## 1. NAME OF PROPERTY

Historic Name: Duck Creek Aqueduct

Other Name/Site Number: Metamora Aqueduct; Whitewater Canal Aqueduct

Designated a National Historic Landmark by the Secretary of the Interior August 25, 2014

## 2. LOCATION

Street & Number: Spanning Duck Creek at Whitewater Canal Not for publication: __

City/Town: Metamora Vicinity: __

State: Indiana County: Franklin Code: 047 Zip Code: 47030

## 3. CLASSIFICATION

| Ownership of Property | Category of Property |
|---|---|
| Private: | Building(s): |
| Public-Local: | District: |
| Public-State: X | Site: |
| Public-Federal: | Structure: X |
| | Object: |

Number of Resources within Property

| Contributing | | Noncontributing | |
|---|---|---|---|
| buildings | 0 | buildings | 0 |
| sites | 0 | sites | 0 |
| structures | 1 | structures | 5 |
| objects | 0 | objects | 0 |
| Total | 1 | Total | 0 |

Number of Contributing Resources Previously Listed in the National Register: 1

Name of Related Multiple Property Listing: *Covered Bridges NHL Context Study*

## 4. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ____ nomination ____ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ____ meets ____ does not meet the National Register Criteria.

Signature of Certifying Official Date

State or Federal Agency and Bureau

In my opinion, the property ____ meets ____ does not meet the National Register criteria.

Signature of Commenting or Other Official Date

State or Federal Agency and Bureau

## 5. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that this property is:

___ Entered in the National Register
___ Determined eligible for the National Register
___ Determined not eligible for the National Register
___ Removed from the National Register
___ Other (explain): _____

Signature of Keeper Date of Action

## 6. FUNCTION OR USE

Historic: Transportation Sub: canal-related (aqueduct)

Current: Transportation Sub: canal-related (aqueduct)

## 7. DESCRIPTION

ARCHITECTURAL CLASSIFICATION: Other: Burr truss covered bridge

MATERIALS:
Foundation: stone
Walls: wood
Roof: metal
Other:

## Describe Present and Historic Physical Appearance.

Duck Creek Aqueduct is the only surviving covered wood aqueduct in the United States. Built to carry the Whitewater Canal, and associated canal traffic, over Duck Creek at Metamora, Indiana, it is a remnant of the vast national internal improvements movement that occurred in the early- to mid-nineteenth century, and it illustrates the widespread application of timber bridge technology to nineteenth-century transportation systems. Duck Creek Aqueduct is nationally significant under NHL Criterion 4, as a property that embodies the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style, or method of construction and under NHL Theme V, Developing the American Economy, Transportation and Communications and NHL Theme VI, Expanding Science and Technology, Technological Applications. Duck Creek Aqueduct is part of the Whitewater Canal Historic District at Metamora, Indiana, which was listed in the National Register of Historic Places in 1973; it is also part of the Metamora Historic District, which was listed in the National Register of Historic Places in 1992. It was recorded by the Historic American Buildings Survey (HABS) in 1934 and by the Historic American Engineering Record (HAER) in 2012. Of the approximately 690 historic (pre-1955) covered bridges surviving in the United States, Duck Creek Aqueduct stands out as an excellent example of nineteenth-century covered bridge construction and preservation.[1]

### Setting

Southeastern Indiana's Whitewater Valley is a picturesque rural landscape of rolling hills and fertile farmland dotted with small industrial hamlets in the heart of the Midwest. The valley was carved by the Whitewater River, a 100-mile-long tributary of Ohio's Great Miami River, and was used as an early transportation corridor into the interior of the state. Built between 1839 and 1847, the Whitewater Canal follows the Whitewater River through the valley, connecting the Ohio River at Lawrenceburg with the National Road at Cambridge City. Although a short-lived venture, the canal stimulated settlement and economic development in the region. Midway along the canal, the village of Metamora was platted in 1838, when the canal's construction was assured. The small industrial hamlet soon grew into a thriving village and was a busy canal port in its heyday. After the canal was supplanted by the railroad in the 1860s, Metamora lost its position as a commercial hub and fell into a century-long period of decline. The historic village became a popular tourist destination after the State of Indiana restored a 15-mile section of the canal as a state historic site in the mid-twentieth century.

### Description

Duck Creek Aqueduct is a single-span through truss covered wood aqueduct on mortared limestone abutments.[2] The structure carries the Whitewater Canal over Duck Creek in Metamora, Indiana. It is actually one of three bridges that span Duck Creek at the eastern edge of Metamora, as the canal parallels Metamora's main street and the tracks of the former Indianapolis & Cincinnati Railroad (today, the line carries the Whitewater Valley Railroad, a weekend excursion line). The superstructure is approximately 90′ long, 25′ wide, and 25′ deep overall, with a clear span (between abutment faces) of 69′-4″, a canal width of 17′-7″, and overhead clearance of approximately 12′ to 11′-6″. The trusses are approximately10′ 10″ to 12′ deep (center on center of chords) and spaced 21′-4″ on center. The bottom of the aqueduct trough is approximately 10′ above Duck Creek.

[1] Approximately half of the 690 extant historic (pre-1955) covered bridges in the United States have been significantly altered, with much loss of historic fabric and character; many others have suffered a moderate loss of integrity.

[2] A through truss is a bridge truss in which most of the structure is above the travel deck, with lateral bracing overhead, so that traffic passes through the structure.

The superstructure is a Burr through truss with inclined posts.[3] It comprises two eight-panel multiple kingpost trusses. Each truss is flanked by a pair of tied arches, measuring 9″x18″ in section. The arches are bolted to the truss posts and set in notches at the ends of the lower chords, where the connection is reinforced with ½”-thick metal plates, which help transfer the thrust of the arches to the lower chords.[4] The upper chords are paired 8″x9″ timbers. The lower chords are paired 9″x16″ timbers. The upper and lower chords are connected by 8″x12″ endposts, a 12″x20″ tapered center post, and 10″x12″ posts whose tops incline outward toward the ends of the bridge; the post angle varies from vertical at mid-span to a maximum of 20 degrees from vertical at the ends of the span. There are 8″x12″ braces, angled down toward the ends of the bridge, between the posts. The upper lateral bracing system consists of 12″x14″ tie beams spaced approximately 16′ apart, with paired 6″x6″ cross-bracing between them.

The trough (or flume) is approximately 17′-7″ wide and 4′-6″ deep overall. It is constructed of white oak tongue-and-groove boards (2″x8″ for the deck and 2″x6″ for the walls), supported by a series of thirty-five 6″x16″x24′ transverse floor beams spaced at 2′ centers. The outer ends of the floor beams bear on two 10″x12″ longitudinal beams that run the length of the bridge. The longitudinal beams are suspended from the lower chords by 1¼″-diameter metal rods spaced at 3′ centers. Each rod passes between the lower chord members, through the outer ends of a floor beams, and through the longitudinal beam. Each rod is secured above the lower chord members and below the longitudinal beam with a plate and nut. The normal water depth in the trough is 24″ and the high water depth is 36″, except when the canal is drained in winter, or for maintenance. A 4′-wide spillway is integrated into the west abutment; this regulates the water level of the aqueduct under normal conditions. During times of heavy precipitation, the water level can be regulated by means of four metal relief valves (flood gates), two on each side of the trough near mid-span. Each relief valve consists of a pivoting metal gate and a chute made up of ¼″-thick metal plates. When the relief valves are opened by inserting and turning a metal T-handle, the excess water is released through the chutes into the creek below.

There is a 4-foot-wide walkway on the north side of the structure to accommodate pedestrians. Its outer edge is supported on 3″x4″ braces that are supported on the outer ends of the floor beams. The walkway comprises five lines of 2″x8″ boards nailed to the floor beams. Four 1″x8″ boards spaced at 10″ on center form a 3′-6″ high railing on the outside of the walkway. This walkway is occasionally mistaken as part of the towpath; in fact, the towpath is on the south side of the structure; it later became the railroad right-of-way. Mule or horse teams are unhitched from a canal boat when it reaches the entrance to the aqueduct, the boat proceeds through the aqueduct under its own momentum, and the team is hooked back up on the far side; one of the animal handlers walks through the structure with the line that is connected to the boat. Friction burns from the ropes can be seen on some of the original timbers inside the structure.

The structure is covered with board-and-batten siding on the south side and is open on the north side, where the roof extends 3′-9″ over the walkway. The portal ends have horizontal wood siding on the gables. The siding is painted red. The gable roof is supported on 3″x4″ rafters spaced at 24″ on center, with their outer ends resting on an 8″x9″ sill. The original roof covering was wood shingles. Sometime prior to 1934, the roof was covered with galvanized standing-seam metal, as shown in the 1934 HABS drawings; in 1949, that roof was replaced again with a modern standing-seam metal roof.[5]

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[3] Some sources describe this structure as a Wernwag truss, but aside from the inclined posts, it does not have any Wernwag characteristics. For further discussion, see: Joseph D. Conwill, “Burr Versus Wernwag,” *Covered Bridge Topics* 55, no. 2 (Spring 1997): 4-5.

[4] In Burr trusses, the arches usually spring from the abutments at a point below the lower chords, but occasionally the arches are tied into the ends of the lower chords. At least a few examples of tied arch Burr truss bridges using the tied arch method of construction once existed in Indiana.

[5] Eugene R. Bock, “Aqueduct Project near Completion,” *Indiana Covered Bridge Topics* 4, no. 3 (June 1949): 2.

## Integrity

Duck Creek Aqueduct clearly illustrates the character-defining features of the resource type. Because it carries water, and is thus subject to rapid deterioration, the Duck Creek Aqueduct has been repaired a number of times during its history. In 1868, it was strengthened with the addition of auxiliary trusses, braces and iron rods, all of which are shown in the 1934 Historic American Buildings Survey (HABS) drawings; these elements were removed in 1946.[6] In 1901, the structure was repaired and the bottom of the trough was raised 18 inches; this was done to decrease the volume of water carried, and thus, the stresses on the structure. In 1946–49, the aqueduct underwent a careful and sympathetic restoration under the supervision of the Indiana Department of Conservation. This was part of a larger effort to restore a section of the canal and its structural features as the Whitewater Canal State Memorial (now, Whitewater Canal State Historic Site). Efforts were made to retain as much historic fabric as possible, and members that could not be repaired were replaced with members of the same wood species and dimensions.[7] In 1988, the structure again underwent repairs to pull the trusses plumb, fix the overhead bracing, and reinforce split members throughout the structure. The trough (or flume), which is especially susceptible to decay, has been repaired numerous times in recent decades; it was most recently replaced in 2005 by J.A. Barker Engineering, Inc., of Bloomington, Indiana, a firm with expertise in the rehabilitation of historic covered bridges.[8] While it has undergone repairs throughout its lifetime, the aqueduct retains a high level of integrity in location, setting, design, materials, workmanship, feeling and association.

Duck Creek Aqueduct is a unique structure, as it is the only surviving covered wood aqueduct in the United States. The bridge exhibits the distinctive features of the Burr truss, one of the most successful and widely-used nineteenth-century bridge truss designs, although it is somewhat unusual, in that the posts are inclined, rather than being vertical, and the arches are tied into the ends of the lower chords, rather than springing from the abutments. These features were occasionally found in Burr trusses in Indiana and elsewhere. Duck Creek Aqueduct was built on-site using local materials and traditional nineteenth-century construction methods. Locally-quarried stone was used for the abutments and locally-produced lumber was used in the trusses. Repairs have been carefully undertaken to be in keeping with the historic nature of the structure. While some historic fabric (including the trough, deck, roof and siding) was replaced during the 1946–49 restoration, the essential structural components (the arches and many truss members) were retained in their original configuration.[9] In cases where members were badly deteriorated, they were repaired or replaced with members of the same dimensions and wood species. Duck Creek Aqueduct retains the feeling of a nineteenth-century covered bridge built to carry canal traffic. The bridge remains at its original site and is maintained as an historic landmark and tourist attraction. It still carries horse-drawn canal boats carrying tourists from May through October. The structure's picturesque and historic setting possesses the feeling of a nineteenth-century industrial village, which includes residences, a commercial district, and a working grist mill. Duck Creek has been associated with the Whitewater Canal since its construction, first as part of a transportation canal, then as part of hydraulic canal, and finally as part of the Whitewater Canal Memorial, one of Indiana's early historic preservation efforts.

[6] This was made possible by the fact that the depth of the trough had been reduced in 1901 and was undertaken to return the structure to its original appearance.

[7] Richard Sanders Allen, "Indiana Moves to Preserve Aqueduct," *Covered Bridge Topics* 4, no. 2 (June 1946): 9; Bock, "Metamora has a Bridge Yard," *Indiana Covered Bridge Topics* 2, no. 1 (December 1946): 1.

[8] J. A. Barker Engineering, Inc., "Indiana Department of Natural Resources, Whitewater Canal State Historic Site, Repair of Duck Creek Aqueduct, Project No. E143459B," measured drawings, 2005.

[9] All of the siding, roofing, trough, and flooring have been replaced periodically over the years, but this is part of routine maintenance, and—as long as materials are replaced in-kind—does not diminish the integrity of the structure.

## 8. STATEMENT OF SIGNIFICANCE

Certifying official has considered the significance of this property in relation to other properties:
Nationally: X Statewide:__ Locally:__

| | |
|---|---|
| Applicable National Register Criteria: | A__ B__ C X D__ |
| Criteria Considerations (Exceptions): | A__ B__ C__ D__ E__ F__ G__ |
| NHL Criteria: | 4 |
| NHL Theme(s): | V. Developing the American Economy<br>3. Transportation and Communications<br>VI. Expanding Science and Technology<br>2. Technological Applications |
| Areas of Significance: | Transportation<br>Engineering |
| Period(s) of Significance: | 1846 |
| Significant Dates: | 1846 |
| Significant Person(s): | N/A |
| Cultural Affiliation: | N/A |
| Architect/Builder: | Whitewater Canal Company<br>Henry C. Moore, Resident Engineer |
| Historic Contexts: | Covered Bridges NHL Context Study<br>XVII. Technology (Engineering and Innovation)<br>B. Transportation |

**State Significance of Property, and Justify Criteria, Criteria Considerations, and Areas and Periods of Significance Noted Above.**

Duck Creek Aqueduct is the only surviving covered wood aqueduct in the United States. Built to carry the Whitewater Canal and associated canal traffic over Duck Creek at Metamora, Indiana, it is a remnant of the vast national internal improvements movement that occurred in the early- to mid-nineteenth century, and it illustrates the widespread application of timber bridge technology to nineteenth-century transportation systems. It is an example of a Burr truss, one of the most significant nineteenth-century timber bridge types, which combines a segmental arch with a multiple kingpost truss; approximately 185 Burr truss covered bridges survive in the United States. Duck Creek Aqueduct is nationally significant under NHL Criterion 4, as a property that embodies the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style, or method of construction and under NHL Theme V, Developing the American Economy, Transportation and Communications and NHL Theme VI, Expanding Science and Technology, Technological Applications. Duck Creek Aqueduct is part of the Whitewater Canal Historic District at Metamora, Indiana, which was listed in the National Register of Historic Places in 1973; it is also part of the Metamora Historic District, which was listed in the National Register of Historic Places in 1992. It was recorded by the Historic American Buildings Survey (HABS) in 1934 and by the Historic American Engineering Record (HAER) in 2012. Of the approximately 690 historic (pre-1955) covered bridges surviving in the United States, Duck Creek Aqueduct stands out as an excellent example of nineteenth-century covered bridge construction and preservation.

