STATE OF VERMONT
AGENCY OF TRANSPORTATION

Scoping Report

FOR

Waterford BF 0225(5)

VT ROUTE 18, BRIDGE 2 OVER UNNAMED BROOK

February 17, 2016

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I. Site Information

Bridge 2 is a State owned bridge located on VT Route 18 in a rural area. The bridge is approximately 7.6 miles south of the intersection of VT Route 18 and US Route 2. The bridge is at a skew to the roadway and is located on a horizontal curve under an average of 13 feet of fill. There is heavy truck traffic on this stretch of road. 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	Rural Major Collector (State Highway)
Bridge Type	Corrugated Metal Plate Pipe
Culvert Span	8 feet
Year Built	1981
Ownership	State of Vermont

Need

Bridge 2 carries VT Route 18 across an unnamed Brook. The following is a list of deficiencies of Bridge 2 and VT Route 18 in this location:

1. The culvert is in serious condition. There is severe piping evident by recent patching along the travel lane. There are holes throughout the culvert, with severe holes at the outlet end.

2. The existing culvert does not meet the calculated bank full width.

3. VT Route 18 though the project area is not banked sufficiently for the horizontal curve.

Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2015 and 2035.

TRAFFIC DATA	2015	2035
AADT	1100	1100
DHV	150	150
ADTT	90	130
%T	6.2	8.5
%D	57	57

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 1,100, a DHV of 150, and a design speed of 50 mph for a Rural Major Collector.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 5.3	12'/4' (32')	11'/3' (28')[1]	
Bridge Lane and Shoulder Widths	VSS Section 5.7	12'/4' (32')	11'/3' (28')[1]	
Clear Zone Distance	VSS Table 5.5		16' fill / 10' cut (1:3) 12' cut (1:4)	
Banking	VSS Section 5.13	6.2%	8% (max)	Substandard
Speed		50 mph	50 mph (Design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	R = 955'	R_{min} = 1480' @ e = 6.2% R_{min} = 901' @ e = 7.8%	Substandard
Vertical Grade	VSS Table 5.6	5.9294% (max)	7% (max) for rolling terrain	
K Values for Vertical Curves	VSS Table 5.1	K_{crest} = 94	110 crest / 90 sag	Acceptable
Vertical Clearance	VSS Section 5.8	No Issues Noted	14'-3" (min)	
Stopping Sight Distance	VSS Table 5.1	451'	400'	
Bicycle/Pedestrian Criteria	VSS Table 5.8	4' shoulder	2' Shoulder	
Bridge Railing	Structures Design Manual Section 13	N/A	TL-3	
Hydraulics	VTrans Hydraulics Section	Roadway not overtopped below the Q_{50} flow, Does not meet minimum bankfull width of 16'	Pass Q_{50} storm event with no roadway overtopping	Acceptable
Structural Capacity	SM, Ch. 3.4.1	Structurally Deficient	Design Live Load: HL-93	Substandard

Inspection Report Summary

Culvert Rating 3 Serious
Channel Rating 6 Satisfactory

11/20/14 – Poor condition, recent patching along travel lane due to severe piping activity that is occurring. Holes are throughout and most severe toward outlet. Pipe needs repairs or replacement. ~MJK/JAS

11/26/2013 – Culvert should be evaluated for a concrete invert or a sleeve in the near future. ~FRE/JAS

11/16/11 – Poor condition, piping is occurring and roadway has been shimmed & patched. Pipe has holes through north side just above the invert and random holes along south side. Unable to view all invert due to fish ladder holding back material. Pipe needs repairs soon ~MK/JM

[1] The Vermont State Standards specifies a minimum lane and shoulder width of 10'/2'. As per HSDEI 11-004, a 14' minimum paved width shall be provided for State plow trucks.

05/24/06 – Culvert is in fair condition. Scattered small holes are forming. Shape is still good except for some damage at the inlet.

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 16-foot width ANR calculation for bank full width. Due to the height of fill over the culvert, hydraulics has considered a 7-foot diameter liner acceptable. Due to increased velocities however, special downstream rock weirs would need to be constructed for the liner option. Hydraulics has also made several recommendations for a replacement structure; these options are outlined in the preliminary hydraulics report in the Appendix. 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

- The Town of Waterford does not have any water or sewer mains anywhere near this area.

Public Utilities

Underground:

- There are no buried utilities between Riverside Cemetery Road (TH 43) and Shadow Lake Road (TH 19).

Aerial:

- There are no electric lines in close proximity to the bridge. The nearest power lines are several hundred feet to the north where VT Route 18 passes under I-93.

- There are 3 communication cables which parallel VT Route 18 on the east side thru the entire project area. These cables are owned by Comcast, New Hampshire Optic Systems, and FairPoint. FairPoint will be the pole setter on this project.

It is anticipated that overhead utilities will not have to be relocated for construction for the preferred alternative.

Right Of Way

The existing Right-of-Way is plotted on the Existing Conditions Layout Sheet. This Right-Of-Way is not centered on the centerline of VT Route 18. Approximately 7 feet of the existing pipe is located outside the State owned Right-Of-Way, and as such, it is anticipated that Right-Of-Way will be required for all alternatives.

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 small class III wetlands have been identified within the vicinity of the culvert on VT Route 18.

Wetland 1 is located on the northeast quadrant of the project area on the upstream end and is a forested\emergent wetland which is likely less than 0.5 acres in size. The wetland is dominated by the following species:

- Red Maple (*Acer rubrum*), American Basswood (*Tilia Americana*), Green Ash (*Fraxinus Americana*), Ironwood (*Carpinus Caroliniana*), NE Aster (*Symphyotrichum Novae-Angliae*), Sensitive fern (*Onoclea Sensibilis*), and Horsetail (*Equiseteum Arvense*), and Goldenrod (*Eutharria Graminifolia and Solidago Gigentea*).

Loamy soils with redox concentrations and depletions were found meeting criteria for hydric soils. Signs of hydrology were saturation, high water table and geomorphic position. The wetland has limited function and value due to its size and position in landscape.

Wetland 2 is located in the northwest quadrant of the project area on the downstream end and is within the Right-of-Way for I-93. The wetland is an emergent wetland mostly dominated by the following species:

- Sedges (*Carex Spp.*), Reed Canary Grass (*Phalaris Arundinacea*), Jewelweed (*Impatiens Capensis*) and Sensitive Fern (*Onoclea Sensibilis*).

It is highly unlikely that this project will impact either of these wetland areas. The soils are hydric and there is saturation and a high water table within this wetland.

An unnamed tributary of the Connecticut River flows through the project area. The watershed appears to be flashy as there was erosion on the banks and debris accumulation in and around the culvert.

Wetlands and below ordinary high (OHW) water are regulated by the US Corps of Engineers at this location. For permitting purposes, VTrans will need to demonstrate that impacts to all aquatic resources have been avoided and minimized.

All wetlands include a 50' regulated buffer zone.

Rare, Threatened, and Endangered Species

The VTrans Environmental Biologist conducted a search of VT Agency of Natural Resources-Wildlife Diversity mapping and found that there are no occurrences 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

According to VT Fish and Wildlife mapping, the wildlife habitat blocks are of lower value at this site. This structure has been evaluated by VT Fish and Wildlife, fisheries biologist in the past, and aquatic organism passage (AOP) was requested at that time. This structure has been retrofitted to pass aquatic organisms. Any alternative considered will need to maintain or improve AOP as per VT Fish and Wildlife.

Agricultural Soils

Prime agricultural soils are present in the vicinity of Bridge 2. The soils are mapped as Moosilauke very fine sandy loam, which is a poorly-drained soil.

Hazardous Materials:

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there is a hazardous waste site located approximately 760 feet west of the culvert. There will be no impacts to this site due to the project.

Historic:

Bridge 2 is not historic and there are no historic or Section 4(f) resources in the project area.

Archeological:

The VTrans Archaeology Officer conducted a resource identification on 10-8-15 and found two areas of archaeological sensitivity. The southwest quadrant contains a high landform between VT 118 and I-93 that is undisturbed. The landform is situated within 200 meters north of the Connecticut River and is in close proximity to watercourses that drain into the Connecticut River and therefore, any undisturbed areas can be considered sensitive for Pre-Contact archaeological resources. The southeast quadrant contains a cemetery. 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

The project area is not in a high crash area. There has been only one crash within 500 feet of the culvert from 2010 to 2014. The existing conditions within the project area are considered adequate for the purposes of safety with the exception of the existing culvert.

III. Alternatives Discussion

No Action

This alternative is not recommended. The culvert is in serious condition, and will continue to deteriorate if no action is taken. Additionally, there is a large drop at the outlet of the culvert making it impossible to pass fish. Something will have to be done to improve this culvert in the near future. Although the culvert does not appear to be in imminent danger of collapse, it will eventually be posted for lower traffic loads. 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.

Rehabilitation

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

Rehabilitation work for a culvert rated in serious condition would require a repair option that would improve the structural integrity of the pipe. A culvert slip liner would be able to restore structural integrity while extending the remaining life of the culvert 40 to 50 years. It is desired to extend the remaining life of this culvert since the existing culvert is only 34 years old and has not reached the desired design life.

For this option, the existing steel baffles that are welded to the pipe would have to be removed. Hydroblasting or hydrodemolition would then be used 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. A liner would then be inserted into the existing pipe, and the void between the existing culvert and the liner would be filled with concrete. Curing in dry conditions would be required, necessitating a re-routing of the stream flow during the work and for a prescribed curing period (usually 24 hours). A headwall with full cutoff walls to frost depth and beveled inlets would be recommended. Since this stream has been identified by the Agency of Natural Resources as being of particular significance, aquatic organism passage would have to be accommodated. Therefore new baffles would have to be placed in the liner and several rock weirs would have to be placed in the downstream channel in order to provide pools for trout to make it upstream of the culvert.

Due to the rapid deterioration of the existing culvert, it is recommended that the VTrans Materials and Research section test the stream water for corrosiveness and make a recommendation on the liner material based on the results.

Advantages: This alternative would address the structural deficiencies of the existing bridge, with minimum upfront costs and minimal disruptions to traffic. This option would provide adequate AOP.

Disadvantages: The existing culvert does not meet the minimum bank full width standard, and this option would slightly reduce the bank full width. The roadway banking through the project area would not be brought up to standard for this option. This option would require Right-of-Way acquisition.

Culvert Replacement – New Buried Structure

This option involves removing the existing corrugated metal plate pipe, and replacing it with a new buried structure having a waterway opening of at least 14 feet wide and 5 feet high.

Since there is an average of 13 feet of fill above the existing bridge/culvert, there would not have to be an extremely large amount of earthwork, making this a good site for a new precast buried structure. Any new structure should have flared wingwalls and headwalls extending down at least four feet, 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 current roadway width is 32 feet. This exceeds the minimum standard of 28 feet. Since a new 80+ year structure is being proposed, the roadway geometry should meet the minimum standards. A 32-foot width roadway will be proposed through the project area to match the existing.

b. Structure Type

The most common structure types for the recommended hydraulic opening are 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 opened bottom structure, since footings would not have to be placed six feet below the stream bed.

c. Culvert Size, Length and Skew

The existing bridge/culvert has a minimum span of 8 feet, which constricts the natural channel width. Hydraulics has recommended a box with a minimum 14 feet wide and 8-foot-high inside opening, with the invert buried 3 feet, resulting in a 14-foot by 5-foot waterway opening. The Waterford Bridge 7 project is utilizing 16-foot by 8-foot box culvert sections, and it is recommended that if Bridge 2 were to be replaced along with the Bridge 7 project, the size should match Bridge 7 for simplicity. The new box culvert should have 12-inch-high bed retention sills spaced no more than 8 feet apart. The top of the sills should be buried 2 feet, resulting in a waterway opening with a rise of 5 feet. This culvert will have no roadway overtopping up to the Q_{50} design flow. The culvert will have a skew of 55 degrees to the roadway to match the existing skew of the channel. In order to accommodate a 32-foot-wide roadway with that culvert skew, the proposed barrel length will be 120 feet long.

d. Roadway Alignment

The existing horizontal alignment does not meet the minimum standard. The banking would be modified as much as possible to get closer to standard, but may not be able to meet standard. Additionally, the vertical alignment meets current geometric standards. As such, both the horizontal and vertical alignment will remain unchanged.

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 an 80-year design life. This option would meet the minimum hydraulic standards and provide adequate AOP. The roadway banking through the project area would be improved for this option.

Disadvantages: This option has the highest upfront costs. This option would require Right-of-Way acquisition.

IV. Maintenance of Traffic

The Vermont Agency of Transportation reviews each new project to determine suitability for the Accelerated Bridge Program, which focuses on expedited delivery of plans and specifications, permitting, and Right-of-Way, as well as accelerated construction of projects in the field. One practice that helps this endeavor is closing bridges for portions of the construction period, rather than providing temporary bridges thereby reducing project impacts. In addition to saving money, the intention is to minimize the closure period with faster construction techniques and incentives to contractors to complete projects sooner. 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 also expedites construction schedules. This applies to bridge decks, superstructures, and substructures. Accelerated Bridge Construction also 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 culvert and reroute traffic onto Interstate-93, back to NH/VT Route 18. This regional detour has an end-to-end distance of 17.3 miles. This detour adds approximately 0.3 miles to travel distance.

