

**STATE OF VERMONT  
AGENCY OF TRANSPORTATION**

**Scoping Report  
FOR  
Elmore BF 0241(55)**

**VT ROUTE 12, BRIDGE 94 OVER UNNAMED BROOK**

April 22, 2020

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## I. Site Information

Bridge 94 is a State-owned bridge located on VT Route 12 in the Town of Elmore approximately 5.6 miles south of the junction with VT Route 15A. The existing conditions were gathered from a combination of a Site Visit, the Inspection Report, the Route Log and the existing Survey. See correspondence in the Appendix for more detailed information.

Roadway Classification	Major Collector
Bridge Type	Aluminum Coated Corrugated Galvanized Metal Plate Pipe (ACCGMPP)
Culvert Span	6 feet
Culvert Length	74 feet
Fill Over Culvert	10 feet
Year Built	1959
Ownership	State of Vermont

### Need

Bridge 94 carries VT Route 12 across an Unnamed Brook. The following is a list of deficiencies of Bridge 94 and VT Route 12 in this location:

1. The culvert is in fair condition. There are holes throughout the invert up to 2-inches in diameter.
2. The asphalt coating is wearing off. Additionally, the outlet of the pipe has moved up causing some deflection in the culvert.
3. The vertical alignment along VT Route 12 through the project area has a slightly substandard sag curve.
4. The existing culvert does not meet the calculated or measured bank full width.

### Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2024 and 2044.

TRAFFIC DATA	2024	2044
AADT	1,700	1,800
DHV	260	270
ADTT	90	140
%T	4.7	7.2
%D	60	60

## Design Criteria

The design standards for this bridge project are the Vermont State Standards, dated October 22, 1997. Minimum standards are based on an ADT of 1,800, a DHV of 270, and a design speed of 50 mph for a Major Collector.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 5.3	11'4" (30')	11'3" (28')	
Bridge Lane and Shoulder Widths	VSS Section 5.7	11'4" (30')	11'3" (28') <sup>1</sup>	
Clear Zone Distance	VSS Table 5.5	No Issues Noted	20' fill / 12' cut (1:3 slope) 14' cut (1:4 slope)	
Banking	VSS Section 5.13	2.2%	8% (max)	
Speed		50 mph (Posted)	50 mph (design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	R = 5,800'	R <sub>min</sub> = 5,400' @ e=2.2%	
Vertical Grade	VSS Table 5.6	-3.5% (max)	6% (max) for level terrain	
K Values for Vertical Curves	VSS Table 5.1	K <sub>sag</sub> = 78	110 crest / 90 sag	Substandard
Vertical Clearance	VSS Section 5.8	No Issues Noted	14'-3" (min)	
Stopping Sight Distance	VSS Table 5.1	360' (Headlight Sight Distance)	400'	Substandard
Bicycle/Pedestrian Criteria	VSS Table 5.8	4' shoulder	3' Shoulder	
Hydraulics	VTrans Hydraulics Section	HW/D = 0.79 Clearspan: 6'	HW/D < 1.2 Bank Full Width: 11'	Substandard Bank Full Width
Structural Capacity	SM, Ch. 3.4.1	Structurally Sufficient	Design Live Load: HL-93	

## Inspection Report Summary

Culvert Rating                      5 Fair  
Channel Rating                      4 Poor

11/23/2016 – Holes in the invert should be addressed soon with new invert before the culvert needs to be replaced. ~JAS

09/29/2011 – Fair condition, random holes along invert up to 2" in diameter, Concrete invert or liner should be done. Inlet has heavy vegetation build up and stream should be ditched and realigned. Heavy erosion around pipe inlet. ~MJK/JM

08/01/2006 – Culvert is in fair condition. There are scattered perforations throughout. Should consider repair or replacement in the near future.

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<sup>1</sup> A typical section of 10'/3' is required for safety and service per Vermont State Standards Table 5.3. However, a minimum paved width of 28' is required for winter maintenance activities per VTrans Highway Safety & Design Engineering Guidance HSDEI 11-004.



## Hydraulics

The existing structure meets the current hydraulic standards of the VTrans hydraulic manual. However, the existing structure constricts the channel width, as it does not meet the 11-foot width ANR calculation for bank full width. The existing 6-foot diameter culvert provides a Headwater to Depth ratio (HW/D) of 0.79 during the design storm event. Per the current standards, a culvert with a diameter greater than 60-inches should provide a maximum HW/D of 1.2 during the design storm event. Hydraulics has made several recommendations for a rehabilitation or replacement structure; these options are outlined in the preliminary hydraulics report in Appendix D. Regardless of the recommendation, Aquatic Organism Passage is required and will need to be incorporated into the design and construction of the project.

Additionally, the existing structure constricts the channel width, as it does not meet the 23-foot field measured bankfull width. The VTrans Hydraulics Section has made several recommendations for a replacement structure; these options are outlined in the preliminary hydraulics report in Appendix D. Regardless of the recommendation, Aquatic Organism Passage is required and will need to be incorporated into the design and construction of the project.

## Utilities

The existing utilities are shown on the Existing Conditions Layout Sheet, and are as follows:

### Municipal Utilities

- There are no municipal utilities within the project area.

### Public Utilities

#### Underground:

- Consolidated Communications has buried infrastructure just north of the culvert.

#### Aerial:

- Aerial infrastructure is located just west of the culvert and is owned by Morrisville Water & Light and Consolidated Communications.

It is anticipated that overhead utilities would need to be relocated for placement of a downstream temporary bridge.

## Right-Of-Way

The existing Right-of-Way (ROW) is plotted on the Existing Conditions Layout Sheet. This ROW is not centered on the centerline of VT Route 12. The state ROW is located approximately 35-feet from the centerline of the road on the east side of VT Route 12 and is located approximately 60-feet from the centerline of the road on the west side of VT Route 12. The inlet of the pipe is located approximately 3-feet within the existing state ROW. As such, additional Right-of-Way will likely be needed regardless of the project scope.

## **Environmental and Cultural Resources**

The environmental resources present at this project are shown on the Existing Conditions Layout Sheet, and are as follows:

### ***Biological:***

#### Wetlands/Floodplains

Two class II wetlands were identified within the vicinity of the culvert on VT Route 12.

**Wetland A:** Wetland A is located on the western side of Route 12 and consists of an Alder Swamp natural community. This site is characterized by a dense shrub layer of speckled alder (*Alnus incana*). The portion of the wetland within the study area is currently being used as a pasture. The understory vegetation, therefore, is highly disturbed due to grazing activity. An unnamed stream runs through this wetland and flows into Lake Elmore.

**Wetland B:** Wetland B is located on the eastern side of Route 12 and is also an Alder Swamp natural community. The alder shrub vegetative layer is more variable, being dense in areas and sparser away from the stream. A diverse understory flora is present, dominated by long-leaved aster (*Symphotrichum lanceolatum*), sensitive fern (*Onoclea sensibilis*) and purple-stemmed aster (*S. puniceum*).

#### Rare, Threatened, and Endangered Species

There are no occurrences of R/T/E species within the project vicinity.

The USFWS IPaC mapping indicates that the project area is within the Northern Long Eared Bat's (NLEB's) habitat range. The NLEB is a federally listed threatened species. Suitable habitats for NLEB's per guidance from USFWS are: trees  $\geq 3$  inches in diameter that have holes, crevices, cracks or peeling bark. During a site visit by the VTrans Environmental Section, trees that fit this description on both sides of the road were identified. As the project moves forward, additional investigation is warranted to avoid impacts to potential roosting habitat.

#### Wildlife Habitat

Vt. Fish and Wildlife identifies the study area as a Highest Priority surface water and riparian area in the Vt. Conservation Design Community and Species Scale Components. The landscape adjacent to the stream west of the crossing structure is currently grazed by livestock but is still generally forest or shrub dominated alder swamp for a distance of at least 75-feet from the streambank. North and east of the crossing structure, the forested area narrows to 10-30 feet in width due to existing residential development. Residential development southeast of the structure is slightly further from the streambank, with approximately 30-40 feet of forested/shrub wetland area adjacent to the banks. This shrub/forest band on both sides of the structure is the only forested connectivity habitat within at least a mile and likely provides an important corridor for aquatic organism and mammal passage from the forest lands east of the structure to extensive forest, wetlands and Elmore Lake to the west of the structure. The current structure is undersized and does not provide a natural bed substrate to benefit aquatic organism passage, nor does it include bank features which would facilitate terrestrial connectivity. Structure design should consider the passage requirements of both aquatic and terrestrial species moving east/west within the riparian corridor.

### Agricultural Soils

The agricultural soils assessment involved a remote review of the NRCS County Soil Survey for the Project area. Primary agricultural soils were identified in the Project area. Primary soil types present include Berkshire (Statewide) and Potsdam (Prime) fine sandy loams. These soil types are both considered potentially highly erodible.

### ***Hazardous Materials:***

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there are no hazardous waste sites located in the project area.

### ***Historic:***

Bridge 94 is not historic and there are no historic or Section 4(f) resources in the project area.

### ***Archeological:***

The VTrans Archaeology Apprentice conducted a field visit on August 6th, 2019. The project area is located 300m east of the bottom tip of Lake Elmore on Route 12, just south of the start of Camp Road. A small unnamed stream runs westward through the culvert towards the lake. The two converge at the lake's southern tip. Archeologically sensitive areas sit outside the project Area of Potential Effect (APE) to the south of the culvert on two large level fields. It is recommended that these two areas be avoided during construction.

The areas of archaeological sensitivity have been plotted on the Existing Conditions Sheet.

### ***Stormwater:***

There are no stormwater concerns for this project.

## **II. Safety**

There have been no recorded crashes within the project area in the last five-year period.

## **III. Local Concerns**

A Local Concerns Questionnaire was completed by the Town of Elmore along with input from the Regional Planning Coordinator with the following findings:

- Four to Five residences are within 0.1 mile on VT Route 12 and Camp Road to Bridge 94. The culvert location is immediately adjacent to Camp Road with ANR Lake Access and seasonal and permanent residences along the eastern and southern shore of Lake Elmore. There are no suitable detour routes or local bypass routes available. VT Route 12 is the major morning and evening commuter road, including use by commercial vehicles and school busses.
- VT Route 12 through the project area is a summer bicycle tour route. This route is a renowned bicycle route for solo, group and tour rides, as well as occasional roller skiers particularly in spring, summer, and autumn. No suitable detour route for bicycles exists.
- Seasonal farm access to hay fields will be required, including large scale fertilizer vehicle traffic.

- There is an ANR Access area immediately adjacent to the project area.
- Bicycle and Pedestrian Traffic should be accommodated during construction.
- Approaches to construction site are somewhat blind as culvert is located in a depression obscured by knolls and a curve.

## IV. Alternatives Discussion

### No Action

This alternative is not recommended. The culvert is in approaching poor condition and will continue to deteriorate if no action is taken. There are holes up to 2-inches in the culvert invert which will continue to grow if no action is taken. Something will have to be done to improve this culvert in the near future. In the interest of safety to the traveling public, the No Action alternative is not recommended. No cost estimate has been provided for this alternative since there are no immediate costs.

### Structure Rehabilitation

Since the minimum hydraulic opening would be substandard for all options, and any rehabilitation will reduce the waterway area, it is assumed that an improved beveled inlet would be required for each option to optimize hydraulic performance and to funnel the stream into the culvert.

#### a. Invert Repair

This option involves removal of the degraded invert and pouring a 2-inch to 3-inch thick section of concrete in its place. Additionally, there would be repair of a number of large holes along the circumference of the pipe. This option would have the least impacts to the hydraulic capacity of the existing culvert. While this option is a good solution to the current degradation of the culvert invert, it adds little structural stability to the current structure, which has shown evidence of squashing.

#### b. Pipe Liner:

A pipe liner involves inserting a culvert liner into the existing culvert, and grouting between the two. The outside diameter of the pipe used for sliplining is generally specified to be at least 4 inches smaller than the inside diameter of the host pipe to allow the grout to be injected into the annular space between the two pipes. A greater reduction would be required at this site since the existing pipe has deformed at midspan. Therefore, type of liner chosen should have a minimum inner diameter of 72 inches. The reduced waterway would have a substandard bankfull width, but would still pass the design flood event with no roadway overtopping. A liner option is anticipated to have the longest life expectancy of the rehabilitation alternatives, since the grout provides an increased structural capacity, prevents liner collapse, prevents fatigue failure, stabilizes the pipe, extends the design life from uncertainty to at least 30 years, and resists temperature changes.

*Advantages:* The rehabilitation alternative would be the most cost-efficient option. It would have minimal impacts to resources and would not interrupt traffic.

*Disadvantages:* The rehabilitation alternative is only a repair and not a new structure. The life span of the repair work is estimated to be 15 to 30 years. Also, the existing culvert does not meet the hydraulic standard, and the rehabilitation option would have a smaller hydraulic opening. This option would not satisfy aquatic organism passage requirements without construction of several



weirs downstream. The existing substandard roadway width would remain unchanged for any culvert rehabilitation option.

*Maintenance of Traffic:* The rehabilitation alternative does not affect traffic. Traffic will remain open during the duration of the project.

This alternative involves the rehabilitation of the existing corrugated metal plate pipe.

Rehabilitation options considered:

- a: Invert Repair
- b: Pipe Liner
- c: Spray on Liner

All rehabilitation options would employ the use of hydro-blasting or hydro-demolition to appropriately clean the existing pipe interior prior to rehabilitation. In addition to cleaning, some grouting would be needed to plug holes in the pipe and fill all voids on the outside of the pipe. Curing in dry conditions would be required in most cases, necessitating a re-routing of the stream flow during the work and for a prescribed curing period (usually 24 hours). A headwall with beveled inlets as well as fish passage would be recommended for all rehabilitation alternatives.

a. Invert Repair

In many cases, invert repair is used to rehabilitate reinforced concrete pipe where the invert has eroded. Invert repair can be utilized on corrugated steel pipe, and typically consists of paving the invert or pouring a concrete invert. Much of the deterioration is located at the invert, making this a suitable repair for the culvert. This option involves removal of the degraded invert and pouring a 2-inch to 3-inch thick section of concrete in its place. Additionally, there may be repair of any holes along the circumference of the pipe. This option would have the least impacts to the hydraulic capacity of the existing culvert. While this option is a good solution to the current degradation of the culvert invert, it adds little structural stability to the current structure. There has been no evidence of crushing or squashing, and as such, additional structural capacity is not required.

b. Pipe Liner

A pipe liner involves inserting a culvert liner into the existing culvert and grouting between the two. Sliplining can be done using several different types of pipe material including corrugated steel, aluminum, reinforced concrete, and polyethylene, and can restore the structural integrity of the culvert. The outside diameter of the pipe used for sliplining is generally specified to be at least 4 inches smaller than the inside diameter of the host pipe to allow the grout to be injected into the annular space between the two pipes. A greater reduction would be required at this site since the existing pipe has deflected slightly. There is some deflection in the pipe, from the outlet heaving up over time. However, this deflection is minor, and a slip liner should be able to be pulled through. Additionally, the pipe was field measured to have a span of 5.5-feet and a height of 6.5-feet. Therefore, type of liner chosen should have a minimum inner diameter of 5-feet (60 inches). The reduced waterway would have a substandard bankfull width, but would still pass the design flood event with no roadway overtopping. A liner option is anticipated to have the longest life expectancy of the rehabilitation alternatives, since the grout provides an increased structural capacity, prevents liner collapse, prevents fatigue failure, stabilizes the

pipe, extends the design life from uncertainty to at least 30 years, and resists temperature changes.

### c. Spray-On Liners

Spray-On liners provide a new rigid interior surface for the pipe and use either cementitious materials (polymer-enhanced cement mortar) or polyurea. These liners are spray applied either by hand or machine, although some users have had better quality control with hand-applied methods. Cementitious liners installed by these methods can provide full structural support, depending on thickness applied. Proper curing is essential to using spray-on liners to avoid bond failures. There could be water quality impacts associated with the application of these liners, their degree of impact related to selection of materials, and adherence to curing requirements. If a spray-on liner is selected, the polymer-enhanced cement mortar is recommended for environmental and safety reasons. Temporary Right of Way would need to be acquired to provide a staging area at each end to accomplish this alternative.

*Advantages:* A repair alternative would address the ongoing deterioration issues with the invert of the existing culvert without affecting traffic flow, and with minimum upfront costs. The rehabilitation alternative would be the most cost-efficient option. It would have minimal impacts to surrounding resources. Additionally, the rehabilitation option meets the minimum hydraulic standard for waterway opening.

*Disadvantages:* The rehabilitation alternative is only a repair and not a new structure. The life span of the repair work is estimated to be 15 to 30 years. The existing culvert does not meet the minimum bank full width standard and this option would slightly reduce the bank full width. Aquatic Organism Passage and wildlife connectivity would not be improved for this option. It is assumed that for any rehabilitation alternative, temporary right-of-way will be necessary for the contractor's access to the ends of the culvert.

*Maintenance of Traffic:* The rehabilitation alternative has minimal effect on traffic. Traffic will remain open during the duration of the project, with the exception of intermittent lane closures for some construction activities.

## **Structure Replacement**

The preliminary hydraulics report suggests several possible configurations for a new structure, including a new precast box, an open bottom precast concrete arch or frame, or a new bridge with either vertical face abutments or integral abutments.

### **Structure Replacement Using Open Cut**

Culvert replacement using an open cut is considered a more cost-effective solution than trenchless methods when there is a shallow amount of fill over the culvert.

This option involves removing the existing Corrugated Galvanized Metal Plate Pipe and replacing it with a new precast structure having a waterway opening 11-feet wide and 6-feet high. Since there is approximately 10 feet of fill above the existing culvert, there would not be a considerable amount of earthwork. Any new structure should have flared wingwalls at the inlet and outlet to make a smooth transition between the channel and the culvert. The various considerations under this option include: the roadway width, structure type, culvert length and skew, and roadway alignment.

*a. Roadway Width*

The existing roadway currently has 11-foot-wide lanes and 4-foot-wide shoulders, which meets the minimum standard of 28-feet as set forth in the Vermont State Standards. Since a new 75+ year structure is being proposed, the roadway geometry should meet the minimum standards. A 30-foot width roadway will be proposed through the project area to match to existing conditions.

*b. Structure Type*

The most common structure type for the recommended hydraulic opening is a 4-sided concrete box culvert, or a 3-sided open bottom concrete structure.

It is preferred that the structure be a precast 4-sided concrete box culvert. This type of structure would provide protection against scour and undermining and would require less excavation than an open bottomed structure. Additionally, it would have a shorter construction duration compared to an open bottom structure, since footings would not have to be placed six feet below the stream bed. Based on available information from nearby wells, shallow ledge may be encountered. As such, a precast box may not be feasible without blasting. Borings should be requested early on in design process to determine the most appropriate structure type.

If an arch or frame is used, it should be founded either on bedrock or a minimum of 6-feet below the channel bottom. Additionally, full-depth headwalls should be installed.

*c. Culvert Size, Length and Skew*

The existing culvert has a span of 6 feet, which constricts the natural channel width. If a new structure is chosen Hydraulics has recommended a box with an 11-foot-wide and 10-foot-high inside opening, with 12-inch-high bed retention sills spaced no more than 8 feet apart. The top of the sills should be buried 3-feet with E-Stone, Type IV, resulting in a waterway opening with a rise of 6 feet. This culvert will have no roadway overtopping up and including the Q<sub>100</sub> design flow. In order to accommodate a 30-foot-wide roadway, the proposed barrel length will be approximately 75 feet long. The culvert will have a skew of 90 degrees to the roadway to match the existing skew of the channel.

*d. Roadway Alignment*

*Horizontal:* The existing horizontal alignment meets the minimum standards as set forth by the AASHTO Green Book. As such it is recommended that the horizontal alignment remains unchanged.

*Vertical:* The existing vertical alignment has a slightly substandard vertical sag curve per the minimum geometric standards as set forth in the Vermont State Standards. By slightly raising the curve, the vertical alignment can be improved, however, it will not meet the minimum standard.

*e. Maintenance of Traffic*

Either an off-site detour, phased construction, or a temporary bridge would be appropriate measures for traffic control at this site.

*Advantages:* This alternative would address the structural deficiencies of the existing bridge, with a brand-new culvert with a 75-year design life. This option would meet the minimum hydraulic

standards and provide adequate AOP as well as address on-going issues with debris blockage. This option would have minimal future maintenance costs.

*Disadvantages:* This option has the higher upfront costs compared to the rehabilitation options.

### **New Steel Pipe Culvert using Trenchless Technology**

This option would replace the existing culvert with a brand-new culvert installed next to the existing pipe. The new pipe would be installed using one of several trenchless technologies while traffic is maintained on the road above. While trenchless pipe methods would have minimal impact to traffic, the equipment and expertise for this size pipe may be unavailable or prohibitively expensive in Vermont. Trenchless techniques are generally more cost effective with 60-inch diameter pipes and smaller, with pipes being driven into favorable soil conditions. This alternative is costly, since an 11-foot span pipe is needed for hydraulics. Additionally, the preliminary geotechnical report has indicated that there are most likely boulders present, which could make trenchless technologies more costly. It is assumed that temporary Right of Way would be necessary for the jack-and-bore or pipe ramming equipment.

This option would not be favorable for wildlife or Aquatic Organism Passage. Due to the size of the required structure, trenchless methods are not being considered further.

*Advantages:* This solution would provide for a typical service life for culverts of at least 60 years, depending on material selection. Traffic would be maintained through the work area with minor impacts.

*Disadvantages:* The location of the culvert and a small length of the stream on each end would be slightly modified, to direct flow into both the new and existing pipe. This alternative has higher initial costs than pipe rehabilitation and slightly higher temporary impacts to resources.

*Maintenance of Traffic:* For this alternative, traffic would be maintained as normal flow through the work zone with minor impacts due to construction vehicles entering and leaving the site.

### **New Bridge**

This alternative would replace the existing culvert with a new integral abutment bridge at the existing location. The various considerations under this option include: the bridge width and length, skew, superstructure type and substructure type.

#### *a. Bridge Width*

The existing lane widths and shoulders on VT Route 12 over the culvert are 11-foot-wide and 4-foot-wide respectively; this exceeds the minimum standard of 28-feet as set forth in the Vermont State Standards. Since a new 75+ year bridge is being proposed, the bridge geometry should meet the minimum standards. A 30-foot rail-to-rail distance is proposed over the bridge.

#### *b. Bridge Length and Skew*

The existing culvert has a 6 foot span with little to no skew. The required bankfull width is 11 feet and the brook has little to no skew to the roadway. In order to meet the minimum bankfull width requirements, the bridge would have an approximate 35-foot span based on the layout procedures



for integral abutment bridges. If spread footings are preferred due to subsurface conditions, the bridge would have a span of approximately 20 feet.

*c. Superstructure Type*

If the bridge is closed during construction, a precast structure would be the preferred choice, due to decreased construction time. The possible 20-foot to 35-foot length bridge types that are most commonly used in Vermont are solid slabs, NEXT Beams, and steel beams with a composite concrete deck (Precast Bridge Units). If VT Route 12 through the project area is to remain open during construction, then a cast-in-place deck on steel beams or a cast-in-place solid slab would be recommended as these types of superstructures are more cost efficient than precast superstructure types. The superstructure depth is not critical for hydraulics; therefore, the beam depth is not a controlling factor in choosing a superstructure type.

*d. Substructure Type*

There were no boulders or bedrock outcroppings observed in the vicinity of the culvert. However, available information on nearby water wells indicates that bedrock may be encountered at a depth of 7 to 25 feet below finished grade. Borings should be taken at the project site, to determine if the subsurface is conducive for an integral abutment at this location. This type of substructure would provide the best scour protection. If it is determined that driving piles will be difficult, then the substructure should be reinforced concrete abutments on spread footings. Any rapid construction alternative should have sufficient subsurface information to verify the in-situ conditions. In order to reduce construction time, precast abutment components may be used where possible. The preliminary geotechnical report can be found in Appendix E.

*e. Maintenance of Traffic:*

Either a temporary bridge, phased construction, or an offsite detour could be utilized for traffic control.

## **V. Maintenance of Traffic**

The Vermont Agency of Transportation has created an Accelerated Bridge Program, which focuses on faster delivery of construction plans, permitting, and Right of Way, as well as faster construction of projects in the field. One practice that helps in this endeavor is closing bridges for portions of the construction period, rather than providing temporary bridges. In addition to saving money, the intention is to minimize the closure period with faster construction techniques and incentives to contractors to complete projects early. The Agency will consider the closure option on most projects where rapid reconstruction or rehabilitation is feasible. The use of prefabricated elements in new bridges will also expedite construction schedules. This can apply to decks, superstructures, and substructures. Accelerated Construction should provide enhanced safety for the workers and the travelling public while maintaining project quality. The following options have been considered:

## **Option 1: Off-Site Detour**

This option would close the bridge and reroute traffic onto an official, signed State detour. There are two detours that could be used if the bridge is closed during construction. The two potential State-signed detours are as follows:

1. VT Route 12, to VT Route 100, and US Route 2, back to VT Route 12 (61 miles end-to-end)
2. VT Route 12, to US Route 2, VT Route 14, and VT Route 15, back to VT Route 12, VT Route 100, and White Road, back to Knowles Flat Road (66 miles end-to-end)

There is a local bypass route that may see an increase in traffic from local passenger cars if VT Route 12 is closed during construction. Local bypass routes are not signed detours but may experience higher traffic volumes during a road closure. The most likely local bypass route is as follows:

Local Bypass 1. VT Route 12, to Elmore Pond Road, VT Route 15, School Street, East Elmore Road, Pleasant Valley Road, Symonds Mill Road, and Lacasse Road, back to VT Route 12 (12.9 miles end-to-end)

A map of the detour routes and possible local bypass route, which could see an increase in traffic, can be found in Appendix O.

*Advantages:* Utilizing an off-site detour would eliminate the need to use a temporary bridge or phase construction to maintain traffic. This would decrease the cost and amount of time required to construct a project in this location. The impacts and amount of temporary rights required to construct a project in this location would also be reduced for this option. The safety of both construction workers and the travelling public will be improved by removing traffic from the construction site. Impacts to wetlands and the need for additional Right-of-Way would be avoided.

*Disadvantages:* Traffic flow would not be maintained through the project corridor during construction.

## **Option 2: Phased Construction**

Phased construction is the maintenance of traffic on the existing bridge while building one lane at a time of the proposed structure. This allows keeping the road open during construction, while having minimal impacts to adjacent property owners and environmental resources.

While the time required to develop a phased construction project would remain the same, the time required to complete a phased construction project increases because some of the construction tasks have to be performed multiple times. In addition to the increased design and construction costs mentioned above, the costs also increase for phased construction because of the inconvenience of working around traffic and the effort involved in coordinating the joints between the phases. Another negative aspect of phased construction is the decreased safety of the workers and vehicular traffic, which is caused by increasing the proximity and extending the duration that workers and moving vehicles are operating in the same confined space. Phased construction is usually considered when the benefits include reduced impacts to resources and decreased costs and development time by not requiring the purchase of additional ROW.

Based on the current traffic volumes, it is acceptable to close one lane of traffic, and maintain one lane of traffic, both ways, with a traffic signal. There is approximately 10 feet of vertical fill over the existing culvert, which would need to be held back for phased construction. Impacts to wetlands and the need for additional Right-of-Way would be avoided.

### **Option 3: Temporary Bridge**

From a constructability standpoint, a temporary bridge could be placed either upstream or downstream of the existing structure. The culvert is located in a wooded area, and a temporary bridge on either side of the road would require tree clearing. On the downstream (western) side of the culvert, there are aerial utilities that would need to be relocated for a temporary bridge. Additionally, a temporary bridge on the downstream side would interfere with the intersection of Camp Road and VT Route 12. A temporary bridge on the upstream side would be in close proximity to a house on the eastern side of the road. There are large wetland areas located on both the upstream and downstream sides of VT Route 12. A temporary bridge on either side would have impacts to these wetlands. A temporary bridge on the upstream side would have limits outside the Right-of-Way. A temporary bridge on the downstream side could be constructed within the existing Right-of-Way on that side.

Additional costs would be incurred to construct a temporary bridge, including the cost of fill for the approaches and the bridge itself, installation and removal of the temporary bridges and approaches, restoration of the disturbed area, and the time and money associated with the temporary Right-of-Way.

If a temporary bridge is chosen as the preferred method of traffic control, it should be a two-way bridge to accommodate the traffic volumes along VT Route 12. See the Temporary Roadway Layout Sheet in the Appendix.

*Advantages:* Traffic flow can be maintained along the VT Route 12 corridor.

*Disadvantages:* An upstream temporary bridge would require additional Right-of-Way acquisition. This option would have adverse impacts to surrounding resources including wetlands. There would be decreased safety to the workers and to vehicular traffic, because of cars driving near the construction site, and construction vehicles entering and exiting the construction site. This traffic control option would be more costly, and time consuming than an offsite detour. The bridge is surrounded by wooded areas, both upstream and downstream. A number of trees would need to be cut down for this temporary condition.

## VI. Alternatives Summary

Based on the existing site conditions, culvert condition, and recommendations from hydraulics and others, the following alternatives are offered:

- Alternative 1: Culvert Rehabilitation with Traffic Maintained on Existing Culvert
  - a. Invert Repair
  - b. 60-inch Culvert Liner
  - c. Spray-On Culvert Liner
- Alternative 2a: New Precast Box Culvert or 3-Sided Structure (open cut) with Traffic Maintained on Offsite Detour
- Alternative 2b: New Precast Box Culvert or 3-Sided Structure (open cut) with Traffic Maintained with Phased Construction
- Alternative 2c: New Precast Box Culvert or 3-Sided Structure (open cut) with Traffic Maintained on a Temporary Roadway
- Alternative 3a: New integral abutment bridge with Traffic Maintained on Offsite Detour
- Alternative 3b: New integral abutment bridge with Traffic Maintained with Phased Construction
- Alternative 3c: New integral abutment bridge with Traffic Maintained on a Temporary Bridge

A cost evaluation for each of the alternatives is shown below.