A discussion of the national significance of Duck Creek Aqueduct is provided in the associated document, *Covered Bridges NHL Context Study*. The study establishes the history and evolution of the property type, and provides a preliminary assessment of the National Historic Landmark (NHL) eligibility of covered bridges that are considered by experts in the field to be the best representative examples of the surviving 690 historic (pre-1955) covered timber bridges in the United States. These properties were selected from the National Covered Bridges Recording Project (NCBRP), undertaken in 2002–2005 by the Historic American Engineering Record (HAER), which is administered by the Heritage Documentation Programs Division of the National Park Service, United States Department of the Interior. The project was funded by the Federal Highway Administration's (FHWA) National Historic Covered Bridge Preservation Program (NHCBP), established in 2000 by Section 1224 of the Transportation Equity Act for the 21st Century (TEA21). Over the course of a multi-year project, HAER recorded 75 covered bridges throughout the United States. In 2010, each of these bridges was individually evaluated against National Historic Landmark criteria and a list compiled of twenty covered bridges that have high integrity and are significant as outstanding representative examples of their type, period, and method of construction. Secondary considerations for inclusion in this list were: historical significance, significance of the designer or builder, and aesthetics of the bridge and site.

**Covered Bridges in the United States**

Covered bridges are pre-eminently—although not exclusively—an American phenomenon. Nowhere else in the world were such impressive timber structures attempted, and nowhere else were they built in such large numbers.[10] Over the course of two centuries, covered bridges have played a significant role in American life, by facilitating settlement, transportation and commerce. They also represent a period of remarkable achievement in

[10] According to the 7th edition of the *World Guide to Covered Bridges* (2009), there are approximately 1,500 extant historic (pre-1955) covered bridges in the world. More than half of these structures are located in North America. American scholars have recently become aware of large numbers of ancient covered bridges in China, but most were built for pedestrian traffic, and their construction techniques and reason for covering differ from the Western tradition.

civil engineering, during which bridge building evolved from an empirical craft to a science. At the height of covered bridge building, around 1870, there were well over 10,000 covered bridges in the United States.[11]

Timber bridges have been built in forested regions of the world for centuries.[12] Wood is an excellent material for building; it is strong, yet relatively lightweight and easy to work with. Since most species of wood suitable for structural applications deteriorate rapidly when exposed to the weather, European bridge builders quickly learned the value of covering wood bridges with roofs and siding to protect the underlying framework.[13]

Bridges were rare in Colonial America. Small streams were spanned with simple wood beams or stone slabs, and occasionally with stone arches, but with few exceptions, larger waterways had to be crossed by ford or ferry. Travel was hazardous and uncertain; delays and accidents were common. A few ambitious crossings were made with pontoons or a series of simple beam spans supported on timber piles, but long-span bridges were generally not built in America until the volume of transportation justified the expenditure of material and labor.[14] Following the American Revolutionary War, the demand for roads and bridges, coupled with access to abundant forests, spurred the development of timber bridge design in the United States.

Internal improvements were a priority of the new nation. Roads, canals and bridges were desperately needed to expand commerce and unite the country. The Louisiana Purchase of 1803 doubled the land area of the United States and over the next half-century, settlement expanded west to the Pacific Ocean. Timber bridges were an ideal solution to America's many transportation hurdles and settlers built hundreds of them as they moved westward across the continent. They provided for safe, efficient and economical overland transportation that was essential to the new nation's growth.

In 1804–05, Timothy Palmer (1751–1821) built America's first covered bridge across the Schuylkill River at Philadelphia. By 1810, covered bridges were common in southern New England, southeastern New York, Pennsylvania and New Jersey. From this core area, covered bridges spread northward, southward and westward. In the 1820s, town and county governments began to specify covered bridges for construction on local roads. By 1830, covered bridges were commonplace at major river crossings in the eastern United States. The builders of timber bridges utilized readily available materials and common hand tools. Making use of patented truss designs, carpenters with basic woodworking ability could erect an average-sized covered bridge in a short time, usually within a few weeks.

Covered bridges were adapted to the needs of every type of transportation corridor, including turnpikes, canals and railroads and they facilitated the settlement of the United States for over a century. The rapid growth of the railroads in the mid-1800s—in particular, the increasing weight of locomotives and rolling stock—encouraged innovations and technical advancements in the design of timber truss bridges and was an important factor in the rise of civil engineering as a profession. All the major technological improvements in American truss bridge design occurred when wood was the building material of choice.

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[11] This is only a rough estimate of known covered bridges that existed c.1870. Initial data compiled by the "Covered Spans of Yesteryear Project," https://www.lostbridges.org/, suggests that this figure may be too low.

[12] In 55 BC, Julius Caesar (100 BC–44 BC) built the earliest known timber bridge across the Rhine River.

[13] Several European covered bridges have survived for more than three centuries, while a few in the United States are nearing the two-century mark.

[14] The Great Bridge (1660) across the Charles River at Boston and the York River Bridge (1761) at York, Maine, were notable exceptions. The Great Bridge consisted of "*cribs of logs filled with stone and sunk in the river—hewn timber being laid across it.*" The York River Bridge was a timber pile bridge, which used tree trunks or piles driven vertically into the river bed to provide a foundation for a series of simple beam spans.

By 1850, there were covered bridges in most settled regions of the United States.[15] Thereafter, the number of covered bridges continued to multiply until about 1870, by which time there were well over 10,000 covered bridges in the United States.[16] The golden era of covered bridge building lasted for about a century in most areas of United States, and even longer in areas where timber was plentiful.[17]

## The Burr Truss

Theodore Burr (1771–1822) is a major figure in the history of covered bridge building. He built many important bridges over the course of a twenty-year career and is credited with the invention of the Burr truss, which was one of the most popular timber truss types in the nineteenth century and continued to be built in some areas until about 1920.[18] Born in Connecticut, Burr learned construction at an early age from his father, who was a miller and millwright. In 1800, Burr built his first bridge, a simple timber stringer span, across the Chenango River on the Catskill Turnpike at Oxford, New York. He subsequently experimented with a wide variety of timber arch designs for bridges that spanned the Hudson, Mohawk, Delaware and Susquehanna rivers. He built his first covered bridge across Schoharie Creek at Esperance, New York in 1811. Burr's masterpiece was the short-lived McCall's Ferry Bridge (1815) across the Susquehanna River near Lancaster, Pennsylvania; with a clear span of 360′-4″, this was the longest timber arch span ever erected during the historic period of covered bridge building.[19]

In 1806, and again in 1817, Burr received patents for the truss design that bears his name.[20] The Burr truss was an innovative trussed arch design, in which a separate segmental arch was superimposed on a multiple kingpost truss.[21] Its structural action was such that the arch bolstered the truss, while at the same time being stabilized by it, a complex interaction. A major advantage of this design was that it allowed for a level deck, in contrast to earlier arched truss spans built by Timothy Palmer (1751–1821) and Lewis Wernwag (1769–1843), an important feature for multiple-span bridges, and later, for railroad bridges. The Burr truss was the first patented bridge truss to gain widespread acceptance among bridge builders, although the inventor reportedly collected few royalties from it. The design was popular in the mid-nineteenth century for both railroad and roadway spans.

In 1822, Burr died under mysterious circumstances while supervising construction of a bridge at Middletown, Pennsylvania.[22] The Union Bridge (1804) spanning the Hudson River at Waterford, New York was the last survivor of the bridges Burr built himself; it was destroyed by fire in 1909. Of the thousands of Burr truss covered bridges that once existed, about 185 historic examples (more than 25 percent of the nation's covered bridge population) survive in the United States, with some of the finest examples located in Pennsylvania and

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[15] Fred Kniffen, "The American Covered Bridge," *The Geographic Review* 41 (1951): 119.

[16] Covered bridges once existed in 41 of the 50 states. No records have been found concerning covered bridges in Colorado, Florida, Idaho, Louisiana, New Mexico, North Dakota, Oklahoma, South Dakota and Utah. The reasons for this presumably vary from region to region, but probably include: absence of readily-available timber, absence of major river crossings, topography more suited to other types of bridges, late-period settlements and low population density.

[17] Covered bridge building ended in New England and the Midwest around 1925, and in the South around 1935. Covered bridges continued to be built in Oregon into the 1950s.

[18] The Edna Collins Bridge (1922) in Putnam County, Indiana was the last historic Burr truss covered bridge built in the United States.

[19] The McCall's Ferry Bridge was destroyed by ice in 1818.

[20] Theodore Burr, United States Letters Patent No. 2769X, 3 April 1817. The 1806 patent was lost in the 1836 patent office fire, but the 1817 patent was recovered.

[21] The truss design Theodore Burr used was not new, as it had been published in the *Columbian Magazine* in 1787, but he is believed to be the first builder to use that design in bridge building.

[22] Hubertis M. Cummings, "Theodore Burr and His Bridges across the Susquehanna," *Pennsylvania History* 23, no. 4 (October 1956): 484.

Indiana.[23] Duck Creek Aqueduct is a somewhat unusual example of this type, in that the posts are inclined, rather than being vertical, and the arches are tied into the ends of the lower chords, rather than springing from the abutments. Moreover, it is the only extant example of the use of a Burr truss in the construction of a covered wood aqueduct.

## Covered Wood Aqueducts

Covered wood aqueducts were never commonplace, but perhaps more existed than was previously believed. They differed from standard covered bridges in that they were used to carry water and canal boats over a geographic obstacle, in this case, the Whitewater Canal over Duck Creek. Where timber was readily available, canal companies erected wood aqueducts to save time and money. The majority of wood aqueducts were probably left uncovered, but some were partially or fully housed in the same manner as traditional covered roadway bridges. Because most canals were quickly superseded by railroads, most covered wood aqueducts disappeared before they could be documented.

Some impressive examples of covered wood aqueducts once existed on major canal corridors in Pennsylvania, Ohio, and Washington DC, and at least one other covered wood aqueduct reportedly existed on Indiana's Whitewater Canal.[24] Below is a list of known covered wood aqueducts that once existed in the United States; presumably, there were others that have not yet been identified. Duck Creek Aqueduct is the only surviving historic covered wood aqueduct in the country.

| STATE | LOCATION | CANAL | SPANNING | DATE | BUILDER | TYPE | NOTES |
|---|---|---|---|---|---|---|---|
| DC | GEORGETOWN | ALEXANDRIA | POTOMAC RIVER | 1843 | TOWN & DAVIS | TOWN | REPLACED 1866 |
| IN | METAMORA | WHITEWATER | DUCK CREEK | 1846 | HENRY C. MOORE | BURR | RESTORED 1949 |
| IN | CONNERSVILLE | WHITEWATER | WILLIAMS CREEK | 1856 | J.C. MACY | | WASHED OUT |
| IN | FORT WAYNE | WABASH & ERIE | ST. MARY'S RIVER | 1846 | | BURR | REMOVED 1882 |
| IN | ATTICA | WABASH & ERIE | BIG SHAWNEE CREEK | 1847 | | | |
| OH | VANDALIA | MIAMI & ERIE | GREAT MIAMI RIVER | 1859 | D.H. MORRISON | BURR | COLLAPSED 1903 |
| OH | CIRCLEVILLE | OHIO & ERIE | SCIOTO RIVER | 1838 | JOHN HOUGH | | BURNED 1915 |
| PA | PITTSBURGH | PENNSYLVANIA | ALLEGHENY RIVER | 1836 | SYLVANUS LOTHROP | LONG | REPLACED 1845 |
| PA | JOHNSTOWN | PENNSYLVANIA | LITTLE CONEMAUGH RIVER | 1845 | | | |
| PA | DUNCANNON | PENNSYLVANIA | SUSQUEHANNA RIVER | 1839 | | BURR | REMOVED |

## History of the Whitewater Canal

Following the War of 1812, the Whitewater Valley in southeastern Indiana saw rapid settlement. The valley had fertile soil, abundant natural resources, and was ideally suited to farming and the establishment of water-powered industries, and because of its geography, the Whitewater River served as a major waterway into the interior of Indiana. By 1820, the Whitewater Valley was the most heavily populated region in the state and agitation soon began for internal improvements that would better existing economic and social conditions.[25]

[23] Joseph D. Conwill, "Burr Truss Bridge Framing," *Timber Framing* 78 (December 2005): 4.

[24] George Gould, *Indiana Covered Bridge Thru the Years* (Indianapolis: Indiana Covered Bridge Society, 1977): 31. According to the 1992 ASCE National Historic Civil Engineering Landmark nomination, there may have been covered wood aqueducts on the Whitewater Canal at Brookville and Laurel, but no primary documentation has been found to confirm this.

[25] Harry O. Garman, "Whitewater Canal, Cambridge City to the Ohio River," *Indiana History Bulletin* 39, no. 9 (September 1962): 127.

In 1822, residents of the Whitewater Valley began lobbying the Indiana legislature for a canal that would provide easy access to the Ohio River.[26] A meeting held at Harrison in 1823 included delegates from each county in the region. In 1824, the United States Army Engineers surveyed the valley, locating a route along the West Fork of the Whitewater River, from the National Road at Cambridge City to the Ohio River at Lawrenceburg. The State was unable to finance such a large venture, so the plan was set aside for more than a decade.

