

Town of Pomfret, Vermont

Bridge No. 9 – Pomfret Road over Pomfret Brook
Bridge No. 5 – Stage Road over Pomfret Brook

Engineering Investigation and Recommendations Report



Prepared by

**DuBois
& King** inc.

July, 2013

Town of Pomfret, Vermont

Bridge No. 9 – Pomfret Road over Pomfret Brook Bridge No. 5 – Stage Road over Pomfret Brook

Engineering Investigation and Recommendations Report

Background and Introduction

The Town of Pomfret has retained the services of DuBois & King, Inc. to conduct an engineering study to investigate options to replace or abandon the two bridges near the Teago General Store. The bridges to be considered carry Pomfret Road (Bridge 9) and Stage Road (Bridge 5) over Pomfret Brook. Both bridges are located close to each other, near the intersection of Pomfret Road and Stage Road. The Town has received a Town Structures Grant from VTrans to replace Bridge 9; however, the Town would like their options explored before this bridge is simply replaced. Because the two bridges are in close proximity to each other, both cross Pomfret Brook, and both are hydraulically inadequate, the Town has asked DuBois & King to consider several options, which include:

- Replacing Bridge 9 with a new bridge approximately 32'x6', and raising the road at the bridge to accommodate the required 6' vertical opening.
- Replacing Bridge 9 with a new bridge approximately 32'x6', and lowering the brook's elevation to accommodate the required 6' vertical opening.
- Removing Bridge 9 altogether and replacing Bridge 5 with a new bridge approximately 32'x6' - this option would include closing Pomfret Road between Stage Road and Library Street.

The Pomfret Selectboard understands that the general feeling of the public is that they would like to keep Pomfret Road open to traffic, which requires replacement of Bridge 9. However, if Bridge 9 were removed, the money the Town would invest in replacing it could be invested in Bridge 5 to replace or repair it rather than Bridge 9. The purpose of this Engineering Investigation and

Recommendations Report is to present the Pomfret Selectboard



Existing Bridge 9, Looking North

with the issues, impacts, costs, and recommendations of the foregoing options so that they can make an informed decision regarding which option to pursue in the best interest of the Town.

Existing Conditions

The two bridges under consideration are located in close proximity to each other, at the 3-way intersection in South Pomfret formed by Pomfret Road, Stage Road and Library Street. All three roads are local, Town-owned roads. Bridge 9 was constructed in 1926, and consists of a cast in place concrete deck and concrete parapets supported on cast in place concrete abutments. It has a clear span of 18'-0", with a clear height of approximately 4.5'. Bridge 9 has a superstructure depth that is approximately 25" from bottom of deck to top of road including the bridge slab and paving. Bridge 9 is located at the south end of a horizontal curve in the roadway, and the road is on a tangent (straight) section south of the bridge. The posted speed limit of Pomfret Road is 35 mph.

Bridge 5 was constructed in 1939 (and later widened), and consists of a cast in place concrete deck supported on cast in place concrete abutments. There is a cast in place concrete parapet and sidewalk on the north side, and fascia mounted bridge rail on the south side. It has a clear span of approximately 17'-3", with a clear height of approximately 5'-6'. The east abutment of this bridge directly ties into the foundation of the Teago building. Bridge 5 has a superstructure depth that is approximately 29" from bottom of deck to top of road including the bridge slab and paving. Bridge 5 is located on a relatively straight section of roadway, with a horizontal curve located just east of the bridge at the intersection of Pomfret Road.



Existing Bridge 5, Looking Southeast

There are no known underground public utilities in the area, although there are a few storm drains, the well of the Teago building, and an underground electric power line to the Fire Station. Approximately 150' upstream of Bridge 9 there is a private pump station with a sewer line that crosses the brook. There are numerous utility poles throughout the area that support overhead electric and communication lines. There are overhead electric lines located directly over Bridge 9 and the electric and communications lines for the Teago General Store are located directly over Bridge 5.

A topographic survey plan of the project area is included in Appendix A of this Report.

The VTrans Hydraulics Unit has prepared a Preliminary Hydraulic Report for this site and concluded that both bridges at this location are hydraulically inadequate (although Bridge 5 is somewhat better than Bridge 9). Both bridges should have a hydraulic opening of approximately 224 square feet, and should be configured to provide a span of 32 feet and a vertical clearance of 7 feet (note, this is 1' taller than requested by the Town in their RFP). This size of structure will provide an opening adequate to convey the flows from a 25-year storm with the required 1 foot of freeboard between the low chord of the bridge and the water surface elevation. DuBois & King has reviewed VTrans' information and conclusions, and has independently confirmed them. The exact bridge configuration would be determined once survey, geotechnical borings, and the preferred bridge option are selected and preliminary design is initiated. A copy of VTrans' Preliminary Hydraulic Report is included in Appendix B of this Report.

Alternatives Investigation

Design Criteria

The Vermont Agency of Transportation has design standards pertaining to local roads and bridges. With the use of State monies (such as with a Structures Grant), Town's are required to follow these standards. Based on these standards, the following summarizes the design criteria we believe are appropriate for these bridges:

Bridge and Roadway Design Codes, Specifications, and Guidelines

- AASHTO LRFD Bridge Design Specifications, 6th Edition
- VAOT 2011 Standard Specifications for Construction
- Structural Capacity: HL-93
- Width of Bridge Lanes: 24'-0" rail-to-rail (2 lanes)
- Overall Width of Bridge: 26'-0" +/-
- Road Functional Classification: Local
- Traffic Volume (AADT): 400-1500 vpd (estimated)
- Design Speed: 35 mph
- Design Storm: 25-year event with 1' of freeboard

The existing approach roadway widths and vertical alignment generally meet current design criteria at both bridges. However, Bridge 9 is located on a horizontal curve that is not superelevated (no banking). To meet design standards, this curve should be superelevated at a 6% cross slope. However, providing this amount of superelevation would not be practical for a project with a scope limited to replacement of the bridge as this would require significant additional work along the roadway. The Selectboard has asked that this curve be evaluated for possible improvement as part of this Study.

Additionally, to provide an adequate hydraulic opening beneath Bridge 9, the roadway would either need to be raised by approximately 2.5 feet, or the stream would need to be lowered by an equivalent amount. In the event that the road profile is raised significantly, then superelevation could be added to the new bridge as the roadway approach would be quite extensive.

Bridge Structure Type Alternatives

DuBois & King has evaluated two structure types that would be appropriate for the replacement of either Bridge 9 or Bridge 5 as part of this alternatives analysis:

- a precast concrete rigid frame or arch
- precast concrete slabs on either cast-in-place concrete abutments or pile foundations

Costs of the alternatives presented later in this report are stated based on experience with similar projects. Following are the structure types considered and their associated advantages and disadvantages:

Precast Concrete Rigid Frame or Arch



Precast Concrete Rigid Frame or Arch (Frame Shown)

Advantages:

- High quality concrete product due to plant controlled manufacturing
- Long, relatively maintenance free service life – expected to be 75 years
- Less costly alternative than precast beams on spread footings

- Short construction time and relatively simple to construct – precast units are placed with a crane
- Jointless structure – no joints to fail or corrode
- Aesthetically appealing option with an arch, or the use of form liners (provide pattern or texture to concrete)

Disadvantages:

- Reduced hydraulic opening (if an arch is used)
- Greater substructure excavation and materials required (as compared to a pile foundation)
- Thicker superstructure configuration required compared to slabs; therefore, more roadway approach work required to raise the profile

Precast Concrete Voids Slabs (On Spread Footing or Pile Foundations)



Precast Concrete Voids Slabs

Advantages:

- High quality concrete for superstructure due to plant controlled manufacturing
- Long, relatively maintenance free service life – expected to be 75 years
- Less excavation and abutment materials (if a pile foundation is used)
- Jointless structure – no joints to fail or corrode (if a pile foundation is used)
- Thinner superstructure configuration required compared to precast frame or arch; therefore, less roadway approach work required to raise the profile

Disadvantages:

- More costly alternative than a precast frame or arch if cast in place footings are required (approximately same cost if piles can be used)
- Somewhat longer construction time due to cast-in-place components, grouting, and post-tensioning required
- Pile foundation may not be ideal for subsurface conditions at this site (would need to be determined through geotechnical borings)
- Greater exposure of deck to road impacts and salts due to less cover compared to precast concrete rigid frame or arch
- Bridge would include joints at each end if spread footings are used, which are a maintenance item

Maintenance of Traffic During Construction

Given the close proximity of these two bridges to each other, closing either bridge site to traffic during construction and detouring traffic across the other bridge would be the most cost effective option. This will save the Town the substantial cost of a temporary bridge detour, or constructing a replacement bridge in two stages.

