.89	-102.87	2,980	0.13475	29.576	0.00246
893	33.16	-96.12	535	0.11879	23.112	0.00426
894	29.47	-96.95	275	0.03940	22.263	0.00043
895	33.17	-99.75	1,600	0.13991	26.089	0.00692
896	31.05	-98.19	1,024	0.14015	26.508	0.00192
897	30.05	-94.80	35	0.04516	22.150	0.00034
898	30.75	-98.69	1,040	0.11817	26.372	0.00131
899	29.67	-97.66	398	0.05250	23.083	0.00066
900	32.54	-94.35	352	0.09010	22.640	0.00173
901	31.14	-102.20	2,450	0.11448	26.967	0.00221
902	31.69	-96.49	535	0.07746	23.011	0.00208
903	35.71	-100.64	2,755	0.26267	27.667	0.01514
904	34.24	-102.74	3,825	0.31879	31.953	0.01100
905	29.74	-98.12	710	0.05244	23.043	0.00074
906	31.42	-103.50	2,610	0.18680	32.852	0.00328
907	34.19	-101.70	3,370	0.23035	28.425	0.01493
908	26.39	-98.87	176	0.02110	25.154	0.00010
909	29.54	-98.47	788	0.04770	21.813	0.00106
910	32.72	-102.67	3,340	0.21522	30.771	0.01034
911	32.72	-100.92	2,335	0.19039	28.048	0.00389
912	36.36	-102.09	3,693	0.31956	29.989	0.01646
913	31.09	-97.32	635	0.06710	22.693	0.00138
914	32.77	-97.82	1,065	0.12491	23.832	0.00304
915	37.44	-112.49	7,040	0.46465	29.174	0.05771
916	38.30	-112.66	5,940	0.46814	32.816	0.03237
917	37.62	-109.49	6,040	0.36653	27.196	0.04528
918	37.29	-109.55	4,315	0.33919	31.258	0.01073
919	41.55	-112.12	4,220	0.34771	28.051	0.03822
920	39.29	-112.66	4,590	0.41204	33.091	0.02578

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
921	39.96	-111.95	4,690	0.35413	29.298	0.03922
922	37.77	-111.60	5,810	0.40755	30.657	0.01916
923	38.96	-112.32	5,120	0.33296	27.572	0.06228
924	40.29	-109.87	5,050	0.37947	32.380	0.01867
925	38.37	-110.72	4,308	0.36660	33.478	0.00924
926	40.51	-111.42	5,630	0.45931	32.796	0.07395
927	39.49	-111.02	7,280	0.34607	22.360	0.05803
928	37.05	-112.54	4,950	0.31846	30.868	0.02813
929	41.82	-111.32	5,980	0.41801	27.753	0.06691
930	39.57	-111.87	5,300	0.37818	29.532	0.05728
931	38.41	-111.66	7,070	0.53109	33.723	0.03672
932	41.76	-111.80	4,790	0.25327	22.046	0.08526
933	39.26	-111.64	5,740	0.38305	28.031	0.07542
934	38.59	-109.55	4,021	0.30854	31.007	0.00870
935	37.80	-113.92	5,460	0.45892	34.077	0.02927
936	41.04	-111.66	5,080	0.42981	31.669	0.05062
937	41.26	-111.95	4,350	0.26439	23.181	0.03971
938	37.82	-112.44	6,610	0.56790	36.500	0.02135
939	37.84	-112.84	6,000	0.42517	30.297	0.05489
940	38.77	-112.09	5,300	0.44138	33.554	0.02524
941	41.16	-112.00	4,400	0.28555	24.517	0.03787
942	37.12	-113.57	2,770	0.21378	32.057	0.00393
943	39.26	-112.10	5,300	0.45261	32.681	0.03610
944	40.55	-111.50	6,010	0.45806	30.503	0.09171
945	40.09	-111.60	4,720	0.27415	26.102	0.04949
946	38.97	-109.72	5,100	0.30756	26.544	0.01481
947	40.54	-112.30	5,070	0.28463	22.448	0.07471
948	40.37	-111.91	4,497	0.36769	27.780	0.04545
949	40.46	-109.52	5,260	0.39411	31.897	0.01521
950	40.74	-114.04	4,237	0.25160	20.838	0.01479
951	41.54	-111.16	6,315	0.47217	31.820	0.05950
952	37.22	-112.99	4,050	0.18771	28.165	0.01043
953	44.47	-73.16	332	0.21141	17.957	0.14585
954	43.39	-72.60	800	0.33868	24.824	0.11926
955	43.99	-72.45	800	0.35533	26.546	0.11333
956	43.96	-73.22	490	0.24363	20.555	0.06543
957	44.92	-72.82	420	0.27560	23.224	0.11890
958	44.42	-72.02	699	0.27656	23.129	0.12512
959	37.09	-81.34	3,300	0.29615	22.597	0.05425
960	38.04	-78.52	870	0.18075	20.300	0.02306
961	38.46	-78.94	1,400	0.25990	23.353	0.02611
962	36.59	-79.39	410	0.21586	23.928	0.00550
963	37.34	-78.39	450	0.24961	25.257	0.01329
964	38.32	-77.45	90	0.25786	24.654	0.01533
965	37.30	-77.30	40	0.17250	23.090	0.00761
966	38.01	-79.84	2,236	0.27440	23.225	0.02750

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
967	37.79	-79.44	1,060	0.25798	24.542	0.02086
968	39.12	-77.72	500	0.23176	23.153	0.01859
969	36.76	-83.05	1,510	0.26392	25.288	0.02197
970	37.01	-79.91	1,232	0.24191	23.477	0.01576
971	38.16	-79.04	1,390	0.27738	23.564	0.01945
972	38.91	-78.47	660	0.26628	24.947	0.02612
973	46.97	-123.82	10	0.09254	15.669	0.00989
974	49.01	-122.75	60	0.14782	16.303	0.01453
975	47.17	-122.00	685	0.12838	19.053	0.01723
976	47.42	-121.74	1,560	0.15421	15.971	0.07302
977	46.72	-122.95	185	0.11716	19.832	0.00844
978	48.97	-122.34	64	0.14352	18.925	0.01728
979	47.19	-120.95	1,920	0.33478	23.421	0.08834
980	46.89	-117.39	1,965	0.27541	24.054	0.05269
981	48.55	-119.75	2,320	0.31094	22.805	0.03772
982	47.66	-118.14	2,440	0.30585	22.999	0.05551
983	46.32	-118.00	1,557	0.19674	23.142	0.02700
984	47.99	-122.19	60	0.11174	16.403	0.00648
985	47.96	-124.37	350	0.13771	17.766	0.02021
986	47.30	-122.87	51	0.08531	17.017	0.00673
987	46.22	-119.10	390	0.16405	23.108	0.01183
988	46.16	-122.92	12	0.12110	19.933	0.00793
989	47.32	-118.70	1,530	0.32399	26.885	0.02925
990	48.62	-122.80	80	0.06135	14.686	0.01072
991	46.49	-117.59	1,900	0.21807	24.190	0.01110
992	48.12	-123.44	90	0.08080	14.414	0.00595
993	48.12	-122.75	100	0.04284	14.550	0.00735
994	47.21	-122.34	50	0.15886	21.137	0.01018
995	47.12	-118.37	1,830	0.29658	24.480	0.04161
996	48.51	-122.24	60	0.11596	17.972	0.01124
997	47.55	-121.85	440	0.14081	18.878	0.01547
998	47.64	-117.54	2,356	0.22266	20.126	0.08900
999	48.36	-120.72	1,270	0.27047	20.428	0.09198
1000	46.32	-120.00	747	0.24052	26.190	0.01861
1001	45.69	-122.66	210	0.11103	19.333	0.00950
1002	47.66	-120.07	2,620	0.29906	21.963	0.05084
1003	47.42	-120.32	640	0.21742	21.730	0.03954
1004	47.76	-118.67	2,230	0.32854	25.036	0.03505
1005	48.47	-120.19	1,755	0.36016	28.062	0.09091
1006	38.99	-80.22	1,455	0.26641	23.454	0.09153
1007	37.37	-81.55	1,430	0.26854	25.055	0.02855
1008	38.94	-80.82	720	0.27588	25.732	0.04118
1009	37.86	-80.41	2,303	0.28852	24.119	0.02913
1010	39.41	-77.99	537	0.24078	22.248	0.02777
1011	39.11	-79.67	1,770	0.28200	23.149	0.07665
1012	38.80	-81.35	740	0.25404	24.095	0.03515

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
1013	40.29	-80.62	660	0.25966	23.538	0.02870
1014	37.67	-82.29	670	0.22255	24.796	0.01817
1015	38.54	-81.92	571	0.23200	22.616	0.02308
1016	46.57	-90.97	650	0.26726	22.567	0.10197
1017	42.62	-89.39	790	0.26224	22.177	0.05118
1018	42.69	-90.12	930	0.26055	22.029	0.04716
1019	43.80	-88.45	760	0.20912	18.596	0.06624
1020	44.12	-89.54	1,076	0.24094	21.809	0.06695
1021	44.41	-90.74	953	0.30491	26.009	0.05582
1022	42.84	-90.79	1,040	0.22143	19.495	0.05654
1023	44.11	-87.69	660	0.21132	16.917	0.03835
1024	44.66	-90.14	1,250	0.23798	21.431	0.07026
1025	45.14	-90.35	1,470	0.21904	20.607	0.07872
1026	45.89	-89.74	1,580	0.25867	22.758	0.10227
1027	44.37	-88.72	805	0.25486	21.874	0.06295
1028	44.91	-87.95	660	0.25603	21.329	0.06519
1029	44.04	-88.55	750	0.22601	19.126	0.07525
1030	43.52	-89.44	800	0.24589	21.375	0.06113
1031	43.04	-91.16	658	0.23824	21.591	0.04589
1032	42.71	-87.77	595	0.20300	16.539	0.05978
1033	45.82	-91.89	1,100	0.24432	22.744	0.07149
1034	44.97	-90.94	1,080	0.24328	22.210	0.08241
1035	43.57	-90.92	1,185	0.23272	20.490	0.06015
1036	43.19	-88.74	820	0.22428	19.772	0.07317
1037	43.79	-111.04	6,430	0.39541	25.260	0.11200
1038	44.39	-108.05	3,837	0.37349	30.831	0.03580
1039	42.26	-111.04	6,110	0.45648	32.406	0.09057
1040	44.51	-109.19	5,156	0.22650	17.830	0.04203
1041	41.16	-104.82	6,130	0.35176	24.835	0.11802
1042	41.76	-104.82	5,304	0.42214	30.620	0.08193
1043	44.94	-104.20	3,570	0.29366	24.509	0.06180
1044	43.24	-108.94	5,575	0.41017	30.018	0.01874
1045	43.57	-109.64	6,960	0.48743	28.759	0.05696
1046	41.27	-110.95	6,825	0.45728	29.434	0.07508
1047	41.54	-109.47	6,089	0.44299	31.794	0.05705
1048	44.55	-110.41	7,770	0.46967	28.329	0.22490
1049	42.76	-104.49	5,090	0.38880	28.366	0.06684
1050	43.41	-106.29	4,815	0.38563	29.891	0.07434
1051	43.86	-110.59	6,798	0.47540	30.675	0.15480
1052	43.86	-104.22	4,315	0.34346	25.191	0.05778
1053	42.47	-106.85	5,930	0.33806	25.747	0.01411
1054	43.26	-108.69	5,440	0.37789	28.025	0.02658
1055	42.87	-109.87	7,175	0.48092	31.944	0.09815
1056	43.02	-108.39	4,950	0.40031	32.174	0.04301
1057	41.46	-106.82	6,790	0.42734	28.434	0.08098
1058	44.84	-106.84	3,750	0.38371	28.969	0.06215

Table A10 Continued: *Weather Station Environmental Characteristics*

Station No. ---	Latitude (deg)	Longitude (deg)	Elevation (ft)	FTR ---	ADTR (deg F)	SFR ---
1059	42.09	-104.22	4,098	0.41756	31.751	0.04668
1060	42.12	-104.95	4,638	0.33828	28.863	0.05497
1061	44.02	-107.97	4,060	0.36897	30.284	0.02794
1062	44.97	-110.70	6,230	0.38279	25.106	0.11821

Table A11: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
		Alabama Counties			
1	Autauga	32.52	-86.58	8	No
3	Baldwin	30.59	-87.75	2	Yes
5	Barbour	31.86	-85.33	12	No
7	Bibb	33.04	-87.12	3	No
9	Blount	33.98	-86.55	6	No
11	Bullock	32.10	-85.70	12	No
13	Butler	31.74	-86.66	4	No
15	Calhoun	33.74	-85.82	9	No
17	Chambers	32.89	-85.29	165	No
19	Cherokee	34.18	-85.62	13	No
21	Chilton	32.85	-86.69	8	No
23	Choctaw	32.03	-88.26	10	No
25	Clarke	31.69	-87.83	10	No
27	Clay	33.27	-85.84	9	No
29	Cleburne	33.65	-85.51	9	No
31	Coffee	31.38	-85.96	11	No
33	Colbert	34.73	-87.73	5	No
35	Conecuh	31.42	-87.00	1	No
37	Coosa	32.96	-86.24	9	No
39	Covington	31.25	-86.42	1	No
41	Crenshaw	31.71	-86.29	4	No
43	Cullman	34.16	-86.83	6	No
45	Dale	31.39	-85.62	11	No
47	Dallas	32.38	-87.07	8	No
49	DeKalb	34.46	-85.80	13	No
51	Elmore	32.60	-86.17	4	No
53	Escambia	31.10	-87.23	1	No
55	Etowah	34.02	-86.03	9	No
57	Fayette	33.75	-87.75	412	No
59	Franklin	34.47	-87.83	5	No
61	Geneva	31.09	-85.80	130	No
63	Greene	32.84	-87.95	3	No
65	Hale	32.77	-87.64	3	No
67	Henry	31.49	-85.25	11	No
69	Houston	31.19	-85.35	130	No
71	Jackson	34.76	-85.95	7	No
73	Jefferson	33.53	-86.83	9	No
75	Lamar	33.77	-88.08	412	No
77	Lauderdale	34.88	-87.61	5	No
79	Lawrence	34.55	-87.30	5	No
81	Lee	32.61	-85.33	165	No
83	Limestone	34.81	-86.97	5	No
85	Lowndes	32.17	-86.66	4	No
87	Macon	32.42	-85.72	12	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
89	Madison	34.73	-86.59	7	No
91	Marengo	32.33	-87.79	3	No
93	Marion	34.12	-87.88	412	No
95	Marshall	34.33	-86.29	7	No
97	Mobile	30.72	-88.14	2	Yes
99	Monroe	31.56	-87.36	10	No
101	Montgomery	32.33	-86.26	4	No
103	Morgan	34.51	-86.92	6	No
105	Perry	32.61	-87.33	3	No
107	Pickens	33.27	-88.09	431	No
109	Pike	31.79	-85.94	11	No
111	Randolph	33.26	-85.45	165	No
113	Russell	32.38	-85.10	165	No
115	St. Clair	33.67	-86.33	9	No
117	Shelby	33.27	-86.70	9	No
119	Sumter	32.56	-88.22	3	No
121	Talladega	33.37	-86.18	9	No
123	Tallapoosa	32.85	-85.84	165	No
125	Tuscaloosa	33.24	-87.51	3	No
127	Walker	33.82	-87.29	6	No
129	Washington	31.37	-88.15	10	No
131	Wilcox	31.99	-87.35	10	No
133	Winston	34.15	-87.42	6	No
		Alaska Boroughs			
13	Aleutians East	55.13	-162.03	---	Yes
60	Bristol Bay	58.69	-156.79	---	Yes
68	Denali	63.89	-149.10	---	No
90	Fairbanks North Star	64.82	-147.57	---	No
100	Haines	59.25	-135.53	---	Yes
110	Juneau	58.35	-134.51	---	Yes
122	Kenai Peninsula	60.35	-150.99	---	Yes
130	Ketchikan Gateway	55.35	-131.62	---	Yes
150	Kodiak Island	57.69	-152.68	---	Yes
164	Lake and Peninsula	58.61	-156.41	---	Yes
170	Matanuska-Susitna	61.76	-149.48	---	Yes
185	North Slope	70.60	-153.94	---	Yes
188	Northwest Arctic	66.82	-160.65	---	Yes
220	Sitka	57.08	-135.33	---	Yes
282	Yakutat	59.79	-140.27	---	No
		Alaska Census Areas			
16	Aleutians West	52.32	-172.45	---	Yes
50	Bethel	60.89	-161.19	---	Yes

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
70	Dillingham	59.19	-158.61	---	Yes
180	Nome	64.81	-164.35	---	Yes
201	Prince of Wales-Outer Ketchikan	55.55	-132.58	---	Yes
232	Skagway-Hoonah-Angoon	58.32	-135.46	---	Yes
240	Southeast Fairbanks	63.61	-143.91	---	No
261	Valdez-Cordova	61.46	-145.33	---	Yes
270	Wade Hampton	62.08	-163.74	---	Yes
280	Wrangell-Petersburg	56.71	-133.07	---	Yes
290	Yukon-Koyukuk	65.13	-151.85	---	No
		Alaska Cities			
110	Juneau	58.35	-134.51	---	Yes
220	Sitka	57.08	-135.33	---	Yes
282	Yakutat	59.79	-140.27	---	No
		Alaska Municipalities			
20	Anchorage	61.19	-149.76	---	Yes
		Arizona Counties			
1	Apache	35.65	-109.45	18	No
3	Cochise	31.75	-109.90	28	No
5	Coconino	35.77	-111.51	17	No
7	Gila	33.71	-110.98	24	No
9	Graham	32.87	-109.82	29	No
11	Greenlee	33.07	-109.27	575	No
12	La Paz	33.86	-114.05	22	No
13	Maricopa	33.49	-112.09	20	No
15	Mohave	35.29	-114.08	543	No
17	Navajo	35.41	-110.26	18	No
19	Pima	32.18	-111.09	28	No
21	Pinal	32.97	-111.50	25	No
23	Santa Cruz	31.48	-110.91	28	No
25	Yavapai	34.65	-112.41	23	No
27	Yuma	32.68	-114.39	32	No
		Arkansas Counties			
1	Arkansas	34.36	-91.43	42	No
3	Ashley	33.19	-91.79	318	No
5	Baxter	36.31	-92.35	38	No
7	Benton	36.35	-94.25	37	No
9	Boone	36.29	-93.07	36	No
11	Bradley	33.52	-92.14	42	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
13	Calhoun	33.60	-92.51	42	No
15	Carroll	36.36	-93.57	36	No
17	Chicot	33.31	-91.31	421	No
19	Clark	34.07	-93.16	44	No
21	Clay	36.36	-90.40	35	No
23	Cleburne	35.54	-92.06	34	No
25	Cleveland	33.90	-92.22	42	No
27	Columbia	33.25	-93.23	327	No
29	Conway	35.21	-92.71	34	No
31	Craighead	35.83	-90.63	43	No
33	Crawford	35.52	-94.26	41	No
35	Crittenden	35.20	-90.27	423	No
37	Cross	35.28	-90.79	33	No
39	Dallas	33.94	-92.61	42	No
41	Desha	33.79	-91.35	421	No
43	Drew	33.60	-91.74	421	No
45	Faulkner	35.12	-92.38	34	No
47	Franklin	35.48	-93.88	41	No
49	Fulton	36.36	-91.73	38	No
51	Garland	34.55	-93.08	34	No
53	Grant	34.31	-92.45	42	No
55	Greene	36.10	-90.51	35	No
57	Hempstead	33.72	-93.65	44	No
59	Hot Spring	34.34	-92.89	44	No
61	Howard	34.05	-93.96	44	No
63	Independence	35.76	-91.59	40	No
65	Izard	36.14	-91.87	38	No
67	Jackson	35.61	-91.23	40	No
69	Jefferson	34.24	-91.99	42	No
71	Johnson	35.50	-93.48	45	No
73	Lafayette	33.27	-93.56	327	No
75	Lawrence	36.07	-91.07	43	No
77	Lee	34.78	-90.76	33	No
79	Lincoln	33.98	-91.71	42	No
81	Little River	33.70	-94.22	881	No
83	Logan	35.22	-93.76	45	No
85	Lonoke	34.78	-91.91	34	No
87	Madison	36.03	-93.73	36	No
89	Marion	36.29	-92.68	36	No
91	Miller	33.38	-93.97	327	No
93	Mississippi	35.81	-90.03	858	No
95	Monroe	34.73	-91.21	33	No
97	Montgomery	34.56	-93.64	39	No
99	Nevada	33.69	-93.33	44	No
101	Newton	35.97	-93.19	36	No
103	Ouachita	33.57	-92.86	44	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
105	Perry	34.98	-92.86	34	No
107	Phillips	34.47	-90.76	418	No
109	Pike	34.18	-93.66	44	No
111	Poinsett	35.59	-90.60	40	No
113	Polk	34.49	-94.25	39	No
115	Pope	35.33	-93.08	45	No
117	Prairie	34.81	-91.53	33	No
119	Pulaski	34.77	-92.29	34	No
121	Randolph	36.32	-90.99	43	No
123	St. Francis	35.02	-90.71	33	No
125	Saline	34.62	-92.64	34	No