**VII. Cost Matrix<sup>2</sup>**

Elmore BF 0241(55)		Do Nothing	Alternative 1			Alternative 2			Alternative 3		
			Culvert Rehabilitation			New Precast Box or 3-Sided Structure			New Integral Abutment Bridge		
			a. Invert Repair	b. 60-inch Culvert Liner	c. Spray-On Liner	a. Offsite Detour	b. Phased Construction	c. Temporary Bridge	a. Offsite Detour	b. Phased Construction	c. Temporary Bridge
COST	Bridge Cost	\$0	106,000	142,599	151,000	372,185	492,214	428,013	596,500	668,000	580,800
	Removal of Structure	\$0	45,000	45,000	45,000	45,000	51,750	45,000	12,150	13,973	12,150
	Roadway	\$0	63,400	81,190	73,850	183,341	303,085	210,842	197,000	299,000	208,000
	Maintenance of Traffic	\$0	29,040	29,040	29,040	199,300	359,100	279,040	174,300	296,600	254,040
	Construction Costs	\$0	243,440	297,829	298,890	799,825	1,206,149	962,894	979,950	1,277,573	1,054,990
	Construction Engineering & Contingencies	\$0	48,688	104,240	104,612	199,956	301,537	288,868	225,389	383,272	263,748
	Accelerated Premium	\$0	0	0	0	31,993	0	0	68,597	0	0
	Total Construction Costs w CEC	\$0	292,128	402,069	403,502	1,031,775	1,507,687	1,251,763	1,273,935	1,660,844	1,318,738
	Preliminary Engineering <sup>3</sup>	\$0	73,032	89,349	89,667	279,939	301,537	337,013	195,990	255,515	210,998
	Right of Way	\$0	0	0	0	0	0	0	0	0	0
	Total Project Costs	\$0	365,160	491,417	493,169	1,311,714	1,809,224	1,588,776	1,469,925	1,916,359	1,529,736
Annualized Costs	\$0	18,258	12,285	12,329	17,490	24,123	21,184	19,599	25,551	20,396	
TOWN SHARE		State owned asset: No Local Share									
TOWN %		State owned asset: No Local Share									
SCHEDULEING	Project Development Duration <sup>4</sup>	N/A	2 years	2 years	2 years	2 years	2 years	2 years	2 years	2 years	2 years
	Construction Duration	N/A	4 months	4 months	4 months	6 months	9 months	9 months	6 months	9 months	9 months
	Closure Duration (If Applicable)	N/A	N/A	N/A	N/A	7 days	N/A	N/A	30 days	N/A	N/A
ENGINEERING	Typical Section - Roadway (feet)	30	30	30	30	30	30	30	30	30	30
	Typical Section - Bridge (feet)	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'	4'-11'-11'-4'
	Geometric Design Criteria	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve	Substandard Vertical Sag Curve
	Traffic Safety	No Change	Improved	Improved	Improved	Improved	Improved	Improved	Improved	Improved	Improved
	Alignment Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Bicycle Access	No Change	No Change	No Change	No Change	Improved	Improved	Improved	Improved	Improved	Improved
	Pedestrian Access		No Change	No Change	No Change	Improved	Improved	Improved	Improved	Improved	Improved
	Hydraulics	Substandard BFW	Substandard BFW	Substandard BFW	Substandard BFW	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards
Utilities	No Change	No Change	No Change	No Change	No Change	No Change	Aerial Relocation	No Change	No Change	Aerial Relocation	
OTHER	ROW Acquisition	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Road Closure	No	No	No	No	Yes	No	No	Yes	No	No
	Design Life (years)	10	20	40	40	75	75	75	75	75	75

<sup>2</sup> Costs are estimates only, used for comparison purposes.

<sup>3</sup> Preliminary Engineering costs are estimated starting from the end of the Project Definition Phase.

<sup>4</sup> Project Development Durations are starting from the end of the Project Definition Phase.

## VIII. Conclusion

**Alternative 2b** is recommended; to replace the existing culvert with a new precast concrete box while maintaining traffic via phased construction.

### Structure:

The existing culvert is 60 years old and has reached the end of its anticipated design life. Additionally, the current culvert does not meet the minimum hydraulic standard for bank full width, which would become even more substandard if rehabilitated, further warranting a full replacement. Aquatic organism passage (AOP) is important for this location and can only be improved with the replacement options.

Due to the amount of fill over the existing culvert along with the required bank full width of a new structure, a new buried structure is more cost effective than a bridge.

The new culvert will be an 11-foot x 10-foot precast concrete box culvert, as per the VTrans Hydraulic Section's recommendation. The new precast box will have bed retention sills, to allow for a natural channel bottom to form, accommodating aquatic organism passage. Since the precast culvert will have a closed bottom, it will be protected from scour. In order to satisfy the AOP needs, the culvert invert should be buried 4-feet with E-Stone, Type IV placed along the length of the channel bottom through the culvert, resulting in a 6-foot-high waterway opening. The new culvert should have headwalls that extend four feet below the channel bottom at the inlet and the outlet to prevent undermining. This structure will have no roadway overtopping below the Q<sub>100</sub> storm event.

By choosing to replace the culvert, the width of the roadway through the project area can be widened slightly on each side to accommodate bicycle traffic, with 4-foot shoulders as per the Vermont State Standards. The new structure will provide a rail-to-rail roadway width of 30-feet, to meet the minimum standard typical section as set forth in the Vermont State Standards.

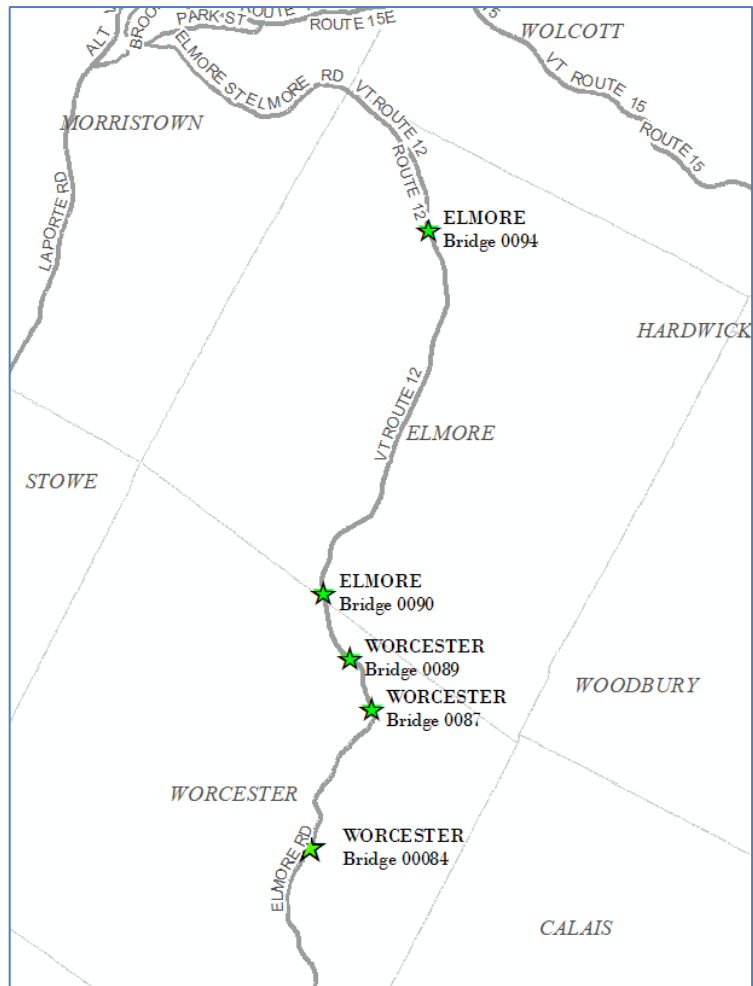
### Traffic Control:

The regional detour routes available have an end-to-end distance of approximately 60 miles, with no local bypass routes available. This distance is considered long for a detour route, and as such, traffic should be maintained through the project area. The recommended method of traffic control is to maintain traffic with phased construction. Phased construction is preferred over a temporary bridge since it will have less impacts to wetlands, Right-of-Way, and aerial utilities. An adequate width will be provided during construction to accommodate bicycles, pedestrians, and farm equipment.

*Coordination with other projects:*

There are several projects in the State Highway Bridge Program within the project area that are currently in the scoping phase of project development. The projects are as follows:

- ELMORE BF 0241(55) 19B212, VT Route 12, Bridge 94 over unnamed brook.
- ELMORE STP CULV(64) 18B003, VT Route 12, Bridge 90 over unnamed brook.
- WORCESTER BF 0241(56) 19B213, VT Route 12, Bridge 87 over Hardwood brook.
- WORCESTER BF 0241(57) 19B214, VT Route 12, Bridge 89 over North brook.
- WORCESTER BF 0241(59) 86E053, VT Route 12, Bridge 84 over the north branch of Winooski river



Consideration should be given to bundling these projects for design and/or construction.

## IX. Appendices

- Appendix A: Site Pictures
- Appendix B: Town Map
- Appendix C: Bridge Inspection Report
- Appendix D: Hydraulics Memo
- Appendix E: Preliminary Geotechnical Information
- Appendix F: Resource Identification Completion Memo
- Appendix G: Natural Resources Memo
- Appendix H: Archeology Memo
- Appendix I: Historic Memo
- Appendix J: Hazardous Sites Map
- Appendix K: Local Input
- Appendix L: Operations Input
- Appendix M: Crash Data
- Appendix N: Detour Map
- Appendix O: Plans

## **Appendix A: Site Pictures**





Picture 1: Looking North on VT Route 12 over Bridge 94



Picture 2: Looking South on VT Route 12 over Bridge 94





Picture 3: Culvert Outlet



Picture 4: Culvert Inlet





Picture 5: Culvert Barrel



Picture 6: Looking Downstream





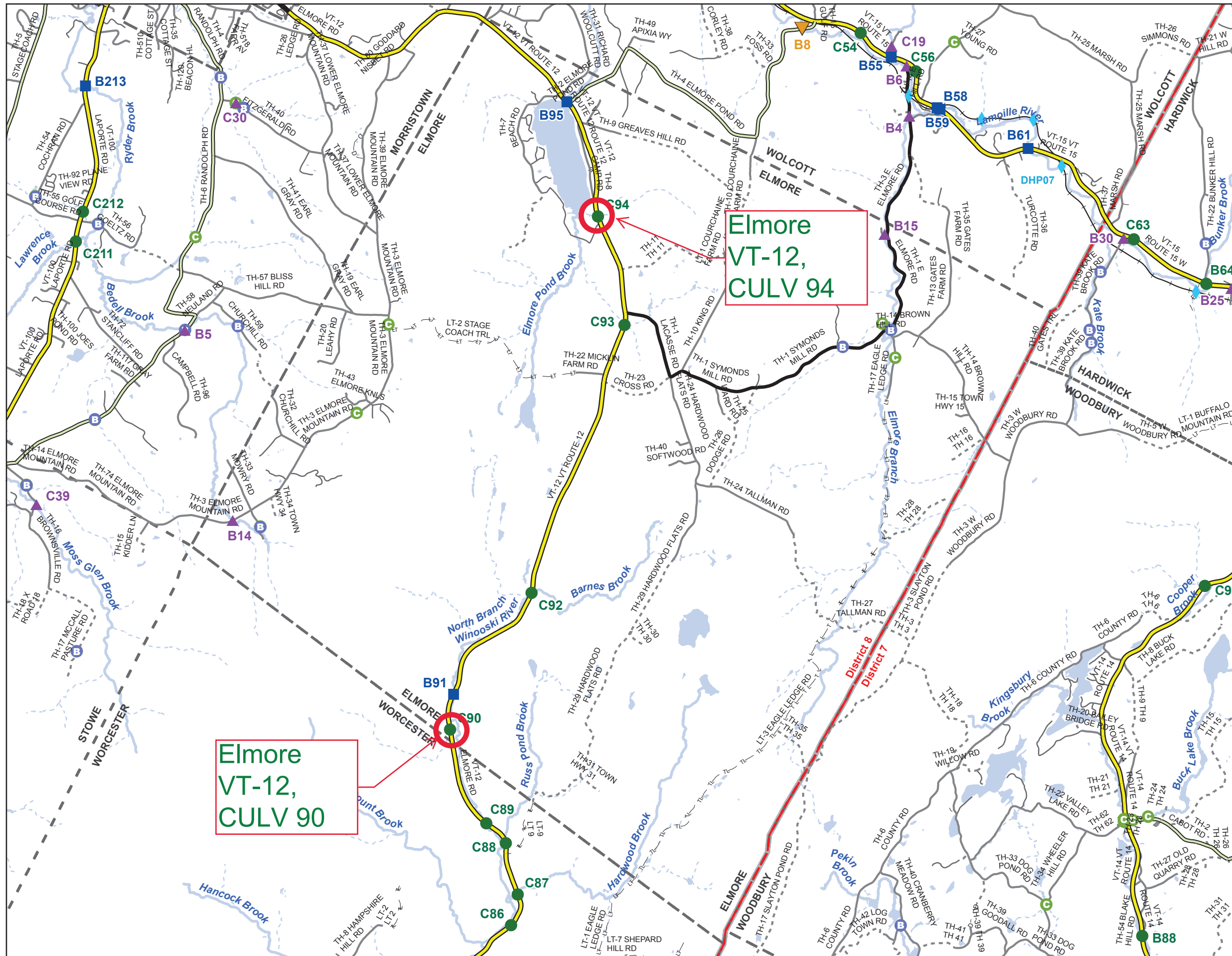
Picture 7: Scour Hole Above Bridge 94



Picture 8: Scour Along Banks

## Appendix B: Town Map

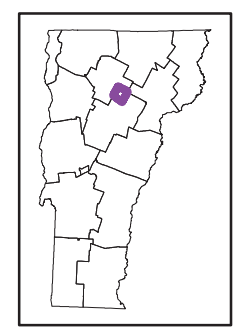




- Scale: 1:58,110
- ★ INTERSTATE
  - STATE LONG
  - STATE SHORT
  - ▲ TOWN LONG
  - ▲ FAS/FAU
  - ◆ BIKE PATH
  - INTERSTATE
  - STATE HIGHWAY
  - CLASS 1
  - CLASS 2
  - CLASS 3
  - CLASS 4
  - - - LEGAL TRAIL
  - - - PRIVATE
  - - - DISCONTINUED
  - FAS/FAU HWY
  - MAINTENANCE DISTRICT
  - POLITICAL BOUNDARY
  - VTRANS REGION BOUNDARY
  - NAMED RIVER-STREAM
  - - - UNNAMED RIVER-STREAM
  - Point from Local Bridge Data \*
  - Point from Local Culvert Data \*

\* Points are from local town bridge and culvert inventories. Some points may overlap where VTrans has also conducted an inventory on the Town highway.  
Data source: VOBGIT aka VTCulverts

Produced by:  
Mapping Section  
Division of Policy, Planning and  
Intermodal Development  
Vermont Agency of Transportation  
May 2017



**ELMORE**  
COUNTY-TOWN CODE: 0804-0  
LAMOILLE COUNTY  
DISTRICT # 8  
District Long Name: St. Albans District  
VTrans Four Region: Northwest

This map was funded in part through grants from the Federal Highway Administration, U.S. Department of Transportation. The representation of the authors expressed herein do not necessarily state or reflect those of the U. S. Department of Transportation.

## Appendix C: Bridge Inspection Report

**STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET**

Vermont Agency of Transportation ~ Structures Section ~ Bridge Management and Inspection Unit

Inspection Report for **ELMORE**

bridge no.: 0094

District: 8

Located on: VT12 over **BROOK**

approximately 5.6 MIS JCT VT 15A

Maintained By: STATE

**CONDITION**

Deck Rating: N NOT APPLICABLE  
Superstructure Rating: N NOT APPLICABLE  
Substructure Rating: N NOT APPLICABLE  
Channel Rating: 4 POOR  
Culvert Rating: 5 FAIR  
Federal Str. Number: 300241009408041

**AGE and SERVICE**

Year Built: 1959 Year Reconstructed: \_\_\_\_\_  
Type of Service On: 1 HIGHWAY  
Type of Service Under: 5 WATERWAY  
Lanes On the Structure: 02  
Lanes Under the Structure: 00  
Bypass, Detour Length (miles): 4  
ADT: 1200 Year of ADT: 1996

**GEOMETRIC DATA**

Length of Maximum Span (ft): 6  
Structure Length (ft): 6  
Lt Curb/Sidewalk Width (ft): 0  
Rt Curb/Sidewalk Width (ft): 0  
Bridge Rdwy Width Curb-to-Curb (ft): 0  
Deck Width Out-to-Out (ft): 0  
Appr. Roadway Width (ft): 32  
Skew: 0  
Bridge Median: 0 NO MEDIAN  
Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD  
Min Vertical Underclr (ft): 06 FT 00 IN

**STRUCTURE TYPE and MATERIALS**

Bridge Type: ACCGMPP  
Number of Main Spans: 1  
Kind of Material and/or Design: 3 STEEL  
Deck Structure Type: N NOT APPLICABLE  
Type of Wearing Surface: N NOT APPLICABLE  
Type of Membrane: N NOT APPLICABLE  
Deck Protection: N NOT APPLICABLE

**CULVERT GEOMETRIC DATA and INDICATORS**

Culvert Barrel Length (ft): 74  
Average Cover Over Culvert (ft): 10  
Waterway Area Through Culvert (sq.ft.): 28  
Wingwall/Headwall Rating: N NOT APPLICABLE

**APPRAISAL**

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

**INSPECTION**

Inspection Date: 112016 Inspection Frequency (months): 60

**INSPECTION SUMMARY and NEEDS**

11/23/2016 - Holes in the invert should be addressed soon with new invert before the culvert needs to be replaced. JAS  
09/29/11 Fair condition, random holes along invert up to 2" in diameter, Concrete invert or liner should be done. Inlet has heavy vegetation build up and stream should be ditched and realigned. Heavy erosion around pipe inlet. MJK & JM  
Culvert is in fair condition. There is scattered perforations throughout. Should consider repair or replacement in the near future. 08/01/06



## Appendix D: Hydraulics Memo

**State of Vermont  
Structures and Hydraulics Section**

One National Life Drive  
Montpelier, Vermont 05633-5001  
[vtrans.vermont.gov](http://vtrans.vermont.gov)

[phone] 802-371-7326  
[fax] 802-828-3566  
[ttd] 800-253-0191

*Agency of Transportation*

**TO:** Laura Stone, Structures, Scoping Engineer

**CC:** Nick Wark, Hydraulics Engineer

**FROM:** Jeff DeGraff, Hydraulics Project Engineer

**DATE:** March 9, 2020

**SUBJECT:** Elmore BF 0241(55) pin #19B212  
Elmore, VT-12 Br94, over Unnamed Brook  
Site location: MM 5.636  
Coordinates: [44.525437, -72.518091](#)

We have completed our hydraulic study for the above referenced site, and offer the following for your use:

On 12/11/19 we met with ANR at the site. In an email on 12/12/19 they indicated a minimum span of 11-feet should be used to span bankfull width (BFW).

Design Storm Flow is 2% AEP (Q50).

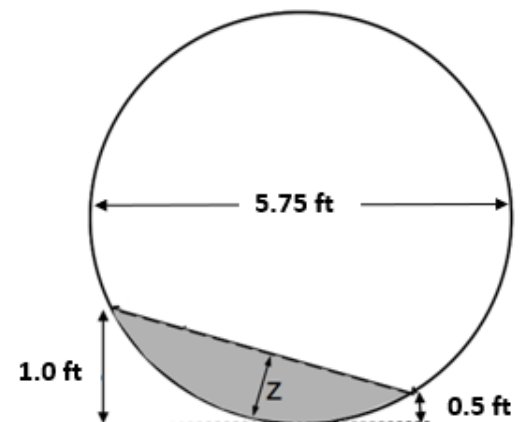
The following options were analyzed:

Existing Conditions: 6-ft Round ACCGMPP Culvert (Existing Conditions)

- Provides a Headwater to Depth ratio (HW/D) of 0.79 and 0.90 during the design and check storm event, respectively. Headwater depths of 4.74-ft and 5.41-ft were determined during the design and check storm event, respectively.
- The existing culvert meets the current hydraulic standards

Option 1: Rehabbed Existing Culvert (Lined w/ Fish Baffles)

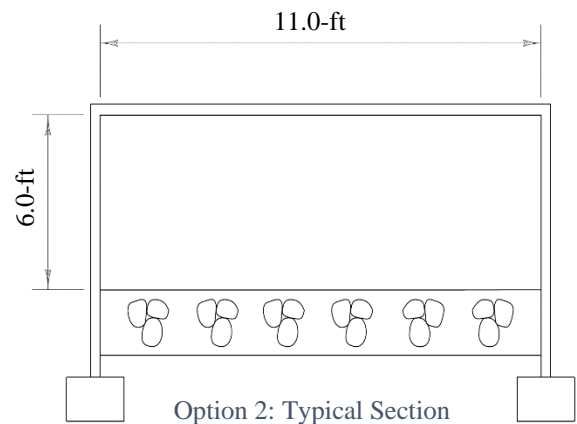
- This analysis assumed that the culvert is to be lined with a 1.5-inch thick liner which would provide a nominal diameter of 5.75-ft
- Assumes that a rock weir will be required.
- The analysis assumed that fish baffles to be installed at 7.5-ft spacing with minimum and maximum height of 0.5-feet and 1.0-feet, respectively (as seen in Option 1)
- The installation of fish baffles would allow for adequate fish passage for Adult Brook Trout
- The HW/D ratio would increase to 0.89 and 1.01 during the 2% and 1 % AEP, respectively. Headwater depths of 5.14-ft and 5.78-ft were determined during the design and check storm event, respectively.



Option 1: Typical Section

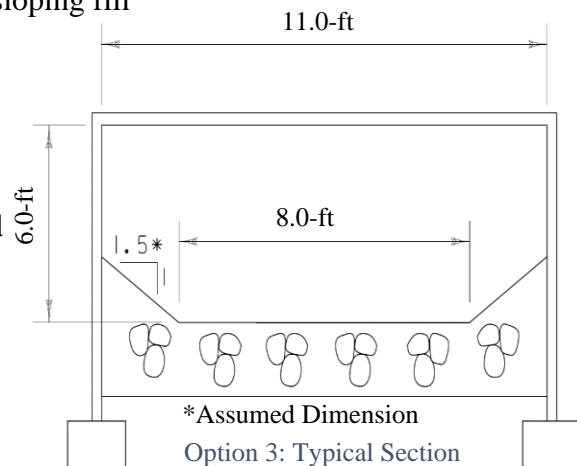
Option 2: Bridge (3-sided) 11-foot span x 6.0-foot clear height

- There is approximately 2.97-feet of freeboard at the design AEP providing a waterway area of 66.0 sq. ft.
- E-Stone, Type IV will need to be used to build the channel through this structure
- For estimating purposes only, the bottom of abutment footings should be at least 6 feet below the channel bottom, or to ledge
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew



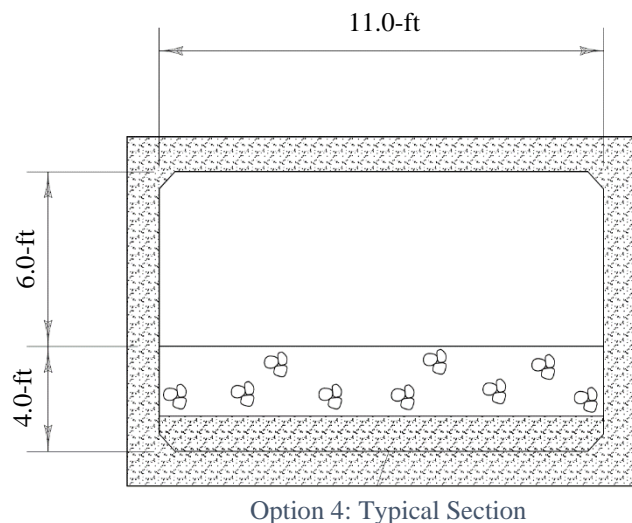
Option 3: Bridge (3-Sided) 11-foot span x 6.0-foot clear height w/sloping fill

- There is approximately 2.7-feet of freeboard at the design AEP, providing a minimum waterway area of 64.5 sq. ft ±.
- E-Stone, Type IV will need to be used to build the channel through this structure
- Stone Fill, Type IV shall be used to protect any disturbed channel banks or roadway slopes at the structure's inlet and outlet
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew



Option 4: Four-Sided Concrete Box (closed bottom) 11-foot span x 10-foot clear height

- There is approximately 2.97-feet of freeboard at the design AEP
- Structure invert is to be buried 4-feet and provide a minimum waterway opening of 11-foot span x 6-foot clear height with a waterway area of 66.0 sq. ft.
- E-Stone, Type IV will need to be used to build the channel through this structure
- Bed retention sills should be added in the bottom of the structure. Sills should be 12 inches high at the edges of the box and 6 inches high in the center, creating a V-shape across the full width of the box. Sills should be spaced no more than 8 feet apart throughout the structure with one sill placed at both the inlet and the outlet
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew



If the Existing crossing were to be spray lined and retrofitted with baffles (Option 1), fish passage standards may be met. However, the existing crossing currently prohibits sediment continuity and hinders channel equilibrium. For these reasons, a replacement in-kind option is not recommended. If Option 1 is the preferred option, further environmental coordination is recommended.

Options 2, 3 and 4 meet or surpass the current hydraulic standards, as well as minimum bankfull width criteria.

A preliminary scour analysis was performed as part of this study for Options 2 and 3 assuming a D50 of 5mm. A preliminary scour depth of 3.5-ft was calculated. For preliminary design assume that the bottom of footing elevation is 6-ft below the streambed or founded on ledge. With that said, a larger E-Stone may be needed to protect the outlet from scouring during the design and check event to adequately dissipate and/or mitigate excessive outlet velocities. Further analysis and stone sizing and/or energy dissipation design will be required during the final design phase of this project as the proposed crossing slope effects hydraulic characteristics. A final scour analysis will be performed during the final design phase.

Other similar sized structures could be considered for this site. If another alternative is considered, coordinate with the Hydraulics Unit to perform additionally analyses.

Please contact us with any questions, or to check substructure configuration scenarios.

## **Appendix E: Preliminary Geotechnical Information**

**To:** Nick Wark, P.E., P.I.I.T. Program Manager  
SPM CEE

**From:** Stephen Madden, Geotechnical Engineer, via Callie Ewald, P.E., Geotechnical Engineering Manager

**Date:** September 19<sup>th</sup>, 2019

**Subject:** Elmore BF 0241(55) Preliminary Geotechnical Information

---

## 1.0 INTRODUCTION

As requested, we have completed our preliminary geotechnical investigation of Bridge No. 94 on VT Route 12 over an unnamed brook in the Town of Elmore, VT. Bridge No. 94 is located approximately 5.6 miles south of the junction of VT Route 12 with VT Route 15A. The subject project consists of replacing or rehabilitating the existing corrugated galvanized metal plate pipe arch culvert. The project is currently in the scoping phase. This review included the examination of as-built record plans, historical in-house bridge boring files, water well logs and hazardous site information on-file at the Vermont Agency of Natural Resources (ANR), published surficial and bedrock geologic maps, and observations made during a site visit.

## 2.0 SUBSURFACE INFORMATION

### 2.1 Published Geologic Data

Mapping conducted in 1970 for the Surficial Geologic Map of Vermont shows that the project area consists of glacial till deposits (Doll, 1970).

According to the 2011 Bedrock Map of Vermont, published by the USGS and State of Vermont, the project site is underlain with amphibolite of the Stowe Formation, and is close to the boundary with phyllite of the Stowe Formation (Ratliffe, et. al, 2011).

The Geotechnical Engineering Section maintains a GIS based historical record of subsurface investigations, which contains electronic records for the majority of borings completed in the past 10 years. An exploration of this database revealed no nearby projects within a 0.5-mile radius of the project site.

### 2.2 Water Well Logs

The Vermont ANR documents and publishes all water wells that are drilled for residential or commercial purposes. Published online, these logs may provide general characteristics of the soil strata and depth to bedrock in the area. The three closest recorded water wells were WRN 84, TAG 53-247-94, and TAG 0811052692 located approximately 120 ft, 390 ft, and 410 ft from the project site, respectively. Bedrock was reported at a depth of 12 ft and 7 ft for wells WRN 84 and TAG 0811052692, respectively. Well TAG 53-247-94 did not report bedrock to a termination depth of 67 feet.

### 2.3 Hazardous Materials and Underground Storage Tanks

The ANR Natural Resource Atlas also maps the location and information of known hazardous waste sites and underground storage tanks. The location of this project is not on the Hazardous Site List. No underground storage tanks are located within a 1.0-mile radius and no impact from other hazardous waste sites is anticipated.

### 2.4 Record Plans

Record plans for the project, dated July 1958, were reviewed as part of this investigation. The plans included a layout and profile sheet however there was no information about the culvert design or installation and the plans did not include any subsurface information.

## 3.0 FIELD OBSERVATIONS

A preliminary site visit was conducted on September 12<sup>th</sup>, 2019 to identify possible obstructions inhibiting boring operations and to make any other pertinent observations about the project. Overhead utilities run parallel with VT Route 12 to the west of the roadway, visible in Figure 3.1, however given the distance of the utilities from the roadway we do not anticipate that they would interfere with boring operations. The streambed appeared to contain some amount of gravel and small cobbles however there were no boulders or bedrock outcroppings visible in the vicinity of the existing structure and the embankments appeared mostly vegetated, as seen in Figures 3.2 and 3.3.



**Figure 3.1:** Facing south along VT Route 12; note overhead utilities to west of roadway. These utilities are not anticipated to interfere with potential boring operations.





**Figure 3.2:** Facing downstream; note vegetated embankments adjacent to culvert outlet.



**Figure 3.3:** Facing culvert outlet; note sloping embankment that may preclude drilling from directly adjacent to culvert outlet.



## 4.0 RECOMMENDATIONS

### 4.1 Preliminary Foundation Alternatives

Based on the information reviewed during this investigation, if a new structure is chosen as the preferred alternative possible foundation options for a replacement structure include the following:

- Reinforced concrete box culvert with new headwalls and wingwalls
- Precast or steel arch bridge with spread footings founded on soil or bedrock

### 4.2 Proposed Subsurface Investigation

If a full replacement of the culvert is chosen as the preferred alternative we recommend a minimum of two borings be advanced, one each at the inlet and outlet of the culvert, in order to more fully assess the subsurface conditions at the site including, but not limited to, the soil properties, depth to and characteristics of bedrock, and groundwater conditions. If shallow bedrock is encountered during drilling operations, additional borings will likely be required to profile the bedrock elevation across the footprint of the proposed structure. Given the steep slope adjacent to the roadway on the inlet side of the culvert the Geotechnical Sections drilling equipment would likely be restricted to drilling from the roadway and borings would need to be advanced from within the travel lanes and shoulder of VT Route 12. On the outlet side, drilling locations may be similarly restricted by the steep slope however a boring could potentially be advanced at the top of the embankment up to approximately 5 feet behind the guardrail if necessary.

## 5.0 CLOSING

When a design alternative as well as a preliminary alignment has been chosen, the Geotechnical Engineering Section can assist in designing a subsurface investigation that efficiently gathers adequate information for the alternative chosen.