There are several local bypass routes that may see an increase in traffic from local passenger cars. Local bypass routes are not signed detours, but may experience higher traffic volumes if VT Route 18 is closed during construction. The most likely local bypass routes are as follows:

1. VT Route 18, to Shadow Lake Road, Old County Road, and Riverside Cemetery Road, back to VT Route 18 (2.9 mi end-to-end)

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

Advantages: This option would eliminate the need for a temporary bridge or phased construction, which would significantly decrease cost and time of construction. Additionally, this option would have the least impacts to adjacent properties and environmental resources.

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

Option 2: Phased Construction

Phased construction is the maintenance of one way alternating traffic on the existing bridge while building one lane at a time of the proposed structure. This allows the road to be kept open during construction, while having minimal impacts to adjacent property owners. There is an average of 13 feet of fill with a maximum of 20 feet of fill over the existing culvert. This would require large amounts of fill to be retained during construction and sheet piling to provide stability to the one lane of alternating one-way traffic increasing the overall cost of the project.

Based on the traffic volumes, it is reasonable to close one lane of traffic, and maintain one lane of alternating one-way traffic with a traffic signal.

The phasing for this site could be accomplished in 2 phases. The layout of this phasing sequence can be found in the Appendix. The following is a description of the phases:

- Phase 1: A single lane open to traffic on the downstream side of the road, over the existing culvert. During this phase, a portion of the existing culvert would be removed and replacement with precast culvert sections would be installed on the upstream side of the road.

- Phase 2: A single lane open to traffic on the upstream side of the road, over the new culvert sections that were placed in Phase 1. During this phase, the remaining portion of the existing culvert would be removed and replaced with precast culvert sections installed on the downstream side of the road. The channel flow would be established in the new culvert at this time.

Advantages: Traffic flow would be maintained through the project corridor during construction. Also, this option would have minimal impacts to adjacent properties, threatened species, surrounding wetlands, and wooded areas.

Disadvantages: Phased construction generally involves higher costs and complexity of construction. Costs are usually higher and construction duration is longer, since many construction activities have to be performed multiple times. Additionally, since cars are traveling near construction activity, there is decreased safety. There would be some delays and disruption to traffic, since the road would be reduced to one-way alternating traffic.

Option 3: Temporary Bridge

From a constructability standpoint, a temporary bridge could be placed on either the upstream or downstream side of the existing culvert. There would be a significant amount of tree clearing for a temporary bridge on both sides of VT Route 18. Additionally, either an upstream or downstream temporary bridge would have temporary impacts to the intersection with Cemetery Road. An upstream temporary bridge would have shorter approaches, but would require an aerial utility relocation. Both an upstream and downstream temporary bridge would have impacts to wetlands and would require additional rights from adjacent property owners. A temporary bridge would require tree clearing that could have impacts to the Northeast Long Eared Bat habitat.

A one-way temporary bridge with traffic signals would be required based on the daily traffic volumes and sight distance. See the Temporary Bridge Layout Sheets in the Appendix.

Advantages: Traffic flow can be maintained through the project corridor during construction.

Disadvantages: This option would require additional Right-of-Way acquisition for placement of the temporary bridge. This option would have adverse impacts to adjacent properties, threatened species, and other environmental resources. 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.

V. Alternatives Summary

Based on the existing site conditions, bridge condition, and recommendations from hydraulics, there are several viable alternatives:

Alternative 1a: Culverts Liner with Aquatic Organism Passage
Alternative 2a: New Precast Box Culvert with Traffic Maintained on Offsite Detour
Alternative 2b: New Precast Box Culvert with Traffic Maintained with Phased Construction
Alternative 2c: New Precast Box Culvert with Traffic Maintained on a Temporary Bridge

VI. Cost Matrix[2]

Waterford BF 0225(5)		Do Nothing	Alt 1a	Alt 2a	Alt 2b	Alt 2c
			Culvert Liner with AOP	16' x 8' Precast Reinforced Concrete Box		
			Temporary Lane Closures	Offsite Detour	Phased Construction	Temporary Bridge
COST	Bridge Cost	$0	$332,320	$778,000	$816,900	$778,000
	Removal of Structure	$0	$20,000	$20,000	$25,000	$20,000
	Roadway	$0	$102,296	$197,000	$209,000	$221,000
	Maintenance of Traffic	$0	$10,000	$30,000	$120,000	$115,000
	Construction Costs	$0	$464,620	$1,025,000	$1,170,900	$1,134,000
	Construction Engineering + Contingencies	$0	$140,000	$308,000	$352,000	$341,000
	Total Construction Costs w CEC	**$0**	**$604,620**	**$1,333,000**	**$1,522,900**	**$1,475,000**
	Preliminary Engineering[3]	**$0**	**$152,000**	**$267,000**	**$305,000**	**$295,000**
	Right of Way	**$0**	**$20,000**	**$20,000**	**$20,000**	**$20,000**
	Total Project Costs	$0	$776,620	$1,620,000	$1,847,900	$1,790,000
	Annualized Costs	$0	$15,600	$20,300	$23,100	$22,400
SCHEDULING	Project Development Duration[4]		2 years	2 years	2 years	2 years
	Construction Duration		2 months	3 months	8 months	8 months
	Closure Duration (If Applicable)		N/A	1 week	N/A	N/A
ENGINEERING	Typical Section - Roadway (feet)	32'	32'	32'	32'	32'
	Typical Section - Bridge (feet)	4-12-12-4	4-12-12-4	4-12-12-4	4-12-12-4	4-12-12-4
	Geometric Design Criteria	No Change	Substandard Roadway Banking	Improved Banking	Improved Banking	Improved Banking
	Traffic Safety	No Change	Improved	Improved	Improved	Improved
	Alignment Change	No	No	No	No	No
	Bicycle Access	No Change	No Change	No Change	No Change	No Change
	Hydraulic Performance	Substandard BFW	Substandard BFW	Meets Standard	Meets Standard	Meets Standard
	Pedestrian Access	No Change	No Change	No Change	No Change	No Change
	Utility	No Change	No Change	No Change	No Change	Possible Relocation
OTHER	ROW Acquisition	No	Yes	Yes	Yes	Yes
	Road Closure	No	No	Yes	No	No
	Design Life	<10 years	40 years	80 years	80 years	80 years

[2] Costs are estimates only, used for comparison purposes.
[3] Preliminary Engineering costs are estimated starting from the end of the Project Definition Phase.
[4] Project Development Durations are starting from the end of the Project Definition Phase.

VII. Conclusion

Alternative 2a is recommended; to replace the existing culvert with a precast box culvert.

Structure:
The existing culvert is only 34 years old and has not reached the end of its anticipated design life. However, the metal culvert has deteriorated at a rapid rate and is in serious condition. Additionally, the current culvert does not meet the minimum hydraulic standard for bank full width. Aquatic organism passage (AOP) is important for this culvert, and with the current size and slope, as well as a drop at the outlet of the existing culvert, velocities may be too fast to design a culvert liner for AOP. As such, a culvert replacement is recommended.

The new culvert will be a 16-foot x 8-foot precast concrete box culvert, in order to meet the VTrans Hydraulic Section's recommendation and to match the dimensions of the culvert 7 project for cost savings in production. The new precast box will have 12-inch-high 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 36 inches and stone should be placed along the length of the channel bottom through the culvert, resulting in a 5-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_{50} storm event.

Traffic Control:
The recommended method of traffic control is to close the culvert for one week, and maintain traffic on an offsite detour. The detour for this project location would add approximately 15.5 miles to the through route, and have an end-to-end distance of 32 miles. There is a local bypass route which would most likely be used by local traffic. This route adds 2.8 miles to the through route, and has an end-to-end distance of 2.9 miles. The option to close the road is the least expensive and the safest option. It seems reasonable to close the road since the benefits outweigh the temporary inconvenience.

VIII. Appendices

- Site Pictures
- Town Map
- Bridge Inspection Report
- Hydraulics Memo
- Preliminary Geotechnical Information
- Natural Resources Memo
- Archeology Memo
- Local Input
- VTrans Operations Input
- Detour and Local Bypass Maps
- Plans
    - Existing Conditions
    - Alternative 1 Proposed Typical Section, Layout, and Profile
    - Alternative 2 Proposed Typical Sections, Layouts, and Profile
    - Phasing Layouts

Looking South over bridge

Looking North over bridge

Inlet End

Outlet End

Holes in Corrugated Metal Pipe

Repaired Sink Hole

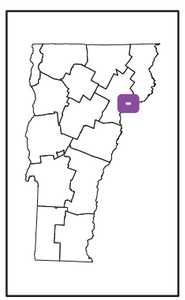
Waterford VT Route 18, Bridge 2

Scale 1:48,778

N

- INTERSTATE
- STATE LONG
- STATE SHORT
- TOWN LONG
- FAS/FAU
- INTERSTATE
- STATE HIGHWAY
- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4
- LEGAL TRAIL
- PRIVATE
- DISCONTINUED
- DISTRICT
- POLITICAL BOUNDARY
- NAMED RIVERS-STREAMS
- UNNAMED RIVERS-STREAMS
- VOBCIT Bridge Data
- VOBCIT Culvert Data

Produced by:
Mapping Unit
Vermont Agency of Transportation
June 2014



WATERFORD
CALEDONIA COUNTY
DISTRICT # 7

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

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

Inspection Report for WATERFORD **bridge no.:** 0002 **District:** 7

Located on: VT18 **over** BROOK **approximately** 7.6 MI S JCT US 2 **Maintained By:** STATE

CONDITION

Deck Rating: N NOT APPLICABLE

Superstructure Rating: N NOT APPLICABLE

Substructure Rating: N NOT APPLICABLE

Channel Rating: 6 SATISFACTORY

Culvert Rating: 3 SERIOUS

Federal Str. Number: 300225000203161

AGE and SERVICE

Year Built: 1981 **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): 0

ADT: 910 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 8

Structure Length (ft): 8

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): 34

Skew: 35

Bridge Median: 0 NO MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 08 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CGMPP

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): 122

Average Cover Over Culvert (ft): 20

Waterway Area Through Culvert (sq.ft.): 50

Culvert Wing/Header Rating: 7 GOOD CONDITION

Steel Culvert Corrosion Indicator: 3 PERFORATIONS > 2" INLET/OUTLET ONLY

Multi Plate Culvert Bolt Line Crack Indicator: 0 NO BOLT LINE CRACKS PRESENT

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 112014 **Inspection Frequency (months):** 12

INSPECTION SUMMARY and NEEDS

11/20/14 Poor condition, recent patching along travel lane due to severe piping activity that is occurring. Holes are throughout and most severe toward outlet. Pipe needs repairs or replacement. MJK JAS

11/26/2013 Culvert should be evaluated for a concrete invert or a sleeve in the near future. ~FRE/JAS

11/16/11 Poor condition, piping is occurring and roadway has been shimmed & patched. Pipe has holes through north side just above the invert and random holes along south side. Unable to view all invert due to fish ladder holding back material. Pipe needs repairs soon MK JM

Culvert is in fair condition. Scattered small holes are forming. Shape is still good except for some damage at the inlet. 05/24/06

VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION

HYDRAULICS UNIT

TO: Jennifer Fitch, P.E., Structures Project Manager

FROM: Leslie Russell, P.E., Hydraulics Project Manager

DATE: 14 September 2015

SUBJECT: Waterford BF 0225(5) Preliminary Hydraulics
VT 18 BR 2 over unnamed brook

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

Existing Conditions

The existing structure is a CGMPP that is 8' in diameter. 1' – 4" high steel baffles were placed inside the pipe in an attempt to provide aquatic organism passage through the pipe. The structure provides a waterway opening of about 45 sq. ft. The pipe invert is deteriorating.

Our calculations, field observations and measurements indicate the existing structure meets the current standards of the VTrans Hydraulic Manual. However, it does not meet the state stream equilibrium standards for bankfull width (span length). The existing structure constricts the channel width, resulting in an increased potential for debris and ice blockage. Headwater depths are 7.2' at 2% Annual Exceedance Probability (AEP) and 8.0' at 1% AEP.

Liner Comments

Due to the high fill over the pipe, a pipe liner has been considered. This option will increase headwater depths, as well as, outlet velocities. The downstream channel will need to be built up with weirs if aquatic organism passage is still required.

A 7' diameter liner can be installed within this pipe. It can have up to 1' high baffles. This structure would have approximately 35.1 sq. ft. of waterway area. Headwater depths would be about 6.7' at 2% Annual Exceedance Probability and a HW/D ratio = 1.1. At 1% AEP, the headwater depth will be 7.8' with a HW/D = 1.3, which meets hydraulic requirements. A full height headwall will reduce the headwater to depth ratios slightly and this should be considered if a liner is used**. It should be noted that this option raises the outlet velocities from 17. 2 fps to 21.1 fps at 1% AEP. Therefore, special stone will have to be used to build up the downstream channel. Also, this option requires the downstream channel to be built up more for aquatic organism passage than a new structure would require.**

Replacement Recommendations

In sizing a new structure we attempt to select structures that meet both the current VTrans hydraulic standards, state environmental standards with regard to span length and opening height, and allow for roadway grade and other site constraints.