On January 27, 1836, Indiana Governor Noah Noble (1794–1844) signed the Internal Improvements Act, which created the Board of Internal Improvements and provided $13 million for an ambitious public works program intended to establish a network of canals, railroads and turnpikes throughout the state. These transportation corridors would connect to the Great Lakes to the north, the Ohio River to the south, and the Erie Canal to the east. The proposed projects included: construction of the Whitewater Canal from the National Road at Cambridge City to the Ohio River; construction of the Central Canal from the Wabash River to Indianapolis; extension of the Wabash & Erie Canal from the Tippecanoe River to Terre Haute; construction of a railroad from Madison to Lafayette via Indianapolis; construction of a macadamized turnpike from New Albany to Vincennes; construction of a railroad or macadamized road from Jeffersonville to Crawfordsville; removal of obstructions to navigation of Wabash River; and construction of the Erie & Michigan canal or railroad.[27]

On September 13, 1836, contracts for the Whitewater Canal were let at Brookville, followed by a groundbreaking ceremony. Construction required clearing and draining the land, excavating and lining the canal, building the embankments and towpath, and constructing dams, locks, aqueducts and culverts. The canal was 76 miles long, 26′ wide at the bottom, 40′ wide at the surface, and 4′ deep, with a 10′-wide towpath on one side and a 5′ wide embankment on the other; the embankments were sloped at approximately 30 degrees from level. The topography of the Whitewater Valley required construction of seven feeder dams to impound and feed water from the river, fifty-six locks to lower and raise boats 490 feet, and twelve aqueducts to carry the canal over rivers and streams. The total cost of construction was $1,164,665, which averaged approximately $15,000 per mile.[28]

The Whitewater Canal was built from Lawrenceburg to Cambridge City, and later extended to Hagerstown. The canal followed the West Fork of the Whitewater River, crossing from the west bank to the east bank at Harrison, and the east bank to the west bank at Laurel. Between Lawrenceburg and Harrison, the canal was diverted into Ohio for a distance of seven miles.[29] The canal was considered such a promising venture that the State of Ohio spent $800,000 on the construction of a 25-mile spur canal from Harrison, Indiana to Cincinnati; that branch opening in 1843 and remained in use until 1856.

By the time the canal was completed between Lawrenceburg and Brookville in 1839, the State of Indiana was experiencing serious financial difficulties. With $193,000 in bond interest due, and just $45,000 in tax revenue, the State declared bankruptcy, abolished the Board of Internal Improvements, suspended work on its internal improvement program, and transferred the projects to private companies.[30]

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[26] Augustus Jocelyn (1821–1873), publisher of *The Western Agriculturalist* at Brookville, Indiana, used his newspaper to generate interest in the establishment of a canal in the Whitewater Valley.

[27] Allen A. White, "Indiana's Network of Canals was Merely a Dream," *Indianapolis Star*, 10 June 1934. This article contains an excellent map showing the canals, railroads, and turnpikes proposed under Indiana's Internal Improvements Act of 1836. Of the 857 miles of canals proposed in Indiana, only 472 miles (55 percent) were built.

[28] These numbers include the Hagerstown extension north of Cambridge City.

[29] Due to some high ground at Harrison, seven miles of the section of canal between Harrison and Lawrenceburg had to be located in Ohio. The State of Ohio initially objected, but when they realized the canal might be of mutual benefit, they approved construction and subsequently built their own canal spur between Cincinnati and Harrison.

[30] Richard Simons, "Indiana's Canal Days," *Indianapolis Star Magazine*, 24 April 1949: 7.

In 1841, the Whitewater Valley Canal Company was chartered with a capital stock of $400,000. That company resumed construction of the canal the following summer. The Whitewater Canal was completed to Laurel in 1844, to Connersville in 1845, and to Cambridge City in 1846. The Hagerstown Canal Company completed an eight-mile canal extension north of Cambridge City in 1847.

From its inception, the Whitewater Canal was beset by financial misfortune, which was in large measure due to repeated floods that swept down the Whitewater Valley disrupting navigation and necessitating costly repairs.[31]

In 1848, one local newspaper termed it, "an unfortunate work."[32] Although it served as a valuable transportation corridor for a time, the Whitewater Canal was never a financial success. Slow return on investments, coupled with increasing competition from railroads, caused the canal to go out of business in less than two decades. Commercial navigation ceased after a series of floods just prior to the beginning of the Civil War.

In 1863, the Indianapolis & Cincinnati Railway purchased the towpath right-of-way; the company chartered the White Water Valley Railroad in 1865, laid tracks along the towpath, and began rail service in 1868.[33] In 1866, the Brookville & Metamora Hydraulic Company was formed to continue hydraulic use of the canal from Brookville to Laurel.[34] During the late nineteenth century, the Whitewater Canal corridor continued to be used for railroad transport and hydraulic power.

In the early 1920s, the Brookville & Metamora Hydraulic Company found business unprofitable and cut off the canal's water supply, leaving a dry ditch, which eventually became choked with vegetation and debris. By the late 1920s, the entire Whitewater Canal corridor had fallen into disuse and disrepair. Many canal-related structures had decayed or sustained damage. What had once been the lifeblood of the Whitewater Valley was now little more than an unsightly relic of yesteryear.

In the late 1930s, the idea of preserving a section of the canal for historical purposes began to form, largely under the influence of Lawrenceburg banker and politician Cornelius O'Brien (1883–1953), who served on the boards of the Indiana Historical Society and the Indiana Historical Bureau. O'Brien worked closely with Brookville businessman John P. Goodwin (1880–1972), who served on the boards of the Indiana State Library and the Indiana Historical Society. When the feeder dam at Laurel was damaged and the aqueduct at Brookville partially collapsed in 1939, O'Brien brought the idea to the attention of Indiana Historical Bureau director, Christopher B. Coleman (1875–1944):

> The remains of the old Whitewater Canal around Brookville and Metamora should be preserved as an exhibit of one of the most important means of transportation in its days. It seems to me that it would be a distinct historical loss if this little piece of it were allowed to disappear. I think it would be fine if it could be preserved as a state park.[35]

On October 24, 1941, O'Brien, Goodwin, and Coleman, along with a number of their associates, formed the Whitewater Canal Association for the purpose of preserving a fifteen-mile section of the canal, from the feeder dam at Laurel to the Whitewater River at Brookville, as a state memorial. In 1942, the Whitewater Canal

[31] The Whitewater River is a rapid stream that flows through a steep valley and is subject to frequent flooding. The Whitewater Canal fell 490 feet over the course of 76 miles (an average fall of 6.45 feet per mile); in comparison, the Erie Canal fell 565 feet over the course of 363 miles (an average fall of 1.55 feet per mile).

[32] "White Water Valley Canal," *Fort Wayne Times & People's Press*, 3 February 1848: 1.

[33] Passenger service was discontinued in 1933; freight service was discontinued in 1973.

[34] The Brookville & Metamora Hydraulic Company Records, Manuscript Collection #L335, B10, at the Indiana State Library contains additional details about the canal's history from 1836 to 1944.

[35] Cornelius O'Brien to Christopher B. Coleman, 30 September 1939, *Cornelius O'Brien Papers, 1938-1944*, Manuscript Collection #M0597, Indiana Historical Society, Indianapolis, Indiana.

Association was incorporated as a non-profit organization. Over the next three years, the association worked tirelessly in securing funding for canal repairs, obtaining title to the most intact section of the canal and easements from adjoining property owners, and lobbying for the State's acquisition and preservation of the Whitewater Canal.[36]

On February 27, 1945, the Indiana General Assembly passed an act authorizing the Indiana Conservation Commission to accept and maintain a section of the Whitewater Canal in Franklin County, with an appropriation of $10,000 for the first year and $15,000 annually thereafter.[37] In addition, they appropriated $52,250 for restoration of the canal corridor, with $23,000 earmarked for restoration of the Duck Creek Aqueduct.[38] The Whitewater Canal Association subsequently conveyed the canal property between Laurel and Brookville to the Indiana Conservation Commission, which designated it the Whitewater Canal State Memorial.[39]

Over the next three decades, the Indiana Department of Conservation (which became the Indiana Department of Natural Resources in 1965) undertook the restoration of representative transportation and industrial features that form the Whitewater Canal State Memorial. The Duck Creek Aqueduct was restored in 1946–49, several locks and dams and a stone arch aqueduct were repaired by 1953, and the canal was dredged by 1955. Canal boat excursions began in 1964.[40] In 1973, the restoration of the old Metamora grist mill was completed. Soon thereafter, the Indiana Department of Natural Resources developed a picnic area near the Laurel feeder dam and erected the Whitewater Canal State Memorial headquarters at Metamora. In 1974, the Whitewater Valley Railroad (a non-profit organization based in Connersville) leased tracks from the Penn Central Railroad and began running weekend steam train excursions between Connersville and Metamora. Since the late 1960s and early 1970s, the Whitewater Canal State Memorial (now, Whitewater Canal State Historic Site) has been a popular tourist destination in Indiana.

**History of Metamora**

In 1812, David Mount (1778–1850) of Pennington, New Jersey, settled near this site on Duck Creek, approximately 65 miles southeast of Indianapolis and 50 miles northwest of Cincinnati. The following year, he established a saw mill, a grist mill, a carding mill, and a fulling mill on the White Water River. Along with a handful of other settlers, Mount was influential in establishing a thriving agricultural and industrial hamlet here.[41] By 1826, the village at "Duck Creek Crossing" was large enough to warrant the establishment of a post office. A dozen years later, when construction of the Whitewater Canal was assured, David Mount and William Holland platted the village of Metamora on the proposed route of the canal.[42]

> The subscribers will offer at public sale on Thursday the 26th of April, A.D. 1838, about fifty in-lots, in the above named town. This place is situated in one of the most extensive, fertile and beautiful valleys of the white water river. …The white water canal is located directly through the centre of the town. …The great State Road and stage route from Indianapolis through Rushville

[36] *Whitewater Canal Association Records, 1939-1964*, Manuscript Collection #SC1567, Indiana Historical Society, Indianapolis, Indiana; "More Funds Needed to Restore Old Canal," *Brookville Democrat*, 3 August 1944: 1.

[37] *Acts of the Indiana General Assembly, 1945* (Indianapolis: Bookwalter Company, 1945): 142-143.

[38] Eugene R. Bock, "Metamora Work Being Resumed," *Indiana Covered Bridge Topics* 3, no. 3 (June 1948): 1.

[39] The Whitewater Canal Memorial became the Whitewater Canal State Historic Site sometime after 1988.

[40] Launched in 1964, the motorized, wood hull *Valley Belle* remained in service until 1980, when it was replaced with the horse-drawn, wood hull *Ben Franklin II* (named after the first boat to traverse the canal in 1839), which remained in service until 1988. The horse-drawn, fiberglass hull *Ben Franklin III* was launched in 1990 and was still in service as of 2012.

[41] August J. Reifel, *History of Franklin County, Indiana* (Indianapolis: B.F. Bowen & Company, 1915): 187.

[42] According to local legend, the village of Metamora was named after the Native American heroine of John Augustus Stone's 1829 play, "Metamora; or, the Last of the Wampanoags."

> and Brookville to Cincinnati, strikes the canal at this point and runs side and side with it through the centre of the town, and nearly all of the lots offered will front on one or the other of these great thoroughfares.[43]

Metamora was one of three towns founded along the proposed canal route, the other two being Laurel (platted 1836) and Cedar Grove (platted 1837); other towns along the corridor, like Brookville and Connersville, predate the planning of the canal. In the 1840s, Metamora grew rapidly as a bustling canal port. By mid-century, this enterprising community of about 1,000 inhabitants boasted a thriving commercial district and a number of mills that produced grain, flour, cotton, wool, wooden barrels, and liquor.

After the canal was supplanted by the railroad in the 1860s, Metamora lost its position as a commercial hub, as larger towns were just a short train ride away. In subsequent decades, water-powered industries began to decline and the population began to shift to urban centers. By 1910, Metamora's population had dwindled to 588 residents. In 1922, the Brookville & Metamora Hydraulic Company drained the canal, leaving a dry ditch in its place. Then, in the early 1930s, US Highway 52 bypassed the village, the railroad discontinued passenger service, and Metamora slid into a period of serious economic decline.

When the State of Indiana established the Whitewater Canal State Memorial at Metamora in 1945, less than 100 residents remained.[44] After the canal and associated structures were restored, the village gradually became a tourist destination, creating economic opportunities for entrepreneurs and artists, who saw the quaint village as an affordable, unique, and laid-back place to live and work. Since the mid-1970s, Metamora's historic district (listed in the National Register of Historic Places in 1973) has featured a variety of craft shops, antique galleries, museums, restaurants, and bed & breakfast establishments. Today, Metamora is the best-preserved canal village in the Whitewater Valley. It hosts tens of thousands of visitors annually, particularly during special events sponsored by Historic Metamora, Inc., a local non-profit organization dedicated to preservation and education.

**History of Duck Creek Aqueduct**

The first aqueduct at this site was reportedly a non-housed timber structure comprising two 50′ spans. It was built sometime between 1839, when assistant engineer Myron S. Webb (1810–1871) laid out work along this section of the Whitewater Canal, and 1843, when boats were traveling as far north as Connersville.[45]

On August 21, 1846, Duck Creek Aqueduct washed out during a storm that caused heavy flooding in the Whitewater Valley. According to the *Brookville American*:

> The Canal had been empty for near two months and was just filled ready for the fall business—merchants, farmers and boatmen were just looking on tiptoe for the profits of the opening trade. But their hopes were suddenly blasted on Friday evening last by the washing away of the Duck Creek aqueduct. This Creek rose in a few minutes to some feet higher than ever known before, undermined the abutments and swept away that noble structure.[46]

Other sections of the canal also suffered damage, including another aqueduct across Big Cedar Creek south of Brookville. The Whitewater Canal Company immediately set to work repairing the damage and restoring

[43] "Notice of Public Sale," *Brookville American*, 23 March 1838: 4.

[44] Louis Hiner, Jr., "Old Canal Aqueduct to be Restored Soon," *Indianapolis News*, 22 March 1948: 1.

[45] Henry C. Prange, "The Whitewater Aqueduct over Duck Creek at Metamora," unpublished typescript, 1946 (Indiana Department of Natural Resources files, Indianapolis, Indiana): 1.

[46] "High Waters—Canal," *Brookville American*, 28 August 1846: 2.

service on the canal. In a September 2, 1846 letter to the *Brookville American*, engineer Henry C. Moore (b. 1813) said, "We hope to have a new aqueduct across Duck Creek at Metamora ready for water by the first day of October and possibly a few days earlier. We have as large a force engaged as can work to advantage, and are getting along very well."[47] The work of constructing the aqueduct took about six weeks. On September 30, 1846, engineer Moore wrote, "The new aqueduct at this place is now ready for the water, which will probably pass over it sometime tonight—at all events it will do so on tomorrow. I think the Canal will be filled to Brookville and ready for navigation by Saturday afternoon next."[48]

Duck Creek Aqueduct has carried the Whitewater Canal almost continuously since its construction, except when closed for inspection, maintenance or repairs.[49] In 1868, the aqueduct was strengthened with auxiliary queen post trusses, additional braces and iron tension rods.[50] In 1901, the structure was again repaired and the floor system raised 18 inches.

By the 1930s, the abandoned aqueduct was in a state of disrepair. Photographs show that it was deflected and wracked. In the early 1930s, Franklin County engineers temporarily braced the structure with angled struts (a common type of structural reinforcement); these braces appear in 1934 HABS photographs. On September 28, 1939, the floor of the aqueduct collapsed.[51] County engineers again completed some temporary repairs with a crew of volunteers and donations from local businesses.[52] Around that time, a group of local businessmen and politicians formed the Whitewater Canal Association for the purpose of preserving a fifteen-mile section of the canal between Laurel and Brookville as a state memorial. The Association raised money to keep the aqueduct stabilized until the State took over its maintenance in 1945.