If you have any questions or would like to discuss this report, please contact us by phone at (802) 828-2561.

## 6.0 REFERENCES

Doll, C. G., 1970, Surficial Geologic Map of Vermont, Vermont Geological Survey, Montpelier, VT.

Ratcliffe, N. M., Stanley, R. S., Gale, M. H., Thompson, P. J., Walsh, G. J., 2011, Bedrock Geologic Map of Vermont, Vermont Geological Survey, Montpelier, VT.

Vermont Agency of Natural Resources Department of Environmental Conservation, Natural Resources Atlas, [www.anr.vermont.gov/maps/nr-atlas%20](http://www.anr.vermont.gov/maps/nr-atlas%20), accessed 9/17/2019.

cc: Laura Stone, P.E., P.I.I.T. Project Engineer  
Electronic Read File/MG  
Project File/CEE  
SPM

[Z:\Highways\CMB\GeotechEngineering\Projects\Elmore BF 0241\(55\)\REPORTS\Elmore BF 0241\(55\) Preliminary Geotechnical Information.docx](Z:\Highways\CMB\GeotechEngineering\Projects\Elmore BF 0241(55)\REPORTS\Elmore BF 0241(55) Preliminary Geotechnical Information.docx)

## **Appendix F: Resource Identification Completion Memo**



**OFFICE MEMORANDUM**  
AOT - PDB - ENVIRONMENTAL SECTION

**RESOURCE IDENTIFICATION COMPLETION MEMO**

**TO:** Laura Stone, Project Manager  
**FROM:** Jeff Ramsey, Environmental Specialist Supervisor  
**DATE:** 11/13/19  
**Project:** Elmore BF 0241 (55)

**ENVIRONMENTAL RESOURCES:**

Archaeological Site:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>See Archaeological Resource ID Memo</u>
Historic/Historic District:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>See Historic Resource ID Memo</u>
Wetlands:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>See Natural Resource Assessment Report</u>
Agricultural Land:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>See Natural Resource Assessment Report</u>
Fish & Wildlife Habitat:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>See Natural Resource Assessment Report</u>
Wildlife Habitat Connectivity:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>See Natural Resource Assessment Report</u>
Endangered Species:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>See Natural Resource Assessment Report</u>
Stormwater:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
6(f) Property:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Hazardous Waste/ ANR Urban Background Soils:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
USDA-Forest Service Lands:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Scenic Highway/ Byway:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Act 250 Permits:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>Permit Number 5L0885, Lynette A. Manning, construct a 12' x 24' fast food/creemee</u>
FEMA Floodplains:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Flood Hazard Area/ River Corridor:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>Mapped River Corridor, may require a FHARC Permit</u>
US Coast Guard:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Lakes and Ponds:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
303D List/ Class A Water/ Outstanding Resource Water:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Surface and Ground Water (SPA) Source Protection Area:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Groundwater Classification:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Public Water Sources/ Private Wells:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>There is a private well near the site, see Wells Map</u>
Other:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<u>Invasive Species, See Natural Resource Assessment Report</u>

cc:  
Project File

## **Appendix G: Natural Resources Memo**

**Natural Resources Assessment Report for  
Vermont Agency of Transportation  
Elmore BF 0241 (55)**

**Elmore, Vermont**

*Prepared by:  
Arrowwood Environmental, LLC*

*October 18, 2019*



**ARROWWOOD ENVIRONMENTAL**

950 BERT WHITE ROAD  
HUNTINGTON, VT 05462  
(802) 434-7276 FAX: (802) 329-2253

**Natural Resources Assessment Report for  
Vermont Agency of Transportation  
Elmore BF 0241 (55)**

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III. Wetlands .....	2
IV. Rare, Threatened and Endangered Species.....	3
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VII. Wildlife Habitat and Habitat Connectivity .....	6
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Appendices

- Appendix 1: Photo Log
- Appendix 2: Resource Map
- Appendix 3: Wetland Delineation Forms
- Appendix 4: Wetland Function and Value Forms
- Appendix 5: Plant Species List
- Appendix 6: Stream Summary Forms

# Natural Resources Assessment Report for Vermont Agency of Transportation Elmore BF 0241 (55)

## I. Introduction and Project Description

Arrowwood Environmental, LLC (AE) was retained by the Vermont Agency of Transportation to perform a natural resources assessment for the proposed Culvert #94 project between mile marker 5.7 and mile marker 5.6 along Route 12 in Elmore, Vermont. The study area for the assessment is shown on the Resource Map in Appendix 2.

The assessment consisted of a remote landscape analysis of the study area as well as a field assessment. The field assessment was conducted on September 16, 2019. This Natural Resource Assessment Report summarizes the results of the remote analysis and field assessment.

## II. Site Characterization

Ecologically the site is within the Northern Vermont Green Mountains biophysical region of the state (Thompson and Sorenson, 2000). The study area is located at approximately 1200 feet above mean sea level according to U.S. Geologic Survey (“USGS”) topographic data. The mapped bedrock that is underlying the site is amphibolite of the Stowe Formation. (Ratcliffe et al. 2011). The soils are mapped as Berkshire fine sandy loams (NRCS Soil Survey). The surrounding landscape is dominated by rural residential development.

Much of the study area consists of mowed roadside dominated by herbaceous vegetation such as wild carrot (*Daucus carota*), goldenrod (*Solidago spp.*) and clovers (*Trifolium spp.*). Two Alder Swamp wetlands are also present within the study area and are described in the wetlands section below.

## III. Wetlands

The wetland assessment involved both a remote review of available maps (including Vermont Significant Wetland Inventory Maps and the NRCS Soil Survey) and a field inventory component

conducted on September 16, 2019. The protocols put forth in the USACE's *Corp of Engineers Wetlands Delineation Manual* (2009 Regional Supplement for the Northcentral and Northeast Region) were employed for delineating wetlands as is the standard practice in Vermont. Two wetlands were mapped within the study area and shown on the Resource Map in Appendix 2. Wetland classifications have not been determined with the Vermont Wetlands Office, but since they are both contiguous with mapped Class 2 wetlands, both are presumed to be Class 2. Wetland delineation data forms and functions and values assessments for each of these wetlands are included in Appendices 3 and 4, respectively.

**Wetland A:** Wetland A is located on the western side of Route 12 and consists of an Alder Swamp natural community. This site is characterized by a dense shrub layer of speckled alder (*Alnus incana*). The portion of the wetland within the study area is currently being used as a pasture. The understory vegetation, therefore, is highly disturbed due to grazing activity. An unnamed stream runs through this wetland and flows into Lake Elmore.

**Wetland B:** Wetland B is located on the eastern side of Route 12 and is also an Alder Swamp natural community. The alder shrub vegetative layer is more variable, being dense in areas and sparser away from the stream. A diverse understory flora is present, dominated by long-leaved aster (*Symphotrichum lanceolatum*), sensitive fern (*Onoclea sensibilis*) and purple-stemmed aster (*S. puniceum*).

#### **IV. Rare, Threatened and Endangered Species**

The RTE species review involved both a remote review of available digital maps for the study area as well as a field survey. AE reviewed digital orthophotography, the NRCS Soil Survey, the 2011 Bedrock Geologic Map of Vermont and the Wildlife Natural Heritage Inventory (NHI) Rare, Threatened and Endangered Species digital database.

In reviewing the NHI digital database, there are no records or occurrences of RTE plant or animal species in or directly adjacent to the study area.



## **Plant Species**

An inventory for RTE and uncommon plant species was undertaken in the study area on September 16, 2019. No uncommon, rare, threatened or endangered species were documented during this inventory. A complete list of plants documented during that inventory is presented in Appendix 5.

## **Animal Species**

The Northern Long Eared Bat (*Myotis septentrionalis*, MYSE) became a federally listed endangered species in May of 2015. The State of Vermont has determined that project clearing greater than 1% of the total forested area within a 1 square mile radius of a project triggers greater review for habitat loss for this endangered species. Although the specific details of the proposed project at this location are unknown, it is located in an extensively forested environment with approximately 1300 acres of forest within a 1 mile radius. The Project would require more than 13 acres of clearing before reaching the 1% threshold triggering MYSE related restrictions or further review.

The study area was reviewed for the presence of trees that may provide potential summer roost habitat for MYSE. Trees with features that could support MYSE roosting were not documented during the field investigation.

No other RTE animal species are documented nearby or are expected to be impacted by the proposed project.

## **V. Non-Native Invasive Species (NNIS)**

A non-native invasive plant species is considered to be a species which has become established outside of its native range and grows aggressively enough to threaten native ecological communities. For the purposes of this study, a NNIS plant is any species listed as a Class A or Class B noxious weed by the Vermont Noxious Weed Quarantine Rule or a plant on the Vermont Invasive Exotic Plant Committee Watch List. An inventory for non-native invasive plant species was conducted on September 16, 2019.

Three different species of NNIS were documented within the study area. Each of these is shown on the Resource Map in Appendix 2 and briefly described below.

N-1 Purple Loosestrife (*Lythrum salicaria*): Five individuals of this Class B noxious weed were documented in Wetland B within the study area. This population occurs on the south side of the stream intermixed with native vegetation.

N-2 Japanese knotweed (*Fallopia japonica*): A dense population of this Class B noxious weed was documented on the east side of Route 12 in the steep road shoulder and along the banks of the unnamed stream which flows through Wetland B. On the steep road shoulder, the Japanese knotweed forms a dense, complete canopy and chokes out most other vegetation. Within Wetland B and along the stream, the knotweed occurs as small patches or scattered individuals. The population appears to continue east out of the study area.

N-3 Chervil (*Anthriscus sylvestris*): A small area colonized by this Watch List species was documented on the east side of Route 12 at the base of the road shoulder. The plants that were discovered were basal leaves only. Though no flowering or fruiting material was discovered, these plants may have gone to seed earlier in the season (typically June- early July). The area shown on the Resource Map in Appendix 2 contained approximately 10-20% cover of chervil.

## **VI. Streams**

The stream assessment involved both a remote review of the USGS topographic map, Vermont Hydrography Dataset (streams, rivers, and waterbodies), LiDAR derived elevation data, and field investigation on September 16, 2019. One stream was mapped in the study area and is summarized below. A stream data form is provided in Appendix 6.

Unnamed Tributary to Lake Elmore: The subject structure crosses an unnamed tributary to Lake Elmore. This stream flows through both the Alder Swamp wetlands described in the wetlands section above. The estimated channel bankfull width is approximately 8 feet wide and the substrate of this riffle pool system is predominately cobble. The streambanks appear to be stable on the eastern side of Route 12 but may be susceptible to erosion from overgrazing on the west side of the road.

## **VII. Wildlife Habitat and Habitat Connectivity**

The wildlife habitat assessment involved both a remote review of available digital maps for the study area and a field inventory component. A remote review of available digital databases was conducted to identify potentially necessary wildlife habitat within the study area and within the vicinity of the study area.

There are no mapped Vt. Fish and Wildlife deer winter habitats in the study area, and field investigation confirmed the absence of deer wintering areas within the study area. No other necessary or significant wildlife features or habitats were found during the course of field investigations.

Vt. Fish and Wildlife identifies the study area as a Highest Priority surface water and riparian area in the Vt. Conservation Design Community and Species Scale Components. The landscape adjacent to the stream west of the crossing structure is currently grazed by livestock but is still generally forest or shrub dominated alder swamp for a distance of at least 75' from the streambank. North and east of the crossing structure, the forested area narrows to 10-30' in width due to existing residential development. Residential development southeast of the structure is slightly further from the streambank, with approximately 30-40' of forested/shrub wetland area adjacent to the banks. This shrub/forest band on both sides of the structure is the only forested connectivity habitat within at least a mile and likely provides an important corridor for aquatic organism and mammal passage from the forest lands east of the structure to extensive forest, wetlands and Elmore Lake to the west of the structure. The current structure is undersized and does not provide a natural bed substrate to benefit aquatic organism passage, nor does it include bank features which would facilitate terrestrial connectivity. Structure design should consider the passage requirements of both aquatic and terrestrial species moving east/west within the riparian corridor.

Concentrated amphibian crossing areas occur when different amphibian habitat features are separated from each other by roads. Typical habitat features include wetland/vernal pool breeding habitats and upland habitats, or, in some cases, different wetland feeding habitats. Movement typically occurs on warm rainy nights in the spring and early summer. Depending on surrounding land-use and the position of the different habitat features, this amphibian movement can be concentrated and involve hundreds or thousands of individuals. When this concentrated movement

occurs across a busy road, mass mortality of amphibians can occur. While minor amphibian movement can occur scattered across the landscape, this movement rarely results in mass amphibian mortality or traffic difficulties. For this reason, it is the concentrated amphibian crossing areas that are of a concern.

Due to the grazing activity in Wetland A, amphibian habitat is likely negligible. Wetland B may offer some limited habitat for spring peepers (*Pseudacris crucifer*). However, given the nature of the wetland and surrounding landuse, this habitat is marginal, and no areas of concentrated amphibian movement are likely present.

Stream salamanders may also be present in the small tributary stream which flows through Wetlands A and B. Based on the habitats present, these species likely include northern dusky salamanders (*Desmognathus fuscus*) and northern two-lined salamanders (*Eurycea bislineata*). Unlike some of the species mentioned above, only limited movement occurs outside of the stream/seepage corridor and mass migrations do not likely occur. Since these species rarely cross roads, they do not pose a management concern as concentrated amphibian crossing areas. However, since they do migrate within the stream corridor, management for these species at road crossings is best achieved by adhering to the AOP Guidelines for culvert and bridge construction.

## **VIII. Agricultural Soils**

The agricultural soils assessment involved a remote review of the NRCS County Soil Survey for the Project area. Primary agricultural soils were identified in the Project area and presented on the Resource Map in Appendix 2. Primary soil types present include Berkshire (Statewide) and Potsdam (Prime) fine sandy loams. These soil types are both considered potentially highly erodible.

# **Appendix 1**

## **Photo Log**



Structure 94 Inlet  
September 16, 2019



Unnamed Tributary  
September 16, 2019





Wetland A  
September 16, 2019



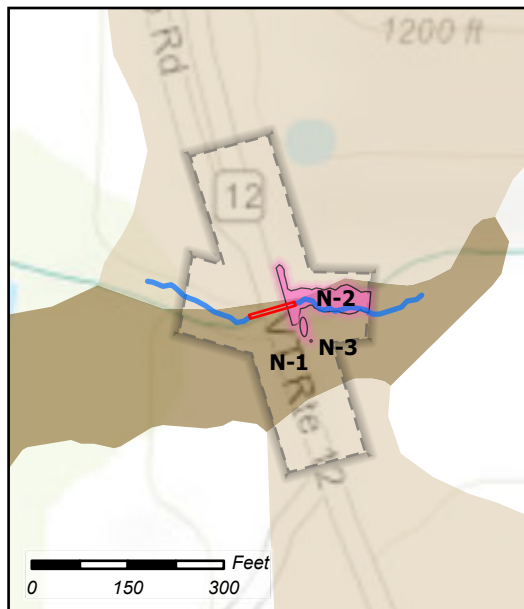
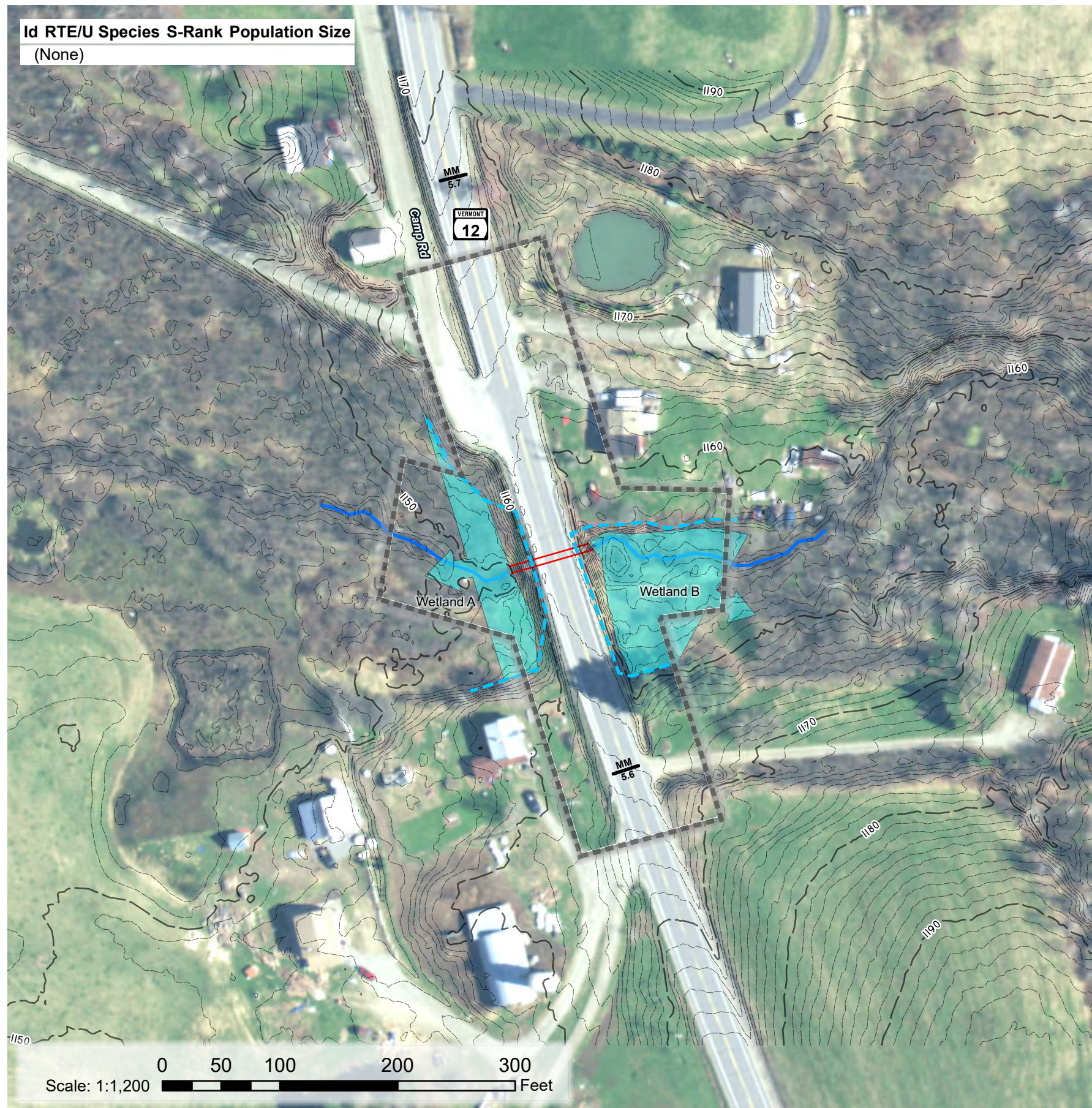
Wetland B  
September 16, 2019

# **Appendix 2**

## **Resource Map**



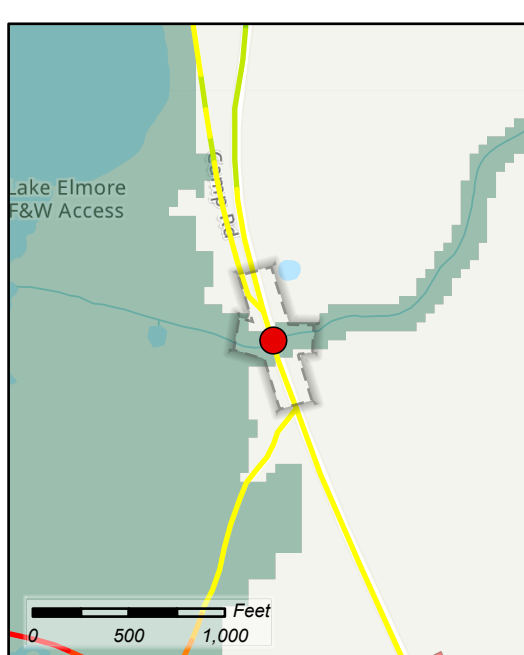
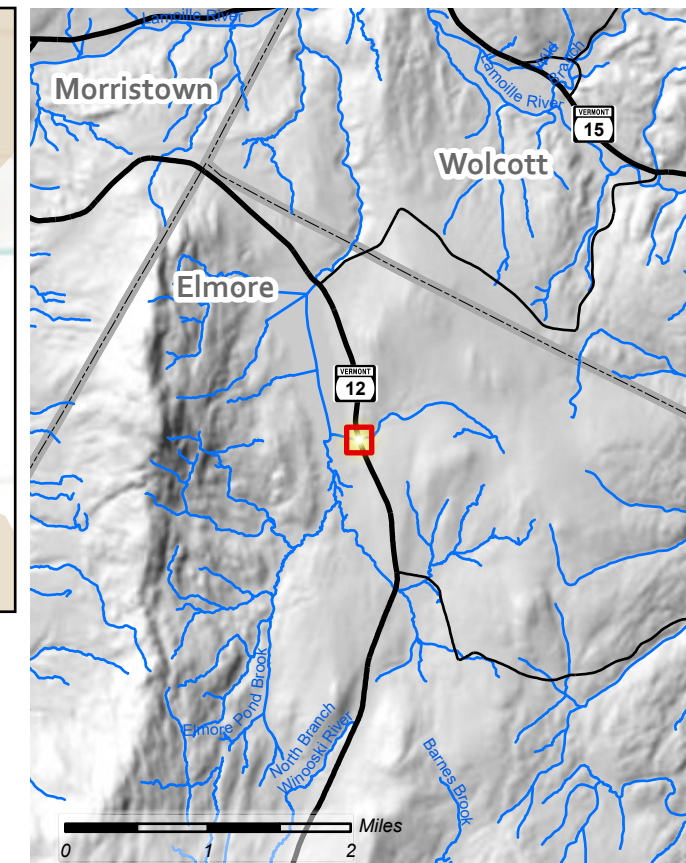
**Id RTE/U Species S-Rank Population Size**  
(None)



**Non-native Invasive Species (NNIS)** ●  
**Prime Ag Soils:**  **Statewide Ag Soils:**

**NNIS Populations at this Site**

NNIS ID	Species
N-1	Lythrum salicaria
N-2	Fallopia japonica
N-3	Anthriscus sylvestris



**Vt. Conservation Design Elements**

- Highest Priority Wildlife Crossings
- Highest Priority Surface Water and Riparian Areas
- Highest Priority Interior Forest Blocks

**Combined Linkage Ratings**  

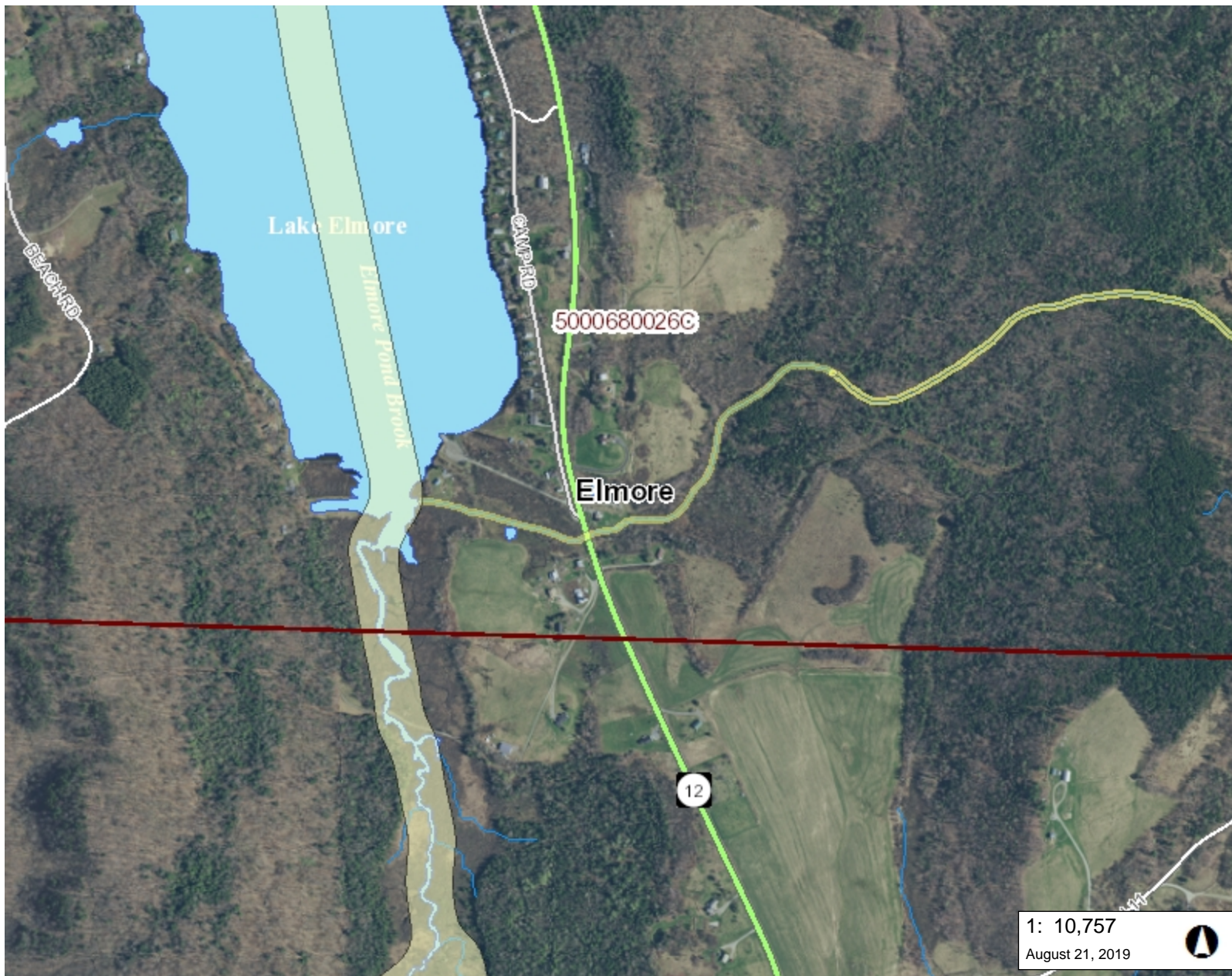
 ◀ not imp.    more imp. ▶

- Mile Markers (VCGI)
- Study Area
- Structures
- Wetlands
- Stream or Edge of Water
- Stream Top-of-Bank
- RTE Plant: S1
- Uncommon Plant: S3
- Potential Bat Tree

NOTES: INFORMATION PROVIDED BASED ON REMOTE AND FIELD ASSESSMENT BY ARROWWOOD ENVIRONMENTAL, 2019. WETLANDS FIELD DELINEATED, FLAGGED AND FLAGS LOCATED WITH SUB-METER GRADE GPS BY ARROWWOOD ENVIRONMENTAL. STREAMS, TOP-OF BANK, PLANT POPULATIONS, WILDLIFE FEATURES, AND STRUCTURE LOCATIONS FROM SUB-METER GRADE GPS, FIELDNOTES, AND ANALYSIS OF AERIAL IMAGERY AND HIGH-RESOLUTION LIDAR TOPOGRAPHIC DATA.

OTHER DATA FROM VCGI, VT AGENCY OF NATURAL RESOURCES. CONTOUR INTERVAL 1' DERIVED FROM LIDAR-BASED ELEVATION MODELS PROVIDED BY VCGI. MILE MARKERS FROM VCGI LAYER TITLED: "VT\_MILE\_POINTS\_110MILE". BACKGROUND IMAGERY- VCGI 2018.