Based on the above considerations and the information available, we recommend any of the following structures as a replacement at this site:

1. A concrete box with a 14' wide by 8' high inside opening. The box invert should be buried 3'. That will result in a 14' wide by 5' high waterway opening above streambed, providing 70-sq. ft. of waterway area. Bed retention sills should be added in the bottom. Sills should be 12" high across the full width of the box. So the top of the sills will be buried 24" and not be visible. Sills should be spaced no more than

8’-0” apart throughout the structure with one sill placed at the inlet and one at the outlet. The box should be filled up to the stream bed level with stone graded to match the natural stream bed material that will keep flow above the surface. This structure will result in a headwater depth of 3.1’ at 2% AEP and 3.6’ at 1 %AEP.

2. An open bottom metal arch that is 14’ wide by 5.58’ high that will provide 58 sq. ft. of waterway area. This arch will have a headwater depth of 3.9’ at 2% AEP and 4.4’ at 1% AEP. Velocities are reasonable with this option at 13.5 fps at 1% AEP. With over 1’ of freeboard at 2% AEP, this arch is hydraulically adequate.

3. A precast concrete open bottom arch that is 14’ wide by 5’ high that provides 63.5 sq. ft. of waterway area. This arch will have a headwater depths similar to those above and will be hydraulically adequate with 1’ of freeboard at 2% AEP.

4. Any similar structure with a minimum clear span of 14’, a clear height of at least 5’ and at least 58-sq. ft. of waterway area, that fits the site conditions, could be considered. Any structure with a closed bottom should have bed retention sills and a buried invert as described above.

Prior to any further action toward implementation of any of the above recommendations, structure size and type must be confirmed, and may be modified, by the VT ANR River Management Engineer to ensure compliance with state environmental standards for stream crossing structures.

General Comments

If a new box is installed, we recommend it have full headwalls at the inlet and outlet. The headwalls should extend at least four feet below the channel bottom, or to ledge, to act as cutoff walls and prevent undermining.

If the open bottom arch option is installed, we recommend full height concrete headwalls be constructed at the inlet and outlet. The bottom of abutment footings under the arch should be at least six feet below the channel bottom, or to ledge, to prevent undermining. We recommend a minimum cover of 3’ over all metal arch structures. Pipe manufactures can provide specific recommendations for minimum and maximum fill heights and required pipe thickness. All structures are required to handle public highway loading.

It is always desirable for a new structure of this size to have flared wingwalls at the inlet and outlet, to smoothly transition flow through the structure, and to protect the structure and roadway approaches from erosion. The wingwalls should match into the channel banks. Any new structure should be properly aligned with the channel, and constructed on a grade that matches the channel. A new structure should span the natural channel width.

Stone Fill, Type IV should be used to protect any disturbed channel banks or roadway slopes at the structure’s inlet and outlet, up to a height of at least one-foot above the top of the opening. The stone fill should not constrict the channel or structure opening.

Please contact us if you have any questions or if we may be of further assistance.

LGR

cc: Hydraulics Project File via NJW

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Chris Williams, P.E., Structures Project Manager

From: Randall Massey, Technician Apprentice IV, via Callie Ewald, P.E., Senior Geotechnical Engineer

Date: August 21, 2015

Subject: Waterford BF 0225(5) Preliminary Geotechnical Information

1.0 INTRODUCTION

We have completed our preliminary geotechnical investigation for the replacement of an existing culvert located on VT Route 18 Br 2 approximately 7.6 miles south of the junction of US Route 2. Between the intersection of VT Route 18 and TH 47, and the intersection of VT route 18 and TH 43. The existing structure is an eight foot diameter corrugated metal plate pipe culvert constructed in 1981, well under the anticipated design life. This review included observations made during a site visit, the examination of historical in-house bridge boring files, as-built record plans, USDA Natural Resources Conservation soil survey records, published surficial and bedrock geologic maps, and water well logs on-file at the Agency of Natural Resources.

2.0 SUBSURFACE INFORMATION

2.1 Previous Projects

Record plans were found for the project. Data from multiple borings was included in the record plans. Based on blow counts and soil samples the soil was identified as dense to very dense sand, silt, and gravel with some cobbles and boulders. The logs did not include bedrock descriptions/elevations. Boring depths ranged from 17.8 to 26.0 feet.

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 one nearby project, Bridge No. 7 located on VT Route 18 over the Mad Brook, located approximately 2 miles north of the proposed culvert replacement. Data from two borings located approximately 50 feet apart were included in the record plans. The soil was reported as dense to very dense sand, silt, and gravel with minimal cobbles and boulders. The logs included bedrock descriptions as good rock with RMR ratings of 67 and 68. Bedrock elevations ranged from 873 to 883 feet.

2.2 Water Well Logs

Figure 1 contains the subject project as well as surrounding well locations found using the ANR Natural Resources Atlas. Published online, the logs can be used to determine general characteristics of soil strata in the area. The soil description given on the logs is done in the field, by unknown personnel, and as such, should only be used as an approximation. One water well nearby the project was used to get an estimate of the depth to bedrock likely to

be encountered for Bridge 3. The specific well used to gain information on the subsurface conditions is highlighted below by red box.

Figure 1. Highlighted well locations near subject project

From the single water well used in gathering the surrounding information, located approximately 500 feet away, the depth to bedrock was noted to be 120 feet below ground surface with and the overlying soils consisting of gravels.

2.3 USDA Soil Survey

The United States Department of Agriculture Natural Resources Conservation Service maintains an online surficial geology map of the United States. According to the Web Soil Survey, the strata directly underlying the project site consists of fine to very fine sandy loam at depths ranging from 1 to 18 inches with sand to coarse sand as depths ranging from 18 to 65 inches below ground surface. Slopes of 0-3% can be found within the soil strata. A depth to bedrock of greater than 80 inches and a depth to groundwater of 0 to 18 inches was also determined based on the USDA soil survey.

2.4 Geologic Maps of Vermont

Mapping conducted in 1970 for the Surficial Geologic map of Vermont shows that the project area is underlain by glaciolacustrine horizontally bedded gravel deposits and sandy loam on top of glacial till.

According to the 2011 Bedrock Map of Vermont, the project site is underlain with fine-grained feldspathic metasandstone and metasiltstone, and phyllite. Lesser amounts of quartzite. Rare calc-silicate nodules. Generally sharply bedded, but graded beds as well as slump structures are locally obvious.

3.0 FIELD OBSERVATIONS

A preliminary site visit was conducted on August 21, 2015 to determine possible obstructions inhibiting boring operations and to make any other pertinent observations about the project. Overhead power lines run along the east side of the existing culvert as shown in Figure 2. However with the available sight distance borings could be completed in the roadway if desired.

Figure 2: View at Culvert Location Looking South

According to record plans from previous construction and seen during a site visit, the existing foundations are founded on spread footings. No visible bedrock was seen during the site visit. The sides of the stream were armored with stone and the footings helped to prevent undermining, shown in Figure 3. There didn't appear to be any visible bedrock in the stream bed. However there were large amounts of cobbles. There also seemed to be a loss of flow through the culvert due to leaks throughout.

Figure 2. View of Inlet of Culvert

4.0 RECOMMENDATIONS

Based on the site visit and a review of the bridge inspection report and photos, the existing culvert appears to be in unsatisfactory condition. However, the use of a slip liner with minor repairs and replacement of the adjacent wing walls should be considered. If this is not the preferred option, possible foundation alternatives for a bridge replacement include the following:

- Reinforced concrete box culvert
- Reinforced concrete abutments on spread footings

When a preliminary alignment has been chosen, the Geotechnical Engineering Section should be contacted to help determine a subsurface investigation that efficiently gathers information.

If you have any questions or would like to discuss this report, please contact us by phone at (802) 828-6910, or via email at chris.benda@state.vt.us.

cc: Project File/CCB
RDM

VERMONT

State of Vermont
Environmental Section
One National Life Drive
Montpelier, VT 05633-5001
www.aot.state.vt.us

Agency of Transportation

[phone] 802-828-3979
[fax] 802-828-2334
[ttd] 800-253-0191

To: James Brady, VTrans Environmental Specialist

From: Glenn Gingras, VTrans Senior Biologist

Subject: Waterford BF 0225(5)—Natural Resource Identification

Date: 09/24/15

The above referenced project involves scoping of BR 2 on VT 18 in the town of Waterford, VT.

The existing structure is a CGMPP that is 8' diameter with baffles installed within the culvert in an attempt to provide AOP at this site. The structure is the first crossing upstream of the Connecticut River.

To assist in my review of potential natural resource involvement I have looked up all natural resource information available within existing mapped resources such as the Vermont Agency of Natural Resources (ANR) Atlas, USFWS Information for Planning and Conservation (IPaC) and I have performed a site visit.

Wetlands and Streams
I have identified two small class III wetlands within the vicinity of BR 2 on VT 18.

Wetland 1 is located on the northwest quadrant of the project area and is a forested \emergent wetland which is likely less than 0.5 ac in size. The wetland is dominated by Red Maple (*Acer rubrum*), American Basswood (*Tilia americana*), Green Ash (*Fraxinus americana*), Ironwood (*Carpinus caroliniana*), NE Aster (*Symphyotrichum novae-angliae*), Sensitive fern (*Onoclea sensibilis*), and Horsetail (*Equiseteum arvense*), and Goldenrod (*Eutharria graminifolia* and *Solidago gigentea*). Loamy soils with redox concentrations and depletions we found meeting criteria for hydric soils. Signs of hydrology were saturation, high water table and geomorphic position. The wetland has limited function and value due to its size and position in landscape.

Wetland 2 is located in the southwest quadrant and is within the right of way for I-93. It is highly unlikely that this project will impact this wetland. I have plotted bounds for reference. The wetland is an emergent wetland mostly dominated by sedges (*carex spp*.), reed canary grass (*Phalaris arundinacea*), jewelweed (*impatiens capensis*) and sensitive fern (*Onoclea sensibilis*). The soils are hydric and there is saturation and high water table within this wetland.

An unnamed tributary of the Connecticut River flows through the project area. The watershed appears to be flashy as there was erosion on the banks and debris accumulation in and around the culvert.

Wetlands and below ordinary high (OHW) water are regulated by the US Corps of Engineers at this location. As the applicant, VTrans will need to demonstrate that we have avoided and minimized impacts to all aquatic resources. As we move into the alternatives analysis this will need to be taking into consideration.

Rare, Threatened and Endangered Species

I have conducted a search of VT Agency of Natural Resources-Wildlife Diversity mapping and there are no occurrences within the project vicinity.

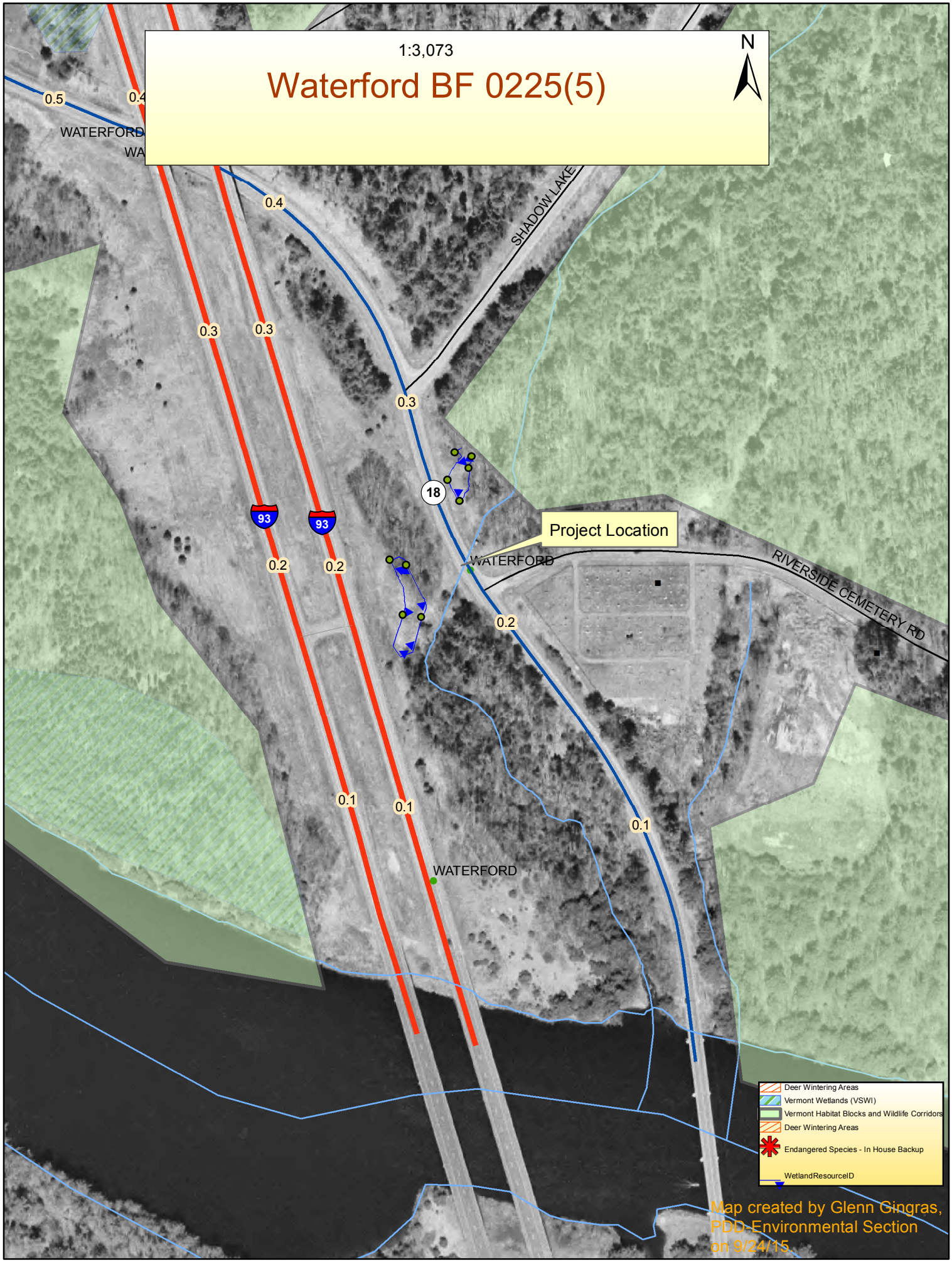
The USFWS IPaC mapping indicates that the project area is within the Northern Long Eared Bat's (NLEB's) habitat range. The NLEB is a federally listed threatened species. Suitable habitats for NLEB's per guidance from USFWS are: trees $\geq$ 3" in diameter that have holes, crevices, cracks or peeling bark. During the site visit there are trees that fit this description on both sides of the road. As the project moves forward we can evaluate the project further and determine which steps need to be taken to avoid impacts to potential roosting habitat.