Project Options

1. Replace Bridge 9 and raise Pomfret Road to provide an adequate hydraulic opening

In order to provide an adequate hydraulic opening for the replacement of Bridge 9, a clear span of 32 feet wide by 7 feet high would be needed. This would result in a new bridge that is longer than the existing bridge, and under this option, the road would also need to be raised in order to accommodate a new bridge deck and provide an adequate hydraulic opening without lowering the brook elevation. For a span of this length, a precast concrete rigid frame structure would be approximately 22" thick, and another 10" of cover/roadway surface would need to be provided over the frame (for a total thickness of 32"). For the precast concrete beams, a superstructure thickness between 18" (voided slabs and pavement) and 32" (precast beams and concrete deck) would be required. The existing vertical distance between the top of roadway surface and bottom of deck is approximately 25". Therefore, to provide an additional 2.5' of hydraulic opening, the roadway elevation at the bridge would need to be raised somewhere between 23" and 37" to provide an adequate hydraulic opening and accommodate the new bridge deck. For purposes of this analysis, we have assumed the minimum deck thickness of 18", and the corresponding need to raise the elevation of the road by 23".

To raise the road profile 23", a gradual transition of the road profile would be needed. Raising the road profile would impact the parking lot of the Teago Store by forcing the

grade to be raised by approximately 24" at the north end, and approximately 6" at the end closest to the building. This would also require adjustments to the catch basin adjacent to the store, and some modifications, such as an additional step, at the basement entrance. A minor grade adjustment would be needed at the entrance to the shed on the east side of the road, and to the driveway to the Fire Station. Additionally, the intersection of Library Street would require grade adjustments. The limits of construction are shown on the plans included in Appendix C.

The existing utility poles on the northwest and southeast corners would need to be removed during construction as they would be directly affected by the excavation for the new bridge. These poles would either be reset at other nearby locations permanently, or temporarily reset and then permanently replaced at their current locations once construction of the bridge was completed. It is likely the lines on the poles would need to be reset at somewhat higher locations in order to provide adequate clearance between the new roadway elevation and the lines.

As requested by the Pomfret Selectboard, DuBois & King has investigated flattening the horizontal curve located at Bridge 9 to eliminate the relative sharp curve that exists just north of the bridge currently. Flattening the curve can be done, but realigning the road would add substantial cost to the project. A plan and profile of a potential realignment is included in Appendix C. The realignment would involve approximately 525 linear feet of roadway, and would shift the location of the bridge approximately 12' to the east. With a road reconstruction such as this, proper superelevation would need to be applied. While shifting the road and bridge to the east would reduce impacts to the Teago property and Library Street intersection, applying superelevation would roughly offset the effects of shifting the road. Because of the additional construction and cost, and minimal benefit, realigning the road to flatten the curve at Bridge 9 is not recommended.

2. Replace Bridge 9 and lower Pomfret Brook to provide an adequate hydraulic opening

As with Option 1, to provide an adequate hydraulic opening for the replacement of Bridge 9, a clear span of 32 feet wide by 7 feet high would be needed. This would result in a new bridge that is longer than the existing bridge, and under this option, the brook would need to be lowered in order to accommodate a new bridge deck and provide an adequate hydraulic opening without raising the road elevation. Again assuming the minimum deck thickness of 18" as described under Option 1, the brook elevation would need to be lowered by 23" in order to provide an adequate hydraulic opening.

Because this option lowers the brook rather than raises the road to achieve an adequate hydraulic opening, it would not have permanent impacts to the Teago Store's parking lot,

the adjacent shed building, or the driveway to the Fire Station. Under this option, the brook would be lowered approximately 23" at the bridge location, and this elevation change would need to be gradually tapered back into the existing brook channel profile for some distance upstream and downstream. Additionally, measures would need to be implemented to keep the brook profile stable over time. These measures would most likely consist of placing large boulders in the channel to form a series of "checks" to minimize the water velocity and keep smaller streambed materials from migrating. Unfortunately, the brook would effectively try to return to its natural state and reestablish its former profile over time. This may result in the channel near the bridge filling back in the future and cause the Town to conduct on-going maintenance to keep the bridge opening clear.

It should be noted that Mr. Todd Menees, VT ANR Stream Alteration Engineer, does not support this option. Mr. Menees stated that he would need very compelling reasons why this would be the best option before he could issue a permit to alter the stream as described herein.

It does not appear that the private sewer force main approximately 150' upstream from the bridge would ultimately be affected by the change in the brook's profile under this option, as it is far enough away and would well out of the influence zone of the change.

Roadway approach would be relatively minor under this option. Pomfret Road could be left largely intact, except for the excavation area immediately surrounding the bridge. This would likely entail reconstructing approximately 90 feet of roadway.

The existing utility poles on the northwest and southeast corners would need to be removed during construction as they would be directly affected by the excavation for the new bridge. These poles would either be reset at other nearby locations permanently, or temporarily reset and then permanently replaced at their current locations once construction of the bridge was completed.

Flattening of the horizontal curve is again not recommended under this option. Flattening of the curve would move the bridge approximately 12' farther upstream, forcing the lowering of the brook farther upstream and therefore forcing the brook to be lowered even more than it would at its current location. Also, the flattening the curve would result in significant additional costs that are well outside the scope of Town Structures Grant.

3. Remove Bridge 9, close Pomfret Road between Stage Road and Library Street, and replace Bridge 5 to provide an adequate hydraulic opening

Under this option, Bridge 9 would be completely removed and the brook channel would be restored to its natural state. Also, Bridge 5 would be replaced to provide a bridge with an adequate hydraulic opening. This option has several benefits:

- Bridge 9 is no longer an obstruction to the brook
- Bridge 9 is no longer a maintenance concern
- The cost to remove Bridge 9 is relatively minimal compared to the cost of replacing the bridge
- The funds that were going to be spent to replace Bridge 9 can be spent to improve or replace Bridge 5, which is also inadequate hydraulically
- This option has no adverse impacts to the Teago Store's parking lot, catch basins, surrounding buildings, and the Fire Station driveway
- The Teago Store parking lot may be able to be expanded somewhat
- Ice and snow that falls off of the Teago Store onto Pomfret Road is less of an immediate maintenance issue for the Town

However, this option has several drawbacks as well:

- Removal of Bridge 9 would force fire responders to go south around the Teago Store and up Library Street in order to respond to emergencies north of the station (it is estimated that this would increase response times by less than one minute)
- Through traffic using Pomfret Road will need to turn onto Stage Road and Library Street and go around the Teago Store
- Library patrons that currently park in the Teago Store parking lot may have to walk slightly farther to reach the Library
- Library Street will experience more traffic, and Library patrons that park in the parking lot across Library Street will experience more potential conflicts with traffic
- With more traffic on Library Street, upgrades to Library Street should be implemented such as minor roadway widening, and better defining movements and rights of way at the intersection of Stage Road
- Potential significant impacts to the property located on the southwest corner of the bridge

Under this option, the Structures grant the Town received for Bridge 9 could be used to remove Bridge 9, and repair Bridge 5. Bridge 5 is actually in relatively good condition and is not in need of replacement due to its condition. Although it is inadequate

hydraulically, this is not a stand-alone justification for replacement. Bridge 5 has a few issues that should be addressed in the near future. These include:

- Spalling of the parapet on the north side should be repaired
- Spalling of the wingwalls should be repaired
- The timber curb along the south curb line should be repaired or replaced
- The guard rail along the south side of the bridge should be repaired

If the Town were to pursue the replacement of Bridge 5 now or in the future, in order to provide an adequate hydraulic opening the span would need to be lengthened by approximately 15 feet. Due to the presence of the Teago Store, all of the lengthening would need to be to the west. Construction of new bridge under this configuration would impact the utility pole on the southwest corner, and have relatively minor impacts to the property on this same corner. Also, this would like affect the existing parking lot along Library Street, as the brook would tend to migrate to the west (through the middle of the new bridge) over time. However, if improvements were also made at the intersection of Library Street and Stage Road, additional space to reconfigure the existing parking would likely be available. Parking could possibly be added on the Library property as well. Plans showing the new bridge layout and possible parking lot reconfigurations are included in Appendix C.

Maintaining traffic during construction under this option would involve removing and replacing Bridge 5 in a first stage with traffic temporarily routed along Pomfret Road to Library Street to Stage Road (or the reverse), and then removing Bridge 9 under a second stage. It would be somewhat difficult for traffic to turn from Library Street to Pomfret Road (southbound) and some minor improvements to the intersection would need to be made to accommodate traffic.

Opinion of Probable Construction Cost

An estimated opinion of probable construction cost has been developed for each Option considered. The costs were prepared based on actual bid prices of similar projects. These conceptual costs are subject to change due to fluctuations in the cost of labor and materials and with the refinement of the overall design during subsequent phases of the project. Below is a summary of the alternatives with their associated construction costs.

The cost of construction to implement Option 1 with precast concrete slabs on pile foundations would be approximately \$455,000. If a rigid frame or slabs on concrete footings was used the cost would increase by approximately \$20,000 or \$80,000 respectively. Engineering, permitting, right of way, and construction inspection would increase the construction cost by approximately 20%.

The cost of construction to implement Option 2 with precast concrete slabs on pile foundations would be approximately \$415,000. If a rigid frame or slabs on concrete footings was used the cost would increase by approximately \$20,000 or \$80,000 respectively. Engineering, permitting, right of way, and construction inspection would increase the construction cost by approximately 20%.

The cost of construction to implement Option 3 with precast concrete slabs on pile foundations would be approximately \$535,000, including the removal of Bridge 9 and replacement of Bridge 5. If a rigid frame or slabs on concrete footings was used the cost would increase by approximately \$20,000 or \$80,000 respectively. Engineering, permitting, right of way, and construction inspection would increase the construction cost by approximately 20%.

If Bridge 9 was removed and Bridge 5 repaired at this time, the cost of construction would be approximately \$80,000, although the costs to remove bridges can vary greatly.

Minimal maintenance costs would be expected over the life of the bridges. If slabs were used, they would need to be resurfaced with new pavement or concrete and the deck joints would need to be replaced every 20-30 years. For a rigid frame, there would be virtually no maintenance whatsoever.

Table 1 - Opinion of Probable Construction Costs

Bridge Option	Estimated Construction Cost *
Option 1 - Replace Bridge 9 and Raise Pomfret Road Profile	\$455,000
Option 2 - Replace Bridge 9 and Lower Pomfret Brook Profile	\$415,000
Option 3a - Remove Bridge 9 and Replace Bridge 5	\$535,000
Option 3b - Remove Bridge 9 and Repair Bridge 5	\$80,000

* - assuming voided concrete slabs on pile foundations

Additional costs for Engineering, Permitting, Right of Way, and Construction Inspection would be necessary. Approximate costs for these items associated with the replacement of Bridge 9 would be as follows. Costs for the removal of Bridge 9 and replacement of Bridge 5 would be slightly higher:

Engineering and Permitting	\$55,000
Right of Way	\$ 5,000
Construction Inspection	<u>\$30,000</u>
Total	\$90,000

Recommendation

DuBois & King provides the following recommendations for this project. The recommendations are based upon the information discussed throughout this report.

DuBois & King recommends Option 3b – Remove Bridge 9 and Repair Bridge 5

This recommendation is based on the following:

- The current cost to replace, and future costs to maintain Bridge 9, would be eliminated.
- The hydraulic problems of Bridge 9 would be eliminated.
- There would be no adverse impacts to the brook with this option.
- There would be no adverse impacts to the Teago Store with this option.
- The grant funds that are available now can be used to eliminate Bridge 9 and to repair Bridge 5.
- The current grant is not enough to replace Bridge 9, so significant additional Town funds would be needed to replace Bridge 9 at this time.
- If Bridge 9 were replaced at this time, a hydraulic problem at this location (Bridge 5) would still exist.
- If Bridge 9 is replaced at this time, Bridge 5 will still need to be repaired and/or replaced in the future. Eventual replacement of Bridge 5 would effectively double the cost of the project.
- Eliminating Bridge 9 and deferring the replacement of Bridge 5 would allow the Town to program funding for the eventual replacement of Bridge 5, and/or solicit more significant funds through the Regional Planning Commission and VTrans to replace the bridge.
- While the traffic patterns would be altered somewhat, they would remain effectively the same.
- Concerns about pedestrian crossings of Library Street can be addressed with minor pavement improvements and a new crosswalk to the parking lot.
- Emergency response times will be minimally affected.

