Survey And Evaluation
Of
Masonry Arch Bridges

Prepared By: Stacie Ham _____
Research Associate

Reviewed By: Andrew Hope _____
Associate Environmental Planner (Architectural History)

Division of Environmental Analysis
California Department of Transportation
Sacramento, California

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Cover Photo: Bridge 51C-43, Ashley Road over Montecito Creek, built in 1918

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I. Introduction

In 1984-86, Caltrans undertook the project of determining which of the thousands of highway bridges in California were eligible for listing on the National Register of Historic Places. The project was referred to as "The Statewide Historic Bridge Survey." While Caltrans evaluates most properties for their historical significance only when they are in the area of potential effects of a proposed project, bridges are a different matter. Many older bridges need to be rehabilitated or replaced every year, and most of these projects are federally funded and therefore subject to federal historic preservation laws. Back in the 1970s, the Federal Highway Administration (FHWA) recognized that it was inefficient to continue to evaluate each bridge on a case by case basis. The FHWA encouraged state highway agencies to survey bridges on a comprehensive basis. The survey was funded by the Federal Highway Administration and implemented by the California Department of Transportation. Close to fifteen years have passed since the survey was completed, and Caltrans is currently in the process of re-evaluating all the extant bridges previously surveyed, as well as evaluating any bridges that are now over fifty years old.

This report is a part of the larger 2002-2004 Caltrans Statewide Historic Bridge Survey Update which includes re-evaluations of all remaining bridges that were surveyed in 1984-86 as well as evaluations for bridges that are now over fifty years old. This report documents one type of bridge in California, the masonry arch, and gives determinations of which of these bridges appear eligible for listing on the National Register of Historic Places and which do not appear eligible.

This report was prepared as a proactive measure to comply with Section 106 of the Historic Preservation Act and its implementing regulations (36 CFR 800.4). The results of this report will assist Caltrans and local agencies comply with applicable sections of the National Historic Preservation Act and the implementing regulations of the Advisory Council on Historic Preservation pertaining to federal agency undertakings and their effects on historic properties.

The 1984-86 survey used quantitative methods for evaluating the more numerous bridge types; trusses, concrete arches, and concrete girders. The survey did not use quantitative methods for evaluating the less numerous bridge types, such as the masonry arch, suspension, steel arch, concrete slab, and steel stringer. In the 1984-86 survey, 47 masonry arch bridges were evaluated. One of the survey's first goals was the determination of structures that were clearly not eligible. Of the 47 bridges surveyed, 17 were considered ineligible based on their loss of integrity. These bridges had both sides widened (usually using a different technology) and significant railing modification. The remaining 30 bridges were then subjected to a further review process which determined: 1) if one side had been widened with the parapet railing being salvaged or removed; 2) if the railing had been modified in some fashion altering the feeling as well as the design; 3) if the bridge was less than 50 years old. Based on this review, 15 additional bridges were determined to be ineligible. Two additional bridges fell into the category of being

widened on one side with a different technology, 21-16 and 21-17. These 2 structures were given the designation of Unevaluated, most likely because the evaluator believed either that the bridges may be a contributor to a potential historic district or that the ornate streetlights attached to the bridge railings may be eligible for listing as objects. Of the 13 bridges remaining, one, the Pope Street Bridge of Napa County (#21C-109), was already listed on the National Register. The remaining 12, after being reviewed on an individual basis, were determined to be eligible for listing.[1] Figure 1 illustrates this distribution.

Figure 1: 1984-86 Survey Results

Determination	**Quantity**
Listed	1
Eligible	12
Unevaluated	2
Ineligible	32
Total	**47**

The current report evaluates 43 masonry arch bridges, versus the 47 that were evaluated in 1984-86. Of the 47 bridges surveyed in 1984-86, 4 have been replaced, 7 have been reclassified as a culvert, and 1 is now on private property and not recognized by Caltrans as an official bridge. Eight additional bridges were surveyed in the 2002-03 survey that were not included in the original survey for unknown reasons. The 43 bridges evaluated constitute all of the known remaining masonry arch bridges on state highways and local roads in California. Numerous masonry arch culverts exist throughout the state as well. These culverts, defined as structures with a span under 20 feet, are not officially recognized as bridges by Caltrans and were therefore not included in this survey.

In reevaluating the bridges in 2002-2003, the approach used in evaluating the integrity and eligibility for each bridge was consistent with the approach used in the original 1984-86 survey. The results of the 1984-86 survey were used as a baseline for the 35 bridges that this data was available for. These 35 structures were surveyed and evaluated to determine if the 1984-86 determinations should be confirmed. In general, all the masonry arch bridges with a high degree of integrity were considered eligible under criterion C, because of the rarity of this bridge type, due to this method of construction no longer being used, and the fact that these structures are generally of the oldest surviving bridges in the state. Bridges that have been widened using different structural systems, or had their original stone railings replaced with other types of railings, were considered to lack sufficient integrity to be eligible. Research was undertaken on each structure to determine if a bridge could be significant, under Criteria A or B, for association with important events or people.

[1] California Department of Transportation. N*ational Register of Historic Places Thematic Determination of Eligibility of Historic Bridges in California: Concrete Arch, Concrete Girder, Concrete Slab, Canticrete, Stone Masonry, Suspension, Steel Girder, and Steel Arch* (California Department of Transportation: Sacramento, 1986), 37.

