STATE OF VERMONT
AGENCY OF TRANPORTATION

Scoping Report

FOR

Waitsfield BRF 013-4(39)

VT ROUTE 100, BRIDGE 177 OVER THE MAD RIVER

November 1, 2012

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I. Site Information

Bridge 177 is located in a rural area along VT Route 100 approximately 0.8 miles south of the junction with VT 17. The bridge is located on a straight segment of VT 100. Town Highway 39 intersects VT 100 approximately 250 feet north of the bridge. There is a farm complex adjacent to the bridge located on the upstream side in the Northwest quadrant, which has been identified as a historic resource. The Easy Street Café and Purple Moon Pub are located on the downstream side in the Southeast quadrant. 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 Minor Arterial (Vermont State Highway)
Bridge Type	Two Span Continuous Rolled Beam Bridge
Bridge Span	168 feet long (Two 81' spans)
Year Constructed	1938
Owner	State of Vermont

Need

Bridge 177 is considered functionally deficient with a Federal Sufficiency Rating of 54 (of a possible 100). The following is a list of the deficiencies of Bridge 177 and VT 100 in this location.

1. The bridge deck is in poor condition. Repairs have been made to full depth holes, which have formed in the deck. As a result of the poor deck, the riding surface is in rough condition; there are many patches, holes, and cracks in the pavement.

2. The width of the bridge is substandard. Currently, there are 11 foot lanes with 0.5 foot shoulders. According to the Vermont State Standards, there should be 11 foot lanes with 5 foot shoulders.

3. There are cracks and spalling in the abutments and wingwalls. The pier has a considerable amount of concrete spalling, exposing the underlying reinforcing steel.

4. The south abutments downstream wingwall has been undermined for the entire length. The south abutment has a large scour hole underneath it. There is debris build up in front of the pier and a gravel bar downstream of the pier. The top of the footing of the pier can be seen at low water.

5. The approach guardrail has collision damage.

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	2055
ADT	4,100	4,400	~
DHV	610	650	~
ADTT	230	400	~
%T	6.2	10.1	~
%D	55	55	~
FLEXIBLE ESAL	~	2015 ~ 2035	2015 ~ 2055
		1,143,000	2,684,000

Design Criteria

The design standards for this bridge project are the Vermont State Standards, dated October 22, 1997. Minimum standards are based on ADT of 4,400 and a design speed of 40 mph.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 4.3	11'/6' (34')	11'/5' (32')	
Bridge Lane and Shoulder Widths	VSS Section 4.7	11'/0.5' (23')	11'/5' (32')	Substandard
Clear Zone Distance	VSS Table 4.4		14' fill / 12' cut	
Banking			8% (max)	
Speed		40 mph (Posted)	40 mph (Design)	
Horizontal Alignment	AASHTO Green Book Exhibit 3-9	Straight Alignment ($R = \infty$)	R_{min} = 5410' (Normal Crown)	
Vertical Grade	VSS Table 4.5	(+)2.41% max	5% (max) for level terrain	
K Values for Vertical Curves	VSS Table 4.1	Bridge located on crest (K = 30), approaches on sags (K=61 & 108)	60 crest / 60 sag	Substandard
Vertical Clearance Issues	VSS Section 4.8	None noted	14'-3" (min)	
Stopping Sight Distance	VSS Table 4.1	317'	275'	
Bicycle/Pedestrian Criteria	VSS Table 4.7	0.5' Shoulder	4' Shoulder (for %T > 10%)	Substandard
Bridge Railing	Structures Design Manual Section 13	W-Beam, Fascia Mounted	TL-2	

Inspection Report Summary

Deck Rating	4 Poor
Superstructure Rating	6 Satisfactory
Substructure Rating	5 Fair
Channel Rating	6 Satisfactory

09/04/2011 – IRENE There is undermining of abutment 2 upstream side that goes under the entire length of the cheek wall. It will need to be filled in at a later date. No settlement at this time. Debris around pier needs to be removed and rip rap added. ~MK/JM

06/09/2011 – Bridge deck is quite poor with full depth hole repairs and additional exterior bay holes pending. Bridge needs either major reconstruction or likely full replacement. In the interim the rough surface should be smoothed and paved. ~MJ/DK

04/09/2009 – This structure is in poor to good condition. The deck, superstructure and substructure continue to deteriorate. This structure needs a major rehab project or a complete replacement project very soon. The approach guard rail has collision damage and needs repair. ~DCP

Hydraulics
From preliminary hydraulics report, 8/15/2012:

Any new structure should maintain the 125' clear span normal to the river that the existing bridge has. Since the bridge has more than 1.0' of freeboard, the superstructure may be lowered to an elevation no lower than 721.2'. All flows up to Q100 will still be able to flow through this bridge at that elevation.

Stone fill, Type III should be used for any disturbed channel banks and should match into existing stream banks. It should not constrict the channel.

Utilities

There are overhead utility lines that run along VT Route 100 on the upstream side of the bridge. The existing utilities are shown on the Existing Conditions and Layout sheets.

Right Of Way

The existing Right-of-Way is plotted on the Layout Sheet. Depending on the alternate chosen, additional rights may need to be obtained.

Resources

The environmental resources present at this project are shown on the Existing Conditions Layout sheet.

Archaeological:
There are archeological resources located in the downstream southern area of the bridge. The VTrans Archaeology Section identified one landform with some sensitivity in the SE quadrant of the project area during their field visit on April 18th, 2012.

The archeological resources present are shown on the Existing Conditions Layout sheet. See the appendix for more information.

Biological:
Wetlands
There are wetlands within the project area. Formal wetland delineation according to US Army Corps of Engineers Wetland Delineation Manual was not completed and wetlands were identified using best professional judgment for resource identification/planning purposes. There is a small wetland within the southwest quadrant of the project as depicted in the appendix. The wetland is small in size and would likely be class III. The Mad River flows north easterly through the project area. This river would support a variety of aquatic organisms including wild brook trout and rainbow trout.

Efforts to minimize water quality impacts during construction will need to be evaluated as the project design moves forward. The US Corps of Engineers and the Agency of Natural Resources-

Department of Environmental Conservation would regulate all activities below ordinary high water and to wetlands.

Wildlife Habitat

General Wildlife habitat exists within the surrounding area. The project area consists of agricultural lands. Good Wildlife habitat exists within the surrounding area. There are large blocks of forested land on both sides of the road mixed with agricultural lands. However, the project area scores low (<5) on the habitat linkage analysis.

There are no wildlife corridor issues within the project area.

Rare, Threatened and Endangered Species

There are no mapped rare, threatened or endangered species within the project area.

Agricultural

There are prime agricultural soils within the project area. These soils are in the Weider very fine sandy loam and Waitsfield silt loam series.

Hazardous Materials:

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there is an underground storage tank located 700 feet north or the bridge, and another 1,800 feet south of the bridge, along VT 100.

Historic:

Bridge 177 is not a historic resource. However, the adjacent farm complex on the upstream side of the river is a historic property. See the map in the appendix and the Existing Conditions Layout sheet.

Stormwater:

There are no stormwater related concerns for this bridge.

II. Maintenance of Traffic

The Vermont Agency of Transportation is in the process of finalizing 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 will help 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 precast 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: Temporary Bridge

A temporary bridge placed upstream of the existing structure would be less expensive, and less complicated to build than a downstream temporary bridge. This is primarily due to constructability reasons. A temporary bridge on the downstream side would encounter a steep hillside on the south end which would require a large cut volume. Also, the downstream area is heavily wooded, and a downstream temporary bridge would require a great deal of clearing. A downstream temporary bridge would also have adverse impacts to archaeological resources located in the southeast quadrant of the bridge. On the other hand, the upstream area of the bridge is relatively flat and open. An upstream temporary bridge would have slight impacts to class III wetlands located in the southwest quadrant of the bridge. Both an upstream and downstream temporary bridge alignment would require acquiring temporary rights from adjacent property owners.

A two-way temporary bridge would be preferred based on the daily traffic volumes. The temporary bridge would have a span of 160 feet. See the Temporary Bridge Layout Sheet in the appendix.

Advantages: Traffic flow can be maintained along the VT Route 100 corridor.

Disadvantages: This option would require some Right-of-Way acquisition, which would lengthen the project development phase by a minimum of two years. This option would have adverse impacts to surrounding 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. This traffic control option would be costly, and time consuming, as construction activities would take a second construction season, in order to set up the temporary bridge.

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 keeping the road open during construction, while having minimal impacts to surrounding resources and adjacent property owners.

Due to horizontal constraints of the existing bridge, phased construction would be complicated for this site, without shifting the alignment of the proposed bridge, widening the bridge, or using a temporary bridge for one of the phases. Additionally, phased construction would result in a longer, more expensive, lower quality, and less safe construction project. Based on the traffic volumes, it could be considered acceptable to close one lane of traffic, but it would not be ideal due to delays and traffic congestion. This option would also create safety concerns for workers and the travelling public during construction.

Advantages: Traffic flow would be maintained through the project corridor during construction. Also, this option would have minimal impacts to the wetlands, archaeological, and historical resources adjacent to the bridge.

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 two times. Additionally, since cars are traveling near

construction activity, there is decreased safety for the traveling public and for construction workers. There would be some delays and disruption to traffic, since the road would be reduced to one-way traffic.

Option 3: Off-Site Detour

This option would close the bridge and reroute traffic onto VT RT 17, VT RT 116, and VT RT 125 back to VT RT 100. This regional detour has an end-to-end distance of 67 miles. This detour adds approximately 25 miles to travel distance. This detour route is unacceptable for trucks; if an off-site detour is chosen as the best option for traffic control, an alternative route for trucks needs to be evaluated.