127	Scott	34.88	-94.09	39	No
129	Searcy	35.92	-92.69	34	No
131	Sebastian	35.29	-94.35	41	No
133	Sevier	34.02	-94.26	39	No
135	Sharp	36.19	-91.50	38	No
137	Stone	35.87	-92.17	40	No
139	Union	33.21	-92.61	318	No
141	Van Buren	35.57	-92.41	34	No
143	Washington	36.05	-94.20	37	No
145	White	35.25	-91.73	40	No
147	Woodruff	35.20	-91.24	33	No
149	Yell	35.04	-93.36	45	No
		California Counties			
1	Alameda	37.72	-122.10	46	Yes
3	Alpine	38.63	-119.89	86	No
5	Amador	38.43	-120.72	55	No
7	Butte	39.65	-121.65	50	No
9	Calaveras	38.17	-120.56	55	No
11	Colusa	39.19	-122.15	93	No
13	Contra Costa	37.94	-122.06	46	Yes
15	Del Norte	41.74	-124.11	751	Yes
17	El Dorado	38.77	-120.57	55	No
19	Fresno	36.64	-119.90	59	No
21	Glenn	39.63	-122.29	93	No
23	Humboldt	40.75	-123.99	56	Yes
25	Imperial	32.96	-115.49	48	No
27	Inyo	36.71	-117.69	63	No
29	Kern	35.30	-118.68	87	No
31	Kings	36.16	-119.81	60	No
33	Lake	39.02	-122.75	89	No
35	Lassen	40.61	-120.72	85	No
37	Los Angeles	34.09	-118.23	76	Yes
39	Madera	37.04	-120.03	59	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
41	Marin	37.99	-122.58	46	Yes
43	Mariposa	37.60	-120.00	94	No
45	Mendocino	39.36	-123.43	89	Yes
47	Merced	37.25	-120.67	70	No
49	Modoc	41.53	-120.79	49	No
51	Mono	37.85	-118.96	94	No
53	Monterey	36.45	-121.53	83	Yes
55	Napa	38.35	-122.33	72	Yes
57	Nevada	39.27	-120.81	65	No
59	Orange	33.73	-117.86	88	Yes
61	Placer	38.97	-120.95	52	No
63	Plumas	40.02	-120.85	79	No
65	Riverside	33.78	-116.80	80	No
67	Sacramento	38.56	-121.39	54	Yes
69	San Benito	36.75	-121.29	83	No
71	San Bernardino	34.39	-116.98	80	No
73	San Diego	32.90	-117.06	51	Yes
75	San Francicso	37.76	-122.44	46	Yes
77	San Joaquin	37.95	-121.28	68	Yes
79	San Luis Obispo	35.37	-120.59	81	Yes
81	San Mateo	37.53	-122.33	46	Yes
83	Santa Barbara	34.65	-120.07	82	Yes
85	Santa Clara	37.31	-121.91	83	Yes
87	Santa Cruz	37.00	-121.97	83	Yes
89	Shasta	40.69	-122.12	92	No
91	Sierra	39.58	-120.53	65	No
93	Siskiyou	41.61	-122.50	95	No
95	Solano	38.24	-122.05	72	Yes
97	Sonoma	38.44	-122.77	84	Yes
99	Stanislaus	37.61	-120.96	70	No
101	Sutter	39.08	-121.66	69	No
103	Tehama	40.12	-122.14	74	No
105	Trinity	40.67	-123.07	92	No
107	Tulare	36.23	-119.17	66	No
109	Tuolumne	37.98	-120.23	55	No
111	Ventura	34.28	-119.05	73	Yes
113	Yolo	38.63	-121.78	54	No
115	Yuba	39.21	-121.42	69	No
		Colorado Counties			
1	Adams	39.87	-104.87	96	No
3	Alamosa	37.51	-105.80	113	No
5	Arapahoe	39.64	-104.84	96	No
7	Archuleta	37.22	-107.11	566	No
9	Baca	37.35	-102.53	729	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
11	Bent	38.07	-103.06	112	No
13	Boulder	40.06	-105.20	96	No
15	Chaffee	38.66	-106.09	116	No
17	Cheyenne	38.82	-102.52	99	No
19	Clear Creek	39.72	-105.61	102	No
21	Conejos	37.19	-106.07	113	No
23	Costilla	37.29	-105.50	113	No
25	Crowley	38.23	-103.79	115	No
27	Custer	38.13	-105.42	97	No
29	Delta	38.81	-107.91	114	No
31	Denver	39.73	-104.97	96	No
33	Dolores	37.76	-108.59	118	No
35	Douglas	39.46	-104.89	98	No
37	Eagle	39.59	-106.71	102	No
39	Elbert	39.29	-104.29	98	No
41	El Paso	38.87	-104.75	98	No
43	Fremont	38.43	-105.30	97	No
45	Garfield	39.54	-107.65	100	No
47	Gilpin	39.84	-105.50	96	No
49	Grand	40.09	-106.07	102	No
51	Gunnison	38.61	-107.01	108	No
53	Hinsdale	37.82	-107.27	109	No
55	Huerfano	37.61	-104.96	119	No
57	Jackson	40.65	-106.27	117	No
59	Jefferson	39.73	-105.14	96	No
61	Kiowa	38.45	-102.64	104	No
63	Kit Carson	39.33	-102.55	99	No
65	Lake	39.21	-106.31	102	No
67	La Plata	37.26	-107.80	103	No
69	Larimer	40.53	-105.21	105	No
71	Las Animas	37.24	-104.38	119	No
73	Lincoln	39.10	-103.57	104	No
75	Logan	40.66	-103.13	515	No
77	Mesa	39.10	-108.51	107	No
79	Mineral	37.70	-106.92	109	No
81	Moffat	40.56	-108.14	117	No
83	Montezuma	37.35	-108.58	103	No
85	Montrose	38.41	-108.15	114	No
87	Morgan	40.26	-103.80	106	No
89	Otero	38.02	-103.70	115	No
91	Ouray	38.15	-107.77	118	No
93	Park	39.17	-105.72	98	No
95	Phillips	40.60	-102.41	120	No
97	Pitkin	39.24	-106.90	108	No
99	Prowers	38.06	-102.43	111	No
101	Pueblo	38.24	-104.62	97	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
103	Rio Blanco	40.01	-108.28	100	No
105	Rio Grande	37.64	-106.33	101	No
107	Routt	40.46	-106.95	117	No
109	Saguache	38.10	-106.21	116	No
111	San Juan	37.81	-107.67	118	No
113	San Miguel	38.02	-108.37	118	No
115	Sedgwick	40.91	-102.33	515	No
117	Summit	39.57	-106.07	102	No
119	Teller	38.91	-105.16	98	No
121	Washington	40.08	-103.14	106	No
123	Weld	40.35	-104.73	105	No
125	Yuma	40.04	-102.48	120	No
		Connecticut Counties			
1	Fairfield	41.21	-73.35	625	Yes
3	Hartford	41.77	-72.72	122	No
5	Litchfield	41.75	-73.21	121	No
7	Middlesex	41.45	-72.54	122	Yes
9	New Haven	41.39	-72.94	625	Yes
11	New London	41.45	-72.09	122	Yes
13	Tolland	41.85	-72.36	122	No
15	Windham	41.83	-71.99	122	No
		Delaware Counties			
1	Kent	39.09	-75.56	123	Yes
3	New Castle	39.70	-75.61	125	Yes
5	Sussex	38.65	-75.34	124	Yes
		District of Columbia			
1	District of Columbia	38.91	-77.01	343	No
		Florida Counties			
1	Alachua	29.68	-82.38	140	No
3	Baker	30.29	-82.24	138	No
5	Bay	30.22	-85.64	130	Yes
7	Bradford	29.93	-82.14	138	No
9	Brevard	28.22	-80.69	144	Yes
11	Broward	26.13	-80.21	134	Yes
13	Calhoun	30.43	-85.19	126	No
15	Charlotte	26.95	-82.13	127	Yes
17	Citrus	28.89	-82.47	137	Yes
19	Clay	30.00	-81.82	132	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
21	Collier	26.16	-81.67	131	Yes
23	Columbia	30.18	-82.64	138	No
27	DeSoto	27.20	-81.87	127	No
29	Dixie	29.61	-83.12	138	Yes
31	Duval	30.32	-81.64	133	Yes
33	Escambia	30.50	-87.28	2	Yes
35	Flagler	29.52	-81.25	132	Yes
37	Franklin	29.84	-84.79	126	Yes
39	Gadsden	30.60	-84.62	142	No
41	Gilchrist	29.71	-82.83	138	No
43	Glades	26.89	-81.17	129	No
45	Gulf	29.94	-85.27	126	Yes
47	Hamilton	30.49	-82.95	139	No
49	Hardee	27.54	-81.81	127	No
51	Hendry	26.70	-81.19	129	No
53	Hernando	28.52	-82.48	141	Yes
55	Highlands	27.44	-81.43	127	No
57	Hillsborough	27.97	-82.41	143	Yes
59	Holmes	30.85	-85.79	130	No
61	Indian River	27.70	-80.45	136	Yes
63	Jackson	30.77	-85.24	130	No
65	Jefferson	30.51	-83.88	139	Yes
67	Lafayette	30.00	-83.18	138	No
69	Lake	28.80	-81.75	140	No
71	Lee	26.60	-81.85	135	Yes
73	Leon	30.46	-84.26	142	No
75	Levy	29.33	-82.71	140	Yes
77	Liberty	30.29	-84.88	142	No
79	Madison	30.44	-83.43	139	No
81	Manatee	27.49	-82.55	127	Yes
83	Marion	29.14	-82.11	140	No
85	Martin	27.13	-80.26	136	Yes
86	Miami-Dade	25.76	-80.30	134	Yes
87	Monroe	24.78	-81.23	131	Yes
89	Nassau	30.62	-81.70	133	Yes
91	Okaloosa	30.64	-86.56	130	Yes
93	Okeechobee	27.33	-80.87	136	No
95	Orange	28.55	-81.40	144	No
97	Osceola	28.23	-81.32	128	No
99	Palm Beach	26.64	-80.18	129	Yes
101	Pasco	28.28	-82.50	141	Yes
103	Pinellas	27.89	-82.73	143	Yes
105	Polk	27.99	-81.76	128	No
107	Putnam	29.60	-81.76	132	No
109	St. Johns	29.88	-81.36	132	Yes
111	St. Lucie	27.35	-80.36	136	Yes

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
113	Santa Rosa	30.61	-87.02	1	Yes
115	Sarasota	27.16	-82.40	127	Yes
117	Seminole	28.71	-81.31	144	No
119	Sumter	28.77	-82.08	137	No
121	Suwannee	30.19	-82.99	138	No
123	Taylor	30.05	-83.59	139	Yes
125	Union	30.03	-82.37	138	No
127	Volusia	29.05	-81.14	144	Yes
129	Wakulla	30.14	-84.37	142	Yes
131	Walton	30.64	-86.16	130	Yes
133	Washington	30.63	-85.64	130	No
		Georgia Counties			
1	Appling	31.75	-82.32	151	No
3	Atkinson	31.30	-82.87	164	No
5	Bacon	31.55	-82.46	164	No
7	Baker	31.34	-84.41	145	No
9	Baldwin	33.08	-83.24	153	No
11	Banks	34.35	-83.51	150	No
13	Barrow	33.99	-83.72	150	No
15	Bartow	34.21	-84.83	157	No
17	Ben Hill	31.73	-83.25	160	No
19	Berrien	31.23	-83.23	160	No
21	Bibb	32.83	-83.67	153	No
23	Bleckley	32.40	-83.34	152	No
25	Brantley	31.20	-82.00	164	No
27	Brooks	30.85	-83.58	156	No
29	Bryan	32.05	-81.44	158	Yes
31	Bulloch	32.42	-81.78	154	No
33	Burke	33.05	-82.01	154	No
35	Butts	33.30	-83.96	147	No
37	Calhoun	31.52	-84.65	145	No
39	Camden	30.87	-81.65	133	Yes
43	Candler	32.41	-82.06	154	No
45	Carroll	33.60	-85.07	155	No
47	Catoosa	34.93	-85.17	13	No
49	Charlton	30.78	-82.05	133	No
51	Chatham	32.05	-81.11	158	Yes
53	Chattahoochee	32.30	-84.78	159	No
55	Chattooga	34.48	-85.35	13	No
57	Cherokee	34.21	-84.48	148	No
59	Clarke	33.95	-83.38	150	No
61	Clay	31.62	-84.99	145	No
63	Clayton	33.57	-84.37	155	No
65	Clinch	30.95	-82.72	164	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
67	Cobb	33.94	-84.56	155	No
69	Coffee	31.54	-82.84	164	No
71	Colquitt	31.19	-83.78	160	No
73	Columbia	33.51	-82.17	162	No
75	Cook	31.15	-83.43	160	No
77	Coweta	33.36	-84.75	155	No
79	Crawford	32.71	-83.98	159	No
81	Crisp	31.94	-83.77	152	No
83	Dade	34.86	-85.50	13	No
85	Dawson	34.42	-84.13	148	No
87	Decatur	30.88	-84.57	142	No
89	DeKalb	33.79	-84.26	147	No
91	Dodge	32.18	-83.17	149	No
93	Dooly	32.16	-83.79	152	No
95	Dougherty	31.57	-84.16	145	No
97	Douglas	33.74	-84.73	155	No
99	Early	31.31	-84.94	145	No
101	Echols	30.71	-82.94	139	No
103	Effingham	32.34	-81.33	158	No
105	Elbert	34.13	-82.87	809	No
107	Emanuel	32.59	-82.30	154	No
109	Evans	32.16	-81.91	151	No
111	Fannin	34.89	-84.30	857	No
113	Fayette	33.43	-84.51	155	No
115	Floyd	34.25	-85.20	157	No
117	Forsyth	34.21	-84.12	150	No
119	Franklin	34.38	-83.18	161	No
121	Fulton	33.78	-84.42	155	No
123	Gilmer	34.68	-84.46	857	No
125	Glascock	33.23	-82.60	162	No
127	Glynn	31.19	-81.50	146	Yes
129	Gordon	34.50	-84.90	157	No
131	Grady	30.88	-84.23	142	No
133	Greene	33.56	-83.16	163	No
135	Gwinnett	33.97	-84.06	150	No
137	Habersham	34.57	-83.54	161	No
139	Hall	34.30	-83.84	150	No
141	Hancock	33.26	-83.01	153	No
143	Haralson	33.76	-85.20	155	No
145	Harris	32.74	-84.90	165	No
147	Hart	34.36	-82.97	806	No
149	Heard	33.31	-85.12	155	No
151	Henry	33.47	-84.18	147	No
153	Houston	32.56	-83.66	152	No
155	Irwin	31.61	-83.28	160	No
157	Jackson	34.15	-83.56	150	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
159	Jasper	33.34	-83.70	147	No
161	Jeff Davis	31.83	-82.62	151	No
163	Jefferson	33.05	-82.42	154	No
165	Jenkins	32.80	-81.97	154	No
167	Johnson	32.69	-82.65	154	No
169	Jones	32.99	-83.54	153	No
171	Lamar	33.08	-84.16	159	No
173	Lanier	31.03	-83.06	156	No
175	Laurens	32.50	-82.93	149	No
177	Lee	31.75	-84.18	145	No
179	Liberty	31.81	-81.54	151	Yes
181	Lincoln	33.80	-82.46	163	No
183	Long	31.76	-81.76	151	No
185	Lowndes	30.85	-83.28	156	No
187	Lumpkin	34.54	-83.99	148	No
189	McDuffie	33.47	-82.48	162	No
191	McIntosh	31.47	-81.41	146	Yes
193	Macon	32.35	-84.05	152	No
195	Madison	34.11	-83.22	161	No
197	Marion	32.37	-84.54	159	No
199	Meriwether	33.00	-84.65	159	No
201	Miller	31.17	-84.73	145	No
205	Mitchell	31.21	-84.17	145	No
207	Monroe	33.03	-83.92	153	No
209	Montgomery	32.18	-82.52	151	No
211	Morgan	33.59	-83.49	147	No
213	Murray	34.78	-84.77	857	No
215	Muscogee	32.49	-84.94	159	No
217	Newton	33.57	-83.86	147	No
219	Oconee	33.87	-83.45	147	No
221	Oglethorpe	33.88	-83.11	163	No
223	Paulding	33.90	-84.83	157	No
225	Peach	32.57	-83.84	152	No
227	Pickens	34.46	-84.44	148	No
229	Pierce	31.34	-82.22	164	No
231	Pike	33.09	-84.38	159	No
233	Polk	34.01	-85.18	157	No
235	Pulaski	32.25	-83.47	152	No
237	Putnam	33.32	-83.35	153	No
239	Quitman	31.86	-85.05	12	No
241	Rabun	34.88	-83.44	641	No
243	Randolph	31.76	-84.75	145	No
245	Richmond	33.43	-82.03	805	No
247	Rockdale	33.65	-84.02	147	No
249	Schley	32.25	-84.32	159	No
251	Screven	32.75	-81.63	154	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
253	Seminole	30.96	-84.87	142	No
255	Spalding	33.26	-84.28	155	No
257	Stephens	34.56	-83.29	161	No
259	Stewart	32.09	-84.82	159	No
261	Sumter	32.05	-84.20	145	No
263	Talbot	32.69	-84.54	159	No
265	Taliaferro	33.57	-82.89	163	No
267	Tattnall	32.05	-82.04	151	No
269	Taylor	32.55	-84.23	159	No
271	Telfair	32.01	-82.91	149	No
273	Terrell	31.79	-84.44	145	No
275	Thomas	30.87	-83.95	156	No
277	Tift	31.46	-83.52	160	No
279	Toombs	32.18	-82.36	151	No
281	Towns	34.93	-83.76	148	No
283	Treutlen	32.40	-82.58	149	No
285	Troup	33.03	-85.03	165	No
287	Turner	31.71	-83.62	160	No
289	Twiggs	32.66	-83.40	152	No
291	Union	34.86	-84.01	148	No
293	Upson	32.90	-84.32	159	No
295	Walker	34.82	-85.29	13	No
297	Walton	33.78	-83.74	147	No
299	Ware	31.21	-82.41	164	No
301	Warren	33.42	-82.66	162	No
303	Washington	32.95	-82.78	153	No
305	Wayne	31.60	-81.93	151	No
307	Webster	32.05	-84.56	145	No
309	Wheeler	32.13	-82.74	149	No
311	White	34.62	-83.74	148	No
313	Whitfield	34.80	-84.97	857	No
315	Wilcox	31.96	-83.45	152	No
317	Wilkes	33.77	-82.74	163	No
319	Wilkinson	32.84	-83.23	153	No
321	Worth	31.56	-83.84	145	No
		Hawaii Counties			
1	Hawaii	19.68	-155.39	---	Yes
3	Honolulu	21.43	-158.04	---	Yes
5	Kalawao	21.19	-156.97	---	Yes
7	Kauai	22.00	-159.48	---	Yes
9	Maui	20.90	-156.62	---	Yes

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
		Idaho Counties			
1	Ada	43.56	-116.28	167	No
3	Adams	44.92	-116.39	181	No
5	Bannock	42.78	-112.35	166	No
7	Bear Lake	42.31	-111.35	178	No
9	Benewah	47.24	-116.64	177	No
11	Bingham	43.18	-112.36	166	No
13	Blaine	43.44	-114.18	179	No
15	Boise	43.96	-115.86	167	No
17	Bonner	48.32	-116.69	186	No
19	Bonneville	43.47	-111.87	168	No
21	Boundary	48.76	-116.37	184	No
23	Butte	43.69	-113.20	179	No
25	Camas	43.39	-114.77	172	No
27	Canyon	43.62	-116.67	169	No
29	Caribou	42.73	-111.66	173	No
31	Cassia	42.36	-113.64	182	No
33	Clark	44.24	-112.29	168	No
35	Clearwater	46.65	-115.86	180	No
37	Custer	44.21	-114.14	171	No
39	Elmore	43.14	-115.54	172	No
41	Franklin	42.15	-111.86	932	No
43	Fremont	44.18	-111.51	168	No
45	Gem	43.97	-116.45	169	No
47	Gooding	42.87	-114.78	176	No
49	Idaho	45.89	-115.89	181	No
51	Jefferson	43.76	-112.11	168	No
53	Jerome	42.68	-114.30	174	No
55	Kootenai	47.70	-116.77	177	No
57	Latah	46.79	-116.80	180	No
59	Lemhi	44.95	-113.78	171	No
61	Lewis	46.23	-116.38	180	No
63	Lincoln	42.97	-114.21	176	No
65	Madison	43.82	-111.74	168	No
67	Minidoka	42.67	-113.70	174	No
69	Nez Perce	46.41	-116.86	180	No
71	Oneida	42.17	-112.41	932	No
73	Owyhee	42.81	-116.19	172	No
75	Payette	44.00	-116.87	183	No
77	Power	42.77	-112.81	166	No
79	Shoshone	47.42	-116.04	177	No
81	Teton	43.72	-111.14	1,037	No
83	Twin Falls	42.49	-114.61	175	No
85	Valley	44.66	-115.92	181	No
87	Washington	44.39	-116.85	170	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
		Illinois Counties			
1	Adams	39.97	-91.27	197	No
3	Alexander	37.15	-89.29	188	No
5	Bond	38.88	-89.43	199	No
7	Boone	42.30	-88.83	204	No
9	Brown	39.95	-90.74	217	No