II. Scope of Survey & Research Methods

The 43 bridges surveyed and evaluated for this report reside in eight different counties as shown in Figure 2.

Figure 2: Distribution By County

County	Quantity
Sonoma	4
Napa	29
Tuolomne	1
San Luis Obispo	1
Santa Barbara	4
Ventura	1
San Bernardino	1
Riverside	2
Total	**43**

Fieldwork was carried out between December 2002 and June 2003 by Caltrans' Research Associate Stacie Ham and Associate Architectural Historian Andrew Hope. Each bridge was photographed and measured, if dimensions were not already available.

Inventory and evaluation forms (DPR-523 forms) as well as location maps were prepared for all 43 structures.

Background research for this report was conducted at the California History Room of the California State Library in Sacramento, the California State University, Sacramento Library, the Caltrans Transportation Library & History Center in Sacramento, the Caltrans Structures & Maintenance Archives in Sacramento, Santa Barbara County Historical Society Library, and the Napa County Historical Society Library.

III. Public Participation

In early April 2003, letters were sent to the county planning departments of each county in California, nine of the largest cities, and 58 historical societies and historic preservation groups, informing them of the statewide Historic Bridge Survey Update and inviting their comments. In addition to the eight counties where there were masonry arch bridges, letters were sent to the following organizations which may also have an interest in the state's masonry arch bridges:

- City of Napa, Cultural Heritage Commission
- Napa County Historical Society
- Mojave Desert Heritage & Cultural Association
- Pioneer Historical Society of Riverside
- San Luis Obispo County Historical Museum
- Santa Barbara Trust for Historic Preservation
- Sonoma League for Historic Preservation
- Sonoma Valley Historical Society
- Tuolumne County Historical Society

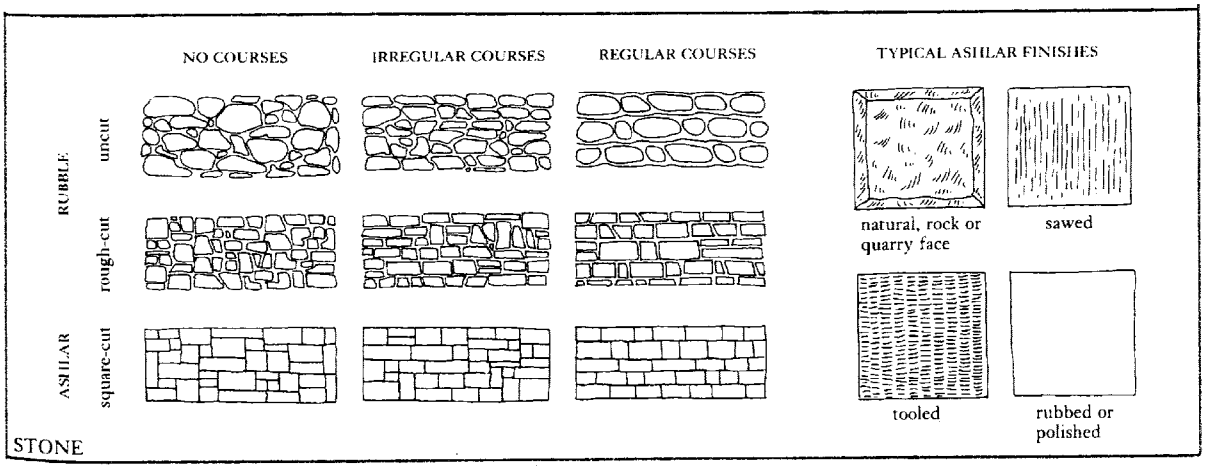
At the time this report was prepared, there had been no reponses regarding masonry arch bridges.

IV. Historical Overview

Masonry Arch Bridge Construction

Masonry construction can use a variety of building materials and techniques. Materials include adobe brick, fired brick, and stone. Adobe and fired brick can be laid in different structural ways and can use several different techniques of jointing with mortar. Stone as a building material can take on several formats. If the stone is used in its raw state, it is referred to as uncut rubble. If the stone is cut, but not smoothed into a square shape, it is referred to as rough-cut stone. If the stone is cut into stackable squares, it is referred to as square-cut. The rows in which the stone is laid are referred to as courses. Stone can be laid in a haphazard fashion with no courses, in a more linear fashion of irregular courses, or in straight horizontal lines of regular courses.[2] Figure 3 illustrates stone masonry structural systems.[3]

Figure 3: Masonry Structural Systems



Building a stone masonry arch bridge follows a general pattern. Once the need for a bridge at a certain site was determined, the builder would need to find a proper stone source and have the stone quarried. The rough quarried stone was then generally carried to the site to be cut before the stones were set. After the masonry abutments or piers were constructed, heavy timber falsework was constructed in the shape of the arch. The arch ring was then carefully built of special blocks of stone, each cut to a wedge shape so that joints between the blocks were at right angles to the ring. This ensured that the joints were in line with the compressive force in the arch and each block was thus secured against falling. The arch was built from the footings into the center where the keystone

