BR 2-222A on Sandy Bend Road over Tappahanna Ditch

Assessment Undertaken 9/12/08 by
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Introduction:

The Delaware Department of Transportation (DelDOT) is replacing the superstructure of Bridge 2-222A on SR 222 over Tappahanna Ditch, southeast of Marydel, Kent County, Delaware (Figure 1 and Figure 2). The contract is being established under State Contract Number 27-075-02 and Federal Aid Number EBHN-K222(1). Repairs are warranted due to its deteriorated structural condition. The new bridge will consist of pre-stressed, pre-cast concrete beams, cast-in-place concrete parapets and a composite concrete deck. The project also includes placing riprap in the stream for scour protection, replacing guardrails and reconstructing approaches as required.

The National Register eligibility evaluation was prepared as part of a Section 106 undertaking with the Federal Highway Administration as the lead federal agency.

Bridge 2-222A was not previously surveyed in Delaware's Historic Bridges because it has recently been deemed 50+ years and qualifies for potential consideration to the National Register.

A historic context for the project area was developed for pre-stressed bridges. The context provides a general overview and discusses the early pre-stressed bridges first used in Delaware. Based on the context and review of DelDOT's bridge inventory, a number of recommendations can be made about the earliest pre-stressed bridge's in the state.

Project Justification:

Bridge 2-222A consists of ten pre-stressed concrete beams with a hot-mix riding surface on reinforced concrete abutments. The beams have deteriorated significantly with evidence of cracks, spalling, and corrosion of exposed bar reinforcement and pre-stressing strands (Photos 1-6). DelDOT Bridge Management Section inspected, evaluated, and recommended the bridge for repairs beginning in fiscal year 08. The bridge has a structural record (2006 data) with a sufficiency rating of 64.6. Compared to others of its type and year built, this is rating is low.

Summary:

DelDOT, Environmental Studies cultural resource staff on behalf of the Federal Highway Administration (FHWA) is evaluating Bridge 2-222A for the National Register of Historic Places as part of the Section 106 undertaking. The DelDOT staff recognized as meeting the Secretary of the Interior's Professional Qualification Standards in the fields of history, historic preservation, and/or architectural history completed the following evaluation of the bridge. Based on the lack of significance and structural integrity, Bridge 2-222A is not recommended eligible for the National Register of Historic Places.

A location map, photographs, aerials, and original contract plans (contract #1675) are enclosed. Other comparable bridge examples are also included.

Location: Sandy Bend Road (SR222) over Tappananna Ditch, southeast of Marydel, Kent County, Delaware.

Age: Bridge 2-222A built and completed in 1958.
Description: Pre-stress concrete box beam with hot mix overlay

Dimension:

With:	29.50ft. (Roadway)
	30.00ft. (Curb to curb)
	36.50ft. (Deck width)
Length:	43.00ft. (Structure)
	40.00ft (Span)

Relevant Maps: USGS 1993, Marydel, Delaware (Figure 1)
State of Delaware Aerial 2007 (Figure 2)
Beers Atlas 1868 (Figure 3)

History: A crossing has been evident since 1868 under the Beers Atlas (Figure 3). According to historic maps and contract plans, Bridge 2-222A was built and completed in 1958 under contract No. 1675 (Figure 4). The bridge was constructed in association with stabilizing, compacting, grading and paving of dirt roads under Kent County Contract No.1608. By 1958 the present bridge replaced another rigid frame bridge that was last inspected in 1942. The bridge serves modern agricultural equipment, horse and buggy, motorized vehicles, and pedestrian use. Considering tax ditches in the region and in Delaware, the Tappahanna Ditch is one of the larger tax ditches with continual volumes of water. It is possible without checking tax ditch improvements (if there are records) that improvements and consolidation of tax ditches with poor or existing drainage systems and with heavier agricultural equipment in the 1950's may have warranted new construction of Bridge 2-222.

Collectively, the Tappahanna Ditch is one of the main watercourses in this area. Stress, wear, and time have deteriorated the superstructure to warrant replacement. Additionally, early pre-stressed bridges were improved and refined in technology, so this particular bridge type is somewhat obsolete. As a result, Bridge 2-222A is not an ideal engineering design of its type.

According to bridge management records, very little maintenance or repair work has been preformed. A defective beam was repaired in 1959. Hot mix surface overlays, drilling the deck beams for better drainage, and placement of guardrail across the bridge are the only alterations.

Background Context:

According to DelDOT Annual Reports, during the fiscal year of 1956 (July 1955), House Bill 172 was introduced and passed. The bill was referred to as the "Dirt Road Bill" by the General Assembly at that time. Under the provisions of this Act, the State Highway Department was to improve 10% of the total dirt road mileage each year for ten years. This improvement consisted of grading, reshaping, draining and surface treating of rural roads. As a priority was established, the dirt roads are designed and the work is treated as any other project advertised and constructed within the State Highway Department.

Of particular importance in the "Dirt Roads Bill", a total of 10 million dollars would be allocated over a 10-year period for these improvements. At the close of 1956, a number of contracts had been awarded and construction was underway on 10 of these projects. The chief effect of this legislation is that it would enable the Department to allocate regular highway construction money to higher "classified type" roads carrying greater volume of traffic.

Prior to the passage of the "Dirt Roads Bill" in 1956, it was estimated that 1617 miles of dirt roads existed and were affected by House Bill 172 and by Senate Bill 387, which also provided for the paving of certain streets in unincorporated developments. However, by the time the laws were enacted for House Bill 172 and Senate Bill 387, the construction and bidding period was so far advanced that during the first year (July 1956 to the 2nd quarter of 1957), only 74 miles of nearly half of the required amount could be designed and built. Thus, during fiscal year of 1957 the Plans and Design Division within the Highway Department increased work production by 1 and ½ years to make up for the effort. By aggressively planning and offering out more formal projects to engineering consultants, a total 347 miles of dirt road contracts could be designed, advertised, and awarded for construction in the next fiscal year (1957 and 1958). As a result, the dirt roads program was brought up to date at that time.

Included within the 1957 State Highway Department's Annual Reports, State Contract Number 1608 was only a project contract completed in design. Road K-222, Sandy Bend Road, was one of the 10 individual dirt roads identified under this contract design to be surfaced treated with pavement in the upcoming year. A 0.47 mile stretch would be paved from SR 8 (Halltown Road) to K224, essentially covering the segment where Bridge 2-222A is located.