11	Bureau	41.39	-89.48	220	No
13	Calhoun	39.17	-90.65	221	No
15	Carroll	42.08	-89.95	209	No
17	Cass	39.98	-90.27	201	No
19	Champaign	40.14	-88.22	219	No
21	Christian	39.53	-89.26	214	No
23	Clark	39.35	-87.80	215	No
25	Clay	38.74	-88.47	211	No
27	Clinton	38.60	-89.44	218	No
29	Coles	39.51	-88.26	191	No
31	Cook	41.84	-87.77	189	No
33	Crawford	39.01	-87.76	213	No
35	Cumberland	39.27	-88.26	191	No
37	DeKalb	41.90	-88.74	189	No
39	De Witt	40.18	-88.91	193	No
41	Douglas	39.77	-88.24	191	No
43	DuPage	41.86	-88.06	189	No
45	Edgar	39.67	-87.75	215	No
47	Edwards	38.40	-88.05	211	No
49	Effingham	39.07	-88.59	222	No
51	Fayette	39.00	-88.99	214	No
53	Ford	40.55	-88.22	200	No
55	Franklin	37.97	-88.96	195	No
57	Fulton	40.50	-90.18	217	No
59	Gallatin	37.78	-88.23	198	No
61	Greene	39.37	-90.38	221	No
63	Grundy	41.31	-88.37	212	No
65	Hamilton	38.10	-88.54	205	No
67	Hancock	40.42	-91.19	202	No
69	Hardin	37.47	-88.28	198	No
71	Henderson	40.83	-90.95	202	No
73	Henry	41.35	-90.12	196	No
75	Iroquois	40.75	-87.83	200	No
77	Jackson	37.77	-89.31	195	No
79	Jasper	39.01	-88.14	211	No
81	Jefferson	38.31	-88.92	210	No
83	Jersey	39.08	-90.34	221	No
85	Jo Daviess	42.39	-90.24	1,018	No
87	Johnson	37.47	-88.89	188	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
89	Kane	41.92	-88.34	189	No
91	Kankakee	41.14	-87.84	249	No
93	Kendall	41.64	-88.42	189	No
95	Knox	40.94	-90.29	207	No
97	Lake	42.31	-87.98	1,032	No
99	La Salle	41.33	-88.90	212	No
101	Lawrence	38.72	-87.72	211	No
103	Lee	41.77	-89.35	194	No
105	Livingston	40.90	-88.57	216	No
107	Logan	40.14	-89.37	203	No
109	McDonough	40.47	-90.67	202	No
111	McHenry	42.30	-88.35	204	No
113	McLean	40.50	-88.88	206	No
115	Macon	39.85	-88.95	193	No
117	Macoupin	39.23	-89.88	190	No
119	Madison	38.81	-90.02	190	No
121	Marion	38.61	-88.99	210	No
123	Marshall	41.05	-89.30	206	No
125	Mason	40.26	-89.91	203	No
127	Massac	37.20	-88.74	188	No
129	Menard	40.03	-89.81	203	No
131	Mercer	41.20	-90.73	187	No
133	Monroe	38.33	-90.18	218	No
135	Montgomery	39.21	-89.50	199	No
137	Morgan	39.71	-90.22	201	No
139	Moultrie	39.64	-88.63	222	No
141	Ogle	42.03	-89.31	194	No
143	Peoria	40.75	-89.67	206	No
145	Perry	38.05	-89.35	195	No
147	Piatt	40.00	-88.58	219	No
149	Pike	39.63	-90.89	197	No
151	Pope	37.41	-88.57	198	No
153	Pulaski	37.20	-89.13	188	No
155	Putnam	41.23	-89.27	212	No
157	Randolph	38.08	-89.80	218	No
159	Richland	38.72	-88.09	211	No
161	Rock Island	41.49	-90.51	187	No
163	St. Clair	38.53	-90.00	218	No
165	Saline	37.75	-88.54	198	No
167	Sangamon	39.76	-89.65	201	No
169	Schuyler	40.14	-90.58	217	No
171	Scott	39.65	-90.48	197	No
173	Shelby	39.39	-88.80	222	No
175	Stark	41.10	-89.80	196	No
177	Stephenson	42.34	-89.64	1,017	No
179	Tazewell	40.56	-89.54	203	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
181	Union	37.46	-89.25	188	No
183	Vermilion	40.16	-87.69	192	No
185	Wabash	38.43	-87.82	241	No
187	Warren	40.88	-90.62	207	No
189	Washington	38.37	-89.38	218	No
191	Wayne	38.42	-88.40	205	No
193	White	38.10	-88.18	205	No
195	Whiteside	41.78	-89.87	208	No
197	Will	41.53	-88.03	189	No
199	Williamson	37.75	-88.97	195	No
201	Winnebago	42.31	-89.08	204	No
203	Woodford	40.78	-89.23	206	No
		Indiana Counties			
1	Adams	40.74	-84.94	225	No
3	Allen	41.09	-85.10	225	No
5	Bartholomew	39.21	-85.89	229	No
7	Benton	40.58	-87.31	200	No
9	Blackford	40.46	-85.34	237	No
11	Boone	40.03	-86.45	250	No
13	Brown	39.23	-86.22	229	No
15	Carroll	40.58	-86.58	230	No
17	Cass	40.75	-86.35	230	No
19	Clark	38.39	-85.73	245	No
21	Clay	39.44	-87.12	232	No
23	Clinton	40.29	-86.50	250	No
25	Crawford	38.31	-86.44	240	No
27	Daviess	38.70	-87.11	248	No
29	Dearborn	39.14	-84.94	227	No
31	Decatur	39.32	-85.50	229	No
33	DeKalb	41.39	-85.02	224	No
35	Delaware	40.21	-85.40	223	No
37	Dubois	38.35	-86.90	247	No
39	Elkhart	41.63	-85.90	231	No
41	Fayette	39.64	-85.16	228	No
43	Floyd	38.32	-85.86	244	No
45	Fountain	40.14	-87.26	192	No
47	Franklin	39.42	-85.07	227	No
49	Fulton	41.06	-86.24	242	No
51	Gibson	38.32	-87.56	241	No
53	Grant	40.52	-85.65	237	No
55	Greene	39.05	-87.04	248	No
57	Hamilton	40.03	-86.07	250	No
59	Hancock	39.82	-85.79	233	No
61	Harrison	38.21	-86.11	244	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
63	Hendricks	39.77	-86.45	250	No
65	Henry	39.92	-85.41	228	No
67	Howard	40.48	-86.13	237	No
69	Huntington	40.84	-85.48	237	No
71	Jackson	38.92	-85.98	246	No
73	Jasper	41.02	-87.13	249	No
75	Jay	40.43	-85.03	225	No
77	Jefferson	38.77	-85.44	236	No
79	Jennings	39.00	-85.63	246	No
81	Johnson	39.51	-86.10	229	No
83	Knox	38.70	-87.42	248	No
85	Kosciusko	41.26	-85.83	231	No
87	LaGrange	41.65	-85.43	231	No
89	Lake	41.53	-87.40	234	No
91	LaPorte	41.60	-86.78	235	No
93	Lawrence	38.84	-86.49	239	No
95	Madison	40.15	-85.72	223	No
97	Marion	39.79	-86.14	250	No
99	Marshall	41.33	-86.27	242	No
101	Martin	38.72	-86.83	247	No
103	Miami	40.75	-86.05	242	No
105	Monroe	39.16	-86.54	226	No
107	Montgomery	40.03	-86.89	243	No
109	Morgan	39.50	-86.41	226	No
111	Newton	40.95	-87.40	249	No
113	Noble	41.41	-85.41	231	No
115	Ohio	38.95	-84.94	315	No
117	Orange	38.56	-86.52	240	No
119	Owen	39.31	-86.82	226	No
121	Parke	39.76	-87.22	243	No
123	Perry	38.01	-86.70	313	No
125	Pike	38.41	-87.24	248	No
127	Porter	41.52	-87.09	234	No
129	Posey	38.03	-87.85	238	No
131	Pulaski	41.05	-86.69	251	No
133	Putnam	39.66	-86.84	232	No
135	Randolph	40.16	-85.00	687	No
137	Ripley	39.15	-85.24	227	No
139	Rush	39.62	-85.48	233	No
141	St. Joseph	41.66	-86.24	231	No
143	Scott	38.70	-85.77	245	No
145	Shelby	39.53	-85.78	233	No
147	Spencer	38.02	-87.01	313	No
149	Starke	41.27	-86.65	251	No
151	Steuben	41.65	-85.01	224	No
153	Sullivan	39.10	-87.40	213	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
155	Switzerland	38.82	-84.99	315	No
157	Tippecanoe	40.41	-86.88	230	No
159	Tipton	40.31	-86.04	223	No
161	Union	39.61	-84.92	227	No
163	Vanderburgh	37.99	-87.56	238	No
165	Vermillion	39.80	-87.44	243	No
167	Vigo	39.46	-87.39	215	No
169	Wabash	40.86	-85.81	237	No
171	Warren	40.31	-87.36	200	No
173	Warrick	38.05	-87.30	313	No
175	Washington	38.59	-86.10	244	No
177	Wayne	39.84	-84.99	228	No
179	Wells	40.74	-85.21	225	No
181	White	40.75	-86.83	230	No
183	Whitley	41.15	-85.50	231	No
		Iowa Counties			
1	Adair	41.35	-94.47	267	No
3	Adams	41.02	-94.71	256	No
5	Allamakee	43.27	-91.37	1,031	No
7	Appanoose	40.75	-92.86	453	No
9	Audubon	41.67	-94.92	266	No
11	Benton	42.07	-92.06	254	No
13	Black Hawk	42.49	-92.34	273	No
15	Boone	42.05	-93.92	262	No
17	Bremer	42.77	-92.35	269	No
19	Buchanan	42.48	-91.86	260	No
21	Buena Vista	42.72	-95.16	272	No
23	Butler	42.74	-92.78	255	No
25	Calhoun	42.39	-94.63	271	No
27	Carroll	42.03	-94.86	271	No
29	Cass	41.36	-94.97	256	No
31	Cedar	41.77	-91.12	187	No
33	Cerro Gordo	43.11	-93.27	261	No
35	Cherokee	42.73	-95.61	272	No
37	Chickasaw	43.05	-92.32	269	No
39	Clarke	41.03	-93.79	263	No
41	Clay	43.10	-95.16	258	No
43	Clayton	42.85	-91.32	1,031	No
45	Clinton	41.87	-90.43	257	No
47	Crawford	42.03	-95.37	266	No
49	Dallas	41.68	-94.02	263	No
51	Davis	40.75	-92.42	252	No
53	Decatur	40.73	-93.79	267	No
55	Delaware	42.47	-91.38	260	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude (deg)	Longitude (deg)	Closest Station	Coastal Area
---	---			---	---
57	Des Moines	40.85	-91.16	202	No
59	Dickinson	43.39	-95.14	258	No
61	Dubuque	42.48	-90.82	1,022	No
63	Emmet	43.38	-94.69	258	No
65	Fayette	42.84	-91.85	260	No
67	Floyd	43.07	-92.78	255	No
69	Franklin	42.74	-93.25	264	No
71	Fremont	40.74	-95.62	494	No
73	Greene	42.04	-94.38	271	No
75	Grundy	42.38	-92.79	264	No
77	Guthrie	41.68	-94.45	263	No
79	Hamilton	42.39	-93.72	264	No
81	Hancock	43.09	-93.72	261	No
83	Hardin	42.40	-93.21	264	No
85	Harrison	41.69	-95.81	266	No
87	Henry	40.98	-91.54	268	No
89	Howard	43.36	-92.29	269	No
91	Humboldt	42.78	-94.22	262	No
93	Ida	42.39	-95.51	272	No
95	Iowa	41.69	-92.06	254	No
97	Jackson	42.15	-90.56	257	No
99	Jasper	41.68	-93.06	273	No
101	Jefferson	41.03	-91.96	259	No
103	Johnson	41.67	-91.57	274	No
105	Jones	42.12	-91.16	257	No
107	Keokuk	41.32	-92.18	259	No
109	Kossuth	43.18	-94.22	253	No
111	Lee	40.58	-91.42	202	No
113	Linn	42.03	-91.63	254	No
115	Louisa	41.22	-91.26	274	No
117	Lucas	41.02	-93.33	263	No
119	Lyon	43.39	-96.21	270	No
121	Madison	41.34	-94.02	263	No
123	Mahaska	41.32	-92.64	252	No
125	Marion	41.33	-93.07	252	No
127	Marshall	42.04	-92.97	273	No
129	Mills	41.03	-95.64	532	No
131	Mitchell	43.35	-92.82	255	No
133	Monona	42.05	-95.95	530	No
135	Monroe	41.04	-92.84	252	No
137	Montgomery	41.01	-95.16	256	No
139	Muscatine	41.47	-91.08	187	No
141	O'Brien	43.09	-95.64	265	No
143	Osceola	43.38	-95.63	270	No
145	Page	40.74	-95.17	256	No
147	Palo Alto	43.09	-94.69	253	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
149	Plymouth	42.75	-96.21	265	No
151	Pocahontas	42.74	-94.68	271	No
153	Polk	41.63	-93.63	263	No
155	Pottawattamie	41.31	-95.68	266	No
157	Poweshiek	41.70	-92.55	273	No
159	Ringgold	40.74	-94.23	267	No
161	Sac	42.38	-95.09	272	No
163	Scott	41.57	-90.58	257	No
165	Shelby	41.68	-95.32	266	No
167	Sioux	43.08	-96.18	265	No
169	Story	42.02	-93.53	264	No
171	Tama	42.07	-92.55	273	No
173	Taylor	40.73	-94.69	256	No
175	Union	41.03	-94.27	267	No
177	Van Buren	40.74	-91.95	259	No
179	Wapello	41.03	-92.42	252	No
181	Warren	41.37	-93.56	263	No
183	Washington	41.33	-91.71	274	No
185	Wayne	40.73	-93.33	453	No
187	Webster	42.45	-94.18	262	No
189	Winnebago	43.36	-93.73	261	No
191	Winneshiek	43.28	-91.85	269	No
193	Woodbury	42.44	-96.23	265	No
195	Worth	43.36	-93.27	383	No
197	Wright	42.73	-93.75	262	No
		Kansas Counties			
1	Allen	37.89	-95.34	283	No
3	Anderson	38.21	-95.28	299	No
5	Atchison	39.54	-95.25	277	No
7	Barber	37.23	-98.57	294	No
9	Barton	38.44	-98.77	288	No
11	Bourbon	37.86	-94.79	283	No
13	Brown	39.81	-95.56	285	No
15	Butler	37.75	-96.93	280	No
17	Chase	38.31	-96.61	280	No
19	Chautauqua	37.12	-96.25	303	No
21	Cherokee	37.14	-94.79	279	No
23	Cheyenne	39.76	-101.72	301	No
25	Clark	37.24	-99.83	276	No
27	Clay	39.36	-97.15	292	No
29	Cloud	39.51	-97.65	295	No
31	Coffey	38.24	-95.73	299	No
33	Comanche	37.25	-99.34	278	No
35	Cowley	37.24	-96.94	737	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
37	Crawford	37.46	-94.79	279	No
39	Decatur	39.78	-100.43	297	No
41	Dickinson	38.85	-97.14	295	No
43	Doniphan	39.79	-95.12	277	No
45	Douglas	38.93	-95.26	289	No
47	Edwards	37.91	-99.32	288	No
49	Elk	37.43	-96.24	303	No
51	Ellis	38.90	-99.32	284	No
53	Ellsworth	38.70	-98.23	281	No
55	Finney	38.00	-100.85	287	No
57	Ford	37.72	-99.91	276	No
59	Franklin	38.58	-95.27	299	No
61	Geary	39.03	-96.82	292	No
63	Gove	38.99	-100.48	304	No
65	Graham	39.34	-99.87	304	No
67	Grant	37.57	-101.32	287	No
69	Gray	37.72	-100.42	287	No
71	Greeley	38.47	-101.78	110	No
73	Greenwood	37.88	-96.22	280	No
75	Hamilton	38.04	-101.78	110	No
77	Harper	37.21	-98.06	275	No
79	Harvey	38.04	-97.41	293	No
81	Haskell	37.54	-100.88	291	No
83	Hodgeman	38.08	-99.85	288	No
85	Jackson	39.43	-95.78	285	No
87	Jefferson	39.23	-95.39	289	No
89	Jewell	39.78	-98.20	525	No
91	Johnson	38.93	-94.75	298	No
93	Kearny	38.03	-101.27	287	No
95	Kingman	37.58	-98.12	275	No
97	Kiowa	37.58	-99.26	278	No
99	Labette	37.22	-95.26	279	No
101	Lane	38.51	-100.49	302	No
103	Leavenworth	39.23	-94.98	290	No
105	Lincoln	39.05	-98.20	281	No
107	Linn	38.22	-94.81	283	No
109	Logan	39.01	-101.06	302	No
111	Lyon	38.43	-96.15	282	No
113	McPherson	38.37	-97.65	293	No
115	Marion	38.34	-97.09	293	No
117	Marshall	39.79	-96.53	523	No
119	Meade	37.26	-100.39	710	No
121	Miami	38.57	-94.85	298	No
123	Mitchell	39.43	-98.20	295	No
125	Montgomery	37.15	-95.70	286	No
127	Morris	38.70	-96.64	282	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
129	Morton	37.12	-101.78	726	No
131	Nemaha	39.80	-95.99	523	No
133	Neosho	37.59	-95.35	286	No
135	Ness	38.53	-99.89	304	No
137	Norton	39.78	-99.90	296	No
139	Osage	38.64	-95.73	299	No
141	Osborne	39.38	-98.76	300	No
143	Ottawa	39.13	-97.67	295	No
145	Pawnee	38.18	-99.21	288	No
147	Phillips	39.77	-99.35	300	No
149	Pottawatomie	39.34	-96.31	292	No
151	Pratt	37.65	-98.73	294	No
153	Rawlins	39.79	-101.07	297	No
155	Reno	38.00	-98.02	293	No
157	Republic	39.82	-97.65	511	No
159	Rice	38.35	-98.22	281	No
161	Riley	39.25	-96.67	292	No
163	Rooks	39.36	-99.33	300	No
165	Rush	38.53	-99.31	284	No
167	Russell	38.91	-98.77	284	No
169	Saline	38.81	-97.61	295	No
171	Scott	38.48	-100.92	302	No
173	Sedgwick	37.68	-97.36	280	No
175	Seward	37.12	-100.88	291	No
177	Shawnee	39.04	-95.71	289	No
179	Sheridan	39.36	-100.45	297	No
181	Sherman	39.34	-101.74	301	No
183	Smith	39.76	-98.80	503	No
185	Stafford	38.04	-98.72	288	No
187	Stanton	37.56	-101.75	287	No
189	Stevens	37.22	-101.31	291	No
191	Sumner	37.26	-97.43	737	No
193	Thomas	39.37	-101.03	297	No
195	Trego	38.94	-99.85	304	No
197	Wabaunsee	38.97	-96.20	282	No
199	Wallace	38.90	-101.76	99	No
201	Washington	39.78	-97.08	501	No
203	Wichita	38.50	-101.36	302	No
205	Wilson	37.54	-95.75	286	No
207	Woodson	37.89	-95.74	286	No
209	Wyandotte	39.10	-94.69	298	No
		Kentucky Counties			
1	Adair	37.10	-85.28	309	No
3	Allen	36.75	-86.18	306	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
5	Anderson	38.01	-84.95	308	No
7	Ballard	37.05	-88.99	188	No
9	Barren	36.98	-85.93	306	No
11	Bath	38.15	-83.76	307	No
13	Bell	36.69	-83.70	312	No
15	Boone	38.97	-84.68	315	No
17	Bourbon	38.22	-84.23	308	No
19	Boyd	38.43	-82.66	697	No
21	Boyle	37.63	-84.84	305	No
23	Bracken	38.73	-84.08	315	No
25	Breathitt	37.53	-83.35	307	No
27	Breckinridge	37.78	-86.45	311	No
29	Bullitt	38.01	-85.67	314	No
31	Butler	37.20	-86.70	306	No
33	Caldwell	37.15	-87.89	310	No
35	Calloway	36.62	-88.27	861	No
37	Campbell	39.04	-84.43	315	No
39	Carlisle	36.85	-88.95	869	No
41	Carroll	38.67	-85.12	236	No
43	Carter	38.31	-83.05	307	No
45	Casey	37.32	-84.93	309	No
47	Christian	36.85	-87.48	310	No
49	Clark	37.98	-84.17	305	No
51	Clay	37.18	-83.74	312	No
53	Clinton	36.72	-85.13	309	No
55	Crittenden	37.33	-88.08	198	No
57	Cumberland	36.78	-85.41	309	No
59	Daviess	37.75	-87.11	313	No
61	Edmonson	37.24	-86.25	311	No
63	Elliott	38.12	-83.10	307	No
65	Estill	37.69	-83.97	305	No
67	Fayette	38.03	-84.49	308	No
69	Fleming	38.38	-83.70	307	No
71	Floyd	37.57	-82.75	1,014	No
73	Franklin	38.20	-84.87	308	No
75	Fulton	36.54	-89.06	869	No
77	Gallatin	38.75	-84.87	315	No
79	Garrard	37.64	-84.55	305	No
81	Grant	38.66	-84.60	315	No