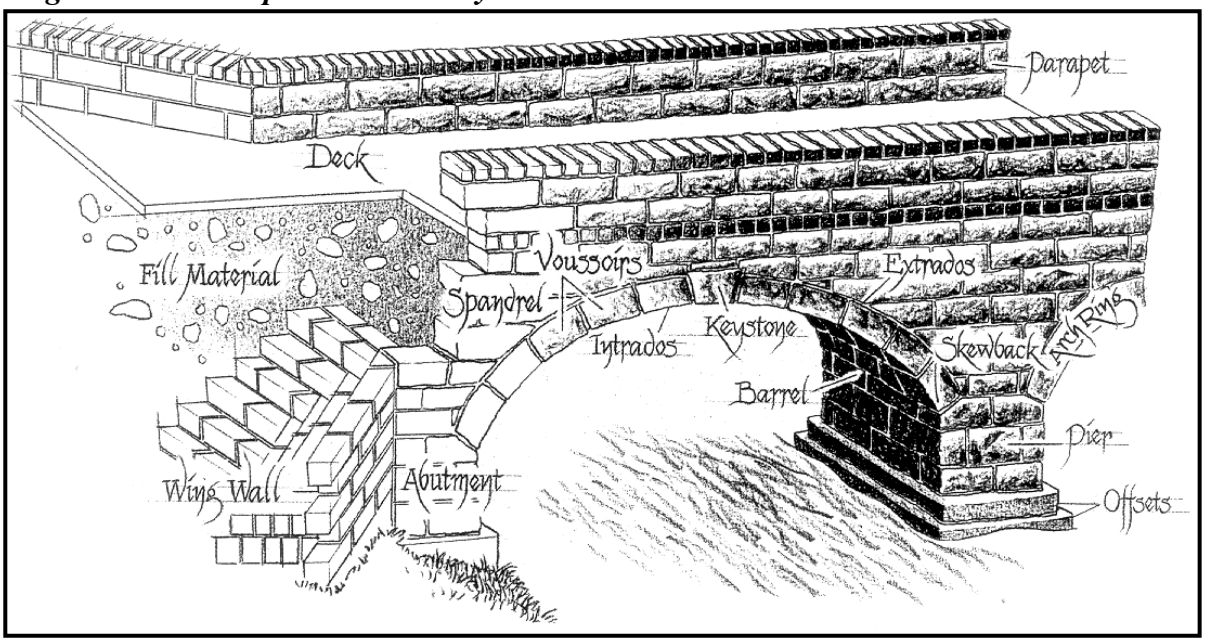
[2] Virginia and Lee McAlester, *A Field Guide To American Houses* (Alfred A. Knopf, Inc: New York, 1984), 38-39.

[3] McAlester, 39.

was set into place. The side walls, called spandrels, were built vertically above the edges of the arch ring and were then filled with earth or rubble which formed the roadway.[4]

The arch shape is ideal for spans built of materials which have good compressive strength but little or unreliable tensile strength. All forces in a properly placed arch are compressive. Early bridges were built without mortar in the joints. Later bridges used volcanic ash or Portland cements to fill joints, which reduced the amount of labor needed to properly shape the blocks to the precise fit needed previously for the dry joint arches.[5] When properly designed, masonry structures constitute the most permanent type of construction an engineer can build.[6] Figure 4 illustrates the components of a closed spandrel, earth filled masonry arch bridge.[7]

Figure 4: Closed Spandrel Masonry Arch



History of Masonry Arch Bridges

The closed spandrel, earth filled masonry arch is one of the oldest bridge types of man made structures used to cross rivers and valleys. Construction of masonry arch bridges began as early as 3000 B.C. in China, but it is the Romans who are most well known for their masonry arch structures built for use with their highway systems and aqueducts.[8]

[4] Stephen Mikesell. *Historic Highway Bridges of California* (Caltrans: Sacramento, 1990), 34.
[5] Mikesell, 34.
[6] Clement C. Williams. *The Design of Masonry Structures and Foundations* (McGraw-Hill Book Company: New York, 1930), 12.
[7] Mikesell, 35.
[8] California Department of Transportation, 33.

The traditional construction techniques of the Romans survived in Europe through the Middle Ages and into the modern period.[9]

With the fall of the Roman Empire, masonry bridge building declined to the construction of massive, crudely designed arches. During the 16th to 17th centuries, bridge building began to display greater refinement of design due to improvements in foundation construction, increased use of wood pilings, and better skilled stone masons.[10]

With the beginning of permanent bridge construction in America during the 18th century, one of the first types of structures built was the masonry arch bridge. Masonry arch construction was relatively labor intensive, especially for large structures, and was never as popular in America as it was in Europe due in part to America's sparse population during this timeframe. Stone masonry bridges were economical for short spans where foundations were good and an adequate supply of field stone was located nearby. Most masonry arch bridges in America were relatively small-scale structures built by local masons.[11] The small-scale structures included bridges along city streets as well as smaller ornamental bridges built in city parks.[12] Following the 18th century, iron, steel, and later concrete emerged as the preferred building materials for bridges. Prior to about 1912, many masonry arch bridges were constructed in America where the right conditions existed.[13] Small scale masonry arch construction flourished in isolated areas into the early 20th century, and in the 1930s the technology even became the focus of several Civilian Conservation Corps work projects.[14]

