4.0 CONCLUSIONS, ISSUES AND RECOMMENDATIONS

This chapter presents a summary of the conclusions regarding the significance of the individual bridge types within the context of this study. It also identifies the issues encountered in preparing the study, and lastly, it offers recommendations for future study.

4.1 Summary Findings

Chapter 3 provided a statement of significance for each of the common bridge types addressed in this study. The context for the significance evaluation is the most common historic bridge types in the United States. This significance evaluation is geared primarily toward the engineering significance of the bridge types, that is, National Register of Historic Places (NRHP) Criterion C. Factors such as technological importance and relative rarity played a role in the significance evaluation. Some of the evaluations also touch upon NRHP Criterion A, for example, a bridge associated with events such as the State Departments of Transportation's (DOTs) standardization of bridge designs that began in the early twentieth century.

Some bridges have subtypes or eras of construction in which they are highly significant, and other subtypes within the same category that are of substantially lower significance. If a type or subtype is denoted as highly significant within the context of this study (common historic bridge types in the United States), it will likely be eligible for the NRHP if it retains a high or medium level of integrity. If a type or subtype is noted as significant, it may be eligible for the NRHP if it retains a high level of integrity. Types or subtypes that have moderate significance would need to have a very high level of integrity and may need added elements of significance to be considered NRHP eligible. Examples of elements that may increase the significance of a bridge within the context presented in this study, include association with an important designer or historic event. Types or subtypes labeled as having low significance are very common types that either played no important technological role in the context of this study or bridges that are more recent and their relative significance cannot yet be determined because of the lack of scholarship or shortage of scholarship on these types.

Table 4-1 summarizes the significance level recommendations that have been derived from the conduct of this study. The second column provides the highest significance level of any bridges within the type, the second column identifies the most significant bridge or subtypes within the type and the last column identifies bridges or subtypes with lower levels of significance.

Table 4-1. Summary of Bridge Type/Subtype Significance Evaluations			
Truss Type	**Highest Level of Significance Within Type**	**Subtypes with Highest Significance Level Within Type**	**Subtypes With Lower Significance Level Within Type**
CATEGORY 1: TRUSS			
King Post Truss	Significant	Pre Civil War examples are of the highest significance.	Late 19th century examples are significant and 20th century examples are of moderate significance.
Queen Post Truss	Significant	Pre Civil War examples are of the highest significance.	Late 19th century examples are significant and 20th century examples are of moderate significance.
Burr Arch Truss	Significant	All 19th century examples are considered significant.	N/A
Town Lattice Truss	Significant	Wood examples dating before 1870 and all metal railroad bridges of the 19th century are of the highest significance.	N/A
Howe Truss	Highly Significant	Highly significant are the railroad bridges of the 1840s and 1850s.	Wooden Howe truss covered bridges from the 19th century and 20th century are significant.
Bowstring Arch Truss	Highly Significant	Whipple bowstring trusses of are the highest level of significance.	Non-Whipple bowstrings are highly significant, but less significant than the Whipples. An exception would be examples such as King Iron or Wrought Iron company-fabricated bowstrings, or rare one-of-kind examples such as the Avery-Bartholomew or Glass Rezner Schneider patented bowstrings.
Pratt Truss	Significant	Early examples (19th century) are of the highest significance, especially multiple-span truss bridges spanning larger rivers.	Later examples are of moderate significance.

Table 4-1. Summary of Bridge Type/Subtype Significance Evaluations			
Truss Type	**Highest Level of Significance Within Type**	**Subtypes with Highest Significance Level Within Type**	**Subtypes With Lower Significance Level Within Type**
Whipple Truss	Highly Significant	Whipples are relatively rare within the context of this study and are of the highest level of significance.	N/A
Baltimore Truss	Significant	Early examples associated with the B&O Railroad are of the highest significance.	Baltimore truss bridges on highways are not common and are considered significant.
Parker Truss	Significant	Pin-connected 19th century examples are of the highest significance.	Twentieth century examples are of moderate significance.
Pennsylvania Truss	Significant	Early examples associated with the railroad are of the highest significance.	Pennsylvania truss bridges on highways are not common and are considered significant.
Warren Truss	Significant	Nineteenth century examples are of the highest significance.	Trusses built after ca. 1920 are of moderate significance.
Subdivided and Double-intersection Warren Truss	Highly Significant	All examples, as they are among the least common types in this study.	N/A
Lenticular Truss	Highly Significant	All examples, as they are among the least common types in this study.	N/A
CATEGORY 2: ARCH			
Stone Arch	Highly Significant	Late 18th and early 19th century examples are of the highest level of significance.	Bridges built under the Depression-era federal work programs are significant. Bridges associated with parks may also be significant.
Reinforced Concrete Melan/ von Emperger Arch	Highly Significant	Documented patented examples of the type are of the highest level of significance.	N/A
Reinforced Concrete Luten Arch	Significant	Documented patented examples of the type are of the highest level of significance.	N/A