There is one notable local bypass route that may see an increase in traffic from local passenger cars. This route has an end-to-end distance of 10 miles. It is likely that this route could see increased traffic if VT 100 were closed during construction. The possible local bypass route is as follows:

1. VT 100, to VT 17 (Mill Brook Road), German Flats Road, Surgarbush Access Road, back to VT 100 (10.5 mi end-to-end)

There are other roads to the east of VT 100 that may see an increase in traffic, but they are not appropriate for the amount of traffic being detoured. A map of the detour route and possible local bypass route, which could see an increase in traffic, can be found in the appendix.

It is possible, with the permission from the Towns of Warren, and Fayston, to sign Local Bypass Route 1 as the official detour.

Advantages: This option would eliminate the need for a temporary bridge, which would significantly decrease cost and time of construction. This option would not require the need to obtain rights from adjacent property owners for a temporary bridge. Also, this option would not have impacts to wetlands and historic resources adjacent to the bridge. This option reduces the time and cost of the project both at the development stage and construction.

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

III. Alternatives Discussion

No Action

This alternative is not recommended. The deck is in poor condition and numerous attempts have been made to patch full depth holes in the deck. Additionally, the substructure is only in fair condition, so something will have to be done to improve this bridge in the near future. Although the bridge is not in imminent danger of collapse, it will eventually be posted for lower traffic loads, and may be closed if it deteriorates much further. 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 and Deck Replacement

This alternative involves the rehabilitation of the existing substructures and the replacement of the deck.

A rehabilitation option for this bridge would include replacement of the deck, concrete repair of the pier, and scour mitigation to address the scour hole at the south abutment. There are also some minor cracks and spalling of the abutments which should be patched for this alternative.

The existing bridge width is substandard. The existing shoulders are 6 inches wide. According to the Vermont State Standards, the shoulders should be at least 5 feet wide at this location. Widening the existing bridge will not be considered for the rehabilitation and deck replacement however. The costs associated with widening the bridge would be too high to justify widening the structure over full replacement.

Advantages: This alternative would address the structural deficiencies of the existing bridge, with minimum upfront costs. This option would not require Right-of-Way acquisition.

Disadvantages: The current bridge has 0.5 foot shoulders, which is functionally deficient. For this site, 5 foot shoulders are required, and this option does not address this issue. Additionally, the substandard vertical alignment would not be addressed. This option would only have a design life of 25 years, at which point the substructure will have reached the end of its useful life, and a full replacement would be necessary.

Maintenance of Traffic: The preferred method of traffic control for the rehabilitation option is phased construction. This would allow the corridor to remain open during construction, without the high costs of a temporary bridge.

New Structure on Existing Alignment

The existing horizontal alignment meets current standards; therefore, any new structure will be placed on the existing horizontal alignment. Since the bridge is on a straight segment of roadway, this alignment is the best option.

This alternative would replace the existing bridge with a new superstructure as well as new substructures at the existing location. The option would be a brand new bridge that addresses the current structural and geometric deficiencies of the existing bridge.

By choosing to replace the bridge, the width of the road can be widened to accommodate 5 foot shoulders as per the Vermont State Standards. The vertical alignment would be slightly improved in order to meet the current standards. Additionally, a new bridge will have a design life of 80 years.

There are two different options for a new structure, depending on how traffic is maintained. These options are discussed in subsection (e) below. Regardless of which option is chosen, there are several considerations which will remain the same, such as bridge width and length, skew, and substructure type.

a. Bridge Width

The current rail to rail width is 23 feet. This does not meet the minimum standard of 32 feet. Since a new 80+ year bridge is being proposed in this location, the bridge geometry should meet the minimum standards. In order to satisfy the Vermont State Standards, the new bridge would have eleven foot lanes with five foot shoulders. A curb to curb width of 32 feet will be proposed.

b. Bridge Length and Skew

The existing bridge consists of two spans, each 81 feet long and with a 45 degree skew. This skew matches the existing channel. The intermediate pier will be removed for improved hydraulic conditions, resulting in a single span of 160 feet. The skew will be 45 degrees to match the channel.

By increasing the span to 195', the skew could be eliminated providing a simple square superstructure. This would be less economical, and thus, it is not recommended to eliminate the skew.

c. Superstructure Type

The low beam elevation required to provide adequate hydraulic capacity is more than 7 feet below the existing grade of the road. Therefore, the superstructure type will not be dependent on its depth. The most economical superstructure type for this span is a steel girder superstructure with a concrete deck.

d. Substructure Type

Based on existing conditions and geotechnical investigations, the south abutment is recommended to be a cast-in-place spread footing founded on bedrock. The north abutment will be a pile cap supported on H-piles.

e. Maintenance of Traffic

Either a temporary bridge or a road closure would be appropriate measures for traffic control at this site. Construction methods would vary depending on which traffic maintenance method is chosen. The two options are explained below.

A. Rapid Bridge Construction Methods (Road Closure)

This alternative would replace the substructure and superstructure with prefabricated bridge elements where possible. As much substructure work as possible would need to take place before closing the road to traffic. Piles would be driven on each side of the bridge at the north abutment while the bridge was open to traffic. Also, the south abutment would be formed and poured to exposed bedrock, directly in front of the existing abutment. Once this substructure work was complete, the bridge could be closed to traffic, and the superstructure, the north abutment, and pier could be removed. A precast pile cap would then be placed over the piles at the north abutment, and a temporary bent placed between the two abutments to support the superstructure while it is being placed. A precast superstructure would then be placed on top of the substructure.

The superstructure for this option would be comprised of precast bridge units. In order to accommodate maximum span and lifting limits, there will be two sections for each bridge unit adding up to a 160 foot span (a 120 foot long section and a 40 foot long section). The spans will be temporarily supported on a bent while they are placed, and then spliced together. For this option, the bridge would need to be closed to traffic for a maximum of three weeks. A map of the state detour route and possible local bypass routes can be found in the appendix.

B. Conventional Construction Methods (Temporary Bridge)

This alternative would replace the substructure and superstructure using conventional methods. Traffic would be diverted onto an upstream temporary bridge, and the existing bridge would be removed. New abutments would be constructed using conventional methods and cast-in-place concrete. 160 foot span steel beam girders would be placed, and a concrete deck poured. Construction activities would most likely last two construction seasons.

Advantages: This alternative would be a new structure with an estimated life span of 80 years. The increased road width would meet Vermont State Standards, and would also make the bridge crossing safer for bikes and pedestrians.

Disadvantages: There would be some disruption to traffic during construction activities. A temporary bridge would adversely affect property owners around the project area, but only temporarily. Additionally, a temporary bridge would require Right-of-Way, which would delay the project development phase by a minimum of two years. A detour would not maintain traffic on VT RT 100 during a portion of construction.

Maintenance of Traffic: Phased construction is not recommended for this option; due to the horizontal constraints of the project, phased construction would be time consuming and costly. This alternative could utilize an upstream temporary bridge, or an offsite detour.

IV. Alternatives Summary

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

Alternative 1: Bridge Rehabilitation with Superstructure Replacement
Alternative 2A: New Structure with Traffic Maintained on Offsite Detour
Alternative 2B: New Structure with Traffic Maintained on Temporary Bridge

V. Cost Matrix

		Do Nothing	Alt 1 Bridge Rehabilitation with Deck Replacement	Alt 2A New Structure with Traffic Maintained on Offsite Detour	Alt 2B New Structure with Traffic Maintained on Upstream Temporary Bridge
COST	Bridge	$0	$487,804	$1,680,200	$1,368,900
	Removal of Structure	$0	$50,000	$75,000	$75,000
	Channel Work	$0	$4,000	$12,000	$12,000
	Roadway	$0	$177,448	$581,681	$630,166
	Erosion Control	$0	$10,000	$20,000	$30,000
	Temporary Bridge	$0	$0	$0	$300,000
	Construction Costs	$0	$729,252	$2,368,881	$2,416,066
	Construction Duration		8 months	6 months, with 3 week closure	18 months
	Preliminary Engineering[1]	**$0**	**$218,775**	**$473,776**	**$483,213**
	Right of Way	**$0**	**$0**	**$0**	**$217,446**
	Construction Costs + Construction Engineering + Contingencies	**$0**	**$948,027**	**$3,197,989**	**$3,140,886**
	Project Development Duration		2 years	2 years	4+ years
	Total Costs	$0	$1,166,803	$3,671,765	$3,841,545
	Premium			0%	4.6%
	Design Life		25 years	80 years	80 years
ENGINEERING					
	Typical Section - Roadway (feet)	34'	34'	32'	32'
	Typical Section - Bridge (feet)	0.5 - 11 - 11 – 0.5	0.5 - 11 - 11 – 0.5	5 - 11 - 11 - 5	5 - 11 - 11 - 5
	Geometric Design Criteria	Substandard	Substandard	Meets Criteria	Meets Criteria
	Traffic Safety	No Change	Improved	Improved	Improved
	Alignment Change	No	No	Vertical Improved	Vertical Improved
	Bicycle Access	No Change	No Change	Improved	Improved
	Hydraulic Performance	No Change	No Change	Improved	Improved
	Pedestrian Access	No Change	No Change	No Change	No Change
	Utility	No Change	No Change	Relocation	Relocation
OTHER	ROW Acquisition	No	No	No	Yes
	Road Closure	No	Yes	Yes	No

[1] Preliminary Engineering costs are estimated starting from the end of the Project Definition Phase.

VI. Conclusion

Our **conditional** recommendation is to pursue alternative 2A; to build a new bridge with a three week closure while maintaining traffic on an offsite detour, on locally owned roads. This alternative will be able to be developed in the shortest possible time with minimal impacts to adjacent property owners and environmental resources. Since the proposed detour route is on locally owned roads, this recommendation is conditional on receiving the approval from the Towns of Warren and Fayston, who own the roads that traffic could be detoured onto.

If the Towns are not willing to give approval to use their roads as the detour route, our recommendation will be to pursue alternative 2B, to build a new bridge on existing alignment, while maintaining traffic on a temporary bridge.