Other dirt roads along this corridor were also identified and included in this contract. Improvements to Road K224 would then continue south 2.11 miles to K208. Road K208 would then continue to be paved/improved for approximately 4.29 miles to its intersection juncture with State Route 10 (Willow Grave Road). From a transportation connection perspective, State Route 8 and State Route 10 are the primary east–west rural routes to more urbanized centers in eastern and central Kent County. As a result, by the end of 1958, at least one adequate paved north-south rural connection from SR 8 to SR 10 became evident for secondary rural routes in the western portion of Kent County and eastern Maryland.

Bridge 2-222A is not specifically illustrated or labeled in Contract Number 1608 as part any of the dirt roads improvements, but was developed and advertised under the Miscellaneous Bridges for Kent County under State Contract Number 1675. Under State Contract Number 1675, Bridges 2-222A 2-208B, 2-208C and 2-265B (re-named 2-268A) were numbered to match their appropriate roadway maintenance number. Within the dirt roads contracts, if a bridge was not specifically identified on any portion of the roadways, larger and multiple reinforced concrete pipes were used. Since design plans for dirt roads are basic and rudimentary in illustration, under State Contract Number 1608 it is difficult to confirm whether nor not the four bridges were plan substitutes in lieu of reinforced concrete piping. Both contracts were built and would have been started and completed in the same year.

Common among all 4 bridges contracts administered under State Contract Number 1675 where its bridge type. All four bridges incorporate and introduce new structural components of ten or twelve 36” by 17” or 36” by 21” sections of pre-stressed concrete box beams. Each box beam is also present with two 10 ½” or 12 ½” diameter voids throughout. While each bridge was essentially similar to one another in design, materials, and a rural location, span lengths of the pre-stressed beams are the essential difference. Bridges 2-222A and 2-208B match the same overall design and dimensions. As indicated on plan sheets, they are illustrated as the same plan and designs under State Contract Number 1675.

Bridge 2-268A is, however, slightly smaller with an overall bridge length of 35 feet. Bridge 2-208C consists of two independent, but matching spans for a total bridge length of 78 feet.

Although difficult to tell because of photographic recordation quality and its simplistic plans, the dirt roads contract under State Contract Number 1608 did not specify or identify any of the four bridge locations, including 2-222A, which were slated for bridge construction under Contract Number

1675. Thus, it is uncertain whether the dirt roads contract and the bridges were actually advertised or constructed together and/or by the same contractor. Contract titles and plans do not reference each other. Each contract design plan is different with an approved signature date. June 12, 1957 is dated for the dirt roads contract and November 12, 1957 is dated for Kent County Bridges. By this account, both plans seem mutually exclusive of one another. Annual Reports for 1958 and 1959 could not be obtained to validate beginning or completion date, much less a contractor. However, the Annual Report for 1957 indicates a design contract 1608 was already tasked for dirt road improvements.

However, it safe to conclude that completed work on all the dirt roads and for all bridges, including Bridge 2-222, were started and completed by the end of 1958 (or by early 1959). Since records could not be found to validate, it is only probable that both projects would have been constructed in unison.

Bridge 2-222A, like its counterparts, consists of a pre-stressed concrete deck. This was emerging technology first applied in Delaware in the late 1950's. However, all pre-stressed bridges under State Contract Number 1675, which includes Bridge 2-222A, are not the first ones designed by or for the State Highway Department. In Delaware, State Contract Number 1434 (or Federal Aid Number S-86(2)) dates prior to Contract 1675 by several months in bridge design. State Contract Number 1434 includes pre-stressed Bridge 3-129 and Bridge 3-130 in design. These two bridge crossings were part of the Bridgeville to Route 42 roadway improvements in Sussex County.

In these plans (i.e. Contract 1434), both pre-stressed bridges were developed by Delaware Highway Department and approved by Bridge Engineer Joe S. Robinson following AASHTO design guidelines and specifications. Both pre-stressed box beams 36” by 21” and pre-stressed I-beams with pre-cast or cast in-place support diaphragms were illustrated, but as two different deck options. Pre-stressed concrete box beams were ultimately used.

In comparison to Bridge 2-222A and its other bridge counterparts under State Contract Number 1675, Bridges 3-129 and 3-130 under State Contract Number 1434 consist of a wider width deck at 45 feet. This was simply accomplished by adding more box beams. As such, Bridges 3-129 and 3-130 exemplify a total of 15 box (not 10 or 12) pre-stressed box beams. Bridge 3-129 is a structure totaling 42 feet with a span length of 39 feet. Bridge 3-130 is 30’ of structure with a span length of 27 feet. Bridge 3-130 also differs since box beams are 36” by 17” with 10 ½” diameter voids within its box beams.

Other pre-stressed bridges were being designed, built, and constructed in late 1957, 1958 and/or 1959 by the State Highway Department. These bridges include: Bridges 2-390, Bridge 2-103A, and Bridge 2-249A. These early pre-stressed box beams are nearly identical to others and essentially vary by span length. All three are characterized with twelve pre-stressed box beams that are either 36" by 21" with a two 12½" diameter voids in their box beam, or 36" by 17" box beams with diameter voids of 10 ½ inches.

In checking what other states have historically said about pre-stressed concrete and for National Register historic evaluations, Indiana DOT and Ohio DOT have recent contexts developed in their states.

Indiana DOT states that, "prestressed concrete uses high-strength concrete containing high-strength steel that has been stretched and anchored to the concrete with sufficient force to significantly reduce tension from occurring in the member. Prestressed concrete is used for continuous and simple spans and is an effective way to increase concrete span lengths and control deflections."[1]

As a bridge engineer may know, deflections are the vertical movements that occur in a structure as a result of loading. Prestressing introduces a controlled strain in the member during construction to counteract unwanted stresses from the live or dead load, thus increasing the overall strength of concrete. Live-load is weight a structure carries that is temporary in nature, such as traffic, wind, and seismic loads. Dead load is the permanent weight of the structure, including its deck, railings, and structural elements.

According to the Indiana DOT, "prestressed concrete offers advantages over reinforced concrete. Prestressed concrete requires less concrete and steel than reinforced concrete spans. For example, a reinforced concrete girder uses much of its load-carrying capacity to support its own weight and this is increased as the structure lengthens. Prestressed concrete is different because a girder will support itself unencumbered by its own weight and allows longer structures to remain free of tension within the Live-load range. Pre-stressing of concrete also prevents cracking, which is a common problem with reinforced concrete.

There are two types of prestressed concrete – pretensioned and post-tensioned. To form pretensioned concrete, steel reinforcing rods are stretched and placed into forms and held under stress until the concrete is poured. Once the concrete is hardened, it holds the steel to its stressed

[1] [1] Mead & Hunt Architecture, Inc., February 2007, pages 84.

length. Post-tensioned concrete is formed when the steel rod or wire is inserted through open recesses or along the outside of the concrete member and is stretched and attached with a permanent anchor to maintain stress.