83	Graves	36.73	-88.65	869	No
85	Grayson	37.47	-86.34	311	No
87	Green	37.26	-85.54	309	No
89	Greenup	38.57	-82.86	697	No
91	Hancock	37.87	-86.81	313	No
93	Hardin	37.74	-85.91	311	No
95	Harlan	36.87	-83.20	969	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
97	Harrison	38.42	-84.32	315	No
99	Hart	37.28	-85.88	309	No
101	Henderson	37.80	-87.57	238	No
103	Henry	38.44	-85.16	314	No
105	Hickman	36.67	-88.95	869	No
107	Hopkins	37.30	-87.54	310	No
109	Jackson	37.41	-83.99	305	No
111	Jefferson	38.21	-85.70	314	No
113	Jessamine	37.88	-84.59	305	No
115	Johnson	37.83	-82.80	1,014	No
117	Kenton	39.03	-84.54	315	No
119	Knott	37.35	-82.96	969	No
121	Knox	36.89	-83.91	312	No
123	Larue	37.53	-85.69	309	No
125	Laurel	37.11	-84.08	305	No
127	Lawrence	38.08	-82.71	1,014	No
129	Lee	37.59	-83.70	305	No
131	Leslie	37.11	-83.37	969	No
133	Letcher	37.14	-82.81	969	No
135	Lewis	38.54	-83.34	697	No
137	Lincoln	37.46	-84.68	305	No
139	Livingston	37.16	-88.33	198	No
141	Logan	36.86	-86.87	306	No
143	Lyon	37.05	-88.08	310	No
145	McCracken	37.06	-88.65	188	No
147	McCreary	36.73	-84.47	312	No
149	McLean	37.50	-87.24	313	No
151	Madison	37.70	-84.27	305	No
153	Magoffin	37.71	-83.06	307	No
155	Marion	37.55	-85.27	309	No
157	Marshall	36.90	-88.32	861	No
159	Martin	37.84	-82.52	1,014	No
161	Mason	38.61	-83.80	307	No
163	Meade	37.95	-86.13	311	No
165	Menifee	37.96	-83.60	307	No
167	Mercer	37.78	-84.85	308	No
169	Metcalfe	36.98	-85.63	309	No
171	Monroe	36.71	-85.71	309	No
173	Montgomery	38.03	-83.89	307	No
175	Morgan	37.91	-83.26	307	No
177	Muhlenberg	37.24	-87.14	310	No
179	Nelson	37.81	-85.46	314	No
181	Nicholas	38.32	-84.01	307	No
183	Ohio	37.46	-86.88	313	No
185	Oldham	38.38	-85.45	314	No
187	Owen	38.51	-84.81	315	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
189	Owsley	37.41	-83.70	305	No
191	Pendleton	38.70	-84.35	315	No
193	Perry	37.25	-83.20	969	No
195	Pike	37.45	-82.41	1,014	No
197	Powell	37.84	-83.85	307	No
199	Pulaski	37.09	-84.60	305	No
201	Robertson	38.51	-84.05	315	No
203	Rockcastle	37.37	-84.33	305	No
205	Rowan	38.19	-83.43	307	No
207	Russell	37.00	-85.05	309	No
209	Scott	38.25	-84.57	308	No
211	Shelby	38.22	-85.21	314	No
213	Simpson	36.73	-86.58	306	No
215	Spencer	38.04	-85.34	314	No
217	Taylor	37.36	-85.35	309	No
219	Todd	36.82	-87.17	310	No
221	Trigg	36.85	-87.86	310	No
223	Trimble	38.61	-85.35	236	No
225	Union	37.65	-87.93	238	No
227	Warren	36.99	-86.42	306	No
229	Washington	37.73	-85.19	314	No
231	Wayne	36.82	-84.83	309	No
233	Webster	37.49	-87.69	238	No
235	Whitley	36.79	-84.13	312	No
237	Wolfe	37.74	-83.50	307	No
239	Woodford	38.07	-84.73	308	No
	Louisiana Parish's				
1	Acadia	30.27	-92.37	325	No
3	Allen	30.65	-92.82	325	No
5	Ascension	30.20	-90.94	322	No
7	Assumption	29.93	-91.05	322	No
9	Avoyelles	31.05	-92.06	316	No
11	Beauregard	30.73	-93.34	325	No
13	Bienville	32.39	-93.04	320	No
15	Bossier	32.59	-93.65	327	No
17	Caddo	32.53	-93.81	327	No
19	Calcasieu	30.24	-93.29	325	No
21	Caldwell	32.08	-92.13	329	No
23	Cameron	29.87	-93.21	325	Yes
25	Catahoula	31.65	-91.87	429	No
27	Claiborne	32.82	-93.03	327	No
29	Concordia	31.58	-91.54	429	No
31	De Soto	32.06	-93.76	900	No
33	East Baton Rouge	30.48	-91.12	319	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
35	East Carroll	32.76	-91.20	318	No
37	East Feliciana	30.84	-91.08	319	No
39	Evangeline	30.69	-92.38	325	No
41	Franklin	32.11	-91.71	329	No
43	Grant	31.58	-92.57	316	No
45	Iberia	29.98	-91.80	323	Yes
47	Iberville	30.28	-91.29	319	No
49	Jackson	32.29	-92.60	320	No
51	Jefferson	29.94	-90.15	321	Yes
53	Jefferson Davis	30.25	-92.75	325	No
55	Lafayette	30.21	-92.04	326	No
57	Lafourche	29.62	-90.58	324	Yes
59	La Salle	31.73	-92.19	316	No
61	Lincoln	32.57	-92.66	320	No
63	Livingston	30.47	-90.80	319	No
65	Madison	32.39	-91.19	328	No
67	Morehouse	32.80	-91.86	318	No
69	Natchitoches	31.74	-93.10	316	No
71	Orleans	29.97	-90.06	321	Yes
73	Ouachita	32.51	-92.12	320	No
75	Plaquemines	29.57	-89.78	324	Yes
77	Pointe Coupee	30.65	-91.53	319	No
79	Rapides	31.26	-92.48	316	No
81	Red River	32.07	-93.34	327	No
83	Richland	32.43	-91.73	329	No
85	Sabine	31.56	-93.56	316	No
87	St. Bernard	29.92	-89.89	321	Yes
89	St. Charles	29.94	-90.40	324	Yes
91	St. Helena	30.81	-90.73	317	No
93	St. James	30.02	-90.76	322	No
95	St. John the Baptist	30.07	-90.53	322	Yes
97	St. Landry	30.53	-92.10	326	No
99	St. Martin	30.19	-91.78	326	No
101	St. Mary	29.74	-91.37	323	Yes
103	St. Tammany	30.40	-89.93	321	Yes
105	Tangipahoa	30.61	-90.46	317	Yes
107	Tensas	31.97	-91.31	328	No
109	Terrebonne	29.54	-90.74	324	Yes
111	Union	32.81	-92.39	320	No
113	Vermilion	29.96	-92.22	326	Yes
115	Vernon	31.12	-93.21	316	No
117	Washington	30.83	-89.98	321	No
119	Webster	32.73	-93.34	327	No
121	West Baton Rouge	30.45	-91.26	319	No
123	West Carroll	32.82	-91.42	318	No
125	West Feliciana	30.87	-91.39	434	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
127	Winn	31.95	-92.64	320	No
		Maine Counties			
1	Androscoggin	44.14	-70.22	333	No
3	Aroostook	46.64	-68.26	337	No
5	Cumberland	43.78	-70.33	336	Yes
7	Franklin	44.88	-70.39	331	No
9	Hancock	44.51	-68.42	335	Yes
11	Kennebec	44.40	-69.78	332	No
13	Knox	44.12	-69.13	332	Yes
15	Lincoln	44.01	-69.54	332	Yes
17	Oxford	44.32	-70.71	333	No
19	Penobscot	45.17	-68.72	335	No
21	Piscataquis	45.57	-69.33	338	No
23	Sagadahoc	43.95	-69.86	332	Yes
25	Somerset	45.13	-69.85	331	No
27	Waldo	44.47	-69.12	335	Yes
29	Washington	44.94	-67.55	339	Yes
31	York	43.45	-70.66	336	Yes
		Maryland Counties			
1	Allegany	39.62	-78.80	347	No
3	Anne Arundel	39.06	-76.58	344	Yes
5	Baltimore	39.37	-76.61	340	Yes
9	Calvert	38.51	-76.52	348	Yes
11	Caroline	38.88	-75.83	124	No
13	Carroll	39.55	-77.01	351	No
15	Cecil	39.59	-75.95	125	Yes
17	Charles	38.52	-76.97	348	Yes
19	Dorchester	38.55	-75.98	341	Yes
21	Frederick	39.46	-77.41	968	No
23	Garrett	39.51	-79.31	347	No
25	Harford	39.53	-76.29	340	Yes
27	Howard	39.22	-76.86	345	No
29	Kent	39.26	-76.05	342	Yes
31	Montgomery	39.07	-77.12	343	No
33	Prince George's	38.91	-76.88	344	No
35	Queen Anne's	39.05	-76.10	342	Yes
37	St. Mary's	38.29	-76.60	348	Yes
39	Somerset	38.11	-75.77	349	Yes
41	Talbot	38.77	-76.11	341	Yes
43	Washington	39.61	-77.77	1,010	No
45	Wicomico	38.38	-75.59	350	Yes
47	Worcester	38.27	-75.26	350	Yes

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
		Maryland Cities			
510	Baltimore	39.31	-76.62	340	Yes
		Massachusetts Counties			
1	Barnstable	41.70	-70.30	359	Yes
3	Berkshire	42.40	-73.21	121	No
5	Bristol	41.78	-71.10	360	Yes
7	Dukes	41.41	-70.61	358	Yes
9	Essex	42.64	-70.97	357	Yes
11	Franklin	42.59	-72.57	352	No
13	Hampden	42.13	-72.57	352	No
15	Hampshire	42.32	-72.62	352	No
17	Middlesex	42.46	-71.28	354	No
19	Nantucket	41.28	-70.09	358	Yes
21	Norfolk	42.20	-71.15	353	Yes
23	Plymouth	41.98	-70.82	359	Yes
25	Suffolk	42.33	-71.07	354	Yes
27	Worcester	42.33	-71.84	355	No
		Michigan Counties			
1	Alcona	44.68	-83.56	368	No
3	Alger	46.39	-86.63	377	No
5	Allegan	42.59	-85.90	362	No
7	Alpena	45.03	-83.54	368	No
9	Antrim	45.01	-85.18	366	No
11	Arenac	44.06	-83.87	368	No
13	Baraga	46.71	-88.40	381	No
15	Barry	42.61	-85.32	362	No
17	Bay	43.64	-83.92	363	No
19	Benzie	44.64	-86.04	370	No
21	Berrien	41.97	-86.43	235	No
23	Branch	41.93	-85.05	367	No
25	Calhoun	42.28	-85.08	367	No
27	Cass	41.92	-86.02	231	No
29	Charlevoix	45.25	-85.10	366	No
31	Cheboygan	45.48	-84.51	366	No
33	Chippewa	46.32	-84.50	366	No
35	Clare	43.97	-84.86	376	No
37	Clinton	42.93	-84.57	379	No
39	Crawford	44.68	-84.64	368	No
41	Delta	45.88	-86.95	369	No
43	Dickinson	45.87	-87.97	372	No
45	Eaton	42.62	-84.78	379	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
47	Emmet	45.48	-84.91	366	No
49	Genesee	43.01	-83.70	379	No
51	Gladwin	43.98	-84.42	376	No
53	Gogebic	46.40	-89.80	373	No
55	Grand Traverse	44.70	-85.57	365	No
57	Gratiot	43.30	-84.62	363	No
59	Hillsdale	41.90	-84.60	371	No
61	Houghton	47.03	-88.61	381	No
63	Huron	43.84	-83.07	368	No
65	Ingham	42.67	-84.47	379	No
67	Ionia	42.96	-85.08	363	No
69	Iosco	44.36	-83.57	368	No
71	Iron	46.20	-88.56	381	No
73	Isabella	43.63	-84.84	376	No
75	Jackson	42.24	-84.40	371	No
77	Kalamazoo	42.26	-85.56	374	No
79	Kalkaska	44.71	-85.12	365	No
81	Kent	42.99	-85.61	362	No
83	Keweenaw	47.43	-88.24	381	No
85	Lake	43.95	-85.83	365	No
87	Lapeer	43.07	-83.23	375	No
89	Leelanau	44.95	-85.77	369	No
91	Lenawee	41.92	-84.07	361	No
93	Livingston	42.57	-83.87	364	No
95	Luce	46.46	-85.59	378	No
97	Mackinac	46.04	-84.99	378	No
99	Macomb	42.59	-82.95	375	No
101	Manistee	44.32	-86.14	370	No
103	Marquette	46.46	-87.61	377	No
105	Mason	43.98	-86.31	370	No
107	Mecosta	43.65	-85.35	365	No
109	Menominee	45.46	-87.57	372	No
111	Midland	43.64	-84.34	376	No
113	Missaukee	44.33	-85.15	365	No
115	Monroe	41.92	-83.48	361	No
117	Montcalm	43.31	-85.18	363	No
119	Montmorency	45.02	-84.15	366	No
121	Muskegon	43.25	-86.22	370	No
123	Newaygo	43.53	-85.81	365	No
125	Oakland	42.59	-83.31	375	No
127	Oceana	43.64	-86.29	370	No
129	Ogemaw	44.33	-84.13	368	No
131	Ontonagon	46.68	-89.28	373	No
133	Osceola	43.98	-85.35	365	No
135	Oscoda	44.68	-84.15	368	No
137	Otsego	45.01	-84.63	366	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
139	Ottawa	42.93	-86.05	362	No
141	Presque Isle	45.37	-83.93	366	No
143	Roscommon	44.36	-84.65	376	No
145	Saginaw	43.38	-84.00	379	No
147	St. Clair	42.92	-82.60	375	No
149	St. Joseph	41.90	-85.53	374	No
151	Sanilac	43.38	-82.76	375	No
153	Schoolcraft	46.14	-86.24	377	No
155	Shiawassee	42.94	-84.13	379	No
157	Tuscola	43.46	-83.43	379	No
159	Van Buren	42.26	-86.04	380	No
161	Washtenaw	42.26	-83.76	364	No
163	Wayne	42.34	-83.20	375	No
165	Wexford	44.33	-85.55	365	No
		Minnesota Counties			
1	Aitkin	46.60	-93.47	406	No
3	Anoka	45.20	-93.28	395	No
5	Becker	46.89	-95.74	386	No
7	Beltrami	47.72	-94.84	392	No
9	Benton	45.65	-94.07	397	No
11	Big Stone	45.41	-96.41	849	No
13	Blue Earth	44.09	-94.04	405	No
15	Brown	44.26	-94.70	399	No
17	Carlton	46.63	-92.60	385	No
19	Carver	44.84	-93.75	395	No
21	Cass	46.90	-94.37	408	No
23	Chippewa	45.00	-95.60	396	No
25	Chisago	45.48	-92.91	397	No
27	Clay	46.87	-96.57	382	No
29	Clearwater	47.53	-95.38	389	No
31	Cook	47.86	-90.50	407	No
33	Cottonwood	43.99	-95.17	399	No
35	Crow Wing	46.48	-94.11	401	No
37	Dakota	44.76	-93.12	388	No
39	Dodge	44.03	-92.84	411	No
41	Douglas	45.92	-95.44	398	No
43	Faribault	43.67	-93.95	409	No
45	Fillmore	43.68	-92.08	390	No
47	Freeborn	43.67	-93.35	383	No
49	Goodhue	44.41	-92.70	411	No
51	Grant	45.94	-95.99	398	No
53	Hennepin	44.97	-93.36	395	No
55	Houston	43.71	-91.47	1,035	No
57	Hubbard	47.05	-94.91	400	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
59	Isanti	45.55	-93.27	397	No
61	Itasca	47.43	-93.57	403	No
63	Jackson	43.68	-95.15	258	No
65	Kanabec	45.89	-93.29	397	No
67	Kandiyohi	45.16	-95.02	396	No
69	Kittson	48.76	-96.85	391	No
71	Koochiching	48.37	-93.66	384	No
73	Lac qui Parle	45.00	-96.16	394	No
75	Lake	47.50	-91.47	407	No
77	Lake of the Woods	48.70	-94.83	384	No
79	Le Sueur	44.36	-93.75	405	No
81	Lincoln	44.41	-96.27	402	No
83	Lyon	44.41	-95.83	402	No
85	McLeod	44.83	-94.26	399	No
87	Mahnomen	47.32	-95.82	389	No
89	Marshall	48.33	-96.48	391	No
91	Martin	43.68	-94.54	387	No
93	Meeker	45.13	-94.51	399	No
95	Mille Lacs	45.86	-93.64	397	No
97	Morrison	46.01	-94.35	401	No
99	Mower	43.66	-92.84	390	No
101	Murray	44.00	-95.74	402	No
103	Nicollet	44.32	-94.14	405	No
105	Nobles	43.66	-95.72	270	No
107	Norman	47.31	-96.53	382	No
109	Olmsted	44.01	-92.44	390	No
111	Otter Tail	46.41	-95.74	386	No
113	Pennington	48.09	-96.08	389	No
115	Pine	46.10	-92.83	397	No
117	Pipestone	44.01	-96.25	402	No
119	Polk	47.77	-96.41	382	No
121	Pope	45.59	-95.45	398	No
123	Ramsey	44.99	-93.11	395	No
125	Red Lake	47.87	-96.08	389	No
127	Redwood	44.41	-95.24	399	No
129	Renville	44.72	-94.93	399	No
131	Rice	44.35	-93.28	388	No
133	Rock	43.67	-96.24	270	No
135	Roseau	48.78	-95.78	404	No
137	St. Louis	47.37	-92.40	407	No
139	Scott	44.70	-93.51	388	No
141	Sherburne	45.42	-93.77	397	No
143	Sibley	44.57	-94.22	399	No
145	Stearns	45.54	-94.50	397	No
147	Steele	44.03	-93.22	383	No
149	Stevens	45.58	-95.98	398	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
151	Swift	45.28	-95.67	394	No
153	Todd	46.08	-94.88	401	No
155	Traverse	45.77	-96.50	398	No
157	Wabasha	44.29	-92.22	411	No
159	Wadena	46.54	-95.00	400	No
161	Waseca	44.03	-93.58	405	No
163	Washington	45.00	-92.91	395	No
165	Watonwan	43.98	-94.61	399	No
167	Wilkin	46.32	-96.48	678	No
169	Winona	44.01	-91.74	390	No
171	Wright	45.19	-93.92	395	No
173	Yellow Medicine	44.72	-95.83	396	No
		Mississippi Counties			
1	Adams	31.54	-91.35	429	No
3	Alcorn	34.91	-88.54	420	No
5	Amite	31.19	-90.84	434	No
7	Attala	33.08	-89.57	424	No
9	Benton	34.79	-89.18	432	No
11	Bolivar	33.80	-90.83	428	No
13	Calhoun	33.91	-89.32	433	No
15	Carroll	33.46	-89.91	424	No
17	Chickasaw	33.93	-88.94	412	No
19	Choctaw	33.34	-89.26	426	No
21	Claiborne	31.96	-90.92	430	No
23	Clarke	32.06	-88.73	425	No
25	Clay	33.63	-88.72	431	No
27	Coahoma	34.25	-90.57	418	No
29	Copiah	31.87	-90.40	416	No
31	Covington	31.64	-89.55	425	No
33	DeSoto	34.90	-89.99	423	No
35	Forrest	31.26	-89.28	422	No
37	Franklin	31.48	-90.90	416	No
39	George	30.86	-88.62	414	No
41	Greene	31.22	-88.64	422	No
43	Grenada	33.78	-89.80	433	No
45	Hancock	30.36	-89.46	414	Yes
47	Harrison	30.43	-89.08	414	Yes
49	Hinds	32.29	-90.31	417	No
51	Holmes	33.11	-90.05	424	No
53	Humphreys	33.13	-90.53	428	No
55	Issaquena	32.79	-90.99	421	No
57	Itawamba	34.28	-88.37	415	No
59	Jackson	30.46	-88.63	414	Yes
61	Jasper	32.00	-89.15	425	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
63	Jefferson	31.74	-91.05	430	No
65	Jefferson Davis	31.58	-89.82	427	No
67	Jones	31.65	-89.17	425	No
69	Kemper	32.75	-88.65	426	No
71	Lafayette	34.35	-89.51	432	No
73	Lamar	31.20	-89.47	422	No
75	Lauderdale	32.40	-88.68	425	No
77	Lawrence	31.55	-90.10	427	No
79	Leake	32.73	-89.53	424	No
81	Lee	34.28	-88.68	415	No
83	Leflore	33.56	-90.27	428	No
85	Lincoln	31.54	-90.45	416	No
87	Lowndes	33.51	-88.42	431	No
89	Madison	32.57	-90.08	417	No
91	Marion	31.24	-89.82	419	No
93	Marshall	34.77	-89.49	432	No
95	Monroe	33.90	-88.50	412	No
97	Montgomery	33.48	-89.65	424	No
99	Neshoba	32.75	-89.13	426	No
101	Newton	32.41	-89.12	425	No
103	Noxubee	33.12	-88.58	431	No
105	Oktibbeha	33.44	-88.86	431	No
107	Panola	34.36	-89.96	413	No
109	Pearl River	30.72	-89.61	321	No