Wildlife Habitat

According to VT Fish and Wildlife mapping the wildlife habitat blocks are of lower value.

This structure has been evaluated by VT Fish and Wildlife, fisheries biologist in the past. Aquatic organism passage (AOP) was requested at the time. This structure has had retrofits completed to try to pass aquatic organisms. Alternatives will need to be discussed with VT Fish and Wildlife to maintain or improve AOP.

Agricultural Land
I have reviewed existing mapped soil information from the ANR-Natural Resource Atlas and prime agricultural soils are present within the project area. The soils are mapped as Moosilauke very fine sandy loam, which is a poorly-drained soil.


1:3,073
Waterford BF 0225(5)
N
WATERFORD
SHADOW LAKE
RIVERSIDE CEMETERY RD
Project Location
WATERFORD
WATERFORD
0.5
0.4
0.3
0.2
0.1
93
18
Deer Wintering Areas
Vermont Wetlands (VSWI)
Vermont Habitat Blocks and Wildlife Corridors
Deer Wintering Areas
Endangered Species - In House Backup
WetlandResourceID
Map created by Glenn Gingras,
PDD-Environmental Section
on 9/24/15

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
PHONE: (603)223-2541 FAX: (603)223-0104
URL: www.fws.gov/newengland

Consultation Code: 05E1NE00-2015-SLI-2032 September 24, 2015
Event Code: 05E1NE00-2015-E-02561
Project Name: Waterford BF 0225(5)

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: Waterford BF 0225(5)

Official Species List

Provided by:

New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
(603) 223-2541
http://www.fws.gov/newengland

Consultation Code: 05E1NE00-2015-SLI-2032
Event Code: 05E1NE00-2015-E-02561

Project Type: TRANSPORTATION

Project Name: Waterford BF 0225(5)
Project Description: The project involves replacement/rehabilitation of an existing culvert structure which carries VT 18 over an unnamed tributary of the Connecticut River

Please Note: The FWS office may have modified the Project Name and/or Project Description, so it may be different from what was submitted in your previous request. If the Consultation Code matches, the FWS considers this to be the same project. Contact the office in the 'Provided by' section of your previous Official Species list if you have any questions or concerns.

Project Location Map:

Project Coordinates: MULTIPOLYGON (((-71.89072787761688 44.346589800970065, -71.89062058925629 44.34648622274385, -71.89055621623993 44.34632510069482, -71.89032554626465 44.34605656296227, -71.89026117324829 44.345903112277064, -71.89050793647766 44.345788023999525, -71.89073860645294 44.345523320103716, -71.89084053039551 44.345603882285495, -71.89111948013306 44.345550174176616, -71.89144134521484 44.34634044567095, -71.89086198806763 44.34660898210301, -71.89072787761688 44.346589800970065)))

Project Counties: Caledonia, VT

Endangered Species Act Species List

There are a total of 1 threatened or endangered species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

Mammals	Status	Has Critical Habitat	Condition(s)
Northern long-eared Bat *(Myotis septentrionalis)*	Threatened		

Critical habitats that lie within your project area

There are no critical habitats within your project area.

VERMONT

Jeannine Russell
VTrans Archaeology Officer
State of Vermont
Environmental Section
One National Life Drive
Montpelier, VT 05633-5001
www.aot.state.vt.us

Agency of Transportation

[phone] 802-828-3981
[fax] 802-828-2334
[ttd] 800-253-0191

To: James Brady, Environmental Specialist
Jeff Ramsey, Environmental Specialist Supervisor

From: Jeannine Russell, VTrans Archaeology Officer

Date: October 9, 2015

Subject: Waterford BF 0225(5) – Archaeological Resource ID

The scope for this project consists of a probable culvert liner to repair an existing corrugated metal pipe culvert in poor condition. This project is located along VT 118 in Waterford at the intersection with Riverside Cemetery Road.

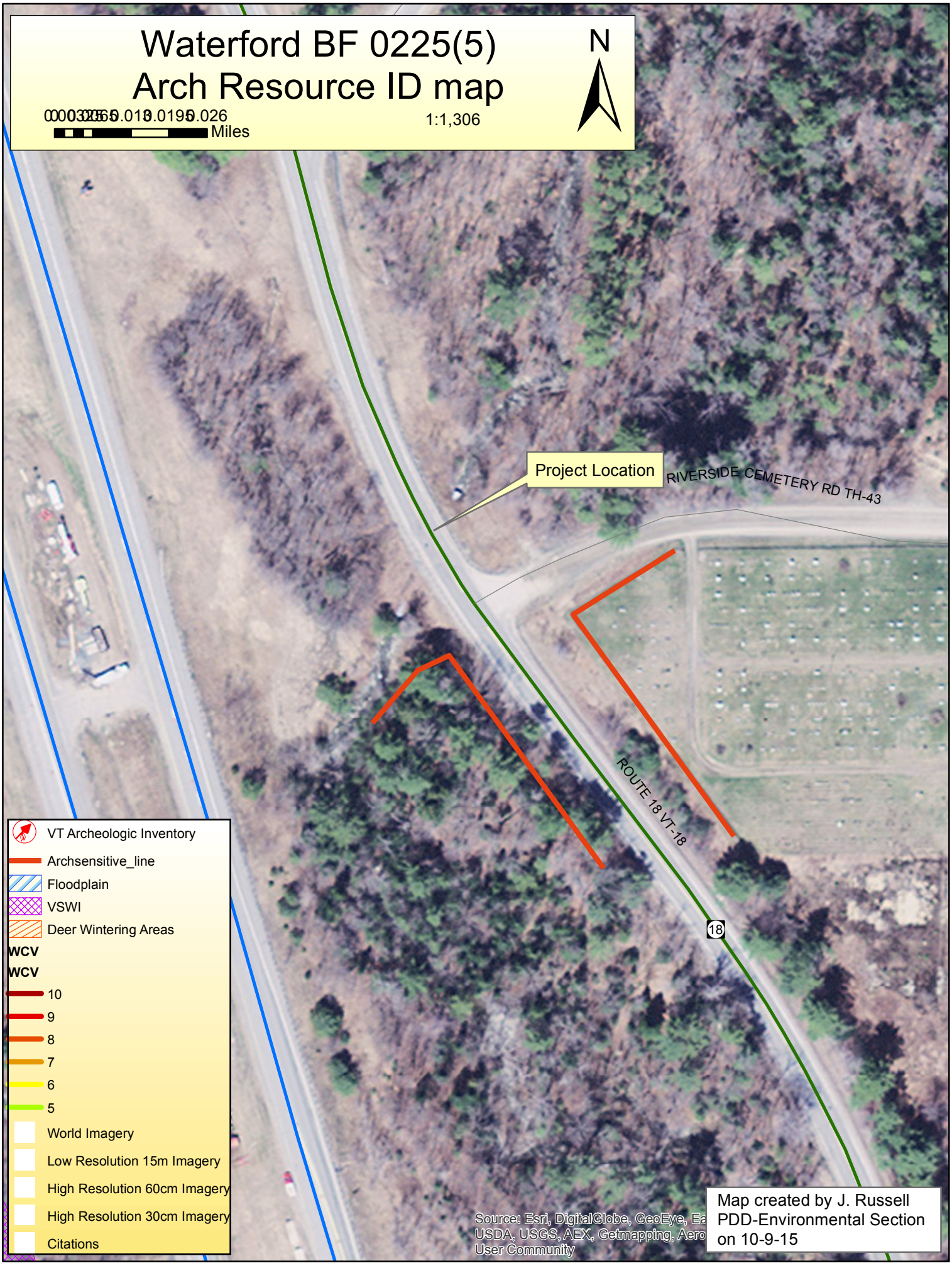
The VTrans Archaeology Officer conducted a resource ID on 10-8-15 and found two areas of archaeological sensitivity. The southwest quadrant contains a high landform between RT 118 and I-93 that is undisturbed. The landform is situated within 200 meters north of the CT River and is in close proximity to watercourses that drain into the CT River and therefore, any undisturbed areas can be considered sensitive for Pre-Contact archaeological resources. The southeast quadrant contains a cemetery. It is recommended that these two areas be avoided during construction.

Please see the attached map for further detail illustration the two sensitive areas.

Please contact me if you have any questions.

Thank you,
Jen Russell
VTrans Archaeology Officer

VTrans Working to Get You There
Vermont Agency of Transportation


Waterford BF 0225(5)
Arch Resource ID map
0 0.0065 0.013 0.0195 0.026
Miles
1:1,306
N
Project Location
RIVERSIDE CEMETERY RD TH-43
ROUTE 18 VT-18
18
VT Archeologic Inventory
Archsensitive_line
Floodplain
VSWI
Deer Wintering Areas
WCV
WCV
10
9
8
7
6
5
World Imagery
Low Resolution 15m Imagery
High Resolution 60cm Imagery
High Resolution 30cm Imagery
Citations
Source: Esri, DigitalGlobe, GeoEye, Ea
USDA, USGS, AEX, Getmapping, Aero
User Community
Map created by J. Russell
PDD-Environmental Section
on 10-9-15

Community Considerations

1. Are there any 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 bridge is closed during construction? Examples include bike races, festivals, parades, cultural events, farmers market, concerts, etc. that could be impacted? If yes, please provide date, location and event organizers' contact info.

None

2. Is there a "slow season" or period of time from May through October where traffic is less?

No

3. Please describe the location of emergency responders (fire, police, ambulance) and emergency response routes.

Waterford Fire Department is on Duck Pond Road
CALEX ambulance service is base in St. Johnsbury

4. Are there businesses (including agricultural operations) that would be adversely impacted either by a detour or due to work zone proximity?

No

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

The Town Offices are approximately one mile from the site, but we would not anticipate any significant impact.

6. What other municipal operations could be adversely affected by a road/bridge closure or detour?

None.

7. Are there any town highways that might be adversely impacted by traffic bypassing the construction on another local road?

No

8. Is there a local business association, chamber of commerce or other downtown group that we should be working with?

No

Schools

1. Where are the schools in your community and what are their schedules?

Waterford School is located on Duck Pond Road and maintains the typical September to June schedule.

2. Is this project on the specific routes that students use to walk to and from school?

No student or school bus traffic.

3. Are there recreational fields associated with the schools (other than at the school)?

No

Pedestrians and Bicyclists

1. What is the current level of bicycle and pedestrian use on the bridge?

Low

2. Are the current lane and shoulder widths adequate for pedestrian and bicycle use?

Yes

3. Does the community feel there is a need for a sidewalk on the bridge?

No

4. Is pedestrian and bicycle traffic heavy enough that it should be accommodated during construction?

No

5. Does the Town have plans to construct either pedestrian or bicycle facilities leading up to the bridge? Please provide a planning document demonstrating this (scoping study, master plan, corridor study, town plan).

No

6. In the vicinity of the bridge, 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?

No

Communications

1. Please identify any local communication channels that are available for us to use in communicating with the local population. Include weekly or daily newspapers, blogs, radio, public access TV, Front Porch Forum, etc. Also include any unconventional means such as local low-power FM.

