**STATE OF VERMONT**
**AGENCY OF TRANSPORTATION**

# Scoping Report

**FOR**

# Springfield BF 0134(43)
## VT ROUTE 11, BRIDGE 57 over UNNAMED BROOK

October 13, 2017

# I. Contents

# I. Site Information

Bridge 57 is a culvert located in a rural area along VT Route 11 approximately 425' east of TH- 86, Breezy Hill Road, and approximately 1.3 miles west of the intersection with VT 106, River St. The culvert is located on a straight segment of VT 11 at approximately mile marker 2.737. The depth of cover on top of the culvert is approximately 9'-10'. The existing conditions were gathered from a combination of the Inspection Report, the Route Log and the existing Survey. See correspondence in the Appendix for more detailed information.

| | |
|---|---|
| Roadway Classification | Rural Major Collector |
| Culvert Type | 14'-1" wide x 8'9' high Corrugated Galvanized Multi-Plate Pipe Arch |
| Culvert Span | 14 feet |
| Culvert Length | 132 ft. |
| Skew | 30 degrees |
| Year Built | 1961 |
| Ownership | State of Vermont |
| County | Windsor |
| VTrans Maintenance District | 2 |

**Need**

The following is a list of the deficiencies of Bridge 57 and VT Route 11 in this location.

1. This culvert has a rating of 2 "Critical" and is showing significant corrosion and section loss at the invert. There are perforations throughout.

2. The roadway above the culvert is showing signs of distress and settlement.

3. The existing culvert meets Hydraulic Standards, but constricts the channel.

4. There are no known roadway geometric deficiencies.

**Traffic**

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2017 and 2037.

| TRAFFIC DATA | 2017 | 2037 |
|---|---|---|
| AADT | 5,000 | 5,300 |
| DHV | 570 | 600 |
| ADTT | 330 | 490 |
| %T | 4.9 | 6.9 |
| %D | 56 | 56 |

## Design Criteria

The design standards for this bridge project include:

1. AASHTO. *A Policy on Geometric Design of Highways and Streets.* Association of State Highway and Transportation Officials, Washington, DC, 2011. ("The Green Book").

2. AASHTO. *Roadside Design Guide.* Association of State Highway and Transportation Officials, Washington, DC, 2011.

3. Vermont State Standards, dated October 22, 1997. Minimum standards are based on an ADT > 2000 and a design speed of 40 mph.

| Design Criteria | Source | Existing Condition | Minimum Standard | Comment |
|---|---|---|---|---|
| Approach Lane and Shoulder Widths | VSS Table 5.3 | 12'/8' (40') plus 5' sidewalk on south side | 11'/3' (28') | |
| Bridge Lane and Shoulder Widths | VSS Table 5.3 | 12'/8' (40') plus 5' sidewalk on south side | 11'/3' (28') | |
| Clear Zone Distance | VSS Table 5.5 | Shielded | 14' fill / 12' cut (1:3), 12' cut (1:4) | |
| Banking | VSS Section 5.13 | 2.6% at culvert location | 8% (max), 6% at side roads | |
| Speed | VSS Section 5.3 | 40 mph (Unposted) | 40 mph (Design) | |
| Horizontal Alignment | AASHTO Green Book Table 3-10b | R= 3820' | $R_{min}$ = 2960' for 2.6% bank | |
| Vertical Grade | VSS Table 5.6 | Roadway centerline slopes at 1.85%. | 8% (max) for rolling terrain | |
| K Values for Vertical Curves | VSS Table 5.1 | Bridge not located on vertical curve. | 60 crest / 60 sag | |
| Vertical Clearance Issues | VSS Section 5.8 | None noted | 14'-3" (min) | |
| Stopping Sight Distance | VSS Table 5.1 | | 275' | |
| Bicycle/Pedestrian Criteria | VSS Table 5.8 | 8' Shoulder | 3' Shoulder[1] | |
| Bridge Railing | Structures Manual Section 13 | Steel Beam Guardrail | Steel Beam Guardrail | N.A. unless non-buried structure is proposed |
| Hydraulics | VTrans Hydraulics Section | Passes $Q_{50}$ storm event without exceeding H/D requirements | Pass $Q_{50}$ storm event without exceeding 1.2X diameter, and $Q_{100}$ without exceeding 1.5X diameter. No roadway overtopping below $Q_{100}$. | Does not meet Bank Full Width |
| Structural Capacity | SM, Ch. 3.4.1 | Unknown | Design Live Load: HL-93 | Structurally Inadequate |

[1] Table 5.8 of the Vermont State Standards requires an additional foot of shoulder for shared use on bridges. If a complete bridge replacement was chosen and a non-buried structure installed, lane and shoulder widths then would be 11'/4'.

## Inspection Report Summary

| | |
|---|---|
| Culvert Rating | 2 Critical |
| Channel Rating | 6 Satisfactory |

From the recent Inspector's Reports:

*"11/08/2016- ** South side roadway has large area of dip/ sinkhole development which is encroaching into the roadway. Displacement increasing in scope, as it now extends to the middle of the eastbound lane. Abrupt sinkhole formation highly probable along south side shoulder and sidewalk area. Culvert has severe corrosion of invert, along with significant distortion, and needs replacement. ~ MJ/SP*

*"04/22/2016 - Special inspection to monitor distress. ** Pipe is in serious condition. Piping action causing sink holes along the eastern slope and a dip now of ~8" to 10" along the sidewalk and now the shoulder area with the dip encroaching inward along the travel lane. 70% od pipe form midlength to the outlet has dropped 1.5 to 2' along with invert eviscerated from corrosion. Pipe needs replacement soon."*

*"12/3/2015 Culvert is in poor condition due to the invert at midspan to the outlet. Should consider replacement or be evaluated for a concrete invert. Culvert would be in good condition if the invert was repaired. Sink holes over the pipe on the outlet should be repaired. ~ FRE/TJB"*

*"09/23/2014 - **Pipe is in poor condition with significant settlement and needs full replacement soon. ~ MJ/JS"*

*"12/05/2013 - **Pipe is in serious condition due to extensive corrosion and subsequent settlement and needs replacement soon. Right side roadway is slowly settling and the eastern side slope has large sinkholes forming as piping action progresses below the eastern half of the pipe. ~MJ/JS"*

*"Culvert is in poor condition due to the invert. Should be evaluated for a concrete invert or replacement in the near future. FRE/JAS"*

*"11/28/2011 - **Pipe is on poor condition due to heavy corrosion and loss along the invert. Pipe needs replacement as settlement from "piping" effect has vitiated viable repair alternatives."*

## Hydraulics

A Preliminary Hydraulics Report was done for this site in the fall of 2014 and can be seen in the Appendix. This report says that the existing pipe arch culvert configuration does not meet the hydraulic standard. However, VTrans adopted a new Hydraulics Manual in the spring of 2015. Modelling the project using the new manual indicates that the hydraulics standard is met in the existing condition. There is a small vertical drop at the outlet end of the culvert, possibly inhibiting Aquatic Organism Passage (AOP) at this location. The structure is at a skew of approximately 30 degrees. The report does not discuss Bank Full Width (BFW), but does state that the existing structure constricts the channel. VTrans Hydraulics and Scoping Staff coordinated with VT ANR to determine a BFW of 18'.

Recommendations

The Preliminary Hydraulics Report does not make a recommendation for culvert repair. It does recommend that no increase in surface water elevations be proposed and there are nearby buildings in the floodplain. There is a Flood Insurance Study for this River.

Several possible solutions are offered in the report if the culvert is replaced:

- An open bottom precast concrete arch or similar 3-sided structure with a 24' minimum clear span (measured perpendicular to the channel) and a 9' minimum clear height above the average channel bottom. Minimum waterway opening is 190 sf.
- A bridge with 24' minimum clear span perpendicular to the channel with vertical abutments aligned with the channel. Minimum low beam elevation would need to be 562.6' or above.
- A bridge with spill-through abutments giving a 20' minimum wide channel bottom width. The bridge span should be a minimum of 30' perpendicular to the channel with a low beam elevation of 562.6 or above. Side slopes of 1:1.5 were assumed in modelling this option.
- Although not specifically stated in the report, if the culvert were replaced with a single round pipe, it would have to be approximately 16' in diameter to meet the 190 sf requirement.

Other scenarios may be possible with input from the Hydraulics Section.

## Utilities

Underground:

There are buried water and wastewater utilities near the site, but are not likely to be impacted by a project to replace the culvert.

Aerial:

There are overhead utility lines passing over the culvert. These include 3-phase power, communications, and cable facilities. These will have to be relocated if a replacement project is chosen.

## Right of Way

The existing Right-of-Way is shown on the Layout sheet. At the project site, the Right-of-Way seems to be somewhat more than 4 rods, but Right-of-Way width varies in the project area. At the culvert, the Right of Way jogs wider to include the ends of the culvert. Any proposed work could probably be done without additional Right-of-Way on the north side of VT 11, but due to the proximity of the culvert to the Right-of-Way limits on the south side, it is likely that additional Right-of-Way will be required for all options considered except the Do-Nothing alternative.

**Resources**

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

***Biological:***

"The Unnamed water course associated with this crossing is Tributary of the Black River and will require a provision for aquatic organism passage." This watercourse is regulated by the US Army Corps of Engineers. Disturbance of vegetation in the riparian zone will need to be repaired and restored after completion of the project.

It is unclear from the Biological Resource ID whether the existing condition provides AOP.

<u>Wetlands</u>

There are no mapped wetlands within the project area.

<u>Rare, Threatened and Endangered Species</u>

There are no mapped rare, threatened or endangered species within the project area, except potentially for the Northern Long Eared Bat.

<u>Agricultural</u>

There are no prime agricultural soils within the project area.

***Archaeological:***

No Archaeological Resources have been identified at the site.

***Historic:***

Input from VTrans Historic staff indicates that no historically significant resources have been identified at the site.

***Hazardous Materials:***

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

***Stormwater:***

There are no known stormwater concerns for this project.

## II. Safety

The project area is in a high crash section of VT 11. The section includes MM 2.440 through MM 2.740, with the culvert location at approximately 2.737. Roadway geometric standards are apparently met in this segment of roadway, and sight distance is good. It is proposed that even in a situation where an open cut is used to replace the culvert, that no roadway improvements be made.

# III. Alternatives Discussion

The existing roadway at the culvert location meets standards in terms of roadway geometry and safety features. Although the project site is in a high crash location, no work on the existing roadway geometry is anticipated. The alternatives presented here are based on improvement of the condition of the culvert and channel.

There are two basic approaches to this project; replacement and rehabilitation.

- A replacement project could be designed to resolve all of the deficiencies that exist today at the project site, including structural deterioration, BFW, AOP, and maintenance of flood elevations.
- A rehabilitation project would restore some degree of structural integrity to the culvert, and could extend the service life of the structure approximately 30-50 years. Hydraulic and flood capacity could even be reduced.

It is recognized that some projects will not get funded for full replacements that meet all standards and resource requirements. Therefore, rehabilitation alternatives will be discussed in this report as a measure to extend the life of this culvert.

### No Action

This alternative would involve leaving the culvert in its current condition. There are two ways used to evaluate whether a "No Action" alternative is appropriate - one is to determine whether the existing structure can stay in place without substantial work being performed on it during the next 10 years. The other is to review the ratings of all of the elements of a bridge or culvert, with the goal that all elements rated 4 or less are to be removed or rehabilitated. In this case, the culvert will likely require substantial work within the next 10 years. Previous inspection reports have already noted that the roadway embankment has been settling due to piping of water around the failing culvert. Also, given the 2 (critical) rating on this culvert, it is not acceptable to leave it as is. Therefore, the No Action alternative is not recommended.

### Structure Replacement with an Integral Abutment Bridge

A full replacement with an integral abutment bridge was discussed in the Preliminary Hydraulics Report. This concept was not developed for this project because it is generally more economical to construct a buried structure for short spans where there is adequate cover for the structure. An integral abutment bridge would require a centerline span of approximately 80' to provide a Bank Full Width of 24' and 1:1.5 slopes and a 20-degree skew. A buried structure in this location will also be more protected from de-icing salts and will require less maintenance.

### Structure Replacement Using Trenchless Methods

Trenchless methods, as defined in this scoping report, include jack and bore, pipe ramming, and similar methods of installing a new pipe without open excavation. A replacement of the existing culvert adjacent to the current location using these methods was considered. Although done more frequently in other states, it is unlikely that there is the expertise or equipment available to make these methods of pipe replacement cost-competitive for this project, which would require one 16' diameter pipe or two 11' diameter pipes be installed. As this method does not seem economical for pipes that have 9'-10' of cover, and it would require relocation of the watercourse, these methods will not be considered further in this report.

**Alternative 1: Rehabilitation**

Rehabilitation is usually considered for any project. Normally on a project with the hydraulic characteristics seen here (constricts the stream and would raise $Q_{100}$ flood elevations if lined), rehabilitation would be discounted, and a replacement project would be recommended. However, two conditions suggest including a discussion of rehabilitation in this report. The first is that economic considerations are becoming a higher priority on many projects, and second, it may be possible for short term improvements to be made in a manner that prevents raising the flood elevations.

Rehabilitation options considered:

a: Invert Repair
b: Pipe Liner
c: Cured In Place Pipe
d: Spray-on Lining

All rehabilitation options would employ the use of hydro-blasting or hydro-demolition to appropriately clean the existing pipe interior prior to rehabilitation. In addition to cleaning, some grouting would be needed to plug holes in the pipe and fill all voids on the outside of the pipe. Additional injection of flowable fill would be recommended to stabilize the roadbed above the culvert. Curing in dry conditions would be required in most cases, necessitating a re-routing of the stream flow during the work and for a prescribed curing period (usually 24 hours). A headwall with beveled inlets would be recommended for all rehabilitation alternatives. A service life of approximately 30 years can be expected if the pipes are rehabilitated.

a. Invert Repair

The condition of the galvanized metal above the ordinary water line in the culvert is very good, suggesting that there is significant service life remaining in that portion of the pipe. Below the water line, the corrosion is severe. There are different types of invert repair that can be utilized on corrugated steel pipe. The following were considered:

- Bituminous concrete paving was discounted for this situation because it is ineffective where structural capacity needs to be replaced.
- Reinforced concrete placed in the culvert on top of the metal invert can also be used to form the new invert. This does restore some of the structural integrity of the culvert and extends the life of the culvert, but it also reduces the waterway area, likely causing higher velocities and higher water surface elevations during flood conditions.
- VTrans' Maintenance and Operations Bureau (Technical Services) is experimenting with a project elsewhere that uses phased plate replacement to accomplish the invert repair. Since this project is likely to be bundled with up to 3 other projects on VT 11,

this project is probably not a good choice for a pilot project. Plate replacement will not be considered further in this report.