111	Perry	31.21	-88.99	422	No
113	Pike	31.20	-90.43	416	No
115	Pontotoc	34.25	-89.02	432	No
117	Prentiss	34.62	-88.53	415	No
119	Quitman	34.26	-90.27	413	No
121	Rankin	32.27	-90.00	417	No
123	Scott	32.39	-89.52	417	No
125	Sharkey	32.92	-90.84	421	No
127	Simpson	31.91	-89.86	427	No
129	Smith	31.99	-89.52	425	No
131	Stone	30.80	-89.13	414	No
133	Sunflower	33.59	-90.58	428	No
135	Tallahatchie	33.94	-90.23	418	No
137	Tate	34.64	-89.96	423	No
139	Tippah	34.77	-88.93	415	No
141	Tishomingo	34.73	-88.24	415	No
143	Tunica	34.67	-90.37	423	No
145	Union	34.49	-89.00	415	No
147	Walthall	31.14	-90.11	419	No
149	Warren	32.34	-90.85	430	No
151	Washington	33.35	-90.96	421	No
153	Wayne	31.65	-88.65	425	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
155	Webster	33.59	-89.24	431	No
157	Wilkinson	31.18	-91.27	434	No
159	Winston	33.09	-89.05	426	No
161	Yalobusha	34.05	-89.73	433	No
163	Yazoo	32.80	-90.39	417	No
		Missouri Counties			
1	Adair	40.19	-92.59	453	No
3	Andrew	39.96	-94.82	439	No
5	Atchison	40.42	-95.45	494	No
7	Audrain	39.21	-91.80	447	No
9	Barry	36.70	-93.83	36	No
11	Barton	37.50	-94.33	442	No
13	Bates	38.25	-94.36	435	No
15	Benton	38.29	-93.30	438	No
17	Bollinger	37.34	-90.01	446	No
19	Boone	38.99	-92.31	447	No
21	Buchanan	39.72	-94.83	277	No
23	Butler	36.72	-90.39	35	No
25	Caldwell	39.66	-93.98	444	No
27	Callaway	38.82	-91.95	441	No
29	Camden	38.09	-92.77	443	No
31	Cape Girardeau	37.36	-89.63	446	No
33	Carroll	39.42	-93.48	436	No
35	Carter	36.95	-90.94	440	No
37	Cass	38.69	-94.38	298	No
39	Cedar	37.73	-93.89	445	No
41	Chariton	39.51	-92.98	436	No
43	Christian	37.02	-93.24	445	No
45	Clark	40.41	-91.73	451	No
47	Clay	39.25	-94.47	290	No
49	Clinton	39.60	-94.39	290	No
51	Cole	38.54	-92.24	441	No
53	Cooper	38.86	-92.80	441	No
55	Crawford	38.03	-91.33	450	No
57	Dade	37.42	-93.83	445	No
59	Dallas	37.68	-93.04	443	No
61	Daviess	39.96	-93.99	452	No
63	DeKalb	39.88	-94.41	439	No
65	Dent	37.63	-91.51	450	No
67	Douglas	36.93	-92.53	448	No
69	Dunklin	36.30	-90.07	437	No
71	Franklin	38.43	-91.04	454	No
73	Gasconade	38.45	-91.51	454	No
75	Gentry	40.20	-94.42	439	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
77	Greene	37.22	-93.32	445	No
79	Grundy	40.11	-93.59	452	No
81	Harrison	40.33	-93.97	452	No
83	Henry	38.39	-93.77	438	No
85	Hickory	37.92	-93.33	443	No
87	Holt	40.10	-95.22	439	No
89	Howard	39.15	-92.70	436	No
91	Howell	36.79	-91.88	38	No
93	Iron	37.54	-90.74	446	No
95	Jackson	39.02	-94.46	298	No
97	Jasper	37.15	-94.41	449	No
99	Jefferson	38.29	-90.50	218	No
101	Johnson	38.75	-93.80	438	No
103	Knox	40.14	-92.15	451	No
105	Laclede	37.66	-92.62	443	No
107	Lafayette	39.07	-93.80	444	No
109	Lawrence	37.06	-93.81	445	No
111	Lewis	40.09	-91.68	451	No
113	Lincoln	39.03	-90.93	454	No
115	Linn	39.83	-93.09	436	No
117	Livingston	39.78	-93.55	452	No
119	McDonald	36.62	-94.38	37	No
121	Macon	39.83	-92.56	451	No
123	Madison	37.50	-90.31	446	No
125	Maries	38.15	-91.90	450	No
127	Marion	39.77	-91.51	451	No
129	Mercer	40.43	-93.58	452	No
131	Miller	38.24	-92.48	441	No
133	Mississippi	36.84	-89.33	869	No
135	Moniteau	38.64	-92.60	441	No
137	Monroe	39.51	-91.99	447	No
139	Montgomery	38.94	-91.47	454	No
141	Morgan	38.36	-92.85	441	No
143	New Madrid	36.59	-89.68	437	No
145	Newton	36.90	-94.37	449	No
147	Nodaway	40.36	-94.88	439	No
149	Oregon	36.64	-91.43	38	No
151	Osage	38.46	-91.86	441	No
153	Ozark	36.63	-92.45	448	No
155	Pemiscot	36.19	-89.77	437	No
157	Perry	37.71	-89.84	446	No
159	Pettis	38.71	-93.26	438	No
161	Phelps	37.92	-91.77	450	No
163	Pike	39.36	-91.15	197	No
165	Platte	39.32	-94.73	290	No
167	Polk	37.61	-93.41	445	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
169	Pulaski	37.85	-92.20	450	No
171	Putnam	40.47	-93.01	453	No
173	Ralls	39.54	-91.50	447	No
175	Randolph	39.43	-92.48	436	No
177	Ray	39.32	-94.02	444	No
179	Reynolds	37.37	-90.98	440	No
181	Ripley	36.62	-90.81	440	No
183	St. Charles	38.78	-90.65	454	No
185	St. Clair	38.05	-93.78	435	No
186	Ste. Genevieve	37.91	-90.17	218	No
187	St. Francois	37.84	-90.51	446	No
189	St. Louis	38.65	-90.38	454	No
195	Saline	39.12	-93.20	436	No
197	Schuyler	40.47	-92.53	453	No
199	Scotland	40.44	-92.15	451	No
201	Scott	37.04	-89.58	446	No
203	Shannon	37.13	-91.40	38	No
205	Shelby	39.77	-92.09	451	No
207	Stoddard	36.85	-89.96	446	No
209	Stone	36.71	-93.46	36	No
211	Sullivan	40.21	-93.13	453	No
213	Taney	36.65	-93.17	36	No
215	Texas	37.29	-91.97	448	No
217	Vernon	37.85	-94.35	283	No
219	Warren	38.77	-91.14	454	No
221	Washington	37.96	-90.83	450	No
223	Wayne	37.11	-90.49	446	No
225	Webster	37.27	-92.90	443	No
227	Worth	40.48	-94.43	267	No
229	Wright	37.23	-92.47	448	No
		Missoura Cities			
510	St. Louis	38.63	-90.24	218	No
		Montana Counties			
1	Beaverhead	45.19	-112.87	463	No
3	Big Horn	45.51	-107.48	461	No
5	Blaine	48.46	-108.96	459	No
7	Broadwater	46.31	-111.49	474	No
9	Carbon	45.31	-109.09	484	No
11	Carter	45.56	-104.48	464	No
13	Cascade	47.43	-111.32	458	No
15	Chouteau	47.92	-110.40	468	No
17	Custer	46.32	-105.77	482	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
19	Daniels	48.79	-105.40	483	No
21	Dawson	47.17	-104.80	470	No
23	Deer Lodge	46.12	-112.99	471	No
25	Fallon	46.37	-104.41	482	No
27	Fergus	47.11	-109.45	480	No
29	Flathead	48.27	-114.32	477	No
31	Gallatin	45.66	-111.19	457	No
33	Garfield	47.21	-106.98	476	No
35	Glacier	48.63	-112.81	462	No
37	Golden Valley	46.39	-109.13	466	No
39	Granite	46.44	-113.37	471	No
41	Hill	48.56	-110.03	468	No
43	Jefferson	46.12	-112.12	474	No
45	Judith Basin	47.05	-110.18	480	No
47	Lake	47.65	-114.13	485	No
49	Lewis and Clark	46.81	-112.15	474	No
51	Liberty	48.55	-111.00	468	No
53	Lincoln	48.56	-115.36	478	No
55	McCone	47.64	-105.73	483	No
57	Madison	45.44	-111.93	488	No
59	Meagher	46.57	-110.87	474	No
61	Mineral	47.14	-114.97	472	No
63	Missoula	46.94	-113.97	485	No
65	Musselshell	46.55	-108.39	466	No
67	Park	45.65	-110.55	457	No
69	Petroleum	47.00	-108.29	466	No
71	Phillips	48.36	-107.82	467	No
73	Pondera	48.22	-112.20	487	No
75	Powder River	45.36	-105.63	464	No
77	Powell	46.63	-112.78	474	No
79	Prairie	46.89	-105.37	470	No
81	Ravalli	46.21	-114.12	471	No
83	Richland	47.78	-104.46	486	No
85	Roosevelt	48.21	-104.99	483	No
87	Rosebud	45.97	-106.65	461	No
89	Sanders	47.63	-115.08	472	No
91	Sheridan	48.71	-104.46	479	No
93	Silver Bow	45.96	-112.56	463	No
95	Stillwater	45.63	-109.37	484	No
97	Sweet Grass	45.86	-109.92	456	No
99	Teton	47.82	-112.15	460	No
101	Toole	48.60	-111.82	462	No
103	Treasure	46.25	-107.29	461	No
105	Valley	48.26	-106.56	467	No
107	Wheatland	46.45	-109.85	480	No
109	Wibaux	46.97	-104.19	470	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
111	Yellowstone	45.82	-108.46	475	No
		Nebraska Counties			
1	Adams	40.56	-98.46	510	No
3	Antelope	42.18	-98.06	522	No
5	Arthur	41.58	-101.68	515	No
7	Banner	41.53	-103.70	514	No
9	Blaine	41.87	-99.98	507	No
11	Boone	41.69	-98.03	490	No
13	Box Butte	42.17	-102.94	491	No
15	Boyd	42.90	-98.71	493	No
17	Brown	42.53	-99.87	524	No
19	Buffalo	40.79	-99.07	520	No
21	Burt	41.85	-96.34	530	No
23	Butler	41.23	-97.13	500	No
25	Cass	40.94	-96.09	532	No
27	Cedar	42.61	-97.24	509	No
29	Chase	40.51	-101.70	513	No
31	Cherry	42.65	-101.15	519	No
33	Cheyenne	41.20	-103.00	515	No
35	Clay	40.52	-98.04	510	No
37	Colfax	41.56	-97.09	500	No
39	Cuming	41.92	-96.77	531	No
41	Custer	41.39	-99.63	497	No
43	Dakota	42.43	-96.49	531	No
45	Dawes	42.73	-103.16	508	No
47	Dawson	40.84	-99.87	506	No
49	Deuel	41.08	-102.31	515	No
51	Dixon	42.47	-96.84	531	No
53	Dodge	41.52	-96.59	530	No
55	Douglas	41.26	-96.05	492	No
57	Dundy	40.11	-101.64	301	No
59	Fillmore	40.53	-97.57	504	No
61	Franklin	40.17	-98.94	503	No
63	Frontier	40.55	-100.40	499	No
65	Furnas	40.19	-99.91	495	No
67	Gage	40.25	-96.69	501	No
69	Garden	41.53	-102.34	515	No
71	Garfield	41.83	-99.04	521	No
73	Gosper	40.55	-99.84	512	No
75	Grant	41.90	-101.72	491	No
77	Greeley	41.57	-98.49	521	No
79	Hall	40.89	-98.42	510	No
81	Hamilton	40.88	-98.02	533	No
83	Harlan	40.15	-99.41	512	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
85	Hayes	40.52	-101.08	513	No
87	Hitchcock	40.20	-101.01	518	No
89	Holt	42.49	-98.73	493	No
91	Hooker	42.04	-101.08	507	No
93	Howard	41.21	-98.54	526	No
95	Jefferson	40.16	-97.15	501	No
97	Johnson	40.39	-96.25	529	No
99	Kearney	40.49	-98.96	520	No
101	Keith	41.17	-101.69	513	No
103	Keya Paha	42.87	-99.74	493	No
105	Kimball	41.21	-103.68	514	No
107	Knox	42.63	-97.85	509	No
109	Lancaster	40.80	-96.68	498	No
111	Lincoln	41.07	-100.76	499	No
113	Logan	41.51	-100.48	507	No
115	Loup	41.87	-99.42	497	No
117	McPherson	41.56	-101.03	507	No
119	Madison	41.96	-97.53	517	No
121	Merrick	41.15	-98.01	505	No
123	Morrill	41.70	-103.09	496	No
125	Nance	41.40	-97.95	505	No
127	Nemaha	40.39	-95.83	494	No
129	Nuckolls	40.15	-98.04	511	No
131	Otoe	40.67	-96.08	528	No
133	Pawnee	40.14	-96.21	523	No
135	Perkins	40.84	-101.63	513	No
137	Phelps	40.49	-99.41	512	No
139	Pierce	42.27	-97.61	522	No
141	Platte	41.52	-97.45	505	No
143	Polk	41.18	-97.59	505	No
145	Red Willow	40.18	-100.50	518	No
147	Richardson	40.13	-95.70	494	No
149	Rock	42.51	-99.47	493	No
151	Saline	40.55	-97.09	498	No
153	Sarpy	41.14	-96.03	492	No
155	Saunders	41.22	-96.61	492	No
157	Scotts Bluff	41.87	-103.69	1,059	No
159	Seward	40.88	-97.13	527	No
161	Sheridan	42.55	-102.43	491	No
163	Sherman	41.20	-98.95	516	No
165	Sioux	42.43	-103.79	508	No
167	Stanton	41.94	-97.21	517	No
169	Thayer	40.17	-97.60	511	No
171	Thomas	41.98	-100.57	507	No
173	Thurston	42.16	-96.56	531	No
175	Valley	41.55	-98.97	521	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
177	Washington	41.52	-96.20	530	No
179	Wayne	42.20	-97.10	531	No
181	Webster	40.18	-98.47	525	No
183	Wheeler	41.91	-98.51	522	No
185	York	40.87	-97.60	533	No
		Nevada Counties			
1	Churchill	39.50	-118.68	537	No
3	Clark	36.14	-115.12	535	No
5	Douglas	38.95	-119.73	86	No
7	Elko	41.00	-115.40	536	No
9	Esmeralda	37.83	-117.56	541	No
11	Eureka	40.01	-116.27	534	No
13	Humboldt	41.31	-117.80	545	No
15	Lander	40.03	-117.02	534	No
17	Lincoln	37.84	-114.75	935	No
19	Lyon	39.18	-119.25	537	No
21	Mineral	38.53	-118.47	541	No
23	Nye	37.90	-116.56	541	No
27	Pershing	40.43	-118.27	539	No
29	Storey	39.39	-119.61	542	No
31	Washoe	39.70	-119.76	542	No
33	White Pine	39.31	-114.92	540	No
		Nevada Cities			
510	Carson	39.16	-119.75	86	No
		New Hampshire Counties			
1	Belknap	43.52	-71.44	547	No
3	Carroll	43.82	-71.18	546	No
5	Cheshire	42.91	-72.24	550	No
7	Coos	44.61	-71.34	546	No
9	Grafton	43.90	-71.89	549	No
11	Hillsborough	42.90	-71.58	357	No
13	Merrimack	43.28	-71.64	547	No
15	Rockingham	42.96	-71.08	547	Yes
17	Strafford	43.26	-70.98	547	Yes
19	Sullivan	43.34	-72.25	954	No
		New Jersey Counties			
1	Atlantic	39.45	-74.62	551	Yes
3	Bergen	40.93	-74.06	617	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
5	Burlington	39.96	-74.78	558	No
7	Camden	39.87	-75.03	558	No
9	Cape May	39.09	-74.80	551	Yes
11	Cumberland	39.40	-75.09	123	Yes
13	Essex	40.77	-74.22	617	Yes
15	Gloucester	39.75	-75.14	558	No
17	Hudson	40.74	-74.07	617	Yes
19	Hunterdon	40.57	-74.90	554	No
21	Mercer	40.25	-74.71	555	No
23	Middlesex	40.49	-74.38	559	Yes
25	Monmouth	40.29	-74.13	557	Yes
27	Morris	40.87	-74.50	552	No
29	Ocean	39.92	-74.21	561	Yes
31	Passaic	40.95	-74.22	552	No
33	Salem	39.63	-75.39	125	Yes
35	Somerset	40.57	-74.58	560	No
37	Sussex	41.10	-74.67	553	No
39	Union	40.66	-74.30	560	Yes
41	Warren	40.80	-75.03	797	No
		New Mexico Counties			
1	Bernalillo	35.10	-106.61	577	No
3	Catron	33.96	-108.44	575	No
5	Chaves	33.36	-104.44	564	No
6	Cibola	35.05	-107.98	573	No
7	Colfax	36.57	-104.67	583	No
9	Curry	34.48	-103.25	904	No
11	De Baca	34.37	-104.23	571	No
13	Dona Ana	32.27	-106.78	574	No
15	Eddy	32.53	-104.26	564	No
17	Grant	32.71	-108.25	570	No
19	Guadalupe	34.86	-104.81	581	No
21	Harding	35.90	-103.88	563	No
23	Hidalgo	32.03	-108.74	572	No
25	Lea	32.73	-103.33	910	No
27	Lincoln	33.62	-105.54	565	No
28	Los Alamos	35.87	-106.28	573	No
29	Luna	32.18	-107.71	572	No
31	McKinley	35.57	-108.41	562	No
33	Mora	35.99	-104.92	583	No
35	Otero	32.79	-105.82	576	No
37	Quay	35.11	-103.62	584	No
39	Rio Arriba	36.45	-106.72	566	No
41	Roosevelt	34.12	-103.37	904	No
43	Sandoval	35.55	-106.82	573	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
45	San Juan	36.58	-108.30	562	No
47	San Miguel	35.50	-105.08	581	No
49	Santa Fe	35.59	-106.01	573	No
51	Sierra	33.10	-107.29	569	No
53	Socorro	34.17	-107.02	582	No
55	Taos	36.53	-105.65	579	No
57	Torrance	34.76	-106.00	577	No
59	Union	36.49	-103.42	568	No
61	Valencia	34.75	-106.77	577	No
		New York Counties			
1	Albany	42.66	-73.85	586	No
3	Allegany	42.23	-78.03	589	No
5	Bronx	40.85	-73.87	617	Yes
7	Broome	42.14	-75.89	792	No
9	Cattaraugus	42.23	-78.64	588	No
11	Cayuga	42.93	-76.56	590	No
13	Chautauqua	42.24	-79.35	604	No
15	Chemung	42.13	-76.79	603	No
17	Chenango	42.48	-75.61	618	No
19	Clinton	44.73	-73.59	601	No
21	Columbia	42.27	-73.66	121	No
23	Cortland	42.59	-76.10	600	No
25	Delaware	42.22	-75.00	591	No
27	Dutchess	41.72	-73.81	605	No
29	Erie	42.86	-78.80	595	No
31	Essex	44.16	-73.74	609	Yes
33	Franklin	44.60	-74.31	597	No
35	Fulton	43.08	-74.36	606	No
37	Genesee	43.00	-78.17	592	No
39	Greene	42.30	-74.02	586	No
41	Hamilton	43.61	-74.51	608	No
43	Herkimer	43.18	-74.97	611	No
45	Jefferson	44.04	-75.94	630	No
47	Kings	40.65	-73.95	617	Yes
49	Lewis	43.77	-75.45	614	No
51	Livingston	42.73	-77.77	607	No
53	Madison	42.94	-75.69	616	No
55	Monroe	43.16	-77.63	623	No
57	Montgomery	42.92	-74.39	606	No
59	Nassau	40.72	-73.60	617	Yes
61	New York	40.77	-73.97	617	No
63	Niagara	43.15	-78.85	613	No
65	Oneida	43.19	-75.39	616	No
67	Onondaga	43.05	-76.18	627	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
69	Ontario	42.88	-77.26	607	No
71	Orange	41.41	-74.28	631	No
73	Orleans	43.26	-78.24	594	No
75	Oswego	43.42	-76.25	620	No
77	Otsego	42.62	-75.04	599	No
79	Putnam	41.42	-73.73	631	No
81	Queens	40.71	-73.82	617	Yes
83	Rensselaer	42.70	-73.60	586	No
85	Richmond	40.58	-74.14	560	Yes
87	Rockland	41.12	-74.01	624	No
89	St. Lawrence	44.59	-75.16	596	No
91	Saratoga	43.04	-73.81	586	No
93	Schenectady	42.81	-73.97	586	No
95	Schoharie	42.61	-74.44	599	No
97	Schuyler	42.38	-76.87	603	No
99	Seneca	42.80	-76.83	590	No
101	Steuben	42.28	-77.36	587	No
103	Suffolk	40.83	-73.03	625	Yes
105	Sullivan	41.70	-74.75	622	No
107	Tioga	42.15	-76.33	603	No