Newspaper – Caledonian-Record
Several radio stations

Design Considerations

1. Are there any concerns with the alignment of the existing bridge? For example, if the bridge is located on a curve, has this created any problems that we should be aware of?

No

2. Are there any concerns with the width of the existing bridge?

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

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?

No

7. Are there any other comments that are important for us to consider?

No

Land Use & Zoning (to be filled out by the municipality or RPC).

1. Please provide a copy of your existing and future land use map or zoning map, if applicable.

Get from Planning Comm.

2. Is there any existing, pending or planned development proposal that would impact future transportation patterns near the bridge? If so please explain.

No

3. Is there any planned expansion of public transit service in the project area? If not known please contact your Regional Public Transit Provider.

No

Bridge Scoping Project
VT Route 18, Waterford BF 0225(5), 15b051
Operations Input Questionnaire

The Structures Section has begun the scoping process for Waterford BF 0225(5), Bridge 2, over an unnamed brook. This is Corrugated Galvanized Metal Plate Pipe (CGMPP) constructed in 1981. The Structure Inspection, Inventory, and Appraisal Sheet (attached) rates the culvert as 3 (serious). 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.

1. Your thoughts on the general condition of this bridge and the general maintenance effort required to keep it in service.
   The invert of this structure is severely compromised. During high flow events, material around the pipe is pulled through the invert and moved downstream which creates sinkholes at the road surface. District 7 has had to fill sinkholes that have developed over the pipe several times.
2. Any comments on the geometry of the bridge (curve, sag, banking, sight distance)?
   District 7 has no issues with the geometry of this structure.

3. Do you feel the posted speed limit is appropriate?
   Yes – this is a rural setting with a good typical and no residences near.

4. Is the width adequate for snow plowing?
   Yes, we have never had an issue there. Ideally, a minimum of 16' from centerline to face of guardrail.

5. Are you aware of any unpermitted driveways within the likely project limits? We frequently encounter driveways that prevent us from meeting railing standards and then discover them to be illegal.
   There are illegal off premise signs that we have been dealing with, but no drives.

6. 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.
   We are not aware of any issues with property owners. The state owns the land at the outlet…..

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

There is not really a problem with slopes and river banks that we are aware of. The road itself keeps developing sink holes due to the invert condition. Whenever there is high water, our crew has to fill in the roadway where the sink holes developed.

8. Does this bridge seem to pick up an unusual amount of debris from the waterway?
   No

9. Do you think a closure with off-site detour and accelerated construction would be appropriate? What should we consider for a detour route, assuming that we use State route for State projects and any route for Town projects?
   Yes, closure with an off-site detour would be appropriate. The interstate is immediately adjacent and it would not be unreasonable to use I93 as the detour.

10. Please describe any larger projects that you have completed that may not be reflected on the attached Appraisal sheet, such as culvert clearing, deck patches, paving patches, railing replacement with new type, steel coating, etc.
    We have not done anything to this structure other than patching the road surface as sink holes develop.

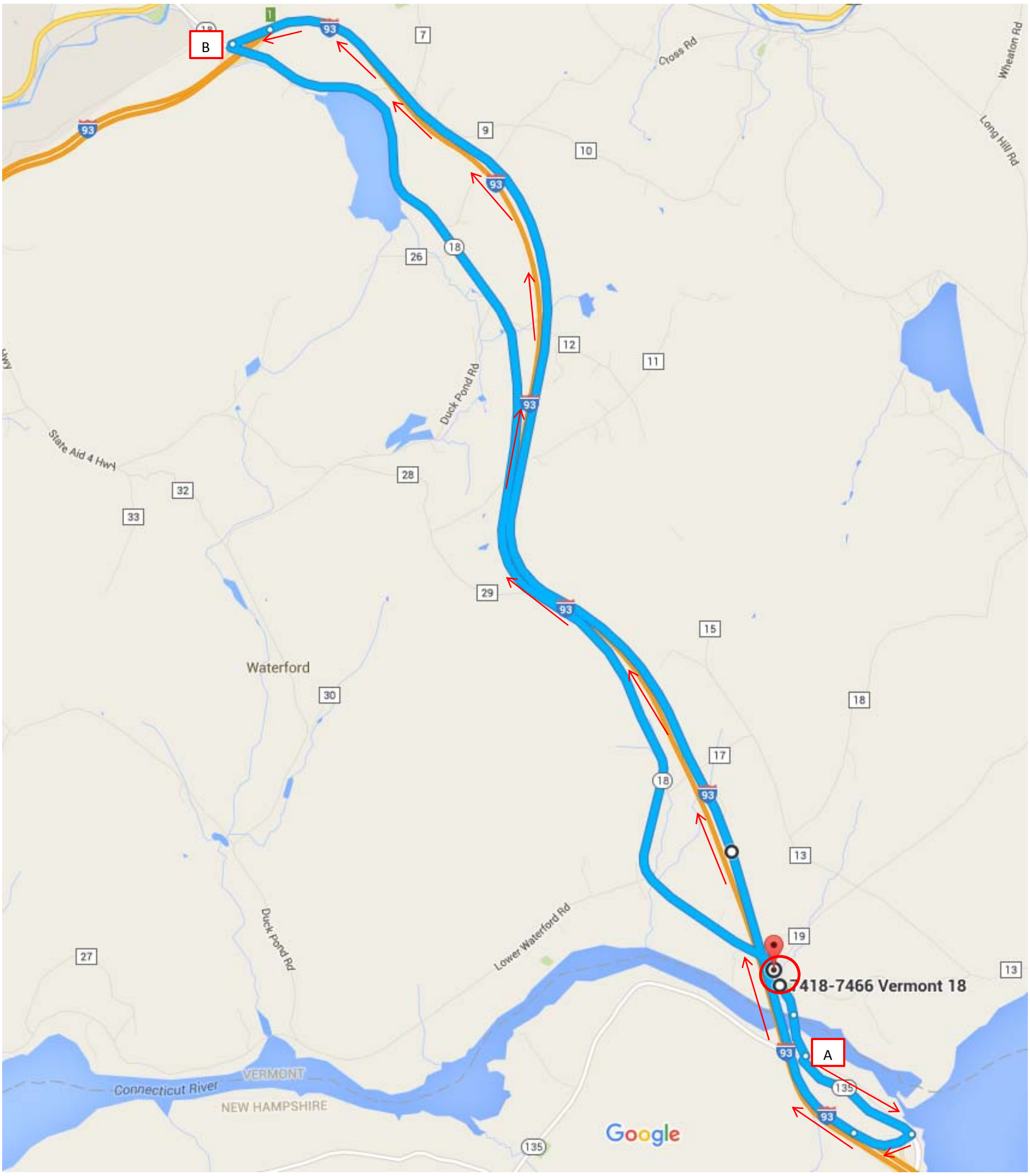
11. If there is a sidewalk over this structure, how effective are the Town's efforts to keep it snow and ice free?
    No sidewalk to present.

12. Are there any drainage issues that we should address on this project?
    There are no drainage issues at this site other than the structure itself.

13. Are you aware of any complaints that the public has about issues that we can address on this project?
    Not aware of any public issues.

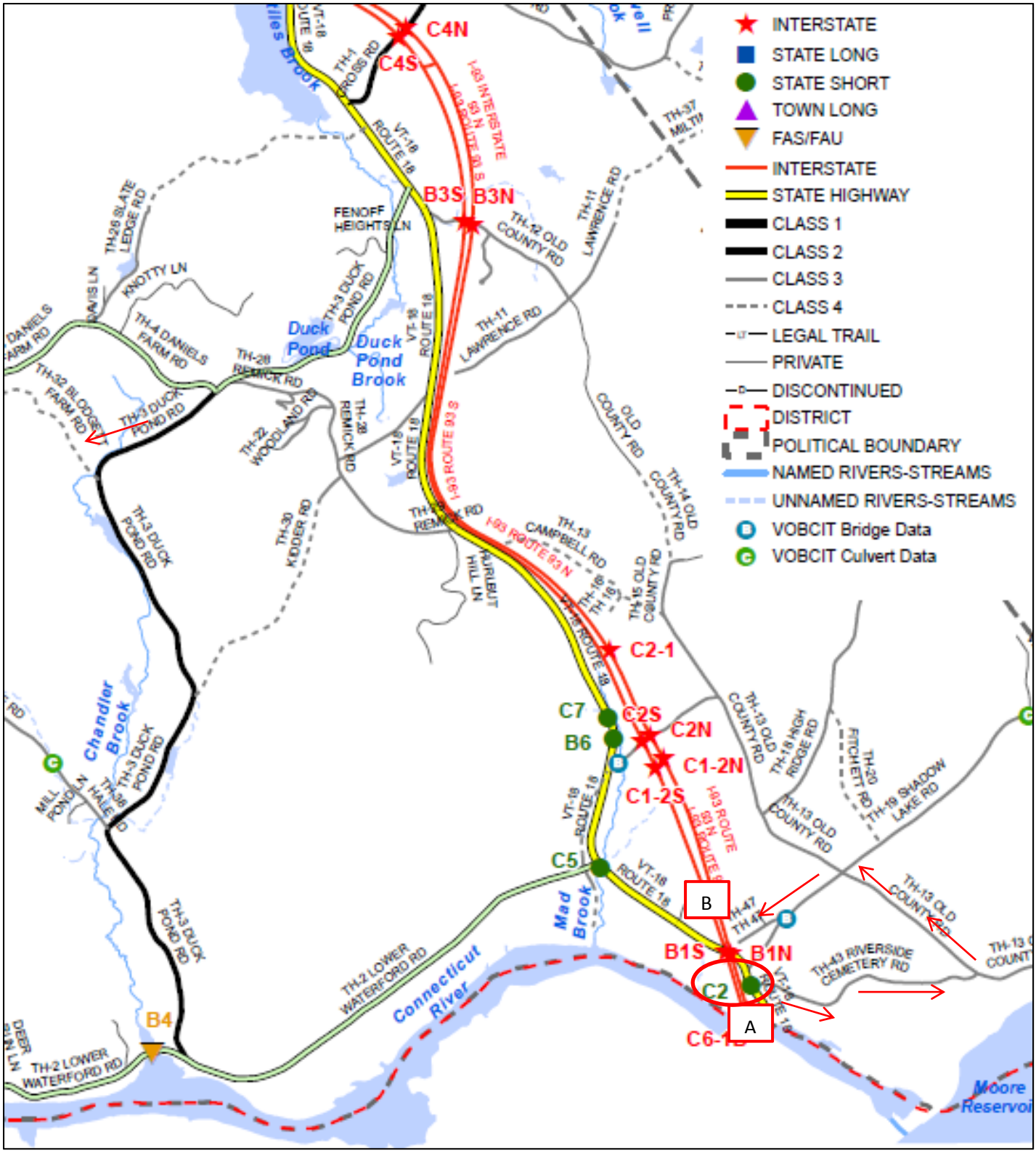
14. Anything else?

I do know that Fish and Wildlife will take a great interest in this project due to proximity to the CT River.



Detour Route

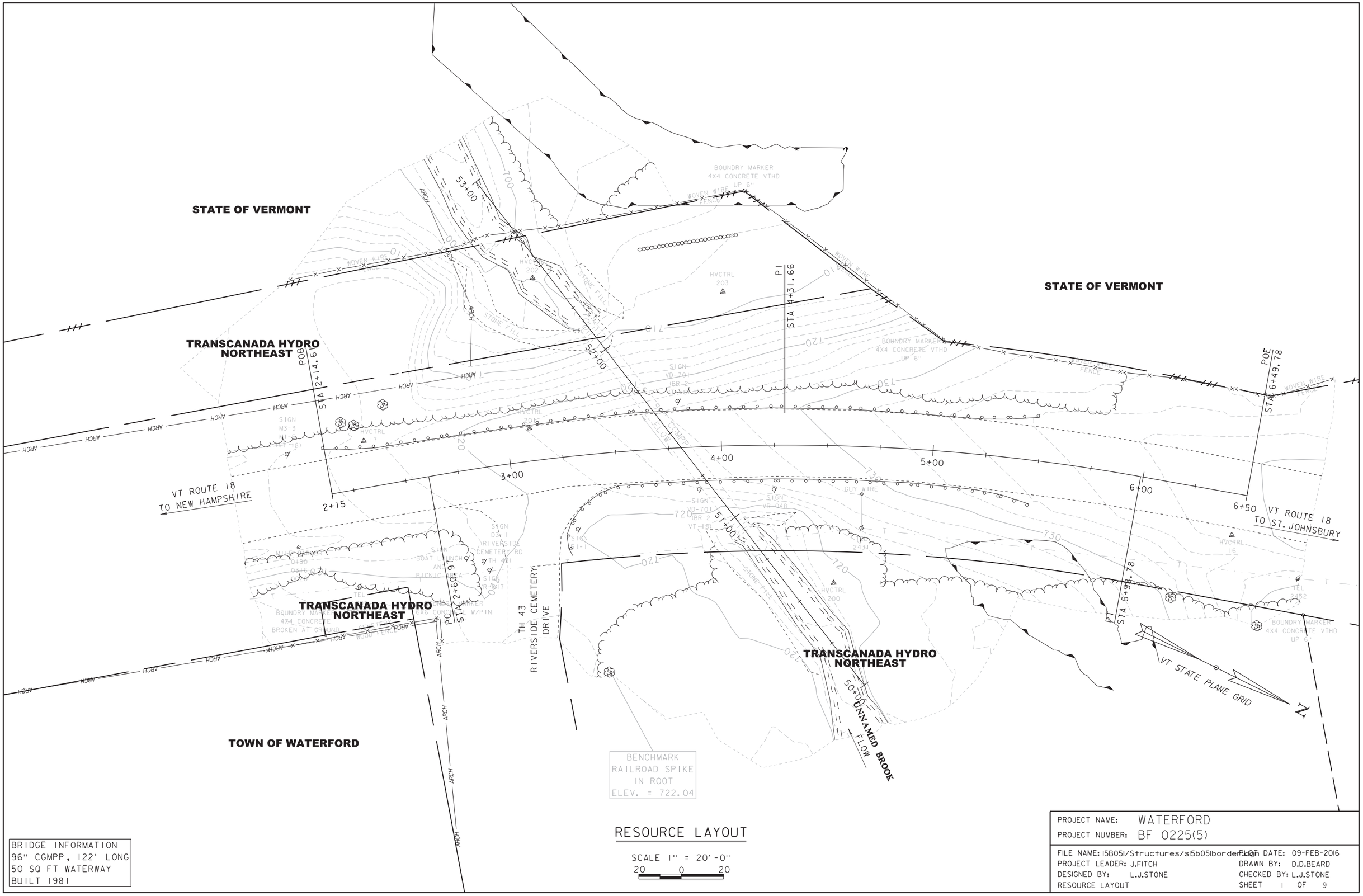
VT Route 18, to NH Route 18. NH Route 135, Interstate 93, back to VT Route 18
A – B Through Route: 7.7 Miles
A – B Detour Route: 9.5 Miles
Added Miles: 1.8 Miles
End-End Distance: 17.2 Miles