Structure:
The bridge will have a single span of 160 feet and a skew of 45 degrees to match the channel. The width of the bridge is substandard, which is an important safety feature that needs to be addressed. The width of the bridge will be widened to meet the current Vermont State Standards. Additionally, the vertical alignment will be slightly improved to meet the current standards. While the rehabilitation option has the lowest upfront costs, a bridge replacement has a lower per year cost based on an 80 year design life compared to a 25 year design life. Additionally, not only does a full bridge replacement address structural deficiencies of the existing bridge, but it also addresses the geometric deficiencies.

Traffic Maintenance:
The official state detour route has an end-to-end distance of 67 miles, which is relatively long for the amount of traffic that would be detoured at this site. The Average Daily Traffic volume is 4,100 vehicles per day. It does not seem reasonable to send that volume of traffic around a detour of that length. However, Local Bypass Route 1, as described in the appendix could be appropriate for a signed detour route, if the Towns give their permission to do so.

Local Bypass Route 1 is as follows: VT Route 100, to VT Route 17, German Flats Road, Sugarbush Access Road, back to VT Route 100. This local bypass route has an end-to-end distance of 10.5 miles, and could be appropriate for a signed detour route.

From a geometric standpoint, the Local Bypass Route could be considered an acceptable signed detour, pending the Towns' approval. Additionally, the Local Bypass Route experiences traffic volumes similar to what is expected during the bridge closure, during ski season.

If the Towns of Warren and Fayston do not wish to have the Local Bypass Route signed, than a temporary bridge will be recommended.

The temporary bridge option with conventional construction methods only adds a 4.6% premium, which is relatively inexpensive. This is due to the increased costs of a pre-fabricated bridge, and the heavy equipment needed to lift a pre-fabricated bridge of this magnitude into place. Right-of-Way would need to be obtained in order to construct a temporary bridge, which would extend the project development stage by at least two years. A temporary bridge could be constructed upstream or downstream, and should have a clear span of 107 feet normal to the river.

VII. Appendices

- Site Pictures
- Town Map
- Bridge Inspection Report
- Hydraulics Memo
- Preliminary Geotechnical Information
- Natural Resources Memo
- Archeology Memo
- Historic Memo
- Stormwater Memo
- Resource ID Completion Memo
- Detour and Local Bypass Route
- Plans
    - Existing Conditions
    - Typical Sections
    - Layouts
    - Profile

Picture 1: North Approach

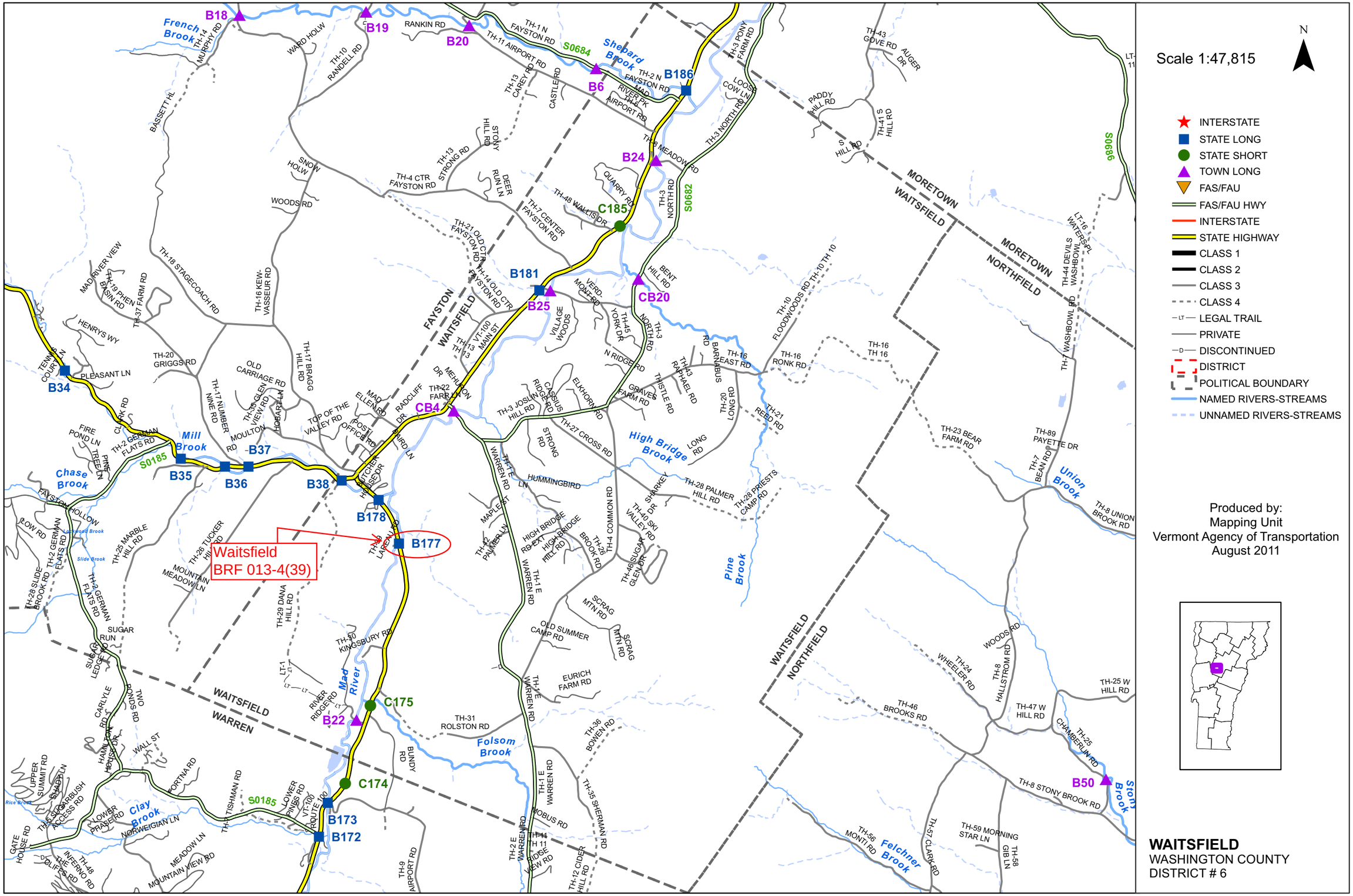
Picture 2: South Approach

Picture 3: Looking Downstream

Picture 4: Looking Upstream

Picture 5: Pavement deterioration

Picture 6: Pier deterioration


Scale 1:47,815
N
INTERSTATE
STATE LONG
STATE SHORT
TOWN LONG
FAS/FAU
FAS/FAU HWY
INTERSTATE
STATE HIGHWAY
CLASS 1
CLASS 2
CLASS 3
CLASS 4
LEGAL TRAIL
PRIVATE
DISCONTINUED
DISTRICT
POLITICAL BOUNDARY
NAMED RIVERS-STREAMS
UNNAMED RIVERS-STREAMS
Produced by:
Mapping Unit
Vermont Agency of Transportation
August 2011
WAITSFIELD
WASHINGTON COUNTY
DISTRICT # 6
Waitsfield
BRF 013-4(39)
FAYSTON
WAITSFIELD
MORETOWN
WAITSFIELD
MORETOWN
NORTHFIELD
WAITSFIELD
WARREN
WAITSFIELD
NORTHFIELD
French Brook
Shepard Brook
Mill Brook
Chase Brook
High Bridge Brook
Pine Brook
Union Brook
Mad River
Folsom Brook
Clay Brook
Stony Brook
Felchner Brook
B18
B19
B20
B6
B186
B24
C185
B181
B25
CB20
B34
B35
B36
B37
B38
B178
B177
CB4
C175
B22
C174
B173
B172
B50
S0684
S0682
S0686
S0185

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

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

Inspection Report for WAITSFIELD **bridge no.:** 00177 **District:** 6

Located on: VT 00100 ML **over** MAD RIVER **approximately** 0.8 MI S JCT. VT.17 **Owner:** 01 STATE-OWNED

CONDITION

Deck Rating: 4 POOR

Superstructure Rating: 6 SATISFACTORY

Substructure Rating: 5 FAIR

Channel Rating: 6 SATISFACTORY

Culvert Rating: N NOT APPLICABLE

Federal Str. Number: 200013017712162

Federal Sufficiency Rating: 54

Deficiency Status of Structure: FD

AGE and SERVICE

Year Built: 1938 **Year Reconstructed:** 0000

Service On: 1 HIGHWAY

Service Under: 5 WATERWAY

Lanes On the Structure: 02

Lanes Under the Structure: 00

Bypass, Detour Length (miles): 28

ADT: 004900 **% Truck ADT:** 09

Year of ADT: 1998

GEOMETRIC DATA

Length of Maximum Span (ft): 0081

Structure Length (ft): 000168

Lt Curb/Sidewalk Width (ft): 0.5

Rt Curb/Sidewalk Width (ft): 0.5

Bridge Rdwy Width Curb-to-Curb (ft): 22.6

Deck Width Out-to-Out (ft): 24.9

Appr. Roadway Width (ft): 034

Skew: 45

Bridge Median: 0 NO MEDIAN

Min Vertical Clr Over (ft): 99 FT 99 IN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 00 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: 2 SPN ROLLED BEAM