Experiments in prestressing concrete occurred as early as the late nineteenth century, but it was decades before it was practical to use. In the 1920s the idea of linear stressing became more practical through the work of French engineer, Eugene Freyssinet. In 1939 he patented the process that allowed the depth of large spans to be reduced by about half for the same concrete section.

The first significant prestressed bridge in the United States was the Walnut Lane Bridge in Philadelphia. Constructed in 1949, the use of prestressed concrete was limited until after World War II, when the economic use of materials was promoted because of the increased cost of building materials such as steel. Prestressed concrete was, however, used widely across the country by the early 1950s. Prestressed concrete was not included in the AASHO specifications as a standard until 1961 due to continuing research and innovations throughout the 1950s.

Precast, prestressed concrete was a material innovation that was popular after 1959, and innovations continued after 1965. Precasting of prestressed concrete units allowed cost savings as large quantities of beams and girders could be mass produced at factories and formwork reused."[2]

In Delaware beyond the pre-stressed box beam, the each bridge consists of relatively the same design details and measurements. Common among all are supporting reinforced concrete abutments, wing walls, and a deck that is characterized with a combined curbing/sidewalk that functions as a reinforced concrete parapet. Each parapet section is then topped with an Alcoa aluminum bridge railing consisting of three tubes. Within each plan construction of the Department's early prestressed concrete box beam bridges, channel and embankment excavations were specified to achieve a uniform design that could be used and repeated at another location. By undertaking this effort on plans sheets, the early pre-stressed bridges had simplified and predictable measurements and construction methods. What was undertaken for bridge "X" was then repeated and copied for bridge "Y". Plan sheets and specifications were the same. Only elevational changes are evident as well as location maps, excavation and embankment effort, and title sheets.

Besides structure and span variations, early pre-stressed box beam bridges may include wire rope guide rail with timber posts for approach safety.

[2] [2] Mead & Hunt Architecture, Inc., February 2007, pages 84-85.

The wire rail is attached to the end of the concrete parapet by a tie rod. Bridges 3-129 and 3-130 are the early examples. Bridge 2-222A did not include an approach guardrail (modern) work until much later. The galvanized modern guardrail can be considered an alteration to Bridge 2-222A.

From a regional perspective, pre-stressed concrete was first applied (generally) in the late 1950's to early 1960's to economize design, materials, and to redefine the application of reinforced concrete. Pre-stressed bridges are similar and exemplify the same design characteristics to ridged frames and deck slabs. Decks differ from slabs to box beams and may include "I" and "T" pre-stressed beams with a reinforced deck. Added pre-stressed diaphragms may be used to support the "I" and "T" pre-stressed beams, too.

Nationally, pre-stressed box beams began to appear on highways in the early 1950's, but were not common until the 1960's as standards became even more refined. Delaware was no exception by introducing incorporating a total of 7 bridges into its bridge and design program in late 1956 and 1957. Six of the 7 pre-stressed box beam bridges were likely built and completed by 1958. According to DelDOT Bridge Records, a total of thirteen pre-stressed concrete bridges were built between 1957/58 and 1962/63; they are still extant. These may be considered the early examples of a pre-stressed bridge used in Delaware. All three counties were and are still represented. Today about 120 pre-stressed bridges (mostly box beams) are evident on Delaware roadways. The pre-stressed technology is relatively modern and is still being used and refined on a regular basis.

According to bridge historian, Patrick Harshbarger who has researched and historically evaluated several state's DOT bridges and their programs, the Pennsylvania Highway Department may have been the first transportation agency to explore pre-stressed concrete. In the National Cooperative Highway Research Program (2005) in determining a historic context for common bridge types, Harshbarger believes PennDOT began using pre-stressed box beams in 1951. "By 1954 they were building about sixty-of then a year, mostly on secondary roads." [3]

The National Cooperative Highway Research Program (NCHRP) continues to add, "problems with fabrication and construction soon became evident. Even so, box beams (and I-beams) remained popular where speed of construction or minimum section depth was critical. May state highway departments (Pennsylvania, Florida, Tennessee, California

[3] National Research Council, *"A Context for Common Historic Bridge Types,"* prepared for the National Cooperative Highway Research Program, 2005, page 3-104.

and Texas) initiated research in the effort to develop economical pre-cast structural shapes. Research resulted in simplified box (as well as I-beam and double tee) standards and, in 1962 AASHTO and the Pre-stressed Concrete Institute (PCI) published recommendations for standard shapes. Construction experience improved and more pre-stressed shapes, such as box beams, were built."[4] Today this pre-stressed concrete technology or engineering fabrication can be repeated over and over again.

As previously described and according to the NCHP most pre-stressed bridges of this type (i.e. boxed beams) have a rectangular cross section in which the top and bottom slabs act as flanges and the side walls as interconnecting webs to other adjacent beams. The interior is void and circular in section.

"A similar type of pre-stressed structure is the "block" beam bridge. Although begun after the Walnut Lane Bridge, the Duffy's Creek Bridge (1950) in Madison County, Tennessee, it was completed first, thus making the first pre-stressed concrete bride to be constructed and put to transportation service in the United States. This bridge features a "block" beam design developed by Ross Bryan (1910-2002). A 1933 graduate of the civil engineering program at the University of Kansas, Bryan worked early in his career at the Kansas Highway Department. He was also a structural design engineer in the Panama Canal Zone before and after World War II, and a structural engineer with Marr and Holman Architects until establishing Bryan and Dozier Consulting Engineers on 1949. Approximately four years later he formed Ross Bryan Associates, Inc., in Nashville, Tennessee; a company that still exists. Bryan led the firm until his retirement in 1977. He also designed a stadium in Fayetteville, Tennessee, which is credited as being the first pre-stressed concrete non-bridge structure in the country. Like many designers of concrete bridges, he was apparently more interested in building designs then in bridges. A small handful of pre-stressed bridges were designed by Bryan using this method, which does not appear to have been widely used by his consulting firm.

According to a 1951 article in the *Engineering News Record (33)*, the Duffy's Creek Bridge consisted of pre-cast concrete standard machine blocks compressed by sever-wire galvanized wires. Each block had three cores. Special end blocks were made for lifting and anchoring the pre-stressed strands, and special depressor blocks held the strands in place. The blocks were strung over the pre-stressing strands and mortared together. An initial tension was then placed in the strand. After the mortal had been allowed to set for a day, additional force was applied. The unified beams thus formed and lifted into the substructure to form the

[4] Ibid, page 3-104.

superstructure of the bridge. A concrete deck slab and integral curb was then set. Transverse strands were then placed and tensioned so that the beams would work together to handle the loads imposed on the bridge.