Local Bypass Route

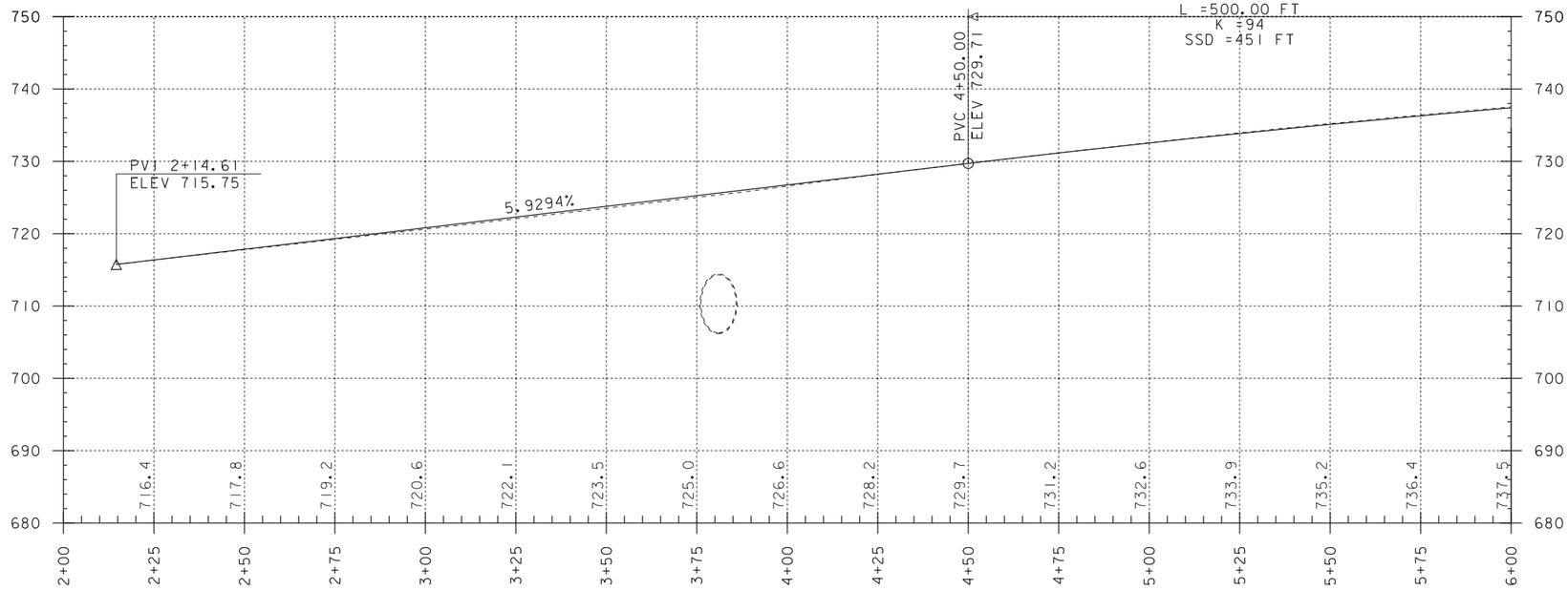
VT Route 18, to Riverside Cemetery Road, Old County Road, and Shadow Lake Road, back to VT Route 18

A – B Through Route: 0.1 Miles
A – B Detour Route: 2.8 Miles
Added Miles: 2.7 Miles
End-End Distance: 2.9 Miles



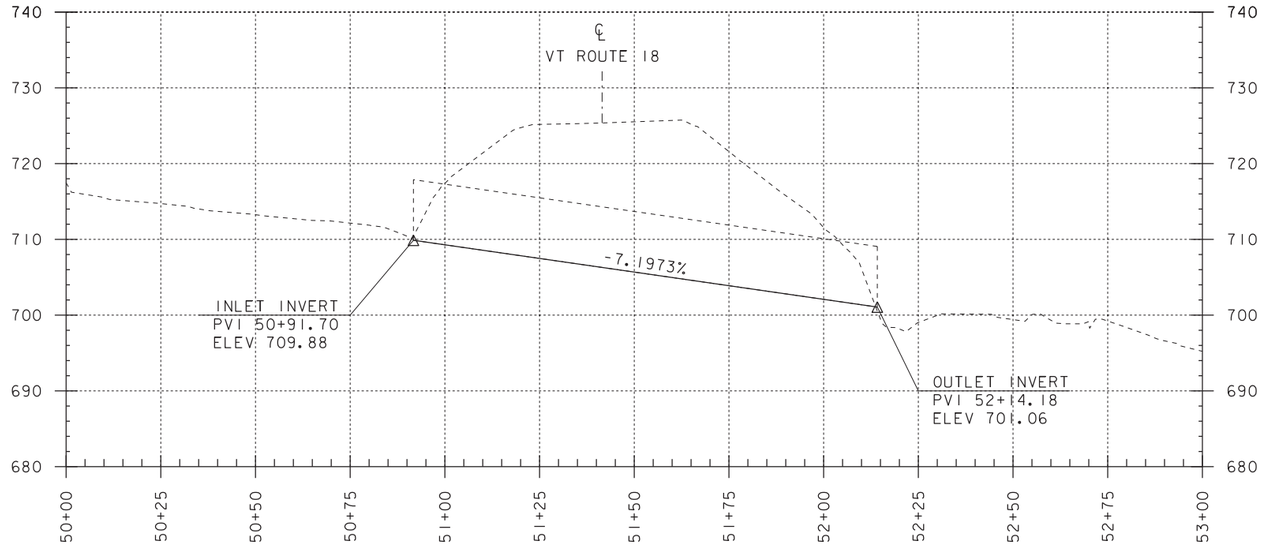
BRIDGE INFORMATION
96" CGMPP, 122' LONG
50 SQ FT WATERWAY
BUILT 1981

PROJECT NAME:	WATERFORD
PROJECT NUMBER:	BF 0225(5)
FILE NAME:	15B051/Structures/s15b051border.dgn
PROJECT LEADER:	J.FITCH
DESIGNED BY:	L.J.STONE
RESOURCE LAYOUT	
PLOT DATE:	09-FEB-2016
DRAWN BY:	D.D.BEARD
CHECKED BY:	L.J.STONE
SHEET	1 OF 9



VT ROUTE 18 PROFILE

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



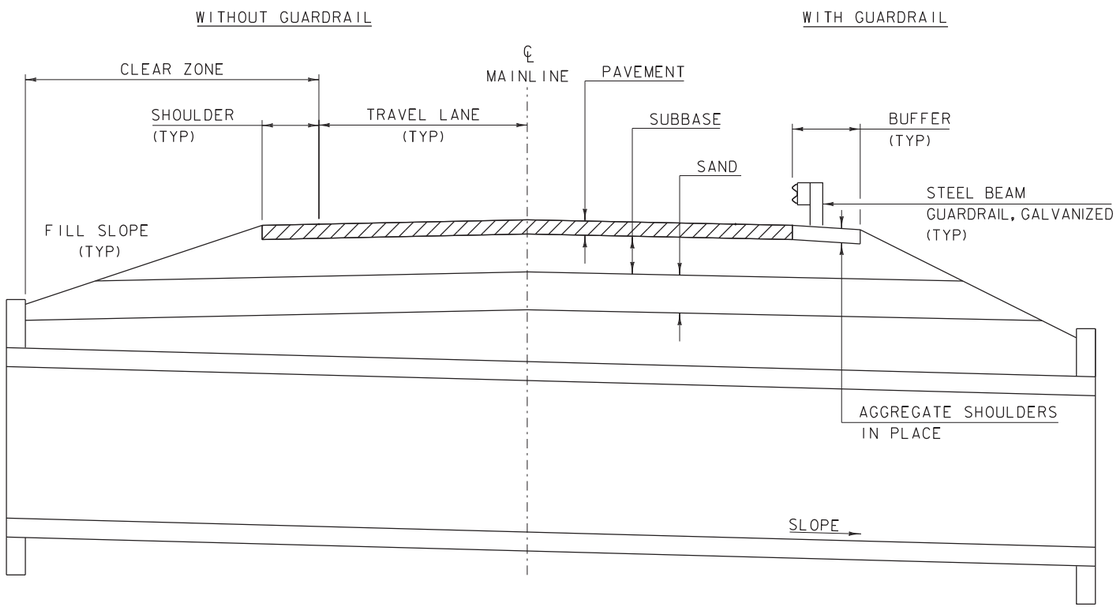
VT ROUTE 18 CULVERT 2 PROFILE

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

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

PROJECT NAME:	WATERFORD
PROJECT NUMBER:	BF 0225(5)

FILE NAME: 15b051/sl5b051profile.dgn	PLOT DATE: 09-FEB-2016
PROJECT LEADER: J.FITCH	DRAWN BY: D.D.BEARD
DESIGNED BY: L.J.STONE	CHECKED BY: L.J.STONE
PROFILE SHEET	SHEET 2 OF 9



CULVERT ELEVATION VIEW

NOT TO SCALE

MATERIAL INFORMATION

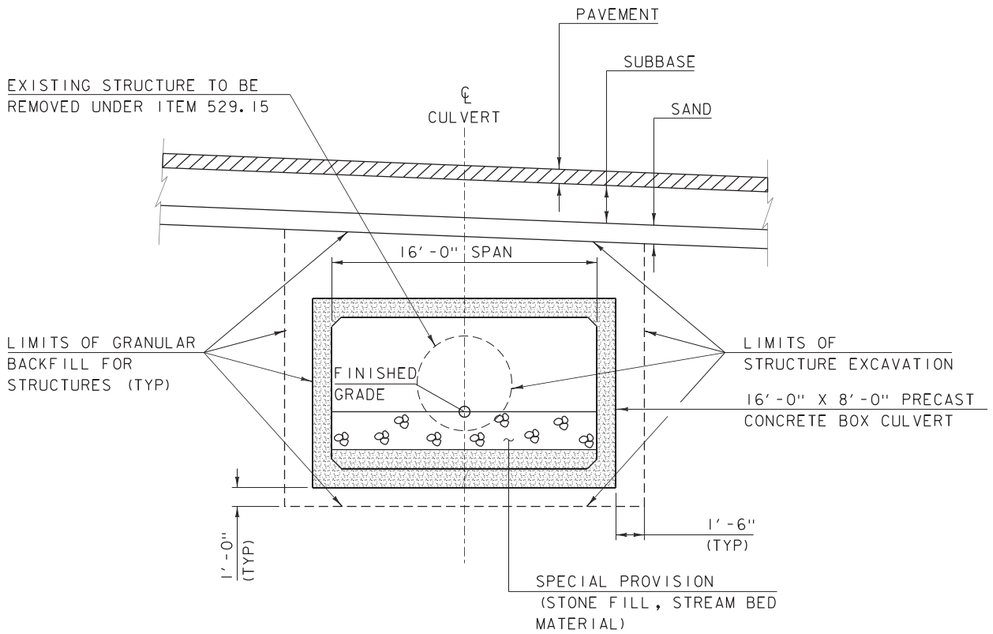
	THICKNESS	TYPE
WEARING COURSE	1½"	BITUMINOUS CONCRETE PAVEMENT TYPE IV
BINDER COURSE	1½"	BITUMINOUS CONCRETE PAVEMENT TYPE IV
BASE COURSE #2	3"	BITUMINOUS CONCRETE PAVEMENT TYPE II
BASE COURSE #1	3"	BITUMINOUS CONCRETE PAVEMENT TYPE II
SUBBASE	18"	SUBBASE OF DENSE GRADED CRUSHED STONE
SAND	15"	SAND BORROW
STONE FILL	N/A	N/A