- To provide a new invert with waterway area comparable to the existing, a configuration of the new invert using reinforced concrete that is lower than the existing pipe bottom could be considered. Provision of AOP and avoidance of higher flood elevations should be considerations.

b. Pipe Liner

Adding a pipe liner, also called sliplining, consists of pulling a complete new pipe into the existing culvert, then grouting the space between the two. Sliplining can be done using several different types of pipe material including corrugated steel, aluminum, reinforced concrete, and polyethylene, and can restore the structural integrity of the culvert. There are drawbacks to sliplining: one is that the waterway area is always reduced when sliplining is done; and two, it can be difficult to get the new liner installed, especially if there is distortion of the original host pipe as would be possible on this project. Another drawback is that it does not enhance AOP. Actions that raise the water surface elevations in Flood Insurance Zones or flood plains are prohibited without additional modelling of the waterway to show no detrimental effects. Crucial to the success of this method would be surveying the interior of the existing CMP to ensure that a rigid liner can be installed in the pipes. In the case of a pipe arch, it may be possible to procure a slightly smaller pipe arch to use as a liner, but it will be costly to produce the matching arch shape and will reduce further the already inadequate waterway area. Temporary Right-of-Way would likely be needed to provide a staging area at each end to accomplish this alternative. Pipe lining with an interior liner will not be considered further in this report.

c. CIPP (Cured in Place Pipe)

CIPP is another way of providing a new lining to the interior of an existing pipe. A resin-saturated felt or fiber tube is inserted into the pipe in a folded configuration, and is then expanded to be in contact with the entire interior surface of the existing culvert. Curing takes place by heating the resin using hot water, steam, or UV light. This method of culvert repair is not considered further in this report because a literature search on the subject yields no data on CIPP over the size of 8' diameter. Therefore, although it is expected that this method of culvert repair will be used in the future in Vermont, it is not considered to be a feasible solution for this project.

d. Spray-On Liners

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

It is important to note that this method of lining also has thickness, which has the result of raising the water elevations and adversely affecting AOP.

*Advantages:* A repair alternative using methods a, b, c, and d would address the structural deficiencies of the existing culvert pipes with minimum upfront costs. Alternative a. would extend the life of the culvert for only a few years. A repair would have minimal impacts on resources and traffic flow.

*Disadvantages:* Several of the rehabilitation methods described above have detrimental impacts on flood elevations, AOP, and normal flow characteristics. Rehabilitation offers the shortest service life projection (approximately 30-50 years would be gained, depending on the alternative chosen). It is assumed that for any rehabilitation alternative, temporary right-of-way will be necessary for the contractor's access.

**Alternative 2: Structure Replacement with a Buried Structure**

Culvert replacement using an open cut was considered. The preliminary hydraulics report suggests several possible configurations for a new structure, including an open bottom precast concrete arch or frame.

The Preliminary Hydraulics Report stated that a new culvert should be a 24' wide (perpendicular to channel) by 9' high (clear interior) precast concrete arch, or frame or any other shape meeting the waterway requirements. Subsequent to that report, it was determined by The Vermont Agency of Natural Resources River Management Engineer that 18' would be an acceptable BFW, given the constraints that exist on the watercourse upstream and downstream. The new structure could be an arch, frame, or box founded on suitable soils a minimum of 6' below the channel bottom or on sound bedrock. Full depth headwalls should be used. Consideration should be given to constructing this configuration with a natural stream bottom. Additional Right-of-Way would be required with this alternative. Roadway geometry would not be revised with this method of replacement. Traffic could be maintained with an offsite detour, or using phased construction. A temporary bridge could also be used.

*Advantages:* A new buried structure would resolve all structural deficiencies at this site and offer at least a 100-year service life. It would provide the full waterway area required to meet the hydraulic standard and BFW, as well as AOP.

*Disadvantages:* This alternative would have the largest initial cost of the alternatives considered and would have the largest impact in terms of traffic disruption and excavation.

## IV. Maintenance of Traffic

In keeping with a nation-wide trend toward accelerated construction aided and supported by the Federal Highway Administration, the Vermont Agency of Transportation has created an Accelerated Bridge Program, which focuses on faster delivery of construction plans, permitting, and Right of Way, as well as faster construction of projects in the field. One practice that 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 prefabricated elements in new bridges will also expedite construction schedules. This can apply to decks, superstructures, and substructures. Accelerated Construction should provide enhanced safety for the workers and the travelling public while maintaining project quality. The following options have been considered:

**Option 1: Off-Site Detour**

This option would close the bridge and reroute traffic onto an official, signed State detour, which detours traffic from the intersection of VT 11 and VT 106 in Springfield north on VT 106 to the intersection of VT 106 and VT 10 in North Springfield. Then the detour heads west on VT 10 to VT 103, south on VT 103 to Chester, and then back onto VT 11.

| | | |
|---|---|---|
| Thru distance: | 7.1 miles | 9 minutes |
| Detour distance: | 13 miles | 19 minutes |
| Added distance for Thru Traffic: | 5.9 miles | 10 minutes |
| End to end distance: | 20.1 miles | 28 minutes |

The times listed include no delays due to traffic congestion.

An alternate detour exists routing traffic to the south of the project:

Starting at the intersection of VT 106 and VT 11 in Springfield, travel southeast on VT 11 to I-91, then south on I-91 to Exit 6 in Rockingham. From Exit 6, travel northwest on VT 103 to Chester, then back to VT 11.

| | | |
|---|---|---|
| Thru distance: | 7.1 miles | 9 minutes |
| Detour distance: | 20 miles | 23 minutes |
| Added distance for Thru Traffic: | 12.9 miles | 14 minutes |
| End to end distance: | 27.1 miles | 22 minutes |

Again, no delays for congestion are included in the travel times above.

There are some opportunities for local bypasses, but they are few and not ideal. TH-8 (French Meadow Road) travels from VT 11 just west of the project site northward to North Springfield. This is a narrow, gravel-surfaced Class 3 Town road.

Another possible bypass starting on the west side of the project site follows TH-78 (Pleasant Valley Road) southward into the Town of Rockingham until it eventually joins VT 103. TH-78 is a Class 3 Town Road and avoids the more developed area of Chester, but is nearly as long as the southern detour route.

A bypass could be used by emergency responders, but would add to response times.

A concept that was briefly considered was routing traffic onto Woodland Drive just west of the project site, which is a dead end residential neighborhood, and constructing a new connector back onto VT 11 east of the project. The connector would be on the order of 400’-600’ long depending on location. This idea was discarded for several reasons. These are Class 3 town roads, and are appropriate for neither trucks nor an additional 4000-5000 vehicles per day. The connector roadway would be expensive to build due to the change in grade, and many trees would be lost. The new connector would then be removed at additional cost. The only possible routes would likely impact businesses on VT 11. Lastly, this option would have an adverse impact on the neighborhood on and near Woodland Drive.

Other bypass routes may be available. Access to driveways and town highways would be maintained. A map of the primary detour route can be found in the appendix.

It is estimated that a closure duration to install a new buried structure would be 25 days.

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

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

**Option 2: Phased Construction**

Phased construction is the maintenance of one lane of alternating traffic on the existing bridge while building one lane at a time of the proposed structure. Once the first half of the project is completed, traffic is shifted to the new lane, and work proceeds on the second lane. This allows keeping the road open during construction, while having minimal impacts to resources and adjacent property owners.

Existing conditions at this project site; traffic volumes, length of project, and existing roadway width, meet the most recent guidance for closing one lane of traffic and maintaining one lane of traffic, alternating direction, with a traffic signal. However, it is likely that with some temporary widening of the roadway fill embankment, two-way traffic could be maintained on each side in turn to allow the project to be completed in phases without the need for alternating one-way traffic. Delays will still occur as speed will be reduced through the work zone.

The excavation to install a 3-sided frame or arch would be approximately 23’-25’ deep to reach the recommended footing scour depth. Phasing would require a fairly deep braced excavation immediately adjacent to a live traffic lane while the work is performed. Two subsurface borings have been obtained which indicate the presence of bedrock at elevation 537.8 at boring B-101A and at elevation 527.9 at boring B-102. The elevation of the channel at the project site averages approximately elevation 553. Bedrock would not interfere with the installation of a new culvert, but would affect the ability to drive sheet piles for bracing the excavation during phased construction. A modified method of bracing the excavation for each phase will likely be required, similar to that used for recent projects at Duxbury or Winhall.

*Advantages:* Traffic would be maintained through the work zone.

*Disadvantages:* Delays would be experienced due to reductions in speed through the work area. Additional ROW would be required and utility relocation would be required. Safety is reduced for both the travelling public and construction workers due to close proximity. This method of traffic maintenance usually results in the project taking most, if not all, of the construction season.

**Option 3: Temporary Bridge**

Although a temporary bridge can physically be installed to maintain traffic through the corridor on this project, it would generate large impacts.

On the south side of VT 11, a significant amount of fill would be required to construct the approaches, and a large amount of vegetation would be lost. The trees are not particularly valuable, but they do serve to screen VT 11 from the neighborhood south of the project area. A large amount of temporary Right-of-Way would be required as well. On the north side, existing grades are more forgiving in terms of fill required to construct approaches, but there is less space for a temporary bridge. The bridge would be located very close to a residence in the NE quadrant, and to a business in the NW quadrant. Significant temporary Right-of-Way would be required.

There are no environmental or cultural resources present except for the waterway itself and possibly bat habitat, but vegetation removed from the riparian zone would need to be restored after the project. This option is very similar to Option 2, Phased Construction. The difference between widening the temporary roadway and building new approaches to a temporary bridge is small for this project. A temporary bridge will not be considered further in this report.

## V. Alternatives Summary

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

Alternative 1a: Culvert Rehabilitation using Invert Repair, with traffic maintained with periodic short term delays.

Alternative 1b: Culvert Rehabilitation using Spray-on Liner with traffic maintained with periodic short term delays.

Alternative 2a: New Buried Structure installed in phases with two-way traffic maintained on an On-Site Detour via a widened shoulder.

Alternative 2b: New Buried Structure with traffic maintained on an Off-Site Detour.

## VI. Cost Matrix[1]

| Springfield BF 0134(43) | | Alt 1a<br>Invert Repair<br>Minor Traffic Impacts | Alt 1b<br>Spray-On Liner<br>Minor Traffic Impacts | Alt 2a<br>New Buried Structure<br>Phased | Alt 2b<br>New Buried Structure<br>Off-Site Detour |
|---|---|---|---|---|---|
| | Bridge Cost | $387,000 | $198,000 | $953,000 | $868,000 |
| | Removal of Structure | $0 | $0 | $5000 | $5,000 |
| | Roadway | $122,000 | $122,000 | $305,000 | $179,000 |
| | Maintenance of Traffic | $25,000 | $25,000 | $160,000 | $43,000 |
| | Construction Costs | $534,000 | $345,000 | $1,423,000 | $1,095,000 |
| | Construction Engineering + Contingencies | $181,000 | $100,000 | $427,000 | $329,000 |
| | Total Construction Costs w CEC | $715,000 | $445,000 | $1,850,000 | $1,424,000 |
| | Preliminary Engineering[2] | $160,000 | $86,000 | $356,000 | $273,000 |
| | Right of Way | $17,000 | $17,000 | $100,000 | $17,000 |
| | **Total Project Costs** | **$892,000** | **$549,000** | **$2,306,000** | **$1,714,000** |
| | Annualized Cost | $29,750 | $18,300 | $23,000 | $17,100 |
| | Project Development Duration[3] | 2 years | 2 years | 4 years | 3 Years |
| | Construction Duration | 2 months | 2 months | 4 months | 3 months |
| | Closure Duration (If Applicable) | NA | NA | NA | 25 days |
| | Typical Section - Roadway (feet) | 40’ | 40’ | 40’ | 40’ |
| | Typical Section - Bridge (feet) | 8-12-12-8 | 8-12-12-8 | 8-12-12-8 | 8-12-12-8 |
| | Geometric Design Criteria | No Change | No Change | No Change | No Change |
| | Traffic Safety | Improved | Improved | Improved | Improved |
| | Alignment Change | No | No | No | No |
| | Bicycle Access | No Change | No Change | No Change | No Change |
| | Hydraulic Performance | Meets Standard | Substandard | Meets Standard | Meets Standard |
| | Pedestrian Access | No Change | No Change | No Change | No Change |
| | Utility | No Change | No Change | Relocation | Relocation |
| | ROW Acquisition | Yes | Yes | Yes | Yes |
| | Road Closure | No | No | No | Yes |
| | Design Life | 30 years | 30 years | 100 years | 100 years |

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

# VII. Conclusion

**Alternative 2a is recommended**; new buried structure constructed in phases with traffic maintained on a temporary on-site detour provided one lane in each direction. A precast or cast in place structure could be used, however if precast, portions of cast in place should be considered for the joint between phases.

Since this culvert received a condition rating of 2 (critical) in the fall of 2016, it is believed that a rehabilitation effort will not be feasible. Any rehabilitation efforts discussed will either: 1. reduce the waterway area and raise water surface elevations, which is prohibited; or 2. is considered too risky to attempt on this unstable structure. Therefore, the removal and replacement of the culvert is recommended. The new structure will meet BFW and will have a natural stream bottom providing AOP. The new structure will meet the Hydraulic Standard and is expected to improve conditions during design flood events. The expected service life of the new structure is 100 years if a precast concrete structure is used and is detailed for protection against road salts and other factors that accelerate deterioration.

Note that the width of the structure is shown on the plans in the appendix as 24' according to the preliminary BFW determination. The final width has been accepted to be 18'.

<u>Maintenance of Traffic:</u>

The recommended method of traffic maintenance for this project is to provide a two lane on-site detour through the project area. ROW will be required, and the duration of the work is expected to consume one full construction season. Delays will be experienced due to reduced speed through the project area.

There are three other culvert projects on VT 11 in Springfield and Chester that are currently being evaluated. They are all rated 3, and it makes sense to consider bundling all four of these projects for economic reasons.