Highway Bridges in California

Until the 1880s highway bridge building in California was predominately a private operation. While a few counties built bridges as early as 1855, it was not until 1874 that the State Legislature adopted a comprehensive program through which counties could establish road districts, road commissioners, and property taxes intended to be used for road construction. The revisions to the State's political code, which were approved by the legislature in March of 1874, recognized the counties'important role in road and bridge work.[15] The ability of counties to execute bridge construction was further enhanced by a state law passed in 1893 mandating that each county seek the advice of its county surveyor on proposed bridge designs. The law resulted in a professionalization of the office of county surveyor and helped to attract trained bridge engineers to fill the office. The 1907 passage of the Savage Act, which permitted counties to incur bonded indebtedness to finance road and bridge construction, further improved the counties' ability to build and improve roads and bridges. The underlying reason for the passage of

[9] Donald C. Jackson. *Great American Bridges and Dams* (Preservation Press: Washington D.C., 1988), 18.
[10] Department of Transportation, 33-34.
[11] Jackson, 19.
[12] Henry Gratten Tyrell. *History of Bridge Engineering* (G.B. Williams Company: Chicgao, 1911), 72.
[13] Wilbur J. Watson. *Bridge Architecture* (William Heburn Inc: New York, 1927), 145.
[14] Jackson, 19.
[15] Israel, 24.

road legislation was the appearance of a large number of automobiles on county roads and the general "Good Roads" movement. The movement began with bicycle enthusiasts who began to stir up public interest in support of public money to be spent providing new roads. The movement gained statewide exposure with the State Road Convention in 1893.[16]

From the 1890s through the early 20th century, county surveyors and other local officials designed or authorized the building of hundreds of highway and local bridges throughout California. The bridges that were built in many cases reflected the local traditions and preferences of the county surveyor.

Typically, counties built truss bridges during this period, but shifted gradually to reinforced concrete. The majority of 19th century metal truss bridges were built by California based bridge building companies.[17] Within all counties, the transition from metal truss to concrete bridge design required a certain amount of experimentation.

This period of extensive bridge building in California resulted in masonry arch bridge construction appearing predominantly in two different areas in California, the Napa Valley and Santa Barbara County.

The majority of the remaining masonry arch bridges in California were constructed in the early 20th century. Figure 5 illustrates the distribution of constructions dates of the 43 bridges surveyed.

Figure 5: Distribution of Construction Dates

Construction Date	Quantity
1860-1869	2
1870-1879	0
1880-1889	0
1890-1899	5
1900-1909	16
1910-1919	13
1920-1929	3
1930-1939	2
Unknown	2

Stone Masonry Construction in the Napa Valley

The early depletion of local timber, combined with numerous small creeks and a river that could be crossed with a short span or spans, resulted in stone masonry bridge construction being a popular choice in the Napa Valley. Of the remaining 43 masonry

[16] Israel, 41-46

[17] California Department of Transportation. N*ational Register of Historic Places Thematic Determineation of Eligibility of Historic Truss Bridges in California* (California Department of Transportation: Sacramento, 1985), 16.

arch bridges in California, 29 are located in the Napa Valley region. This disproportionate distribution can be attributed to several factors.

First were the traditions of the settlers in the area who brought with them the building methods and architectural styles with which they were familiar. Most of the early settlers of the Napa Valley were from the rural provinces of Europe where stone masonry construction was common and they were trained in those techniques. Many experienced stonemasons were among the early immigrants to the area. As they settled farms and vineyards, there was a need for fences, bridges, distilleries, and cellars, and stone masonry construction was chosen.[18]

Second was the availability of appropriate natural resources. Both sides of the Napa Valley have ample supplies of easily reached volcanic rock and sandstone. In addition to these supplies, a great deal of suitable building stone was also available in the fields and the streambeds.[19] A history of Napa County published in 1878 said of the stone there:

> Napa has some of the most valuable building stone in California, a light volcanic rock found in the in the mountains east of Napa Valley. It is light yellow in color, coarse in texture, not susceptible of polish; so soft that when first quarried it can be shaped with an axe, yet hard enough to preserve its shape lines, growing harder with the exposure to air and not liable to injury by heat.[20]

Third was the availability of abundant and inexpensive manual labor. Many Chinese immigrants were indentured to work in the vineyards and quicksilver mines. The mines were in operation for a short time, until about 1875, and the vineyards required labor only on a seasonal basis. During the vineyards' off-season and after the closure of the mines in the late 19th century, ample manpower was usually present for the manual labor needed for the building of stone structures.[21]

Stone has been used extensively in the Napa Valley for the construction of private dwellings, public and commercial buildings, wine cellars and distilleries, bridges, fences, and resorts. These stone structures have become part of the tradition and heritage of the area.

The first masonry arch bridge to be constructed in the Napa Valley was built in 1860 to carry First Street over the Napa River in the town of Napa. According to the 1895-96 Biennial Report of the Bureau of Highways, in Napa County stone for bridge purposes was plentiful and had been utilized to great advantage. The report also stated that Napa County led all other counties in the introduction of permanent structures and had already constructed nine stone bridges that spanned in length from 50 to 300 feet.[22]

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[18] Robert Fredericks, "Nineteenth Century Stonework in California's Napa Valley*," The California Georgrapher,* 1969,43.

[19] Fredericks, 43.

[20] *Illustrations of Napa County, California* (Smith and Elliott: Oakland, 1878), 3.

[21] Fredericks, 43.

[22] California Bureau of Highways, *Biennial Report of the Bureau of Highways, 1895-1896* (California State Printing: Sacramento, 1896), 71.