109	Tompkins	42.46	-76.48	600	No
111	Ulster	41.86	-74.15	615	No
113	Warren	43.48	-73.75	608	No
115	Washington	43.27	-73.45	586	No
117	Wayne	43.15	-77.06	590	No
119	Westchester	41.06	-73.79	624	Yes
121	Wyoming	42.70	-78.20	592	No
123	Yates	42.63	-77.07	607	No
	North Carolina Counties				
1	Alamance	36.08	-79.41	634	No
3	Alexander	35.91	-81.18	654	No
5	Alleghany	36.50	-81.14	650	No
7	Anson	34.98	-80.10	812	No
9	Ashe	36.42	-81.49	633	No
11	Avery	36.09	-81.92	633	No
13	Beaufort	35.49	-76.91	642	Yes
15	Bertie	36.10	-76.99	635	Yes
17	Bladen	34.60	-78.59	645	No
19	Brunswick	34.00	-78.23	653	Yes
21	Buncombe	35.60	-82.53	647	No
23	Burke	35.74	-81.64	649	No
25	Cabarrus	35.41	-80.59	651	No
27	Caldwell	35.90	-81.52	643	No
29	Camden	36.35	-76.18	636	Yes

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
31	Carteret	34.74	-76.77	642	Yes
33	Caswell	36.41	-79.32	962	No
35	Catawba	35.70	-81.25	654	No
37	Chatham	35.70	-79.28	634	No
39	Cherokee	35.12	-84.01	857	No
41	Chowan	36.11	-76.63	635	Yes
43	Clay	35.04	-83.79	857	No
45	Cleveland	35.31	-81.53	649	No
47	Columbus	34.27	-78.68	645	No
49	Craven	35.10	-77.06	642	Yes
51	Cumberland	35.06	-78.91	637	No
53	Currituck	36.40	-75.96	636	Yes
55	Dare	35.84	-75.66	636	Yes
57	Davidson	35.82	-80.20	651	No
59	Davie	35.93	-80.54	651	No
61	Duplin	34.92	-77.99	638	No
63	Durham	36.00	-78.90	634	No
65	Edgecombe	35.92	-77.64	655	No
67	Forsyth	36.11	-80.24	651	No
69	Franklin	36.05	-78.31	644	No
71	Gaston	35.28	-81.17	830	No
73	Gates	36.45	-76.74	635	Yes
75	Graham	35.35	-83.80	641	No
77	Granville	36.28	-78.65	639	No
79	Greene	35.48	-77.69	638	No
81	Guilford	36.05	-79.85	634	No
83	Halifax	36.33	-77.66	655	No
85	Harnett	35.35	-78.78	637	No
87	Haywood	35.52	-82.96	656	No
89	Henderson	35.32	-82.47	640	No
91	Hertford	36.34	-77.00	635	Yes
93	Hoke	34.98	-79.24	637	No
95	Hyde	35.51	-76.22	635	Yes
97	Iredell	35.74	-80.87	654	No
99	Jackson	35.31	-83.18	656	No
101	Johnston	35.53	-78.37	652	No
103	Jones	35.04	-77.38	642	Yes
105	Lee	35.47	-79.17	634	No
107	Lenoir	35.25	-77.63	642	No
109	Lincoln	35.48	-81.21	654	No
111	McDowell	35.69	-82.04	646	No
113	Macon	35.15	-83.37	641	No
115	Madison	35.85	-82.67	647	No
117	Martin	35.84	-77.12	655	No
119	Mecklenburg	35.23	-80.83	830	No
121	Mitchell	35.98	-82.14	633	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
123	Montgomery	35.34	-79.90	632	No
125	Moore	35.24	-79.45	637	No
127	Nash	35.95	-77.93	655	No
129	New Hanover	34.20	-77.90	653	Yes
131	Northampton	36.44	-77.47	655	No
133	Onslow	34.71	-77.37	642	Yes
135	Orange	36.01	-79.10	634	No
137	Pamlico	35.12	-76.75	642	Yes
139	Pasquotank	36.29	-76.25	636	Yes
141	Pender	34.50	-77.90	653	Yes
143	Perquimans	36.17	-76.45	635	Yes
145	Person	36.39	-78.99	962	No
147	Pitt	35.59	-77.39	655	Yes
149	Polk	35.26	-82.21	640	No
151	Randolph	35.75	-79.81	632	No
153	Richmond	34.95	-79.71	812	No
155	Robeson	34.66	-79.11	645	No
157	Rockingham	36.41	-79.77	962	No
159	Rowan	35.62	-80.52	651	No
161	Rutherford	35.37	-81.93	646	No
163	Sampson	35.00	-78.39	637	No
165	Scotland	34.82	-79.47	812	No
167	Stanly	35.32	-80.23	632	No
169	Stokes	36.37	-80.27	650	No
171	Surry	36.43	-80.67	650	No
173	Swain	35.42	-83.45	656	No
175	Transylvania	35.20	-82.76	640	No
177	Tyrrell	35.84	-76.24	635	Yes
179	Union	35.00	-80.57	648	No
181	Vance	36.34	-78.40	639	No
183	Wake	35.80	-78.67	634	No
185	Warren	36.44	-78.11	639	No
187	Washington	35.86	-76.62	635	Yes
189	Watauga	36.22	-81.70	633	No
191	Wayne	35.36	-78.00	638	No
193	Wilkes	36.19	-81.16	643	No
195	Wilson	35.72	-77.93	655	No
197	Yadkin	36.17	-80.68	650	No
199	Yancey	35.91	-82.30	647	No
	North Dakota Counties				
1	Adams	46.09	-102.60	665	No
3	Barnes	46.92	-98.06	667	No
5	Benson	48.08	-99.38	677	No
7	Billings	46.99	-103.36	659	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
9	Bottineau	48.77	-100.79	657	No
11	Bowman	46.13	-103.42	665	No
13	Burke	48.82	-102.51	658	No
15	Burleigh	46.89	-100.64	670	No
17	Cass	46.90	-97.08	382	No
19	Cavalier	48.76	-98.46	668	No
21	Dickey	46.10	-98.45	662	No
23	Divide	48.83	-103.45	658	No
25	Dunn	47.30	-102.57	660	No
27	Eddy	47.75	-98.98	667	No
29	Emmons	46.27	-100.19	673	No
31	Foster	47.46	-98.89	667	No
33	Golden Valley	46.91	-103.89	470	No
35	Grand Forks	47.91	-97.30	664	No
37	Grant	46.41	-101.71	672	No
39	Griggs	47.46	-98.21	671	No
41	Hettinger	46.43	-102.51	672	No
43	Kidder	47.00	-99.79	673	No
45	LaMoure	46.45	-98.53	662	No
47	Logan	46.46	-99.51	673	No
49	McHenry	48.23	-100.66	677	No
51	McIntosh	46.11	-99.48	839	No
53	McKenzie	47.81	-103.42	660	No
55	McLean	47.58	-101.24	670	No
57	Mercer	47.28	-101.69	676	No
59	Morton	46.79	-101.29	670	No
61	Mountrail	48.20	-102.34	660	No
63	Nelson	47.91	-98.18	671	No
65	Oliver	47.14	-101.39	670	No
67	Pembina	48.77	-97.55	675	No
69	Pierce	48.25	-99.99	677	No
71	Ramsey	48.22	-98.75	668	No
73	Ransom	46.48	-97.67	669	No
75	Renville	48.73	-101.64	657	No
77	Richland	46.25	-96.90	678	No
79	Rolette	48.79	-99.85	679	No
81	Sargent	46.11	-97.57	669	No
83	Sheridan	47.61	-100.33	677	No
85	Sioux	46.14	-100.87	661	No
87	Slope	46.43	-103.44	674	No
89	Stark	46.85	-102.71	659	No
91	Steele	47.47	-97.72	671	No
93	Stutsman	46.97	-98.87	667	No
95	Towner	48.67	-99.24	668	No
97	Traill	47.45	-97.19	666	No
99	Walsh	48.36	-97.68	663	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
101	Ward	48.26	-101.49	677	No
103	Wells	47.62	-99.66	677	No
105	Williams	48.34	-103.50	658	No
		Ohio Counties			
1	Adams	38.85	-83.50	688	No
3	Allen	40.77	-84.12	690	No
5	Ashland	40.83	-82.28	704	No
7	Ashtabula	41.78	-80.75	789	No
9	Athens	39.36	-82.08	691	No
11	Auglaize	40.55	-84.25	690	No
13	Belmont	40.03	-80.91	681	No
15	Brown	38.93	-83.87	688	No
17	Butler	39.43	-84.51	227	No
19	Carroll	40.60	-81.11	693	No
21	Champaign	40.13	-83.77	700	No
23	Clark	39.92	-83.83	700	No
25	Clermont	39.06	-84.18	688	No
27	Clinton	39.42	-83.83	688	No
29	Columbiana	40.77	-80.74	693	No
31	Coshocton	40.29	-81.89	684	No
33	Crawford	40.83	-82.88	680	No
35	Cuyahoga	41.46	-81.66	689	No
37	Darke	40.13	-84.61	687	No
39	Defiance	41.30	-84.46	702	No
41	Delaware	40.25	-83.02	685	No
43	Erie	41.40	-82.63	694	No
45	Fairfield	39.78	-82.64	683	No
47	Fayette	39.56	-83.46	688	No
49	Franklin	39.99	-83.00	685	No
51	Fulton	41.60	-84.12	702	No
53	Gallia	38.84	-82.28	1,015	No
55	Geauga	41.50	-81.22	689	No
57	Greene	39.71	-83.95	700	No
59	Guernsey	40.02	-81.52	696	No
61	Hamilton	39.18	-84.49	227	No
63	Hancock	41.03	-83.65	686	No
65	Hardin	40.67	-83.65	690	No
67	Harrison	40.30	-81.08	681	No
69	Henry	41.34	-84.07	702	No
71	Highland	39.21	-83.58	688	No
73	Hocking	39.52	-82.45	683	No
75	Holmes	40.56	-81.93	692	No
77	Huron	41.16	-82.62	694	No
79	Jackson	39.02	-82.61	703	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
81	Jefferson	40.36	-80.73	1,013	No
83	Knox	40.40	-82.43	692	No
85	Lake	41.69	-81.30	689	No
87	Lawrence	38.53	-82.55	697	No
89	Licking	40.07	-82.48	696	No
91	Logan	40.39	-83.79	700	No
93	Lorain	41.37	-82.14	695	No
95	Lucas	41.65	-83.61	361	No
97	Madison	39.90	-83.38	700	No
99	Mahoning	41.05	-80.71	701	No
101	Marion	40.58	-83.13	680	No
103	Medina	41.11	-81.87	682	No
105	Meigs	39.06	-82.01	1,015	No
107	Mercer	40.53	-84.62	225	No
109	Miami	40.06	-84.24	687	No
111	Monroe	39.73	-81.08	681	No
113	Montgomery	39.75	-84.22	700	No
115	Morgan	39.62	-81.84	691	No
117	Morrow	40.53	-82.81	685	No
119	Muskingum	39.96	-81.98	696	No
121	Noble	39.77	-81.47	691	No
123	Ottawa	41.54	-83.04	694	No
125	Paulding	41.12	-84.59	702	No
127	Perry	39.74	-82.22	696	No
129	Pickaway	39.64	-83.00	683	No
131	Pike	39.07	-83.04	703	No
133	Portage	41.17	-81.25	689	No
135	Preble	39.74	-84.64	687	No
137	Putnam	41.01	-84.12	686	No
139	Richland	40.77	-82.54	680	No
141	Ross	39.34	-83.03	703	No
143	Sandusky	41.35	-83.13	698	No
145	Scioto	38.79	-82.94	697	No
147	Seneca	41.13	-83.17	698	No
149	Shelby	40.33	-84.19	700	No
151	Stark	40.82	-81.38	693	No
153	Summit	41.10	-81.52	682	No
155	Trumbull	41.24	-80.76	701	No
157	Tuscarawas	40.46	-81.47	692	No
159	Union	40.27	-83.37	685	No
161	Van Wert	40.86	-84.57	225	No
163	Vinton	39.24	-82.47	703	No
165	Warren	39.44	-84.22	688	No
167	Washington	39.45	-81.49	691	No
169	Wayne	40.83	-81.89	704	No
171	Williams	41.55	-84.58	224	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
173	Wood	41.41	-83.61	686	No
175	Wyandot	40.86	-83.30	699	No
		Oklahoma Counties			
1	Adair	35.90	-94.64	745	No
3	Alfalfa	36.70	-98.33	714	No
5	Atoka	34.38	-96.09	707	No
7	Beaver	36.74	-100.50	710	No
9	Beckham	35.32	-99.60	718	No
11	Blaine	35.92	-98.44	738	No
13	Bryan	33.97	-96.34	716	No
15	Caddo	35.14	-98.34	713	No
17	Canadian	35.52	-97.90	730	No
19	Carter	34.21	-97.22	708	No
21	Cherokee	35.89	-95.00	745	No
23	Choctaw	34.02	-95.51	727	No
25	Cimarron	36.75	-102.40	711	No
27	Cleveland	35.25	-97.42	733	No
29	Coal	34.58	-96.30	705	No
31	Comanche	34.63	-98.42	731	No
33	Cotton	34.30	-98.36	746	No
35	Craig	36.70	-95.17	734	No
37	Creek	35.97	-96.30	740	No
39	Custer	35.60	-98.92	747	No
41	Delaware	36.47	-94.82	37	No
43	Dewey	36.00	-99.03	736	No
45	Ellis	36.27	-99.80	736	No
47	Garfield	36.39	-97.83	717	No
49	Garvin	34.72	-97.29	741	No
51	Grady	35.05	-97.90	713	No
53	Grant	36.79	-97.79	728	No
55	Greer	34.93	-99.50	732	No
57	Harmon	34.72	-99.87	732	No
59	Harper	36.79	-99.70	712	No
61	Haskell	35.24	-95.10	748	No
63	Hughes	35.08	-96.30	725	No
65	Jackson	34.61	-99.38	706	No
67	Jefferson	34.13	-97.88	746	No
69	Johnston	34.28	-96.68	716	No
71	Kay	36.78	-97.17	737	No
73	Kingfisher	35.94	-97.92	730	No
75	Kiowa	34.93	-99.00	724	No
77	Latimer	34.86	-95.26	748	No
79	Le Flore	34.98	-94.68	39	No
81	Lincoln	35.70	-96.86	733	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
83	Logan	35.89	-97.44	721	No
85	Love	33.94	-97.19	708	No
87	McClain	35.04	-97.47	741	No
89	McCurtain	34.11	-94.79	881	No
91	McIntosh	35.38	-95.60	748	No
93	Major	36.31	-98.45	738	No
95	Marshall	34.01	-96.73	716	No
97	Mayes	36.31	-95.21	715	No
99	Murray	34.48	-97.04	708	No
101	Muskogee	35.69	-95.37	735	No
103	Noble	36.37	-97.24	743	No
105	Nowata	36.78	-95.62	709	No
107	Okfuskee	35.44	-96.30	739	No
109	Oklahoma	35.51	-97.50	721	No
111	Okmulgee	35.60	-95.97	740	No
113	Osage	36.57	-96.35	742	No
115	Ottawa	36.86	-94.84	734	No
117	Pawnee	36.28	-96.58	742	No
119	Payne	36.07	-96.96	744	No
121	Pittsburg	34.94	-95.71	725	No
123	Pontotoc	34.75	-96.66	705	No
125	Pottawatomie	35.27	-96.94	733	No
127	Pushmataha	34.42	-95.36	707	No
129	Roger Mills	35.67	-99.67	722	No
131	Rogers	36.33	-95.63	715	No
133	Seminole	35.17	-96.60	725	No
135	Sequoyah	35.48	-94.79	748	No
137	Stephens	34.50	-97.94	746	No
139	Texas	36.75	-101.47	720	No
141	Tillman	34.38	-98.93	706	No
143	Tulsa	36.12	-95.94	715	No
145	Wagoner	35.97	-95.54	735	No
147	Washington	36.73	-95.94	709	No
149	Washita	35.30	-99.03	724	No
151	Woods	36.75	-98.75	714	No
153	Woodward	36.41	-99.33	736	No
		Oregon Counties			
1	Baker	44.73	-117.79	782	No
3	Benton	44.55	-123.33	754	No
5	Clackamas	45.31	-122.48	763	No
7	Clatsop	46.04	-123.77	781	Yes
9	Columbia	45.93	-123.01	988	Yes
11	Coos	43.24	-124.15	774	Yes
13	Crook	44.21	-120.53	777	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
15	Curry	42.40	-124.28	751	Yes
17	Deschutes	44.00	-121.34	750	No
19	Douglas	43.29	-123.29	779	Yes
21	Gilliam	45.31	-120.15	753	No
23	Grant	44.49	-118.93	764	No
25	Harney	43.46	-119.04	775	No
27	Hood River	45.60	-121.61	766	No
29	Jackson	42.39	-122.79	749	No
31	Jefferson	44.58	-121.24	777	No
33	Josephine	42.36	-123.43	762	No
35	Klamath	42.66	-121.65	756	No
37	Lake	42.71	-120.58	775	No
39	Lane	43.99	-123.08	755	Yes
41	Lincoln	44.71	-123.94	773	Yes
43	Linn	44.54	-122.73	752	No
45	Malheur	43.60	-117.39	783	No
47	Marion	44.94	-122.84	770	No
49	Morrow	45.45	-119.59	764	No
51	Multnomah	45.52	-122.61	1,001	No
53	Polk	44.92	-123.37	754	No
55	Sherman	45.51	-120.75	772	No
57	Tillamook	45.48	-123.78	781	Yes
59	Umatilla	45.64	-118.82	776	No
61	Union	45.33	-118.03	782	No
63	Wallowa	45.58	-117.31	784	No
65	Wasco	45.35	-121.27	759	No
67	Washington	45.50	-122.92	760	No
69	Wheeler	44.73	-119.99	753	No
71	Yamhill	45.23	-123.22	770	No
	Pennsylvania Counties				
1	Adams	39.85	-77.18	802	No
3	Allegheny	40.44	-79.96	1,013	No
5	Armstrong	40.79	-79.50	791	No
7	Beaver	40.70	-80.31	793	No
9	Bedford	40.03	-78.47	791	No
11	Berks	40.38	-75.91	785	No
13	Blair	40.48	-78.38	791	No
15	Bradford	41.81	-76.50	798	No
17	Bucks	40.25	-75.03	558	No
19	Butler	40.87	-79.93	793	No
21	Cambria	40.44	-78.79	791	No
23	Cameron	41.45	-78.20	795	No
25	Carbon	40.89	-75.70	794	No
27	Centre	40.89	-77.83	796	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
29	Chester	39.99	-75.68	801	No
31	Clarion	41.16	-79.44	787	No
33	Clearfield	40.98	-78.50	795	No
35	Clinton	41.18	-77.54	796	No
37	Columbia	41.04	-76.39	788	No
39	Crawford	41.66	-80.12	789	No
41	Cumberland	40.20	-77.13	790	No
43	Dauphin	40.32	-76.80	790	No
45	Delaware	39.91	-75.35	801	No
47	Elk	41.42	-78.66	795	No
49	Erie	42.05	-80.06	789	No
51	Fayette	39.96	-79.72	799	No
53	Forest	41.51	-79.25	800	No
55	Franklin	39.89	-77.67	786	No
57	Fulton	39.92	-78.09	786	No
59	Greene	39.86	-80.16	799	No
61	Huntingdon	40.39	-77.99	796	No
63	Indiana	40.63	-79.12	791	No
65	Jefferson	41.10	-78.99	795	No
67	Juniata	40.56	-77.34	796	No
69	Lackawanna	41.43	-75.63	792	No
71	Lancaster	40.07	-76.28	802	No
73	Lawrence	40.98	-80.34	793	No
75	Lebanon	40.35	-76.45	790	No
77	Lehigh	40.61	-75.51	785	No
79	Luzerne	41.18	-75.95	788	No
81	Lycoming	41.27	-77.00	798	No
83	McKean	41.85	-78.59	588	No
85	Mercer	41.29	-80.31	789	No
87	Mifflin	40.59	-77.63	796	No
89	Monroe	41.05	-75.33	797	No
91	Montgomery	40.17	-75.32	801	No
93	Montour	41.00	-76.64	788	No
95	Northampton	40.70	-75.32	785	No
97	Northumberland	40.86	-76.69	788	No
99	Perry	40.42	-77.18	790	No
101	Philadelphia	40.00	-75.14	558	No
103	Pike	41.33	-75.00	622	No
105	Potter	41.79	-77.91	587	No
107	Schuylkill	40.72	-76.20	788	No
109	Snyder	40.78	-77.01	790	No
111	Somerset	40.00	-79.03	791	No
113	Sullivan	41.46	-76.51	798	No
115	Susquehanna	41.81	-75.78	792	No
117	Tioga	41.78	-77.22	603	No
119	Union	40.95	-77.01	796	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
121	Venango	41.40	-79.76	787	No
123	Warren	41.84	-79.26	800	No
125	Washington	40.18	-80.14	1,013	No
127	Wayne	41.58	-75.30	792	No
129	Westmoreland	40.33	-79.56	799	No
131	Wyoming	41.54	-75.96	792	No
133	York	39.93	-76.74	802	No
		Rhode Island Counties			