Table 4-1. Summary of Bridge Type/Subtype Significance Evaluations			
Truss Type	**Highest Level of Significance Within Type**	**Subtypes with Highest Significance Level Within Type**	**Subtypes With Lower Significance Level Within Type**
Reinforced Concrete Marsh or Rainbow (Through) Arch	Significant	Documented patented examples of the type are of the highest level of significance.	Rainbow arches that cannot be documented as patented are less significant, but still possess significance.
Reinforced Concrete Closed Spandrel Arch	Significant	Early examples and types built according to State DOT standardized bridge plans are of the highest level of significance.	Later examples are less significant, but still possess significance.
Reinforced Concrete Open Spandrel Arch	Significant	Early examples and types built according to State DOT standardized bridge plans are of the highest level of significance.	Later examples are less significant, but still possess significance.
Steel Tied Arch	Significant	Most examples will possess significance.	N/A
Reinforced Concrete Tied Arch	Significant	Most examples will possess significance.	N/A
Steel Hinged Arch	Highly Significant	Most examples will possess significance.	N/A
Reinforced Concrete Hinged Arch	Highly Significant	Most examples will possess significance.	N/A
CATEGORY 3: BEAM, GIRDER & RIGID			
Timber Stringers	Low Significance	Early examples and examples built according to State DOT standard plans are of the highest level of significance.	Timber stringers associated with parks may also possess significance.
Reinforced Concrete Cast-In-Place Slabs	Significant	Early examples and examples built according to early 20th century State DOT standard plans are of the highest level of significance.	Examples from the 2nd quarter of the 20th century are less significant, but still may possess significance.

Table 4-1. Summary of Bridge Type/Subtype Significance Evaluations			
Truss Type	**Highest Level of Significance Within Type**	**Subtypes with Highest Significance Level Within Type**	**Subtypes With Lower Significance Level Within Type**
CATEGORY 3: BEAM, GIRDER & RIGID, Continued			
Reinforced Concrete T-Beams	Moderate Significance	Early examples and examples built according to early 20th century State DOT standard plans are of the highest level of significance.	Long examples (>30 feet) and examples with decorative features may also possess significance.
Reinforced Concrete Channel Beams	Low to Moderate Significance	Early 20th century representative examples or those built according to early 20th century State DOT standard plans are of the highest level of significance.	Examples with decorative features may also possess significance.
Reinforced Concrete Girders	Moderate Significance	Early examples and examples built according to early 20th century State DOT standard plans, and through girders are of the highest level of significance.	Examples from the 2nd quarter of the 20th century are less significant, but still may possess significance.
Reinforced Concrete Rigid Frames	Significant	Early examples and those that can be documented as having been built according to State DOT standard plans are of the highest level of significance.	Also significant are examples built on parkway systems.
Reinforced Concrete Pre-cast Slabs	Low Significance*	The earliest examples of the type possess the highest level of significance.*	N/A*
Pre-stressed Concrete I-Beams	Significant*	Early 1950s examples of the type possess the highest level of significance.*	Other examples possess a low level of significance.*