In 1996 Bryan was awarded the Medal of Honor by the Precast/Prestressed Concrete Institute in recognition of this contribution to the design of pre-stressed concrete structures. The Precast/Prestressed Concrete Institute also recognizes a pre-stressed block beam bridge built in Michigan by C.L. Johnson in 1950, but little is known about this designer or work."[5]

Under Criterion C of the National Register of Historic Places, for a pre-stressed concrete beam (box, "I", "T" or double "T") to be potentially eligible for the National Register of Historic Places, the bridge must be of exceptional structural integrity and condition. The bridge's original structural components (substructure and superstructure) must be in good condition to convey their early technology. It must have and demonstrate all its original design fabric and it should be in good condition (e.g. since the technology and engineering of a bridge might be recognized as character defining and not necessarily the aesthetic look). Drilled holes that allow additional drainage and ventilation within beams should be minimal and not show signs of stress. Typically undertaken by maintenance forces with little or no records, additional drill holes only demonstrate a pre-stressed design and technology flaw since moisture and water can be trapped within the beams accelerating deterioration.

For the earliest pre-stressed bridges (1958-1963), the presence of wire rope guardrail still connected to the ends of parapet sections would aid in the amount of historic fabric present – i.e. setting, location, design, & materials. It is not part of the structural importance. However, modern guardrail used and applied across the bridge would inhibit the integrity of the bridge because intended parapet and curb functions would be less conveyed and essentially render them unsafe and non-functional.

Since early pre-stressed bridges were not fully standardized and refined until the early 1960's, the better condition bridges should be more favorable in a National Register consideration. Also, as most pre-stressed bridges are typically one span length and consist or 10 or 12 beams. A wider the bridge deck (12 or more beams) or a double span deck becomes a more rare and unique example. If present, these bridges should be recognized before others since most pre-stressed concrete bridges where first used for smaller crossings and first applied on secondary roads. Sizes of beams should be 36" by 17" or 36" by 21" and be approximately 40' in length. If pre-stressed concrete diaphragms are present for longitudinal

[5] Ibid, page 3-104 – 3-105.

support in the application of "I" or "T" pre-stressed beams, this may be even more unique, provided they are one of the first of its type to be applied. For Delaware, single spans of considerable length that can exemplify the use of engineering technology should be greater then 40 feet. As they are commonplace today, smaller pre-stressed bridges should be dismissed because they are not historically interesting or unique. In addition, those pre-stressed concrete bridges not in primarily rural settings should be dismissed since their standard and early practice was experimental on secondary type roads. When refinements to pre-stressed concrete became evident in the early 1960's its technology and engineering application became commonplace. In the future, only those with considerable design, span length, and one's of its kind might be eligible. Land use, transportation, and road/bridge records with general knowledge of the area should be first determined before making conclusions about secondary roads or rural conditions. Suburban development and land use changes are non-ending.

Other National Register Criteria Consideration in evaluating and determining the significance of a pre-stressed concrete bridge are dubious, but possible:

A pre-stressed concrete bridge will not be found or recommended eligible under Criterion A unless a significant event in history occurred on or under the bridge. This would be determined on a case-by-case basis. To date, this would rarely apply. However, this should not preclude an engineering for contractor's firm if the bridge can demonstrate a significant event or application with pre-stressed concrete over time and in the future. Although more symbolic in principal, would a prestressed concrete bridge (i.e. any of them) best demonstrate a significant contribution to Delaware history that is applicable with any of the construction and civil engineering industries as a marquee bridge in their company's history? Perhaps the importance of a flood, transportation, or natural disaster may occur where the bridge played some significant role in human or biologic intervention in saving lives or property? This may deem the bridge eligible for listing to the National Register.

A transportation causality occurring at a bridge due to inadequate or adequate design standards or driver error (unless purposely intended) would not likely deem a pre-stressed concrete bridge historic for the National Register under important broad patters of historical events.

Under Criterion B of the National Register of Historic Places, a person of exceptional importance would have to be identified within the State Highway Department's bridge design or consulting firm if a pre-stressed concrete bridge were recommended eligible in Delaware. Although many

bridge engineers are important to/for Delaware's transportation history, is there a distinguished individual throughout his/her career who exclusively designed and managed pre-stressed bridges throughout Delaware? A symbolic bridge example could be the first or last of his/her career? However, one should also be able to demonstrate that this individual facilitated most of the engineering design, management, and any refinements beyond typical AASHTO or Bridge Design standards for its nominated and affiliated bridge.

Under Criterion D of the National Register of historic Places, it is doubtful that any pre-stressed concrete bridges would ever be recommended eligible. Information on construction technology is widespread and readily available. It is a common engineering practice and application, including minor changes and refinements over the years.

Evaluation: Bridge 2-222A is not a significant example of a pre-stress concrete box beam bridge. Nor is there any significant engineering, technological, or architectural features. The bridge does not relate or maintain an association with a known historic property, landscape or district, or any other applicable defined contexts. The bridge is simple in design and reflects common and undistinguished engineering design and materials. Common examples of this bridge type are extensive throughout the county and in Delaware. In fact, under contract 1675 a series of replica bridges (four total) were included in the contract. Included in this contract, Bridge 2-208B (still extant) over Shades Branch is the same exact bridge as Bridge 2-222A. Both bridges match <u>all</u> relevant design specifications. However, it should be noted that the parapets on Shades Branch prestressed concrete bridge have been altered and replaced with Jersey barriers.

Nonetheless, in checking DelDOT Bridge records, Bridge 2-390C located on Road 390 south of Federica and completed the fallowing year (1959) is the same exact bridge, too.

Since there are equal and similar representations, Bridge 2-222 is not a representative example that is National Register eligible of its bridge type. In checking bridge management records in the spring of 2008 and confirmed with bridge engineers, other representative early examples exist and with better integrity such as bridges 2-103A 2-249A and 2-268A. As examples are present, having the same bridge type only demonstrates a simplistic design and frequency of use. This is not significant. Plus this raises the question for the National Register: which one is more representative for National Register consideration, especially when there are even others of the same time period?

In addition, Bridge 2-222A is not the first one of its design and bridge type (i.e. pre-stressed concrete). Both Bridges 3-129 and 3-130 precede and exist as the first pre-stressed bridges in Delaware. Furthermore, other prestressed concrete boxed bridges are known to be first constructed in other states preceding 1958 or early 1959.