ROAD TYPICAL INFORMATION

	LEFT		RIGHT	
	WIDTH	SLOPE	WIDTH	SLOPE
TRAVEL LANE	12'-0"	VARIES	12'-0"	VARIES
SHOULDER	4'-0"	VARIES	4'-0"	VARIES
BUFFER	3'-7"	6.00%	3'-7"	6.00%
FILL SLOPE		1:2.0		1:2.0

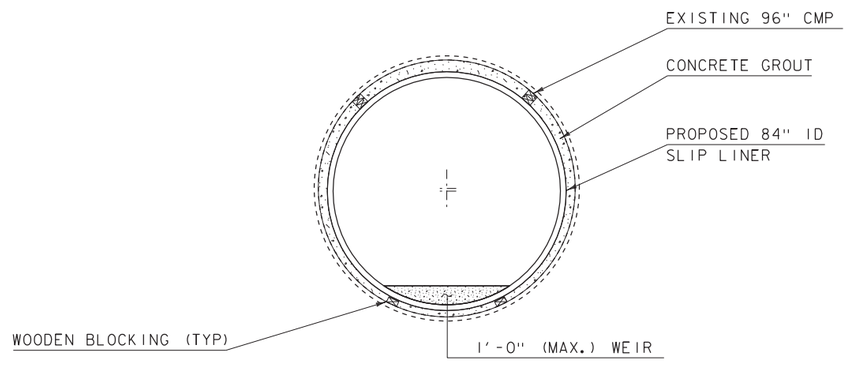
CLEAR ZONES

FILL SLOPES	16'-0"
CUT SLOPES	10'-0"
BEHIND GUARDRAIL	4'-0"



ALTERNATIVE 2 TYPICAL SECTION

NOT TO SCALE

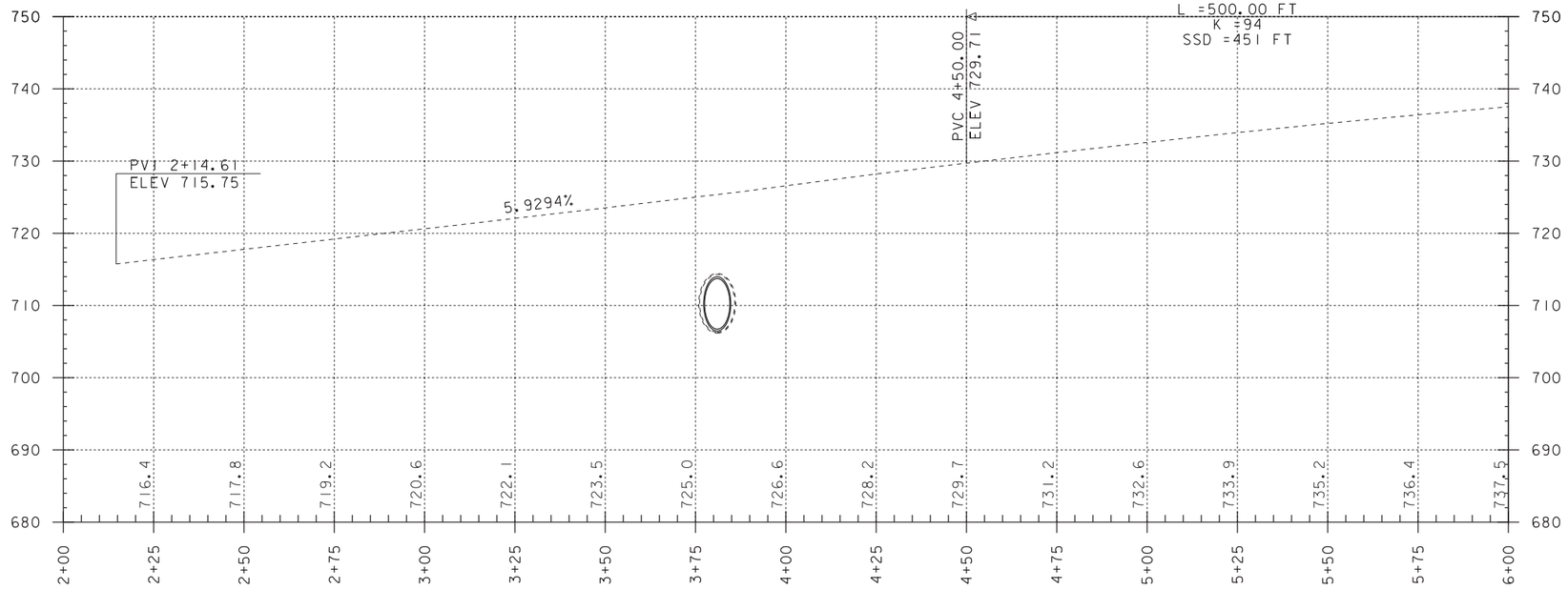


ALTERNATIVE 1A TYPICAL SECTION

PROJECT NAME: WATERFORD
PROJECT NUMBER: BF 0225(5)

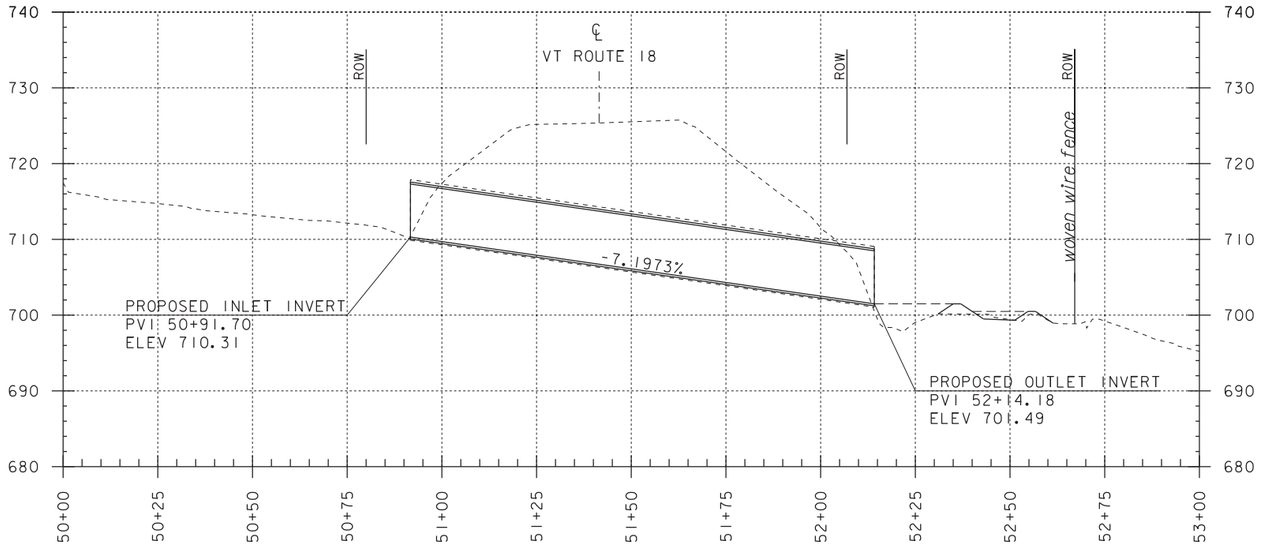
FILE NAME: 15b051/sl5b051typical.dgn
PROJECT LEADER: J.FITCH
DESIGNED BY: L.J.STONE
TYPICAL SECTIONS

PLOT DATE: 09-FEB-2016
DRAWN BY: D.D.BEARD
CHECKED BY: L.J.STONE
SHEET 3 OF 9



VT ROUTE 18 PROFILE

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



VT ROUTE 18 CULVERT 2 ALTERNATIVE 1 PROFILE

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

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

PROJECT NAME:	WATERFORD
PROJECT NUMBER:	BF 0225(5)
FILE NAME: 15b051/sl5b051profile.dgn	PLOT DATE: 09-FEB-2016
PROJECT LEADER: J.FITCH	DRAWN BY: D.D.BEARD
DESIGNED BY: L.J.STONE	CHECKED BY: L.J.STONE
ALTERNATIVE 1 PROFILE SHEET	SHEET 4 OF 9