Table 4-1. Summary of Bridge Type/Subtype Significance Evaluations			
Truss Type	**Highest Level of Significance Within Type**	**Subtypes with Highest Significance Level Within Type**	**Subtypes With Lower Significance Level Within Type**
CATEGORY 3: BEAM, GIRDER & RIGID, Continued			
Pre-stressed Concrete Box Beams	Low Significance*	The earliest examples of the type possess the highest level of significance.*	N/A*
Metal Rolled Multi-Beams	Low Significance	Early examples of the type possess the highest level of significance.	Other examples that use innovative fabricating techniques may be significant.
Metal Fabricated Girders	Moderate Significance	Early 20th century examples possess the highest level of significance.	First generation, welded steel girders that survive from the 1950s may also be significant.
Metal Rigid Frames	Significant	Early examples and those documented as having been built according to State DOT standard plans possess the highest level of significance.	Also significant are examples built on parkway systems.
CATEGORY 4: MOVABLE SPANS			
Center-bearing Swing Span	Highly Significant	Late 19th and early 20th century examples possess the highest level of significance.	Examples built late in the historic period (through 1955) may be significant or moderately significant.
Rim-bearing Swing Span	Highly Significant	Late 19th and early 20th century examples possess the highest level of significance.	Examples built late in the historic period (through 1955) may be significant or moderately significant.
Vertical Lift Span	Highly Significant	Most examples will possess significance.	N/A
Simple Trunnion (Milwaukee, Chicago) Bascule Span	Significant	Early examples and examples associated with the Chicago Department of Public Works.	Other examples are less significant, but still considered significant.

Table 4-1. Summary of Bridge Type/Subtype Significance Evaluations			
Truss Type	**Highest Level of Significance Within Type**	**Subtypes with Highest Significance Level Within Type**	**Subtypes With Lower Significance Level Within Type**
CATEGORY 4: MOVABLE SPANS, Continued			
Multi-trunnion (Strauss) Bascule Span	Highly Significant	Most examples will possess significance.	N/A
Rolling Lift (Scherzer) Bascule Span	Highly Significant	Of the highest significance are early examples of the type.	Most other examples will possess significance.
CATEGORY 5: SUSPENSION			
Monumental Suspension Bridges	Highly Significant	Most examples will possess significance.	N/A
Shorter-span and Vernacular Spans	Significant	Most examples will possess significance.	N/A
CATEGORY 6: TRESTLES AND VIADUCTS			
Trestles	Significant	Nineteenth century examples possess the highest level of significance.	Twentieth century examples are of moderate to low significance, but may possess significance for their great length or for solving a topographical problem.
Viaducts	Highly Significant	Stone railroad and other viaducts from the second quarter of the 19th century are of the highest significance level.	Many viaducts should be evaluated within the bridge type that they fall under, e.g., girder, concrete arch.
CATEGORY 7: CANTILEVERS			
Cantilevers	Significant	Early examples and those of very long length are of the highest significance.	Twentieth century examples are of lower significance, unless they are very long in length or for solving a topographical problem.

*More modern types of bridges for which scholarship is just being developed.

4.2 Issues

A number of issues were encountered in the preparation of this study. These are described below.

4.2.1 Lack of National Database/Repository for Bridge Studies

The first issue is the lack of a national database for the nation's historic bridges and a common repository for the many state bridge survey reports, historic contexts and historic bridge management plans. In addition, the many bridge reports present data in inconsistent formats. Some reports list all of the surveyed bridges and identify which are eligible and ineligible for the NRHP, some only identify the eligible bridges, and some of the glossier reports feature only the most significant and/or interesting examples of a state's bridges. This caused problems for the Study Team in identifying regional trends for inclusion in this report. In addition, many of the reports were prepared a number of years ago and it is unknown how many of the bridges have been replaced. That made identifying the most common types today difficult.

Secondly, access to online data was of critical importance. The Historic American Engineering Record (HAER) collection at the Library of Congress was highly important to this study and its documentation was accessible. The HAER records were relied upon heavily, particularly for identifying the needed examples. It was, however, difficult to search the HAER collection for several of the bridge types in this study. The HAER documentation was relied on for its accuracy and while most HAER documentation is accurate, a small number of errors were found in the HAER records. The Study Team hopes that they found and identified the errors in the HAER records that were consulted before the information and examples were included in this study.

The NRHP records were not accessible as a rule online. Searches generally came up with no records. And, the nominations are not accessible online. The Study Team was fortunate to obtain a list early in the study process that had online links to many of the NRHP-listed state historic bridge contexts or multiple property submittals. This list is in Appendix A.

4.2.2 Less than Fifty Common Bridge Types

Another issue is that the scope of work for this study requested the "fifty most common bridge types." Since the Study Team was unable to identify fifty types that were moderately to very common, some of the types in this study are, in reality, not very common at all. However, when compared to rare bridge types, such as the Bollman truss, these bridges are not rare, as a number of examples exist.