In 1945, the Whitewater Canal Association conveyed the canal property between Laurel and Brookville, including the Duck Creek Aqueduct, to the Indiana Conservation Commission for designation as a state memorial. The "Preliminary Planning Report on the Whitewater Canal Memorial," dated August 2, 1945, discussed restoration of various components of the canal, and the language of that report suggests, at least, that the intent of the entire project, including the aqueduct, was careful and sympathetic restoration:

> This venerable structure can and should be restored. …The structure is in such bad condition it appears to have been spared from complete collapse only by a kind Providence. …This is a unique structure that commands keen interest from visitors. It is worthy of a good job of restoration.[53]

The Duck Creek Aqueduct was restored to its present appearance in 1946–49, under the direction of Indiana Department of Conservation Engineer Thomas Godfrey MacKenzie (b. 1899) and Assistant Engineer Henry C. Prange (b. 1904). Foreman Donald E. Bates (1896–1959) of Metamora was able to use the original arches and many members of the original trusses. In cases where timbers had deteriorated beyond repair, they were

[47] H. C. Moore, "Letter to the Editor," *Brookville American*, 4 September 1846: 2.

[48] "The Canal," *Brookville American*, 2 October 1846: 2.

[49] In winter, the canal water depth is emptied, or lowered to a few inches.

[50] These elements, which are shown in the 1934 Historic American Buildings Survey (HABS) drawings, were removed during the 1946-1949 restoration.

[51] "Aqueduct Falls Thursday Night," *Brookville Democrat*, 5 October 1939: 1.

[52] "Aqueduct Repair is now Complete," *Brookville Democrat*, 23 October 1941: 1.

[53] Richard E. Bishop, "A Preliminary Planning Report on the Whitewater Canal Memorial, 2 August 1943," *Goodwin Family Papers*, Manuscript Collection #M0115, Box 3, Folder 11, Indiana Historical Society, Indianapolis, Indiana: 3.

replaced with members of the same wood species and dimensions.[54] Non-original elements, including the auxiliary trusses added in 1868, were removed during the project.

According to records of the Indiana Department of Natural Resources and the Indiana State Museum and Historic Sites, the Duck Creek Aqueduct spillway was repaired in 1968, and the abutments were repaired in 1996. In 1988, the trusses were pulled plumb, the overhead bracing was fixed, and members with splits were reinforced.[55] The trough, which is especially susceptible to decay, has been repaired numerous times in recent decades; it was most recently replaced in 2005 by J. A. Barker Engineering, Inc., of Bloomington, Indiana, a firm with expertise in the rehabilitation of historic covered bridges.

Since the 1930s, Duck Creek Aqueduct has been celebrated as a local landmark, due in part to its prominent location in the picturesque village of Metamora, Indiana. In 1931, a photograph of the structure was published in Rosalie Wells' (b. 1876) *Covered Bridges in America*, which was the first book to look at covered bridges from a historical perspective.[56] The following year, the aqueduct was featured in *Civil Engineering* magazine.[57] In 1934, this structure was one of the first covered bridges in the United States to be recorded by the Historic American Buildings Survey (HABS), a division of the National Park Service.[58] By the late 1930s, antiquarians and historians recognized Duck Creek Aqueduct as the only surviving covered wood aqueduct in the United States.[59]

In recent decades, Duck Creek Aqueduct has received national recognition. It is a contributing structure to the Whitewater Canal Historic District, which was listed in the National Register of Historic Places in 1973, and the Metamora Historic District, which was listed in the National Register of Historic Places in 1992.[60] Also in 1992, the American Society of Civil Engineers (ASCE) designated Duck Creek Aqueduct a National Historic Civil Engineering Landmark.[61] The Historic American Engineering Record (HAER) documented the structure as part of the National Historic Covered Bridges Recording Project, with large-format photographs in 2005, and a written history and measured drawings in 2012. Duck Creek Aqueduct is one of twenty nationally significant covered bridges identified in the National Park Service's 2012 *Covered Bridges NHL Context Study*.[62]

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[54] Richard Sanders Allen, "Indiana Moves to Preserve Aqueduct, *Covered Bridge Topics* 4, no. 2 (June 1946): 9; Eugene Bock, "Famed Aqueduct Fully Restored," *Indiana Covered Bridge Topics* 4, no. 2 (March 1949): 1.

[55] AECON Engineers & Consultants, "Indiana Department of Natural Resources, Whitewater Canal State Historic Site, Repair of Duck Creek Aqueduct, Project No. 147459, 1988" measured drawings.

[56] Rosalie Wells, *Covered Bridges in America* (New York: William Edwin Rudge, 1931): 92.

[57] "Whitewater Canal Aqueduct," *Civil Engineering* 2, no. 10 (October 1932): 662.

[58] See HABS No. IN-24-20, Whitewater Canal Aqueduct, Franklin County, Indiana.

[59] Frederick Polley, "Decline of Unique Aqueduct Bridge," *Indianapolis Star*, 14 May 1939, Part 1: 20.

[60] Robert D. Starrett, National Register of Historic Places Inventory-Nomination Form: "Whitewater Canal Historic District" (Washington, DC: National Park Service, 1973); and William L. Selm and R. Paul Baudendistel, National Register of Historic Places Registration Form: "Metamora Historic District" (Washington, DC: National Park Service, 1992).

[61] American Society of Civil Engineers, National Historic Civil Engineering Landmark Nomination: "Whitewater Canal Duck Creek Aqueduct," 1992.

[62] Lola Bennett, *Covered Bridges NHL Context Study* (Washington, DC: National Park Service, 2012).

## Chronology

1805 America's first documented covered bridge completed at Philadelphia
1816 State of Indiana admitted to the Union
1827 Whitewater Valley Canal Company chartered
1833 Indiana State Assembly authorizes a preliminary survey for Whitewater Canal
1836 State of Indiana begins construction of Whitewater Canal
1839 Whitewater Canal completed to Brookville, Indiana
Indiana Board of Internal Improvements ceases work on canal due to financial problems
1842 Whitewater Valley Canal Company incorporated to take over canal construction
First Duck Creek Aqueduct completed by this date
1843 State of Ohio completes 25-mile long Cincinnati & Whitewater Canal
1846 Whitewater Canal completed to Cambridge City, Indiana
First Duck Creek Aqueduct washed out; present Duck Creek Aqueduct constructed
1847 Whitewater Canal extended to Hagerstown
1853 Whitewater Canal Company suspends navigation on the canal
1855 Whitewater Canal Company forced into receivership
1865 Whitewater Valley Railroad Company secures right-of-way along former canal towpath
1866 Brookville & Metamora Hydraulic Company formed to maintain canal as a millrace
1867 Duck Creek Aqueduct strengthened with auxiliary trusses
1901 Duck Creek Aqueduct raised 18 inches
1931 Duck Creek Aqueduct pictured in *Covered Bridges in America* by Rosalie Wells
1934 Historic American Buildings Survey records Whitewater Canal Aqueduct
1936 Whitewater Canal stops being used for hydraulic power
1941 Whitewater Canal Association formed
1945 Indiana Department of Conservation establishes the Whitewater Canal State Memorial
1949 Duck Creek Aqueduct restoration completed
1973 Whitewater Canal Historic District listed in the National Register of Historic Places
1988 Duck Creek Aqueduct repaired
2005 Duck Creek Aqueduct trough replaced
2012 Duck Creek Bridge proposed for consideration as a National Historic Landmark
Historic American Engineering Record records Duck Creek Aqueduct

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*White Water Canal Collection, 1835-2000*, Manuscript Collection #M0988. Indiana Historical Society, Indianapolis, Indiana.

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Wood, Henry. "A Link with Yesterday," *Indianapolis Star Magazine*, 22 February 1953: 18.

Wright, David, editor. *World Guide to Covered Bridges*, 7th edition. Concord, New Hampshire: National Society for the Preservation of Covered Bridges, Inc., 2009.

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Previous Documentation on File (NPS):

__ Preliminary Determination of Individual Listing (36 CFR 67) has been requested.
X Previously Listed in the National Register: Whitewater Canal Historic District [NRIS #IN-73000272, 1973]
Metamora Historic District [NRIS #IN-92001646, 1992]
__ Previously Determined Eligible by the National Register.
__ Designated a National Historic Landmark.
X Recorded by Historic American Buildings Survey: HABS No. IN-24-20, Whitewater Canal Aqueduct
X Recorded by Historic American Engineering Record: HAER No. IN-108, Duck Creek Aqueduct

Primary Location of Additional Data:

X State Historic Preservation Office
X Other State Agency: Indiana Department of Natural Resources, Indianapolis, Indiana
Indiana State Museum and Historic Sites, Indianapolis, Indiana
Indiana State Library, Indianapolis, Indiana
Whitewater Canal State Historic Site, Metamora, Indiana
__ Federal Agency
__ Local Government
__ University
X Other (Specify Repository): Indiana Historical Society, Indianapolis, Indiana

## 10. GEOGRAPHICAL DATA

Acreage of Property: Less than one acre

| UTM References: | Zone | Easting | Northing |
|---|---|---|---|
| | 16 | 660903 | 4367969 |

Verbal Boundary Description: The property consists of the superstructure, housing, substructure and approaches of the Duck Creek Aqueduct. The superstructure is approximately 90 feet long, 30 feet wide and 25 feet deep overall. The abutments rise approximately 15 feet above the creek bed. The structure, which is aligned on a northwest-southeast axis, carries the Whitewater Canal over Duck Creek at the east end of the historic village of Metamora, Indiana.

Boundary Justification: The property boundary includes the essential components of the bridge: the superstructure, including the trusses, trough, floor, bracing systems and walkway; the housing, including the siding and roof; the substructure, including abutments, foundations, retaining walls and spillway; and the canal approaches to the structure.

## 11. FORM PREPARED BY

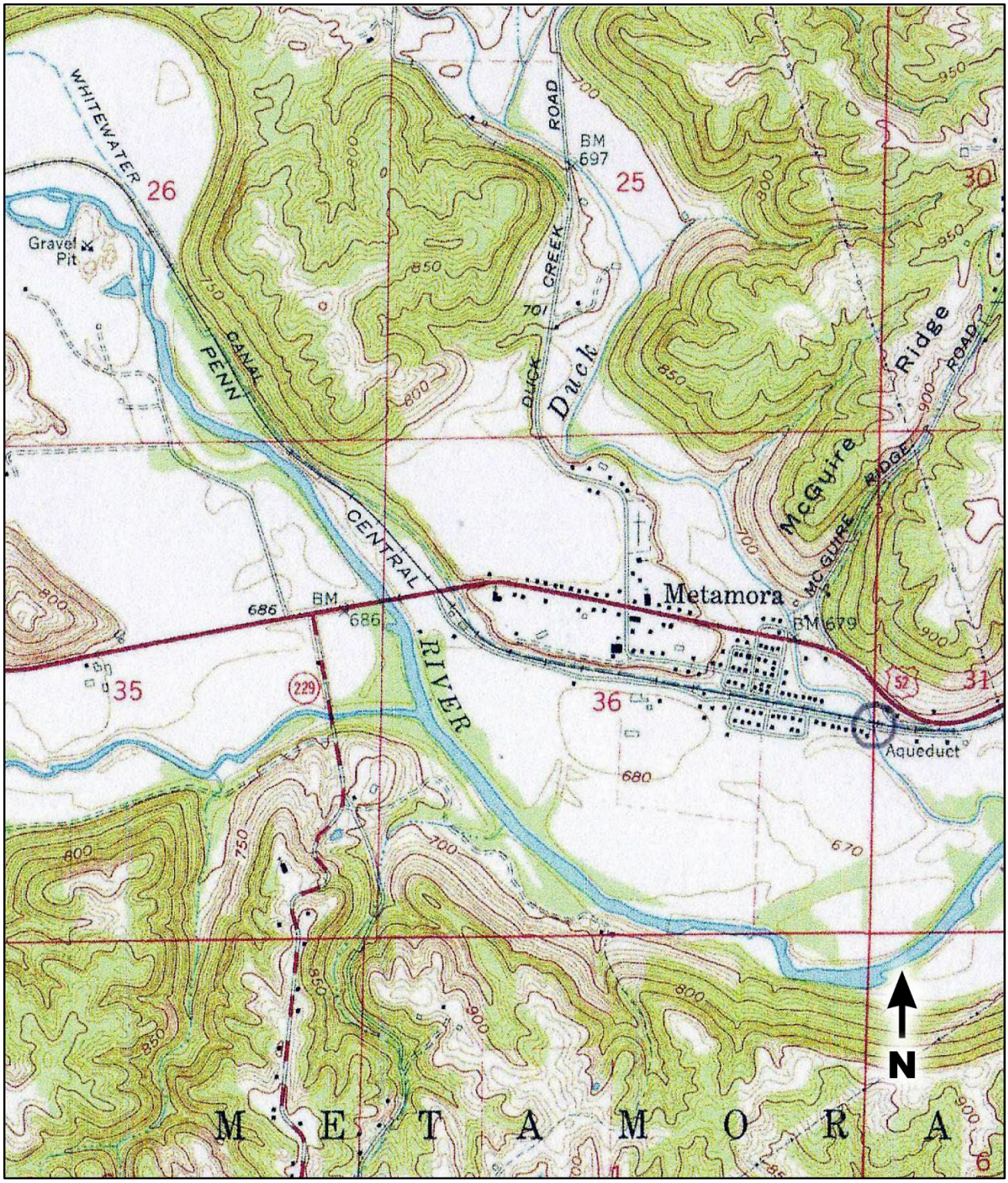
Name/Title: Lola Bennett, Historian
Heritage Documentation Programs
National Park Service
1201 I St. NW (2270)
Washington, DC 20005