## VIII. Appendices

# Appendix A: Site Pictures

VT 11 looking west

VT 11 looking east

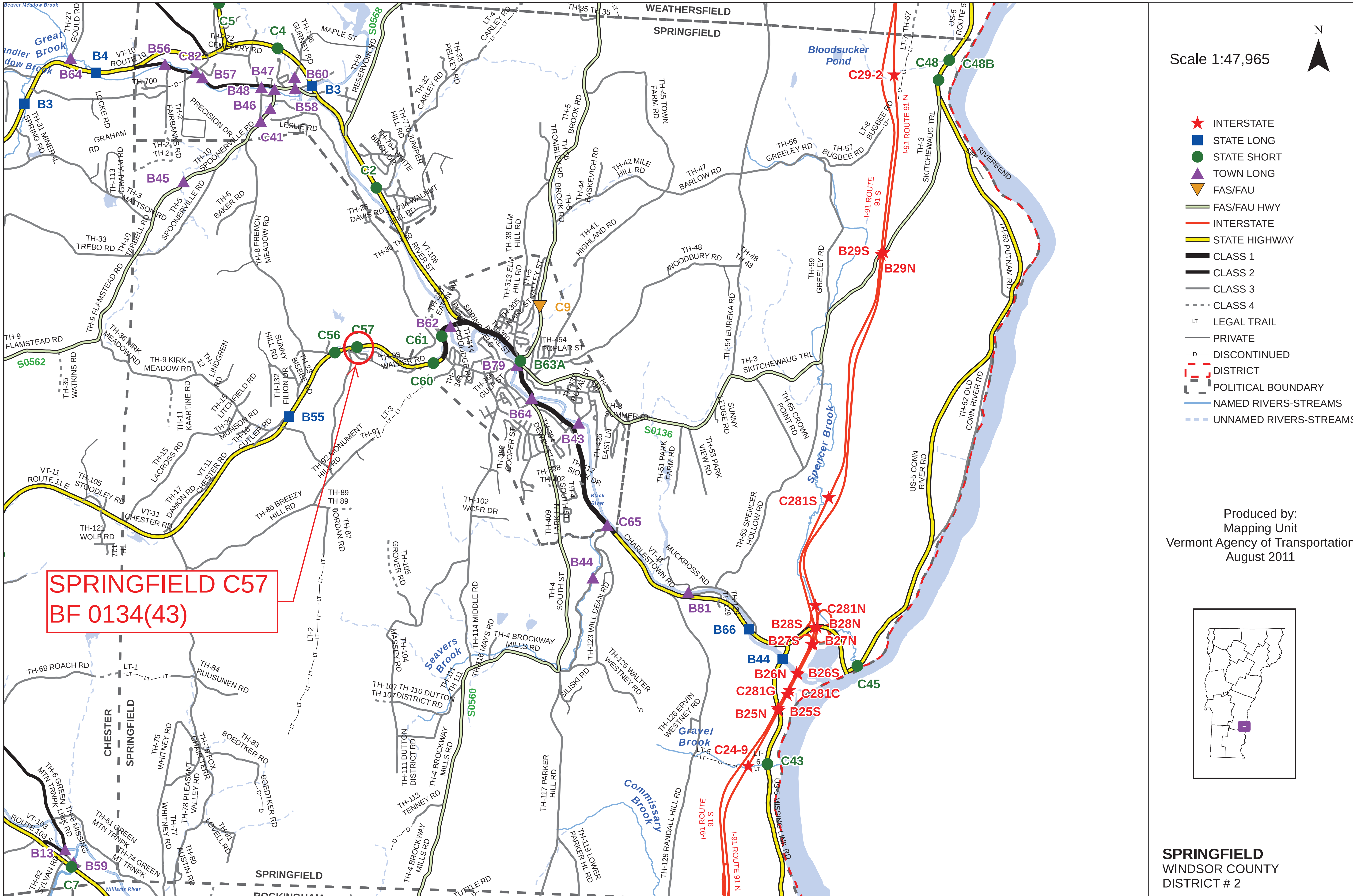

Culvert Inlet


Looking Downstream

Missing invert


Condition of Pipe above waterline

# Appendix B: Town Map


SPRINGFIELD C57
BF 0134(43)
Scale 1:47,965
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
SPRINGFIELD
WINDSOR COUNTY
DISTRICT # 2
WEATHERSFIELD
SPRINGFIELD
CHESTER
ROCKINGHAM
Bloodsucker Pond
Great Brook
Seavers Brook
Spencer Brook
Gravel Brook
Commissary Brook
C57
C56
C61
C60
B55
B62
B63A
B79
B64
B43
C65
B44
B81
B66
C9
C2
C4
C5
B3
B4
B56
C82
B57
B47
B60
B48
B46
B58
C41
B45
B64
C29-2
C48
C48B
B29S
B29N
C281S
C281N
B28S
B28N
B27S
B27N
B26N
B26S
C281G
C281C
B25N
B25S
C24-9
C43
C45
B13
B59
C7
S0568
S0562
S0136
S0560
VT-11 ROUTE 11 E
VT-10 ROUTE 10
VT-106 RIVER ST
I-91 ROUTE 91 N
I-91 ROUTE 91 S
US-5 ROUTE 5
CHARLESTOWN RD

# Appendix C: Bridge Inspection Report

# STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

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

**Inspection Report for** SPRINGFIELD | **bridge no.:** 0057 | **District:** 2

**Located on:** VT11 **over** BROOK | **approximately** 1.3 MI W JCT VT 106 | **Maintained By:** STATE

## CONDITION

**Deck Rating:** N NOT APPLICABLE

**Superstructure Rating:** N NOT APPLICABLE

**Substructure Rating:** N NOT APPLICABLE

**Channel Rating:** 6 SATISFACTORY

**Culvert Rating:** 2 CRITICAL

**Federal Str. Number:** 300134005714181

## AGE and SERVICE

**Year Built:** 1961 **Year Reconstructed:** ____

**Type of Service On:** 1 HIGHWAY

**Type of Service Under:** 5 WATERWAY

**Lanes On the Structure:** 02

**Lanes Under the Structure:** 00

**Bypass, Detour Length (miles):** 4

**ADT:** 5600 **Year of ADT:** 1996

## GEOMETRIC DATA

**Length of Maximum Span (ft):** 14

**Structure Length (ft):** 14

**Lt Curb/Sidewalk Width (ft):** 0

**Rt Curb/Sidewalk Width (ft):** 0

**Bridge Rdwy Width Curb-to-Curb (ft):** 0

**Deck Width Out-to-Out (ft):** 0

**Appr. Roadway Width (ft):** 40

**Skew:** 30

**Bridge Median:** 0 NO MEDIAN

**Feature Under:** FEATURE NOT A HIGHWAY OR RAILROAD

**Min Vertical Underclr (ft):** 08 FT 00 IN

## STRUCTURE TYPE and MATERIALS

**Bridge Type:** CGMPPA

**Number of Main Spans:** 1

**Kind of Material and/or Design:** 3 STEEL

**Deck Structure Type:** N NOT APPLICABLE

**Type of Wearing Surface:** N NOT APPLICABLE

**Type of Membrane:** N NOT APPLICABLE

**Deck Protection:** N NOT APPLICABLE

## CULVERT GEOMETRIC DATA and INDICATORS

**Culvert Barrel Length (ft):** 132

**Average Cover Over Culvert (ft):** 07

**Waterway Area Through Culvert (sq.ft.):** 97

**Wingwall/Headwall Rating:** 4 POOR CONDITION

## APPRAISAL

**Appr. Rdwy. Alignment:** 8 EQUAL TO DESIRABLE CRITERIA

## INSPECTION

**Inspection Date:** 112016 **Inspection Frequency (months):** 12

## INSPECTION SUMMARY and NEEDS

11/08/2016 - ** South side roadway has large area of dip/ sinkhole development which is encroaching into the roadway. Displacement increasing in scope, as it now extends to the middle of the eastbound lane. Abrupt sink hole formation highly probable along south side shoulder and sidewalk area. Culvert has severe corrosion of invert, along with significant distortion, and needs replacement. ~ MJ/SP

04/22/2016 - Special inspection to monitor distress. ** Pipe is in serious condition. Piping action causing sink holes along the eastern slope and a dip now of ~ 8" to 10" along the sidewalk and now the shoulder area with the dip encroaching inward along the travel lane. 70% of pipe from midlength to the outlet has dropped 1.5 to 2' along with invert eviscerated from corrosion. Pipe needs replacement soon.

12/3/2015 Culvert is in poor condition due to the invert at midspan to the outlet. Should consider replacement or be evaluated for a concrete invert. Culvert would be in good condition if the invert was repaired. Sink holes over the pipe on the outlet should be repaired. ~FRE/TJB

09/23/2014 - ** Pipe is in poor condition with significant settlement and needs full replacement soon. ~ MJ/JS

12/05/2013 - ** Pipe is in serious condition due to extensive corrosion and subsequent settlement and needs replacement soon. Right side roadway is slowly settling and the eastern side slope has large sink holes forming as piping action progresses below the eastern half of the pipe. ~ MJ/JS

# Appendix D: Preliminary Hydraulics Report

**VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION**

# HYDRAULICS UNIT

**TO:** Chris Williams, Structures Project Manager

**FROM:** David Willey, Hydraulics Project Supervisor

**DATE:** October 3, 2014

**SUBJECT:** Springfield BF 0134(43), VT 11 BR 57 over unnamed stream
Preliminary Hydraulics

---

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

**Existing Conditions**

The existing structure is a 14'-1" X 8'-9" X 132' long CGMPPA. It was built in 1961. This pipe is on a large skew to the road. The pipe is rusted with some holes through the invert. Rocks have accumulated in the culvert. The stream makes a bend coming into the pipe and is straight downstream. There is a small drop into a large scour pool at the outlet. There is about 8' of cover over the existing pipe.

Our calculations show the existing structure does not meet the current hydraulic standards, as headwater to depth ratios exceed the allowable values. The Q10 is the largest flow that does not submerge the inlet. Q10 headwater elevation is 559.7'. Water does not overtop the roadway below the design 50-year flood, due to the fill height over the pipe. The Q50 headwater elevation is 565.2'. The pipe constricts the channel width and that has resulted in a large scour pool at the outlet.

**Recommendations**

There is a Flood Insurance Study for this river. That fact, nearby buildings in the floodplain and the fact that the existing pipe is undersized all dictate there should be no increase in water surface elevations. A complete replacement appears to be the best solution for this site.

In sizing a new structure we attempt to select structures that meet both the current VTrans hydraulic standards, state environmental standards with regard to span length and opening height, and allow for roadway grade and other site constraints. Based on the above considerations and the information available, we recommend any of the following structures as a replacement at this site:

1. An open bottom precast concrete arch, or similar 3 sided structure, with a 24' minimum clear span and 9' minimum clear height above the average channel bottom. The structure should have at least 190sq. ft. of waterway area. This structure will provide 1' of freeboard at the design Q50 and will have no roadway overtopping below Q100. So it will meet the hydraulic standards.

2. A bridge with a 24’ minimum clear span length, measured perpendicular to the channel, with vertical abutments aligned with the channel. The clear span length along the road will need to be about 29’, due to the skew. No fill should be placed between the abutments that would reduce the waterway area of the bridge. Minimal stone fill could be placed in front of the abutments to create a minimum channel bottom width of 20’, if it matched the upstream channel banks. Assuming the upstream bridge fascia is located near the existing edge of road, the bottom of beams would need to be at least elevation 562.6’ to have 1’ of freeboard at the design Q50. This size bridge will lower upstream water surface elevations by about 5’ at Q100. All flows up to Q100 will pass through the bridge with no roadway overtopping.

3. A bridge with spill-through abutments should have a 20’ wide channel bottom width with 1 vertical to 1.5 horizontal slopes up to the abutments. This bridge should have a 30’ minimum clear span length, measured perpendicular to the channel. The span will likely be longer to reduce the abutment height. The bottom of beams would need to be at least elevation 562.6’ to have 1’ of freeboard at the design Q50. All flows up to Q100 will pass through the bridge with no roadway overtopping.

Many variables are in play such as span, low beam, roadway grade and site constraints. There are limitless combinations, all with different impacts. We have done our best to describe the ideal solution above. Please realize the above recommendations are the minimum required to meet the standards and are based on making assumptions for the variables listed. The final design may be different than our assumptions, and therefore may have different results. You may want to consider making the waterway area larger than recommended, to ensure the proposed design meets the standards. If you are unable to meet these recommendations and/or would like to have us test other options, please let us know.

We recommend early coordination with the Agency of Natural Resources River Management Engineer. They may have other recommendations for this project, including a different span length.

**<u>General Comments</u>**

If a new bridge or open bottom structure is installed, the bottom of abutment footings should be at least six feet below the channel bottom, or to ledge, to prevent undermining. Abutments on piles should be designed to be free standing for a scour depth at least 6’ below channel bottom.

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.

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

DCW

cc: Hydraulics Project File via NJW
Hydraulics Chrono File

# Appendix E: Geotechnical Data Report

**AGENCY OF TRANSPORTATION** **OFFICE MEMORANDUM**

**To:** Jennifer Fitch, P.E., Structures Project Manager

END CEE

**From:** Eric Denardo, Geotechnical Engineer via Callie Ewald, P.E., Geotechnical Engineering Manager

**Date:** September 26, 2016

**Subject:** Springfield BF 0134(43) – Subsurface Investigation

## 1.0 INTRODUCTION

We have completed our geotechnical and geological subsurface investigation for the culvert located on Vermont RT 11 located approximately 1.3 miles west of the intersection of VT RT 11 and VT RT 106 in Springfield, Vermont. The borings were completed to determine the soil strata and depth to bedrock to aid in design for a replacement structure. Contained herein are the results of our field sampling and testing, laboratory analyses of soil and rock samples, as well as boring logs.

## 2.0 FIELD INVESTIGATION

The field investigation was conducted between July 25 and July 27, 2016. Three standard penetration borings were drilled to determine the existing subsurface strata. A summary of the location of each boring and corresponding ground surface elevation can be found in Table 1 as well as in the attached Boring Location Plan. The values for the Northings and Eastings are based on the Vermont State Plane Grid Coordinate System NAD 83, and were located by a handheld GPS. Elevations for the borings were then taken off a VTrans survey file. The locations and elevations of the borings should be considered accurate only to the degree implied by the method used to determine them.