**LEGEND**

- DFIRM X-Sections
- DFIRM - Letter of Map Revisio
- DFIRM Panels
- DFIRM Floodways
- Flood Hazard Areas (Only FEM)
  - AE (1-percent annual chance flood)
  - A (1-percent annual chance floodpl.)
  - AO (1-percent annual chance zone feet)
  - 0.2-percent annual chance flood ha
- River Corridors (Jan 2, 2015)
  - .5 - 2 sqmi.
  - .25-.5 sqmi.
- Roads
  - Interstate
  - Principal Arterial
  - Minor Arterial
  - Major Collector
  - Minor Collector
  - Local
  - Not part of function Classification S
- Waterbody
- Stream
- Town Boundary

1: 10,757  
August 21, 2019

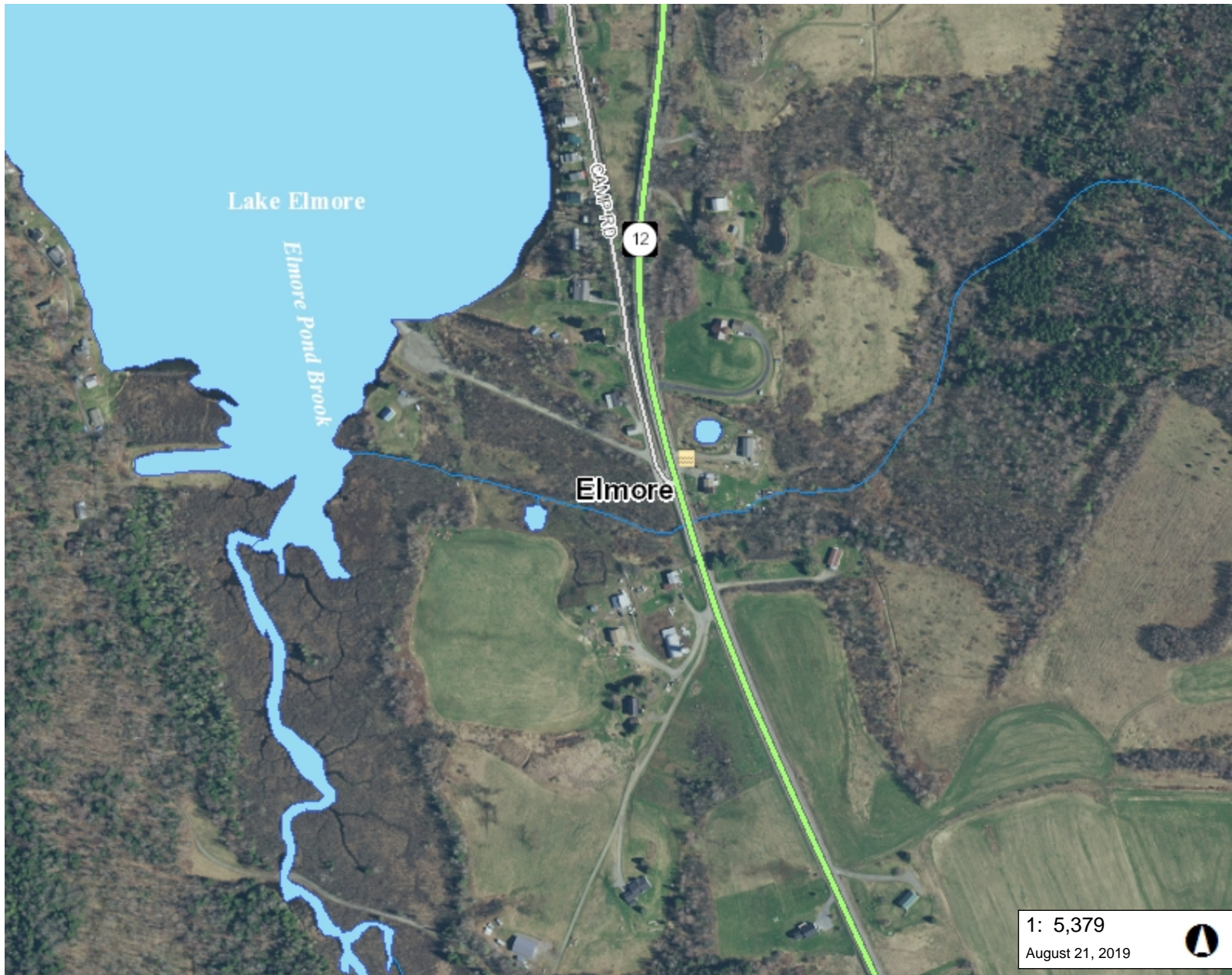


546.0 0 273.00 546.0 Meters  
WGS\_1984\_Web\_Mercator\_Auxiliary\_Sphere 1" = 896 Ft. 1cm = 108 Meters  
© Vermont Agency of Natural Resources THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

**NOTES**  
Map created using ANR's Natural Resources Atlas





### LEGEND

- 303(d) List of Impaired Stream
  - Designated ORW (Streams an
  - Prospective ORW (Streams an
  - Prospective ORW (Lakes and
  - Green Mountain National Fore
  - Act250 Permits **\*\*INCOMPLET**
- Roads**
- Interstate
  - Principal Arterial
  - Minor Arterial
  - Major Collector
  - Minor Collector
  - Local
  - Not part of function Classification S
- Waterbody
- Stream
- Town Boundary

1: 5,379  
August 21, 2019

### NOTES

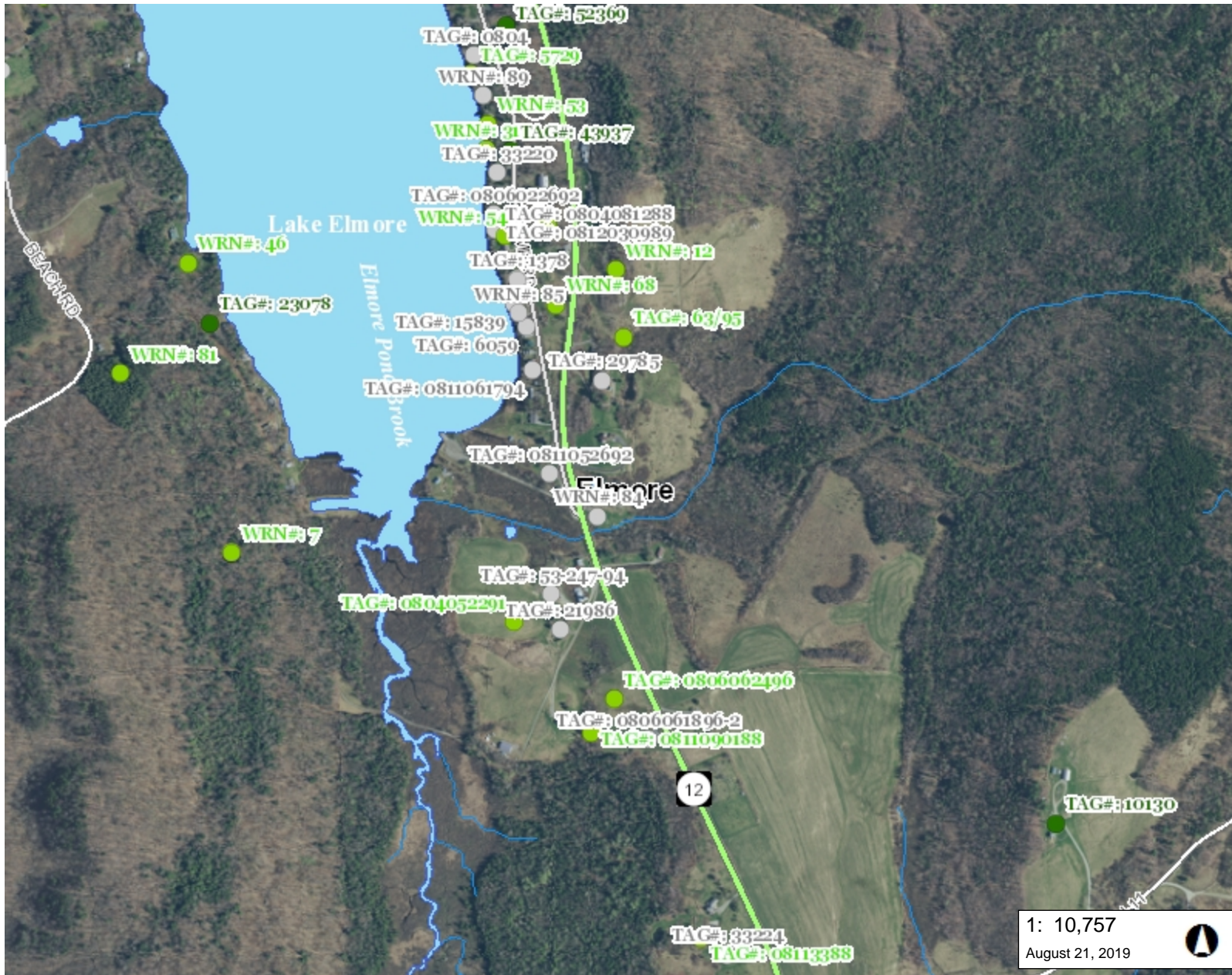
Map created using ANR's Natural Resources Atlas



WGS\_1984\_Web\_Mercator\_Auxiliary\_Sphere      1" = 448 Ft.      1cm = 54 Meters  
© Vermont Agency of Natural Resources      THIS MAP IS NOT TO BE USED FOR NAVIGATION

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### LEGEND

- Private Wells**
  - Incorrectly Located
  - GPS Located
  - Screen Digitized
  - E911 Address Matched
  - Welldriller/Clarion
  - Unknown Location Method
- Public Water Sources**
  - Active
  - Proposed
  - Inactive
- Surface Water SPA**
  - Active
  - Inactive
- Ground Water SPA**
  - Active
  - Proposed
  - Inactive
- Roads**
  - Interstate
  - Principal Arterial
  - Minor Arterial
  - Major Collector
  - Minor Collector
  - Local
  - Not part of function Classification S
- Waterbody**

### NOTES

Map created using ANR's Natural Resources Atlas

546.0 0 273.00 546.0 Meters  
 WGS\_1984\_Web\_Mercator\_Auxiliary\_Sphere 1" = 896 Ft. 1cm = 108 Meters  
 © Vermont Agency of Natural Resources THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

## Appendix H: Archeology Memo

**Jeannine Russell**  
**VTrans Archaeology Officer**  
**State of Vermont**  
**Environmental Section**  
One National Life Drive  
Montpelier, VT 05633-5001  
802-477-3460 phone  
[Jeannine.russell@vermont.gov](mailto:Jeannine.russell@vermont.gov)

*Agency of Transportation*

To: Jeff Ramsey, Environmental Specialist Supervisor

From: Jeannine Russell, VTrans Archaeology Officer via Timothy Quesnell, Archaeology Technical Apprentice II

Date: August 8<sup>th</sup>, 2019

Subject: Elmore BF 0241(55) – Archaeological Resource ID

VTrans proposes work on a bridge in the town of Elmore located along VT Route 12. The current scope and boundaries of the project are unknown. A circle with the bridge sitting at the center has been used for a stand in project area on the map provided. The VTrans Archaeology Apprentice was able to conduct a field visit on August 6<sup>th</sup>, 2019.

The project area is located 300m east of bottom tip of Lake Elmore on Route 12, just south of the start of Camp Road. A small unnamed stream runs westward through the culvert towards the lake. The two converge at the lake's southern tip. Archaeologically sensitive areas sit outside the project APE to the south of the culvert on two large level fields.

The area all along the west side of the culvert appears to be wetlands. Due to the presence of wetlands bordering the western side of the culvert, the areas on the western side are not archaeologically sensitive. Additionally, much of the area around the culvert appears disturbed. The land in the southwest, northeast quadrants appear significantly disturbed from residential activity, while the area in the northwest quadrant is a mix of wetland and a dirt road. The southeast quadrant appears comparatively less disturbed and has dense overgrowth.

Using the environmental predictive model, a score of 36 was found for the culvert area, marking it as sensitive. Additionally, the stream on the northern end of Lake Elmore does connect the lake to the Lamoille River, a known precontact travel corridor. However, the nearest precontact site is over 4 miles away from the culvert, and little has been found on the Lamoille at elevation where it connects to Lake Elmore. This in combination with the existing wetlands immediately adjacent to the culvert and the residential disturbance around the culvert, there is low archaeological sensitivity for the project APE.

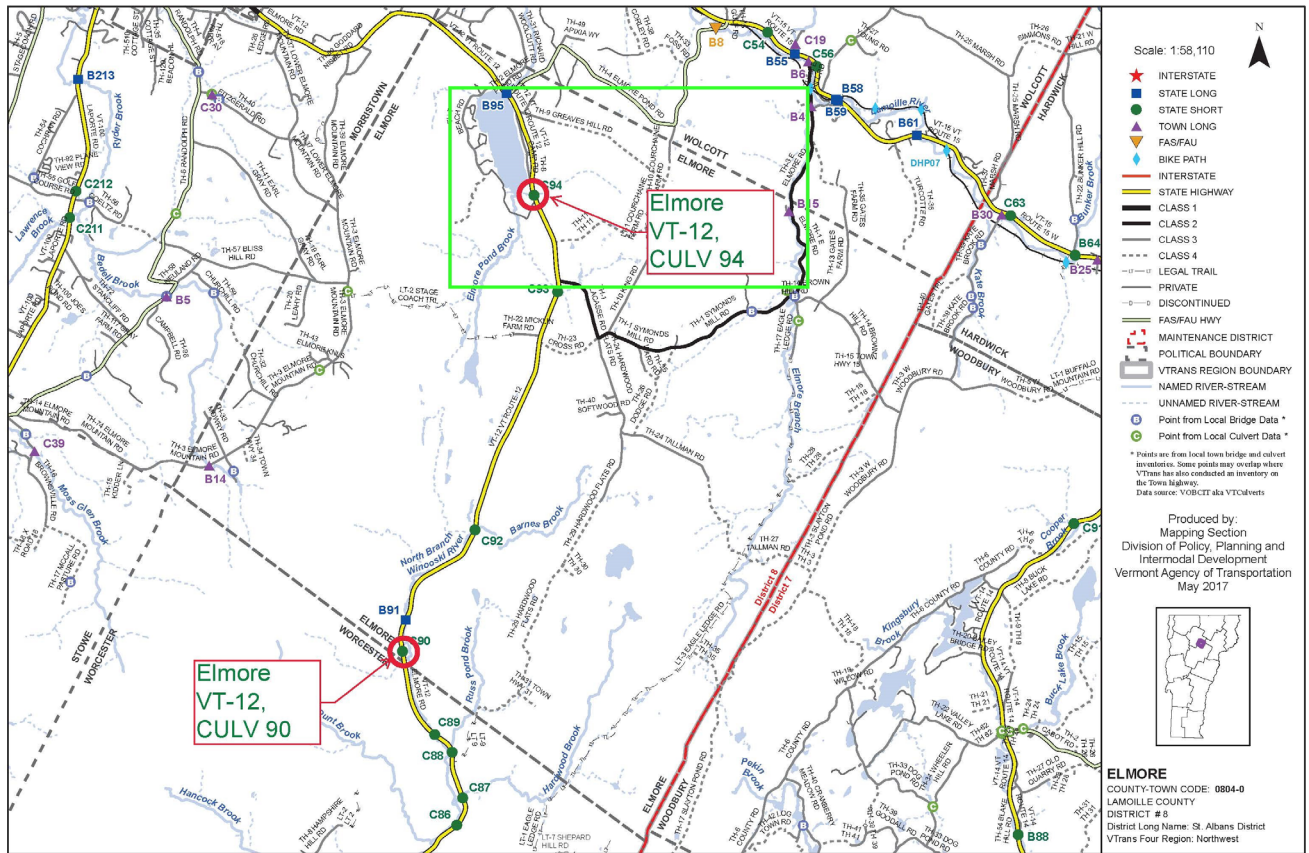
We recommend avoiding the two open fields marked as sensitive on the ARA map, south of the project area. This map and other images that provide context for the project area can be found below. Final clearance can be given after plans have been received.



Please let me know if you have any questions.  
Thank you,

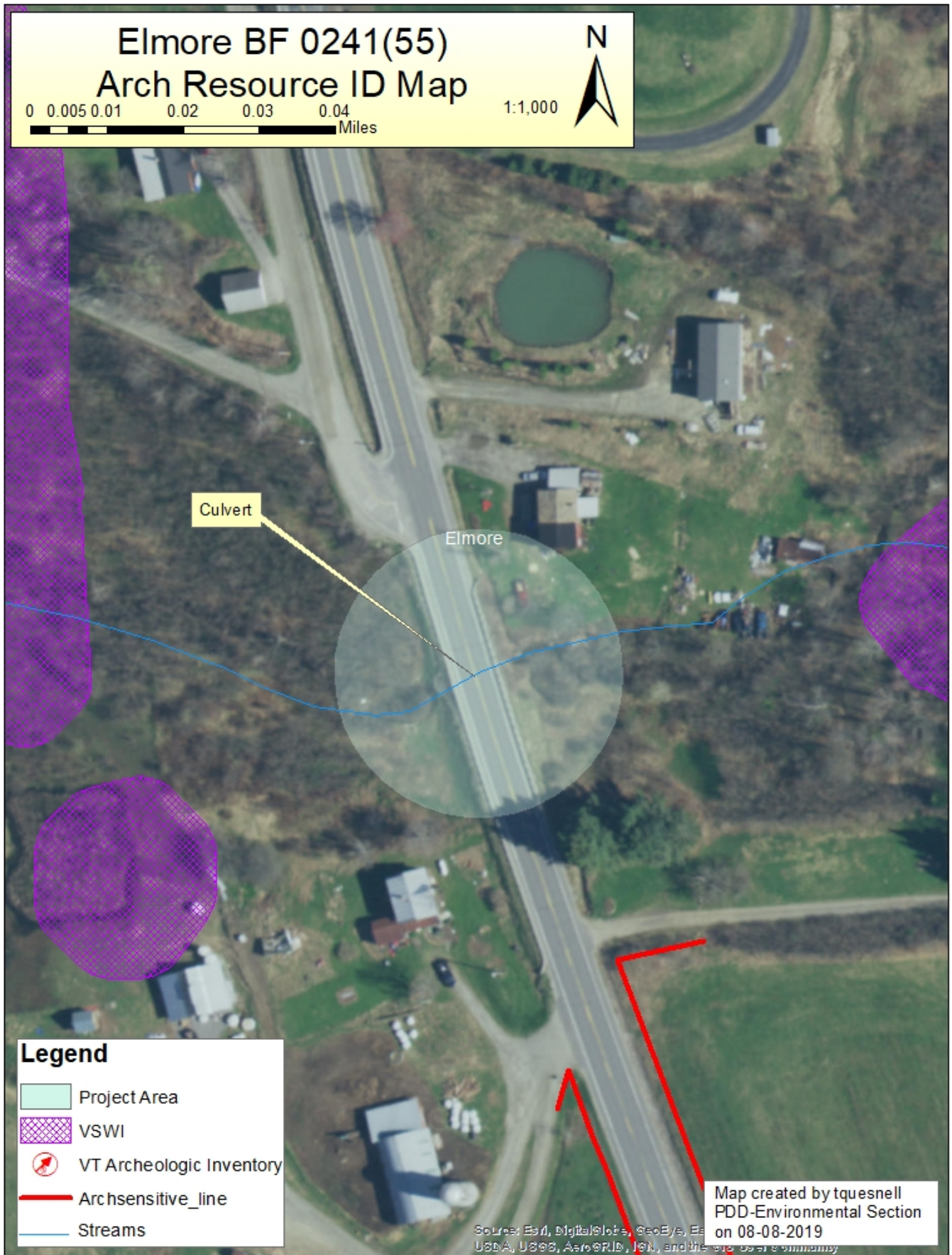
Jen Russell  
VTrans Archaeology Office

Figure 1: Project Location



This map was funded in part through grants from the Federal Highway Administration, U.S. Department of Transportation. The representation of the authors expressed herein do not necessarily state or reflect those of the U. S. Department of Transportation.

Figure 2: ARA map made using ArcMap





**Figure 3: Photo of culvert from west side of road**





**Figure 4: Aerial Image of four quads around culvert using Google Earth**



**Figure 5: Photo 1 of Northwest quadrant**





**Figure 6: Photo 2 of Northwest quadrant**



**Figure 7: Photo of Southwest quadrant**





**Figure 8: Photo of Southeast quadrant**



**Figure 9: Photo of Northeast quadrant**





## **Appendix I: Historic Memo**



State of Vermont

*Agency of Transportation*

Gabrielle Fernandez  
AOT Technical Apprentice IV  
Gabrielle.Fernandez@vermont.gov  
(802) 793-3738

**Project Delivery Bureau - Environmental Section**  
One National Life Drive  
Montpelier, VT 05633-5001  
vtrans.vermont.gov

## Historic Resources Identification Memo

To: Jeff Ramsey, AOT Environmental Specialist  
CC: Jeannine Russell, AOT Archaeology Officer  
Reviewer: Judith Ehrlich, AOT Historic Preservation Officer

Date: November 13, 2019

**Subject:** Elmore BF 0241(55) 19B212

Hello Jeff,

I have completed the Resource Identification for Elmore BF 0241(55). At this time, two resources over fifty years of age were identified within the possible project area: culvert 94 and a home at 2347 VT-12 in Elmore. No 4(f) resources were identified within the survey area.

This Resource Identification effort is being undertaken to provide information to the VTrans designers working on a proposed improvement project. Toward that end, VTrans Cultural Resources staff have identified potential resources within a broad preliminary Area of Potential Effect to ensure the designers are aware of all cultural resources that could possibly be affected by a project. Once the project is defined at the Conceptual Design phase, Cultural Resources staff will be able to determine a formal Area of Potential Effect for purposes of Section 106 and 22 VSA § 14.

This Resource ID is being undertaken to identify cultural resources within a survey area that could possibly be impacted by a VTrans project on culvert 94 in Elmore (Figure 1). Once the project has been formally developed at the Conceptual Design phase, VTrans Cultural Resources staff will be able to determine a formal Area of Potential Effect for purposes of Section 106 and Section 4(f) responsibilities.

Culvert 94 is a metal culvert over a small brook on VT 12 in Elmore (Figure 2). Built in 1959, this culvert meets the 50-year criteria for eligibility for the National Register. However, because of the condition of the culvert and the fact that it displays common materials, design, and construction, VTrans has determined that it is not historic as it does not possess any qualities of significance necessary for inclusion in the National Register of Historic Places individually or as a contributing resource to an existing or potential historic district under any applicable evaluation criteria.

An additional older resource was identified at 2347 VT-12 (Figure 3). This residence is a 1 ½ story vernacular mid-1800s structure that has been extensively altered. New roofing, door fenestration, window alignments and fenestration, and the building's footprint have been altered throughout the years. Because of these alterations, VTrans has determined that this building no longer retains enough integrity to be considered a historic resource as it does not possess any qualities of significance necessary for inclusion in the National Register of Historic Places individually or as a contributing resource to an existing or potential historic district under any applicable evaluation criteria.

Three other structures are within the survey area but are ineligible for consideration for the National Register. These structures are:

- A 1 ½ story modern cabin-inspired home on Draper Farm Road that is ineligible due to age.
- A two-story ranch and single-story outbuilding at 2299 VT-12 that are ineligible due to alterations and a lack of integrity.
- A single-story unoccupied mobile home on the property of 2299 VT-12 that is ineligible due to a lack of integrity.

Please do not hesitate to contact me should you have any questions.

Attachments:

- Map
- Photos

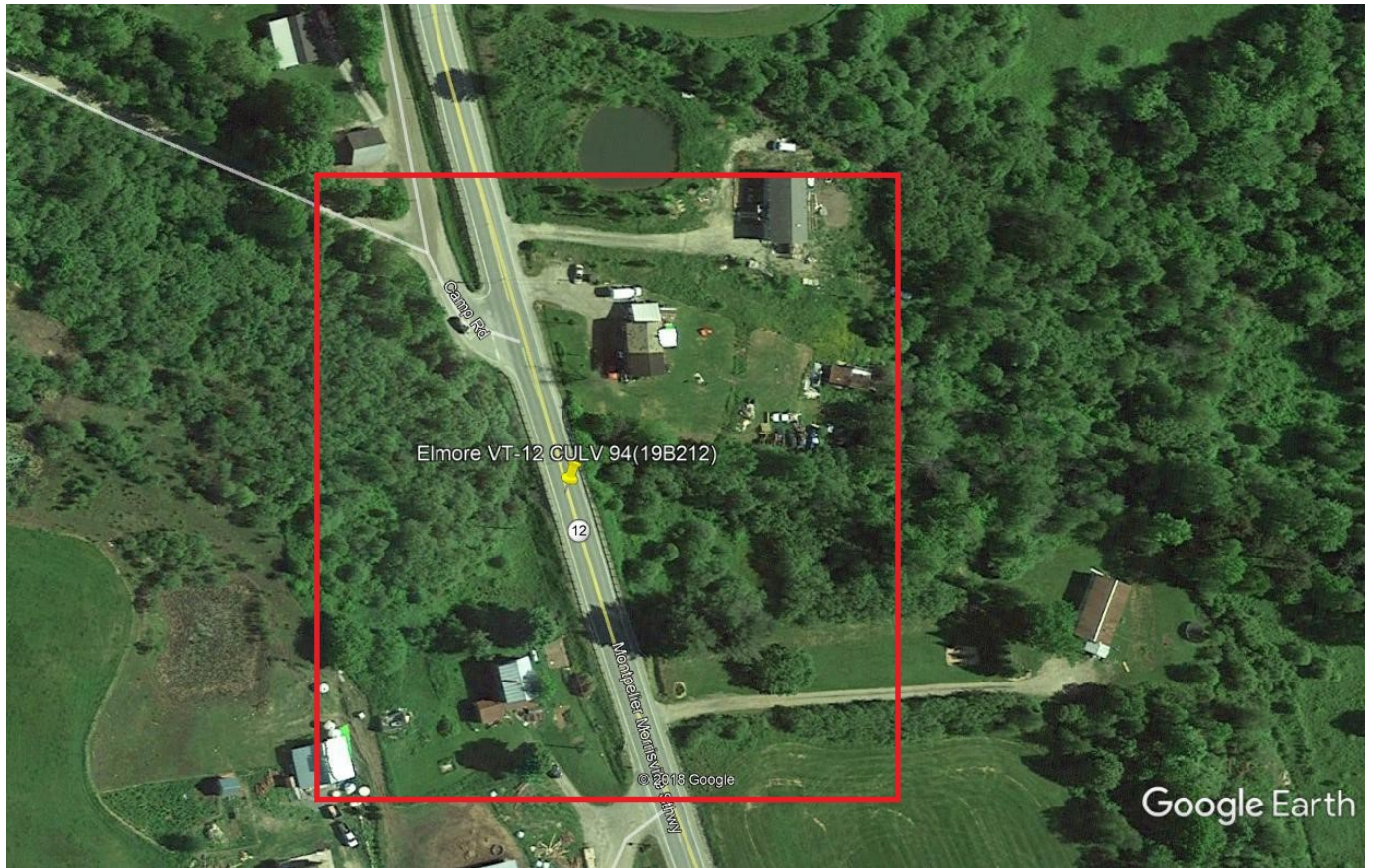


Figure 1: Approximate survey area for Elmore BF 0241(55).



Figure 2: Culvert 94 in Elmore.





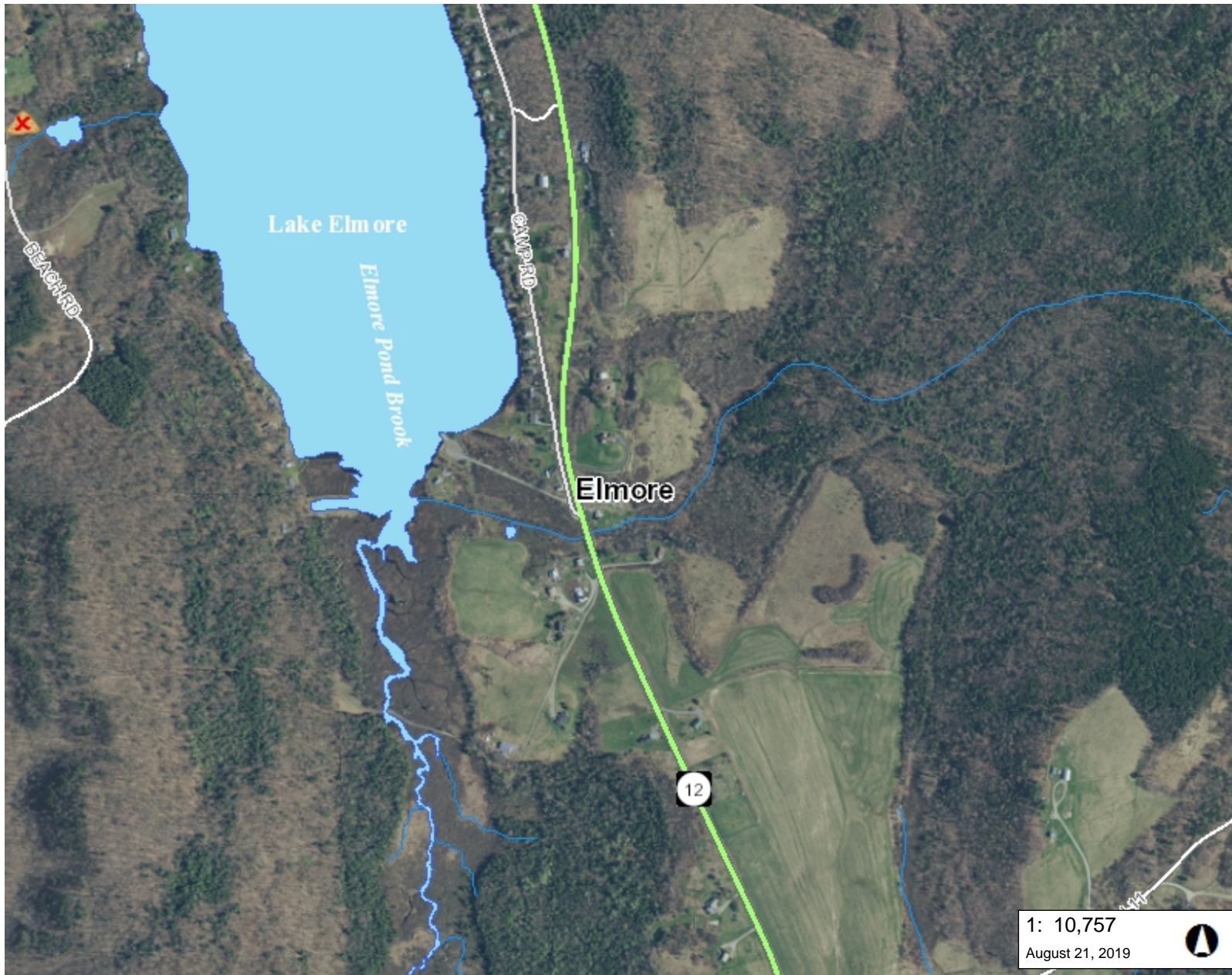
Figure 3: Google Maps view of 2347 VT-12 in Elmore. The ineligible 1 ½ story cabin on Draper Farm Road is visible in the background.



Figure 4: Google Maps view of the survey area and culvert 94 from the northern boundary. The left half of the image displays three buildings within the survey area that are determined to be ineligible for the National Register.

## Appendix J: Hazardous Sites Map





### LEGEND

- Landfills**
  - OPERATING (Brown triangle)
  - CLOSED (Red 'X' in triangle)
- Land Use Restrictions**
  - Class IV GW Reclass (Blue circle)
  - Class VI GW Reclass (Light blue circle)
  - Deed Restriction (Yellow circle)
  - Easement (Pink circle)
  - Land Record Notice (Brown circle)
  - Other (Grey circle)
- Hazardous Site** (Yellow diamond)
- Hazardous Waste Generators** (Red diamond)
- Brownfields** (Green square)
- Salvage Yard** (Green house icon)
- Aboveground Storage Tank** (Green circle)
- Underground Storage Tank (w/)** (Yellow circle)
- Dry Cleaner** (Green circle with 'X')
- Urban Soil Background Areas** (Blue square with grid)
- Roads**
  - Interstate (Red line)
  - Principal Arterial (Orange line)
  - Minor Arterial (Yellow line)
  - Major Collector (Green line)
  - Minor Collector (Grey line)
  - Local (Thin grey line)
  - Not part of function Classification S (Thin grey line)
- Waterbody** (Blue area)

1: 10,757  
August 21, 2019

### NOTES

Map created using ANR's Natural Resources Atlas

546.0 0 273.00 546.0 Meters

WGS\_1984\_Web\_Mercator\_Auxiliary\_Sphere 1" = 896 Ft. 1cm = 108 Meters

© Vermont Agency of Natural Resources THIS MAP IS NOT TO BE USED FOR NAVIGATION

**DISCLAIMER:** This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

## Appendix K: Local Input

## Local & Regional Input Questionnaire

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### Project Summary

This project, BF 0241(55), focuses on culvert 94 on VT Route 12 in Elmore, Vermont. The culvert is deteriorating and is in need of either a major maintenance action or replacement. Potential options being considered for this project include a new liner applied to the interior of the existing culvert pipe, removal of the existing pipe and replacement with a new culvert placed in the same location, or removal of the existing pipe and replacement in a new location. It is possible that VTrans will recommend a road closure and detour traffic away from the project site for the duration of the work. Efforts will be made to limit the detour to State roads.