CURVE (1)
DELTA = 20° 16′ 01"
D = 5° 59′ 58"
R = 955.00′
T = 170.69′
L = 337.81′
E = 15.13′

POB STA 2+14.61

PI STA 4+31.66

POE STA 6+49.78

PC STA 2+60.97

PT STA 5+98.78

N 36° 32′ 07.89" W

N 16° 16′ 06.84" W

VT ROUTE 18
TO NEW HAMPSHIRE

VT ROUTE 18
TO ST. JOHNSBURY

TH 43
RIVERSIDE CEMETERY
DRIVE

UNNAMED BROOK
FLOW

BENCHMARK
RAILROAD SPIKE
IN ROOT
ELEV. = 722.04

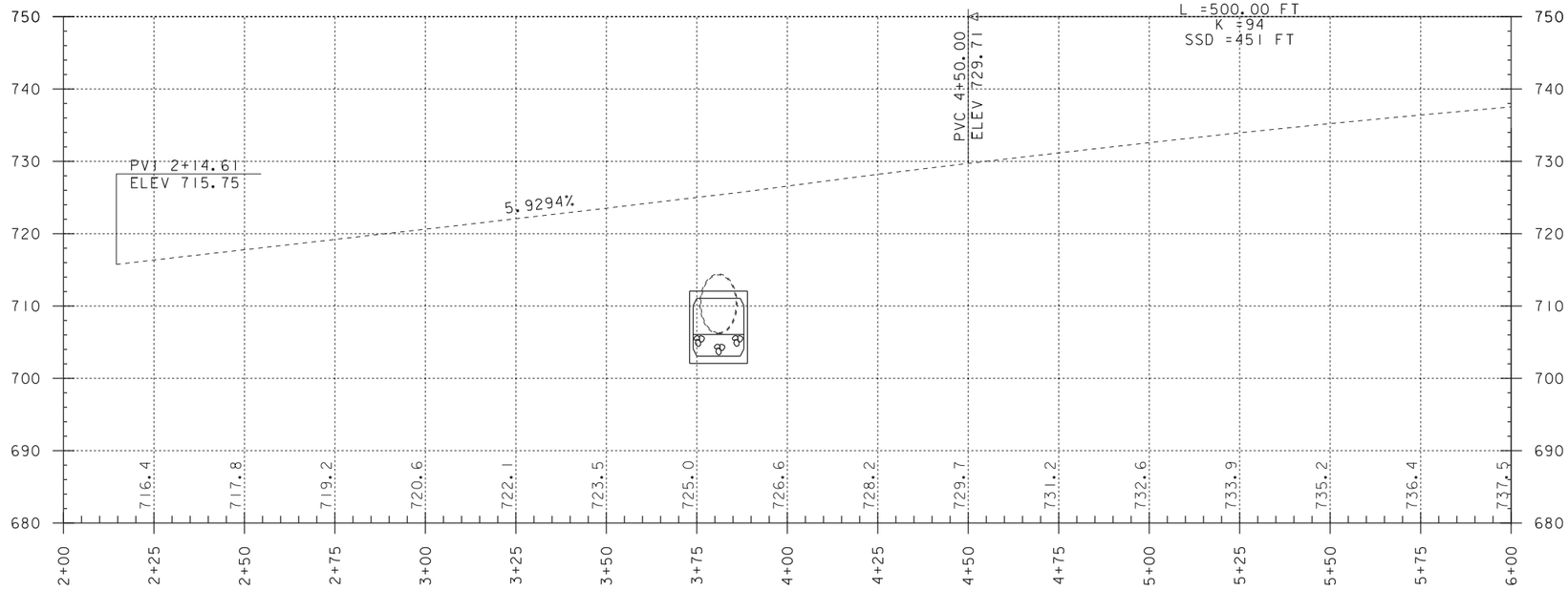
VT STATE PLANE GRID

BRIDGE INFORMATION
96" CGMPP, 122′ LONG
50 SQ FT WATERWAY
BUILT 1981

ALTERNATIVE 2 LAYOUT

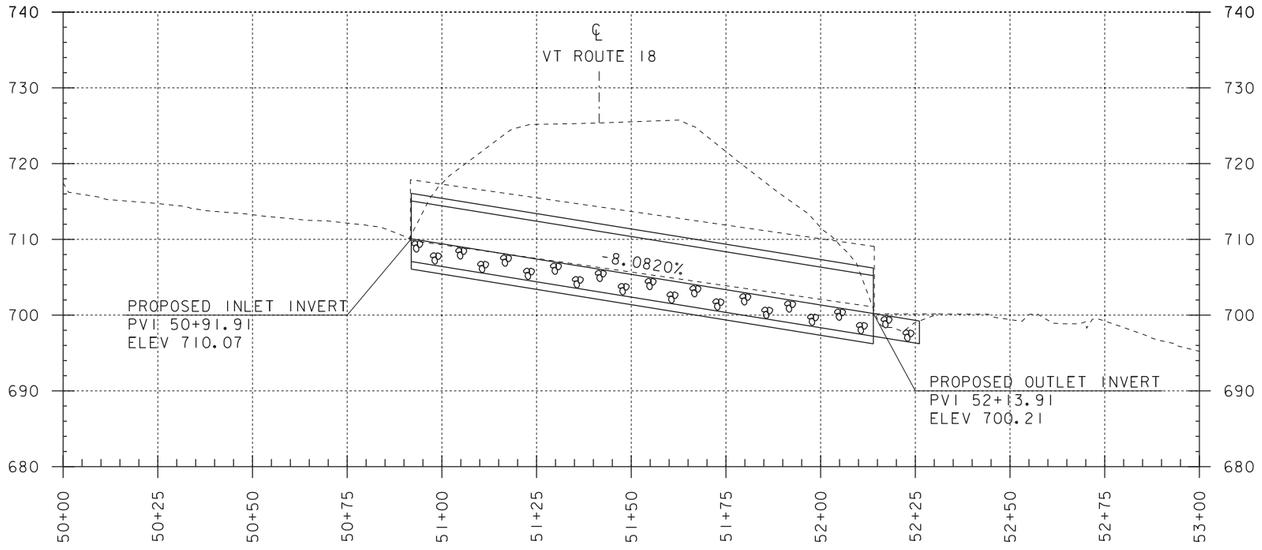
SCALE 1" = 20′-0"
20 0 20

PROJECT NAME:	WATERFORD
PROJECT NUMBER:	BF 0225(5)
FILE NAME:	I5B05I/Structures/sI5b05Iborder.dgn
PROJECT LEADER:	J.FITCH
DESIGNED BY:	L.J.STONE
ALTERNATIVE 2 LAYOUT	
PLOT DATE:	09-FEB-2016
DRAWN BY:	D.D.BEARD
CHECKED BY:	L.J.STONE
SHEET	5 OF 9



VT ROUTE 18 PROFILE

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



VT ROUTE 18 CULVERT 2 ALTERNATIVE 2 PROFILE

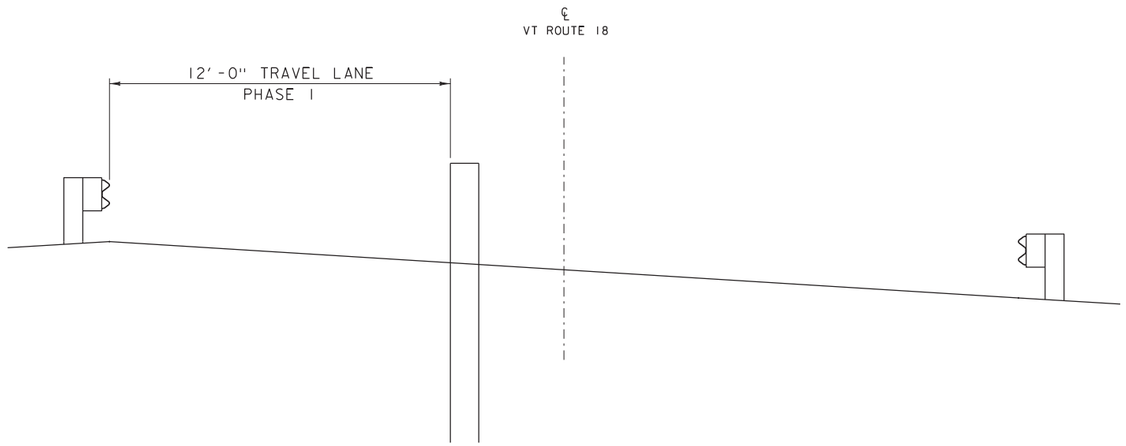
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

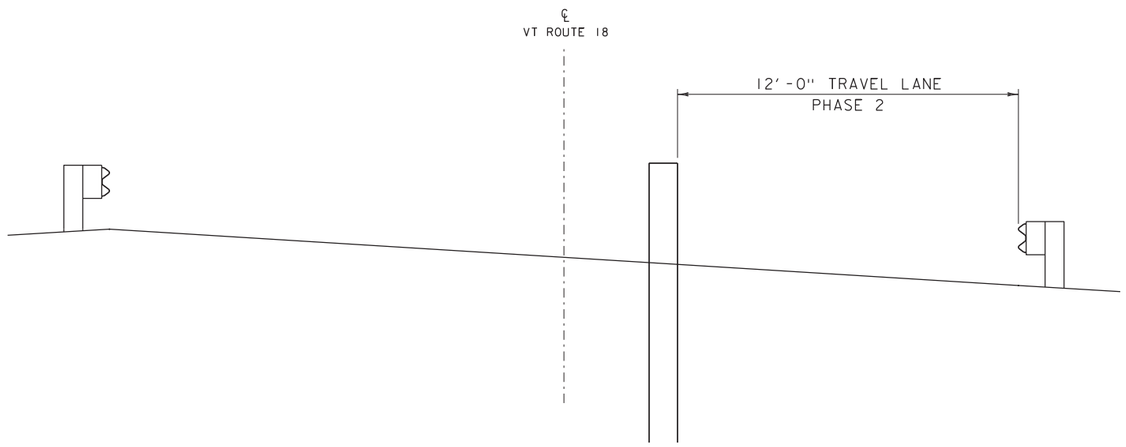
PROJECT NAME: WATERFORD
PROJECT NUMBER: BF 0225(5)

FILE NAME: 15b051/sl5b051profile.dgn
PROJECT LEADER: J.FITCH
DESIGNED BY: L.J.STONE
ALTERNATIVE 2 PROFILE SHEET

PLOT DATE: 09-FEB-2016
DRAWN BY: D.D.BEARD
CHECKED BY: L.J.STONE
SHEET 6 OF 9



PHASE 1 TYPICAL SECTION



PHASE 2 TYPICAL SECTION

PROJECT NAME:	WATERFORD
PROJECT NUMBER:	BF 0225(5)
FILE NAME: 15b051/sl5b051phasing.dgn	PLOT DATE: 09-FEB-2016
PROJECT LEADER: J.FITCH	DRAWN BY: D.D.BEARD
DESIGNED BY: L.J.STONE	CHECKED BY: L.J.STONE
PHASING TYPICALS	SHEET 7 OF 9

CURVE (1)
DELTA = 20° 16' 01"
D = 5° 59' 58"
R = 955.00'
T = 170.69'
L = 337.81'
E = 15.13'

POB
STA 2+14.61

PI
STA 4+31.66

POE
STA 6+49.78

POC
STA 2+60.97

PT
STA 5+98.78

53+00

52+00

50+00

2+15

3+00

4+00

5+00

6+00

6+50

N 36° 32' 07.89" W

N 16° 16' 06.84" W

VT ROUTE 18
TO NEW HAMPSHIRE

VT ROUTE 18
TO ST. JOHNSBURY

TH 43
RIVERSIDE CEMETERY
DRIVE

BOUNDRY MARKER
4X4 CONCRETE VTHD
UP 6"

BOUNDRY MARKER
4X4 CONCRETE
BROKEN AT GROUND

BOUNDRY MARKER
6X6 CONCRETE W/PIN

WOVEN WIRE FENCE

WOOD FENCE

STONE FILL

GUY WIRE

HVCTRL
202

HVCTRL
203

HVCTRL
201

HVCTRL
17

HVCTRL
200

HVCTRL
16

TEL
120T
2430

TEL
2431

TEL
2432

UNNAMED BROOK
FLOW

VT STATE PLANE GRID

N

BENCHMARK
RAILROAD SPIKE
IN ROOT
ELEV. = 722.04

PHASE I LAYOUT

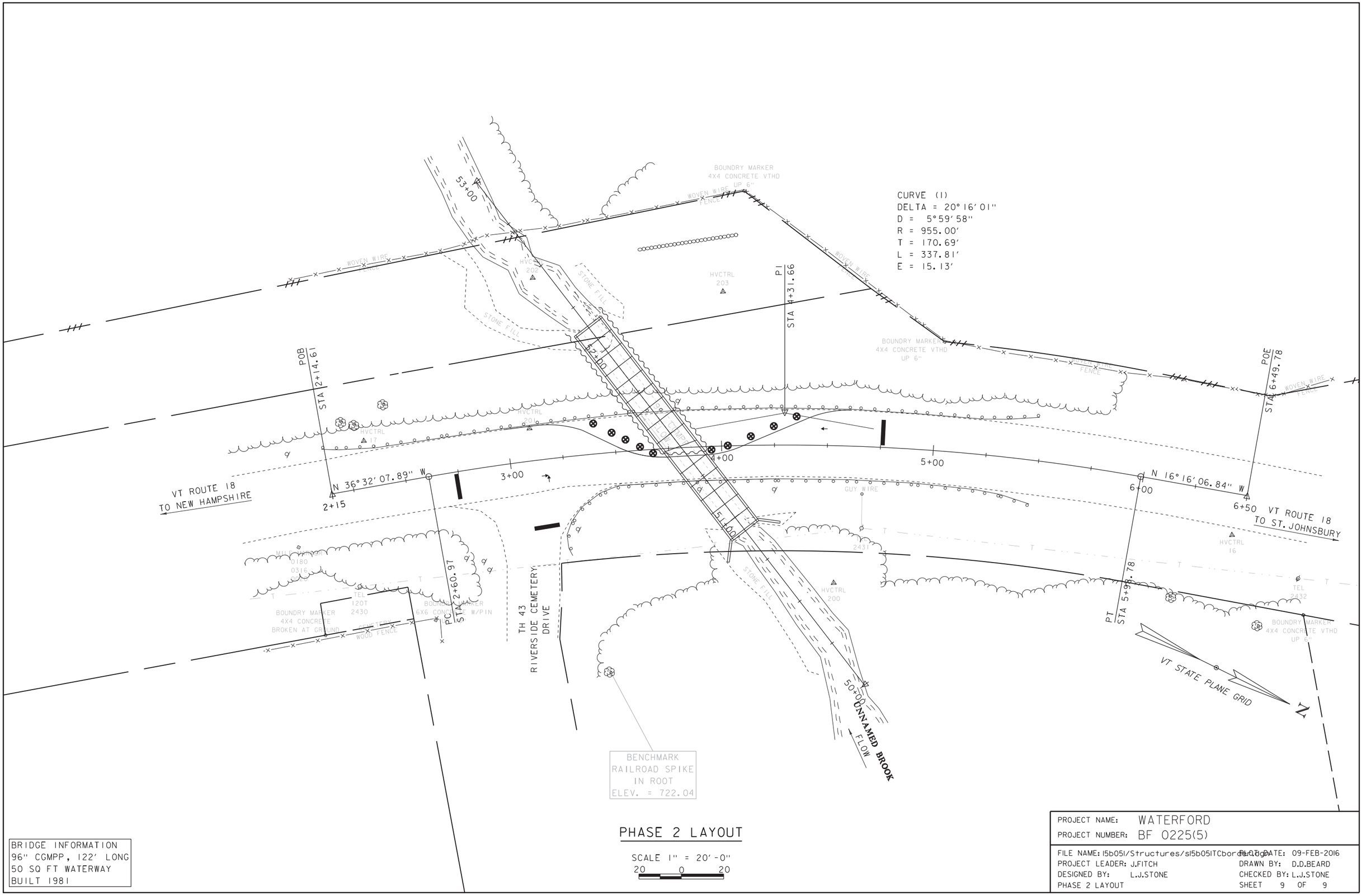
SCALE 1" = 20'-0"
20 0 20

BRIDGE INFORMATION
96" CGMPP, 122' LONG
50 SQ FT WATERWAY
BUILT 1981

PROJECT NAME: WATERFORD
PROJECT NUMBER: BF 0225(5)

FILE NAME: 15b051/Structures/sl5b051TCborder.dgn
PROJECT LEADER: J.FITCH
DESIGNED BY: L.J.STONE
PHASE I LAYOUT

PLOT DATE: 09-FEB-2016
DRAWN BY: D.D.BEARD
CHECKED BY: L.J.STONE
SHEET 8 OF 9



PHASE 2 LAYOUT

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

BRIDGE INFORMATION
96" CGMPP, 122' LONG
50 SQ FT WATERWAY
BUILT 1981

PROJECT NAME:	WATERFORD
PROJECT NUMBER:	BF 0225(5)
FILE NAME:	I5b051/Structures/sI5b051ITCbordr1.dgn
PROJECT LEADER:	J.FITCH
DESIGNED BY:	L.J.STONE
PHASE 2 LAYOUT	
PLOT DATE:	09-FEB-2016
DRAWN BY:	D.D.BEARD
CHECKED BY:	L.J.STONE
SHEET	9 OF 9