Number of Approach Spans: 0000 **Number of Main Spans:** 002

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: 1 CONCRETE CIP

Type of Wearing Surface: 6 BITUMINOUS

Type of Membrane 2 PREFORMED FABRIC

Deck Protection: 0 NONE

APPRAISAL *AS COMPARED TO FEDERAL STANDARDS

Bridge Railings: 1 MEETS CURRENT STANDARD

Transitions: 1 MEETS CURRENT STANDARD

Approach Guardrail: 1 MEETS CURRENT STANDARD

Approach Guardrail Ends: 1 MEETS CURRENT STANDARD

Structural Evaluation: 5 BETTER THAN MINIMUM TOLERABLE CRITERIA

Deck Geometry: 2 INTOLERABLE, REPLACEMENT NEEDED

Underclearances Vertical and Horizontal: N NOT APPLICABLE

Waterway Adequacy: 7 SLIGHT CHANCE OF OVERTOPPING BRIDGE & ROADWAY

Approach Roadway Alignment: 8 EQUAL TO DESIRABLE CRITERIA

Scour Critical Bridges: 8 STABLE FOR SCOUR

DESIGN VEHICLE, RATING, and POSTING

Load Rating Method (Inv): 2 ALLOWABLE STRESS (AS)

Posting Status: A OPEN, NO RESTRICTION

Bridge Posting: 5 NO POSTING REQUIRED

Load Posting: 10 NO LOAD POSTING SIGNS ARE NEEDED

Posted Vehicle: POSTING NOT REQUIRED

Posted Weight (tons):

Design Load: 2 H 15

INSPECTION and CROSS REFERENCE

X-Ref. Route:

Insp. Date: 062011 **Insp. Freq. (months)** 24 **X-Ref. BrNum:**

INSPECTION SUMMARY and NEEDS

09/04/2011 IRENE There is undermining of abutment 2 upstream side that goes under the entire length of the cheek wall. I will need to be filled in at a later date. No settlement at this time. Debris around pier needs to be removed and rip rap added. MK JM

06/09/2011 - * Bridge deck is quite poor with full depth hole repairs and additional exterior bay holes pending. Bridge needs either major reconstruction or likely full replacement. In the interim the rough surface should be smoothed and paved. ~ MJ/DK

4/09/09 This structure is in poor to good condition. The deck, superstructure and substructure continue to deteriorate. This structure needs a major rehab project or a complete replacement project very soon. The approach guard rail has collision damage and needs repair. DCP

VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION

HYDRAULICS UNIT

TO: Chris Williams, Structures Project Manager

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

DATE: 15 August 2012

SUBJECT: Waitsfield BHF 013-4(39) VT 100 BR 177 over the Mad River (12b136)

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

Existing Bridge Information

The existing bridge was built in 1938. It is a two-span continuous rolled beam bridge. The abutments are concrete. Each span has a clear span of 57' and an approximate clear height of 16'. It provides approximately 1760 sq. ft. of waterway area.

According to the record plans, abutment 1 is founded on ledge. Abutment 2 and the pier are founded on piles.

The inspection report states that during Tropical Storm Irene, upstream of abutment 2 was undermined for the entire length of the wingwall. Debris builds up in front of the pier. There is a gravel bar downstream of the pier. The top of the footing of the pier can be seen at low water. The south abutment has a large scour hole underneath it.

The bridge and channel are on an approximate 45 degree skew to the road. The deck is in bad disrepair.

The bridge is hydraulically adequate because it has more than 1.0' of freeboard at Q50. All flows up to Q500 currently flow through the bridge although the fields and property upstream of the bridge are part of the floodplain and are flooded at the Q100 flow.

Recommendations

Since this project is still in the early stages of development, alternatives are unknown at this time. Any new structure should maintain the 125' clear span normal to the river that the existing bridge has. Since the bridge has more than 1.0' of freeboard, the superstructure may be lowered to an elevation no lower than 721.2'. All flows up to Q100 will still be able to flow through this bridge at that elevation. It should be noted, however, that upstream property will continue to flood and that the Q500 water surface elevation will rise if the bridge is lowered.

Scour was not reviewed at this time, but will be when we have more details on the proposed structure that will be designed for this site.

Stone fill, Type III should be used for any disturbed channel banks and should match into existing stream banks. It should not constrict the channel.

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. The new structure should be aligned with the channel as much as possible.

Temporary Bridge

A temporary bridge was analyzed upstream of the existing bridge for construction purposes. It should have a 107' minimum clear span normal to the river with low beam elevation no lower than 720.0'. It should provide approximately 1045 sq. ft. of waterway area. It can have a 4' wide pier, if needed. This structure will raise Q100 water surface elevation by 0.5'. If this is not acceptable, then the low beam elevation should be higher or the bridge longer than 107' minimum clear span.

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

LGR

cc Hydraulics Project File via NJW
Hydraulics Chrono File

12b136\Hydraulics\Waitsfield VT 100 BR 177 prel hyd memo.docx

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

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

NSM CCB

From: Nicholas S. Meltzer, Geotechnical Engineer, via Christopher C. Benda P. E., Soils and Foundations Engineer

Date: May 29, 2012

Subject: Waitsfield BHF 013-4(39) Preliminary Geotechnical Information

1.0 INTRODUCTION

We have completed our preliminary geotechnical investigation for the replacement of Bridge #177 on VT-100, in the town of Waitsfield, VT. Located approximately 0.8 miles south of the junction with VT-17, the subject project consists of replacing the existing two span, rolled beam bridge. This report documents our initial search of historical information and field observations to determine the characteristics of the site. A number of materials were reviewed including: VTrans boring files and record plans, Agency of Natural Resources (ANR) water well logs, USDA Surficial Geologic maps and VTrans Bridge Inspection Photos.

2.0 SUBSURFACE INFORMATION

2.1 Previous Projects

Record plans were found from when the bridge was constructed in 1938. The southern abutment was founded directly on bedrock, while the pier and north abutment were founded on timber piles, at an approximate length of 25 feet at the pier and 40 feet at the northern abutment. The Soils and Foundations Unit maintains a GIS based historical record of subsurface investigations, which contains electronic records for the majority of borings completed in the past 10 years. No information in the area was found for this project.

2.2 Water Well Logs

The Agency of Natural Resources (ANR) documents and publishes all water wells that are drilled for residential or commercial purposes. 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. Three surrounding well logs were examined for depths to bedrock and soil strata.

Figure 1 contains the project and surrounding well locations. The specific wells used to gain information on the subsurface conditions are highlighted by a red box. Four water

wells within a 1000' radius were used to get an estimate of the depth to bedrock and types of soils likely to be encountered on the project.

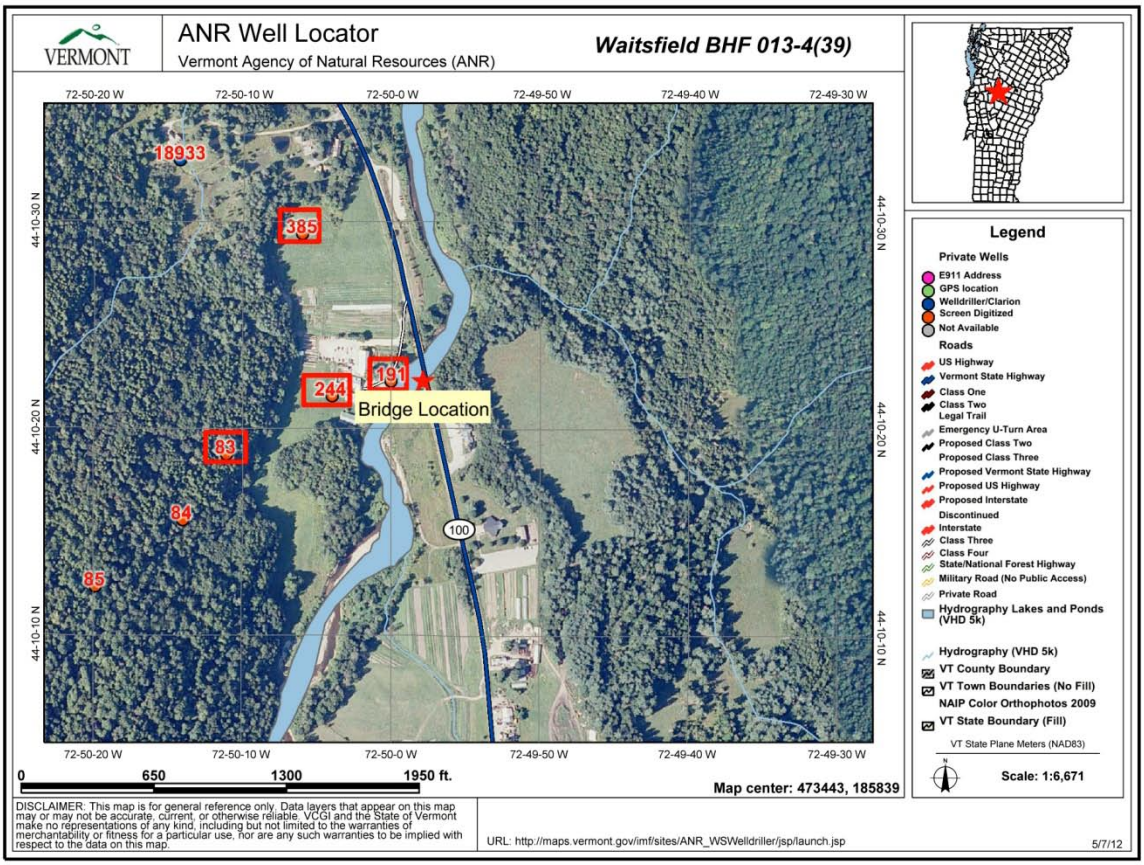


Figure 1. Highlighted well locations near subject project

Table 1 lists the well sites used in gathering the surrounding information. Four water wells are listed with the distance from the bridge project, depth to bedrock, and type of soils encountered.

Table 1. Depths to bedrock and subsurface strata of surrounding sites

Well Number	Distance From Project (feet)	Depth To Bedrock (feet)	Overburden Material
191	100	10	Not Listed
244	400	75	Sand and silt
385	990	23	Gravel and silty clay
83	1000	10	Hardpan (very dense gravelly silt)

2.3 USDA Soil Survey

The United States Department of Agriculture Natural Resources Conservation Service maintains a surficial geology map of the United States, which is available online. According to the Web Soil Survey, the strata directly underlying the project site consists of Machias fine sandy loam and Weider very fine sandy loam, which has a water table between 12 and 36 inches.