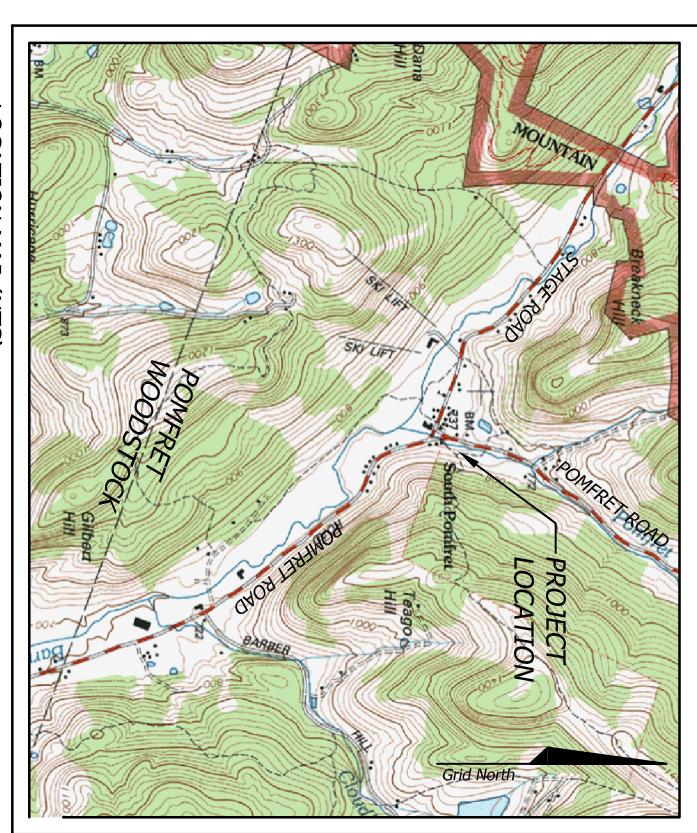
Town of Pomfret, Vermont

Bridge No. 9 – Pomfret Road over Pomfret Brook

Bridge No. 5 – Stage Road over Pomfret Brook

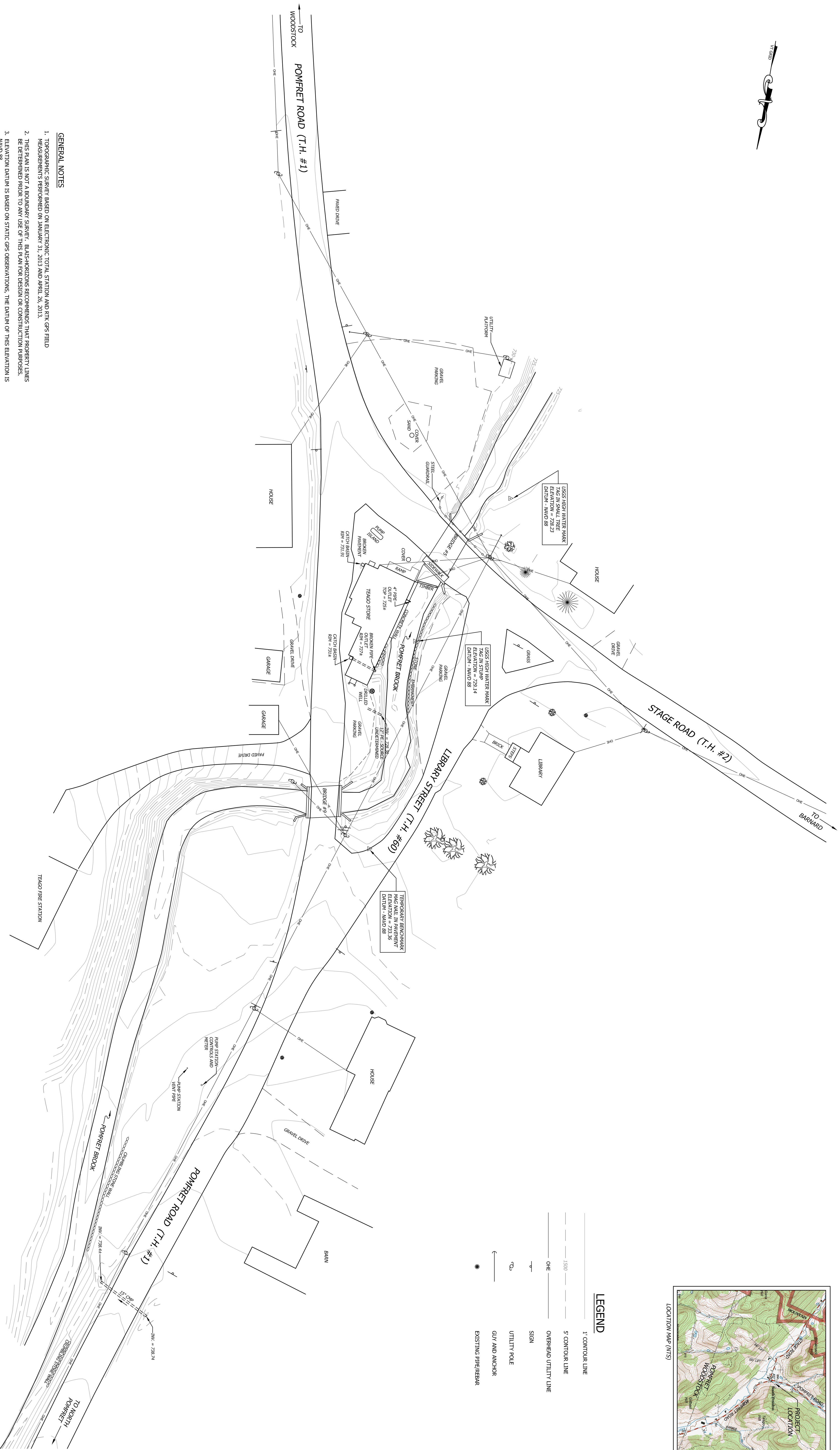
Engineering Investigation and Recommendations Report

Appendix A – Topographic Survey Plan



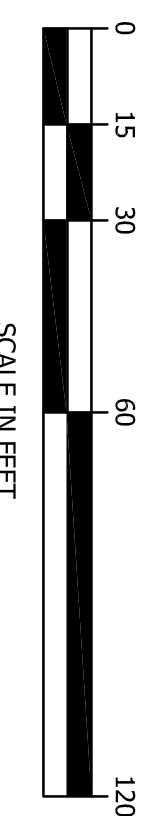
LOCATION MAP (NTS)

- LEGEND**
- 1" CONTOUR LINE
 - 5" CONTOUR LINE
 - OVERHEAD UTILITY LINE
 - UTILITY POLE
 - GUY AND ANCHOR
 - EXISTING PIPE/REBAR
 - 1500'
 - OHE
 - SIGN
 - UTILITY POLE
 - GUY AND ANCHOR
 - EXISTING PIPE/REBAR



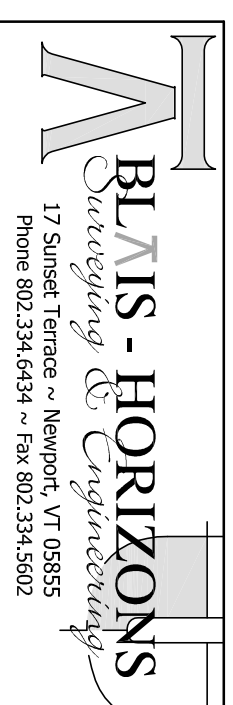
GENERAL NOTES

1. TOPOGRAHIC SURVEY BASED ON ELECTRONIC TOTAL STATION AND RTK GPS FIELD MEASUREMENTS PERFORMED ON JANUARY 31, 2013 AND APRIL 26, 2013.
2. THIS PLAN IS NOT A BOUNDARY SURVEY. BLAIS-HORIZONS RECOMMENDS THAT PROPERTY LINES BE DETERMINED PRIOR TO ANY USE OF THIS PLAN FOR DESIGN OR CONSTRUCTION PURPOSES.
3. ELEVATION DATUM IS BASED ON STATIC GPS OBSERVATIONS. THE DATUM OF THIS ELEVATION IS NAVD 83.
4. NO SITE ASSESSMENT OF HAZARDOUS OR OTHER WASTE MATERIALS WAS PERFORMED AND HORIZONS ENGINEERING, INC. TAKES NO RESPONSIBILITY FOR ANY MATERIALS OR CONDITIONS THAT MAY EXIST ON THIS SITE.