Bridge 2-222A has been altered with the application of modern guardrail laid across the travel surface and deck, thereby decreasing the function and use of the parapet walls – i.e. a character defining feature. De-lamination of concrete is evident, particularly with outside fascia beams. More recently a top section of metal posting on the parapet wall has been removed. Lastly, a defective beam was repaired in May of 1959. To what extent of beam repair is uncertain, but its only demonstrates alterations that are more recent.

Conditionally, the bridge lacks integrity since it is deteriorating with more serious cracking and loss of concrete and spalling of fascia walls. Abutments are not in good shape. Drilled holes have occurred in beams to allow additional drainage and ventilation. These areas show sign of further cracking. The last inspection, September 9th, 2007, has ranked the bridge as 64.6, which is poor.

According to longtime DelDOT bridge and engineering personnel Dennis O'Shea, "*pre-stressed beam technology is more innovative than traditional reinforced concrete, but it is still very common place.*"[6] O'Shea believes that a pre-stressed bridge's life span can vary since the quality of materials and construction methods always differ. However, replacement and/or significant repairs are inevitable for most DOT's, including those states with fluctuating and seasonal climates. "*In Delaware, with 120 pre-stressed concrete bridges evident, this number is likely not to change dramatically or decrease over time. In many cases and because of economical benefits and the good condition of the remaining bridge, pre-stressed beam superstructures are being replaced with pre-stressed beams in-kind, thereby making this engineering technology and representation common and continually repeated. We also continue to use pre-stressed technology for the replacement of many other types of bridges types such as Bridge 1-686, South Wilmington Causeway that continues to be National Register historic with the main superstructure replacement in 1994.*" [7]

O'Shea further concludes that Bridge 2-222A will not be replaced in its entirety but, as mentioned, its pre-stressed concrete superstructure is being replaced in-kind. Thereby, the technology preserved and repeated.

[6] DelDOT Dennis O'Shea discussions, June 2008.
[7] Ibid.

From a national perspective, according to the NCHRP, "because of its relative commonness, the prestressed concrete box beam possesses a low level of significant within the context of this study (e.g. development of a historic context for a common bridge type). Early examples (pre-1955) that possess integrity are the most significant of this type."[8] Bridge 2-222A does not apply to this time frame and includes only a hand full of eligible pre-stressed concrete bridges from Ohio, Pennsylvania, and Tennessee. No other bridge examples are evident.

In sum, Bridge 2-222 is one of the early Delaware examples in use of pre-stressed concrete box beams, but it is not rare or significant for National Register consideration. If a historic representative example of this bridge type becomes necessary in DelDOT's future Historic Bridge Update, DelDOT records has more favorable early examples. Collectively, Bridge 2-222A is recommended not eligible for the National Register of Historical Places under Criterion C.

Other National Register Criterion considerations do not apply, but were considered.

Under Criterion A, Bridge 2-222A does not have an association with events that have made a significant contribution to the broad pattern of our history. Tax ditch bridges and crossings are common phenomena in Delaware and in the country. The bridge is recommended not eligible under Criterion A. No other events of state or local importance are known to have existed, included any events that may have achieved significance within the last 50 years.

For Criterion B, Bridge 2-222A is not associated with persons significant in local, State or National history. According to contract plans, Delaware State Highway/Bridge Engineers undertook the designed of bridge. Plan and document research does not indicate association with a historically significant person for the National Register. The bridge is recommended not eligible under Criterion B.

The bridge has not yielded, or is not likely to yield information about important building construction practices not available through other means. Design plans are currently documented. Therefore the bridge is recommended not eligible under Criterion D.

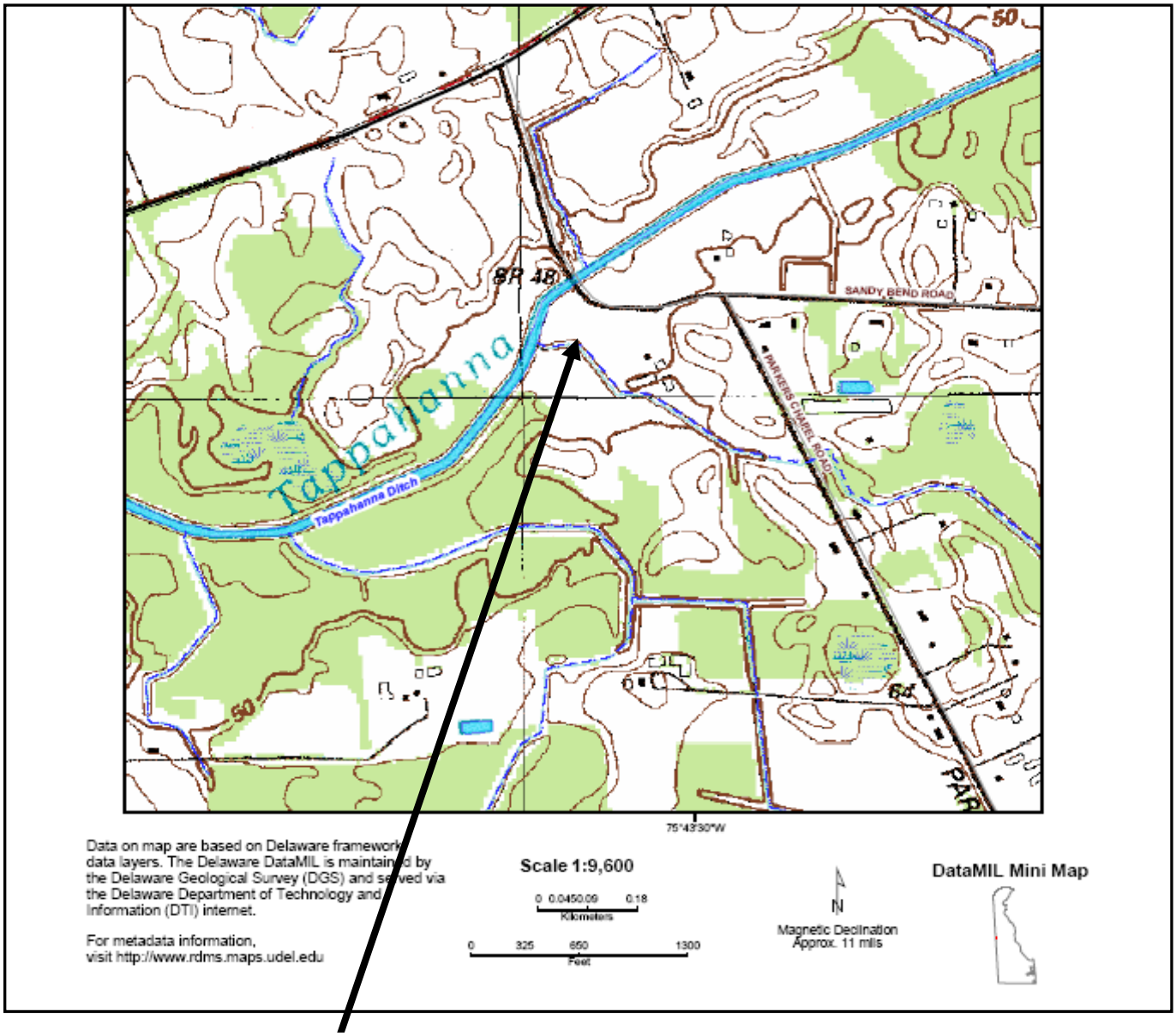
Conclusion:

[8] National Research Council, *"A Context for Common Historic Bridge Types,"* prepared for the National Cooperative Highway Research Program, 2005, page 3-105

The superstructure of State Bridge 2-222A will be replaced with pre-stressed, pre-cast concrete beams, cast-in-place concrete parapets and a composite concrete deck. Riprap will be placed in the stream for scour protection, DelDOT will replace guardrails and reconstruct approaches as required the work is consistent with the Department's Programmatic Agreement. The bridge has been determined/recommended not eligible for the National Register and the work is limited to the bridge structure. No potential historic dwellings surrounding the bridge project are evident. The area has been dredged and excavated, so the presence of past bridges should not be encountered. Past engineering plans also indicate the removal of existing structures. There should be No Historic Properties Affected to conclude Section 106 responsibilities.

As far as a context development of pre-stressed concrete bridges in Delaware, an expanded historic context can and should elaborate further on this topic when DelDOT develops revisions and extends time lines within its historic bridge report. The current bridge report ends 1957 at a time when pre-stressed concrete technology was first introduced in Delaware in design and throughout the county, but no constructed examples existed at the time.

Figure 1. USGS Marydel, Del. – Md., 1993 Illustrates Bridge Crossing at Tappahanna Ditch



Bridge 2-222A Location

Figure 2. State of Delaware 2007 Aerial

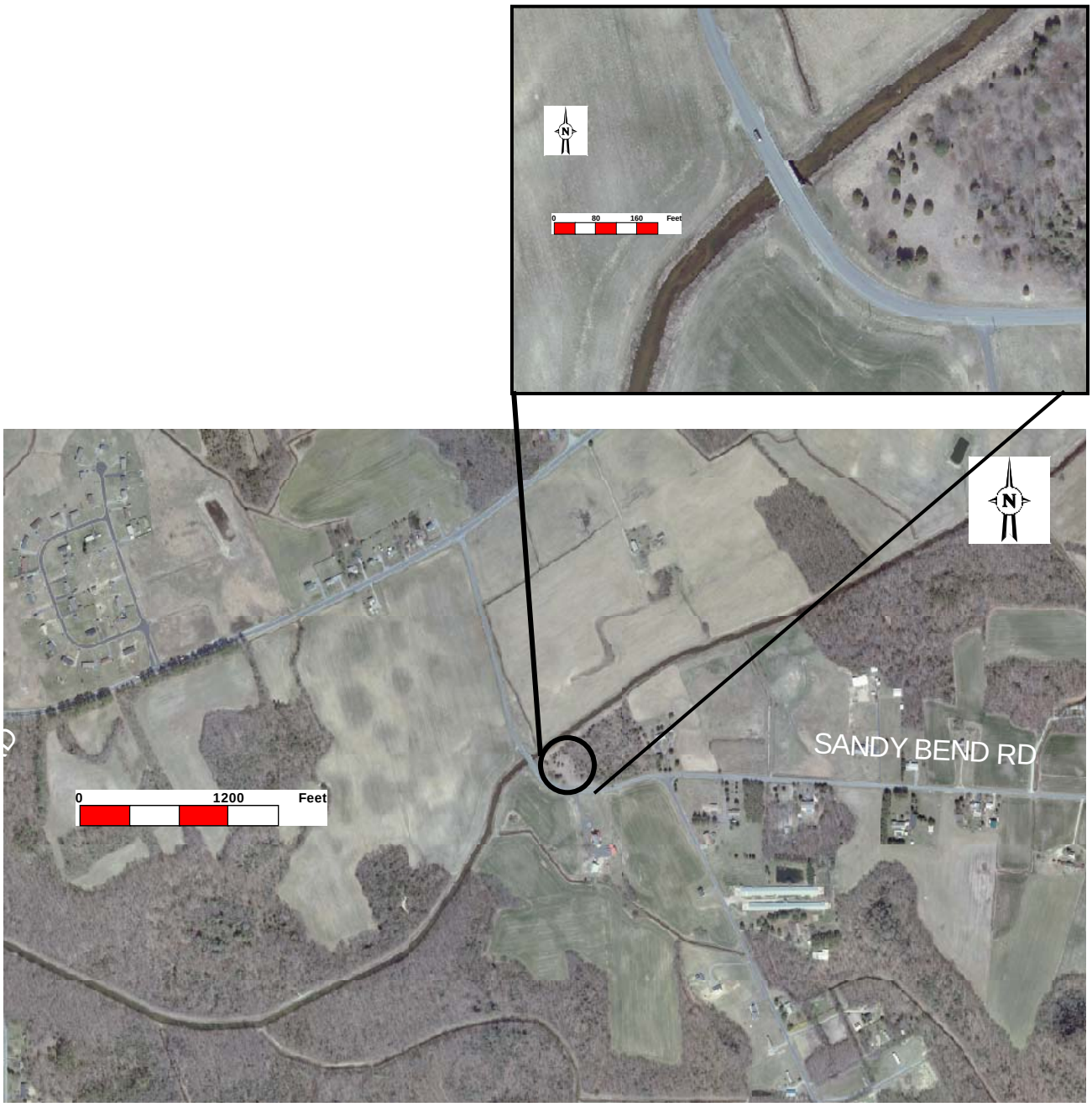
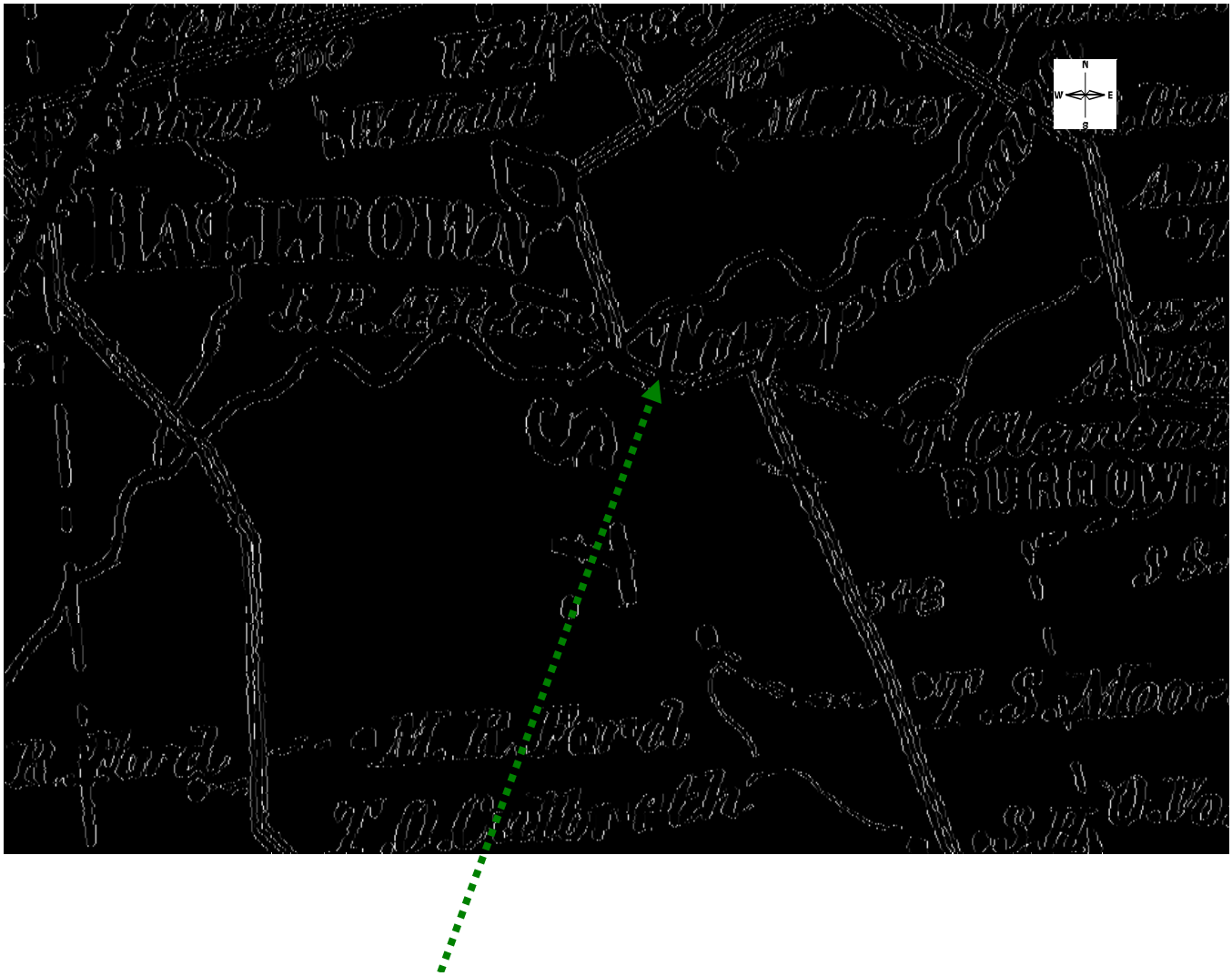