Date: 24 July 2013

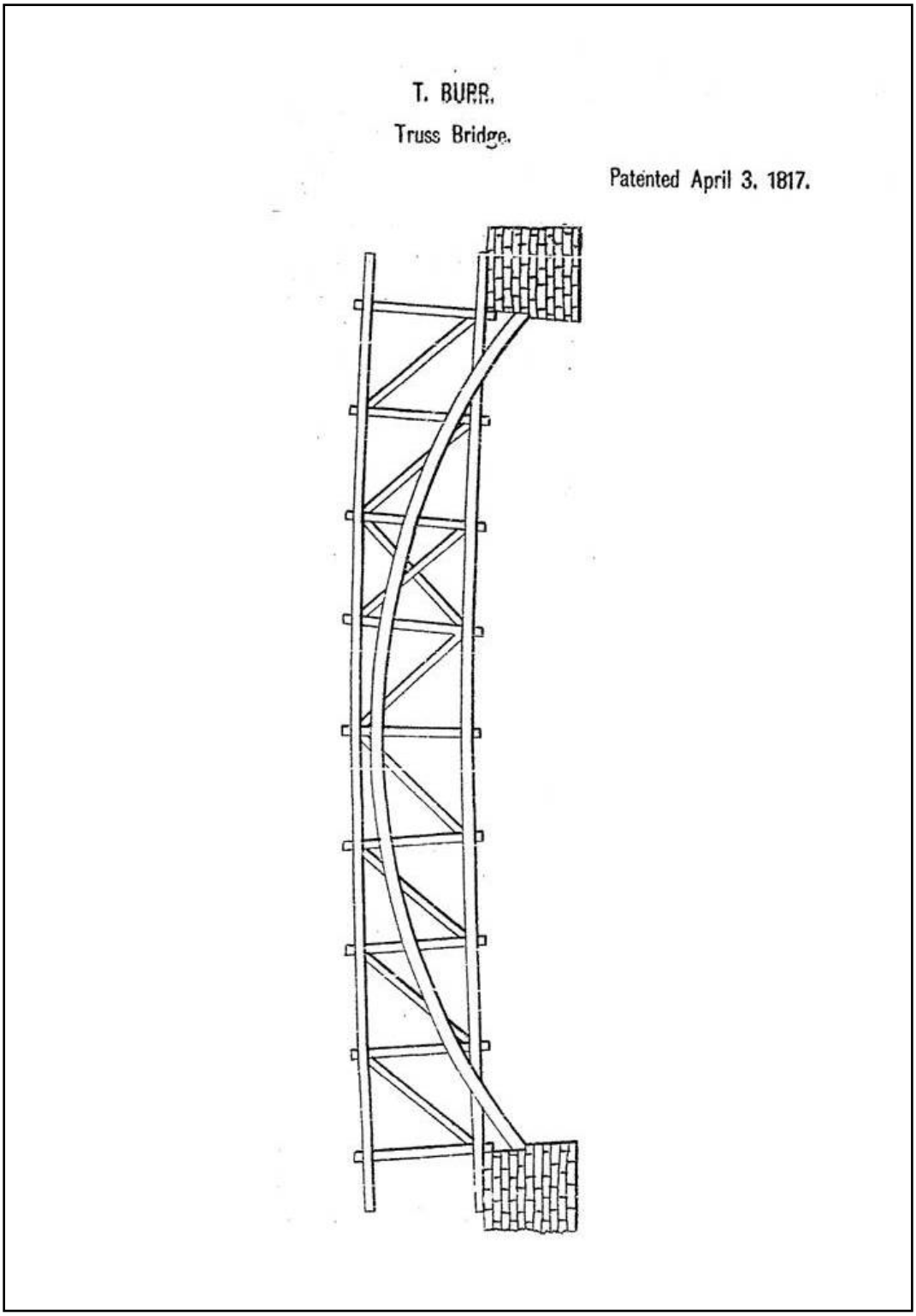
Edited by: Roger Reed and Christopher Marston
National Park Service
National Historic Landmarks Program
1201 Eye St. NW (2280), 8th Floor
Washington, DC 20005

Telephone: (202) 354-2278 (Reed)
(202) 354-2162 (Marston)

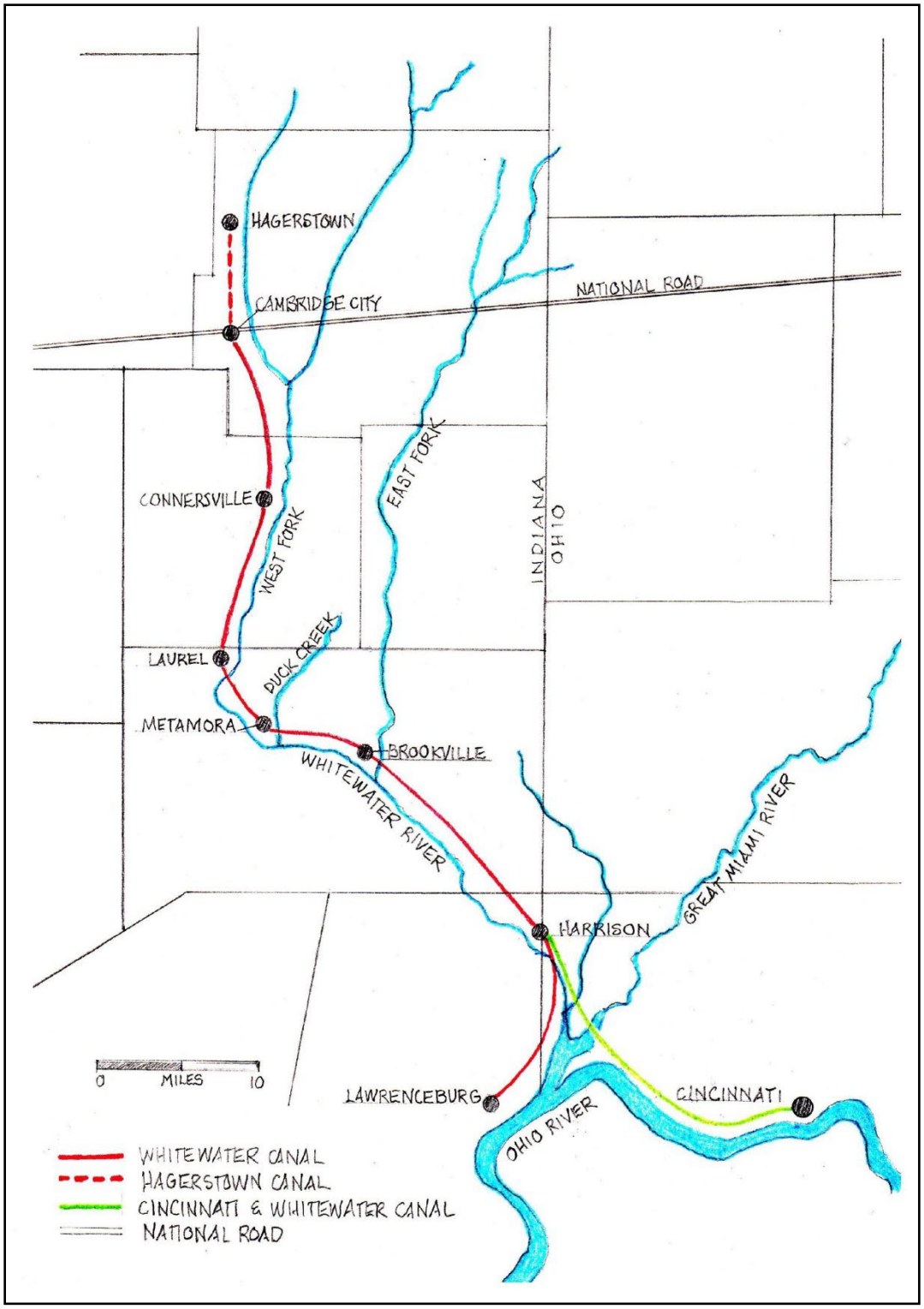
NATIONAL HISTORIC LANDMARK
August 25, 2014




DUCK CREEK AQUEDUCT
Spanning Duck Creek at Whitewater Canal
Metamora, Franklin County, Indiana
UTM: 16.660903.4367969, Metamora, Indiana USGS Quadrangle (1972)




Theodore Burr, United States Letters Patent No. 2769X, 3 April 1817.




Sketch map showing approximate alignment of Whitewater Canal
[Adapted from Garman, *Indiana History Bulletin*, September 1962.]




DUCK CREEK AQUEDUCT. General view from southwest.
Photograph by John R. Kelly, 1934.
[HABS IN-24-20-1]




DUCK CREEK AQUEDUCT. View of north side.
Photograph by John R. Kelly, 1934.
[HABS-IN-24-20-2]




DUCK CREEK AQUEDUCT. Interior view of south truss.
Photograph by John R. Kelly, 1934.
[HABS IN-24-20-3]




DUCK CREEK AQUEDUCT. Detail of northwest corner.
Photograph by John R. Kelly, 1934.
[HABS IN-24-20-4]



DUCK CREEK AQUEDUCT. View of east portal from southeast.
Photograph by James W. Rosenthal, 2004.
[HAER IN-108-1]



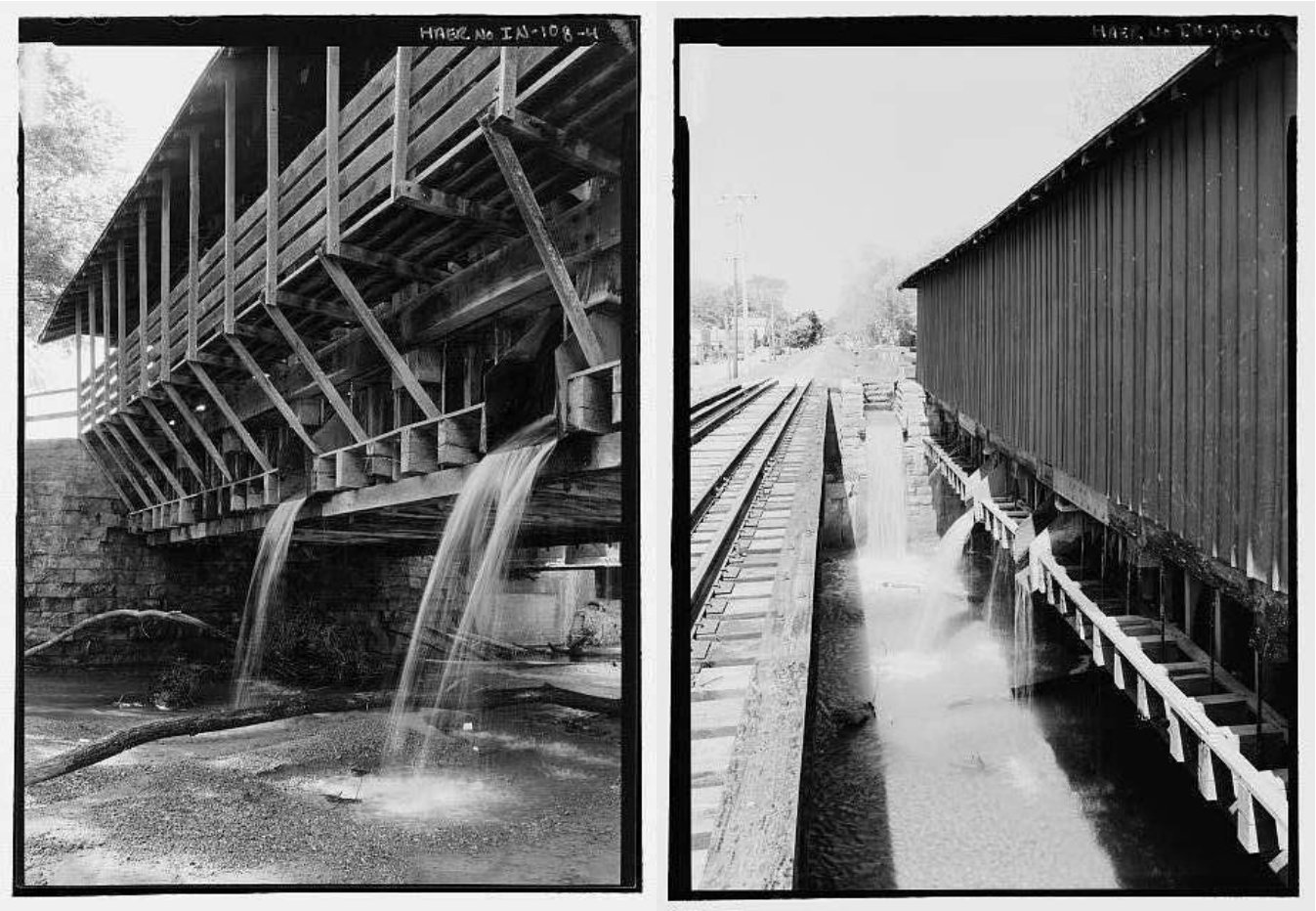
DUCK CREEK AQUEDUCT. Oblique view of north interior from south.
Photograph by James W. Rosenthal, 2004.
[HAER IN-108-2]



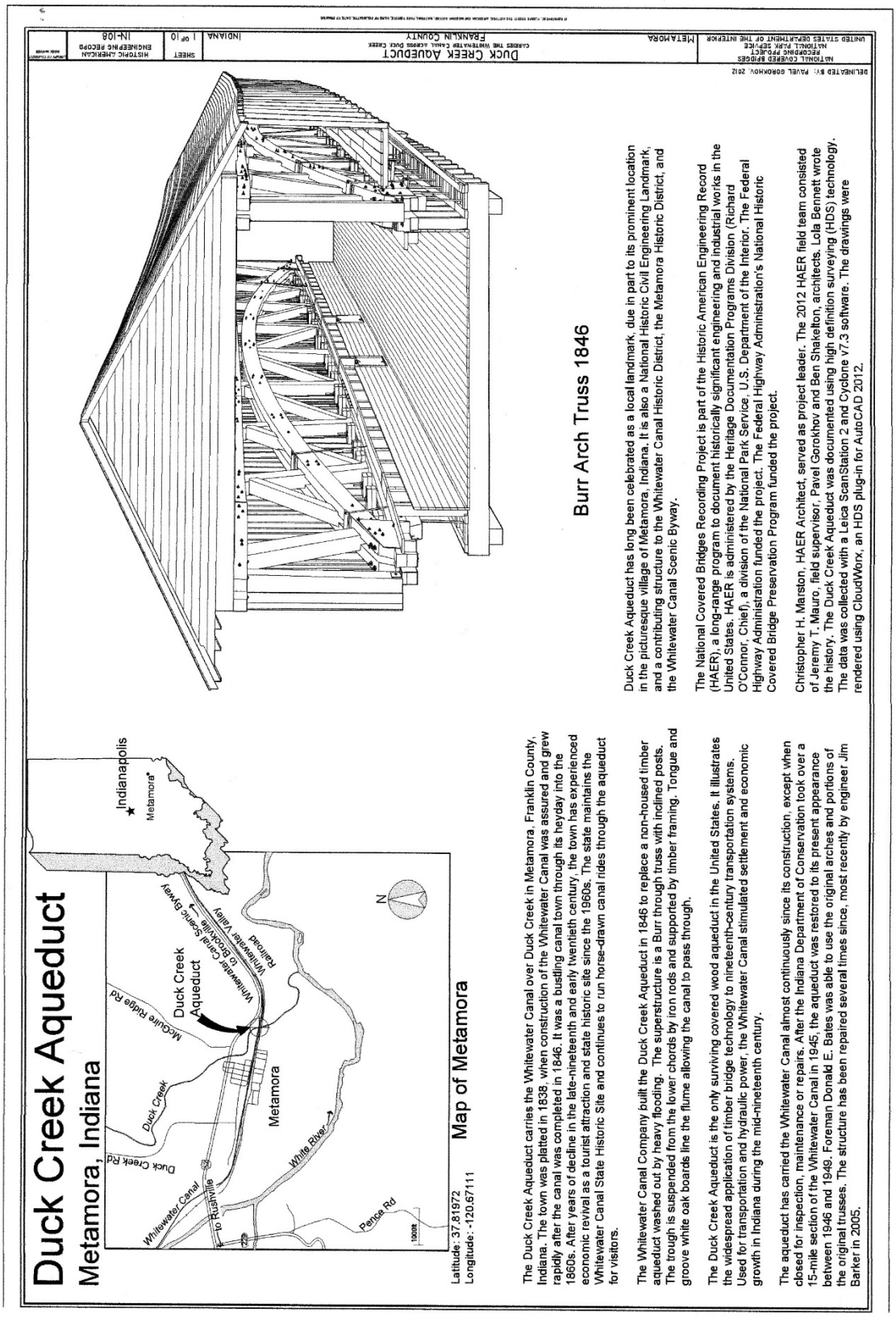
DUCK CREEK AQUEDUCT. North elevation.
Photograph by James W. Rosenthal, 2004.
[HAER IN-108-3]