SCALE IN FEET

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17 Sunset Terrace - Newport, VT 05855
Phone 802.334.4434 - Fax 802.334.5502

DATE:	5/3/2013	PROJECT #:	13501
ENGINEER BY:	DRAWN BY:	PROJECT NAME:	TOWN OF POMFRET SELECTBOARD
CHECKED BY:	ARCHITECT BY:	PROJECT ADDRESS:	5218 POMFRET ROAD NORTH POMFRET, VT 05853
DATE:	5/3/2013	PROJECT #:	13501
ENGINEER BY:	DRAWN BY:	PROJECT NAME:	TOWN OF POMFRET SELECTBOARD
CHECKED BY:	ARCHITECT BY:	PROJECT ADDRESS:	5218 POMFRET ROAD NORTH POMFRET, VT 05853
DATE:	5/3/2013	PROJECT #:	13501
ENGINEER BY:	DRAWN BY:	PROJECT NAME:	TOWN OF POMFRET SELECTBOARD
CHECKED BY:	ARCHITECT BY:	PROJECT ADDRESS:	5218 POMFRET ROAD NORTH POMFRET, VT 05853

EXISTING CONDITIONS SITE PLAN PREPARED FOR
TOWN OF POMFRET SELECTBOARD
5218 POMFRET ROAD
NORTH POMFRET, VT 05853
SOUTH POMFRET
STAGE ROAD - POMFRET ROAD
POMFRET, WINDSOR COUNTY, VERMONT

Town of Pomfret, Vermont

Bridge No. 9 – Pomfret Road over Pomfret Brook

Bridge No. 5 – Stage Road over Pomfret Brook

Engineering Investigation and Recommendations Report

Appendix B – Preliminary Hydraulic Report

HYDRAULICS UNIT

TO: Neil Lamson, Chair Pomfret Selectboard
FROM: Leslie Russell, P.E., Hydraulics Project Engineer
DATE: 29 October 2012
SUBJECT: Pomfret TH 1 BR 9 over Pomfret Brook
Pomfret Road N43.66525 W72.53873

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

Hydrology

This site has a hilly to mountainous drainage basin. It is mostly forested. The total contributing drainage area is about 6.4 sq. mi. There is an overall length of 25,980 feet from the divide to the site, with a 1110 foot drop in elevation, giving an average overall channel slope of 4.3%. The stream slope at the site was estimated to be about 1 - 2%. Using several hydrologic methods, we came up with the following design flow rates:

<u>Recurrence Interval in Years</u>	<u>Flow Rate in Cubic Feet per Second (CFS)</u>
Q2.33	310
Q10	700
Q25	950
Q50	1200 – State Highway Design Flow
Q100	1400 - Check flow

Existing Conditions

The existing structure is a concrete slab bridge that has a clear span length of 18.3', with a clear height of about 4.5', providing a waterway opening of 82 sq. ft. There are bends into and out of the bridge and scour through the bridge. The southeast wingwall is cracked away from the bridge.

The downstream channel is constricted by the roadway fill and a retaining wall along a store/post office. Just downstream of this structure is TH 2 (Stage Road) BR 5 that is 16' by 6' high. It also is a concrete slab bridge.

Our calculations show both the existing structures are inadequate hydraulically. Neither structure has 1' of freeboard at Q50 and both structures overtop the roadway below a Q25 flow.

Recommendations

In sizing a new structure we attempt to select structures that meet the hydraulic standards, fit the natural channel width, the roadway grade and other site conditions. We measured a channel width of over 18' upstream of BR 9 during our site visit. It was difficult to get an exact natural channel width measurement due to the roadway fill constrictions. The Agency of Natural Resources VT Regional Hydraulic Geometry Curve gives a bank full width of 30' for this size drainage area. Those curves are only based on drainage area and do not consider other factors. **Usually for structures of this size, it is**

important to have survey so the waterway can be modeled. The downstream bridge (on Stage Road) is also hydraulically inadequate. It might be preferable to replace that structure first. Based on our calculations and the information available, we recommend any of the following structures as a replacement for these two sites:

1. A bridge with a 32' by 7' minimum waterway opening, providing 224 sq. ft. of waterway area. This structure will result in a headwater depth at Q50 = 6.0' and at Q100 = 6.6'. Therefore, it will provide the required 1.0' of freeboard at Q50. If the roadway cannot be raised more than 6', a much wider structure would be needed. It is probably not feasible to build such a structure to obtain 1' of freeboard at Q50.
2. Another option the town may want to consider would be to replace BR 5 on Stage Road and eliminate BR 9.
3. Any similar structure with a minimum clear span of 32' and at least 224 sq. ft. of waterway area, that fits the site conditions, could be considered.

General Comments

If a new bridge is installed, the bottom of abutment footings should be at least six feet below the channel bottom, or to ledge, to prevent undermining.

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.

Stone Fill, Type III 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.

The Agency of Natural Resources (ANR), Corps of Engineers, or other permitting agency may have additional concerns regarding replacement of this structure, or any channel work. The River Management Engineer should be contacted with respect to those concerns, before a replacement structure is ordered.

Please keep in mind that while a site visit was made, these recommendations were made without the benefit of a survey and are based on limited information. The final decision regarding the replacement of this structure should take into consideration matching the natural channel conditions, the roadway grade, environmental concerns, safety, and other requirements of the site.

A bridge of this size warrants a more detailed hydraulic study if survey becomes available.

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

LGR

cc: Todd Menees, A.N.R. River Management Engineer
Hydraulics Project File via NJW
Hydraulics Chrono File