Figure 3. Beer's Atlas 1868 Kent County Dover Hundred
The map illustrates the possibility of a bridge crossing the Tappahanna Ditch



Bridge 2-222A Location

Photo1. Bridge 2-222A North Approach (photo taken 9-12-06)

Photo 2. Bridge 2-222A East Elevation (photo taken 9-12-06)

Photo 3. Bridge 2-222A General View Looking South (photo taken 9-12-06)

Photo 4. Bridge 2-222A, Rust Stained Long Crack at S. End Of Beam #6 (photo taken 9-12-06)

Photo 5. Bridge 2-222A De-lamination and Deterioration of West Fascia Beam at N. End (photo taken 9-12-06)

Photo 6.Bridge 2-222A Broken Aluminum Rail Post Base; Third From South End of West Rail (photo taken 9-12-06)

Photo 7.Bridge 2-222A Broken Top Rail and Guardrail Slapped Across Parapet (photo taken 9-19-07)

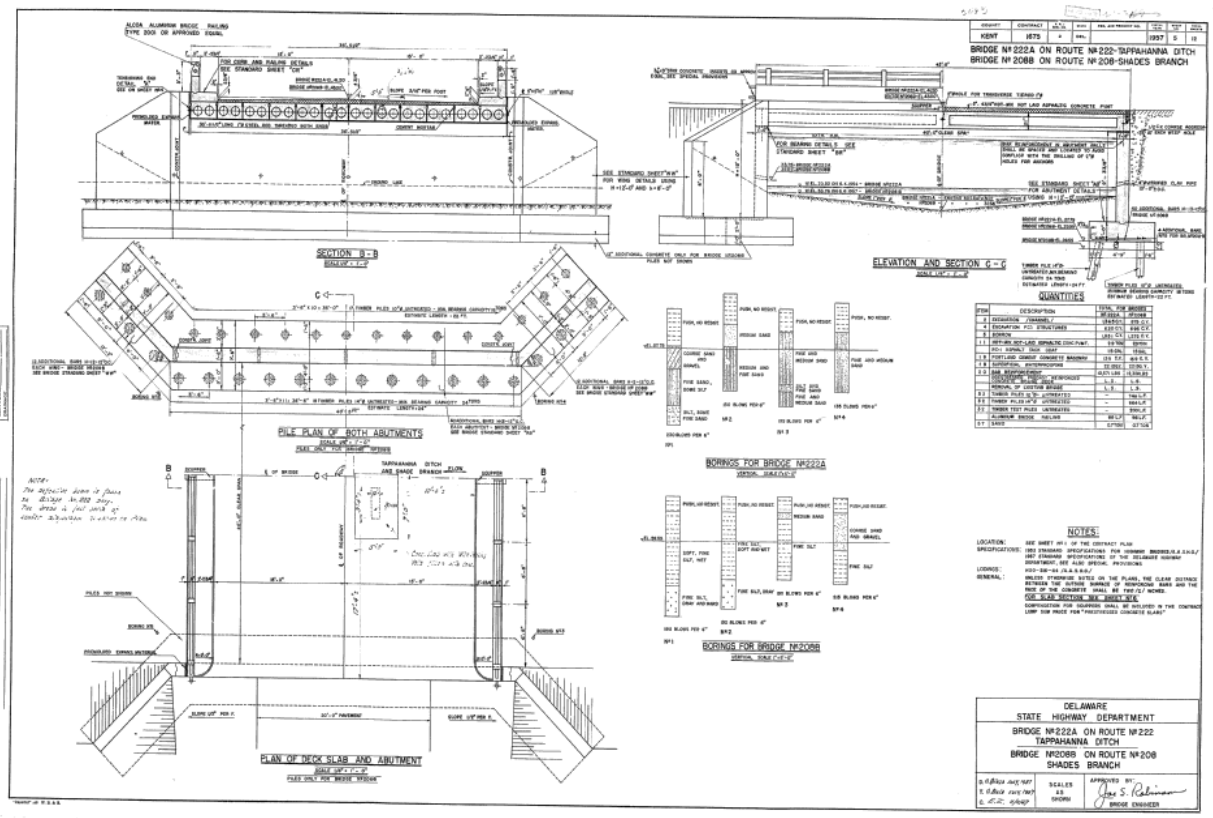
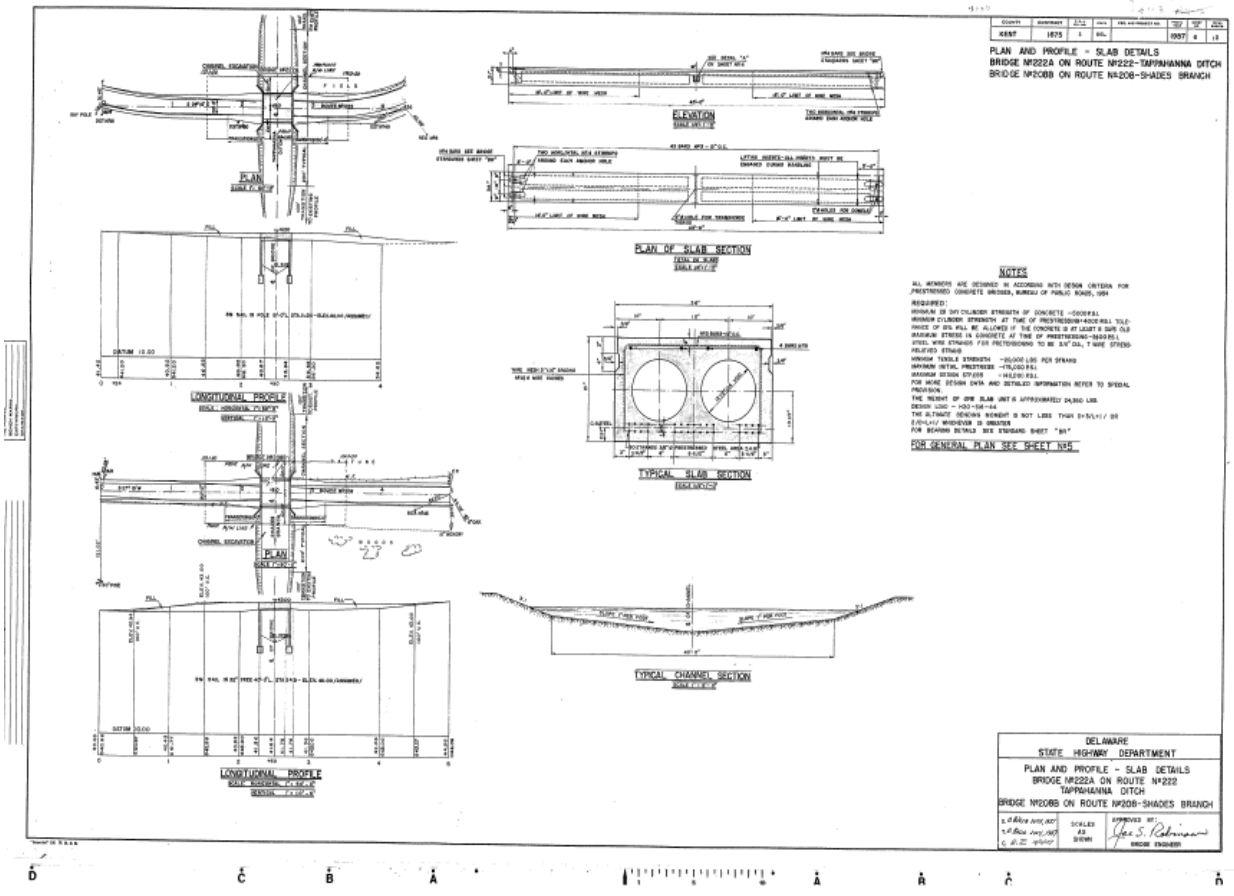


Figure 4. Relevant Design Sheets Taken From State Contract Number 1675. Original Plan Sheets May Be Found at DelDOT.



Pre-Stressed Concrete Box Beam Comparable Bridge Examples

Bridge 3-129 off Road 40

- Constructed with Bridge 3-130 under state contract number 1434 in 1958.
- Both bridges believed to be the first recorded and constructed pre-stressed concrete brides in the state.