### Community Considerations

1. Are there regularly scheduled public events in the community that will generate increased traffic (e.g. vehicular, bicycles and/or pedestrians), or may be difficult to stage if the culvert is closed during construction? Examples include annual bike races, festivals, parades, cultural events, weekly farmers market, concerts, etc. that could be impacted? If yes, please provide approximate date, location and event organizers' contact info.  
**No regularly scheduled events planned. Route 12 is THE major commuter (AM&PM), Commercial, School Bus and bicycle tour route (summer). No suitable detour exists. The culvert location is immediately adjacent to Camp Road with ANR Lake Access and seasonal and permanent residences along the eastern and southern shore of Lake Elmore**
2. Is there a "slow season" or period of time from May through October where traffic is less or no events are scheduled? **Spring, Summer and Autumn see highest transient traffic load. Commuter and Commercial traffic will be consistently steady all seasons.**
  - Please describe the location of the Town garage, emergency responders (fire, police, ambulance) and emergency response routes that might be affected by the closure of the culvert, one-way traffic, or lane closures and provide contact information (names, address, email addresses, and phone numbers. **Town Garage located at north shore of Lake Elmore (Beach Road). Emergency, Town, School Bus will require 24 hour width and load bearing passage.**
  - **Road Commissioner: Michel LaCasse W=802-888-5485; H=802-888-4330**
  - **Fire & Emergency Management: Brent Hosking 802-888-3448**
3. Are there businesses (including agricultural operations and industrial parks) or delivery services (fuel or goods) that would be adversely impacted either by a detour or due to work zone proximity? **4-5 residences are within 0.1 mile on Route 12 and Camp Road. Detours not possible. Seasonal farm access to hay fields will be required, including large scale fertilizer vehicle traffic.**

## Local & Regional Input Questionnaire

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4. Are there important public buildings (town hall, community center, senior center, library) or community facilities (recreational fields, town green, etc.) close to the project?

**No public buildings. ANR Access area immediately adjacent to construction area.**

5. What other municipal operations could be adversely affected by a road/culvert closure or detour? **Periodic highway and emergency equipment and activities.**
6. Are there any town highways that might be adversely impacted by traffic bypassing the construction on other local roads? Please indicate which roads may be affected and their condition (paved/unpaved, narrow, weight-limited structures, etc), including those that may be or go into other towns. **No bypass options available.**
7. Is there a local business association, chamber of commerce, regional development corporation, or other downtown group that we should be working with? If known, please provide name, organization, email, and phone number. **NO**
8. Are there any public transit services or stops that use the culvert or transit routes in the vicinity that may be affected if they become the detour route? **School Bus Route for Elmore**

### Schools

1. Where are the schools in your community and what are their yearly schedules (example: first week in September to third week in June)? **Last 1 room school located in village center, 1 mile north. Standard VT school schedule.**
2. Is this project on specific routes that school buses or students use to walk to and from school?  
**Bus = YES, pedestrian = NO**
3. Are there recreational facilities associated with the schools nearby (other than at the school)?  
**NO**

### Pedestrians and Bicyclists

1. What is the current level of bicycle and pedestrian use on the culvert? **Route 12 is a renowned bicycle route for solo, group and tour rides, occasional roller skiers particularly in spring, summer, autumn.**
2. Are the current lane and shoulder widths adequate for pedestrian and bicycle use? **Single file YES, abreast NO.**
3. Does the community feel there is a need for a sidewalk or bike lane on the culvert? Sidewalk **NO. Incorporate Complete Streets guidelines of min 9' travel and 3' shoulder.**
4. Is pedestrian and bicycle traffic heavy enough that it should be accommodated during construction? **YES**



## Local & Regional Input Questionnaire

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5. Does the Town have plans to construct either pedestrian or bicycle facilities leading up to the culvert? Please provide any planning documents demonstrating this (scoping study, master plan, corridor study, town or regional plan). **NO Plans.**
6. In the vicinity of the culvert, is there a land use pattern, existing generators of pedestrian and/or bicycle traffic, or zoning that will support development that is likely to lead to significant levels of walking and bicycling? **None currently existing or planned. Rural-Residential**

### Design Considerations

1. Are there any concerns with the alignment of the existing culvert? For example, if the culvert is located on a curve, has this created any problems that we should be aware of? **Approaches to construction site are somewhat blind as culvert is located in a depression obscured by knolls and a curve. One accident (drug related) has resulted in loss of life in this area.**
2. Are there any concerns with the width of the existing culvert? **NO**
3. Are there any special aesthetic considerations we should be aware of? **NO**
4. Does the location have a history of flooding? If yes, please explain. **NO flooding observed during 2019 "Halloween Storm" with 4" measured rainfall 24hrs.**
5. Are there any known Hazardous Material Sites near the project site? **NO**
6. Are there any known historic, archeological and/or other environmental resource issues near the project site? **None Known, No recent site assessment for H,A or E has been conducted.**
7. Are there any utilities (water, sewer, communications, power) attached to the existing culvert? Please provide any available documentation. **None Known**
8. Are there any existing, pending, or planned municipal utility projects (communications, lighting, drainage, water, wastewater, etc.) near the project that should be considered? **None Known**
9. Are there any other issues that are important for us to understand and consider? **Non known**

### Land Use & Zoning

1. Please provide a copy of your existing and future land use map or zoning map, if applicable. **Not applicable**
2. Are there any existing, pending or planned development proposal that would impact future transportation patterns near the culvert? If so, please explain. **None Known**



## Local & Regional Input Questionnaire

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3. Is there any planned expansion of public transit or intercity transit service in the project area?  
Please provide the name and contact information for the relevant public transit provider.  
**None Known**

### Communications

1. Please identify any local communication outlets that are available for us to use in communicating with the local population. Include weekly or daily newspapers, blogs, radio, public access TV, Facebook, Front Page Forum, etc. Also include any unconventional means such as local low-power FM. **WDEV, Front Porch Forum, News&Citizen, Stowe Reporter**
2. Other than people/organizations already referenced in this questionnaire, are there any others who should be kept in the loop as the project moves forward? **None Known**

**Appendix L: Operations Input**

## Culvert Scoping Project BF 0241(55) Operations Input Questionnaire

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The Structures Section has begun the scoping process for BF 0241(55), VT Route 12, Culvert 94, over an unnamed brook. This is an ACCGMPP constructed in 1959. The Structure Inspection, Inventory, and Appraisal Sheet (attached) rates the culvert as 5(fair), and the channel as 4 (poor). We are interested in hearing your thoughts regarding the items listed below. Leave it blank if you don't wish to comment on a particular item.

Commented [CM1]:

1. What are your thoughts on the general condition of this culvert and the general maintenance effort required to keep it in service?

Due to location, low difficulty and the fact that the stream bed needs work I recommend full replacement

2. What are your comments on the current geometry and alignment of the road over the culvert (curve, sag, banking, sight distance)?

Roadway should have more slope from north to the south as this area holds water

3. Do you feel that the posted speed limit is appropriate?

Yes

4. Is the current roadway width adequate for winter maintenance including snow plowing?

Yes

5. Are the railings constantly in need of repair or replacement? What type of railing works best for your district?

No the w beam that's in place works and is fairly new and in good condition

6. Are you aware of any unpermitted driveways within close proximity to the culvert? We frequently encounter driveways that prevent us from meeting railing and safety standards.

House on east side not sure about permit

There are no permits issued in this area, Mike.

7. Are you aware of abutting property owners that are likely to need special attention during the planning and construction phases? These could be people with disabilities, elderly, or simply folks who feel they have been unfairly treated in the past.

House on east side has been difficult in the past but nothing recently

8. Do you find that extra effort is required to keep the slopes and river banks around the culvert in a stable condition? Is there frequent flood damage that requires repair?

NO



**Culvert Scoping Project BF 0241(55)**  
**Operations Input Questionnaire**

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9. Does this culvert seem to catch an unusual amount of debris from the waterway?

No

10. Are you familiar with traffic volumes in the area of this project?

Low

11. Do you think a closure with off-site detour and accelerated construction would be appropriate?

Do you have any opinion about a possible detour route, assuming that we use State route for State projects and any route for Town projects? Are there locations on a potential detour that are already congested that we should consider avoiding?

I think it can easily be done while maintaining one-way traffic

12. Please describe any larger projects that you have completed that may not be reflected on the attached Appraisal sheet, such as deck patches, paving patches, railing replacement with new type, steel coating, etc.

none

13. Are there any drainage issues that we should address on this project?

Roadway holds water due to low spot on north east end

14. Are you aware of any complaints that the public has about issues that we can address on this project?

No

15. Is there anything else we should be aware of?

A small town road called camp road comes onto rt 12 just north of this culvert and may be impacted by work in this area but this road runs alongside of route 12 with the other end also coming onto rt 12 only a mile or so further north. I think the south end could be closed to allow more room and reduce confusion in the work area.

## Appendix M: Crash Data

## General Yearly Summaries - Crash Listing: State Highways and All Federal Aid Highway Systems

WHERE Year of Crash &gt;= 2012 AND Year of Crash &lt;= 2016

* Reporting Agency/ Incident No.	City/Town	Mile Marker	Crash Date	Time	Weather	Contributing Circumstances	Direction of Collision	Number Of Injuries	Number Of Fatalities	Number Of Untimely Deaths	Direction	Road Group
VTVSP1200/13A303188	Worcester	2.39	08/04/2013	12:43	Clear	Failed to yield right of way, No improper driving	Left Turn and Thru, Angle Broadside -->v--	1	0	0	N, S	SH Owned
VTVSP1200/16A304476	Worcester	2.68	10/18/2016	10:20	Clear	Driving too fast for conditions	Single Vehicle Crash	1	0	0	S	SH State Owned
VTVSP1200/15A305585	Worcester	2.87	11/19/2015	14:17	Rain	Fatigued, asleep, Failure to keep in proper lane	Single Vehicle Crash	0	0	0	S	SH
VTVSP1200/15A301256	Worcester	2.99	03/15/2015	11:45	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP1200/13A304653	Worcester	3.16	11/05/2013	07:19	Cloudy	Failure to keep in proper lane, Inattention	Single Vehicle Crash	0	0	0	S	SH
VTVSP1200/15A305109	Worcester	3.87	10/18/2015	20:07	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP1200/16A305468	Worcester	6.20	12/16/2016	06:30	Clear	Driving too fast for conditions, Under the influence of medication/drugs/alcohol, No improper driving	Head On	2	0	0	S, N	SH State Owned
VTVSP1200/16A305156	Worcester	6.23	11/29/2016	07:36	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP1200/12A302163	Worcester	6.73	05/25/2012	18:00	Clear	Failure to keep in proper lane	Single Vehicle Crash	1	0	0	N	SH
VTVSP1200/12A301994	Worcester	UNK	05/14/2012	07:25	Rain	Other improper action	Rear End	2	0	0	N	SH
VTVSP1200/13A300873	Worcester	UNK	02/27/2013	21:00	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP1200/13A301934	Worcester	UNK	05/16/2013	20:50	Cloudy	No improper driving	Single Vehicle Crash	2	0	0	S	SH
VTVSP1200/14A301410	Worcester	UNK	03/30/2014	01:00	Sleet, Hail (Freezing Rain or Drizzle)	Fatigued, asleep, Failure to keep in proper lane	Single Vehicle Crash	1	0	0	N	SH
VTVSP0100/16A101604	Elmore	1.79	04/02/2016	21:51	Cloudy	Under the influence of medication/drugs/alcohol, Exceeded authorized speed limit	Single Vehicle Crash	1	0	0	S	SH State Owned
VTVSP0100/12A103503	Elmore	3.52	09/08/2012	19:12	Rain	Under the influence of medication/drugs/alcohol	Single Vehicle Crash	1	0	0	N	SH
VTVSP0100/14A105918	Elmore	4.65	12/26/2014	14:38	Clear	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway etc, No improper driving	Same Direction Sideswipe	0	0	0	N	SH
VTVSP0100/15A100413	Elmore	4.66	01/25/2015	07:06	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP0100/16A106536	Elmore	4.66	12/22/2016	21:50	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP0100/16A103497	Elmore	4.90	07/14/2016	13:26	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP0100/16A106388	Elmore	4.96	12/15/2016	17:39	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP0100/15A100804	Elmore	5.07	02/11/2015	10:27	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP0100/15A105765	Elmore	5.11	11/10/2015	17:40	Cloudy	No improper driving	Single Vehicle Crash	0	0	0	N	SH

\*Crash occurred prior to the last Highway Improvement Project. This data should not be used in a crash analysis. UNK indicates Mile Marker is Unknown.



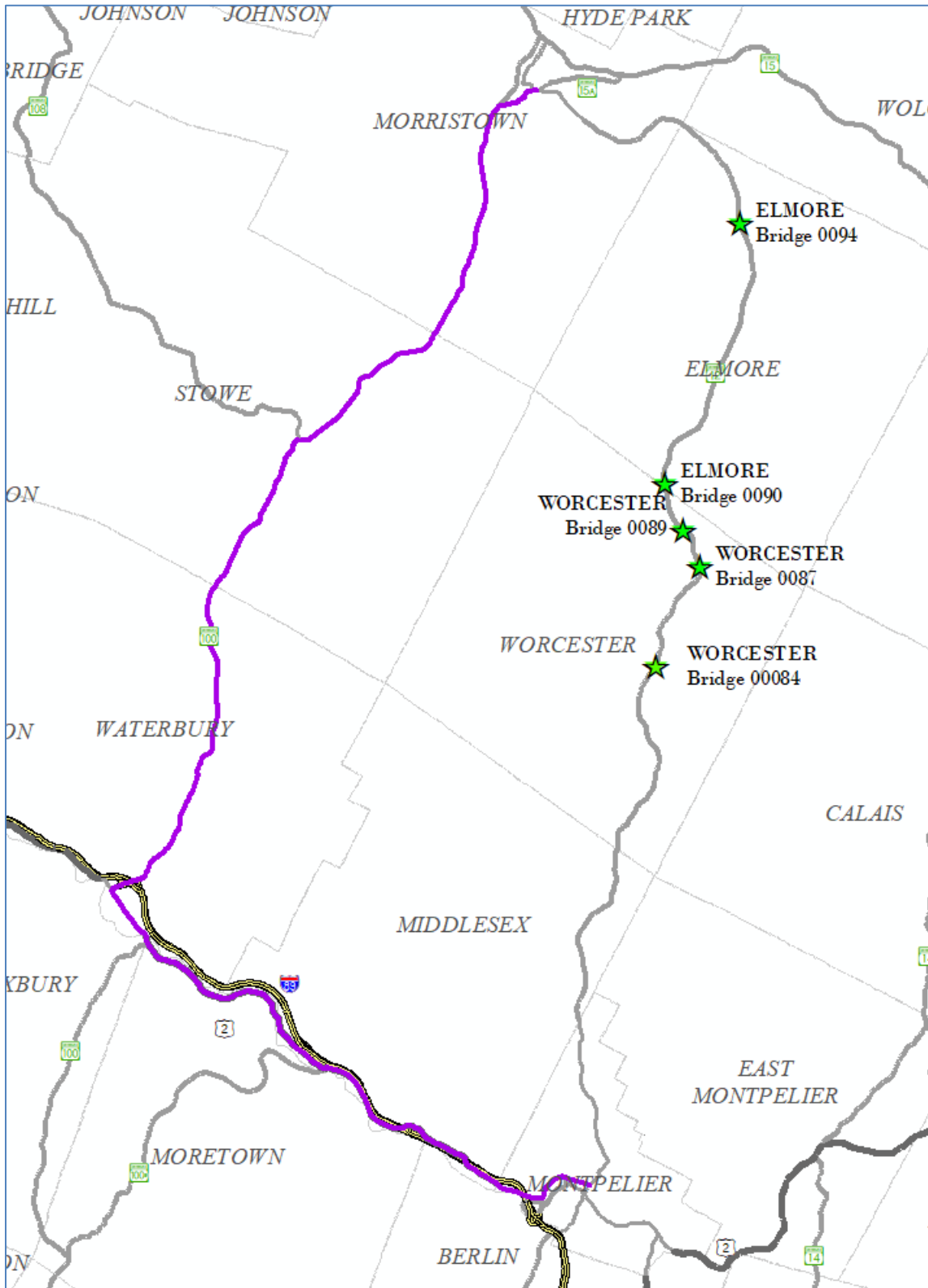
General Yearly Summaries - Crash Listing: State Highways and All Federal Aid Highway Systems

WHERE Year of Crash >= 2012 AND Year of Crash <= 2016

* Reporting Agency/ Incident No.	City/Town	Mile Marker	Crash Date	Time	Weather	Contributing Circumstances	Direction of Collision	Number Of Injuries	Number Of Fatalities	Number Of Untimely Deaths	Direction	Road Group
VTVSP0100/14A102703	Elmore	5.91	06/19/2014	06:55	Clear	Other improper action, No improper driving	Other - Explain in Narrative	1	0	0	N, S	SH
VTVSP0100/13A100096	Elmore	5.94	01/06/2013	20:22	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP0100/13A102438	Elmore	6.33	06/26/2013	09:00	Cloudy	Distracted, Failure to keep in proper lane	Single Vehicle Crash	0	0	0	N	SH
VTVSP0100/15A103907	Elmore	6.58	07/30/2015	21:21	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP0100/16A105941	Elmore	6.60	11/22/2016	20:12	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP0100/14A102185	Elmore	6.74	05/18/2014	03:23	Clear	Under the influence of medication/drugs/alcohol	Single Vehicle Crash	0	0	0	S	SH
VTVSP0100/14A103178	Elmore	6.89	07/15/2014	17:30	Clear	Inattention, No improper driving	Left Turns, Same Direction, Rear End v--v--	2	0	0	E	SH
VTVSP0100/15A102454	Elmore	6.91	05/17/2015	13:10	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP0100/16A104685	Elmore	6.91	09/09/2016	18:38	Clear	Failure to keep in proper lane, Under the influence of medication/drugs/alcohol	Single Vehicle Crash	1	0	0	N	SH State Owned
VTVSP0100/16A100701	Elmore	7.08	02/10/2016	19:40	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP0100/16A105967	Elmore	7.09	11/24/2016	22:14	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP0100/15A103097	Elmore	7.11	06/18/2015	15:36	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP0100/13A100799	Elmore	7.67	02/27/2013	13:54	Snow	Driving too fast for conditions	Single Vehicle Crash	2	0	0	N	SH
VTVSP0100/15A100414	Elmore	7.92	01/25/2015	08:35	[No Weather]		[No Direction of Collision]	0	0	0		SH
VTVSP0100/12A101076	Elmore	UNK	03/23/2012	14:00	Clear		Single Vehicle Crash	0	0	0	N	SH
VTVSP0100/16A102431	Elmore	UNK	05/22/2016	23:37	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
VTVSP0100/16A103856	Elmore	UNK	07/31/2016	09:38	Clear	Failure to keep in proper lane	Single Vehicle Crash	0	0	0	S	SH State Owned
VT0080100/015MR003684	Morristown	0.00	11/10/2015	15:22	Clear		Single Vehicle Crash	3	0	0	E	SH
VT0080100/12MR03007	Morristown	0.08	11/16/2012	09:20	Clear	Failure to keep in proper lane, No improper driving	Opp Direction Sideswipe	3	0	0	S, N	SH
VT0080100/14MR000387	Morristown	0.18	01/31/2014	22:43	Clear	Exceeded authorized speed limit	Single Vehicle Crash	0	0	0	W	SH
VT0080100/14MR003974	Morristown	0.18	11/17/2014	08:22	Snow	Driving too fast for conditions	Single Vehicle Crash	0	0	0	N	SH
VT0080100/15MR002687	Morristown	0.18	08/24/2015	17:16	Clear	Inattention, No improper driving	Rear End	0	0	0	N	SH
VT0080100/12MR00405	Morristown	0.34	02/23/2012	08:45	Cloudy	Driving too fast for conditions	Head On	0	0	0	W	SH
VT0080100/16MR003492	Morristown	0.93	10/08/2016	11:51	Clear	Failure to keep in proper lane, Other Outside Vehicle	Single Vehicle Crash	1	0	0	E	SH Class 1 TH

\*Crash occurred prior to the last Highway Improvement Project. This data should not be used in a crash analysis. UNK indicates Mile Marker is Unknown.

## Appendix N: Detour Map



**Regional Detour Route 1: VT Route 12, to VT Route 100, and US Route 2, back to VT Route 12**

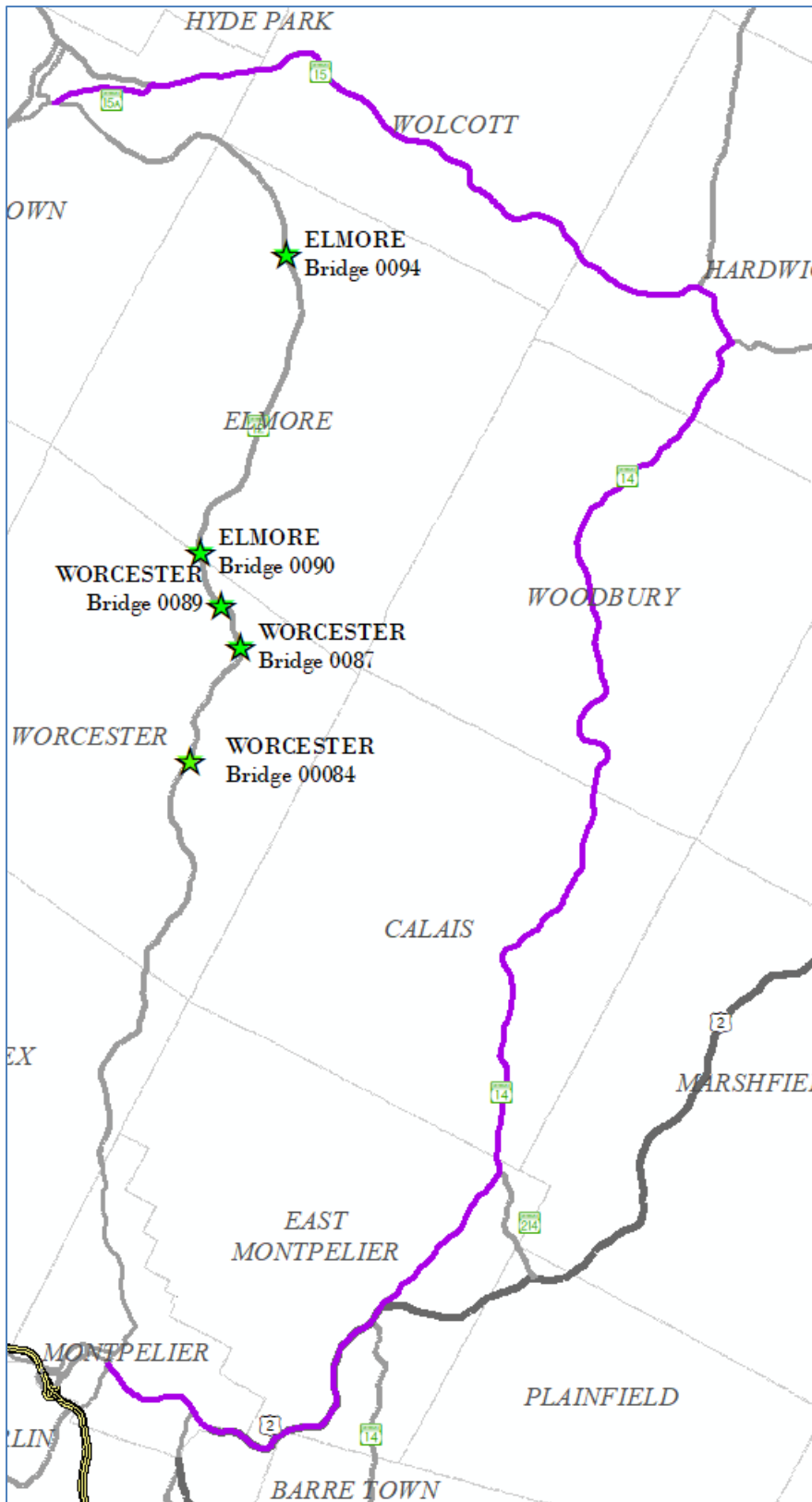
Through Route: 26.2 miles

Detour Route: 30.9 miles

Added Distance: 4.7 miles

End-to-End Distance: 57.1 miles





**Regional Detour Route 2:** VT Route 12, to US Route 2, VT Route 14, and VT Route 15, back to VT Route 12

Through Route: 26.4 miles

Detour Route: 40.0 miles

Added Distance: 13.6 miles

End-to-End Distance: 66.4 miles

## **Appendix O: Plans**

JOHNATHAN & AMY  
DRAPER

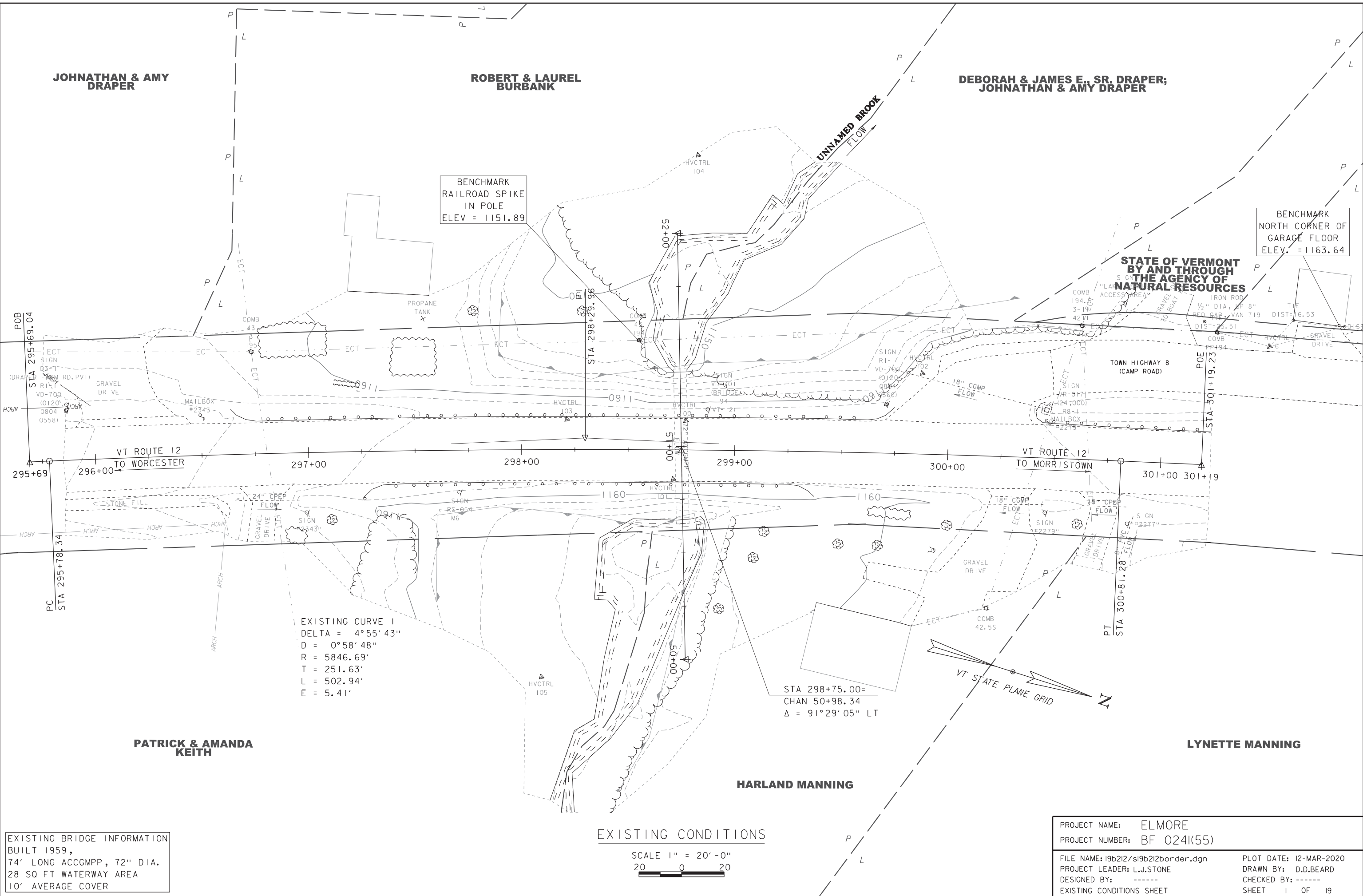
ROBERT & LAUREL  
BURBANK

DEBORAH & JAMES E., SR. DRAPER;  
JOHNATHAN & AMY DRAPER

BENCHMARK  
RAILROAD SPIKE  
IN POLE  
ELEV = 1151.89

BENCHMARK  
NORTH CORNER OF  
GARAGE FLOOR  
ELEV. = 1163.64

STATE OF VERMONT  
BY AND THROUGH  
THE AGENCY OF  
NATURAL RESOURCES



EXISTING CURVE 1  
DELTA = 4°55'43"  
D = 0°58'48"  
R = 5846.69'  
T = 251.63'  
L = 502.94'  
E = 5.41'

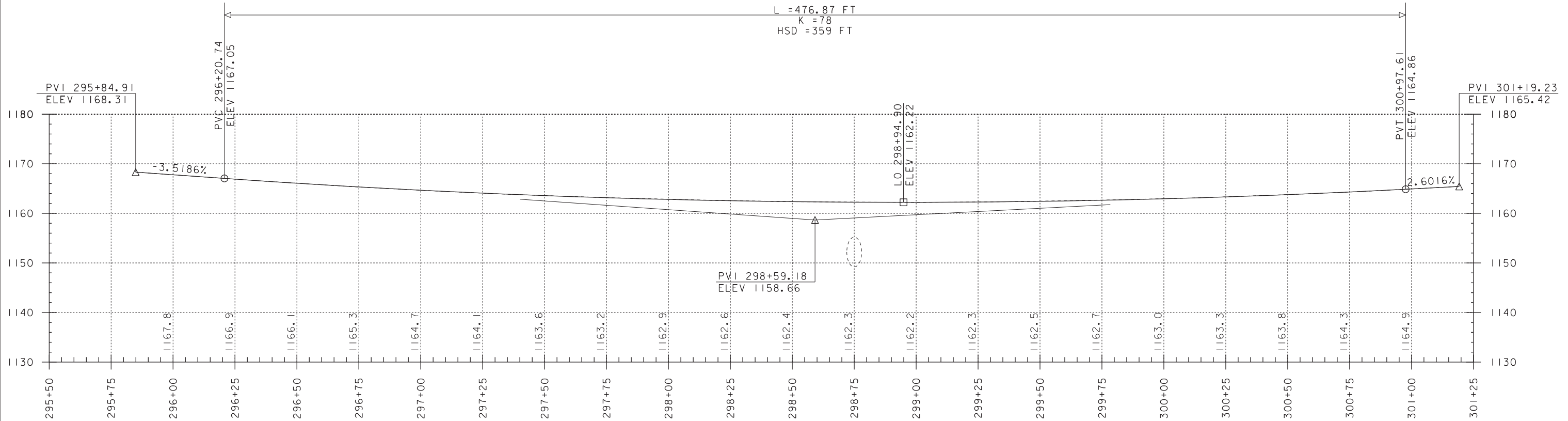
STA 298+75.00=  
CHAN 50+98.34  
Δ = 91°29'05" LT