Many additional masonry arch bridges soon followed and by the turn of the 20th century Napa County was known as the "county of the stone bridges." Between 60 and 70 public masonry arch bridges were constructed during the late 19th and early 20th centuries, some of them being the largest in the western United States. Nearly all the bridges were built from quarried volcanic rock or in combination with sandstone and show evidence of highly competent workmanship and considerable engineering skill.[23]

The largest of the Napa County masonry arch bridges was built 1896. The bridge spanned Putah Creek about one and a half miles south of Monticello. This bridge, designed by R.H. Pithie for a cost of $19,800, consisted of three spans and had a total length of 298 feet making it the longest masonry arch bridge west of the Rocky Mountains. The bridge is still extant, but completely inundated by Lake Berryessa.[24]

For nearly 70 years, from 1846 until start of World War I, stone masonry construction was the prominent method of construction of bridges and wineries in the Napa Valley. Two examples of prominent buildings in the community built of stone are the Napa County Asylum, built in 1872-73, and the George E. Goodman Library, built in 1901. According to a survey initiated by the County Board of Supervisors in 1914, at that time the county had 326 cut-stone bridges and culverts.[25]

Eventually the use of newer, cheaper, labor saving methods of building such structures became inevitable. Several factors led to the end of the stone masonry construction era in the Napa valley.

First, the nature of the population settled in the area changed. The original Europeans were gradually replaced with both their own American heirs as well as new settlers to the area. The new generation, without the Old World heritage and traditions of the previous generation, were more interested in newer, faster, less expensive methods of construction.

Second, the mass supply of inexpensive manual labor diminished. The Chinese that had provided manual labor for the masonry structures were now replaced by second generation Chinese-Americans most of whom either moved to the cities or returned to their homelands.

Third, the overall mood of the times had changed. After the First World War, the traditional time honored methods of workmanship no longer seemed as important as they had in the past. Americans were beginning to crave the new, innovative, and different.[26]

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[23] Fredericks, 45-46.

[24] John Wichels, *Napa County Stone Bridges* (Napa County Historical Society: Napa, CA, 1982), 2.

[25] "Cut-Stone bridges*," The Architect and Engineer,* October 1914, 127.

[26] Fredericks, 47.

Figure 6: List of Extant Masonry Arch Bridges in Napa County

Bridge Number	Bridge Name	Facility Carried
21-3	Tulucay Creek	Highway 121
21-5	Garnett Creek	Highway 29
21-9	Capell Creek	Highway 121
21-16	Sulphur Creek	Highway 29
21-17	York Creek	Highway 29
21-57	Ritchie Creek	Highway 29
21-60	Diamond Mountain Creek	Highway 29
21-62	Soda Creek	Highway 128
21-68	Blossom Creek	Highway 128
21-71R	Suscol Creek	Highway 29
21C-2	Napa River	Zinfandel Lane
21C-10	Napa Creek	Jefferson Street
21C-17	Carneros Creek	Old Sonoma Road
21C-42	Garnett Creek	Greenwood Avenue
21C-44	Napa Creek	Main Street
21C-46	Swartz Creek	Aetna Springs Road
21C-51	Milliken Creek	Trancas Street
21C-58	Maxwell Creek	Hardin Road
21C-75	Chiles Creek	Chiles-Pope Valley Road
21C-46	Chiles Creek	Chiles-Pope Valley Road
21C-92	Napa Creek	Seminary Street
21C-94	Napa Creek	Coombs Street
21C-96	Napa Creek	First Street
21C-97	Napa Creek	Pearl Street
21C-104	Napa River Overflow	Oak knoll Avenue
21C-108	Dutch Henry Creek	Larkmead Avenue
21C-109	Napa River	Pope Street
21C-110	Sulphur Creek	Pope Street
21C-113	York Creek	Spring Mountain Road

Stone Masonry Construction in Santa Barbara County

Use of masonry for construction in the Santa Barbara area dates back to the time the Spanish arrived. Since it was necessary to travel some distance into the woods to obtain lumber, but rocks were found scattered on the ground, stone became the preferred building material. Stones were cut and incorporated into the original Santa Barbara Mission structures, although most of the early buildings and walls of the mission were made of adobe. In 1811 stone arches were erected the length of the main corridor. After the mission was badly damaged in the earthquake of 1812, thick walls of sandstone were incorporated into the towers.[27]

[27] Santa Barbara News Press, March 2, 1975.

The tradition of building with stone continued in Santa Barbara County through the 19th century. This method of construction was often chosen because local brown sandstone was readily available and easily transformed from round or shapeless boulders into symmetrical smooth faced stone for building purposes. A local stonemason explained in July of 1883, "When a quantity of it is wanted, a blast of powder is drilled into the heart of one of the large boulders and exploded and a number of square edged building stones are produced."[28] Many residences, walls, bridges, and commercial structures were constructed out of local sandstone during the nineteenth and early twentieth century.

Immediately after the First World War, Santa Barbara began a concerted effort to revamp its visual image. During this time city planners carefully monitored all construction of any new structure to make sure it was consistent with the master plan that was based on a Hispanic/Mediterranean streetscape mode.[29] The use of a traditional building material, sandstone, in the construction of the many new bridges and culverts built during this period was in line with Santa Barbara's planning and design efforts.