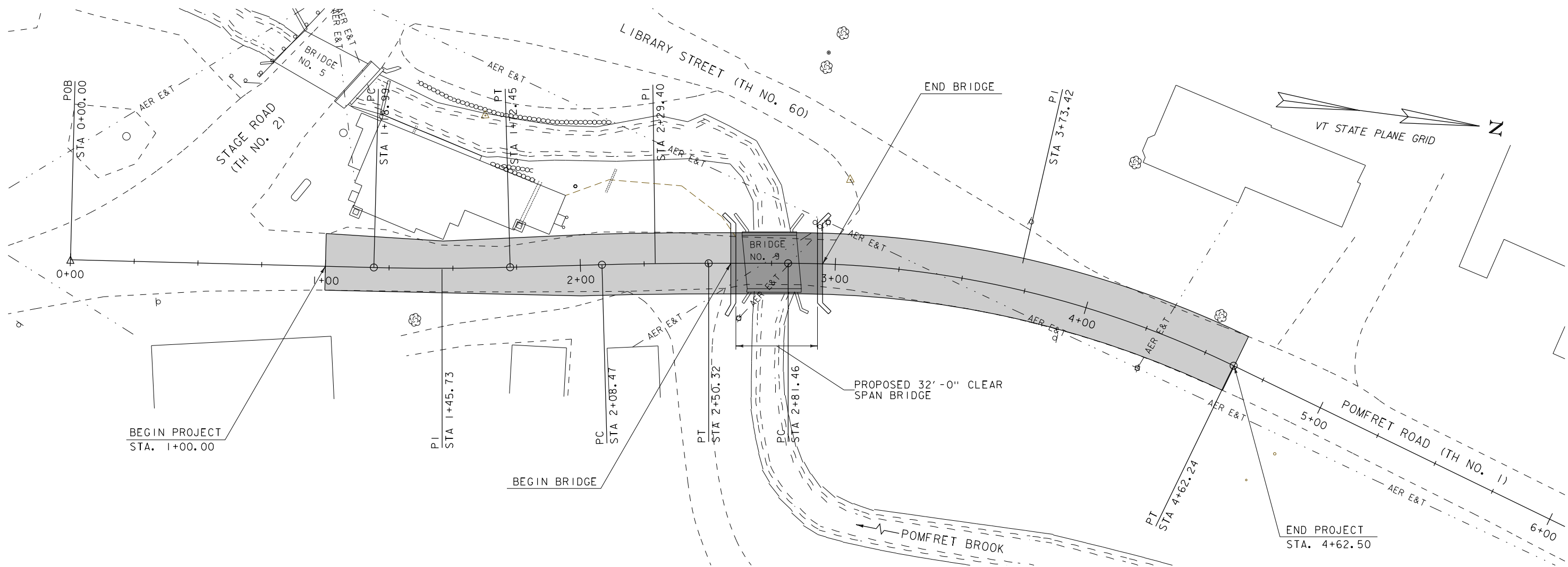
Town of Pomfret, Vermont

Bridge No. 9 – Pomfret Road over Pomfret Brook

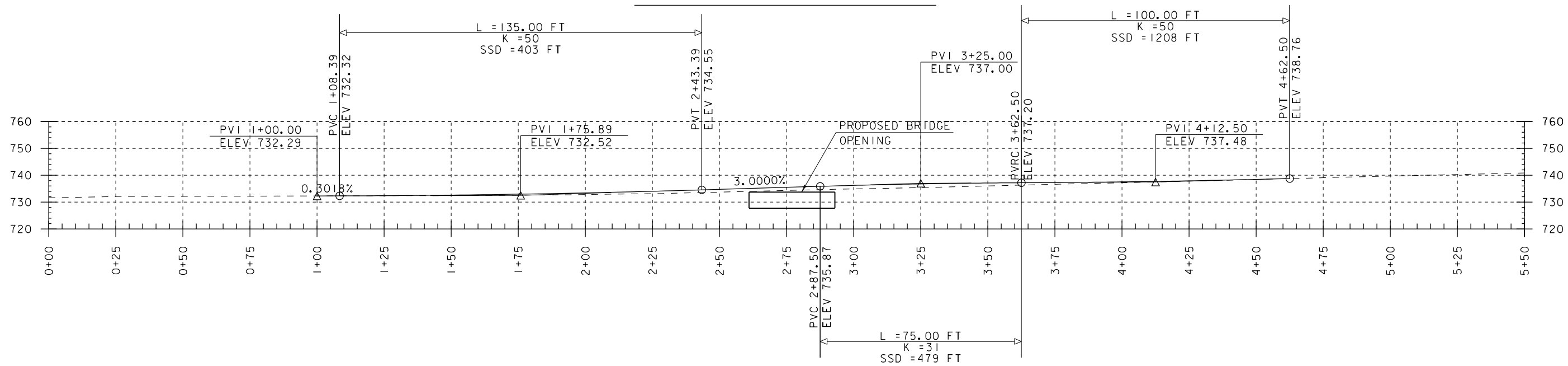
Bridge No. 5 – Stage Road over Pomfret Brook

Engineering Investigation and Recommendations Report

Appendix C – Plans of Alternatives



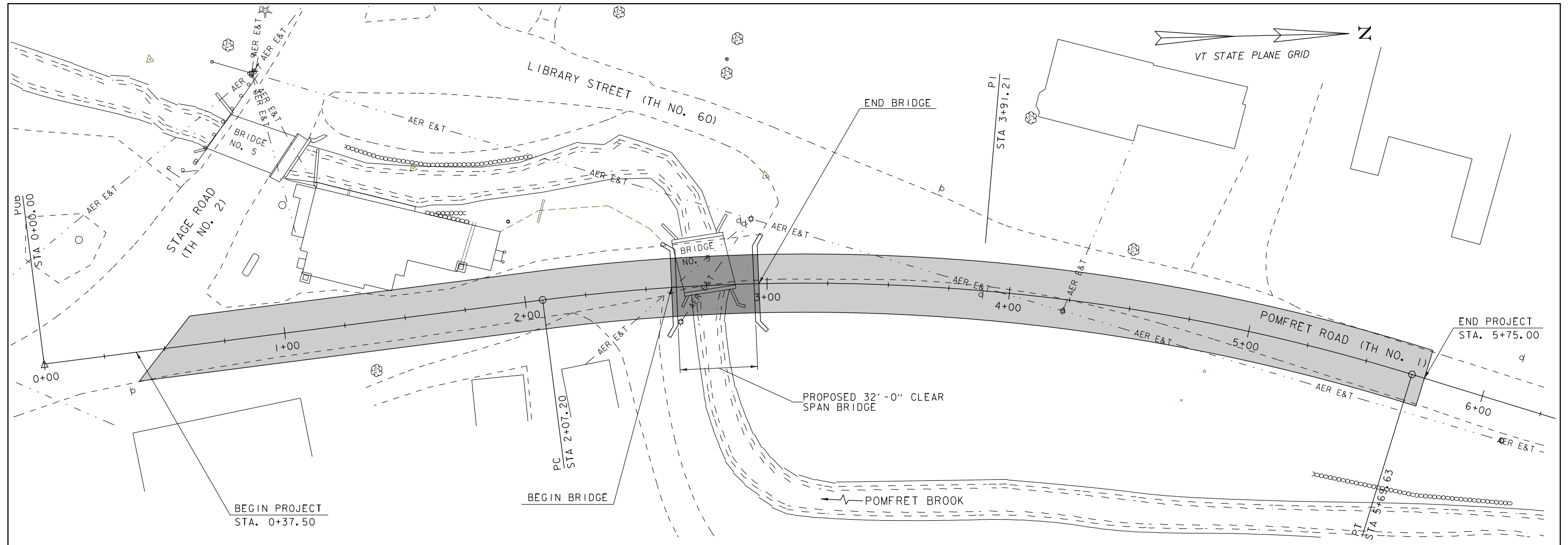
ALTERNATIVE NO. 1 - PLAN



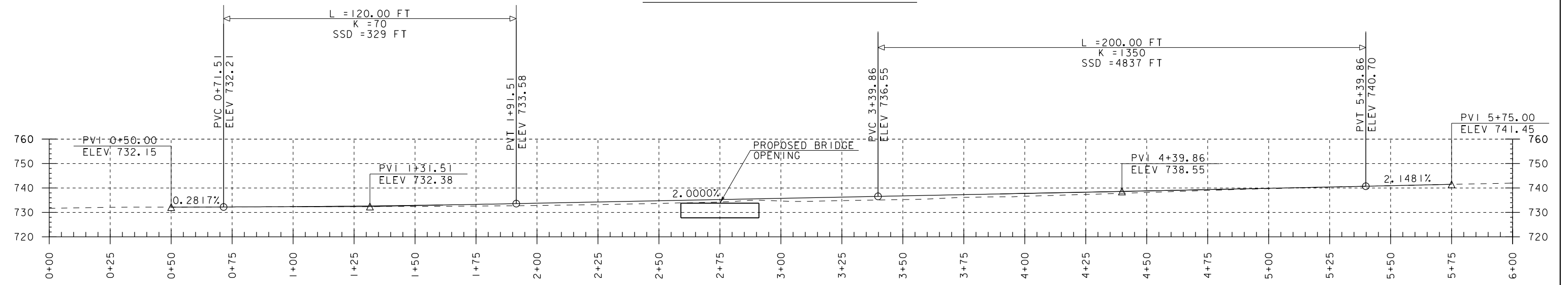
ALTERNATIVE NO. 1 - PROFILE

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

PROJECT NAME:	POMFRET	FILE NAME:	... \622060_BDR.dgn	PLOT DATE:	7/3/2013
PROJECT NUMBER:	622060	PROJECT LEADER:	E. DETRICK	DRAWN BY:	R. BARNES
		DESIGNED BY:	R. BARNES	CHECKED BY:	E. DETRICK
		ALTERNATIVE NO. 1		SHEET	1 OF 1