1	Bristol	41.72	-71.29	360	Yes
3	Kent	41.70	-71.48	804	Yes
5	Newport	41.54	-71.28	804	Yes
7	Providence	41.85	-71.46	360	Yes
9	Washington	41.45	-71.58	804	Yes
		South Carolina Counties			
1	Abbeville	34.24	-82.45	809	No
3	Aiken	33.55	-81.70	805	No
5	Allendale	32.99	-81.32	808	No
7	Anderson	34.53	-82.62	806	No
9	Bamberg	33.23	-81.08	808	No
11	Barnwell	33.30	-81.35	808	No
13	Beaufort	32.36	-80.73	807	Yes
15	Berkeley	33.13	-79.98	826	Yes
17	Calhoun	33.67	-80.79	814	No
19	Charleston	32.81	-79.99	811	Yes
21	Cherokee	35.08	-81.63	825	No
23	Chester	34.70	-81.12	830	No
25	Chesterfield	34.65	-80.16	812	No
27	Clarendon	33.68	-80.22	827	No
29	Colleton	32.89	-80.67	831	Yes
31	Darlington	34.33	-79.98	816	No
33	Dillon	34.39	-79.36	645	No
35	Dorchester	33.04	-80.33	826	No
37	Edgefield	33.77	-81.90	805	No
39	Fairfield	34.38	-81.09	829	No
41	Florence	34.07	-79.74	816	No
43	Georgetown	33.42	-79.31	817	Yes
45	Greenville	34.86	-82.35	806	No
47	Greenwood	34.19	-82.14	818	No
49	Hampton	32.80	-81.13	831	No
51	Horry	33.85	-78.94	815	Yes
53	Jasper	32.45	-81.02	807	Yes
55	Kershaw	34.29	-80.61	810	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
57	Lancaster	34.70	-80.71	819	No
59	Laurens	34.49	-82.01	821	No
61	Lee	34.19	-80.27	827	No
63	Lexington	33.95	-81.23	814	No
65	McCormick	33.89	-82.29	818	No
67	Marion	34.16	-79.34	815	No
69	Marlboro	34.64	-79.67	812	No
71	Newberry	34.27	-81.59	823	No
73	Oconee	34.72	-83.02	828	No
75	Orangeburg	33.46	-80.81	808	No
77	Pickens	34.83	-82.70	813	No
79	Richland	34.04	-80.97	814	No
81	Saluda	33.99	-81.70	824	No
83	Spartanburg	34.96	-82.00	821	No
85	Sumter	33.93	-80.39	827	No
87	Union	34.72	-81.61	825	No
89	Williamsburg	33.63	-79.74	820	No
91	York	34.98	-81.09	830	No
	South Dakota Counties				
3	Aurora	43.71	-98.54	833	No
5	Beadle	44.41	-98.26	841	No
7	Bennett	43.25	-101.74	519	No
9	Bon Homme	43.00	-97.87	848	No
11	Brookings	44.35	-96.80	402	No
13	Brown	45.54	-98.38	832	No
15	Brule	43.75	-99.10	833	No
17	Buffalo	44.05	-99.27	842	No
19	Butte	44.75	-103.62	1,043	No
21	Campbell	45.76	-100.05	839	No
23	Charles Mix	43.19	-98.54	833	No
25	Clark	44.85	-97.73	836	No
27	Clay	42.89	-96.98	853	No
29	Codington	44.94	-97.16	854	No
31	Corson	45.75	-101.14	661	No
33	Custer	43.69	-103.52	844	No
35	Davison	43.69	-98.08	834	No
37	Day	45.37	-97.57	836	No
39	Deuel	44.75	-96.66	854	No
41	Dewey	45.21	-101.00	838	No
43	Douglas	43.38	-98.36	834	No
45	Edmunds	45.42	-99.21	840	No
47	Fall River	43.34	-103.56	844	No
49	Faulk	45.09	-99.10	840	No
51	Grant	45.19	-96.71	849	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
53	Gregory	43.18	-99.21	833	No
55	Haakon	44.19	-101.47	837	No
57	Hamlin	44.67	-97.18	854	No
59	Hand	44.55	-98.99	843	No
61	Hanson	43.66	-97.79	834	No
63	Harding	45.62	-103.51	665	No
65	Hughes	44.42	-100.16	851	No
67	Hutchinson	43.33	-97.74	848	No
69	Hyde	44.58	-99.46	843	No
71	Jackson	43.77	-101.67	837	No
73	Jerauld	44.08	-98.55	841	No
75	Jones	43.95	-100.69	850	No
77	Kingsbury	44.38	-97.47	845	No
79	Lake	44.02	-97.10	845	No
81	Lawrence	44.40	-103.80	852	No
83	Lincoln	43.32	-96.72	835	No
85	Lyman	43.88	-99.81	846	No
87	McCook	43.66	-97.38	834	No
89	McPherson	45.76	-99.25	839	No
91	Marshall	45.74	-97.58	832	No
93	Meade	44.44	-103.09	852	No
95	Mellette	43.58	-100.79	855	No
97	Miner	44.02	-97.60	845	No
99	Minnehaha	43.60	-96.74	835	No
101	Moody	44.01	-96.66	402	No
103	Pennington	44.05	-103.11	852	No
105	Perkins	45.65	-102.44	665	No
107	Potter	45.05	-99.93	840	No
109	Roberts	45.62	-96.95	849	No
111	Sanborn	44.02	-98.12	841	No
113	Shannon	43.28	-102.49	519	No
115	Spink	44.93	-98.38	847	No
117	Stanley	44.38	-100.58	851	No
119	Sully	44.71	-100.09	851	No
121	Todd	43.23	-100.82	855	No
123	Tripp	43.36	-99.88	855	No
125	Turner	43.31	-97.13	835	No
127	Union	42.82	-96.66	853	No
129	Walworth	45.47	-100.14	839	No
135	Yankton	42.96	-97.39	848	No
137	Ziebach	44.97	-101.68	838	No
		Tennessee Counties			
1	Anderson	36.11	-84.19	312	No
3	Bedford	35.51	-86.44	868	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
5	Benton	36.07	-88.08	861	No
7	Bledsoe	35.62	-85.18	859	No
9	Blount	35.75	-83.97	866	No
11	Bradley	35.17	-84.86	857	No
13	Campbell	36.40	-84.14	312	No
15	Cannon	35.81	-86.06	864	No
17	Carroll	36.01	-88.44	862	No
19	Carter	36.31	-82.19	633	No
21	Cheatham	36.27	-87.08	860	No
23	Chester	35.43	-88.61	862	No
25	Claiborne	36.49	-83.67	312	No
27	Clay	36.56	-85.55	859	No
29	Cocke	35.93	-83.15	866	No
31	Coffee	35.47	-86.12	868	No
33	Crockett	35.80	-89.12	862	No
35	Cumberland	35.95	-85.00	859	No
37	Davidson	36.16	-86.77	865	No
39	Decatur	35.62	-88.12	870	No
41	DeKalb	35.98	-85.85	864	No
43	Dickson	36.12	-87.36	860	No
45	Dyer	36.06	-89.36	437	No
47	Fayette	35.20	-89.40	858	No
49	Fentress	36.39	-84.94	859	No
51	Franklin	35.20	-86.10	868	No
53	Gibson	35.97	-88.90	862	No
55	Giles	35.18	-87.03	863	No
57	Grainger	36.27	-83.50	866	No
59	Greene	36.19	-82.84	867	No
61	Grundy	35.35	-85.73	864	No
63	Hamblen	36.21	-83.28	866	No
65	Hamilton	35.10	-85.23	13	No
67	Hancock	36.52	-83.22	867	No
69	Hardeman	35.20	-89.00	862	No
71	Hardin	35.21	-88.21	870	No
73	Hawkins	36.44	-82.92	867	No
75	Haywood	35.56	-89.28	858	No
77	Henderson	35.64	-88.38	862	No
79	Henry	36.32	-88.31	861	No
81	Hickman	35.82	-87.45	860	No
83	Houston	36.30	-87.74	861	No
85	Humphreys	36.06	-87.77	860	No
87	Jackson	36.35	-85.66	859	No
89	Jefferson	36.06	-83.44	866	No
91	Johnson	36.43	-81.85	633	No
93	Knox	35.97	-83.96	866	No
95	Lake	36.33	-89.49	437	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
97	Lauderdale	35.79	-89.52	858	No
99	Lawrence	35.21	-87.38	870	No
101	Lewis	35.53	-87.52	870	No
103	Lincoln	35.14	-86.58	863	No
105	Loudon	35.74	-84.30	859	No
107	McMinn	35.42	-84.60	857	No
109	McNairy	35.18	-88.55	420	No
111	Macon	36.54	-86.01	306	No
113	Madison	35.63	-88.83	862	No
115	Marion	35.10	-85.63	868	No
117	Marshall	35.45	-86.78	863	No
119	Maury	35.62	-87.06	863	No
121	Meigs	35.52	-84.80	859	No
123	Monroe	35.51	-84.33	857	No
125	Montgomery	36.51	-87.37	856	No
127	Moore	35.28	-86.36	868	No
129	Morgan	36.12	-84.62	859	No
131	Obion	36.37	-89.09	869	No
133	Overton	36.35	-85.30	859	No
135	Perry	35.64	-87.87	870	No
137	Pickett	36.56	-85.13	859	No
139	Polk	35.11	-84.54	857	No
141	Putnam	36.16	-85.50	859	No
143	Rhea	35.58	-84.94	859	No
145	Roane	35.88	-84.53	859	No
147	Robertson	36.51	-86.85	856	No
149	Rutherford	35.88	-86.44	865	No
151	Scott	36.44	-84.49	312	No
153	Sequatchie	35.36	-85.40	864	No
155	Sevier	35.83	-83.54	866	No
157	Shelby	35.13	-89.93	423	No
159	Smith	36.24	-85.96	865	No
161	Stewart	36.48	-87.81	861	No
163	Sullivan	36.53	-82.38	867	No
165	Sumner	36.44	-86.49	865	No
167	Tipton	35.49	-89.73	858	No
169	Trousdale	36.39	-86.16	865	No
171	Unicoi	36.14	-82.41	647	No
173	Union	36.27	-83.81	312	No
175	Van Buren	35.70	-85.46	864	No
177	Warren	35.69	-85.80	864	No
179	Washington	36.32	-82.44	867	No
181	Wayne	35.24	-87.79	870	No
183	Weakley	36.29	-88.74	869	No
185	White	35.93	-85.48	859	No
187	Williamson	35.91	-86.88	865	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
189	Wilson	36.18	-86.34	865	No
		Texas Counties			
1	Anderson	31.80	-95.63	902	No
3	Andrews	32.34	-102.59	910	No
5	Angelina	31.29	-94.67	897	No
7	Aransas	28.05	-97.05	882	Yes
9	Archer	33.65	-98.69	746	No
11	Armstrong	35.01	-101.37	907	No
13	Atascosa	28.93	-98.53	909	No
15	Austin	29.85	-96.24	879	No
17	Bailey	34.11	-102.82	904	No
19	Bandera	29.72	-99.12	878	No
21	Bastrop	30.13	-97.30	891	No
23	Baylor	33.61	-99.25	895	No
25	Bee	28.41	-97.75	876	No
27	Bell	31.08	-97.52	913	No
29	Bexar	29.45	-98.51	909	No
31	Blanco	30.24	-98.38	877	No
33	Borden	32.72	-101.44	911	No
35	Bosque	31.89	-97.61	886	No
37	Bowie	33.44	-94.25	881	No
39	Brazoria	29.21	-95.40	885	Yes
41	Brazos	30.63	-96.34	879	No
43	Brewster	29.99	-103.40	873	No
45	Briscoe	34.48	-101.27	907	No
47	Brooks	27.10	-98.21	890	No
49	Brown	31.77	-99.00	880	No
51	Burleson	30.44	-96.62	879	No
53	Burnet	30.72	-98.22	896	No
55	Caldwell	29.82	-97.67	899	No
57	Calhoun	28.54	-96.62	885	Yes
59	Callahan	32.33	-99.37	871	No
61	Cameron	26.08	-97.56	908	Yes
63	Camp	32.98	-95.00	881	No
65	Carson	35.41	-101.27	903	No
67	Cass	33.08	-94.32	900	No
69	Castro	34.53	-102.28	904	No
71	Chambers	29.75	-94.68	897	Yes
73	Cherokee	31.89	-95.19	900	No
75	Childress	34.47	-100.21	706	No
77	Clay	33.77	-98.19	746	No
79	Cochran	33.65	-102.79	904	No
81	Coke	31.90	-100.51	874	No
83	Coleman	31.82	-99.44	880	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
85	Collin	33.13	-96.65	893	No
87	Collingsworth	34.93	-100.24	718	No
89	Colorado	29.64	-96.54	894	No
91	Comal	29.78	-98.23	905	No
93	Comanche	31.97	-98.56	886	No
95	Concho	31.34	-99.88	874	No
97	Cooke	33.62	-97.17	708	No
99	Coryell	31.31	-97.81	896	No
101	Cottle	34.06	-100.26	884	No
103	Crane	31.44	-102.45	901	No
105	Crockett	30.74	-101.36	901	No
107	Crosby	33.62	-101.32	884	No
109	Culberson	31.31	-104.58	875	No
111	Dallam	36.19	-102.66	568	No
113	Dallas	32.80	-96.79	893	No
115	Dawson	32.74	-101.94	910	No
117	Deaf Smith	34.90	-102.50	904	No
119	Delta	33.39	-95.71	893	No
121	Denton	33.13	-97.06	914	No
123	DeWitt	29.09	-97.33	894	No
125	Dickens	33.59	-100.82	884	No
127	Dimmit	28.46	-99.75	889	No
129	Donley	34.98	-100.81	903	No
131	Duval	27.71	-98.51	872	No
133	Eastland	32.35	-98.82	886	No
135	Ector	31.87	-102.43	901	No
137	Edwards	30.03	-100.25	887	No
139	Ellis	32.39	-96.80	883	No
141	El Paso	31.77	-106.35	888	No
143	Erath	32.21	-98.23	886	No
145	Falls	31.27	-96.96	913	No
147	Fannin	33.56	-96.15	893	No
149	Fayette	29.85	-96.92	891	No
151	Fisher	32.77	-100.40	911	No
153	Floyd	34.10	-101.35	907	No
155	Foard	33.99	-99.76	706	No
157	Fort Bend	29.58	-95.69	885	No
159	Franklin	33.10	-95.21	881	No
161	Freestone	31.71	-96.19	902	No
163	Frio	28.88	-99.11	909	No
165	Gaines	32.78	-102.67	910	No
167	Galveston	29.39	-94.94	897	Yes
169	Garza	33.18	-101.33	884	No
171	Gillespie	30.28	-98.93	877	No
173	Glasscock	31.86	-101.54	901	No
175	Goliad	28.69	-97.40	876	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
177	Gonzales	29.46	-97.51	899	No
179	Gray	35.44	-100.86	903	No
181	Grayson	33.65	-96.64	716	No
183	Gregg	32.49	-94.80	900	No
185	Grimes	30.49	-95.99	879	No
187	Guadalupe	29.59	-97.99	905	No
189	Hale	34.09	-101.79	907	No
191	Hall	34.54	-100.66	907	No
193	Hamilton	31.75	-98.10	886	No
195	Hansford	36.27	-101.31	720	No
197	Hardeman	34.28	-99.72	706	No
199	Hardin	30.32	-94.33	897	No
201	Harris	29.79	-95.36	897	Yes
203	Harrison	32.55	-94.35	900	No
205	Hartley	35.87	-102.55	912	No
207	Haskell	33.21	-99.79	895	No
209	Hays	29.99	-97.98	905	No
211	Hemphill	35.82	-100.27	903	No
213	Henderson	32.23	-95.92	883	No
215	Hidalgo	26.24	-98.16	908	No
217	Hill	32.00	-97.16	883	No
219	Hockley	33.62	-102.37	904	No
221	Hood	32.43	-97.80	914	No
223	Hopkins	33.13	-95.58	893	No
225	Houston	31.33	-95.43	902	No
227	Howard	32.24	-101.44	911	No
229	Hudspeth	31.49	-105.40	888	No
231	Hunt	33.11	-96.08	893	No
233	Hutchinson	35.74	-101.42	903	No
235	Irion	31.28	-100.97	874	No
237	Jack	33.21	-98.17	914	No
239	Jackson	28.92	-96.57	885	Yes
241	Jasper	30.77	-94.01	897	No
243	Jeff Davis	30.68	-104.13	875	No
245	Jefferson	29.98	-94.06	897	Yes
247	Jim Hogg	27.13	-98.70	890	No
249	Jim Wells	27.71	-98.09	872	No
251	Johnson	32.40	-97.34	914	No
253	Jones	32.79	-99.91	895	No
255	Karnes	28.88	-97.87	876	No
257	Kaufman	32.62	-96.30	883	No
259	Kendall	29.90	-98.73	878	No
261	Kenedy	26.86	-97.74	890	Yes
263	Kent	33.24	-100.72	911	No
265	Kerr	30.05	-99.20	878	No
267	Kimble	30.51	-99.75	898	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
269	King	33.61	-100.25	895	No
271	Kinney	29.30	-100.44	887	No
273	Kleberg	27.46	-97.85	872	Yes
275	Knox	33.53	-99.72	895	No
277	Lamar	33.65	-95.56	727	No
279	Lamb	34.06	-102.36	904	No
281	Lampasas	31.15	-98.22	896	No
283	La Salle	28.35	-99.16	889	No
285	Lavaca	29.39	-97.00	894	No
287	Lee	30.27	-96.95	879	No
289	Leon	31.28	-96.06	902	No
291	Liberty	30.16	-94.85	897	No
293	Limestone	31.58	-96.55	902	No
295	Lipscomb	36.29	-100.29	710	No
297	Live Oak	28.31	-98.11	876	No
299	Llano	30.71	-98.56	898	No
301	Loving	31.81	-103.61	906	No
303	Lubbock	33.57	-101.85	884	No
305	Lynn	33.16	-101.81	884	No
307	McCulloch	31.16	-99.34	880	No
309	McLennan	31.54	-97.17	913	No
311	McMullen	28.36	-98.54	872	No
313	Madison	30.95	-95.96	902	No
315	Marion	32.79	-94.42	900	No
317	Martin	32.26	-101.89	910	No
319	Mason	30.75	-99.21	898	No
321	Matagorda	28.86	-96.01	885	Yes
323	Maverick	28.74	-100.39	887	No
325	Medina	29.29	-99.03	909	No
327	Menard	30.90	-99.81	874	No
329	Midland	31.97	-102.07	901	No
331	Milam	30.78	-97.01	913	No
333	Mills	31.50	-98.59	880	No
335	Mitchell	32.34	-100.89	911	No
337	Montague	33.66	-97.74	746	No
339	Montgomery	30.27	-95.47	897	No
341	Moore	35.85	-101.90	912	No
343	Morris	33.06	-94.71	900	No
345	Motley	34.08	-100.79	884	No
347	Nacogdoches	31.63	-94.63	900	No
349	Navarro	32.07	-96.46	883	No
351	Newton	30.85	-93.74	325	No
353	Nolan	32.38	-100.40	911	No
355	Nueces	27.75	-97.46	882	Yes
357	Ochiltree	36.33	-100.83	710	No
359	Oldham	35.38	-102.56	580	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
361	Orange	30.11	-93.84	897	Yes
363	Palo Pinto	32.75	-98.26	914	No
365	Panola	32.16	-94.32	900	No
367	Parker	32.78	-97.77	914	No
369	Parmer	34.52	-102.78	904	No
371	Pecos	30.93	-102.75	892	No
373	Polk	30.78	-94.90	897	No
375	Potter	35.26	-101.84	907	No
377	Presidio	29.99	-104.24	873	No
379	Rains	32.88	-95.80	893	No
381	Randall	35.07	-101.89	907	No
383	Reagan	31.35	-101.51	901	No
385	Real	29.78	-99.87	878	No
387	Red River	33.61	-95.06	881	No
389	Reeves	31.31	-103.61	906	No
391	Refugio	28.29	-97.21	876	Yes
393	Roberts	35.80	-100.79	903	No
395	Robertson	30.98	-96.58	913	No
397	Rockwall	32.91	-96.43	893	No
399	Runnels	31.82	-99.98	874	No
401	Rusk	32.16	-94.80	900	No
403	Sabine	31.34	-93.86	316	No
405	San Augustine	31.39	-94.16	900	No
407	San Jacinto	30.60	-95.14	897	No
409	San Patricio	27.98	-97.46	882	Yes
411	San Saba	31.17	-98.80	898	No
413	Schleicher	30.88	-100.48	874	No
415	Scurry	32.69	-100.96	911	No
417	Shackelford	32.71	-99.33	871	No
419	Shelby	31.82	-94.14	900	No
421	Sherman	36.27	-101.93	912	No
423	Smith	32.33	-95.30	900	No
425	Somervell	32.25	-97.75	886	No
427	Starr	26.45	-98.77	908	No
429	Stephens	32.73	-98.86	871	No
431	Sterling	31.82	-101.05	874	No
433	Stonewall	33.15	-100.22	895	No
435	Sutton	30.51	-100.60	874	No
437	Swisher	34.51	-101.75	907	No