Figure 7: List of Extant Masonry Arch Bridges in Santa Barbara County

Bridge Number	Bridge Name	Facility Carried
51-106	Sycamore County Creek	Highway 192
51C-43	Montecito Creek	Ashley Road
51C-51	Mission Creek	Mission Canyon Road
51C-54	Rattlesnake Canyon	Las Canoas Road

Designers and Builders

Masonry arch bridges built in California were designed and built by a variety of early residents but primarily reflect the local traditions and preferences of the county surveyor. In the late nineteenth and early twentieth centuries, the county surveyor became the center of bridge development and design in California.

In Napa County, Achilles F. Grigsby is credited by some as being the first to advocate the use of local stone as a building material. He arrived in Napa County in 1845 and became a county supervisor in 1857. It was during his time as a county supervisor that the county's first masonry arch bridge was built in 1860.[30]

Two of the most famous Napa County masonry arch bridges, the now under water Putah Creek Bridge and the National Register listed Pope Street bridge over the Napa River, were designs of R.H. Pithie. Pithie, a stonemason of Scot origins, arrived in the upper Napa Valley in the 1880s. He constructed many of the stone buildings and wine cellars in the northern part of the county. Pithie succeeded in winning the bid to replace the existing wooden structure that spanned the Napa River at Pope Street, over a San

[28] Santa Barbara News Press, July 1883.

[29] Rebecca Conrad and Christopher H. Nelson. *Santa Barbara: A Guide To El Pueblo Viejo* (Capra Press: Santa Barbara, 1986), 14.

[30] *Illustrations of Napa County, California.* (Smith and Elliott: Oakland, 1878), 22.

Francisco firm that was proposing a steel structure. The Pope Street Bridge is one of the earlier examples of the use of stone for bridge building in Napa County.[31]

The majority of the masonry arch bridges in Napa were built under the direction of the county surveyor, Oliver H. Buckman. Buckman was born December 14, 1847 in Baltimore, Maryland to Quaker parents. In 1855 the family moved to a farm in Iowa where Buckman lived until he was 25. He attended the State University of Iowa and graduated in 1876 with a degree in civil engineering. In 1877 Buckman came to California and settled in the city of Napa. He held the office of Napa City Engineer beginning in 1880. He also served as Napa County Surveyor beginning in 1885. He held both positions until about the time of World War I.[32] Buckman married in 1903 at the age of 56. He was a Napa resident for over 50 years and died there on June 19, 1928.[33]

Two of the primary stone masonry bridge contractors in the Napa valley were James B. Newman and his partner in many ventures, H.W. Wing who were both were expert stone masons who emigrated from England to America. Newman was born in England in 1851 and arrived in the United States in 1872. After a brief time in Baltimore and Chicago, he settled in the Napa valley.[34] In 1878, Newman and Wing began Napa Marble Works, a successful business that produced cemetery stones and vaults, located at the intersection of Coombsville Road and Silverado Trail. In 1901, Newman traveled to Europe to study all the latest designs in marble stone cutting. As a result of his study abroad, their firm had the most modern and efficient tools available at that time. Prior to 1901, the firm was credited with building over thirty masonry arch bridges and culverts, as well as well as a large number of vaults in the cemetery.[35]

The majority of the masonry arch bridges built in Santa Barbara County were the result of designs by county surveyor Owen Hugh O'Neill, Jr. O'Neill was born on February 8, 1873 in La Graciosa in Santa Barbara County. His father, O.H. O'Neill Sr., was born in Ireland and educated at Trinity College in Dublin, and upon coming to the United States, he found work in a company of engineers. The younger O'Neill spent time in Mexico where he worked from 1905 until 1909 at various companies including the Canarea Consolidated Copper Company and Guerrero Plantation and Investment Company. He returned to Santa Barbara County in 1909 where he worked as a draftsman for both the city engineer and county surveyor. He was elected county surveyor in 1914 and held that position until 1946. While serving as county surveyor, he also maintained a private practice until the surveyor's position became a full-time job in 1931. He served as president of the California County Engineer's Association and was a life member of the American Society of Civil Engineers. After retiring, he was elected to the Santa Barbara City Council for one term in 1949 and then became planning commissioner for Santa Barbara County until 1961. An important local figure in the Santa Barbara community, O'Neill edited a history of the county in 1939 and also lectured on California history. He

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[31] Wichels, 7-8.
[32] *History of Napa County, Illustrated. (*Enquirer Print: Oakland, 1901), 264-265. Israel, 173.
[33] Napa Daily Morning Journal, June 20, 1928.
[34] *History of Napa County Illustrated*, 328.
[35] *History of Napa County Illustrated*, 290.

was also a Mason and a member of the Rotary Club and the Native Sons of the Golden West. O'Neill was married to Zaida Evelyn Frisbie in Benson, Arizona on January 20, 1910 and the couple had twelve children.[36] O'Neill died on December 13, 1967 in San Luis Obispo County.[37]

These men brought to their respective areas the traditional masonry building methods and architectural styles with which they were familiar. Much of the design and building of the masonry arch bridges in California was undertaken by settlers or descendents of settlers, from the rural provinces of Europe where masonry construction was common.

[36] Israel, 199.
[37] California Death Index, 1961-1970.