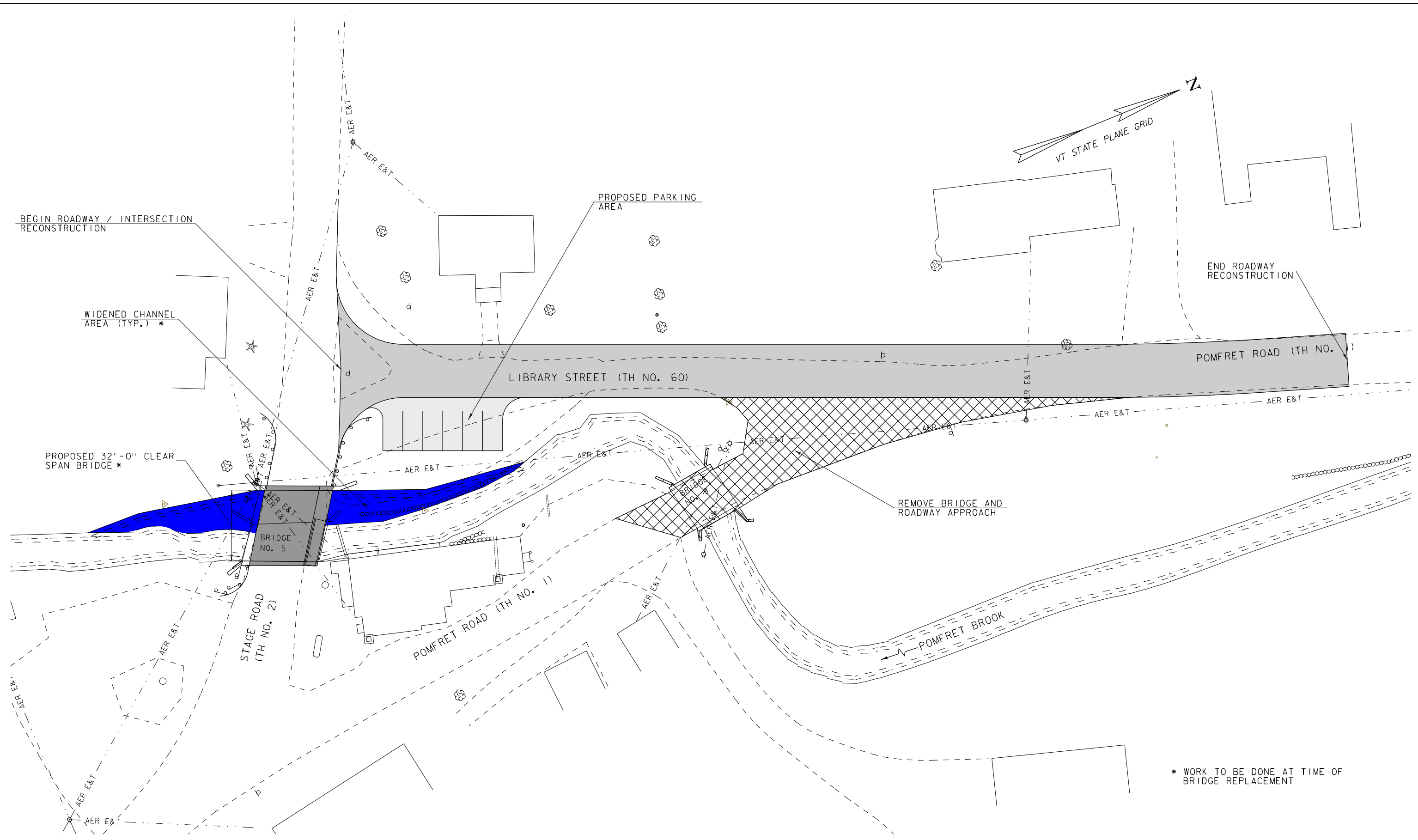
ALTERNATIVE NO. 2 - PLAN



ALTERNATIVE NO. 2 - PROFILE

SCALE 1" = 20'-0"
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PROJECT NAME:	POMFRET	FILE NAME:	...622060_BDR.dgn	PLOT DATE:	7/3/2013
PROJECT NUMBER:	622060	PROJECT LEADER:	E. DETRICK	DRAWN BY:	R. BARNES
		DESIGNED BY:	R. BARNES	CHECKED BY:	E. DETRICK
		ALTERNATIVE NO. 2		SHEET	1 OF 1



BEGIN ROADWAY / INTERSECTION RECONSTRUCTION

WIDENED CHANNEL AREA (TYP.) *

PROPOSED 32'-0" CLEAR SPAN BRIDGE *

BRIDGE NO. 5

STAGE ROAD (TH NO. 2)

POMFRET ROAD (TH NO. 1)

PROPOSED PARKING AREA

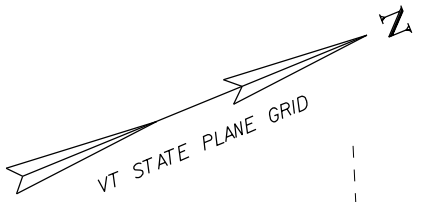
LIBRARY STREET (TH NO. 60)

END ROADWAY RECONSTRUCTION

POMFRET ROAD (TH NO. 1)