**Table 1:** Boring Locations and Elevations

| Boring Number | Station | Offset(ft) | Northing (ft) | Easting (ft) | Ground Surface Elevation (ft) | Top of Bedrock Elevation (ft) |
|---|---|---|---|---|---|---|
| **B – 101*** | 327+95.0 | 18.81 | 291889.55 | 1637993.49 | 568.0 | Not Encountered |
| **B – 101A** | 327+100.0 | 18.81 | 291890.35 | 1637998.41 | 567.9 | 537.8 |
| **B-102** | 327+44.37 | -12.10 | 291911.84 | 1637938.37 | 569.9 | 527.9 |

**Encountered culvert at 9.8 feet, moved 5 feet to B-101A*

The borings were performed in general accordance with AASHTO T206, *Standard Method of Test for Penetration Test and Split-Barrel Sampling of Soils.* During boring operations, for boring B-101, split spoon samples and standard penetration tests (SPT) were taken continuously until 9.8 feet where the drill casing encountered the culvert. After hitting the culvert, the drill rig was moved 5 feet parallel to the roadway away from the culvert to where boring operations were continued as B-101A. For boring B-101A, the boring was advanced to a depth of 11 feet before sampling began. Split spoon samples and SPTs were taken continuously from 11 feet to 21 feet and then at 5 foot intervals to bedrock. When bedrock was encountered, NX rock cores were taken 10 feet into bedrock to collect five foot core sample runs to confirm the presence of bedrock. For B-102, split spoon samples and SPTs were taken continuously to 21 feet, then at 5 foot intervals to bedrock. When bedrock was encountered, one five foot core run was completed to confirm the presence of bedrock.

Soil samples were visually identified in the field and SPT blow counts were recorded on the boring logs when applicable. Soil and rock samples were preserved and returned to the Construction and Materials Bureau Central Laboratory for testing and further evaluation. Upon completion of the laboratory testing, the boring logs were revised to reflect the results of the laboratory classification analysis.

## 3.0 FIELD AND LABORATORY TESTING

The standard penetration resistance of the in-situ soil is determined by the number of blows required to drive a 2 inch OD split barrel sampler into the soil with a 140 pound hammer dropped from a height of 30 inches, in accordance with procedures specified in AASHTO T206. During the standard penetration test (SPT), the sampler is driven for a total length of 2 feet, while counting the blows for each 6 inch increment. The SPT N-value, which is defined as the sum of the number of blows required to drive the sampler through the second and third increments, is commonly used with established correlations to estimate a number of soil parameters, particularly the shear strength and density of cohesionless soils. The N-values provided on the boring logs are raw values and have not been corrected for energy, borehole diameter, rod length, or overburden pressure. The VT Agency of Transportation has determined a hammer correction value, $C_E$, to account for the efficiency of the SPT hammer on the drill rig. For all of the borings, a CME 45C Skid Rig was used, with a hammer energy correction factor of 1.42. This value, included on the boring logs, should be used in calculations to determine soil parameters. Laboratory tests were conducted on all samples to evaluate grain size, moisture content, and percent finer than No. 200 sieve. Results from this testing can be found on the attached boring logs.

A detailed description of the rock cores is presented on the boring logs including run length, drill times, recovery, and Rock Quality Designation (RQD). Recovery is defined as the length of core obtained expressed as a percentage of the total length cored. In accordance with ASTM D6032, RQD is the total length of core pieces, 4 inches or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams, jointing and bending planes. The Rock Mass Rating (RMR) is also included on the logs. RMR is AASHTO's (LRFD Bridge Design Specification) recommended method of classifying rock, and is based on five different parameters that all have relative ratings which combine to form the RMR. These parameters include rock strength, RQD, joint spacing, joint condition, and groundwater (AASHTO Section 10.4.6.4).

## 4.0 RECOMMENDATIONS

Based on this information, we believe steel sheet piles can be driven to a depth of approximately 25 to 30 feet below the roadway surface in order to retain the roadway if phased construction is selected. A layer of broken and weathered rock was encountered in both B-101A and B-102 directly above the bedrock. It may prove difficult to drive sheeting into these materials. Although some dense materials were encountered above this depth, no large boulders or cobbles were noted by the drillers. As a result, it appears sheet piles can be driven by equipment commonly used by contractors in the region through the soils encountered. These recommendations are based on the information encountered at the boring locations and it should be noted that site conditions can vary across the project site.

In the previous scoping report dated July 17, 2014, a precast arch bridge on spread footings or a reinforced concrete box culvert with new headwalls and wingwalls were possible options for the replacement of the culvert. Based on the findings of this geotechnical investigation, we believe these remain feasible options. Once this project moves further along in the design phase, we would be happy to assist with any foundation design required.

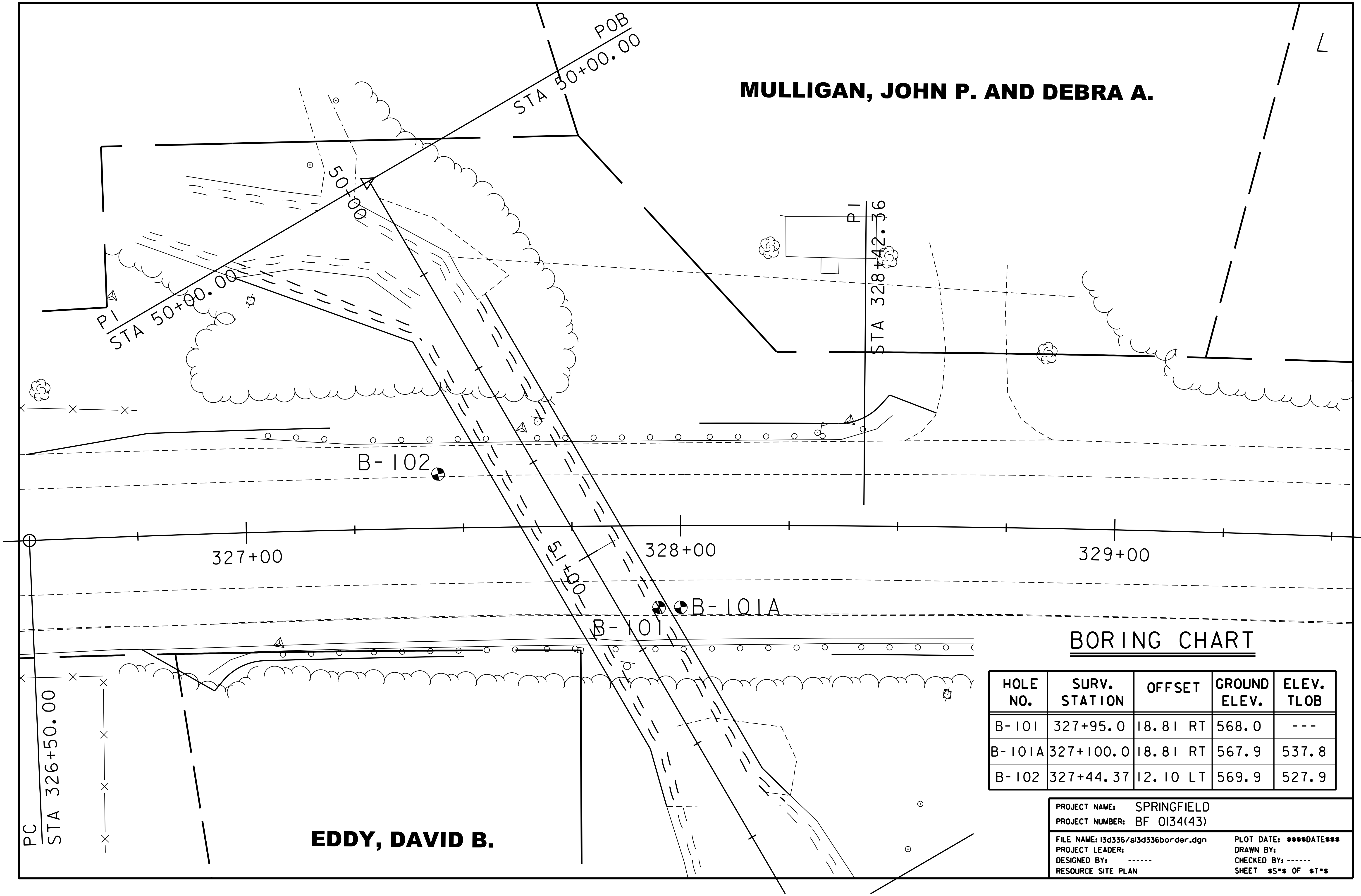
## 5.0 CONCLUSION

If you have any questions, or you would like to discuss this report, please contact us at (802) 828-2561. The boring logs are attached as available in the *M:Projects\13c334\MaterialsResearch* folder.

Enclosures: Boring Location Plan (1 page)
Boring Logs (3 pages)

cc: Gary Sweeny
Electronic Read File/DJH
Project File/CEE
END

Z:\Highways\CMB\GeotechEngineering\Projects\Springfield BF 0134(43)\REPORTS\Springfield BF 0134(43) Geotechnical Data Report.docx




## BORING CHART

| HOLE NO. | SURV. STATION | OFFSET | GROUND ELEV. | ELEV. TLOB |
|---|---|---|---|---|
| B-101 | 327+95.0 | 18.81 RT | 568.0 | --- |
| B-101A | 327+100.0 | 18.81 RT | 567.9 | 537.8 |
| B-102 | 327+44.37 | 12.10 LT | 569.9 | 527.9 |

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(43)

FILE NAME: l3d336/sl3d336border.dgn
PROJECT LEADER:
DESIGNED BY: ------
RESOURCE SITE PLAN

PLOT DATE: $$$$DATE$$$
DRAWN BY:
CHECKED BY: ------
SHEET $S*$ OF $T*$

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

# BORING LOG

**Springfield**
**BF 0134(43)**
**VT 11 Culvert 57**

Boring No.: **B-101**

Pin No.: 13c334
Checked By: END

Boring Crew: Gomes, Judkins, Emerson
Date Started: 7/25/16 Date Finished: 7/25/16
VTSPG NAD83: N 291889.55 ft E 1637993.49 ft
Station: 327+95 Offset: 18.81
Ground Elevation: 568.0 ft

| | Casing | Sampler |
|---|---|---|
| Type: | WB | SS |
| I.D.: | 4 in | 1.5 in |
| Hammer Wt: | N.A. | 140 lb. |
| Hammer Fall: | N.A. | 30 in. |
| Hammer/Rod Type: | Auto/AWJ | |
| Rig: | CME 45C SKID | $C_E$ = 1.42 |

Groundwater Observations

| Date | Depth (ft) | Notes |
|---|---|---|
| 07/25/16 | | No W.T. observed |

| Depth (ft) | Strata (1) | CLASSIFICATION OF MATERIALS (Description) | Blows/6" (N Value) | Moisture Content % | Gravel % | Sand % | Fines % |
|---|---|---|---|---|---|---|---|
| | | Asphalt Pavement, 0.0 ft - 0.5 ft | | | | | |
| | | A-1-b, GrSa, gry-brn, Moist, Rec. = 0.8 ft | 2-3-3-3 (6) | 10.5 | 33.5 | 55.8 | 10.7 |
| 2.5 | | Field Note:, Rollercone, Cleaned out casing | | | | | |
| | | A-2-4, GrSiSa, gry-brn, Moist, Rec. = 0.8 ft | 4-6-8-8 (14) | 9.3 | 26.2 | 44.6 | 29.2 |
| | | Field Note:, Rollercone, Cleaned out casing | | | | | |
| 5.0 | | A-2-4, SiSa, gry-brn, Moist, Rec. = 1.0 ft | 8-4-7-5 (11) | 9.0 | 18.3 | 52.2 | 29.5 |
| | | Field Note:, Rollercone, Cleaned out casing | | | | | |
| 7.5 | | A-3, Sa, brn, Moist, Rec. = 1.0 ft | 3-4-3-3 (7) | 12.9 | 5.3 | 86.7 | 8.0 |
| | | A-3, GrSa, brn, Moist, Rec. = 0.5 ft | 1-R@3.5" (R) | 17.0 | 20.8 | 72.1 | 7.1 |
| 10.0 | | Hole stopped @ 9.8 ft | | | | | |
| 12.5 | | | | | | | |

Remarks:
Hole collapsed at 9.3 feet.

1.) Hit culvert at 9.8 feet. Aborted drilling operations.

Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. $C_E$ is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.