4.2.3 Lack of Scholarship and Examples For More Recent Bridge Types

Post World-War II bridges, and particularly, those types of the 1950s, are just recently reaching the age where they fall within the 50-year NRHP age criterion.

Consequently, State DOTs are just beginning to address the significance of these structures through the preparation of historic contexts and survey reports. An example of a recent report that addresses the significance of structures built during this era is *The Third Ohio Historic Bridge Inventory, Evaluation and Management Plan for Bridges Built 1951 – 1960 and the Development of Ohio's Interstate Highway System*. This report was prepared in 2004 by Lichtenstein Consulting Engineers for the Ohio Department of Transportation, in Cooperation with the Federal Highway Administration and the Ohio Historic Preservation Office.

In the opinion of the Study Team, a body of scholarship that would place structures of this era in their national context is not yet in existence. It was particularly difficult to obtain examples of NRHP listed or HAER recorded examples from this period, but kindly, Mary McCahon of Lichtenstein Consulting Engineers provided assistance with this, as did Kara Russell of PENNDOT.

4.2.4 Inconsistencies in Terminology

Different studies consulted for this study used different terms and names for both bridge types and bridge members. It was often hard to translate information in some studies for use in this study. In addition, some studies were so general, e.g., simply labeling a bridge as a "concrete arch," that these examples could not be used to illustrate the defined types used in this study. This occurred in the HAER documentation, NRHP documentation forms and throughout state historic bridge surveys, context reports and management plans.

4.2.5 Inability to Locate Peer Reviewers

Many peers assisted with the development of the list of common bridge types for this study. Throughout the study, historic bridge experts provided information and examples of bridge types. The Study Team had high hopes that members of the historic bridge community would assist in the preparation of this important study through volunteering their time to conduct a peer review of the draft study findings. However, with the exception of Martha Carver at Tennessee DOT who reviewed Chapter 2, and Claudette Stager of the Tennessee State Historic Preservation Office, who reviewed Chapters 1 and 2, the Study Team was unable to locate any peer reviewers.

4.3 Recommendations

One near-term recommendation would improve the significance evaluation of historic bridges as presented in this report:

- Prepare a companion report to this study that would discuss in detail and depict the character-defining features of each of the common bridge types.

Other recommendations of high importance include:

1. The National Park Service (NPS) should improve the accessibility of the NRHP records.
2. The NPS should implement an online system for reporting errors found in HAER documentation.
3. A glossary of historic bridge terms should be created and published.
4. A study should be undertaken that looks at the feasibility of creating a national historic bridge database/repository and presents a suggested methodology for undertaking this task.
5. Encourage FHWA to require the state DOTs to complete historic bridge management plans. Management plans are seminal to saving historic bridges, serving as the umbrella under which other actions (e.g., Programmatic Agreements (PAs), identifying best practices examples, and improving data accessibility) would insure the preservation of the Nation's historic bridges. Management plans should be "bridge-specific," rather than a series of vague, general recommendations. Every attempt should be made to identify those bridges where rehabilitation/preservation is appropriate and feasible, and to develop specific treatments for these bridges. This recommendation logically follows completion of the statewide historic bridge surveys and begins to address the question: "Now that we have identified all these wonderful spans, what do we do with them?"
6. The scope of work for this study involved only the development of a context for "common, historic bridge types." Rare, one-of-a-kind bridges are mentioned in the overview essays in Chapters 3 and 4. There was, however, no effort made to identify surviving examples of rare bridge types, as this was outside the scope of this study. A companion study to this study is needed, one that would be concerned with identifying and protecting rare, one-of-a-kind structures. More than half the historic bridges of the United States have been destroyed in the last twenty years. Most Americans resonate to wooden covered spans and stone arches, but the true bridge heritage most at risk is metal trusses and concrete arches. Identification of all nationally significant bridges, regardless of type, should be a national priority, with FHWA taking the lead and coordinating with state and local governments to identify and protect these structures. These bridges illustrate the bench marks of American bridge design and building technology. Inventories have revealed the wealth of historic bridges remaining. Most states know their rare, one-of-a-kind examples. Hence, it will not be difficult to compile this list. Funds are limited; therefore there can be little argument that they need to be directed to saving the truly outstanding bridges. FHWA, with the backing of the groups mentioned above and funding from Congress, should identify the truly outstanding, nationally significant bridges at the earliest possible moment so they can be protected.