EXISTING BRIDGE INFORMATION  
BUILT 1959,  
74' LONG ACCGMPP, 72" DIA.  
28 SQ FT WATERWAY AREA  
10' AVERAGE COVER

EXISTING CONDITIONS

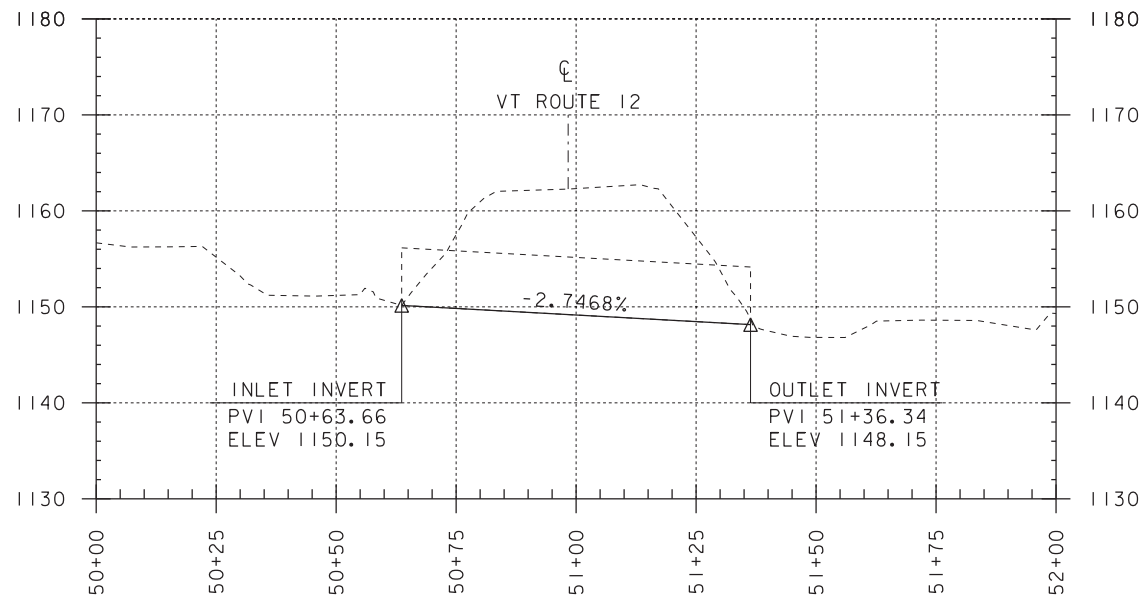
SCALE 1" = 20'-0"  
20 0 20

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: I9b212/sl9b212border.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 1 OF 19
DESIGNED BY: -----	
EXISTING CONDITIONS SHEET	



**VT ROUTE 12 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"



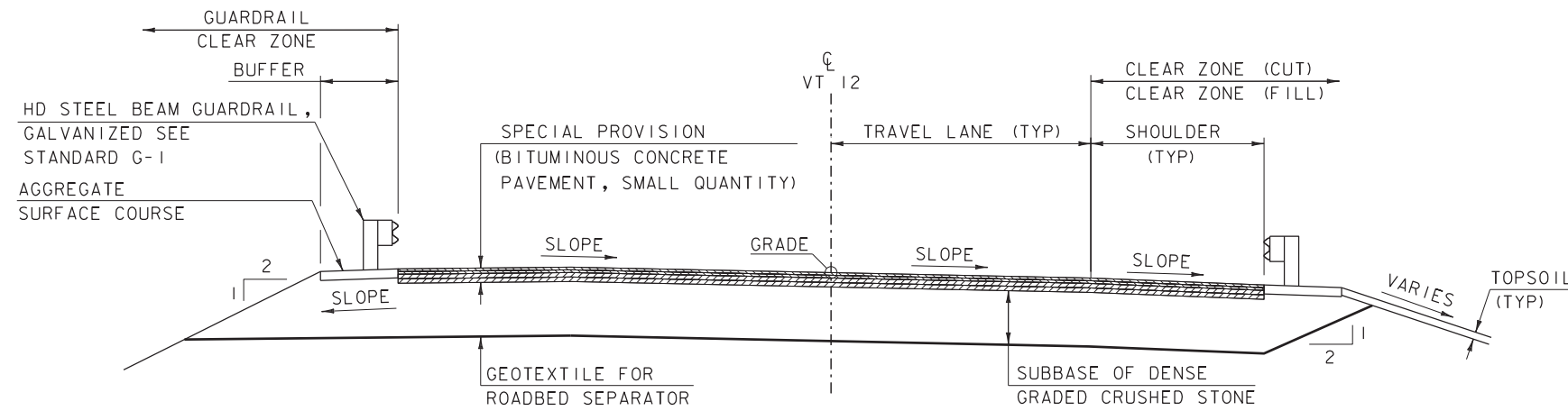
**VT ROUTE 12 BRIDGE 94 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"

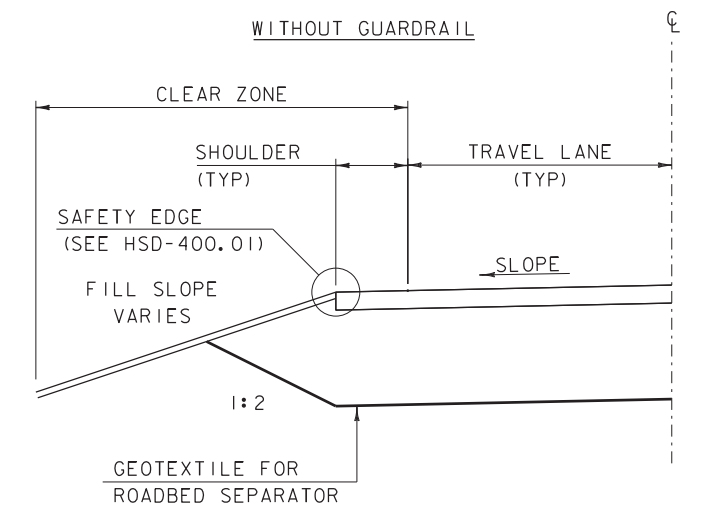
NOTE:  
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG CL  
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG CL

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: i2b2i2/st2b2i2profile.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 2 OF 19
DESIGNED BY: -----	
EXISTING PROFILE SHEET	

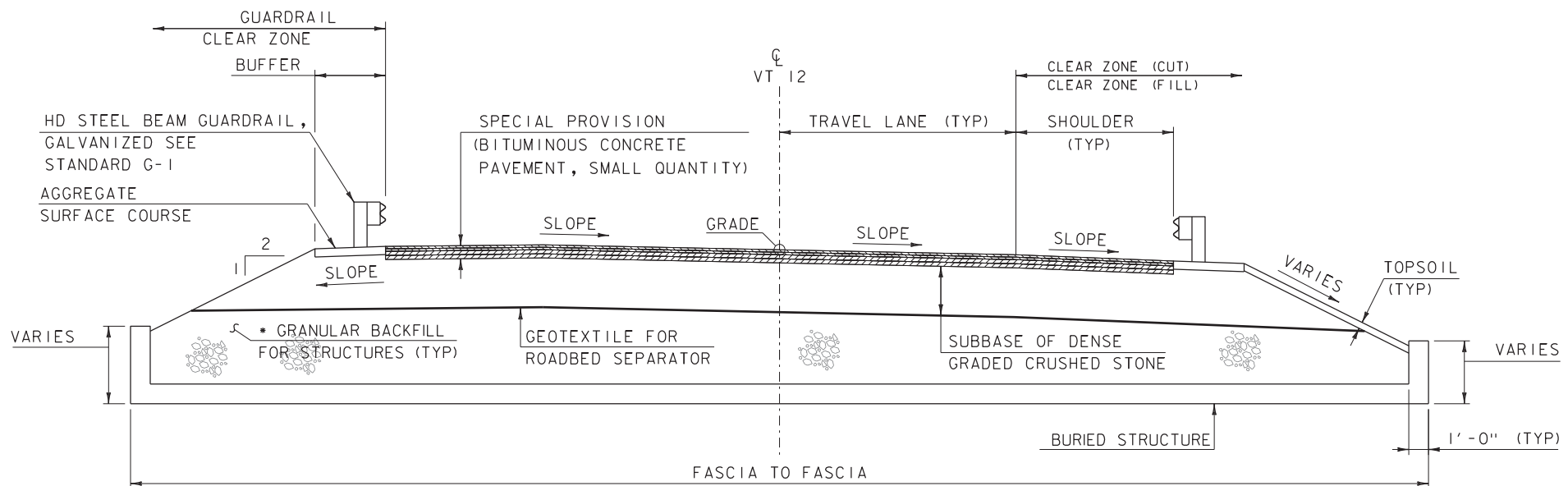




**VT ROUTE 12 TYPICAL SECTION**  
SCALE: 1/4" = 1'-0"



**ROADWAY TYPICAL SECTION**  
NOT TO SCALE



**VTTX BURIED STRUCTURE TYPICAL SECTION**  
SCALE: 1/4" = 1'-0"

**ROAD TYPICAL INFORMATION**

	LEFT		RIGHT	
	WIDTH	SLOPE	WIDTH	SLOPE
TRAVEL LANE	11'-0"	VARIES	11'-0"	VARIES
SHOULDER	4'-0"	VARIES	4'-0"	VARIES
BUFFER	3'-7"	-0.060	3'-7"	-0.060
FILL SLOPE	---	VARIES	---	VARIES
CLEAR ZONE (CUT)	14'-0"	---	14'-0"	---
CLEAR ZONE (FILL)	20'-0"	---	20'-0"	---
CLEAR ZONE (GUARDRAIL)	4'-9"	---	4'-9"	---

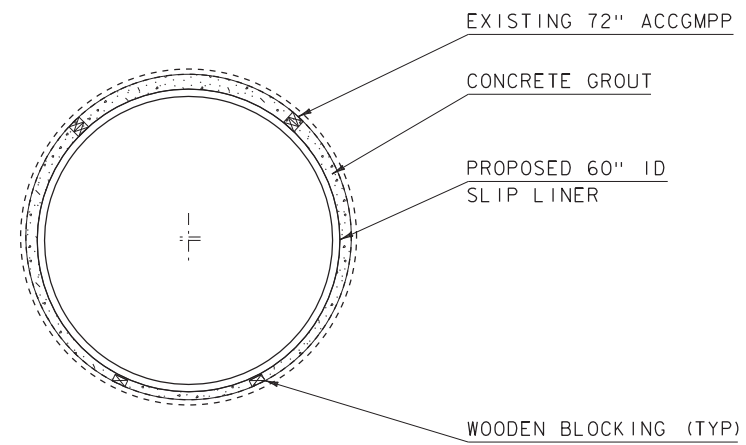
**MATERIAL INFORMATION**

	THICKNESS	TYPE
WEARING COURSE	1 1/2"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IVS)
BINDER COURSE	1 1/2"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IVS)
BASE COURSE #2	2 1/2"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IIS)
BASE COURSE #1	2 1/2"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IIS)
BUFFER	8"	AGGREGATE SURFACE COURSE
SUBBASE	XX"	SUBBASE OF DENSE GRADED CRUSHED STONE
TOPSOIL	4"	TOPSOIL

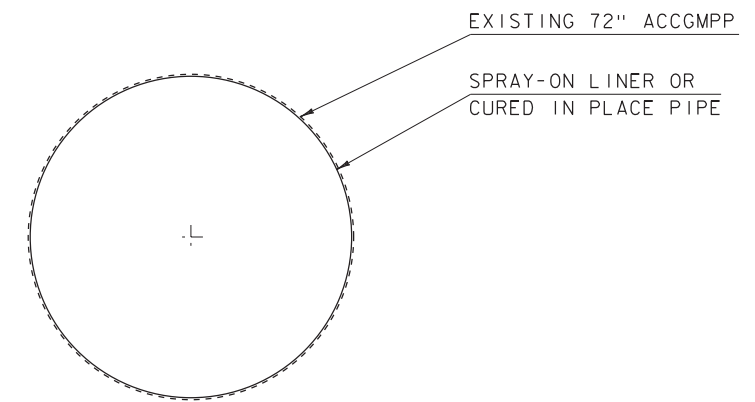
TACK COAT: EMULSIFIED ASPHALT IS TO BE APPLIED AT A RATE OF 0.025 GAL/SY BETWEEN SUCCESSIVE COURSES OF PAVEMENT AND 0.080 GAL/SY ON COLD PLANED SURFACES AS DIRECTED BY THE ENGINEER.

MATERIAL TOLERANCES (IF USED ON PROJECT)	
SURFACE	
- PAVEMENT (TOTAL THICKNESS)	+/- 1/4"
- AGGREGATE SURFACE COURSE	+/- 1/2"
SUBBASE	+/- 1"
SAND BORROW	+/- 1"

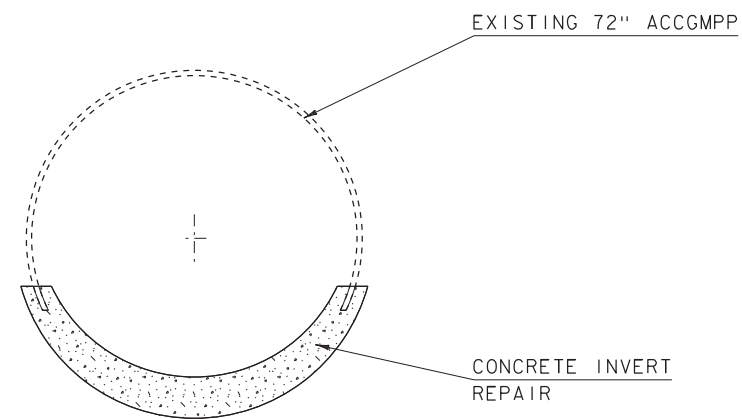
PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: I9b212/sb9b212+yp.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 3 OF 19
DESIGNED BY: -----	
TYPICAL SECTION SHEET 1	



CULVERT LINER TYPICAL SECTION



SPRAY-ON LINER TYPICAL SECTION

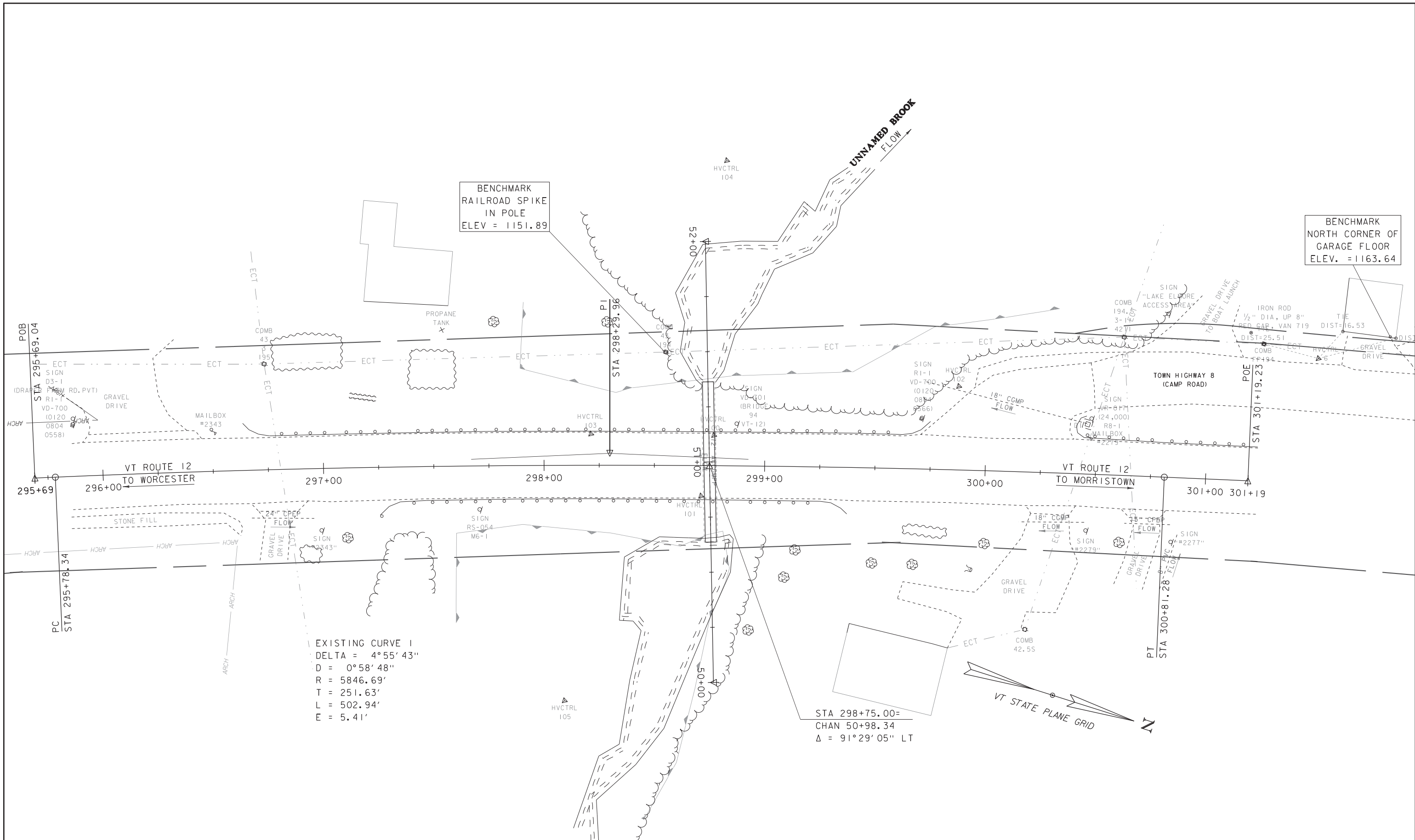


INVERT REPAIR TYPICAL SECTION

PROJECT NAME: ELMORE  
 PROJECT NUMBER: BF 0241(55)

FILE NAME: I9b212/s19b212+yp.dgn  
 PROJECT LEADER: L.J.STONE  
 DESIGNED BY: -----  
 REHABILITATION TYPICAL SECTIONS

PLOT DATE: 12-MAR-2020  
 DRAWN BY: D.D.BEARD  
 CHECKED BY: -----  
 SHEET 4 OF 19



BENCHMARK  
RAILROAD SPIKE  
IN POLE  
ELEV = 1151.89

BENCHMARK  
NORTH CORNER OF  
GARAGE FLOOR  
ELEV. = 1163.64

EXISTING CURVE 1  
DELTA = 4°55'43"  
D = 0°58'48"  
R = 5846.69'  
T = 251.63'  
L = 502.94'  
E = 5.41'

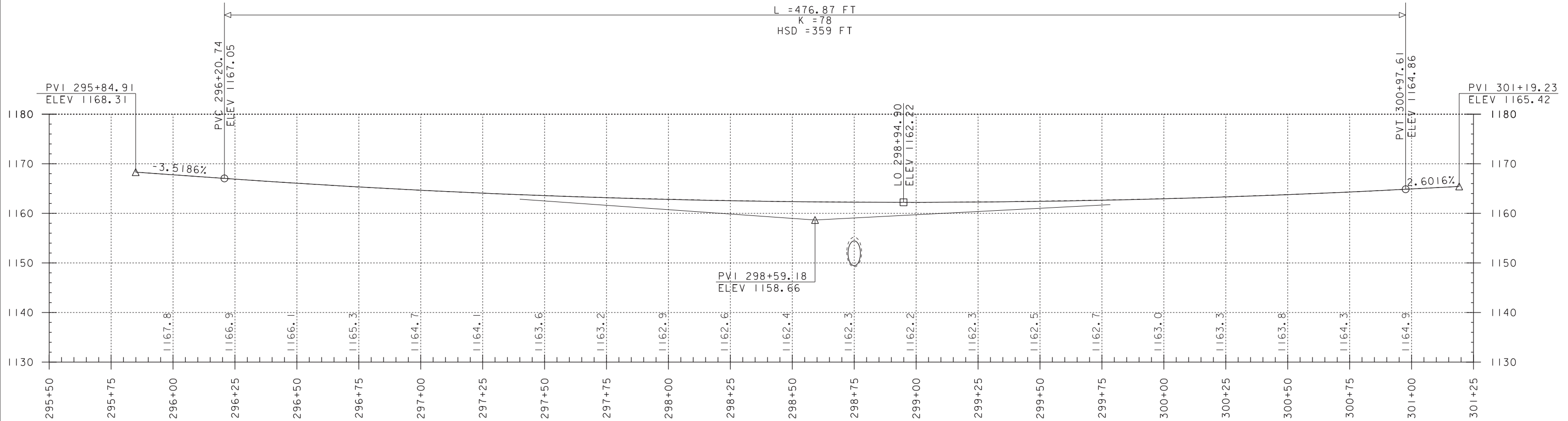
STA 298+75.00=  
CHAN 50+98.34  
Δ = 91°29'05" LT

CULVERT REHABILITATION LAYOUT

SCALE 1" = 20'-0"  
20 0 20

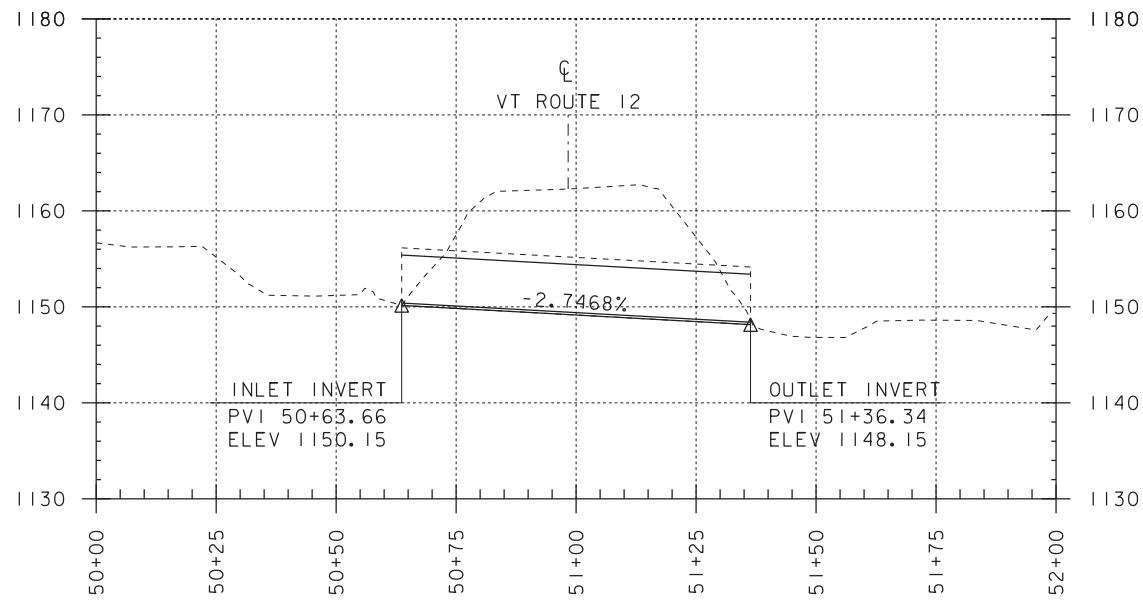
EXISTING BRIDGE INFORMATION  
BUILT 1959,  
74' LONG ACCGMPP, 72" DIA.  
28 SQ FT WATERWAY AREA  
10' AVERAGE COVER

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: I9b212/s19b212border.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 5 OF 19
DESIGNED BY: -----	
CULVERT REHABILITATION LAYOUT SHEET	



**VT ROUTE 12 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
 VERTICAL 1"=10'-0"



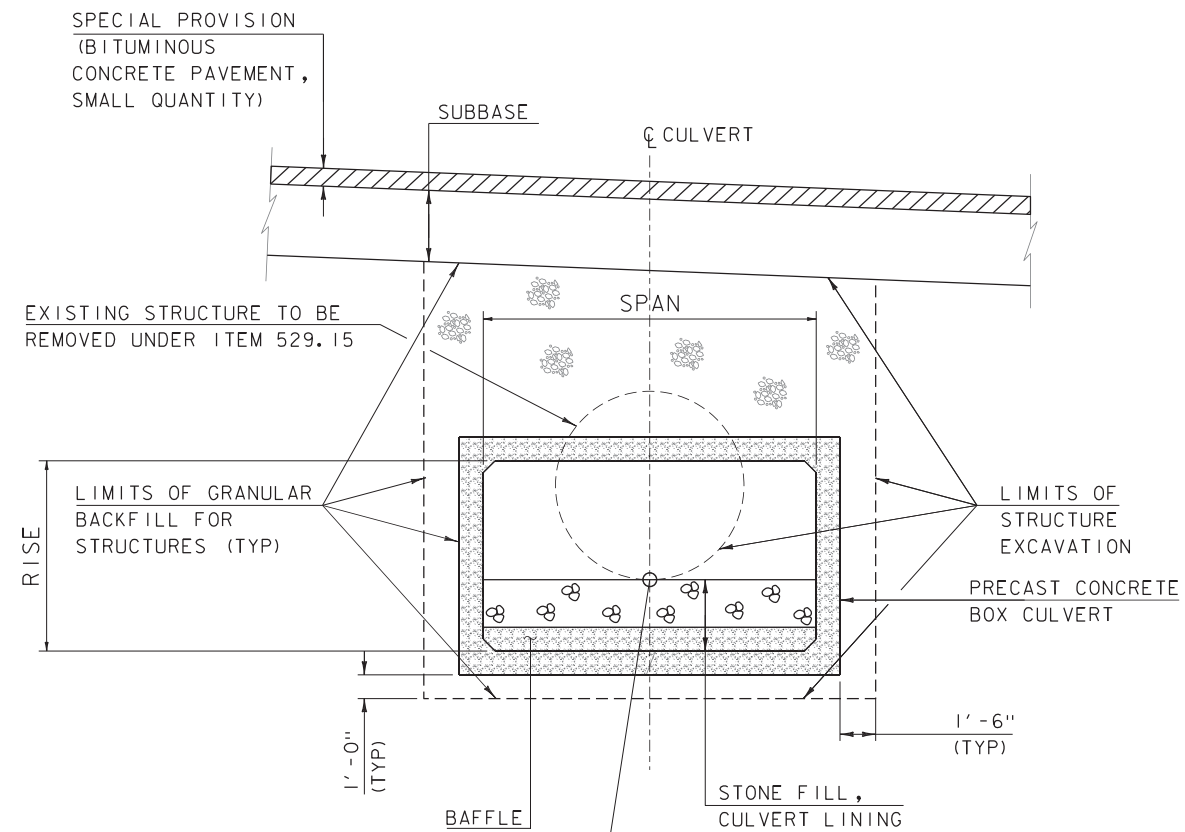
**VT ROUTE 12 BRIDGE 94 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
 VERTICAL 1"=10'-0"

NOTE:  
 GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG CL  
 GRADES SHOWN TO THE NEAREST HUNDRETH ARE FINISH GRADE ALONG CL

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: i2b2i2/st2b2i2profile.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 6 OF 19
DESIGNED BY: -----	
CULVERT REHABILITATION PROFILE SHEET	

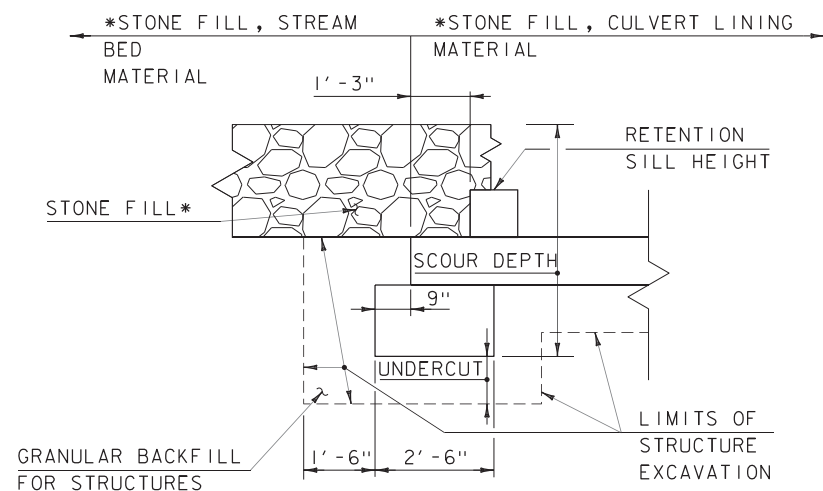




SPAN	12'-0"
RISE	XX'-X"
LENGTH	XXX'-X"

**CULVERT TYPICAL SECTION**

NOT TO SCALE



**CUTOFF WALL TYPICAL SECTION**

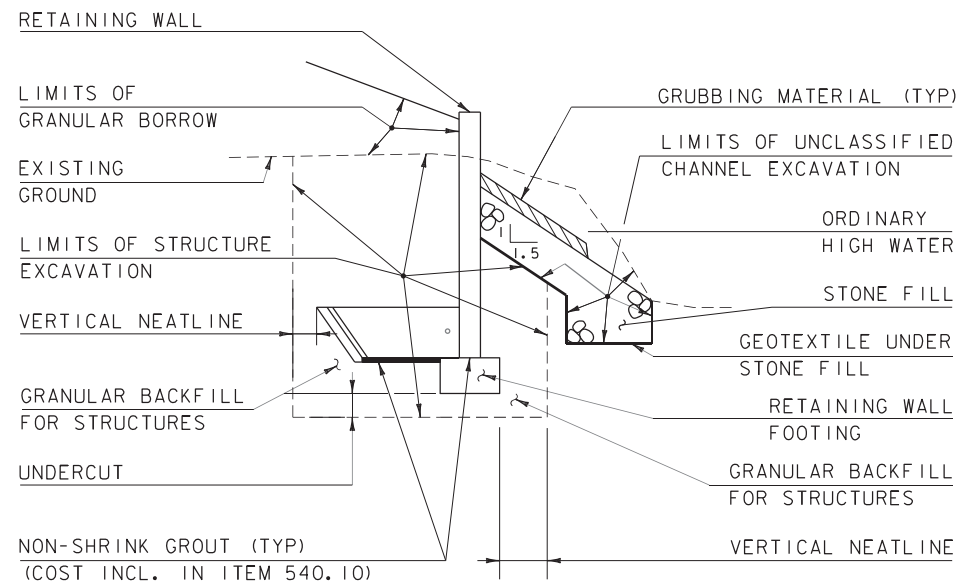
NOT TO SCALE

NOTE:

THE CUTOFF WALL MAY BE OMITTED IF THE DEPTH OF CULVERT LINING MATERIAL PLUS THE THICKNESS TO THE BOTTOM OF THE BOX MEETS OR EXCEEDS THE LISTED SCOUR DEPTH.