STATE OF VERMONT
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CONSTRUCTION AND
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# BORING LOG

**Springfield**
**BF 0134(43)**
**VT 11 Culvert 57**

| | |
|---|---|
| Boring No.: | **B-101A** |
| Page No.: | 1 of 1 |
| Pin No.: | 13c334 |
| Checked By: | END |

Boring Crew: Gomes, Judkins, Emerson
Date Started: 7/25/16 Date Finished: 7/26/16
VTSPG NAD83: N 291890.35 ft E 1637998.41 ft
Station: 327+99.99 Offset: 18.81
Ground Elevation: 567.9 ft

| | Casing | Sampler |
|---|---|---|
| Type: | WB | SS |
| I.D.: | 4 in | 1.5 in |
| Hammer Wt: | N.A. | 140 lb. |
| Hammer Fall: | N.A. | 30 in. |
| Hammer/Rod Type: | Auto/AWJ | |
| Rig: | CME 45C SKID | $C_E$ = 1.42 |

Groundwater Observations

| Date | Depth (ft) | Notes |
|---|---|---|
| 07/26/16 | 16.6 | W.T. before drilling |

| Depth (ft) | Strata (1) | CLASSIFICATION OF MATERIALS (Description) | Run (Dip deg.) | Core Rec. % (RQD %) | Drill Rate minutes/ft | Blows/6" (N Value) | Moisture Content % | Gravel % | Sand % | Fines % |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Asphalt Pavement, 0.0 ft - 0.43 ft | | | | | | | | |
| 5 | | | | | | | | | | |
| 10 | | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| | | Field Note:, No Reocvery, Rock stuck in end of sampler | | | | 6-7-11-9 (20) | | | | |
| | | A-1-a, SaGr, brn, Moist, Rec. = 0.5 ft, Lab Note: Broken rock was within sample | | | | 7-7-11-9 (18) | 12.3 | 50.1 | 42.7 | 7.2 |
| 15 | | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| | | A-1-a, SaGr, brn, Moist, Rec. = 0.1 ft | | | | 11-13-11-13 (24) | 8.9 | 73.2 | 22.7 | 4.1 |
| | | 16.4 ft - 17.0 ft<br>A-1-a, SaGr, brn, Moist, Rec. = 0.3 ft | | | | 16-15-6-5 (21) | 11.3 | 59.7 | 31.2 | 9.1 |
| 20 | | 18.3 ft - 19.0 ft<br>A-2-4, SiSa, brn, Moist, Rec. = 1.0 ft | | | | 2-2-2-2 (4) | 29.2 | 0.8 | 75.4 | 23.8 |
| 25 | | 24.4 ft - 25.0 ft<br>A-1-b, SaGr, gry-brn, Moist, Rec. = 0.5 ft, Lab Note: Broken and weathered rock was within sample | | | | 12-44-R@5" (R) | 12.0 | 54.8 | 30.1 | 15.1 |
| 30 | | 28.7 ft - 30.0 ft<br>A-1-b, SaGr, blk, Moist, Rec. = 0.1 ft, Lab Note: Broken and weathered rock was within sample | 1 (70) | 94 (21) | 3 | R@1" (R) | 8.2 | 52.3 | 32.3 | 15.4 |
| | | 30.1 ft - 35.1 ft, Gray to dark gray, Biotite-muscovite-quartz-plagioclase gneissic SCHIST, Slightly vuggy along some plagioclase foliations, rust and brown staining along joints. Hard, Slightly weathered, Poor rock, NX, RMR=39 | | | 4<br>3<br>2<br>4 | | | | | |
| 35 | | 35.1 ft - 40.1 ft, Gray to dark gray, Biotite-muscovite-quartz-plagioclase gneissic SCHIST, Few vugs along plagioclase foliations and rust staining along joints. Hard, Slightly weathered, Fair rock, NX, RMR=50 | 2 (70) | 100 (66) | 3<br>2<br>2<br>2<br>3 | | | | | |
| 40 | | Hole stopped @ 40.1 ft | | | | | | | | |

Remarks:
Hole collapsed at 19.1 feet.

Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. $C_E$ is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.

| STATE OF VERMONT AGENCY OF TRANSPORTATION CONSTRUCTION AND MATERIALS BUREAU CENTRAL LABORATORY | BORING LOG | |
|---|---|---|
| VTrans Working to Get You There – Vermont Agency of Transportation | **Springfield** **BF 0134(43)** **VT 11 Culvert 57** | Boring No.: **B-102** Page No.: 1 of 1 Pin No.: 13c334 Checked By: END |

| | |
|---|---|
| Boring Crew: | Judkins, Gomes |
| Date Started: | 7/26/16 |
| Date Finished: | 7/27/16 |
| VTSPG NAD83: | N 291911.84 ft E 1637938.37 ft |
| Station: | 327+44.37 |
| Offset: | -12.45 |
| Ground Elevation: | 569.9 ft |

| | Casing | Sampler |
|---|---|---|
| Type: | WB | SS |
| I.D.: | 4 in | 1.5 in |
| Hammer Wt: | N.A. | 140 lb. |
| Hammer Fall: | N.A. | 30 in. |
| Hammer/Rod Type: | | Auto/AWJ |
| Rig: | CME 45C SKID | $C_E$ = 1.42 |

Groundwater Observations

| Date | Depth (ft) | Notes |
|---|---|---|
| 07/27/16 | 12.1 | W.T. after drilling |
| 07/27/16 | 17.0 | W.T. before drilling |

| Depth (ft) | CLASSIFICATION OF MATERIALS (Description) | Run (Dip deg.) | Core Rec. % (RQD %) | Drill Rate minutes/ft | Blows/6" (N Value) | Moisture Content % | Gravel % | Sand % | Fines % |
|---|---|---|---|---|---|---|---|---|---|
| | Asphalt Pavement, brn, Moist, 0.0 ft - 0.58 ft | | | | | | | | |
| | A-1-b, GrSa, brn, Moist, Rec. = 1.4 ft | | | | 10-15-18-8 (33) | 9.0 | 31.9 | 53.4 | 14.7 |
| | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| | A-2-4, SiSa, brn, Moist, Rec. = 1.4 ft | | | | 8-11-14-14 (25) | 10.0 | 10.9 | 60.6 | 28.5 |
| | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| | A-1-b, GrSa, brn, Moist, Rec. = 1.0 ft | | | | 24-18-14-12 (32) | 7.6 | 36.1 | 49.6 | 14.3 |
| | Field Note:, Rollercone, Cleaned out casing | | | | | | | | |
| | A-2-4, GrSa, brn, Moist, Rec. = 1.0 ft | | | | 9-9-10-5 (19) | 9.0 | 25.2 | 59.0 | 15.8 |
| 10 | A-4, SaSi, brn, Moist, Rec. = 0.9 ft | | | | 3-3-2-2 (5) | 25.0 | 8.2 | 39.6 | 52.2 |
| | Field Note:, Rollercone, Cleaned out casing | | | | | | | | |
| | A-2-4, SiSa, brn, Moist, Rec. = 0.9 ft | | | | 3-3-2-7 (5) | 19.2 | 14.8 | 53.8 | 31.4 |
| | A-2-4, GrSa, brn, Moist, Rec. = 1.4 ft | | | | 7-5-3-4 (8) | 17.4 | 21.7 | 60.6 | 17.7 |
| | Field Note:, Rollercone, Cleaned out casing | | | | | | | | |
| | A-1-b, GrSa, brn, Moist, Rec. = 1.1 ft | | | | 3-5-14-15 (19) | 11.9 | 33.9 | 54.2 | 11.9 |
| | Field Note:, Rollercone, Cleaned out casing | | | | | | | | |
| | A-1-b, GrSa, brn, Moist, Rec. = 1.2 ft | | | | 15-12-18-12 (30) | 14.0 | 32.5 | 51.9 | 15.6 |
| 20 | A-2-4, SiGrSa, brn, Moist, Rec. = 0.7 ft | | | | 9-12-26-25 (38) | 13.7 | 31.4 | 42.5 | 26.1 |
| | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| | A-2-4, SiSa, brn, Moist, Rec. = 1.0 ft, Lab Note: Broken rock was within sample | | | | 15-20-20-R@2.5" (40) | 16.2 | 16.8 | 52.8 | 30.4 |
| | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| 30 | A-2-4, GrSa, gry, Moist, Rec. = 0.9 ft, Lab Note: Broken rock was within sample | | | | R@5" (R) | 15.8 | 34.8 | 48.3 | 16.9 |
| | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| | Field Note:, No Recovery | | | | R@3.5 (R) | | | | |
| | Field Note:, NXDC, Cleaned out casing | | | | | | | | |
| 40 | A-1-b, SaGr, gry, Moist, Rec. = 0.3 ft, Lab Note: Broken rock was within sample | | | | R@5" (R) | 7.6 | 58.9 | 22.8 | 18.3 |
| | 42.0 ft - 47.0 ft, Gray to white, Muscovite-biotite-plagioclase-quartz granitic GNEISS, Rust and brown staining along joints. Hard, Slightly weathered, Fair rock, NX, RMR=47 | 1 (65) | 80 (18) | 5 3 3 2 2 | Top of Bedrock @ 42.0 ft | | | | |
| | Hole stopped @ 47.0 ft | | | | | | | | |
| 50 | | | | | | | | | |

Remarks:
Hole collapsed at 14.4 feet.

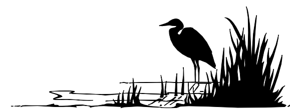
Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. $C_E$ is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.

# Appendix F: Natural Resources ID

**AGENCY OF TRANSPORTATION** **OFFICE MEMORANDUM**

**TO:** Lee Goldstein, Environmental Specialist

**FROM:** John Lepore, Transportation Biologist



**DATE:** February 5, 2014

**SUBJECT:** **Springfield B_F 0134 (43)**
**Natural Resources ID**
**Br. 57 on VT 11**

I have completed my review of this project which included both a desk review and a site visit. Based on my review, I have report the following:

**<u>Wetlands</u>**
There are no mapped wetlands in the immediate vicinity of this crossing.

**<u>Agricultural Soils</u>**
There are no prime agricultural soils located in the vicinity of this crossing.

**<u>Floodplains</u>**
This project is located on a mapped floodplain.

**<u>Fisheries</u>**
The unnamed watercourse associated with this crossing is tributary of the Black River and will require a provision for aquatic organism passage.

**<u>Species of Special Concern</u>**
There are no rare, threatened or endangered species or habitats of special concern in the vicinity of this crossing.

**<u>Permits & Construction</u>**
This watercourse is regulated by the US Army Corps of Engineers, and if a temporary detour and/or a construction haul road is used during construction, the removal of vegetation in the riparian zone will need to be minimized. In addition, upon removal of the detour or haul road, the riparian zone will need to be restored by planting native trees and shrubs.

Should you have any questions about this, please call me at 828-3963.

# Appendix G: Archaeological Memo

**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: James Brady, VTrans Environmental Specialist

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

Date: 5/9/2014

Subject: Springfield BF 0134(43) – Archaeological Resource ID

James,

A field visit was conducted on May 8th, 2014 by VTrans Archaeology Officer Jen Russell in order to identify archaeological resources in APE of Bridge 57 on VT Route 11 in the town of Springfield, Windsor County, Vermont. Based on field observations it has been determined that there are no identifiable areas of archaeological sensitivity in the project area. Please feel free to contact myself of Jen with any questions or concerns that may arise as part of this project.

Sincerely,

Brennan

**Brennan Gauthier**
VTrans Archaeologist
Vermont Agency of Transportation
Program Development Division
Environmental Section
1 National Life Drive
Montpelier, VT 05633
tel. 802-828-3965
fax. 802-828-2334
Brennan.Gauthier@state.vt.us

# Appendix H: Historic Memo

## Sweeny, Gary

**From:** O'Shea, Kaitlin
**Sent:** Wednesday, February 12, 2014 1:35 PM
**To:** Brady, James
**Cc:** Newman, Scott; Williams, Chris
**Subject:** Springfield BF 0134(43) Historic Resource ID

Hi James, I have completed the historic resource ID for Springfield BF 0134(43). Bridge 57 which carries Route 11 over a brook in Springfield, VT is not historic. There are no historic properties. This project can be processed as a Section 106 NHPA for historic.

Thanks,
Kaitlin

-------
Kaitlin O'Shea
Historic Preservation Specialist
Vermont Agency of Transportation

802-828-3962
Kaitlin.O'Shea@state.vt.us

# Appendix I: Local Input

# Local & Regional Input Questionnaire

**<u>Project Name: Springfield Culverts 57 and 60 on VT-11</u>**
**<u>Project Number: Springfield BF 0134(43) and Springfield BF 0134(45)</u>**

***Please note that answers apply to both C57 and C60, unless otherwise noted.***

Attachments to give context to answers uploaded at
https://drive.google.com/folderview?id=0B2jtfm2nTjt4LUxBR2FYeWU2TUU&usp=sharing :

- Land Use Map
- Context Map (includes sidewalks and some land use)
- Future Land Use Map
- Current Land Use Map
- Base Features Map (includes water and sewer lines)
- Public Transit Route Map
- Regional Transportation Map

## Community Considerations

1. Are there any scheduled public events in the community that will generate increased traffic (e.g. vehicular, bicycles and/or pedestrians), or may be difficult to stage if the bridge is closed during construction? Examples include: a bike race, festivals, cultural events, farmers market, concerts, etc. that could be impacted? If yes, please provide date, location and event organizers' contact info.
   High School Alumni Day Parade (2nd or 3rd weekend in June)

2. Is there a "slow season" or period of time from May through October where traffic is less?
   No particular slow season. Very high traffic all year round.

3. Please describe the location of emergency responders (fire, police, ambulance) and emergency response routes.
   Springfield Police. 201 Clinton Street, Springfield, VT. Phone: (802)885-2113. Chief Douglas Thompson douglas.johnston@state.vt.us

   Springfield Fire and Ambulance. 77 Hartness Avenue, Springfield, VT. Phone 802-885-4546. Fire Chief Russ Thompson

4. Where are the schools in your community and what are their schedules?
   Elm Hill Primary School (K-2) – 10 Hoover Street, Springfield, Vermont 05156
   Union Street Elementary School (3-5) – 43 Union Street, Springfield, Vermont 05156
   Riverside Middle School – 13 Fairground Road, Springfield, Vermont 05156
   Springfield High School – 303 South St, Springfield, Vermont 05156

   School District summer dates approx 4th week in June through 3rd week of August

5. In the vicinity of the bridge, is there a land use pattern, existing generators of pedestrian and/or bicycle traffic, or zoning that will support development that is likely to lead to significant levels of walking and bicycling? Please explain.

Residential and commercial land use. Near to Middle School, Hospital and several residential areas. This is a major through road carrying significant truck traffic. Sidewalks already exist (see map).

6. Are there any businesses (including agricultural operations) that would be adversely impacted either by a detour or due to work zone proximity?
   Many local businesses that have truck traffic travelling through the Town would be affected. See map for locations of businesses in town.

7. Are there any important public buildings (town hall or community center) or community facilities (recreational fields or library) in close proximity to the proposed project?
   Riverside Middle School, Springfield Hospital (main campus), Springfield Hospital (Rehabilitation Center).

8. Are there any town highways that might be adversely impacted by traffic bypassing the construction on another local road?
   Several town roads would be affected. No local roads could accommodate volume of traffic diverted.

9. Are there any other municipal operations that could be adversely impacted if the bridge is closed during construction? If yes, please explain.
   All operations in town would be adversely affected if bridge closed – due to large volume of traffic.