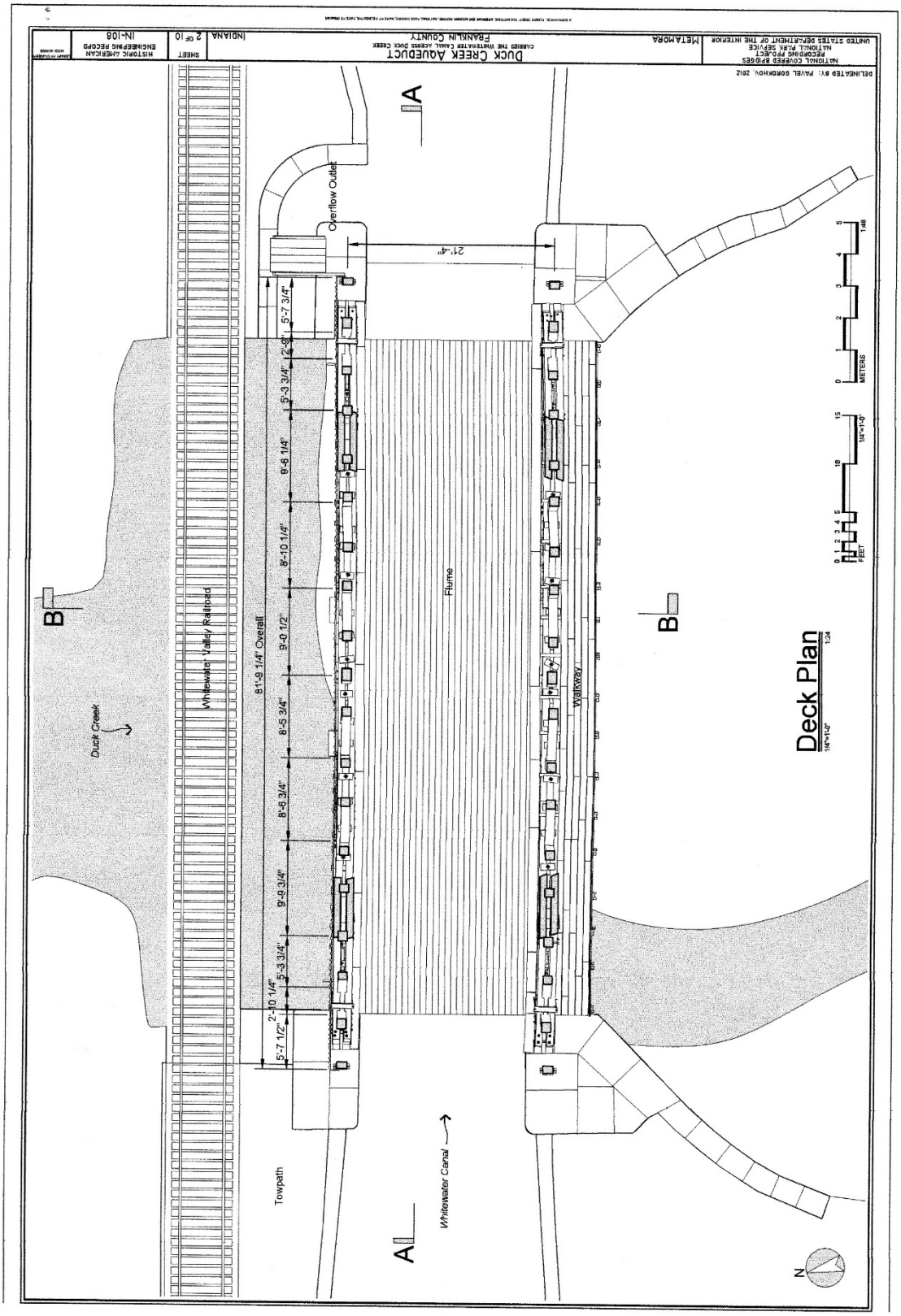


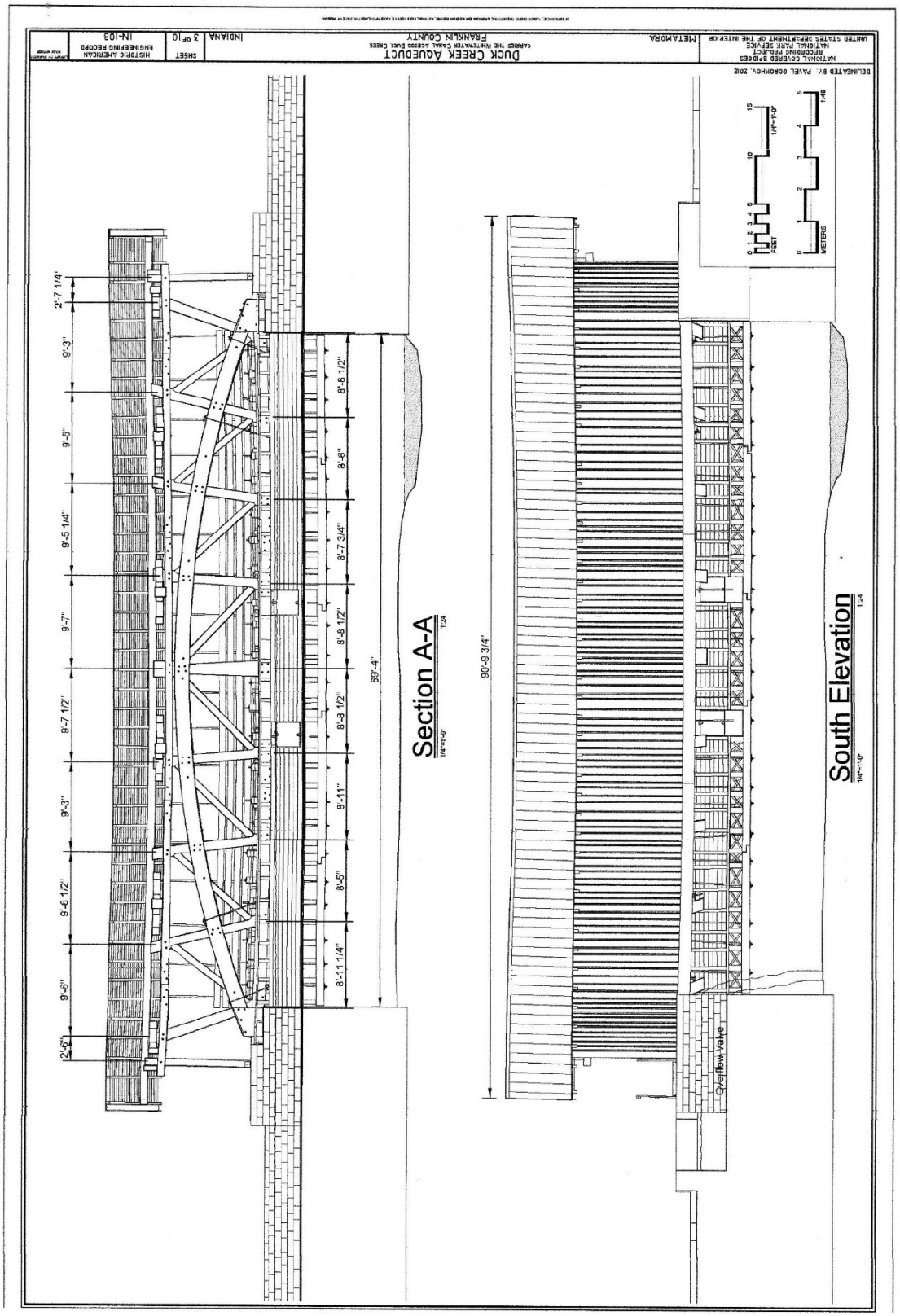
DUCK CREEK AQUEDUCT. Perspective view from southwest.
Photograph by James W. Rosenthal, 2004.
[HAER IN-108-5]

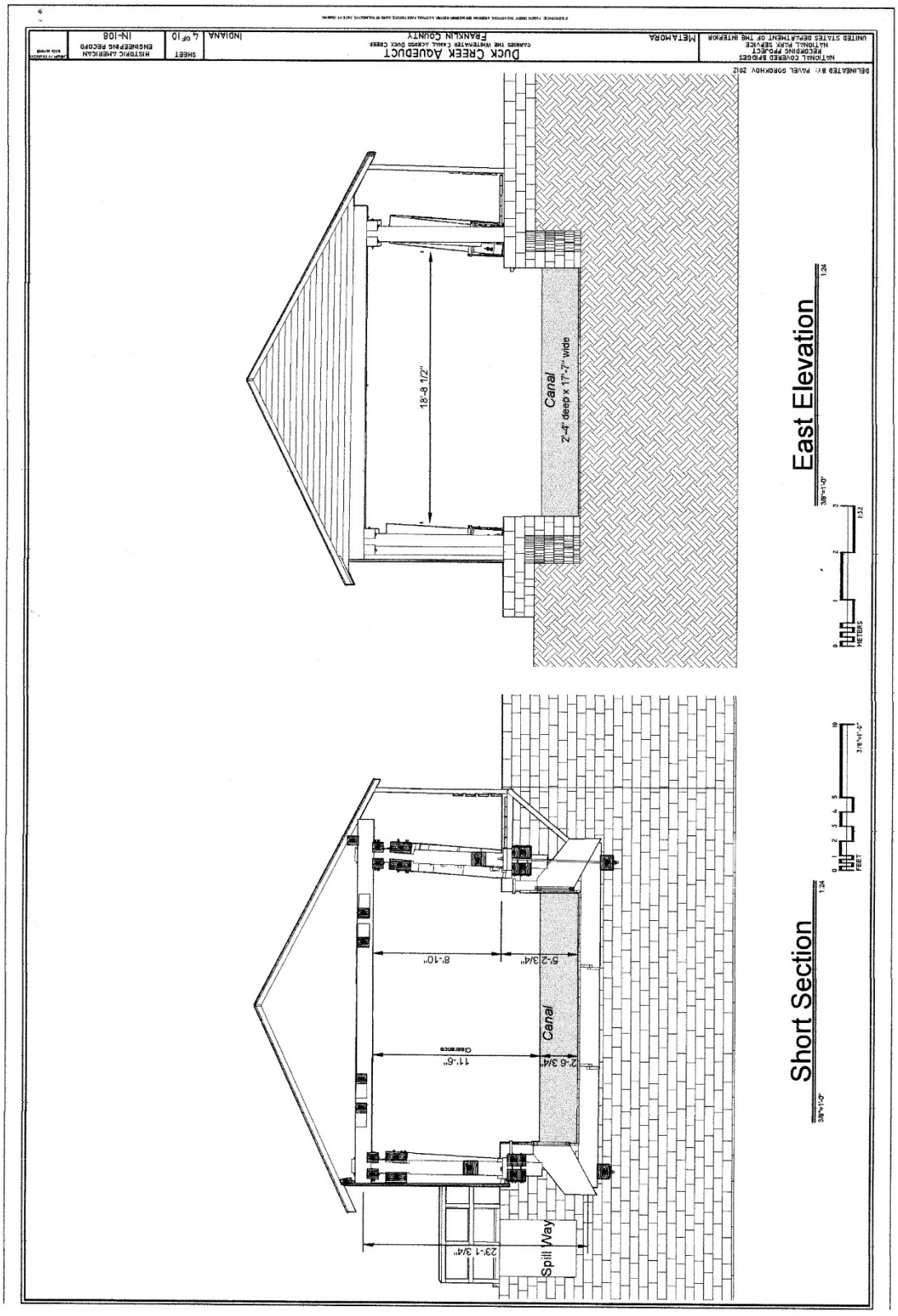


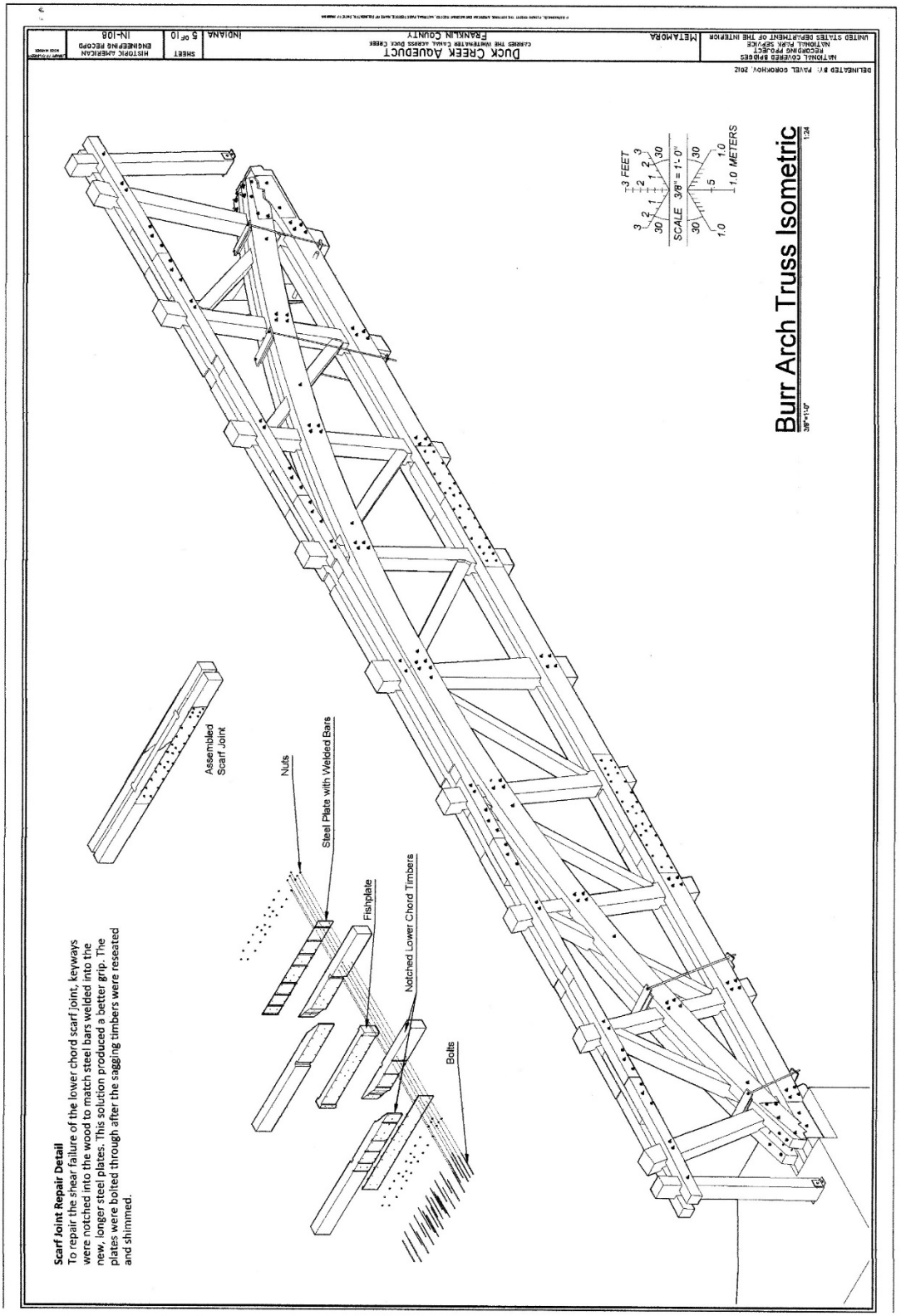

Left: DUCK CREEK AQUEDUCT. Oblique view of north elevation.
Photograph by James W. Rosenthal, 2004.
[HAER IN-108-4]
Right: DUCK CREEK AQUEDUCT. Oblique view of south elevation.
Photograph by James W. Rosenthal, 2004.
[HAER IN-108-6]