**CUTOFF WALL - CRITICAL DIMENSIONS**

	DIMENSION
SCOUR DEPTH	4'-0"
RETENTION SILL HEIGHT	1'-0"
UNDERCUT	1'-0"

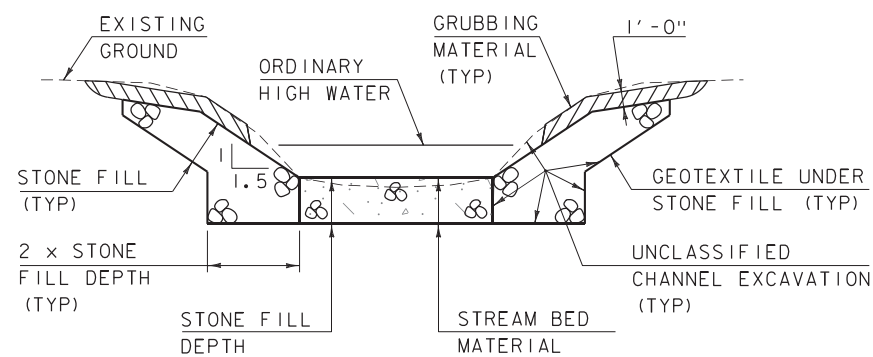


**RETAINING WALL EARTHWORK TYPICAL SECTION**

NOT TO SCALE

NOTE:

TOP OF RETAINING WALL FOOTING SHALL BE AT OR BELOW BOTTOM OF BOX CULVERT.



**TYPICAL CHANNEL SECTION**

(NOT TO SCALE)

- 1) WHENEVER CHANNEL SLOPE INTERSECTS ROADWAY SUBBASE, GRUBBING MATERIAL SHALL BEGIN AT THE BOTTOM OF SUBBASE.
- 2) THE CONTRACTOR SHALL CREATE A LOW FLOW CHANNEL IN THE STREAM BED MATERIAL AS DIRECTED BY THE ENGINEER.
- 3) GRUBBING MATERIAL SHALL BE PLACED UNDERNEATH STRUCTURES WHERE THERE IS MORE THAN 6 FEET VERTICALLY FROM ORDINARY HIGH WATER (OHW) TO THE BOTTOM OF SUPERSTRUCTURE AND MORE THAN 6 FEET HORIZONTALLY FROM OHW LINE TO FRONT FACE OF ABUTMENT. THIS MATERIAL SHALL START JUST ABOVE THE OHW ELEVATION AND TERMINATE 3 FEET HORIZONTALLY FROM THE FRONT FACE OF THE ABUTMENT. THIS MATERIAL SHALL NOT BE PLACED UNDERNEATH DOWNSPOUTS. SEE THE CHANNEL SECTIONS FOR ADDITIONAL DETAILING.

**MATERIAL INFORMATION**

	THICKNESS	TYPE
STONE FILL	X'-0"	TYPE X
STONE FILL, CULVERT LINING	X'-0"	E-STONE TYPE X
STONE FILL, STREAM BED MATERIAL	X'-0"	E-STONE TYPE X

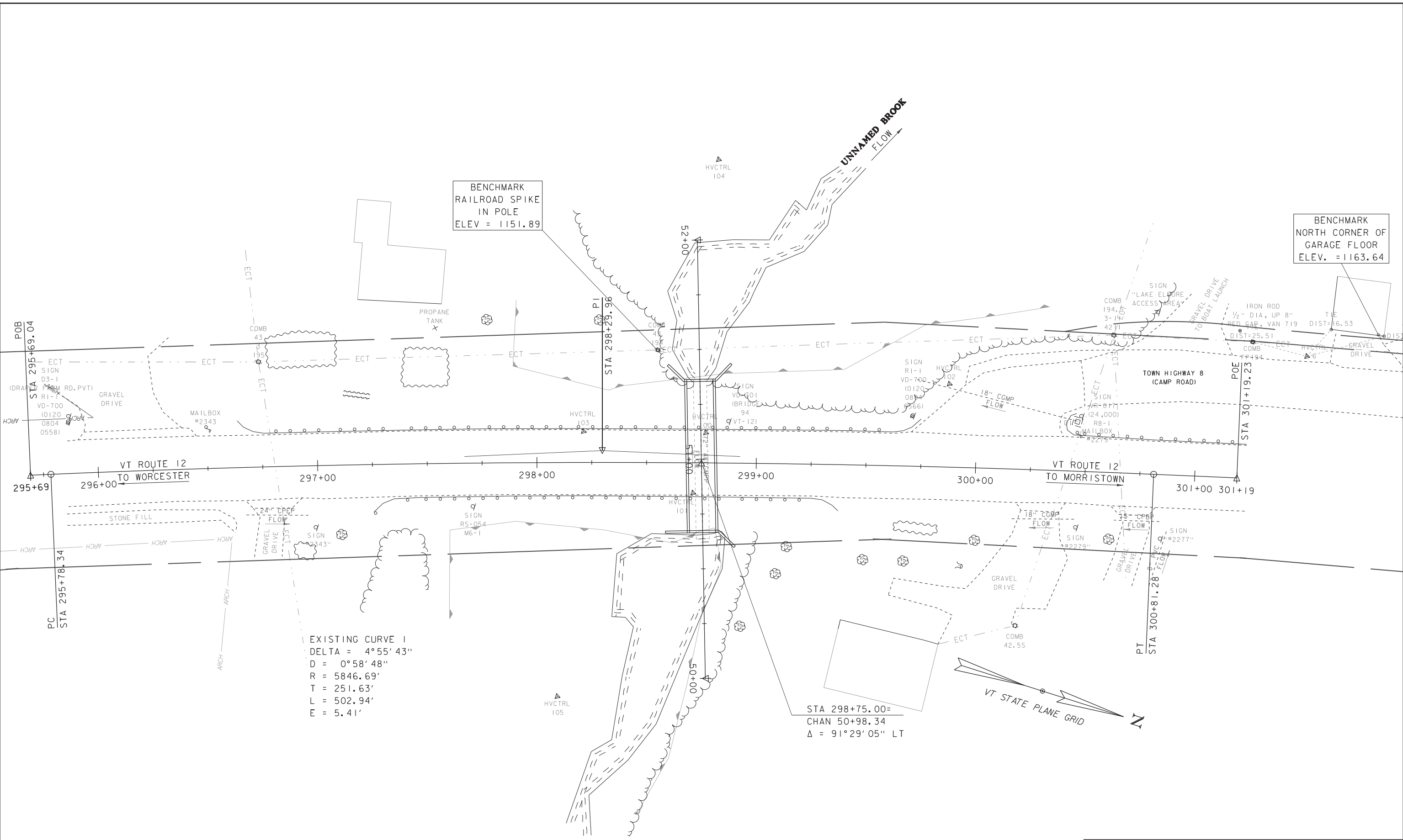
**RETAINING WALL - ASSUMED DIMENSIONS**

LEVELING PAD	
WIDTH	DIMENSION
WIDTH	2'-6"
TOE	0'-9"
HEEL	0'-9"
THICKNESS	1'-0"
UNDERCUT	1'-0"
WALL	
THICKNESS	1'-0"
HEIGHT	VARIES
EXCAVATION LIMITS	
VERTICAL NEATLINE	1'-6"
UNDERCUT	1'-0"

PROJECT NAME: ELMORE  
PROJECT NUMBER: BF 0241(55)

FILE NAME: I9b212/s19b212+yp.dgn  
PROJECT LEADER: L.J.STONE  
DESIGNED BY: -----  
PRECAST CULVERT TYPICAL SECTION

PLOT DATE: 12-MAR-2020  
DRAWN BY: D.D.BEARD  
CHECKED BY: -----  
SHEET 7 OF 19



BENCHMARK  
RAILROAD SPIKE  
IN POLE  
ELEV = 1151.89

BENCHMARK  
NORTH CORNER OF  
GARAGE FLOOR  
ELEV. = 1163.64

EXISTING CURVE 1  
DELTA = 4°55'43"  
D = 0°58'48"  
R = 5846.69'  
T = 251.63'  
L = 502.94'  
E = 5.41'

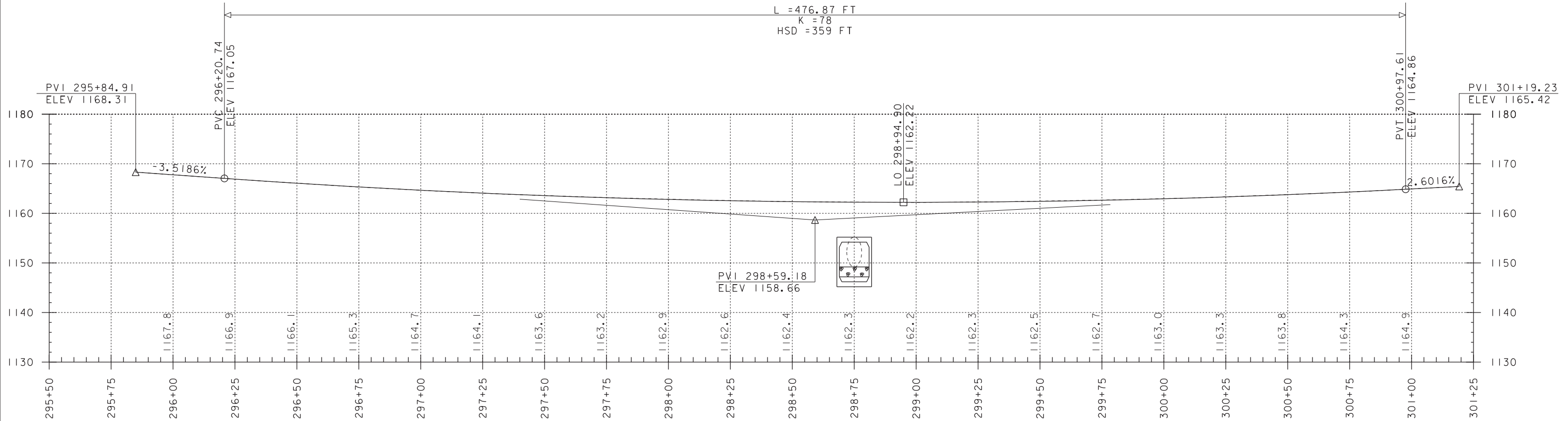
STA 298+75.00=  
CHAN 50+98.34  
Δ = 91°29'05" LT

EXISTING BRIDGE INFORMATION  
BUILT 1959,  
74' LONG ACCGMPP, 72" DIA.  
28 SQ FT WATERWAY AREA  
10' AVERAGE COVER

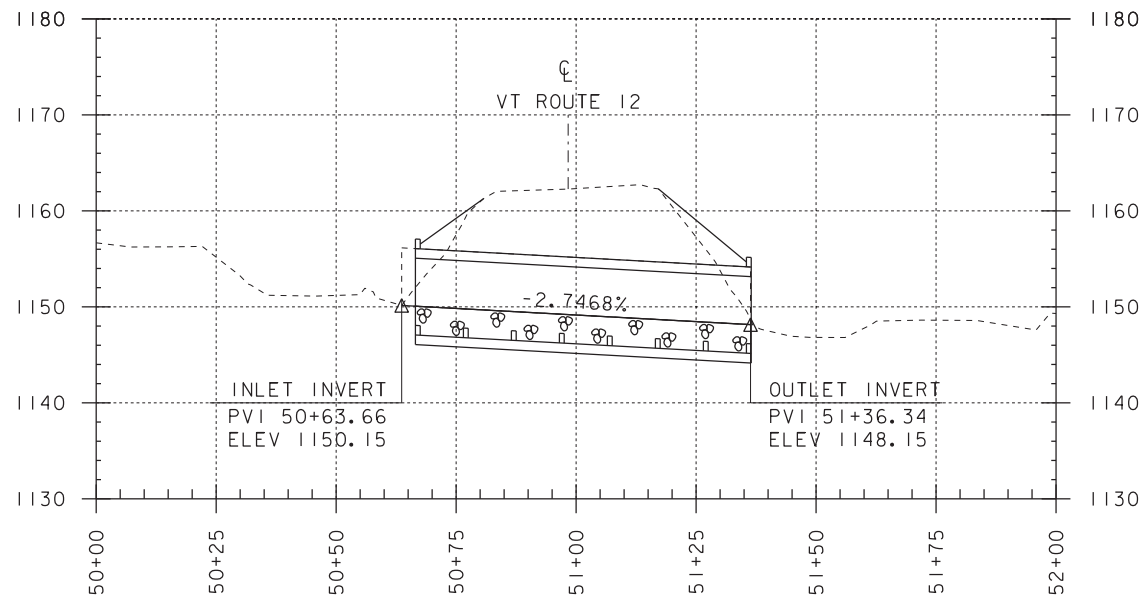
NEW CULVERT LAYOUT

SCALE 1" = 20'-0"  
20 0 20

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: I9b212/s19b212border.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 8 OF 19
DESIGNED BY: -----	
NEW CULVERT LAYOUT SHEET	



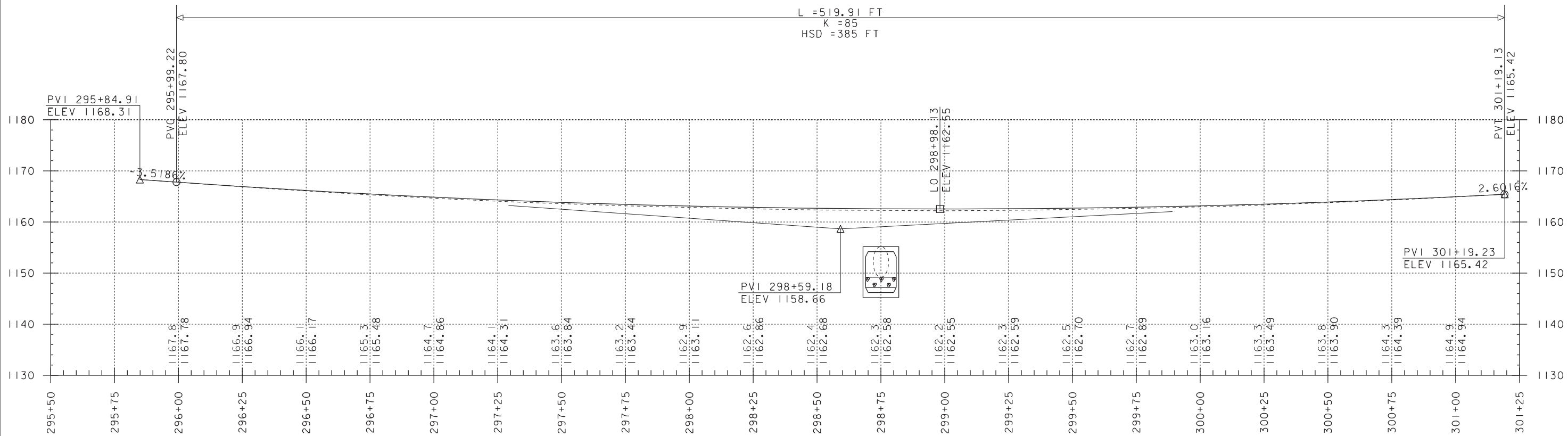
**VT ROUTE 12 PROFILE**  
 SCALE: HORIZONTAL 1"=20'-0"  
 VERTICAL 1"=10'-0"



**VT ROUTE 12 BRIDGE 94 PROFILE**  
 SCALE: HORIZONTAL 1"=20'-0"  
 VERTICAL 1"=10'-0"

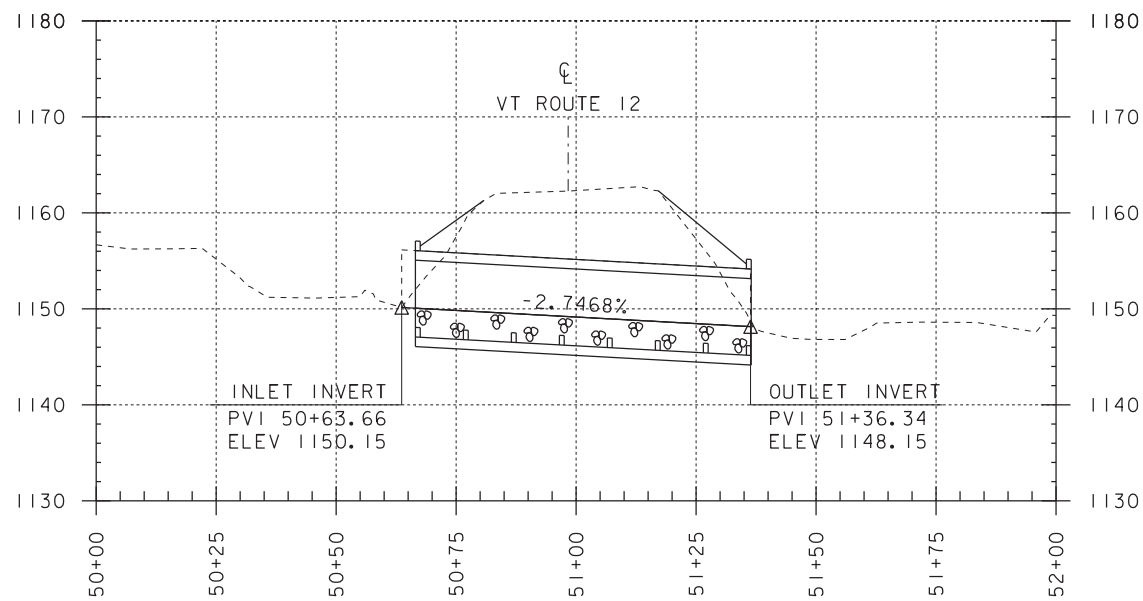
NOTE:  
 GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG  $\mathcal{C}$   
 GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG  $\mathcal{C}$

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: I2b212/st2b212profile.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 9 OF 19
DESIGNED BY: -----	
NEW CULVERT PROFILE SHEET	



**VT ROUTE 12 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"



**VT ROUTE 12 BRIDGE 94 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"

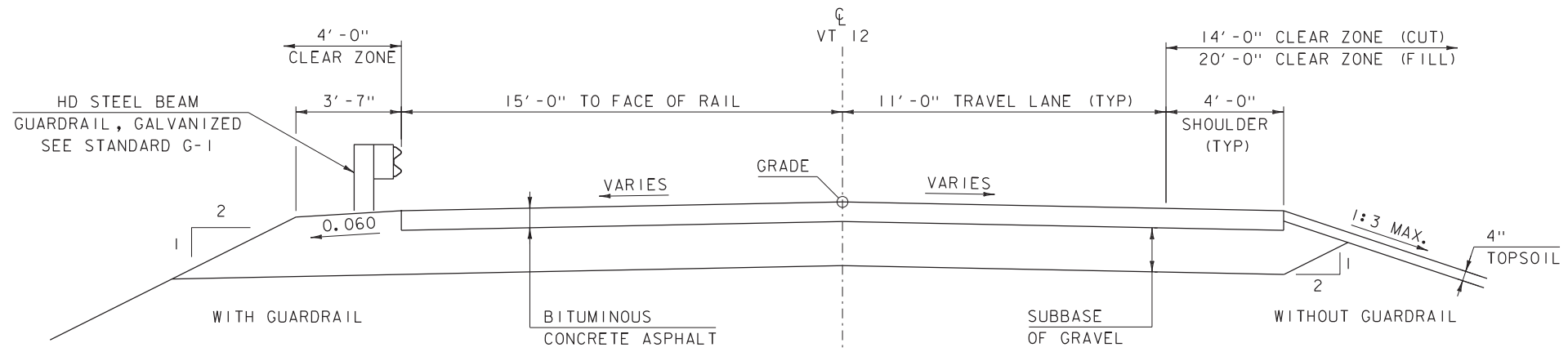
NOTE:  
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG CL  
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG CL

PROJECT NAME: ELMORE  
PROJECT NUMBER: BF 0241(55)

FILE NAME: i2b2i2/st2b2i2profile.dgn  
PROJECT LEADER: L.J.STONE  
DESIGNED BY: -----  
NEW CULVERT PROFILE SHEET

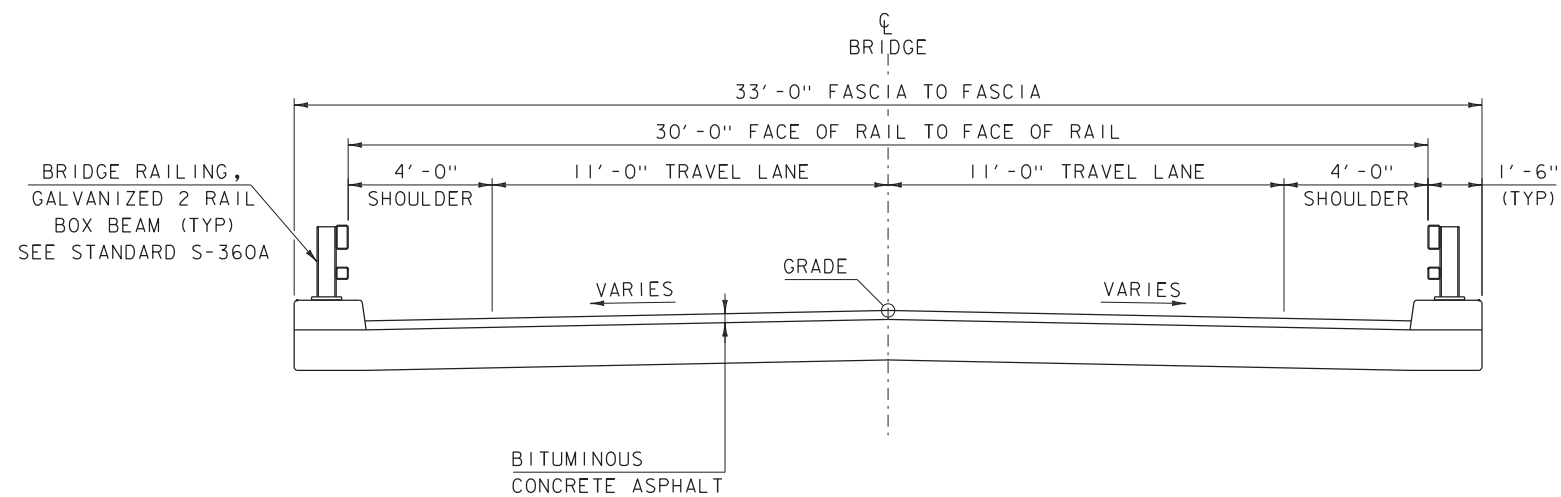
PLOT DATE: 12-MAR-2020  
DRAWN BY: D.D.BEARD  
CHECKED BY: -----  
SHEET 10 OF 19





**PROPOSED VT ROUTE 12 TYPICAL SECTION**

SCALE  $\frac{3}{8}$ " = 1'-0"



**PROPOSED BRIDGE TYPICAL SECTION**

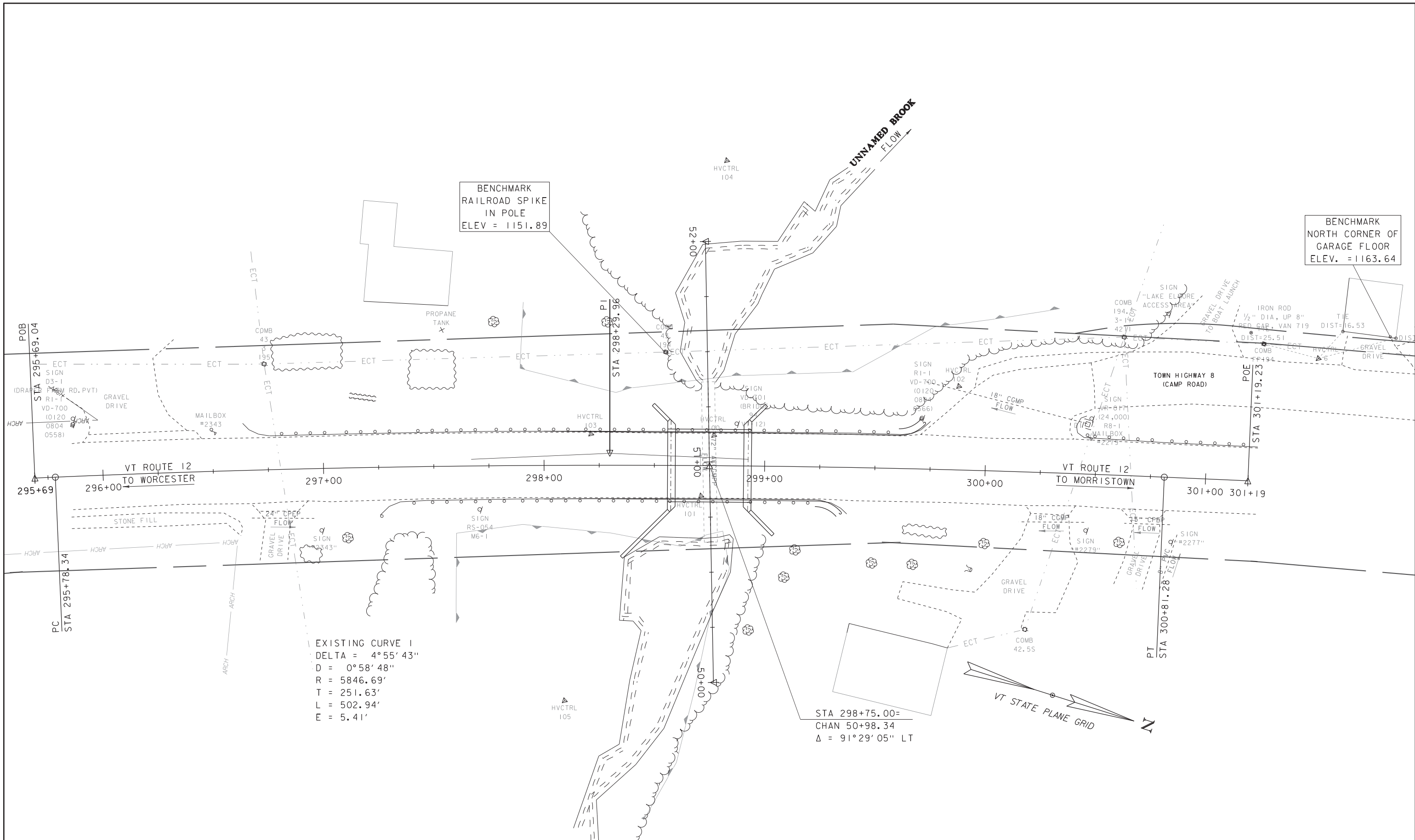
SCALE  $\frac{3}{8}$ " = 1'-0"

**MATERIAL TOLERANCES**  
(IF USED ON PROJECT)

SURFACE	
- PAVEMENT (TOTAL THICKNESS)	+/- 1/4"
- AGGREGATE SURFACE COURSE	+/- 1/2"
SUBBASE	+/- 1"
SAND BORROW	+/- 1"

PROJECT NAME: ELMORE  
PROJECT NUMBER: BF 0241(55)

FILE NAME: I9b212\sb9b212\typical.dgn PLOT DATE: 12-MAR-2020  
PROJECT LEADER: L.J.STONE DRAWN BY: D.D.BEARD  
DESIGNED BY: ----- CHECKED BY: -----  
NEW BRIDGE TYPICAL SECTIONS SHEET 11 OF 19



BENCHMARK  
RAILROAD SPIKE  
IN POLE  
ELEV = 1151.89

BENCHMARK  
NORTH CORNER OF  
GARAGE FLOOR  
ELEV. = 1163.64

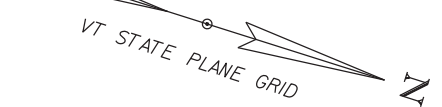
EXISTING CURVE 1  
DELTA = 4°55'43"  
D = 0°58'48"  
R = 5846.69'  
T = 251.63'  
L = 502.94'  
E = 5.41'

STA 298+75.00=  
CHAN 50+98.34  
Δ = 91°29'05" LT

EXISTING BRIDGE INFORMATION  
BUILT 1959,  
74' LONG ACCGMPP, 72" DIA.  
28 SQ FT WATERWAY AREA  
10' AVERAGE COVER

NEW BRIDGE LAYOUT

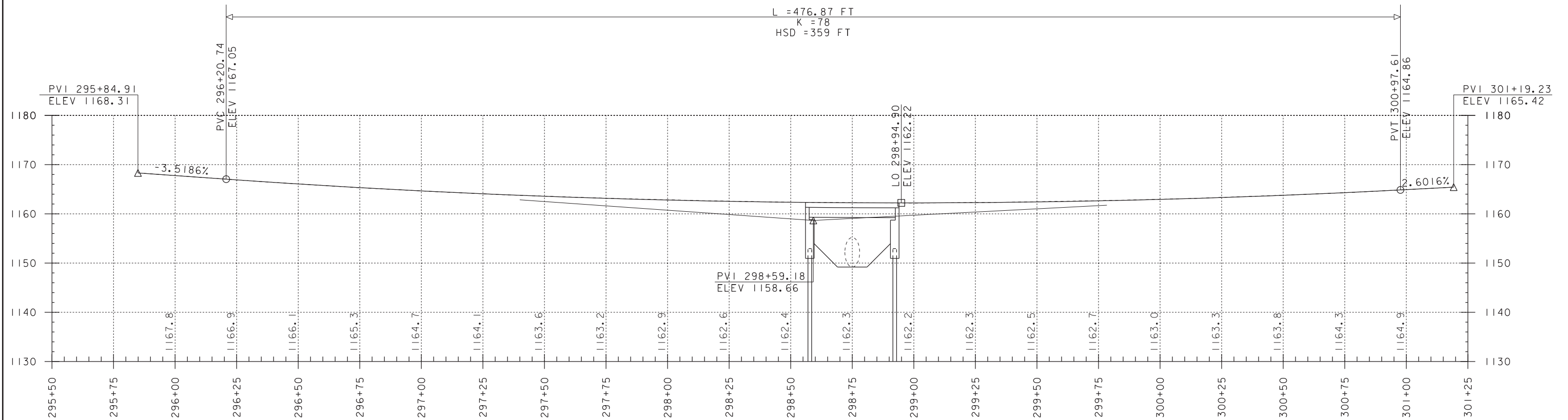
SCALE 1" = 20'-0"  
20 0 20



PROJECT NAME: ELMORE  
PROJECT NUMBER: BF 0241(55)