- Photo taken 8/1/07; structural sufficiency rating 98.8.
- Fifteen 36” by 21” beams.
- 42’ bridge span

Bridge 3-130 off Road 40

- Constructed with Bridge 3-130 under state contract number 1434 in 1958.
- Both bridges believed to be the first recorded and constructed pre-stressed concrete brides in the state.
- Photo taken 8/1/07; structural sufficiency rating 95.8
- Fifteen 36” by 17” beams
- 30’ bridge span

Underside of BR 3-130 in good condition

Pre-Stressed Concrete Box Beam Comparable Bridge Examples – cont.

Bridge 2-208C over Cow Marsh Road on Road 208

- Built 1958 with 3 other pre-stressed concrete bridges under State Contract Number 1675.
- 2 spans (unique for Delaware) for total bridge span of 78 feet.
- Photo taken 10/1/07; structural sufficiency rating 96.9.
- Rural secondary road.
- No additional guardrail attachments.
- Two sets of twelve 36" by 21" beams

Bibliography and References.

DelDOT Interviews and Correspondence, June 2008:
- Dennis O'Shea – Bridge Design Engineer; Assistant Director, Design
- Doug Finney – Bridge Design Engineer; Bridge Management Engineer

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DelDOT Bridge Data Base

DelDOT Bridge Management System

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