3.0 FIELD OBSERVATIONS

A site visit was conducted to determine potential issues with boring operations, and to make any other pertinent observations about the project. Figure 2 was taken on May 7, 2012.

Figure 2. View of bridge, looking downstream (east)

4.0 RECOMMENDATIONS

Based on this information, the southern abutment is likely to be a spread footing founded on bedrock. Possible foundation options for pier include spread footings and pile supported concrete abutments, while for the northern abutment, pile caps on a single row of H-Piles, stub

abutments on a MSE Wall, and reinforced concrete abutments on spread footings are all feasible options.

A minimum of one boring at each substructure location should be performed for use in design. Additional hand steel soundings at the southern abutment could be used to ascertain the elevation of bedrock across the width of the abutment.

5.0 CONCLUSION

If you have any questions or would like to discuss this report, please contact us by phone at (802) 828-6911, or via email at Nick.Meltzer@state.vt.us.

cc: Project File/CCB
NSM

VERMONT

State of Vermont
Program Development Division
One National Life Drive
Montpelier, VT 05633-5001
www.aot.state.vt.us

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

Agency of Transportation

To: James Brady, VTrans Environmental Specialist

From: Glenn Gingras, VTrans Environmental Biologist

Date: 4/19/2012

Subject: Waitsfield BHF 013-4(39) - Natural Resource ID

I have completed my natural resource scoping review for the above referenced project. My evaluation has included the following resources: wetlands, wildlife habitat, agricultural soils, and rare, threatened and endangered species. I have reviewed all existing mapped information and performed a site review of the project area.

Wetlands/Watercourses
There are wetlands within the project area. Formal wetland delineation according to US Army Corps of Engineers Wetland Delineation Manual was not completed and wetlands were identified using best professional judgment for resource identification/planning purposes. There is a small wetland within the southwest quadrant of the project as depicted in the attached map. The wetland is small in size and would likely be class III. A shape file with approximate wetland boundaries is available for reference.

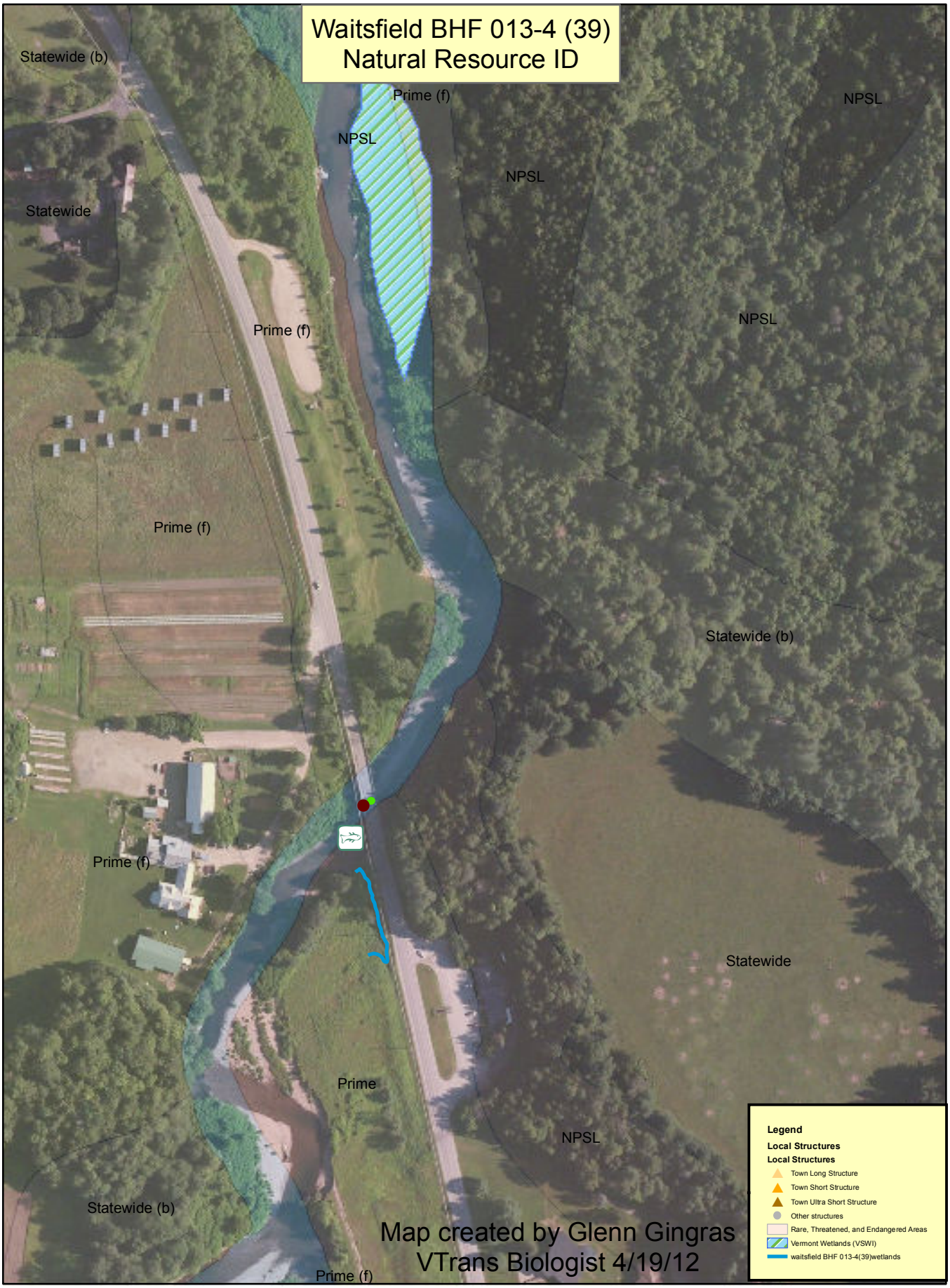
The Mad River flows north easterly through the project area. This river would support a variety of aquatic organisms including wild brook trout and rainbow trout. Efforts to minimize water quality impacts during construction will need to be evaluated as the project design moves forward.

The US Corps of Engineers and the Agency of Natural Resources- Department of Environmental Conservation would regulate all activities below ordinary high water and to wetlands.

Wildlife Habitat
Good Wildlife habitat exists within the surrounding area. There are large blocks of land forested land on both sides of the road mixed with agricultural lands. The project area scores low (<5) on the habitat linkage analysis although. There are no wildlife corridor issues within the project area.

Rare, Threatened and Endangered Species
There are no mapped rare, threatened or endangered species within the project area.

Agricultural Soils
There are prime agricultural soils within the project area. These soils are in the Weider very fine sandy loam and Waitsfield silt loam series.


Waitsfield BHF 013-4 (39)
Natural Resource ID
Statewide (b)
Prime (f)
NPSL
NPSL
NPSL
Statewide
Prime (f)
NPSL
Prime (f)
Statewide (b)
Prime (f)
Statewide
Prime
NPSL
Statewide (b)
Prime (f)
Map created by Glenn Gingras
VTrans Biologist 4/19/12
Legend
Local Structures
Local Structures
Town Long Structure
Town Short Structure
Town Ultra Short Structure
Other structures
Rare, Threatened, and Endangered Areas
Vermont Wetlands (VSWI)
waitsfield BHF 013-4(39)wetlands

VERMONT

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

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

Agency of Transportation

To: Jeff Ramsey, VTrans Environmental Specialist

From: Jeannine Russell, VTrans Archaeology Officer
via Brennan Gauthier, VTrans Assistant Archaeologist

Date: 6/4/2012

Subject: Waitsfield BHF 013-4(39) – Archaeological Resource ID

Jeff,

We've completed our archaeological resource identification for bridge 177 along VT RT 100 in Waitsfield. We identified one landform with some sensitivity in the SE quadrant of the project area during our field visit on 4/18/2012. I've attached a visual map along with this ID memo. The data has been added to the archaeology geodatabase for inclusion into future CADD plans.

Feel free to contact me with any questions or concerns,

~Brennan

Brennan Gauthier
VTrans Assistant Archaeologist
tel. 802-828-3965
Brennan.Gauthier@state.vt.us

VTrans Working to Get You There
Vermont Agency of Transportation

Waitsfield BHF 013-4(39)
N
1:1,117
0 0.005 0.01 0.015 0.02
Miles
TH-39
LAREAU RD
MAIN ST
VT-100
100
Arch Sens
Map created by BCG,
PDD-Environmental Section
on 6/4/2012.

Brady, James

From: O'Shea, Kaitlin
Sent: Friday, April 13, 2012 4:52 PM
To: Brady, James
Cc: Williams, Chris; Newman, Scott
Subject: Pilot Project - Waitsfield BHF 013-4(39) Historic Resource ID
Attachments: Waitsfield BHF013-4(39) Historic Resource ID.pdf

Good afternoon,

I have completed the historic resource ID for Waitsfield BHF 013-4(39): Bridge 177 is not a historic resource; however, the adjacent farm complex – located across the river – is a historic property. See the attached map.

This resource ID is part of the GPS/GIS Pilot Project. As discussed, initial review for historic resources is completed via desk review (maps, bridge inspection photos, Google Earth) and can be determined to have no historic resources without site visits. Other projects will require a site visit in order to determine if there are historic resources located within the project area. Historic resources will continue to be identified on a map and scanned for the project files. When appropriate, historic resources will be mapped by the GPS in order to compare and contrast the effectiveness and application of these resource ID procedures.

I am keeping a spreadsheet for these pilot projects which outlines review methods, resource notes, resource ID and how the ID is submitted (GPS data, email memo, resource map, etc.) I'll bring this to the next project meeting.