V. Results of Survey

Figure 8: Comparison of Survey Results

Determination	1984-86 Survey	2002-03 Survey
Listed	1	2
Eligible	12	14
Unevaluated	2	1
Ineligible	32	26
Total	**47**	**43**

As previously stated, in reevaluating the bridges in 2002-2003, the approach used in evaluating the integrity and eligibility for each bridge was consistent with the approach used in the original 1984-86 survey. In general, all the masonry arch bridges with a high degree of integrity were considered eligible under criterion C, because of the rarity of this bridge type and the fact that they are generally of the oldest surviving bridges in the state. Bridges that have been widened using different structural systems, or had their original stone railings replaced with other types of railings, were considered to lack sufficient integrity to be eligible. Research was undertaken on each structure to determine if a bridge appeared to be significant for association with important events or people.

Of the 43 structures surveyed in 2002-03, 9 were eliminated due to lack of integrity resulting from the structure being widened on both sides in such a way that the original masonry spandrel walls were no longer visible. The remaining 34 bridges were then subjected to the further evaluation. If they had been widened on one side or had been subjected to extensive railing modifications that detracted from the original feeling of the bridge or if the surrounding setting had changed so dramatically that it detracted from the original feeling of the bridge, the structure was also eliminated. Being subjected to this additional evaluation found an additional 18 bridges to be ineligible due to lack of integrity, 12 due to widening and 6 due to railing modifications. One of the bridges evaluated that fell into this category, 54C-132 (Workman Wash Bridge), while appearing individually ineligible, appears to be a possible contributor of a potential unevaluated historic road, a segment of old Route 66, and therefore is proposed for category 4 (unevaluated) designation pending an evaluation of old Route 66. Of the remaining 16 bridges, one, 21C-109 (Pope Street Bridge) is already listed individually on the National Register and the update survey confirmed the status. A second bridge, 20C-520 (Nathanson Creek Bridge), was included as a contributing element of an already National Register listed historic district in downtown Sonoma and also retains its status.

The remaining 14 bridges were then further reviewed on an individual basis. All 14 appear to be individually eligible under Criterion C as fine examples of a rare bridge type in California, the masonry arch.

None of these 14 bridges, other than 20C-520 (Nathanson Creek Bridge) which is a contributor to a listed historic district, appear to be in potential historic districts.

None of the 43 bridges surveyed and evaluated were found to be significant for association with important events or people, and therefore do not appear to be eligible under criteria A or B.

The results of the 2002-03 survey were fairly consistent with the results of the 1984-86 survey. Of the two bridges already listed on the National Register, the 1984-86 survey of 21-109 also confirmed the bridge's status. The second listed structure, 20C-520, was not surveyed in 1984-86. Of the 14 bridges that appear eligible, 10 of the structures were also determined eligible in the original survey. There were also two bridges that were determined to not be eligible in the original survey but now appear to be eligible, these are 21C-96 and 51C-54. The remaining two bridges that appear eligible in the current survey were not surveyed in 1984-86. Of the 26 bridges that appear to be not eligible, 19 were also determined not eligible in the original survey, two were considered to be potentially eligible because it was thought they may be contributors to potential historic districts or that the ornate streetlights attached to the bridge railings may be eligible for listing as objects, and five bridges were not surveyed. There were no bridges that were determined eligible in the original survey that appear to be ineligible in the 2002-03 survey. There was one bridge surveyed and evaluated on an individual basis in the current evaluation, 54C-132, that appears individually ineligible, but appears to be a possible contributor to an unevaluated potential historic highway, old Route 66. This bridge was not evaluated in the original survey. It is being proposed that this structure be given a category 4 (unevaluated) designation pending an evaluation of old Route 66. Figure 9 lists the results of both surveys for each bridge.

Figure 9: Comparison of 1984-86 and 2002-03 Surveys

Bridge #	Bridge Name	1985-86 Finding	2002-03 Finding
3-16	Willow Creek	Not Eligible	Reclassified as a Culvert
7C-80	Pit River Overflow	Not Eligible	Reclassified as a Culvert
20-30	Hooker Creek	-	Not Eligible
20C-271	Calabazas Creek (Dunbar Road)	Not Eligible	Not Eligible
20C-324	Calabazas Creek (O'Donnell Lane)	Eligible	Eligible
20C-520	Nathanson Creek	-	Listed (District)
21-3	Tulucay Creek	Not Eligible	Not Eligible
21-5	Garnett Creek (Hwy 29)	Eligible	Eligible
21-9	Cappell Creek	Not Eligible	Not Eligible
21-14L	Dry Creek	Not Eligible	Replaced with a concrete slab in 1997
21-16	Sulphur Creek (Hwy 29)	Unevaluated	Not Eligible
21-17	York Creek (Hwy 29)	Unevaluated	Not Eligible
21-46	Bale Slough Overflow	Not Eligible	Reclassified as a Culvert