REMOVE BRIDGE AND ROADWAY APPROACH

POMFRET BROOK

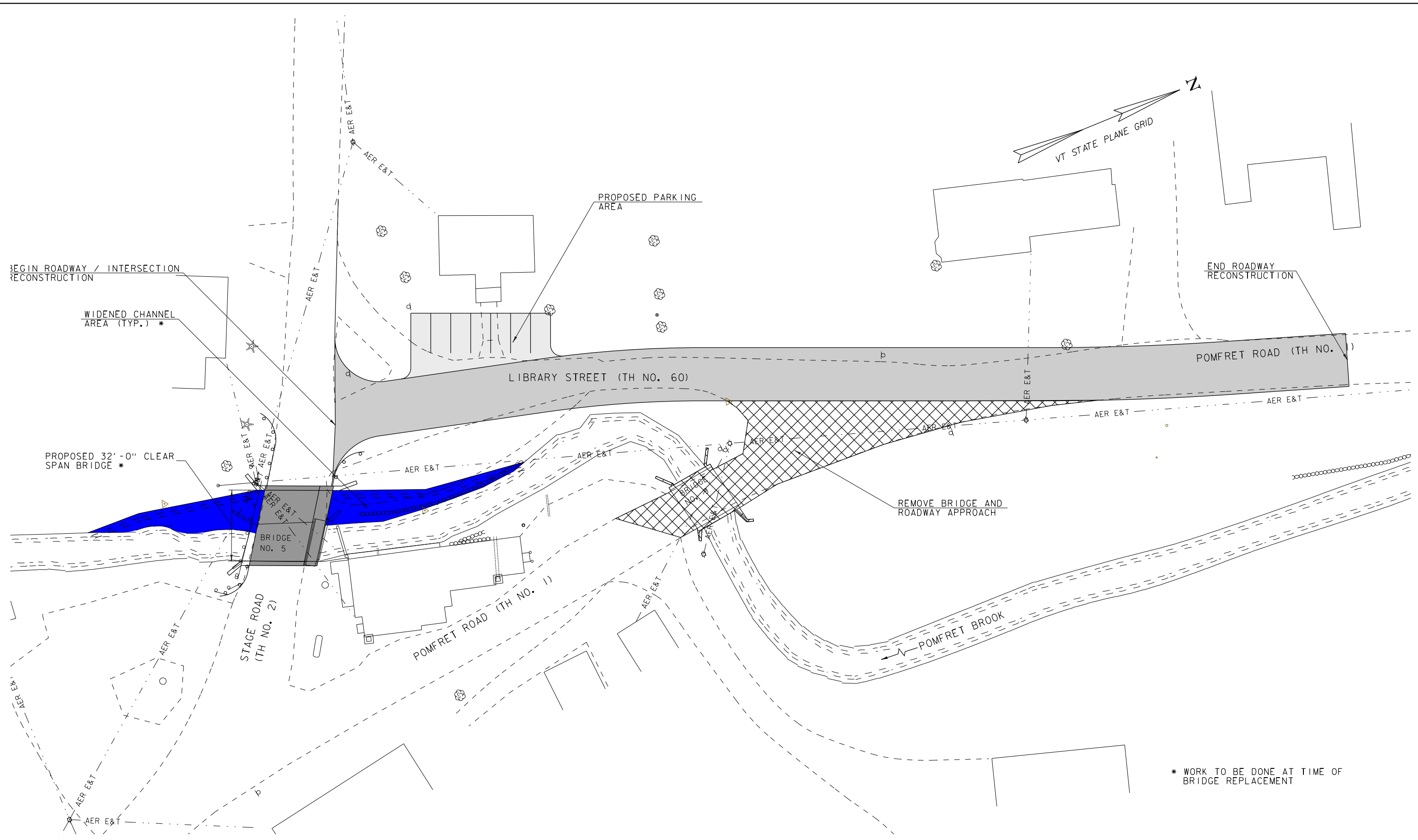


* WORK TO BE DONE AT TIME OF BRIDGE REPLACEMENT

ALTERNATIVE NO. 3A - PLAN

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

PROJECT NAME:	POMFRET	FILE NAME:	...622060_BDR.dgn	PLOT DATE:	7/15/2013
PROJECT NUMBER:	622060	PROJECT LEADER:	E. DETRICK	DRAWN BY:	R. BARNES
		DESIGNED BY:	R. BARNES	CHECKED BY:	E. DETRICK
		ALTERNATIVE NO. 3A		SHEET	1 OF 1



BEGIN ROADWAY / INTERSECTION RECONSTRUCTION

WIDENED CHANNEL AREA (TYP.) *

PROPOSED 32'-0" CLEAR SPAN BRIDGE *

BRIDGE NO. 5

STAGE ROAD (TH NO. 2)

POMFRET ROAD (TH NO. 1)

LIBRARY STREET (TH NO. 60)

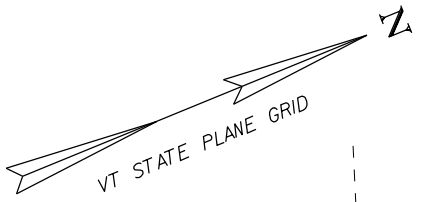
PROPOSED PARKING AREA

REMOVE BRIDGE AND ROADWAY APPROACH

POMFRET BROOK

POMFRET ROAD (TH NO. 1)

END ROADWAY RECONSTRUCTION

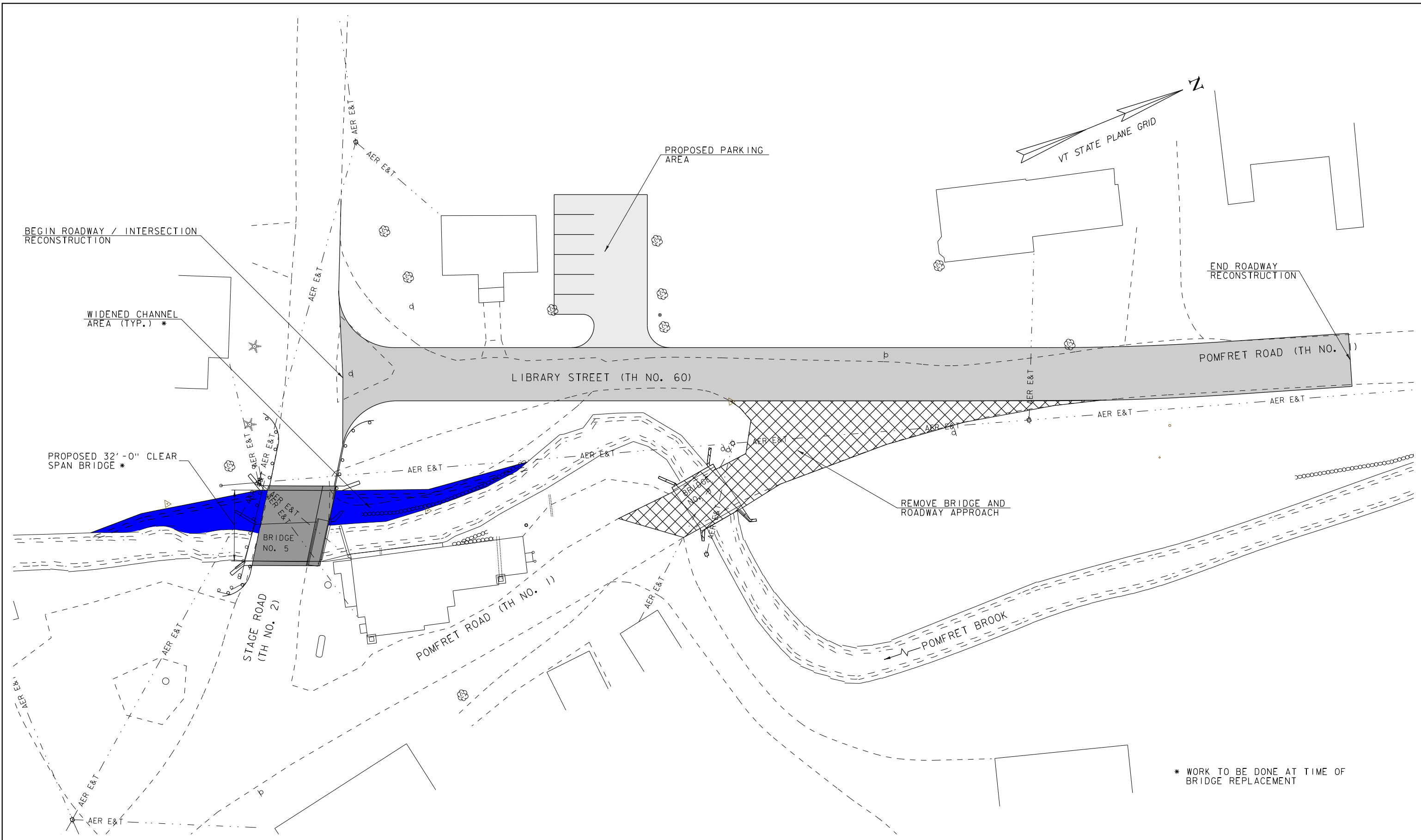


* WORK TO BE DONE AT TIME OF BRIDGE REPLACEMENT

ALTERNATIVE NO. 3B - PLAN

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

PROJECT NAME: POMFRET	PLOT DATE: 7/15/2013
PROJECT NUMBER: 622060	DRAWN BY: R. BARNES
FILE NAME: ...622060_BDR.dgn	CHECKED BY: E. DETRICK
PROJECT LEADER: E. DETRICK	SHEET 1 OF 1
DESIGNED BY: R. BARNES	
ALTERNATIVE NO. 3B	



* WORK TO BE DONE AT TIME OF BRIDGE REPLACEMENT

ALTERNATIVE NO. 3C - PLAN

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

PROJECT NAME:	POMFRET	FILE NAME:	...622060_BDR.dgn	PLOT DATE:	7/15/2013
PROJECT NUMBER:	622060	PROJECT LEADER:	E. DETRICK	DRAWN BY:	R. BARNES
		DESIGNED BY:	R. BARNES	CHECKED BY:	E. DETRICK
		ALTERNATIVE NO. 3C		SHEET	1 OF 1