Let me know if you have any questions.
Thanks,
Kaitlin

Kaitlin O'Shea
Historic Preservation Specialist
Vermont Agency of Transportation

802-279-0869
Kaitlin.O'Shea@state.vt.us

bing Maps

My Notes

On the go? Use **m.bing.com** to find maps, directions, businesses, and more

Waitsfield BHF013-4(39) Historic Resource ID
4/13/2012
K. O'Shea

BR 177 = Not Historic (NC)
Adjacent Farm Complex = Historic (H)

Brady, James

From: Armstrong, Jon
Sent: Wednesday, May 23, 2012 4:27 PM
To: Brady, James
Subject: Waitsfield BHF 013-4(39)

Hi James,
I don't have any noteworthy stormwater related concerns for the subject project at this stage.

Jonathan B. Armstrong, PE
VTrans Stormwater Management Engineer
(802) 828-1332

"*We forget that the water cycle and the life cycle are one*."
- Jacques Cousteau

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·.¸.¸¸.·´`·.. ><((((º>`·.¸¸.·´`·.¸.·´¯`·...><((((º>

From: Brady, James
Sent: Friday, March 30, 2012 8:53 AM
To: Gingras, Glenn; Gauthier, Brennan; O'Shea, Kaitlin; Armstrong, Jon
Cc: Williams, Chris
Subject: Batch of five PDWP GIS/GPS resource ID projects

Hello All,

Attached you will find the Resource ID & Plot Memo for **five** Chris Williams bridge projects. The resource ID will be conducted by a pilot group under PDWP GIS/GPS work plan. Please let me know if you have any questions.

Projects:
Castleton BRF 015-2(10)
Clarendon BRO 1443(48)
Granville BRF 013-4(38)
Huntington BRO 1445(35)
Waitsfield BHF 013-4(39)

Thank you,
James

James Brady
Environmental Specialist
Vermont Agency of Transportation
1 National Life Drive
Montpelier, VT 05633-5001
(802) 828-3978

OFFICE MEMORANDUM

AOT - PROGRAM DEVELOPMENT DIVISION

RESOURCE IDENTIFICATION COMPLETION MEMO

TO: Chris Williams, Project Manager
FROM: James Brady, Environmental Specialist
DATE: June 25, 2012

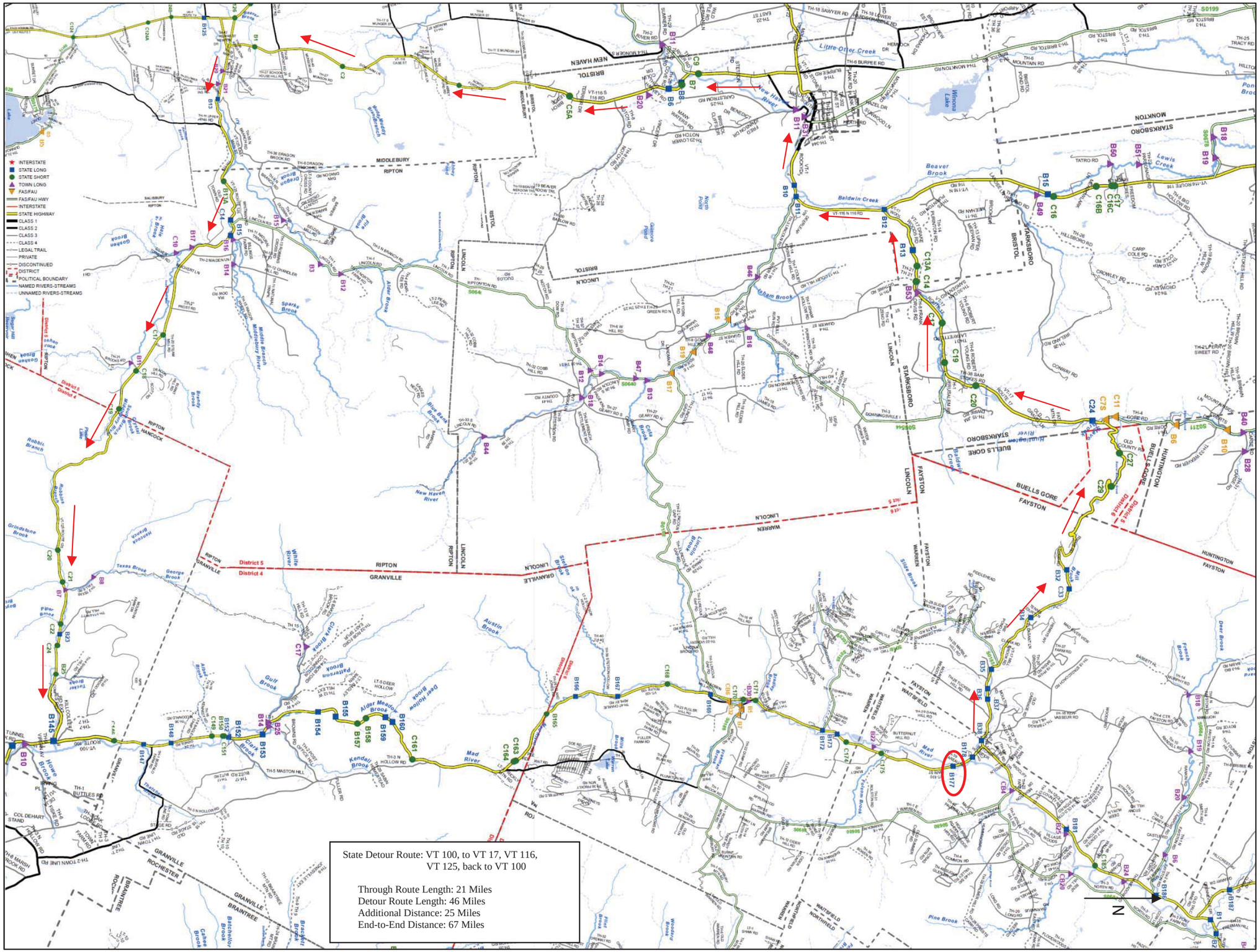
Project: Waitsfield BHF 013-4(39)

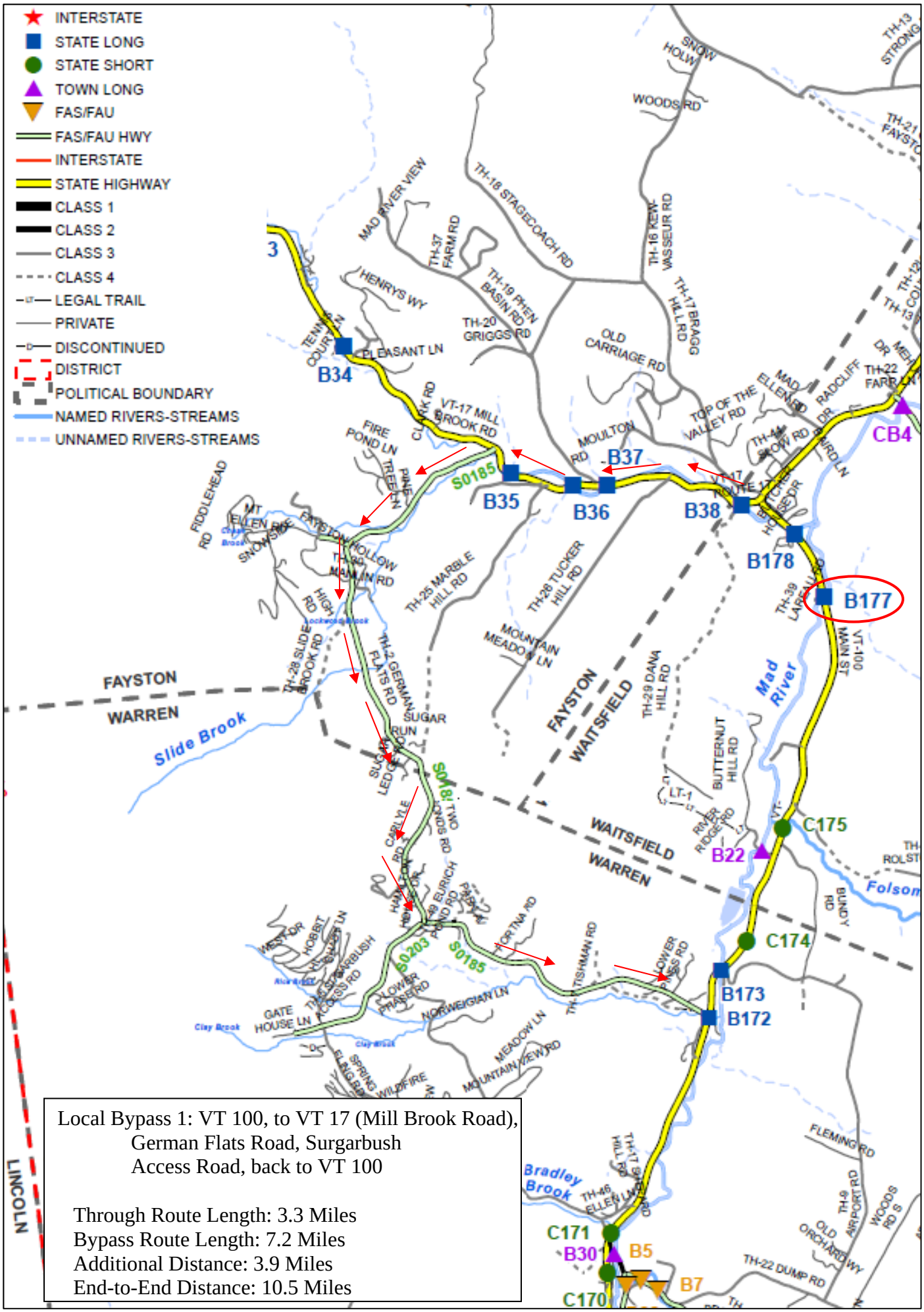
ENVIRONMENTAL RESOURCES:

Wetlands:	X Yes	___ No	See: Waitsfield BHF 013-4(39)-NR_ID.pdf
Historic/Historic District:	X Yes	___ No	See: Waitsfield BHF013-4(39) Historic Resource ID.pdf and Waitsfield BHF013-4(39) Historic Resource ID memo.pdf and DGN file
Archaeological Site:	X Yes	___ No	See: Waitsfield BHF013-4(39)Arch.pdf and DGN file
4(f) Property:	___ Yes	X No	Per Scott Newman, HPO
6(f) Property:	___ Yes	X No	There are no 6(f) properties in the town of Waitsfield
Agricultural Land:	X Yes	___ No	See: Waitsfield BHF 013-4(39)-NR_ID.pdf
Fish & Wildlife Habitat:	X Yes	___ No	See: Waitsfield BHF 013-4(39)-NR_ID.pdf
Endangered Species:	___ Yes	X No	See: Waitsfield BHF 013-4(39)-NR_ID.pdf
Hazardous Waste:	___ Yes	X No	ANR Environmental Interest Locator checked
Stormwater:	___ Yes	X No	See: Waitsfield BHF 013-4(39)SW.pdf
USDA-Forest Service Lands:	___ Yes	X No	
Wildlife Habitat Connectivity:	___ Yes	X No	See: Waitsfield BHF 013-4(39)-NR_ID.pdf
Scenic Highway/ Byway:	X Yes	___ No	Mad River Byway
Act 250 Permits:	___ Yes	___ No	Unknown

If you have any questions or need additional information please let me know.
Thank you,

James
cc:
Project File


State Detour Route: VT 100, to VT 17, VT 116,
VT 125, back to VT 100
Through Route Length: 21 Miles
Detour Route Length: 46 Miles
Additional Distance: 25 Miles
End-to-End Distance: 67 Miles
N



Local Bypass 1: VT 100, to VT 17 (Mill Brook Road), German Flats Road, Surgarbush Access Road, back to VT 100

Through Route Length: 3.3 Miles
Bypass Route Length: 7.2 Miles
Additional Distance: 3.9 Miles
End-to-End Distance: 10.5 Miles

WAITSFIELD, TOWN OF

LAREAU FARM PROPERTIES LLC

TOWN HIGHWAY 38

HISTORIC

HABITAT

RAIL FENCE

FIELD DRIVE

SIGN VR-17 (24K)

2 MAILBOXES #46 / #48

LAREA COUNT

COMB 1311 229 51

GUY COMB 123142 230 52

SIGN OM3-L

COMB 1310 228 3 50

COMB 1308 227 49

SIGN RI-1

SIGN EW11-1 W16-1P

OL LIGHT

VT 100 TO WARREN

VT 100 TO MORETOWN

12+00

13+00

14+00

15+00

16+00

17+00

15" RCP PLUGGED FLOW

STONE FILL

SIGN OM3-R

GUYPOLE 1313 229 30 51S

GUY

SIGN W11-1 W16-1P

GUYPOLE 1309 227 30 49S

GUY

LIGHT POST

RAIL X FENCE

2' DIA DI

16" CCMP FLOW

PAVED DRIVE

BOUNDRY MARKER

BENCHMARK BRIDGE DISK ST157

ARCH

MAD RIVER FLOW

WAITSFIELD, TOWN OF

VT STATE PLANE GRID

N

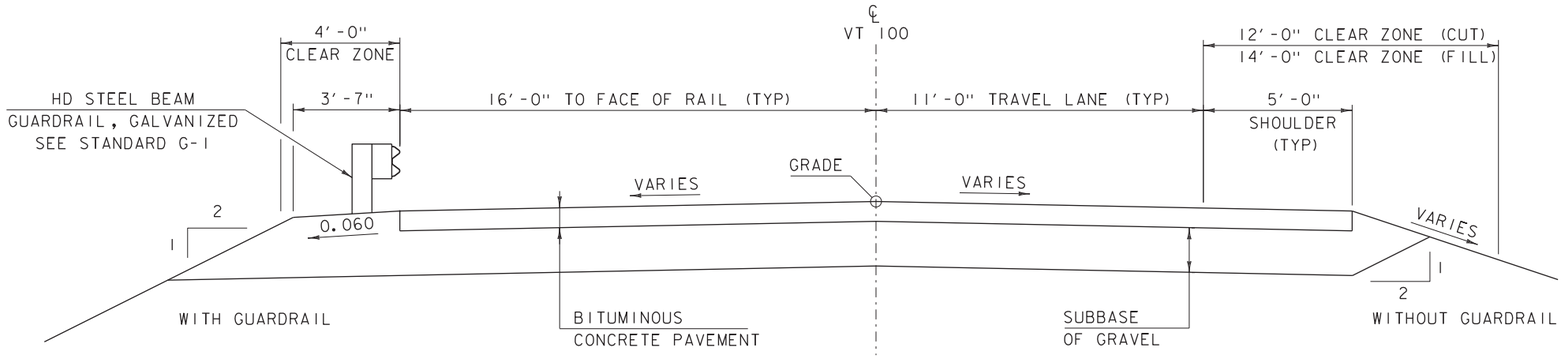
OUR LADY OF SNOWS PARISH CHARITABLE TURST

Existing Conditions

SCALE 1" = 20'-0"

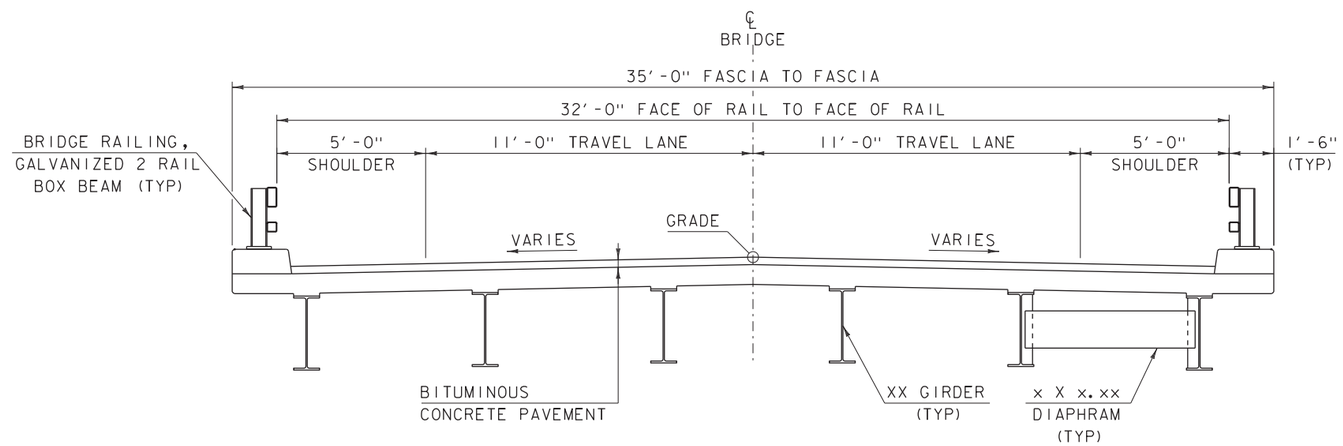
20 0 20

PROJECT NAME: WAITSFIELD	
PROJECT NUMBER: BHF 013-4(39)	
FILE NAME: 12b136\s12b136bdr.dgn	PLOT DATE: 15-OCT-2012
PROJECT LEADER: C.P.WILLIAMS	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
LAYOUT SHEET	SHEET 1 OF 5



PROPOSED VT 100 TYPICAL SECTION

SCALE 3/8" = 1'-0"



FLOW

PROPOSED BRIDGE TYPICAL SECTION

SCALE 3/8" = 1'-0"

NOTE: STEEL BEAMS SHOWN
SUPERSTRUCTURE NOT YET DESIGNED

MATERIAL TOLERANCES

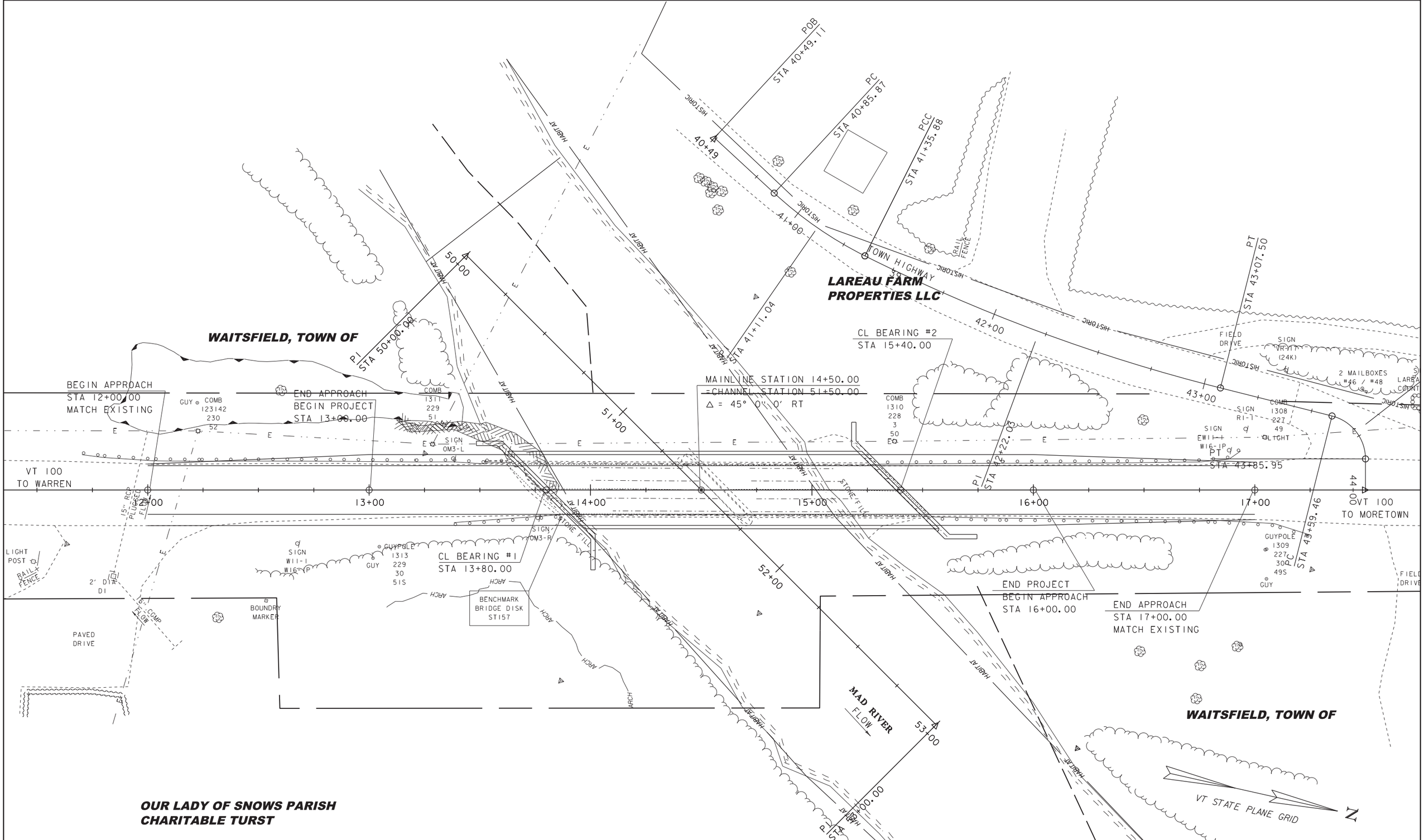
(IF USED ON PROJECT)