10. Please identify any local communication channels that are available—e.g. weekly or daily newspapers, blogs, radio, public access TV, Front Porch Forum, etc. Also include any unconventional means such as local low-power FM.
    Newspaper of record – Springfield Reporter

    Springfield Reporter – Weekly newspaper
    Eagle Times – Daily newspaper

    News updates emailed from Town Website - http://www.springfieldvt.govoffice2.com/

    Facebook (Town) - https://www.facebook.com/townofspringfieldvermont?fref=ts
    Facebook (Police Dept) - https://www.facebook.com/pages/Springfield-Police-Department-Springfield-VT/133631763326692?fref=ts
    Facebook (Springfield Regional Chamber of Commerce) - https://www.facebook.com/pages/Springfield-Regional-Chamber-of-Commerce/320106738039513?fref=ts
    Facebook (Springfield On The Move) - https://www.facebook.com/pages/Springfield-On-The-Move/168814006467688?ref=stream

11. Is there a local business association, chamber of commerce or other downtown group that we should be working with?
    Springfield Regional Chamber of Commerce – Jen Johnson spfldcoc@vermontel.net

Springfield Regional Development Corporation (SRDC) – Bob Flint
bobf@springfielddevelopment.org

Springfield On The Move (Downtown Organization) – Carol Lighthall som@vermontel.net

**Design Considerations**

1. Are there any concerns with the alignment of the existing bridge? For example, if the bridge is located on a curve, has this created any problems that we should be aware of?
   No particular concerns

2. Are there any concerns with the width of the existing bridge?
   No particular concerns

3. What is the current level of bicycle and pedestrian use on the bridge?
   Some pedestrians on the sidewalk

4. If a sidewalk or wide shoulder is present on the existing bridge, should the new structure have one? Are there existing bicycle and/or pedestrian facilities on the approaches to the bridge?
   Retain or widen shoulder width and area for sidewalk where possible.

5. Does the Town have plans to construct either bicycle or pedestrian facilities leading up to the bridge? Please provide a copy of the planning document that demonstrates this (e.g. scoping study, master plan, corridor study) Please explain and provide documentation.
   Existing sidewalk shown on map attached. Currently no plans for bike lane.

6. Does the bridge provide an important link in the town or statewide bicycle or pedestrian network such that you feel that bicycle and pedestrian traffic should be accommodated during construction?
   Important connection in sidewalk network from Downtown to residential neighborhoods in southeast part of town.

7. Are there any special aesthetic considerations we should be aware of?
   Not aware of any

8. Are there any traffic, pedestrian or bicycle safety concerns associated with the current bridge? If yes, please explain.
   No particular safety concerns known.

9. Does the location have a history of flooding? If yes, please explain.
   No known history

10. Are you aware of any nearby Hazardous Material Sites?
    None known

11. Are you aware of any historic, archeological and/or other environmental resource issues?
    None known

12. Are there any other comments you feel are important for us to consider that we have not mentioned yet?
    No

**Land Use & Public Transit Considerations –** to be filled out by the municipality or RPC.

1. Does your municipal land use plan reference the bridge in question? If so please provide a copy of the applicable section or sections of the plan.
   No specific mention of bridges in municipal land use plan

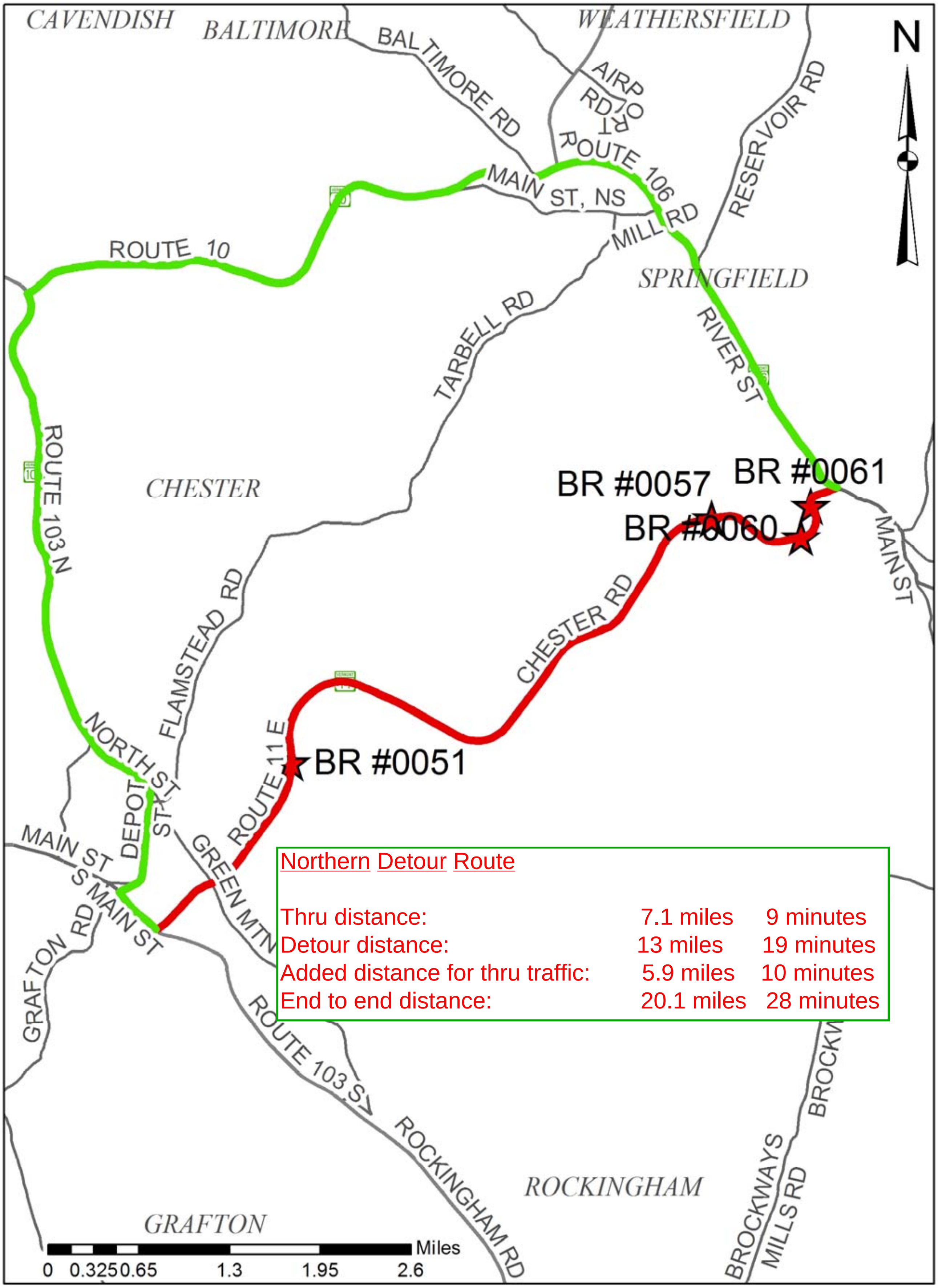
2. Please provide a copy of your existing and future land use map, if applicable.
   Attached

3. Are there any existing, pending or planned development proposal that would impact future transportation patterns near the bridge? If so please explain.
   None. But traffic will increase over time. VT-11 is a route over the Green Mountains which carries significant truck traffic.

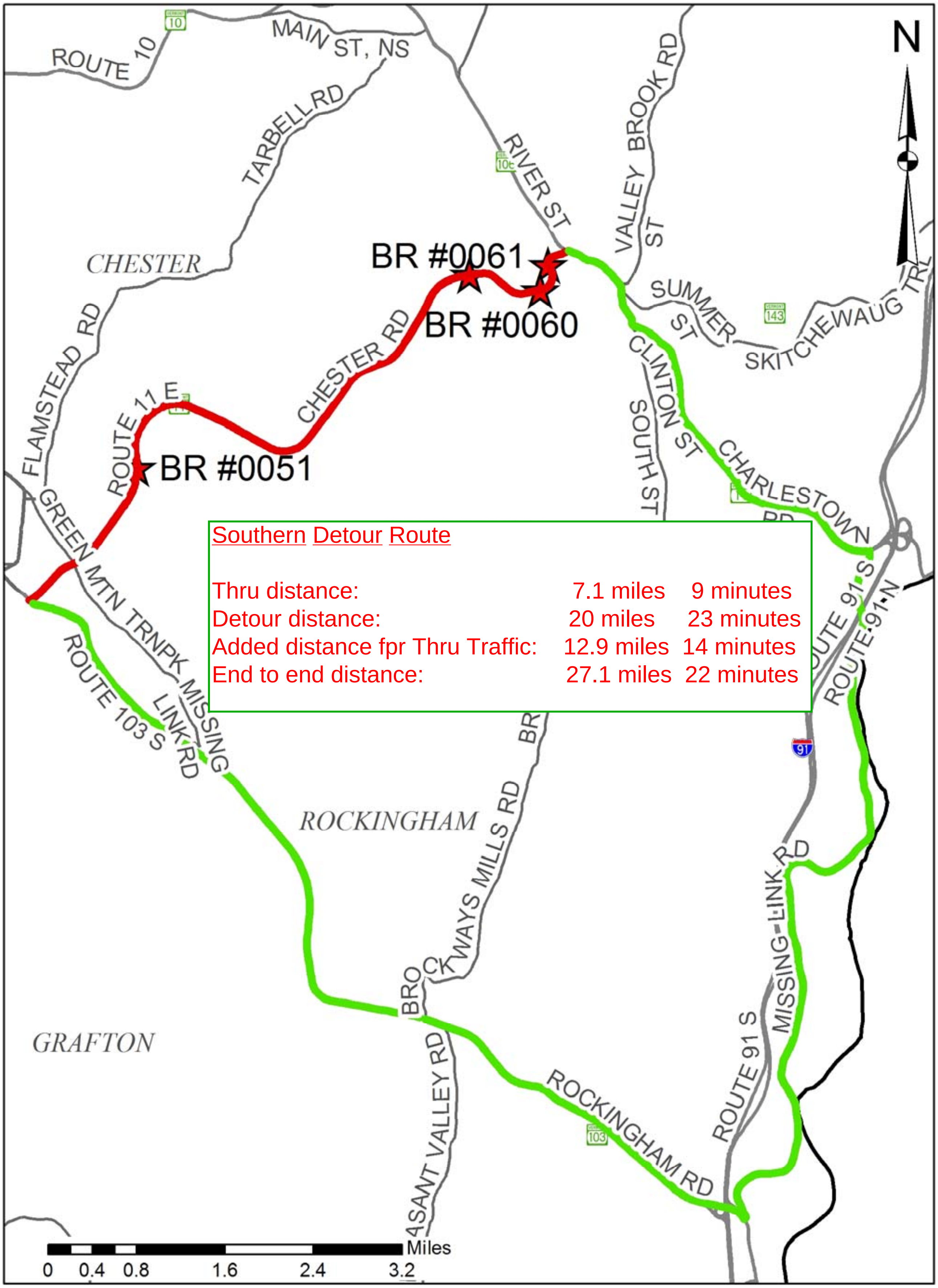
4. Is there any planned expansion of public transit service in the project area? If not known please contact your Regional Public Transit Provider.
   None known expansion of public transit route known. Does not affect Fixed Route Transit Service (see map attached) but would affect Dial-A-Ride service – which covers the entire town of Springfield.

   For more information contact Rebecca Gagnon at Connecticut River Transit (The Current) who provides all transit services – rgagnon@crtransit.org

# Appendix J: Detour Maps



CAVENDISH
BALTIMORE
BALTIMORE RD
WEATHERSFIELD
AIRPORT RD
ROUTE 106
RESERVOIR RD
N
MAIN ST, NS
ROUTE 10
MILL RD
SPRINGFIELD
TARBELL RD
RIVER ST
ROUTE 103 N
CHESTER
BR #0057
BR #0061
BR #0060
MAIN ST
FLAMSTEAD RD
CHESTER RD
ROUTE 11 E
BR #0051
NORTH ST
DEPOT ST
MAIN ST
S MAIN ST
GREEN MTN
GRAFTON RD
ROUTE 103 S
ROCKINGHAM RD
ROCKINGHAM
BROCKWAYS MILLS RD
GRAFTON
Miles
0 0.325 0.65 1.3 1.95 2.6
Northern Detour Route
Thru distance: 7.1 miles 9 minutes
Detour distance: 13 miles 19 minutes
Added distance for thru traffic: 5.9 miles 10 minutes
End to end distance: 20.1 miles 28 minutes


Southern Detour Route
Thru distance: 7.1 miles 9 minutes
Detour distance: 20 miles 23 minutes
Added distance fpr Thru Traffic: 12.9 miles 14 minutes
End to end distance: 27.1 miles 22 minutes
BR #0061
BR #0060
BR #0051
N
CHESTER
ROCKINGHAM
GRAFTON
ROUTE 10
MAIN ST, NS
TARBELL RD
RIVER ST
VALLEY BROOK RD
ST
SUMMER ST
SKITCHEWAUG TRL
CLINTON ST
SOUTH ST
CHARLESTOWN RD
CHESTER RD
ROUTE 11 E
FLAMSTEAD RD
GREEN MTN TRNPK
ROUTE 103 S
LINK RD
MISSING
ROUTE 91 S
ROUTE 91 N
BROCKWAYS MILLS RD
MISSING LINK RD
ROCKINGHAM RD
PLEASANT VALLEY RD
Miles
0 0.4 0.8 1.6 2.4 3.2