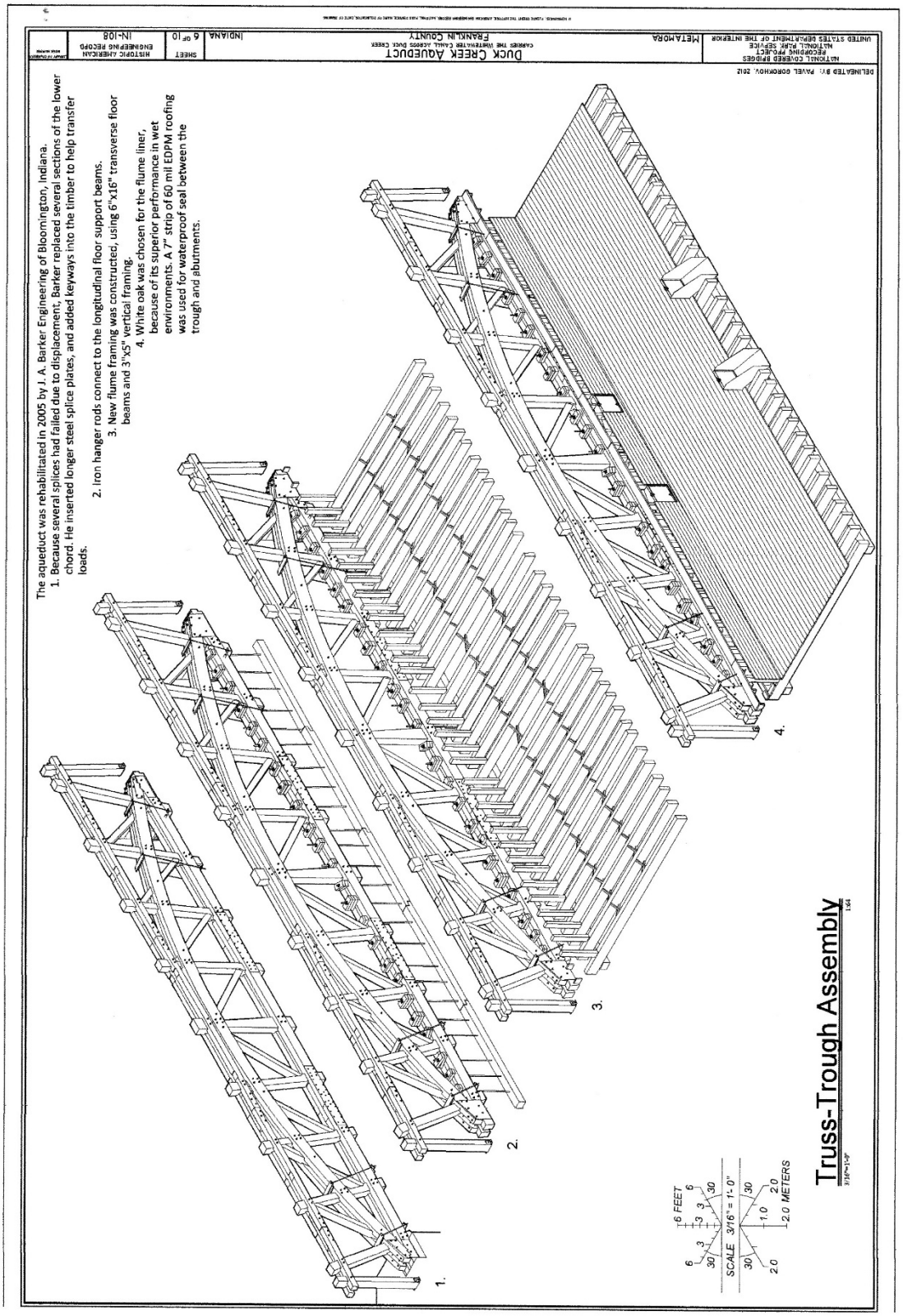

Duck Creek Aqueduct
Metamora, Indiana
Indianapolis
Metamora
Duck Creek Aqueduct
Whitewater Canal Scenic Byway
Whitewater to Brookville Valley Railroad
McGuire Ridge Rd
Duck Creek
Duck Creek Rd
Whitewater Canal
to Rushville
Metamora
White River
Pence Rd
N
Latitude: 37.81972
Longitude: -120.67111
Map of Metamora
Burr Arch Truss 1846
Duck Creek Aqueduct has long been celebrated as a local landmark, due in part to its prominent location in the picturesque village of Metamora, Indiana. It is also a National Historic Civil Engineering Landmark, and a contributing structure to the Whitewater Canal Historic District, the Metamora Historic District, and the Whitewater Canal Scenic Byway.
The National Covered Bridges Recording Project is part of the Historic American Engineering Record (HAER), a long-range program to document historically significant engineering and industrial works in the United States. HAER is administered by the Heritage Documentation Programs Division (Richard O'Connor, Chief), a division of the National Park Service, U.S. Department of the Interior. The Federal Highway Administration funded the project. The Federal Highway Administration's National Historic Covered Bridge Preservation Program funded the project.
Christopher H. Marston, HAER Architect, served as project leader. The 2012 HAER field team consisted of Jeremy T. Mauro, field supervisor, Pavel Gorokhov and Ben Shakelton, architects. Lola Bennett wrote the history. The Duck Creek Aqueduct was documented using high definition surveying (HDS) technology. The data was collected with a Leica ScanStation 2 and Cyclone v7.3 software. The drawings were rendered using CloudWorx, an HDS plug-in for AutoCAD 2012.
The Duck Creek Aqueduct carries the Whitewater Canal over Duck Creek in Metamora, Franklin County, Indiana. The town was platted in 1838, when construction of the Whitewater Canal was assured and grew rapidly after the canal was completed in 1846. It was a bustling canal town through its heyday into the 1860s. After years of decline in the late-nineteenth and early twentieth century, the town has experienced economic revival as a tourist attraction and state historic site since the 1960s. The state maintains the Whitewater Canal State Historic Site and continues to run horse-drawn canal rides through the aqueduct for visitors.
The Whitewater Canal Company built the Duck Creek Aqueduct in 1846 to replace a non-housed timber aqueduct washed out by heavy flooding. The superstructure is a Burr through truss with inclined posts. The trough is suspended from the lower chords by iron rods and supported by timber framing. Tongue and groove white oak boards line the flume allowing the canal to pass through.
The Duck Creek Aqueduct is the only surviving covered wood aqueduct in the United States. It illustrates the widespread application of timber bridge technology to nineteenth-century transportation systems. Used for transportation and hydraulic power, the Whitewater Canal stimulated settlement and economic growth in Indiana during the mid-nineteenth century.
The aqueduct has carried the Whitewater Canal almost continuously since its construction, except when closed for inspection, maintenance or repairs. After the Indiana Department of Conservation took over a 15-mile section of the Whitewater Canal in 1945, the aqueduct was restored to its present appearance between 1946 and 1949. Foreman Donald E. Bates was able to use the original arches and portions of the original trusses. The structure has been repaired several times since, most recently by engineer Jim Barker in 2005.
DELINEATED BY: PAVEL GOROKHOV, 2012
NATIONAL COVERED BRIDGES RECORDING PROJECT
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
METAMORA
DUCK CREEK AQUEDUCT
CARRIES THE WHITEWATER CANAL ACROSS DUCK CREEK
FRANKLIN COUNTY
INDIANA
SHEET 1 OF 10
HISTORIC AMERICAN ENGINEERING RECORD
IN-108

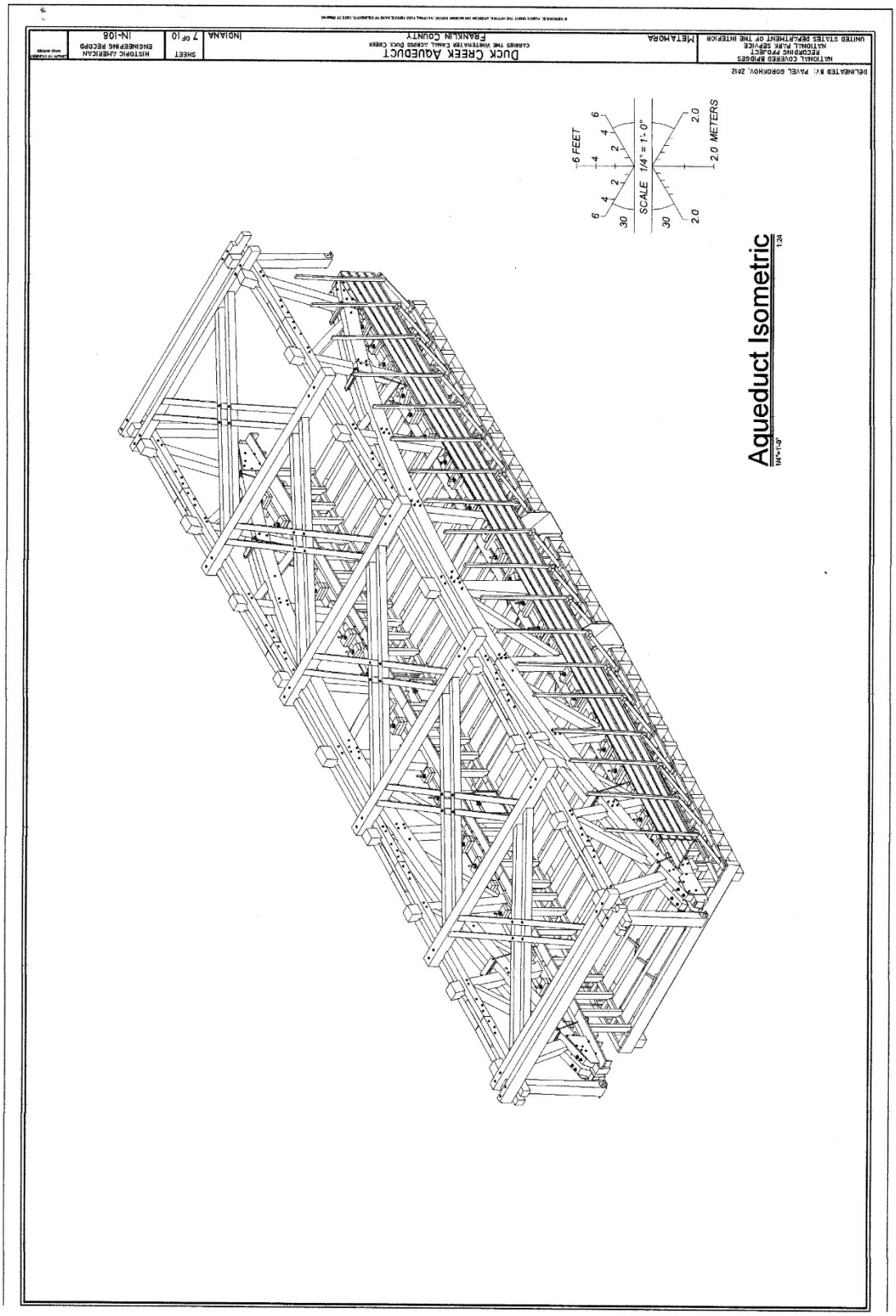

Deck Plan
Overflow Outlet
Flume
Walkway
Whitewater Valley Railroad
Duck Creek
Towpath
Whitewater Canal
81'-9 1/4" Overall
21'-4"
5'-7 3/4"
2'-9"
5'-3 3/4"
9'-5 1/4"
8'-10 1/4"
9'-0 1/2"
8'-5 3/4"
8'-8 3/4"
9'-3 3/4"
5'-3 3/4"
2'-10 1/4"
5'-7 1/2"
A
B
N