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

PROJECT NAME: WAITSFIELD
PROJECT NUMBER: BHF 013-4(39)

FILE NAME: 12B136\s12B136typical.dgn
PROJECT LEADER: C.P.WILLIAMS
DESIGNED BY: ----------
TYPICAL SECTIONS

PLOT DATE: 15-OCT-2012
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 2 OF 5

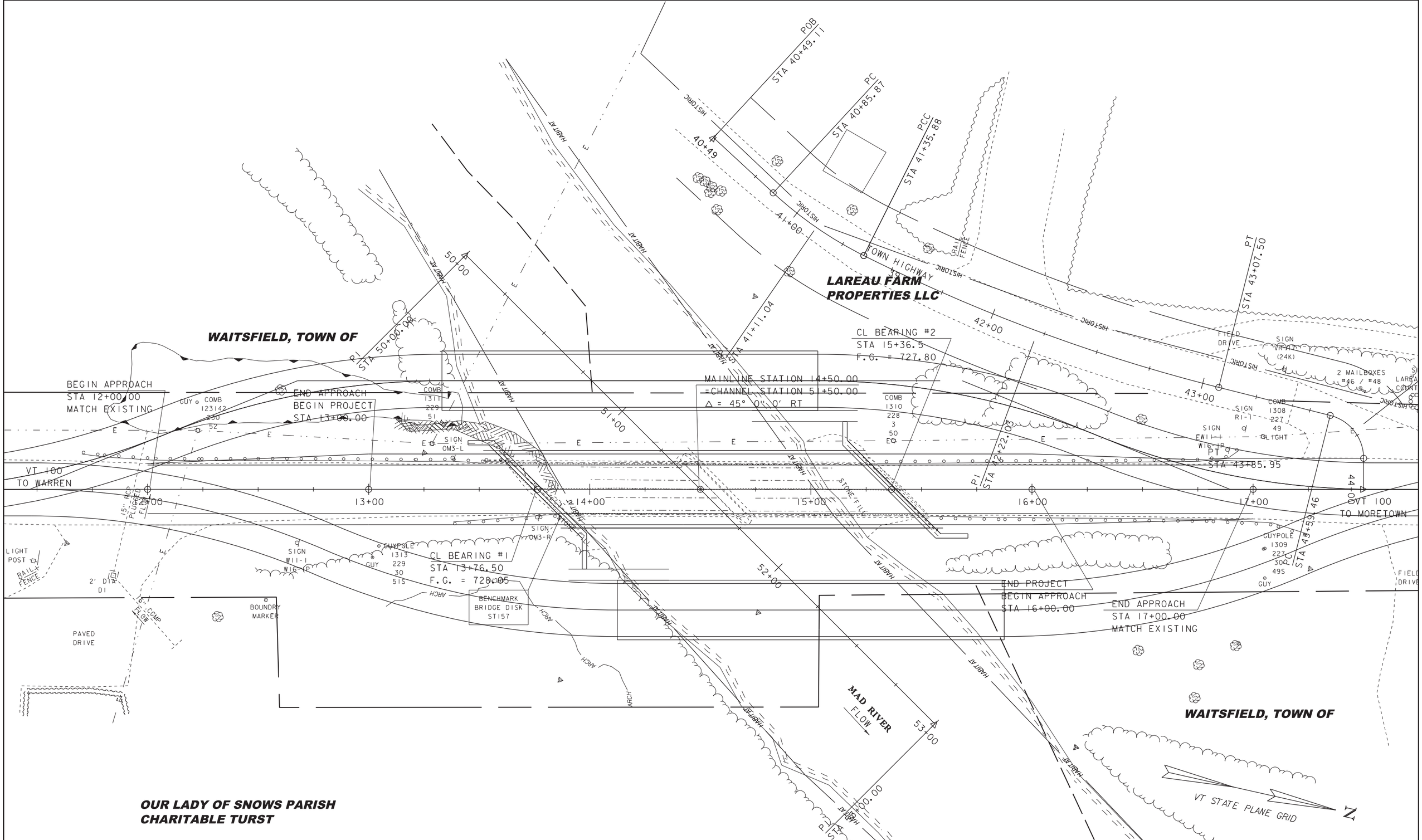


Alternative 2a

SCALE 1" = 20'-0"

20 0 20

PROJECT NAME: WAITSFIELD	
PROJECT NUMBER: BHF 013-4(39)	
FILE NAME: 12b136\s12b136bdr.dgn	PLOT DATE: 15-OCT-2012
PROJECT LEADER: C.P.WILLIAMS	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
LAYOUT SHEET	SHEET 3 OF 5

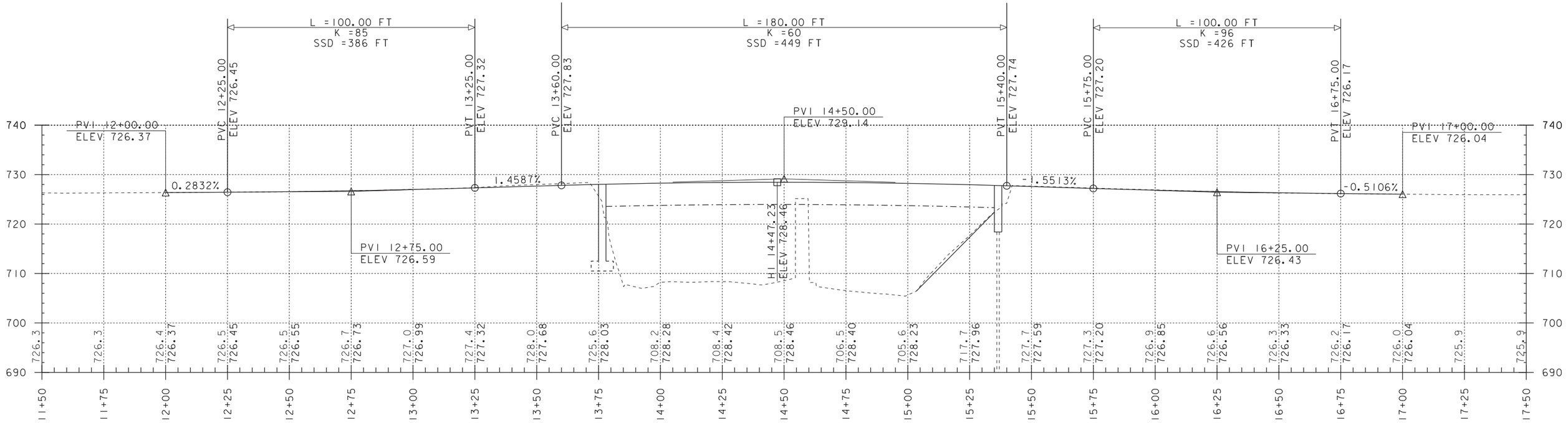


Alternative 2b - Upstream and Downstream Temporary Bridge Shown

DETOUR IS DESIGNED FOR 30 MPH
WITH A 2% SUPERELEVATION

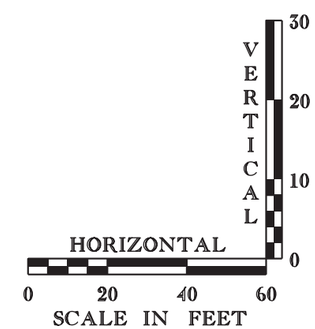
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME: WAITSFIELD	
PROJECT NUMBER: BHF 013-4(39)	
FILE NAME: 12b136\s12b136bdr.dgn	PLOT DATE: 15-OCT-2012
PROJECT LEADER: C.P.WILLIAMS	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
LAYOUT SHEET	SHEET 4 OF 5



LINE	SURFACE	OFFSET
--------	x12b136og	0.00
Scaled	2.0000	Times Ver.
Scaled	1.0000	Times Hor.

VT RT 100 PROFILE



NOTE:

GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄

GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: WAITSFIELD
PROJECT NUMBER: BHF 013-4(39)

FILE NAME: 12b136\s12b136profile.dgn
PROJECT LEADER: C.P.WILLIAMS
DESIGNED BY: ------
PROFILE SHEET

PLOT DATE: 15-OCT-2012
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 5 OF 5