# Appendix K: Plans


EXISTING 132′-0" LONG CGMPPA
14′-1" SPAN X 8′-9" RISE
BUILT 1961
7′ AVERAGE COVER

## EXISTING CONDITIONS

SCALE 1" = 20′-0"
20 0 20

| | |
|---|---|
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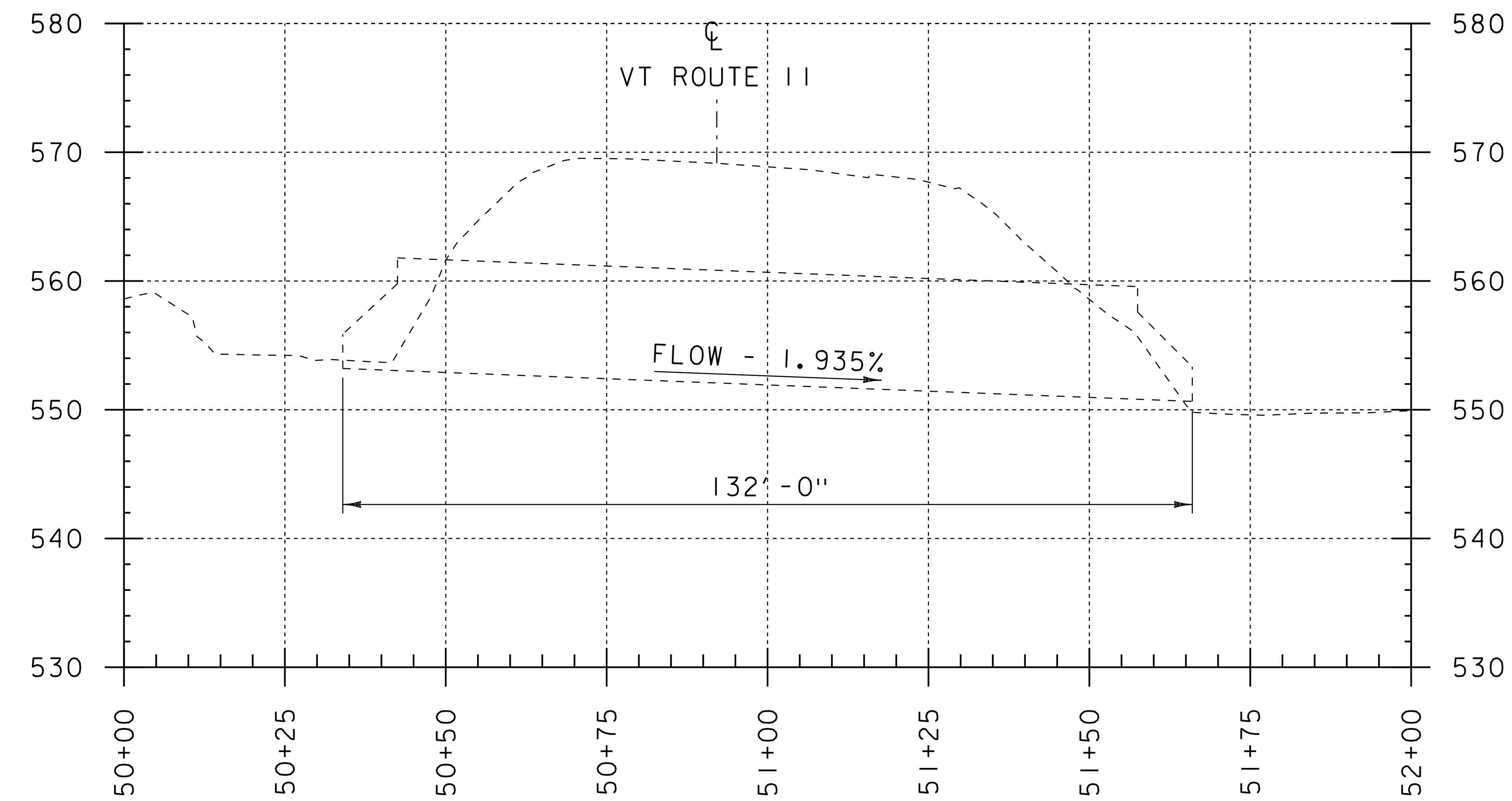
| PROJECT NUMBER: BF 0134(43) | |
| FILE NAME: 13c334/sl3c334border.dgn | PLOT DATE: 23-FEB-2017 |
| PROJECT LEADER: ----- | DRAWN BY: D.D.BEARD |
| DESIGNED BY: G.SWEENY | CHECKED BY: G.SWEENY |
| EXISTING CONDTIONS LAYOUT | SHEET 1 OF 11 |




## EXISTING CULVERT PROFILE

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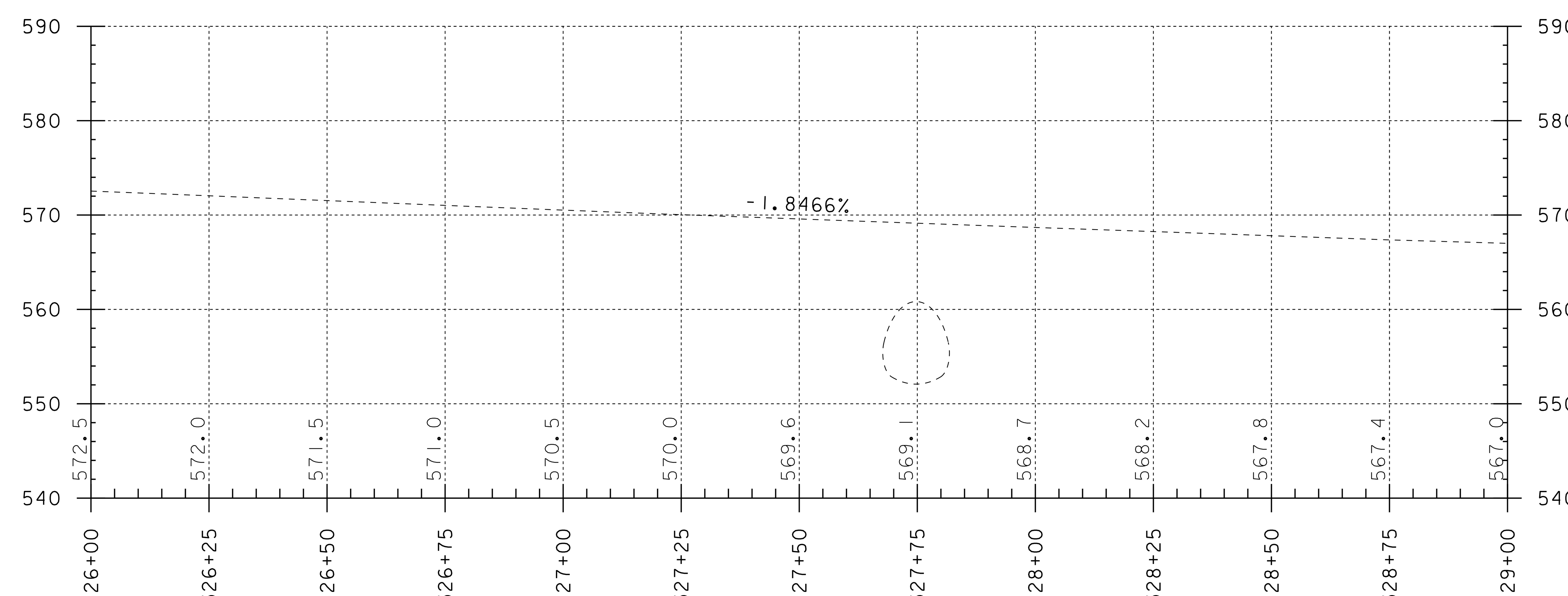
VERTICAL 1"=10'-0"




## VT ROUTE 11 PROFILE

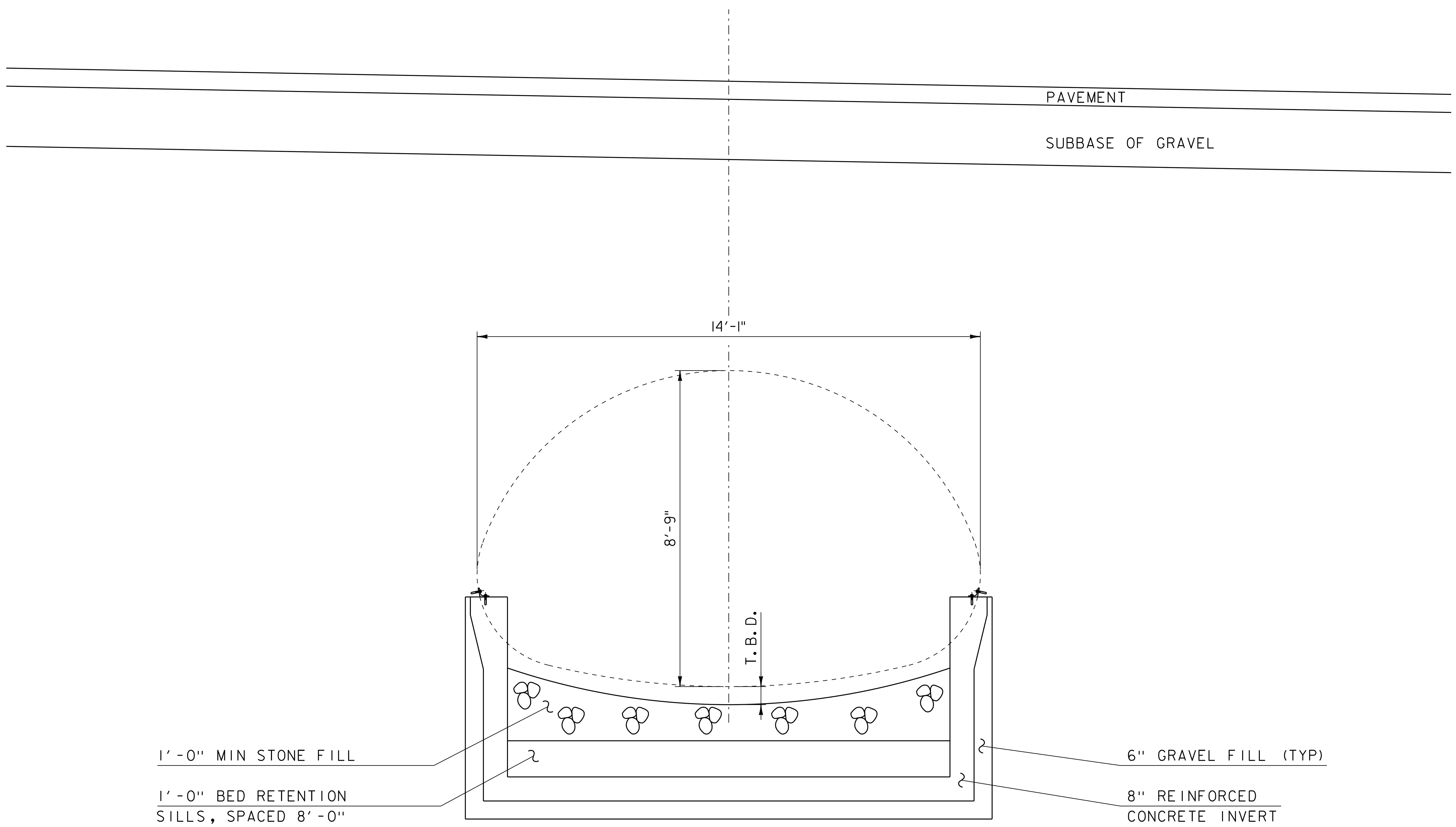
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(43)

FILE NAME: 13c344/s13c344profile.dgn
PROJECT LEADER: -----
DESIGNED BY: G.SWEENY
PROFILE SHEET

PLOT DATE: 23-FEB-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 2 OF 11




ALTERNATIVE 1 SECTION

NOTES:
1) CONCRETE INVERT, RETENTION SILLS, AND OTHER MATERIALS NOT YET DESIGNED.
2) THE INTENT IS TO RETAIN THE SAME OR SLIGHTLY LARGER WATERWAY AREA TO AVOID RISE IN THE 50 & 100 YEAR FLOODS
3) REINFORCED CONCRETE INVERT MAY BE CAST IN PLACE OR PRECAST
4) CONTRACTOR TO DETERMINE THE LENGTH OF CULVERT TO BE REMOVED AT ANY ONE TIME.

| | |
|---|---|
| PROJECT NAME: SPRINGFIELD | |
| PROJECT NUMBER: BF 0134(43) | |
| FILE NAME: 13c334/s13c334typical.dgn | PLOT DATE: 23-FEB-2017 |
| PROJECT LEADER: ----- | DRAWN BY: D.D.BEARD |
| DESIGNED BY: G.SWEENY | CHECKED BY: G.SWEENY |
| ALTERNATIVE 1A PROPOSED SECTIONS | SHEET 3 OF 11 |

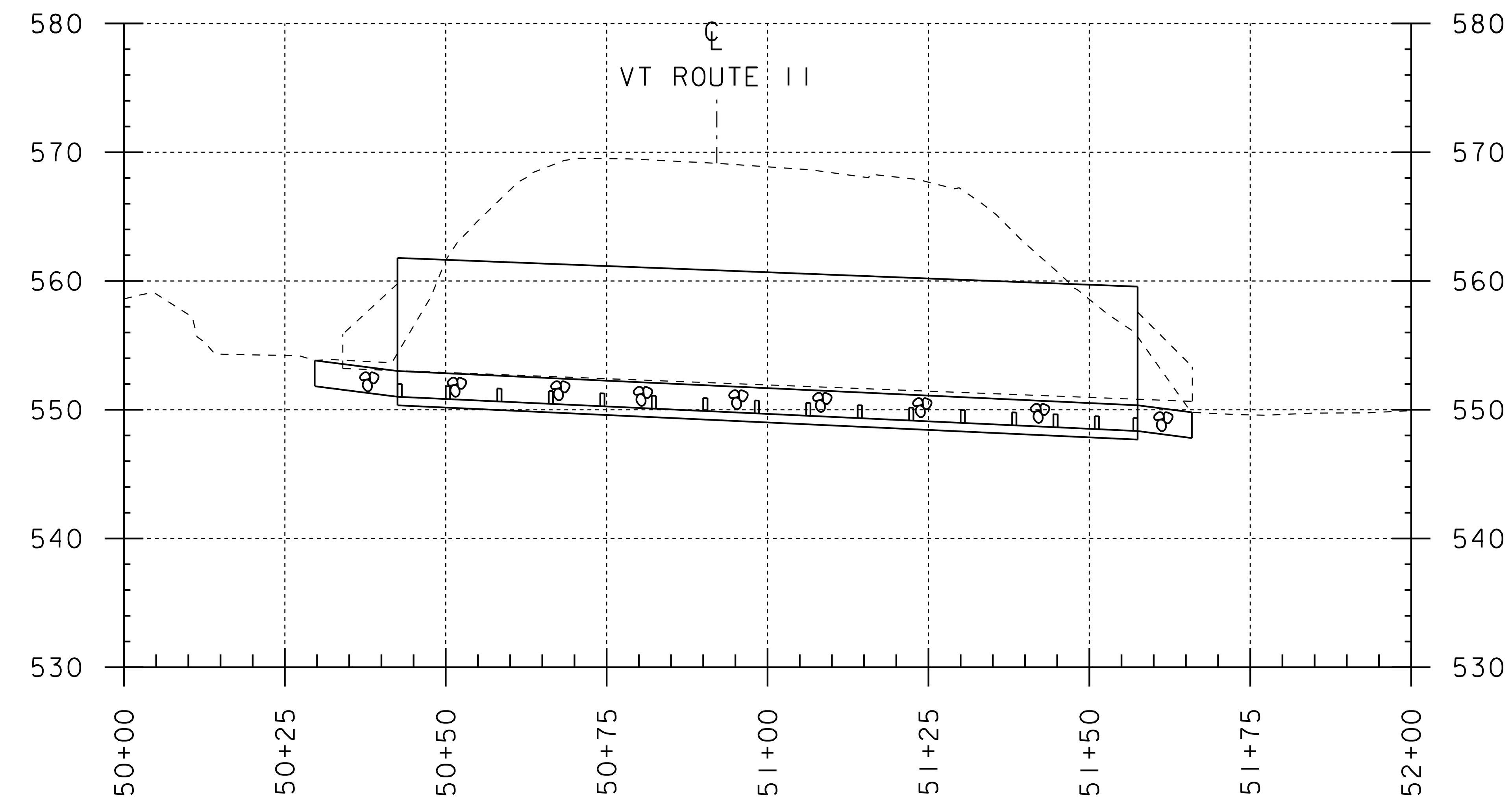

EXISTING 132′-0" LONG CGMPPA
14′-1" SPAN X 8′-9" RISE
BUILT 1961
7′ AVERAGE COVER

ALTERNATIVE 1

SCALE 1" = 20′-0"