Bridge #	Bridge Name	1985-86 Finding	2002-03 Finding
21-54	Doak Creek	Not Eligible	Reclassified as a Culvert
21-56	Mill Creek	Not Eligible	Reclassified as a Culvert
21-57	Ritchie Creek	Not Eligible	Not Eligible
21-60	Diamond Mountain Creek	Not Eligible	Not Eligible
21-62	Soda Creek	Not Eligible	Not Eligible
21-68	Blossom Creek	Not Eligible	Not Eligible
21-71R	Suscol Creek	-	Not Eligible
21C-2	Zinfandel Lane	Eligible	Eligible
21C-10	Napa Creek (Jefferson Street)	Not Eligible	Not Eligible
21C-17	Carneros Creek	Eligible	Eligible
21C-18	Pieratt Creek	Not Eligible	Reclassified as a Culvert
21C-42	Garnett Creek (Greenwood Ave)	Eligible	Eligible
21C-44	Napa Creek (Main Street)	Not Eligible	Not Eligible
21C-46	Swartz Creek	Eligible	Eligible
21C-50	Salvador Overflow	Not Eligible	Replaced with a concrete slab in 1988
21C-51	Milliken Creek	Eligible	Eligible
21C-58	Maxwell Creek	Eligible	Eligible
21C-73	Redwood Creek	Not Eligible	Replaced with a concrete box girder in 1989
21C-75	Chiles Creek	Not Eligible	Not Eligible
21C-76	Chiles Creek	Not Eligible	Not Eligible
21C-79	Murphys Creek	Not Eligible	Replaced with a concrete slab in 1994
21C-92	Napa Creek (Seminary Street)	Not Eligible	Not Eligible
21C-94	Napa Creek (Coombs Street)	Not Eligible	Not Eligible
21C-96	Napa Creek (First Street)	Not Eligible	Eligible
21C-97	Napa Creek (Pearl Street)	Not Eligible	Not Eligible
21C-104	Napa River Overflow	Not Eligible	Not Eligible
21C-108	Dutch Henry Creek	Not Eligible	Not Eligible
21C-109	Napa River (Pope Street Bridge)	Listed	Listed
21C-110	Sulphur Creek	Not Eligible	Not Eligible
21C-113	York Creek (Spring Mountain Road)	Not Eligible	Not Eligible
21C-9999	Hurchica Creek	Eligible	On private property
25-45	Eagle Creek	Eligible	Reclassified as a Culvert
32-14	Sonora Creek	Not Eligible	Not Eligible
49-123	Stenner Creek	-	Not Eligible
51-106	Sycamore Canyon Creek	-	Eligible
51C-43	Montecito Creek	Eligible	Eligible
51C-51	Mission Creek	Eligible	Eligible
51C-54	Rattlesnake Creek	Not Eligible	Eligible
52-102	Lion Canyon Creek	-	Not Eligible
54C-132	Workman Wash	-	Unevaluated
56-169	Morrill Canyon	-	Eligible
56-170	Decker Canyon	-	Not Eligible

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Appendix A:

Inventory Forms (DPR-523) for bridges that appear eligible for National Register listing

Bridge #	Bridge Name	2002-03 Finding
20C-324	Calabazas Creek (O'Donnell Lane)	Eligible
20C-520	Nathanson Creek	Listed (District)
21-5	Garnett Creek (hwy 29)	Eligible
21C-2	Zinfandel Lane	Eligible
21C-17	Carneros Creek	Eligible
21C-42	Garnett Creek (Greenwood Ave)	Eligible
21C-46	Swartz Creek	Eligible
21C-51	Milliken Creek	Eligible
21C-58	Maxwell Creek	Eligible
21C-96	Napa Creek (First Street)	Eligible
21C-109	Napa River (Pope Street Bridge)	Listed
51-106	Sycamore Canyon Creek	Eligible
51C-43	Montecito Creek	Eligible
51C-51	Mission Creek	Eligible
51C-54	Rattlesnake Creek	Eligible
56-169	Morrill Canyon	Eligible

Appendix B:

Inventory form (DPR-523) for bridge that is being recommended for an unevaluated designation

Bridge #	Bridge Name	2002-03 Finding
54C-132	Workman Wash	Unevaluated

Appendix C:

Inventory Forms (DPR-523) for bridges that appear ineligible for National Register listing

Bridge #	Bridge Name	2002-03 Finding
20-30	Hooker Creek	Not Eligible
20C-271	Calabazas Creek (Dunbar Road)	Not Eligible
21-3	Tulucay Creek	Not Eligible
21-9	Cappell Creek	Not Eligible
21-16	Sulphur Creek (Hwy 29)	Not Eligible
21-17	York Creek (Hwy 29)	Not Eligible
21-57	Ritchie Creek	Not Eligible
21-60	Diamond Mountain Creek	Not Eligible
21-62	Soda Creek	Not Eligible
21-68	Blossom Creek	Not Eligible
21-71R	Suscol Creek	Not Eligible
21C-10	Napa Creek (Jefferson Street)	Not Eligible
21C-44	Napa Creek (Main Street)	Not Eligible
21C-75	Chiles Creek	Not Eligible
21C-76	Chiles Creek	Not Eligible
21C-92	Napa Creek (Seminary Street)	Not Eligible
21C-94	Napa Creek (Coombs Street)	Not Eligible
21C-97	Napa Creek (Pearl Street)	Not Eligible
21C-104	Napa River Overflow	Not Eligible
21C-108	Dutch Henry Creek	Not Eligible
21C-110	Sulphur Creek	Not Eligible
21C-113	York Creek (Spring Mountain Road)	Not Eligible
32-14	Sonora Creek	Not Eligible
49-123	Stenner Creek	Not Eligible
52-102	Lion Canyon Creek	Not Eligible
56-170	Decker Canyon	Not Eligible