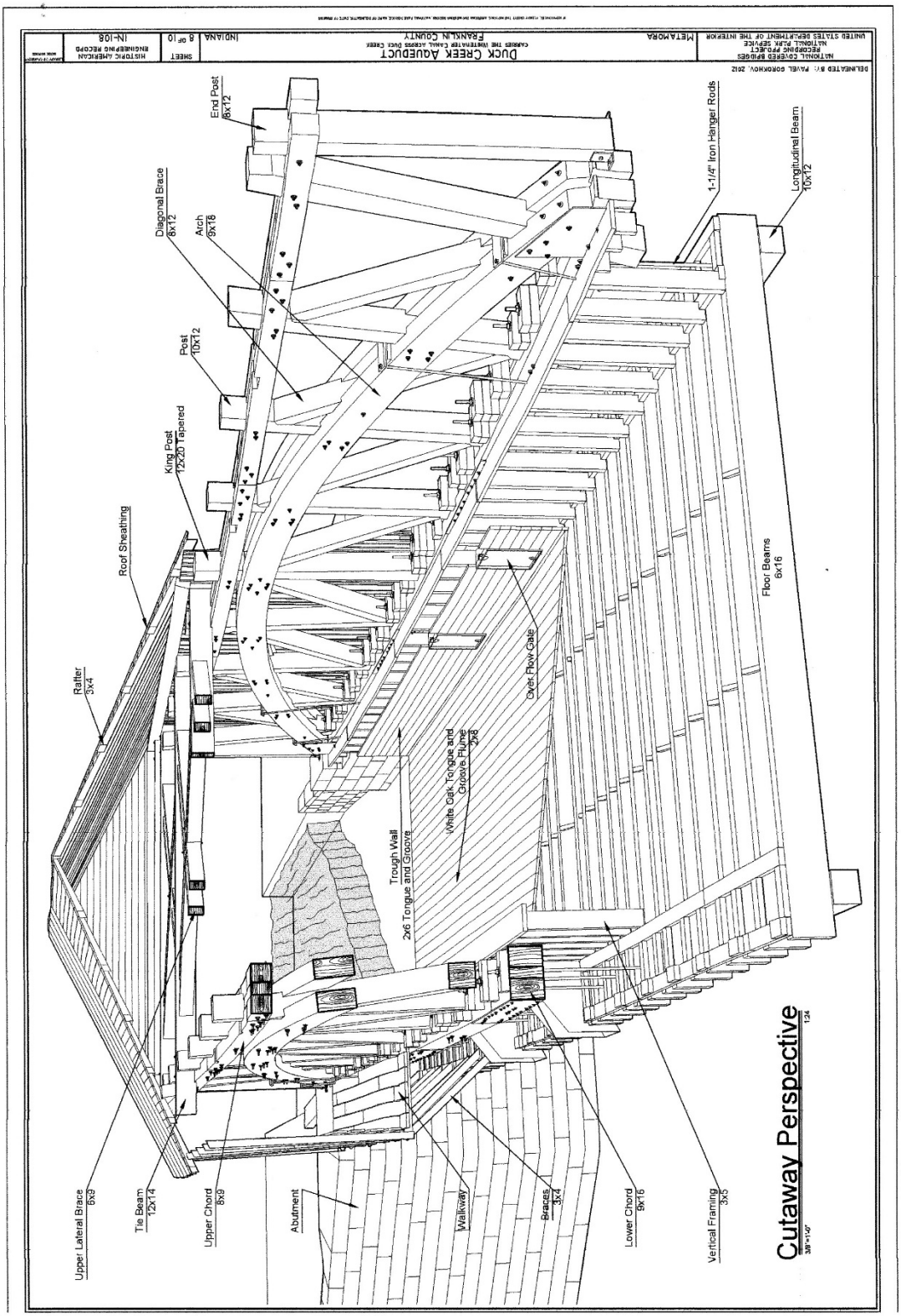

Section A-A
South Elevation
Overflow Valve
2'-7 1/4"
9'-3"
9'-5"
9'-5 1/4"
9'-7"
9'-7 1/2"
9'-3"
9'-6 1/2"
9'-6"
2'-6"
8'-8 1/2"
8'-6"
8'-7 3/4"
8'-8 1/2"
8'-8 1/2"
8'-11"
8'-5"
8'-11 1/4"
69'-4"
90'-9 3/4"

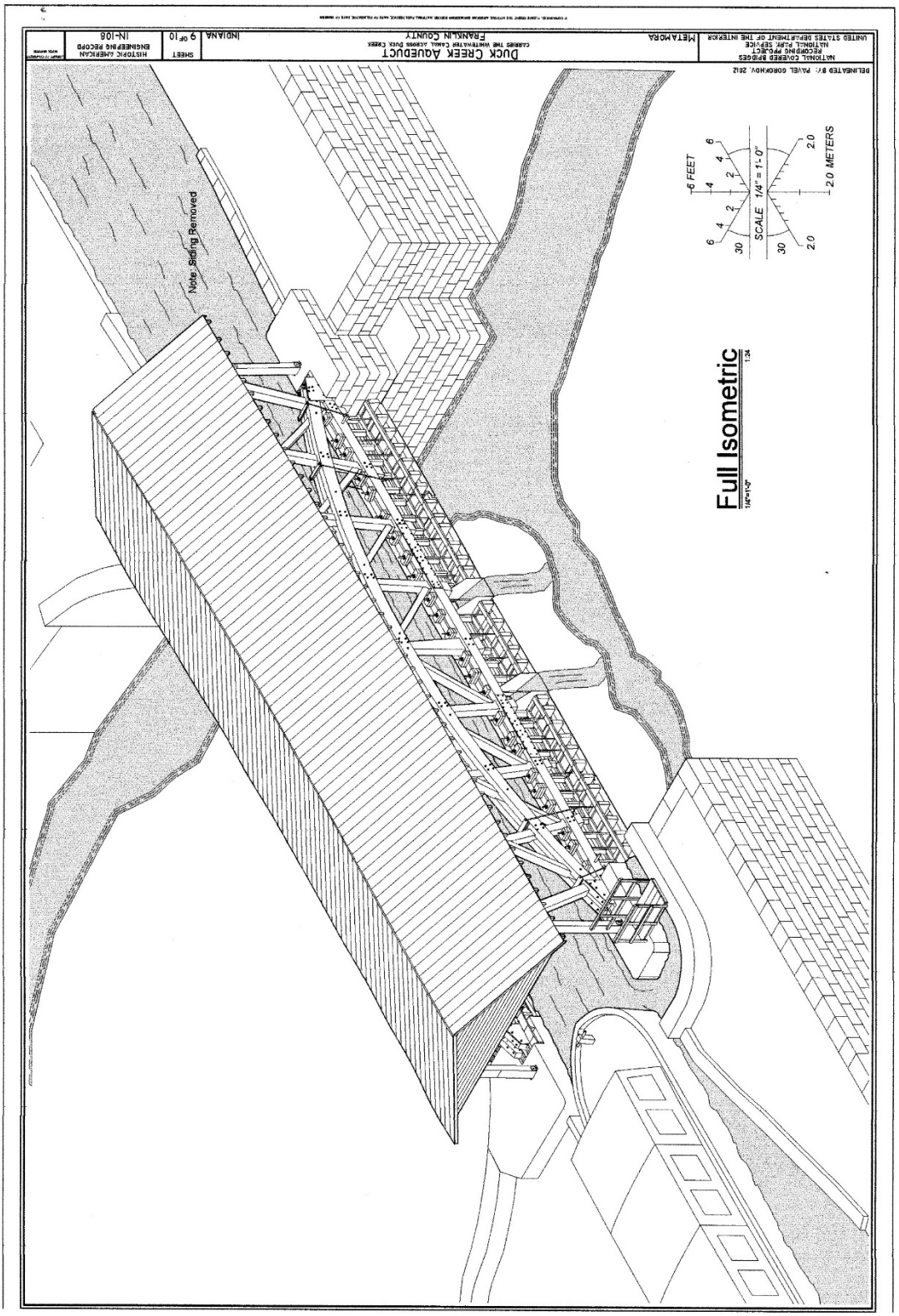

East Elevation
Canal
2'-4" deep x 17'-7" wide
18'-8 1/2"
Short Section
Canal
Spill Way
23'-1 3/4"
11'-6"
8'-10"

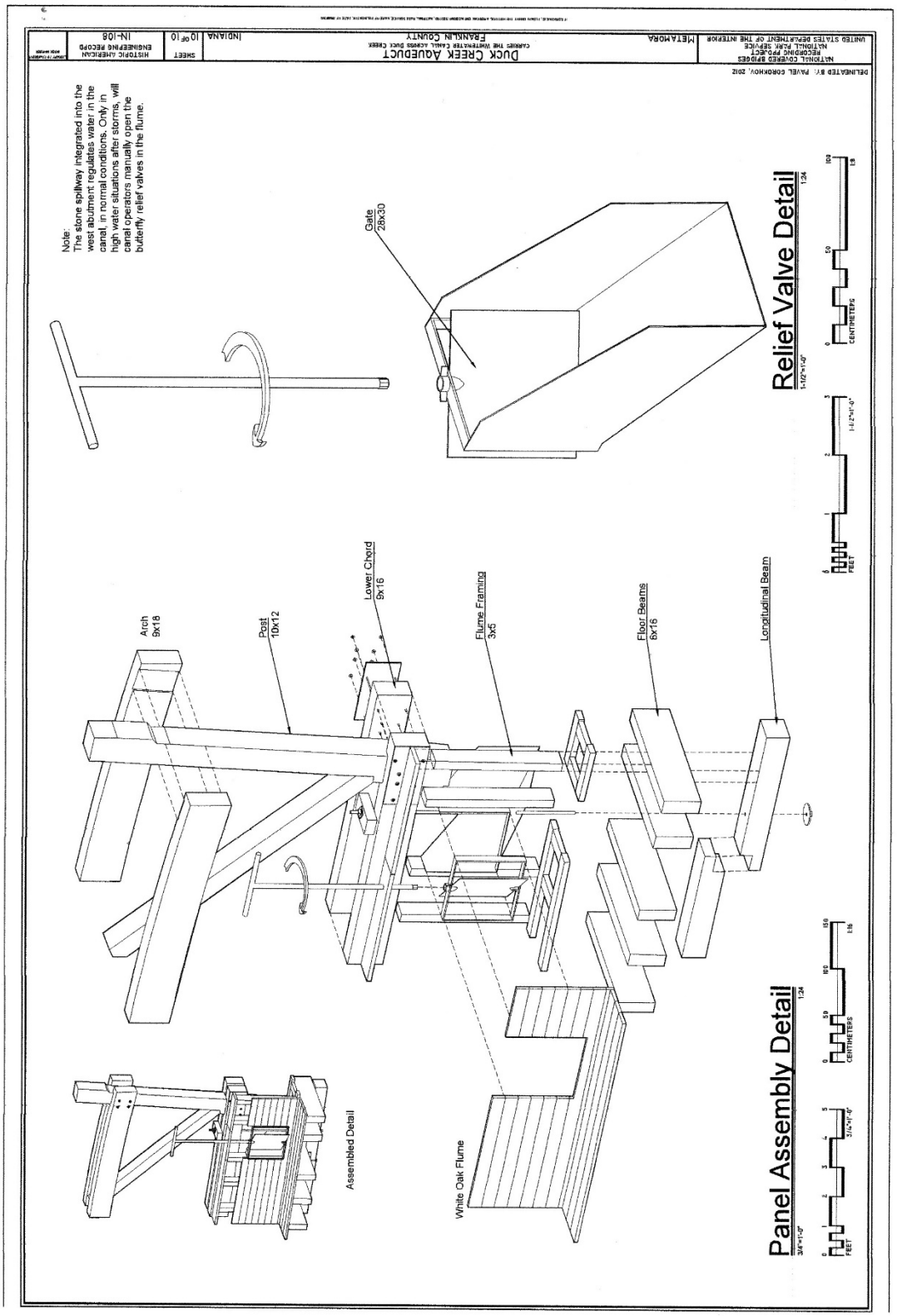

Burr Arch Truss Isometric
Assembled Scarf Joint
Nuts
Steel Plate with Welded Bars
Fishplate
Notched Lower Chord Timbers
Bolts
Scarf Joint Repair Detail
To repair the shear failure of the lower chord scarf joint, keyways were notched into the wood to match steel bars welded into the new, longer steel plates. This solution produced a better grip. The plates were bolted through after the sagging timbers were reseated and shimmed.


NATIONAL COVERED BRIDGES
RECORDING PROJECT
HISTORIC AMERICAN
ENGINEERING RECORD
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
METAMORA
CARRIES THE WHITEWATER CANAL ACROSS DUCK CREEK
DUCK CREEK AQUEDUCT
FRANKLIN COUNTY
INDIANA
SHEET 6 OF 10
IN-108
DELINEATED BY: PAVEL BOROKHOV, 2012
The aqueduct was rehabilitated in 2005 by J. A. Barker Engineering of Bloomington, Indiana.
1. Because several splices had failed due to displacement, Barker replaced several sections of the lower chord. He inserted longer steel splice plates, and added keyways into the timber to help transfer loads.
2. Iron hanger rods connect to the longitudinal floor support beams.
3. New flume framing was constructed, using 6"x16" transverse floor beams and 3"x5" vertical framing.
4. White oak was chosen for the flume liner, because of its superior performance in wet environments. A 7" strip of 60 mil EDPM roofing was used for waterproof seal between the trough and abutments.
1.
2.
3.
4.
6 FEET
SCALE 3/16" = 1'-0"
2.0 METERS
Truss-Trough Assembly


Aqueduct Isometric
SCALE 1/4" = 1'-0"
6 FEET
2.0 METERS
DUCK CREEK AQUEDUCT
FRANKLIN COUNTY
INDIANA
METAMORA
IN-108


End Post 8x12
Diagonal Brace 8x12
Arch 9x18
Post 10x12
King Post 12x20 Tapered
Roof Sheathing
Rafter 3x4
1-1/4" Iron Hanger Rods
Longitudinal Beam 10x12
Floor Beams 6x16
Dyes Flow Gate
White Oak Tongue and Groove Plank 2x8
Trough Wall 2x6 Tongue and Groove
Upper Lateral Brace 8x9
Tie Beam 12x14
Upper Chord 8x9
Abutment
Walkway
Braces 3x4
Lower Chord 8x16
Vertical Framing 3x6
Cutaway Perspective
DUCK CREEK AQUEDUCT
FRANKLIN COUNTY
METAMORA
INDIANA
8 OF 10
IN-108


DUCK CREEK AQUEDUCT
CARRIES THE WHITEWATER CANAL ACROSS DUCK CREEK
FRANKLIN COUNTY
METAMORA
INDIANA
SHEET 9 OF 10
IN-108
HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL COVERED BRIDGES RECORDING PROJECT
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
DELINEATED BY: PAVEL GORCHKOV, 2012
Note: Siding Removed
Full Isometric
SCALE 1/4" = 1'-0"
6 FEET
2.0 METERS


Duck Creek Aqueduct
Franklin County
Indiana
Metamora
Sheet
10 of 10
IN-108
Historic American Engineering Record
National Covered Bridges Recording Project
National Park Service
United States Department of the Interior
Delineated by: Pavel Gorokhov, 2012
Note:
The stone spillway integrated into the west abutment regulates water in the canal. In normal conditions, Only in high water situations after storms, will canal operators manually open the butterfly relief valves in the flume.
Gate
28x30
Relief Valve Detail
1:24
1-1/2"=1'-0"
Arch
9x18
Post
10x12
Lower Chord
9x16
Flume Framing
3x5
Floor Beams
8x16
Longitudinal Beam
Assembled Detail
White Oak Flume
Panel Assembly Detail
1:24
3/4"=1'-0"
3/4"=1'-0"
1-1/2"=1'-0"
Feet
Centimeters