439	Tarrant	32.76	-97.27	914	No
441	Taylor	32.40	-99.81	871	No
443	Terrell	30.23	-102.13	901	No
445	Terry	33.19	-102.32	910	No
447	Throckmorton	33.16	-99.20	871	No
449	Titus	33.18	-94.98	881	No
451	Tom Green	31.44	-100.47	874	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
453	Travis	30.32	-97.77	877	No
455	Trinity	31.01	-95.20	897	No
457	Tyler	30.76	-94.37	897	No
459	Upshur	32.71	-94.95	900	No
461	Upton	31.33	-102.09	901	No
463	Uvalde	29.28	-99.73	887	No
465	Val Verde	29.58	-100.99	887	No
467	Van Zandt	32.57	-95.82	893	No
469	Victoria	28.79	-96.98	894	Yes
471	Walker	30.74	-95.53	897	No
473	Waller	30.02	-96.00	879	No
475	Ward	31.52	-103.02	906	No
477	Washington	30.19	-96.41	879	No
479	Webb	27.59	-99.39	889	No
481	Wharton	29.25	-96.19	885	No
483	Wheeler	35.36	-100.28	718	No
485	Wichita	33.94	-98.62	746	No
487	Wilbarger	34.10	-99.24	706	No
489	Willacy	26.47	-97.76	890	Yes
491	Williamson	30.60	-97.67	913	No
493	Wilson	29.20	-98.11	909	No
495	Winkler	31.84	-103.10	906	No
497	Wise	33.21	-97.67	914	No
499	Wood	32.77	-95.38	893	No
501	Yoakum	33.08	-102.83	910	No
503	Young	33.21	-98.66	871	No
505	Zapata	26.95	-99.20	908	No
507	Zavala	28.86	-99.76	887	No
		Utah Counties			
1	Beaver	38.34	-113.00	916	No
3	Box Elder	41.60	-112.48	919	No
5	Cache	41.75	-111.84	932	No
7	Carbon	39.63	-110.77	927	No
9	Daggett	40.95	-109.53	949	No
11	Davis	41.00	-111.94	941	No
13	Duchesne	40.25	-110.34	924	No
15	Emery	39.16	-110.86	927	No
17	Garfield	37.80	-111.95	922	No
19	Grand	38.82	-109.47	934	No
21	Iron	37.78	-113.23	939	No
23	Juab	39.70	-112.35	930	No
25	Kane	37.28	-112.36	915	No
27	Millard	39.10	-112.86	920	No
29	Morgan	41.09	-111.61	936	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
31	Piute	38.33	-112.09	931	No
33	Rich	41.67	-111.27	951	No
35	Salt Lake	40.66	-111.92	948	No
37	San Juan	37.43	-109.51	918	No
39	Sanpete	39.39	-111.60	933	No
41	Sevier	38.77	-111.94	940	No
43	Summit	40.83	-111.27	944	No
45	Tooele	40.42	-112.69	947	No
47	Uintah	40.28	-109.58	949	No
49	Utah	40.24	-111.74	945	No
51	Wasatch	40.45	-111.37	926	No
53	Washington	37.16	-113.49	942	No
55	Wayne	38.31	-111.34	931	No
57	Weber	41.23	-111.97	937	No
		Vermont Counties			
1	Addison	44.03	-73.17	956	No
3	Bennington	43.03	-73.11	954	No
5	Caledonia	44.46	-72.10	958	No
7	Chittenden	44.48	-73.13	953	No
9	Essex	44.72	-71.75	958	No
11	Franklin	44.87	-72.96	957	No
13	Grand Isle	44.82	-73.30	598	No
15	Lamoille	44.60	-72.63	957	No
17	Orange	44.00	-72.37	955	No
19	Orleans	44.84	-72.22	957	No
21	Rutland	43.60	-73.05	956	No
23	Washington	44.25	-72.58	955	No
25	Windham	43.00	-72.67	550	No
27	Windsor	43.56	-72.53	954	No
		Virginia Counties			
1	Accomack	37.80	-75.64	349	No
3	Albemarle	38.02	-78.54	960	No
5	Alleghany	37.79	-79.97	966	No
7	Amelia	37.34	-77.96	963	No
9	Amherst	37.59	-79.14	967	No
11	Appomattox	37.37	-78.82	963	No
13	Arlington	38.88	-77.11	343	Yes
15	Augusta	38.13	-79.09	971	No
17	Bath	38.05	-79.75	966	No
19	Bedford	37.31	-79.55	970	No
21	Bland	37.13	-81.13	959	No
23	Botetourt	37.51	-79.82	967	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
25	Brunswick	36.76	-77.86	639	No
27	Buchanan	37.26	-82.03	1,007	No
29	Buckingham	37.57	-78.53	963	No
31	Campbell	37.22	-79.14	963	No
33	Caroline	38.03	-77.38	964	No
35	Carroll	36.72	-80.71	650	No
36	Charles City	37.34	-77.07	965	Yes
37	Charlotte	37.00	-78.63	963	No
41	Chesterfield	37.42	-77.55	965	No
43	Clarke	39.11	-77.99	968	No
45	Craig	37.47	-80.21	1,009	No
47	Culpeper	38.49	-77.98	964	No
49	Cumberland	37.50	-78.27	963	No
51	Dickenson	37.14	-82.37	1,014	No
53	Dinwiddie	37.10	-77.61	965	No
57	Essex	37.92	-76.91	964	Yes
59	Fairfax	38.84	-77.25	343	Yes
61	Fauquier	38.75	-77.79	968	No
63	Floyd	36.91	-80.35	970	No
65	Fluvanna	37.86	-78.30	960	No
67	Franklin	37.01	-79.86	970	No
69	Frederick	39.19	-78.24	1,010	No
71	Giles	37.32	-80.72	959	No
73	Gloucester	37.36	-76.51	965	Yes
75	Goochland	37.70	-77.87	963	No
77	Grayson	36.65	-81.17	650	No
79	Greene	38.29	-78.46	960	No
81	Greensville	36.69	-77.57	965	No
83	Halifax	36.73	-78.93	962	No
85	Hanover	37.71	-77.44	965	No
87	Henrico	37.58	-77.48	965	No
89	Henry	36.70	-79.90	970	No
91	Highland	38.38	-79.57	966	No
93	Isle of Wight	36.89	-76.70	965	Yes
95	James City	37.30	-76.75	965	Yes
97	King and Queen	37.70	-76.90	965	No
99	King George	38.29	-77.15	964	Yes
101	King William	37.66	-77.00	965	No
103	Lancaster	37.70	-76.45	965	Yes
105	Lee	36.74	-83.10	969	No
107	Loudoun	39.06	-77.57	968	No
109	Louisa	37.99	-77.96	960	No
111	Lunenburg	36.95	-78.22	963	No
113	Madison	38.42	-78.26	960	No
115	Mathews	37.44	-76.32	965	Yes
117	Mecklenburg	36.66	-78.34	639	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
119	Middlesex	37.60	-76.49	965	Yes
121	Montgomery	37.17	-80.40	970	No
125	Nelson	37.79	-78.87	960	No
127	New Kent	37.49	-77.00	965	No
131	Northampton	37.36	-75.93	349	No
133	Northumberland	37.87	-76.37	349	Yes
135	Nottoway	37.13	-78.07	963	No
137	Orange	38.24	-78.05	960	No
139	Page	38.61	-78.49	972	No
141	Patrick	36.67	-80.29	650	No
143	Pittsylvania	36.82	-79.41	962	No
145	Powhatan	37.55	-77.88	963	No
147	Prince Edward	37.25	-78.43	963	No
149	Prince George	37.20	-77.26	965	No
153	Prince William	38.70	-77.41	964	Yes
155	Pulaski	37.07	-80.71	959	No
157	Rappahannock	38.69	-78.17	972	No
159	Richmond	37.93	-76.73	964	Yes
161	Roanoke	37.25	-80.00	970	No
163	Rockbridge	37.80	-79.44	967	No
165	Rockingham	38.47	-78.84	961	No
167	Russell	36.93	-82.12	1,007	No
169	Scott	36.70	-82.59	969	No
171	Shenandoah	38.86	-78.55	972	No
173	Smyth	36.83	-81.55	959	No
175	Southampton	36.71	-77.09	965	No
177	Spotsylvania	38.21	-77.60	964	No
179	Stafford	38.39	-77.43	964	Yes
181	Surry	37.11	-76.89	965	Yes
183	Sussex	36.93	-77.26	965	No
185	Tazewell	37.14	-81.57	959	No
187	Warren	38.92	-78.18	972	No
191	Washington	36.71	-81.96	633	No
193	Westmoreland	38.16	-76.83	964	Yes
195	Wise	36.95	-82.62	969	No
197	Wythe	36.93	-81.08	959	No
199	York	37.19	-76.50	965	Yes
		Virginia Cities			
510	Alexandria	38.82	-77.07	343	Yes
515	Bedford	37.33	-79.52	970	No
520	Bristol	36.61	-82.18	633	No
530	Buena Vista	37.73	-79.35	967	No
540	Charlottesville	38.03	-78.49	960	No
550	Chesapeake	36.77	-76.29	636	Yes

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
560	Clifton Forge	37.82	-79.82	966	No
570	Colonial Heights	37.26	-77.40	965	No
580	Covington	37.79	-79.99	966	No
590	Danville	36.59	-79.40	962	No
595	Emporia	36.69	-77.54	965	No
600	Fairfax	38.85	-77.30	343	Yes
610	Falls Church	38.88	-77.18	343	Yes
620	Franklin	36.67	-76.93	635	No
630	Fredericksburg	38.30	-77.47	964	No
640	Galax	36.66	-80.92	650	No
650	Hampton	37.03	-76.36	636	Yes
660	Harrisonburg	38.44	-78.87	961	No
670	Hopewell	37.29	-77.30	965	No
678	Lexington	37.78	-79.45	967	No
680	Lynchburg	37.40	-79.17	967	No
683	Manassas	38.75	-77.48	968	Yes
685	Manassas Park	38.77	-77.45	968	No
690	Martinsville	36.69	-79.87	970	No
700	Newport News	37.07	-76.48	965	Yes
710	Norfolk	36.89	-76.26	636	Yes
720	Norton	36.94	-82.63	969	No
730	Petersburg	37.21	-77.40	965	No
735	Poquoson	37.13	-76.37	965	Yes
740	Portsmouth	36.83	-76.35	636	Yes
750	Radford	37.13	-80.57	970	No
760	Richmond	37.54	-77.46	965	No
770	Roanoke	37.28	-79.96	970	No
775	Salem	37.29	-80.06	970	No
790	Staunton	38.16	-79.08	971	No
800	Suffolk	36.74	-76.61	636	Yes
810	Virginia Beach	36.83	-76.09	636	Yes
820	Waynesboro	38.07	-78.89	971	No
830	Williamsburg	37.27	-76.71	965	Yes
840	Winchester	39.18	-78.17	1,010	No
		Washington Counties			
1	Adams	46.97	-118.68	995	No
3	Asotin	46.31	-117.12	991	No
5	Benton	46.25	-119.39	987	No
7	Chelan	47.64	-120.42	1,003	No
9	Clallam	48.10	-123.82	992	Yes
11	Clark	45.69	-122.55	1,001	No
13	Columbia	46.34	-117.96	983	No
15	Cowlitz	46.17	-122.75	988	No
17	Douglas	47.67	-119.89	1,002	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
19	Ferry	48.50	-118.52	1,004	No
21	Franklin	46.40	-119.04	987	No
23	Garfield	46.41	-117.55	991	No
25	Grant	47.22	-119.41	989	No
27	Grays Harbor	47.06	-123.77	973	Yes
29	Island	48.18	-122.59	993	No
31	Jefferson	47.86	-123.19	992	Yes
33	King	47.55	-122.20	997	Yes
35	Kitsap	47.62	-122.64	986	Yes
37	Kittitas	47.10	-120.71	979	No
39	Klickitat	45.86	-120.96	772	No
41	Lewis	46.60	-122.68	977	No
43	Lincoln	47.61	-118.38	982	No
45	Mason	47.31	-123.10	986	Yes
47	Okanogan	48.54	-119.58	981	No
49	Pacific	46.54	-123.81	973	Yes
51	Pend Oreille	48.45	-117.28	185	No
53	Pierce	47.17	-122.38	994	Yes
55	San Juan	48.58	-122.97	990	Yes
57	Skagit	48.47	-122.22	996	Yes
59	Skamania	45.90	-121.95	766	No
61	Snohomish	47.98	-122.09	984	Yes
63	Spokane	47.67	-117.38	998	No
65	Stevens	48.40	-117.84	185	No
67	Thurston	46.97	-122.85	977	Yes
69	Wahkiakum	46.29	-123.46	988	Yes
71	Walla Walla	46.13	-118.41	771	No
73	Whatcom	48.83	-122.40	978	Yes
75	Whitman	46.92	-117.39	980	No
77	Yakima	46.48	-120.51	1,000	No
	West Virginia Counties				
1	Barbour	39.13	-80.01	1,006	No
3	Berkeley	39.46	-77.98	1,010	No
5	Boone	38.06	-81.73	1,015	No
7	Braxton	38.68	-80.74	1,008	No
9	Brooke	40.30	-80.59	1,013	No
11	Cabell	38.41	-82.32	1,015	No
13	Calhoun	38.86	-81.11	1,012	No
15	Clay	38.46	-81.08	1,012	No
17	Doddridge	39.28	-80.72	1,008	No
19	Fayette	38.03	-81.12	1,009	No
21	Gilmer	38.93	-80.85	1,008	No
23	Grant	39.09	-79.18	347	No
25	Greenbrier	37.90	-80.51	1,009	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
27	Hampshire	39.32	-78.63	972	No
29	Hancock	40.50	-80.58	1,013	No
31	Hardy	39.05	-78.89	972	No
33	Harrison	39.30	-80.34	1,006	No
35	Jackson	38.85	-81.70	1,012	No
37	Jefferson	39.30	-77.84	1,010	No
39	Kanawha	38.35	-81.61	1,015	No
41	Lewis	39.02	-80.48	1,006	No
43	Lincoln	38.20	-82.06	1,015	No
45	Logan	37.84	-81.95	1,014	No
47	McDowell	37.38	-81.61	1,007	No
49	Marion	39.50	-80.20	1,006	No
51	Marshall	39.91	-80.71	1,013	No
53	Mason	38.82	-82.04	1,015	No
55	Mercer	37.35	-81.16	959	No
57	Mineral	39.43	-78.94	347	No
59	Mingo	37.70	-82.17	1,014	No
61	Monongalia	39.63	-79.99	799	No
63	Monroe	37.56	-80.57	1,009	No
65	Morgan	39.57	-78.27	1,010	No
67	Nicholas	38.30	-80.80	1,009	No
69	Ohio	40.08	-80.68	1,013	No
71	Pendleton	38.68	-79.35	961	No
73	Pleasants	39.38	-81.17	1,008	No
75	Pocahontas	38.32	-79.98	966	No
77	Preston	39.47	-79.67	347	No
79	Putnam	38.49	-81.92	1,015	No
81	Raleigh	37.77	-81.23	1,007	No
83	Randolph	38.83	-79.88	1,006	No
85	Ritchie	39.20	-81.07	1,008	No
87	Roane	38.72	-81.36	1,012	No
89	Summers	37.68	-80.85	1,009	No
91	Taylor	39.34	-80.04	1,011	No
93	Tucker	39.13	-79.60	1,011	No
95	Tyler	39.50	-80.93	1,008	No
97	Upshur	38.95	-80.23	1,006	No
99	Wayne	38.23	-82.47	1,015	No
101	Webster	38.50	-80.43	1,006	No
103	Wetzel	39.63	-80.73	1,013	No
105	Wirt	39.02	-81.38	1,012	No
107	Wood	39.26	-81.53	691	No
109	Wyoming	37.62	-81.54	1,007	No
		Wisconsin Counties			
1	Adams	43.95	-89.79	1,020	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
---	---	(deg)	(deg)	---	---
3	Ashland	46.34	-90.72	1,016	No
5	Barron	45.43	-91.82	1,033	No
7	Bayfield	46.54	-91.20	1,016	No
9	Brown	44.49	-88.03	1,028	No
11	Buffalo	44.38	-91.75	411	No
13	Burnett	45.87	-92.36	1,033	No
15	Calumet	44.11	-88.21	1,029	No
17	Chippewa	45.02	-91.32	1,034	No
19	Clark	44.76	-90.59	1,034	No
21	Columbia	43.46	-89.34	1,030	No
23	Crawford	43.20	-90.98	1,031	No
25	Dane	43.07	-89.39	1,030	No
27	Dodge	43.41	-88.71	1,036	No
29	Door	44.97	-87.29	1,028	No
31	Douglas	46.53	-91.94	385	No
33	Dunn	44.95	-91.90	1,034	No
35	Eau Claire	44.78	-91.41	1,034	No
37	Florence	45.84	-88.36	372	No
39	Fond du Lac	43.76	-88.49	1,019	No
41	Forest	45.60	-88.77	381	No
43	Grant	42.88	-90.67	1,022	No
45	Green	42.65	-89.58	1,017	No
47	Green Lake	43.82	-89.03	1,029	No
49	Iowa	42.99	-90.14	1,018	No
51	Iron	46.28	-90.20	373	No
53	Jackson	44.33	-90.86	1,021	No
55	Jefferson	43.04	-88.78	1,036	No
57	Juneau	43.90	-90.11	1,020	No
59	Kenosha	42.57	-87.95	1,032	No
61	Kewaunee	44.52	-87.59	1,023	No
63	La Crosse	43.86	-91.19	1,035	No
65	Lafayette	42.66	-90.13	1,018	No
67	Langlade	45.24	-89.09	1,026	No
69	Lincoln	45.34	-89.68	1,025	No
71	Manitowoc	44.10	-87.76	1,023	No
73	Marathon	44.90	-89.74	1,024	No
75	Marinette	45.31	-87.94	1,028	No
77	Marquette	43.83	-89.41	1,030	No
78	Menominee	44.94	-88.65	1,028	No
79	Milwaukee	43.03	-87.96	1,032	No
81	Monroe	43.94	-90.59	1,035	No
83	Oconto	45.03	-88.25	1,028	No
85	Oneida	45.72	-89.50	1,026	No
87	Outagamie	44.34	-88.41	1,027	No
89	Ozaukee	43.33	-87.94	1,036	No
91	Pepin	44.59	-92.01	411	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No. ---	County Name ---	Latitude (deg)	Longitude (deg)	Closest Station ---	Coastal Area ---
93	Pierce	44.74	-92.46	411	No
95	Polk	45.45	-92.45	1,033	No
97	Portage	44.49	-89.52	1,020	No
99	Price	45.71	-90.37	1,026	No
101	Racine	42.74	-87.96	1,032	No
103	Richland	43.36	-90.41	1,035	No
105	Rock	42.65	-89.05	1,017	No
107	Rusk	45.44	-91.14	1,034	No
109	St. Croix	45.03	-92.51	395	No
111	Sauk	43.44	-89.90	1,030	No
113	Sawyer	45.91	-91.25	1,033	No
115	Shawano	44.79	-88.76	1,027	No
117	Sheboygan	43.73	-87.85	1,023	No
119	Taylor	45.19	-90.49	1,025	No
121	Trempealeau	44.32	-91.35	1,021	No
123	Vernon	43.60	-90.81	1,035	No
125	Vilas	46.02	-89.53	1,026	No
127	Walworth	42.65	-88.53	204	No
129	Washburn	45.88	-91.81	1,033	No
131	Washington	43.36	-88.23	1,036	No
133	Waukesha	43.04	-88.26	1,036	No
135	Waupaca	44.45	-88.96	1,027	No
137	Waushara	44.11	-89.25	1,020	No
139	Winnebago	44.09	-88.57	1,029	No
141	Wood	44.45	-89.97	1,024	No
		Wyoming Counties			
1	Albany	41.41	-105.73	1,041	No
3	Big Horn	44.54	-108.07	1,038	No
5	Campbell	44.09	-105.50	1,050	No
7	Carbon	41.70	-106.91	1,057	No
9	Converse	42.86	-105.50	1,049	No
11	Crook	44.56	-104.64	1,043	No
13	Fremont	43.10	-108.68	1,054	No
15	Goshen	42.09	-104.32	1,059	No
17	Hot Springs	43.69	-108.32	1,061	No
19	Johnson	44.07	-106.59	1,050	No
21	Laramie	41.20	-104.76	1,041	No
23	Lincoln	42.22	-110.69	1,039	No
25	Natrona	42.92	-106.45	1,050	No
27	Niobrara	43.03	-104.48	1,049	No
29	Park	44.57	-109.00	1,040	No
31	Platte	42.19	-104.95	1,060	No
33	Sheridan	44.78	-106.97	1,058	No
35	Sublette	42.75	-109.99	1,055	No

Table A11 Continued: *County Environmental Characteristics*

FIPS No.	County Name	Latitude	Longitude	Closest Station	Coastal Area
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37	Sweetwater	41.64	-109.17	1,047	No
39	Teton	43.61	-110.67	1,051	No
41	Uinta	41.28	-110.60	1,046	No
43	Washakie	43.96	-107.73	1,061	No
45	Weston	43.88	-104.56	1,052	No