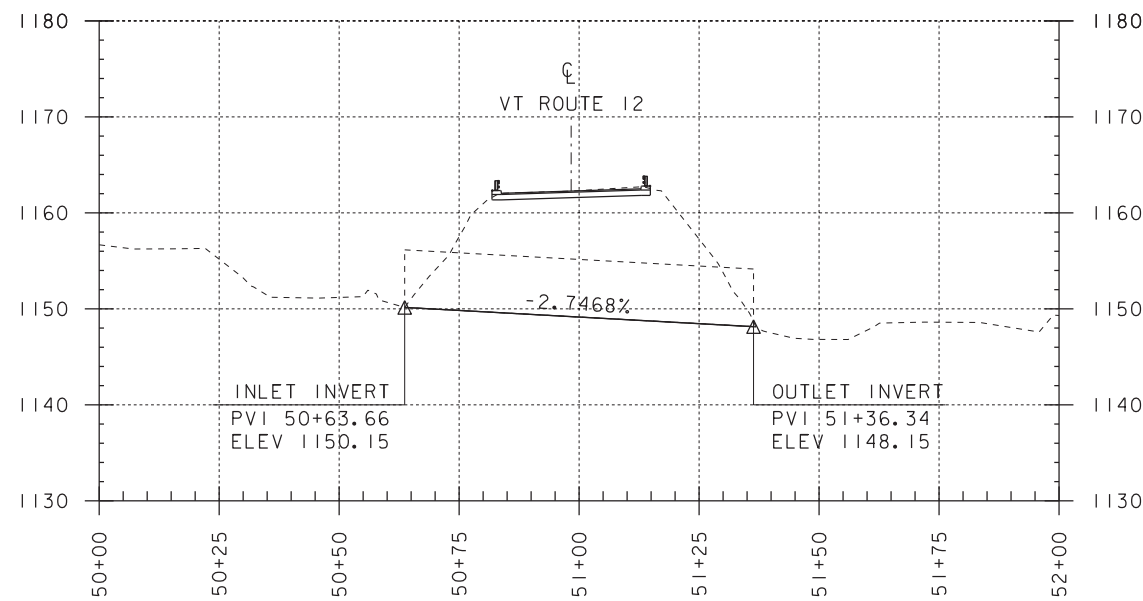
FILE NAME: I9b212/s19b212border.dgn  
PROJECT LEADER: L.J.STONE  
DESIGNED BY: -----  
NEW BRIDGE LAYOUT SHEET

PLOT DATE: 12-MAR-2020  
DRAWN BY: D.D.BEARD  
CHECKED BY: -----  
SHEET 12 OF 19



**VT ROUTE 12 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"



**VT ROUTE 12 BRIDGE 94 PROFILE**

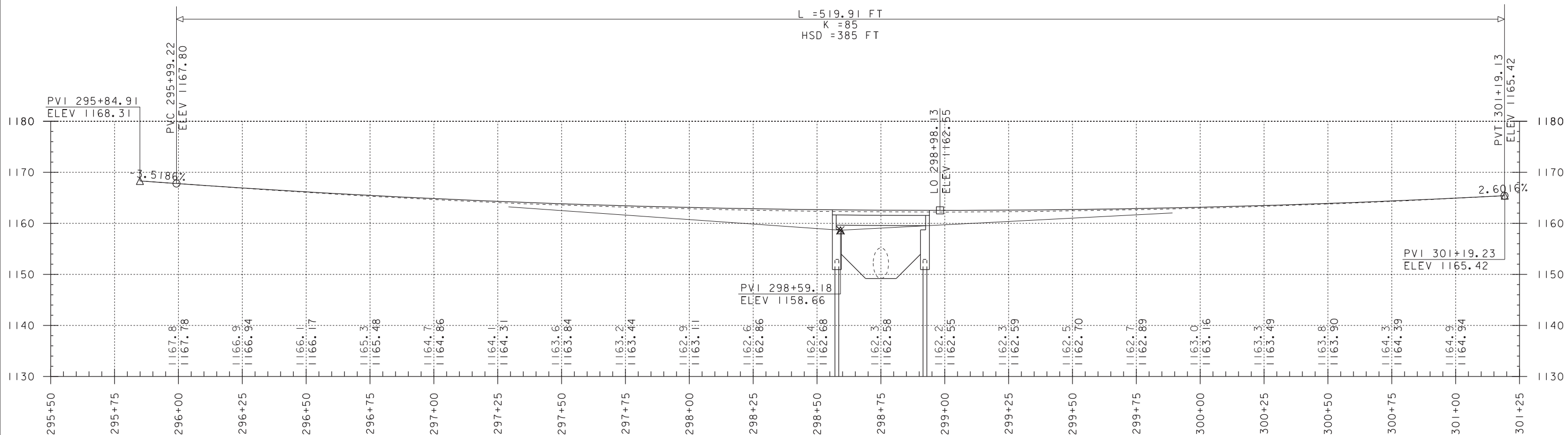
SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"

NOTE:  
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG CL  
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG CL

PROJECT NAME: ELMORE  
PROJECT NUMBER: BF 0241(55)

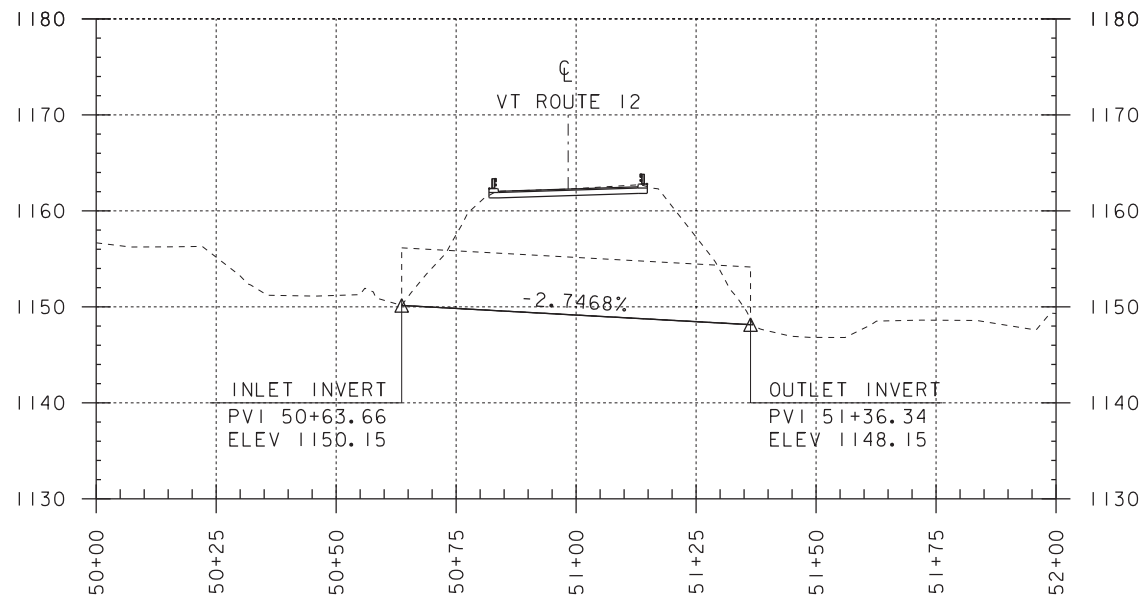
FILE NAME: i2b2i2/st2b2i2profile.dgn  
PROJECT LEADER: L.J.STONE  
DESIGNED BY: -----  
NEW BRIDGE PROFILE SHEET

PLOT DATE: 12-MAR-2020  
DRAWN BY: D.D.BEARD  
CHECKED BY: -----  
SHEET 13 OF 19



**VT ROUTE 12 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"



**VT ROUTE 12 BRIDGE 94 PROFILE**

SCALE: HORIZONTAL 1"=20'-0"  
VERTICAL 1"=10'-0"

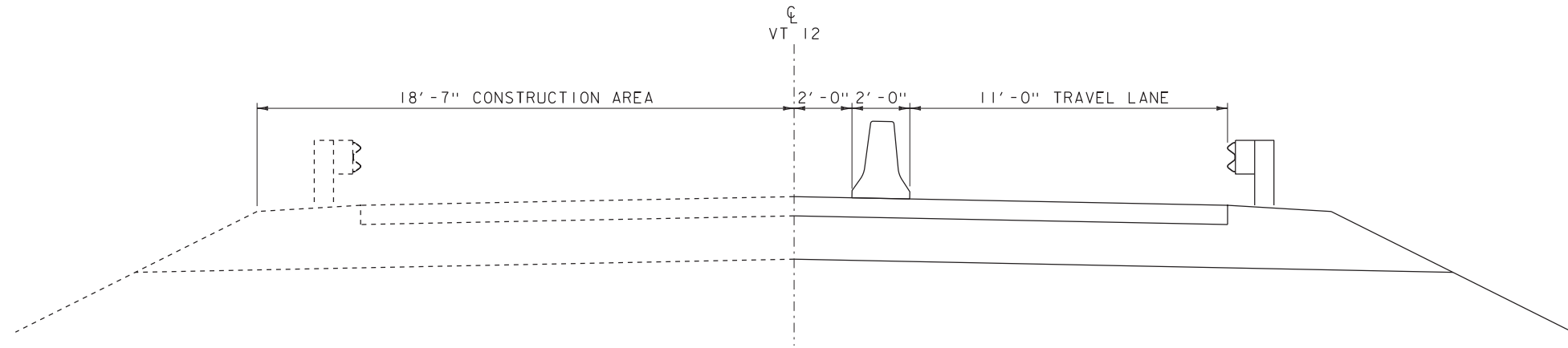
NOTE:  
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG CL  
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG CL

PROJECT NAME: ELMORE  
PROJECT NUMBER: BF 0241(55)

FILE NAME: I2b212/st2b212profile.dgn  
PROJECT LEADER: L.J.STONE  
DESIGNED BY: -----  
NEW BRIDGE PROFILE SHEET

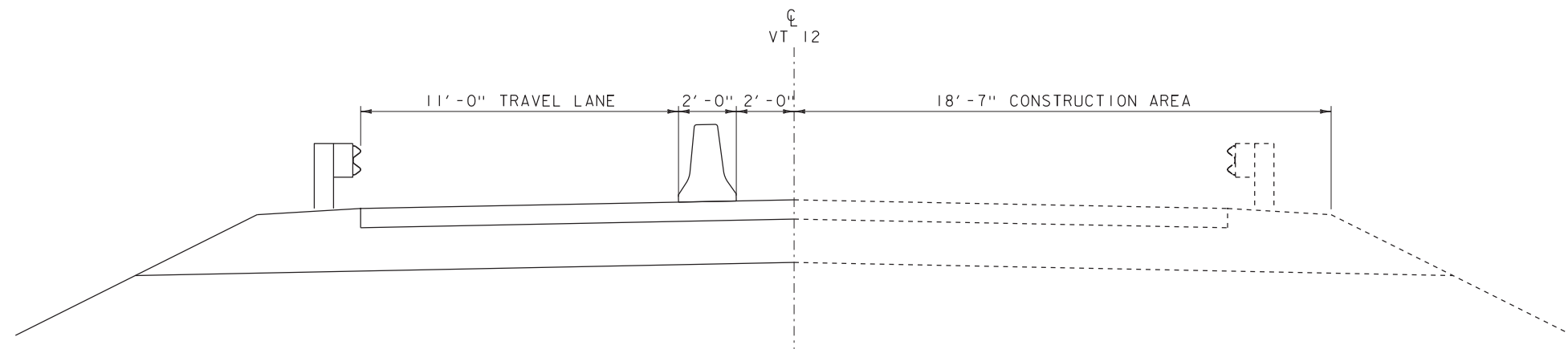
PLOT DATE: 12-MAR-2020  
DRAWN BY: D.D.BEARD  
CHECKED BY: -----  
SHEET 14 OF 19





PHASE 1 TYPICAL SECTION

SCALE  $\frac{3}{8}$ " = 1'-0"

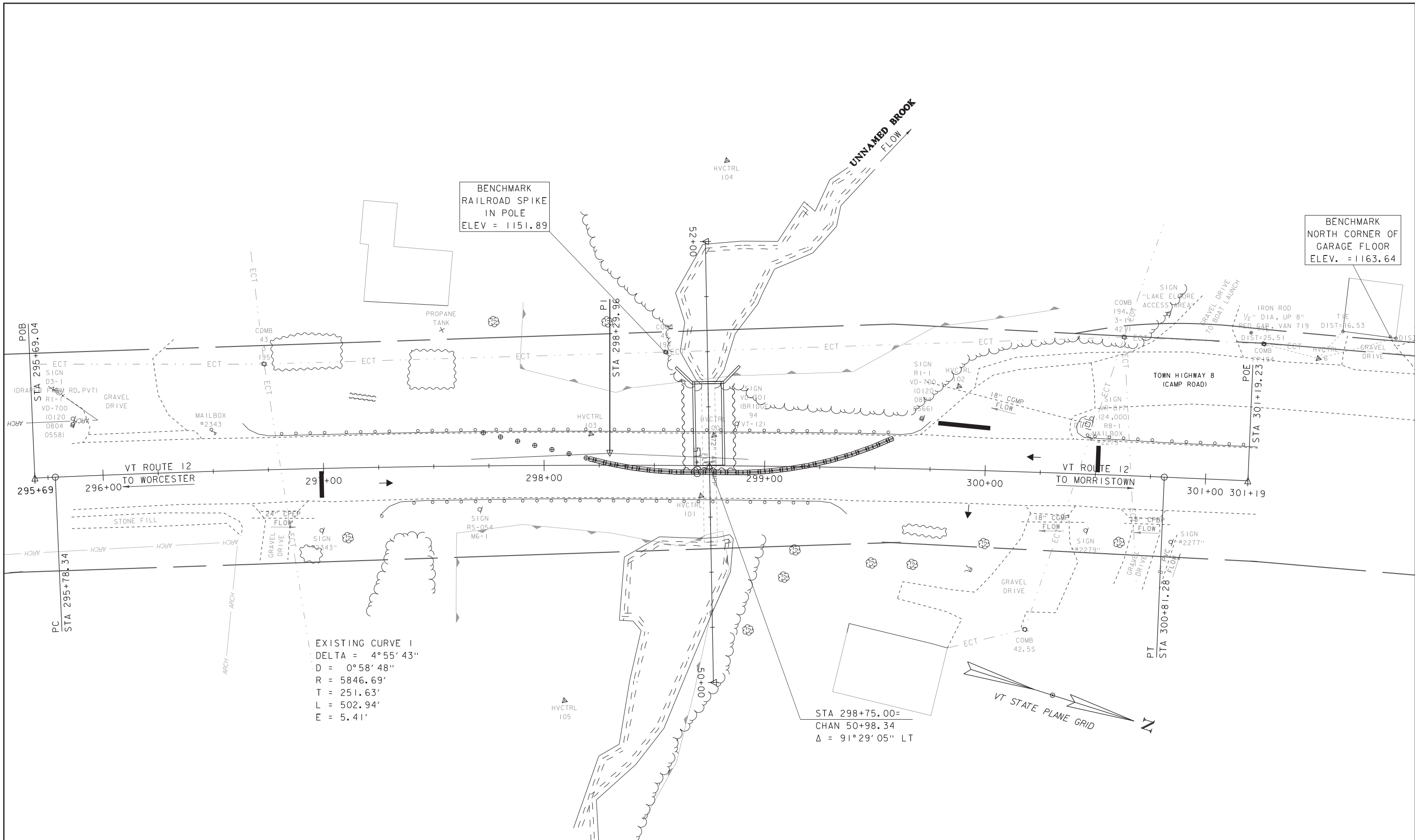


PHASE 2 TYPICAL SECTION

SCALE  $\frac{3}{8}$ " = 1'-0"

PROJECT NAME: ELMORE  
 PROJECT NUMBER: BF 0241(55)

FILE NAME: I9b212\sb9b212\typical.dgn	PLOT DATE: 12-MAR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: -----	CHECKED BY: -----
NEW BRIDGE TYPICAL SECTIONS	SHEET 15 OF 19



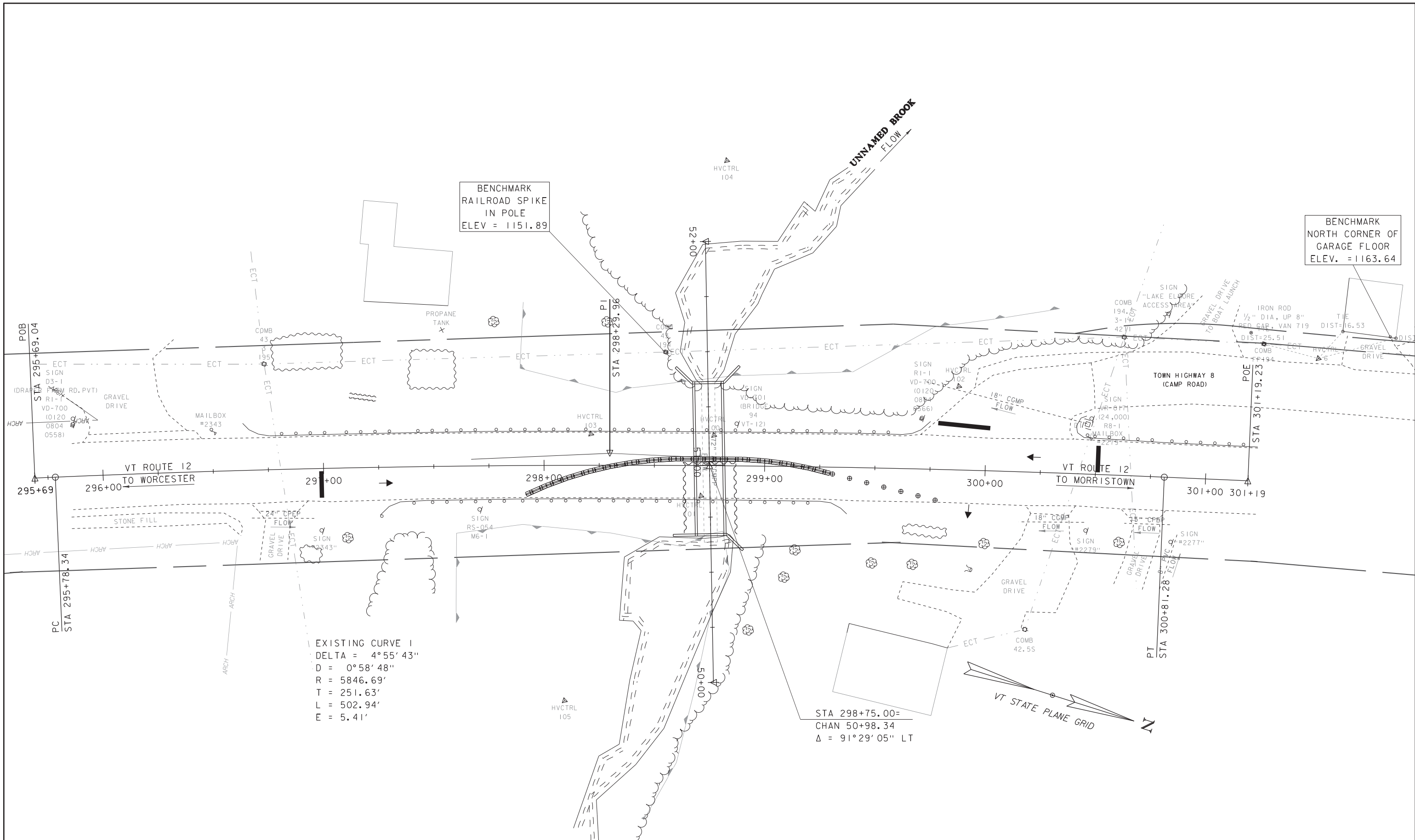
EXISTING BRIDGE INFORMATION  
 BUILT 1959,  
 74' LONG ACCGMPP, 72" DIA.  
 28 SQ FT WATERWAY AREA  
 10' AVERAGE COVER

EXISTING CURVE 1  
 DELTA = 4°55'43"  
 D = 0°58'48"  
 R = 5846.69'  
 T = 251.63'  
 L = 502.94'  
 E = 5.41'

PHASE I LAYOUT

SCALE 1" = 20' - 0"  
 20 0 20

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: I9b212/s19b212Tcborder.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 16 OF 19
DESIGNED BY: -----	
PHASE I LAYOUT SHEET	

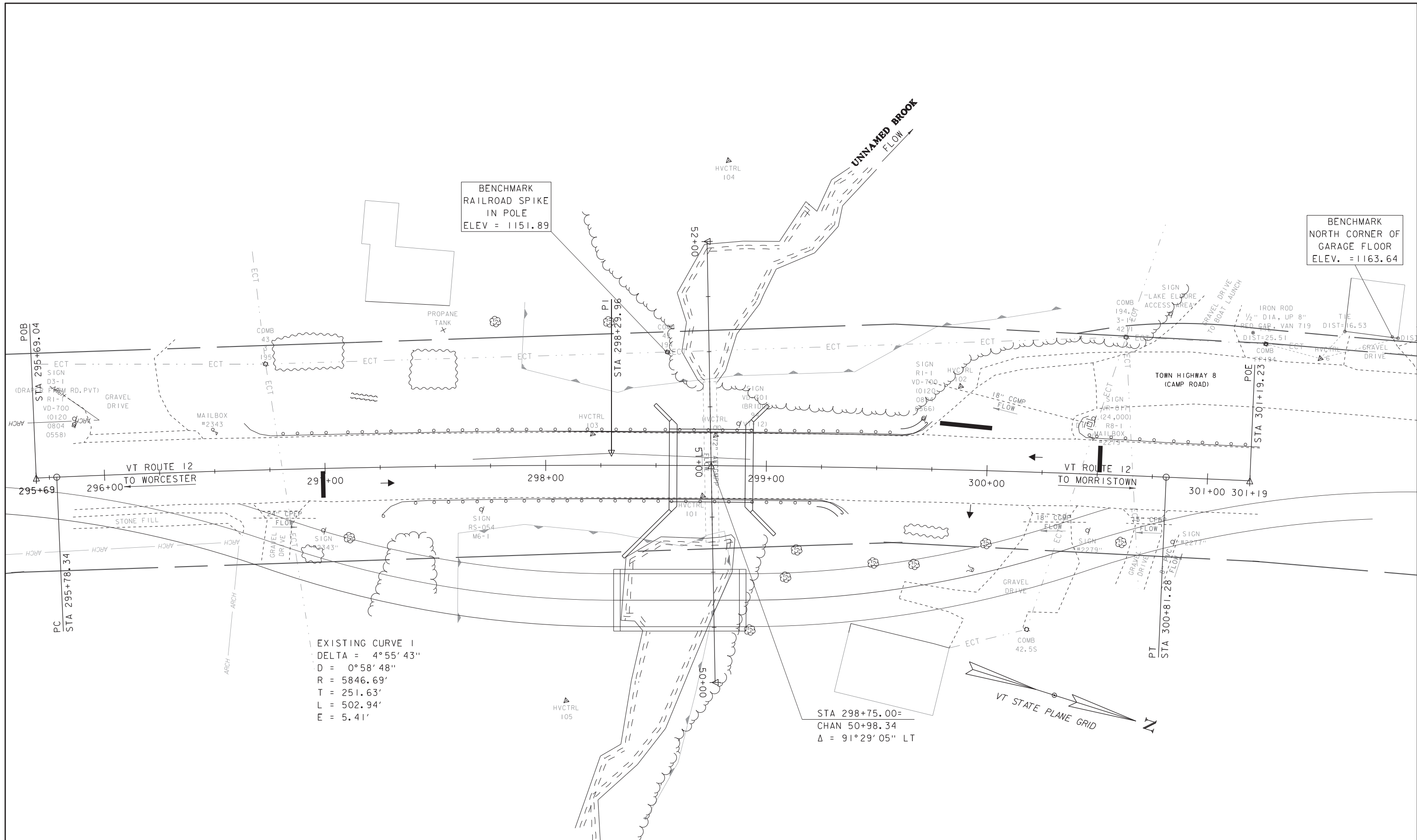


EXISTING BRIDGE INFORMATION  
 BUILT 1959,  
 74' LONG ACCGMPP, 72" DIA.  
 28 SQ FT WATERWAY AREA  
 10' AVERAGE COVER

PHASE 2 LAYOUT

SCALE 1" = 20'-0"  
 20 0 20

PROJECT NAME: ELMORE	PLOT DATE: 12-MAR-2020
PROJECT NUMBER: BF 0241(55)	DRAWN BY: D.D.BEARD
FILE NAME: I9b212/s19b212Tcborder.dgn	CHECKED BY: -----
PROJECT LEADER: L.J.STONE	SHEET 17 OF 19
DESIGNED BY: -----	
PHASE 2 LAYOUT SHEET	



BENCHMARK  
RAILROAD SPIKE  
IN POLE  
ELEV = 1151.89

BENCHMARK  
NORTH CORNER OF  
GARAGE FLOOR  
ELEV. = 1163.64

EXISTING CURVE 1  
DELTA = 4°55'43"  
D = 0°58'48"  
R = 5846.69'  
T = 251.63'  
L = 502.94'  
E = 5.41'

STA 298+75.00=  
CHAN 50+98.34  
Δ = 91°29'05" LT

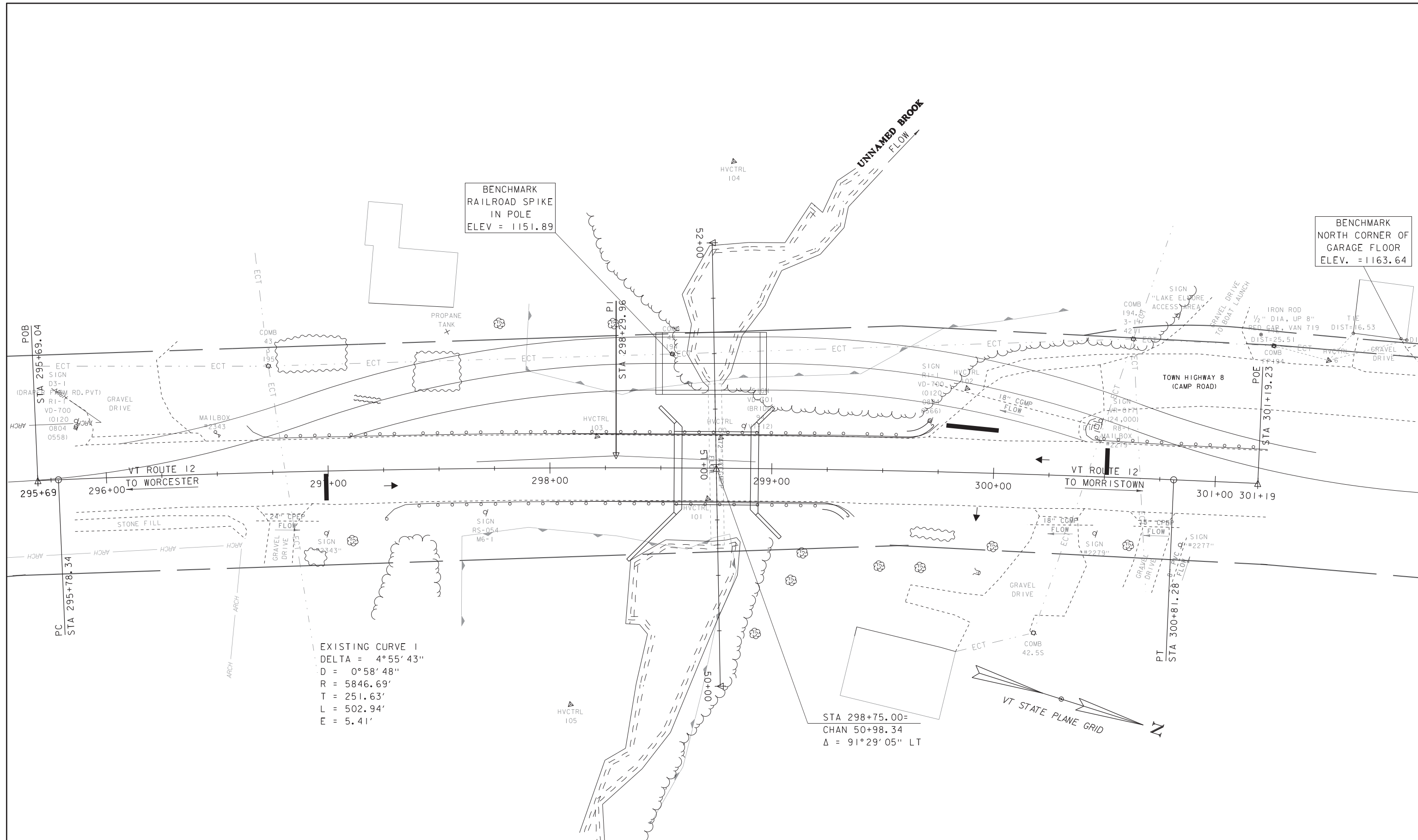
UPSTREAM TEMPORARY BRIDGE LAYOUT

SCALE 1" = 20' - 0"  
20 0 20

EXISTING BRIDGE INFORMATION  
BUILT 1959,  
74' LONG ACCMPP, 72" DIA.  
28 SQ FT WATERWAY AREA  
10' AVERAGE COVER

PROJECT NAME:	ELMORE	PLOT DATE:	12-MAR-2020
PROJECT NUMBER:	BF 0241(55)	DRAWN BY:	D.D.BEARD
FILE NAME:	I9b212/s19b212Tborder.dgn	CHECKED BY:	-----
PROJECT LEADER:	L.J.STONE	UPSTREAM TEMP BRIDGE LAYOUT SHEET	SHEET 18 OF 19





BENCHMARK  
RAILROAD SPIKE  
IN POLE  
ELEV = 1151.89

BENCHMARK  
NORTH CORNER OF  
GARAGE FLOOR  
ELEV. = 1163.64

EXISTING CURVE 1  
DELTA = 4°55'43"  
D = 0°58'48"  
R = 5846.69'  
T = 251.63'  
L = 502.94'  
E = 5.41'

STA 298+75.00=  
CHAN 50+98.34  
Δ = 91°29'05" LT

DOWNSTREAM TEMPORARY BRIDGE LAYOUT

SCALE 1" = 20' - 0"  
20 0 20

EXISTING BRIDGE INFORMATION  
BUILT 1959,  
74' LONG ACCMPP, 72" DIA.  
28 SQ FT WATERWAY AREA  
10' AVERAGE COVER

PROJECT NAME:	ELMORE
PROJECT NUMBER:	BF 0241(55)
FILE NAME:	I9b212/sl9b212Tcborder.dgn
PROJECT LEADER:	L.J.STONE
DESIGNED BY:	-----
DOWNSTREAM TEMP BRIDGE LAYOUT SHEET	
PLOT DATE:	12-MAR-2020
DRAWN BY:	D.D.BEARD
CHECKED BY:	-----
SHEET	19 OF 19