20 0 20

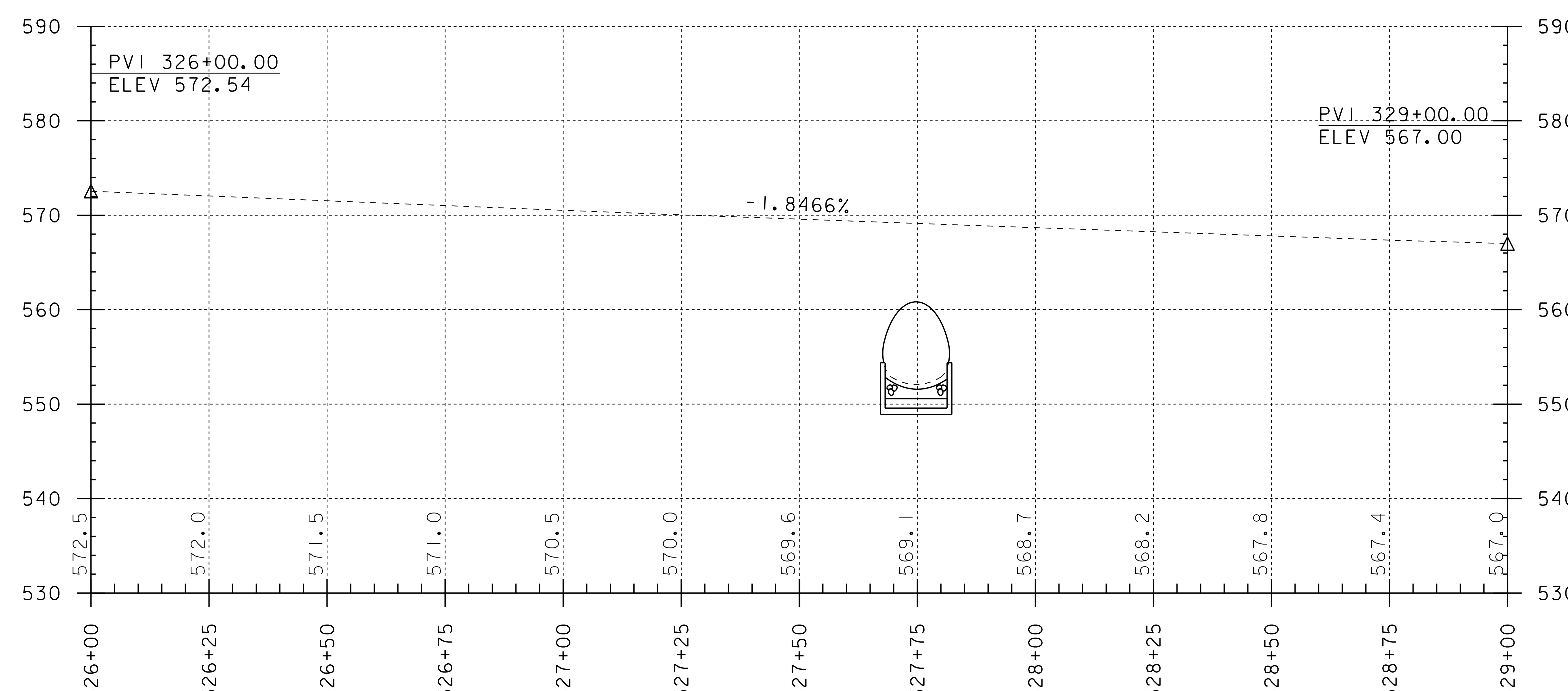
| | |
|---|---|
| PROJECT NAME: SPRINGFIELD | |
| PROJECT NUMBER: BF 0134(43) | |
| FILE NAME: 13c334/sl3c334border.dgn | PLOT DATE: 23-FEB-2017 |
| PROJECT LEADER: ----- | DRAWN BY: D.D.BEARD |
| DESIGNED BY: G.SWEENY | CHECKED BY: G.SWEENY |
| ALTERNATIVE 1 LAYOUT | SHEET 4 OF 11 |




## ALTERNATIVE 1 CULVERT PROFILE

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

NOTE: STREAM BED ELEVATION TO BE DETERMINED AT A LATER TIME WITH CONSIDERATION TO IMPROVED AOP




## VT ROUTE 11 ALTERNATIVE 1 PROFILE

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

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

| | |
|---|---|
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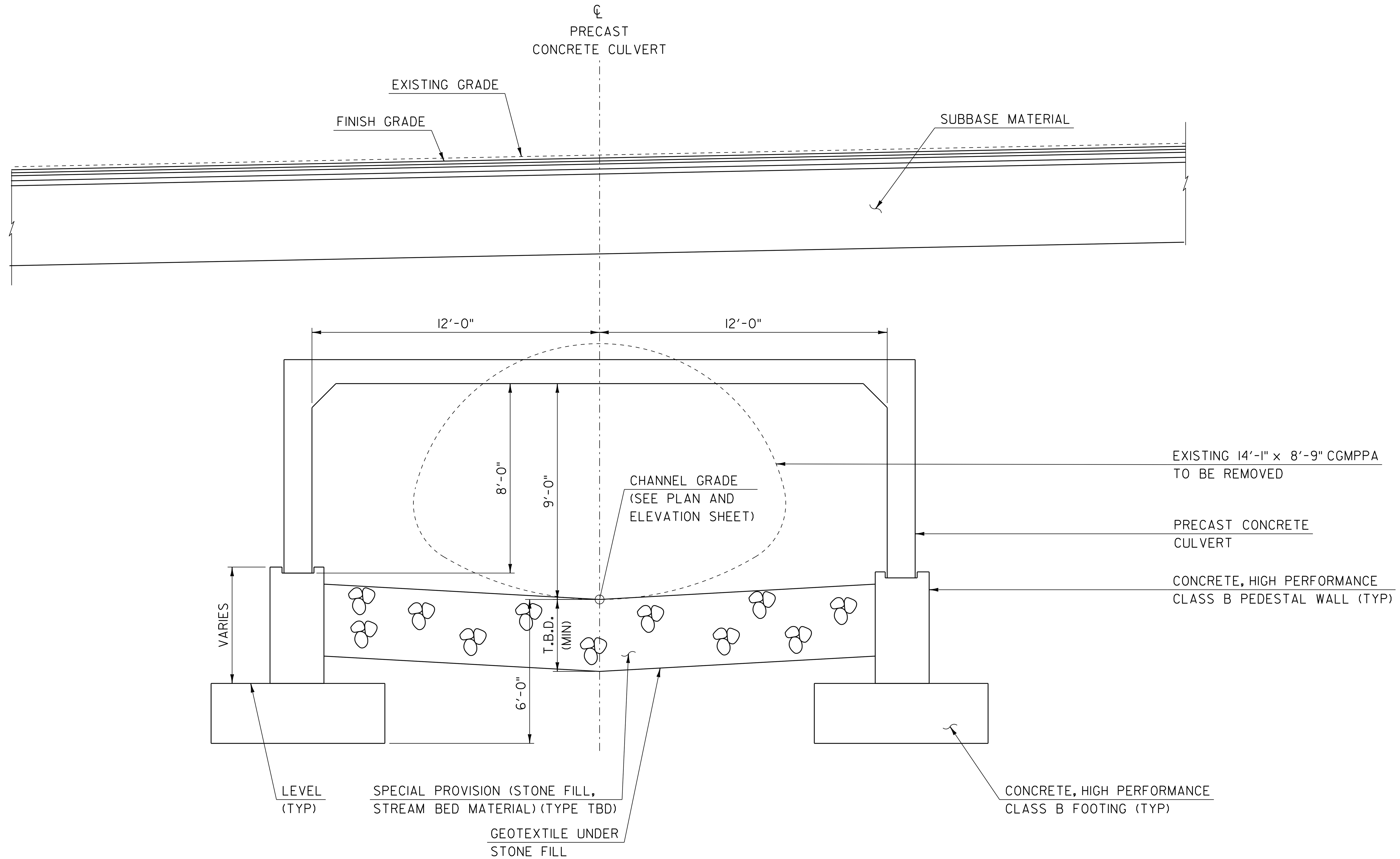
| PROJECT NUMBER: BF 0134(43) | |
| FILE NAME: 13c344/s13c344profile.dgn | PLOT DATE: 23-FEB-2017 |
| PROJECT LEADER: ----- | DRAWN BY: D.D.BEARD |
| DESIGNED BY: G.SWEENY | CHECKED BY: G.SWEENY |
| ALTERNATIVE 1 PROFILE SHEET | SHEET 5 OF 11 |

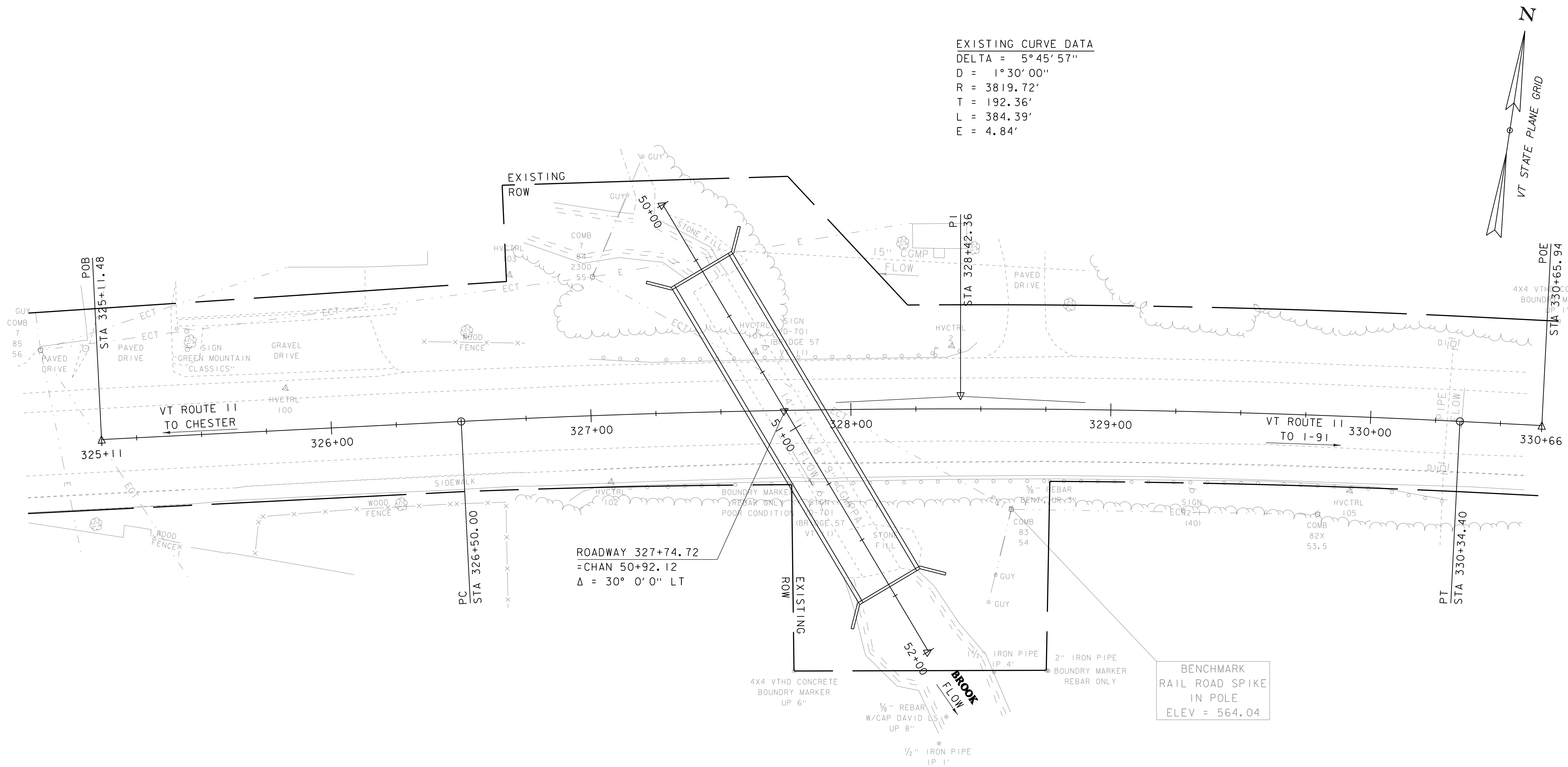



ALTERNATIVE 2 CULVERT AND EARTHWORK SECTION

(NORMAL TO CHANNEL ALIGNMENT)

SCALE: 3/8" = 1'-0"

| | |
|---|---|
| PROJECT NAME: SPRINGFIELD | |
| PROJECT NUMBER: BF 0134(43) | |
| FILE NAME: 13c334\s13c334typical.dgn | PLOT DATE: 23-FEB-2017 |
| PROJECT LEADER: ----- | DRAWN BY: D.D.BEARD |
| DESIGNED BY: G.SWEENY | CHECKED BY: G.SWEENY |
| ALTERNATIVE 2 SECTION | SHEET 6 OF 11 |




EXISTING 132′-0″ LONG CGMPPA
14′-1″ SPAN X 8′-9″ RISE
BUILT 1961
7′ AVERAGE COVER

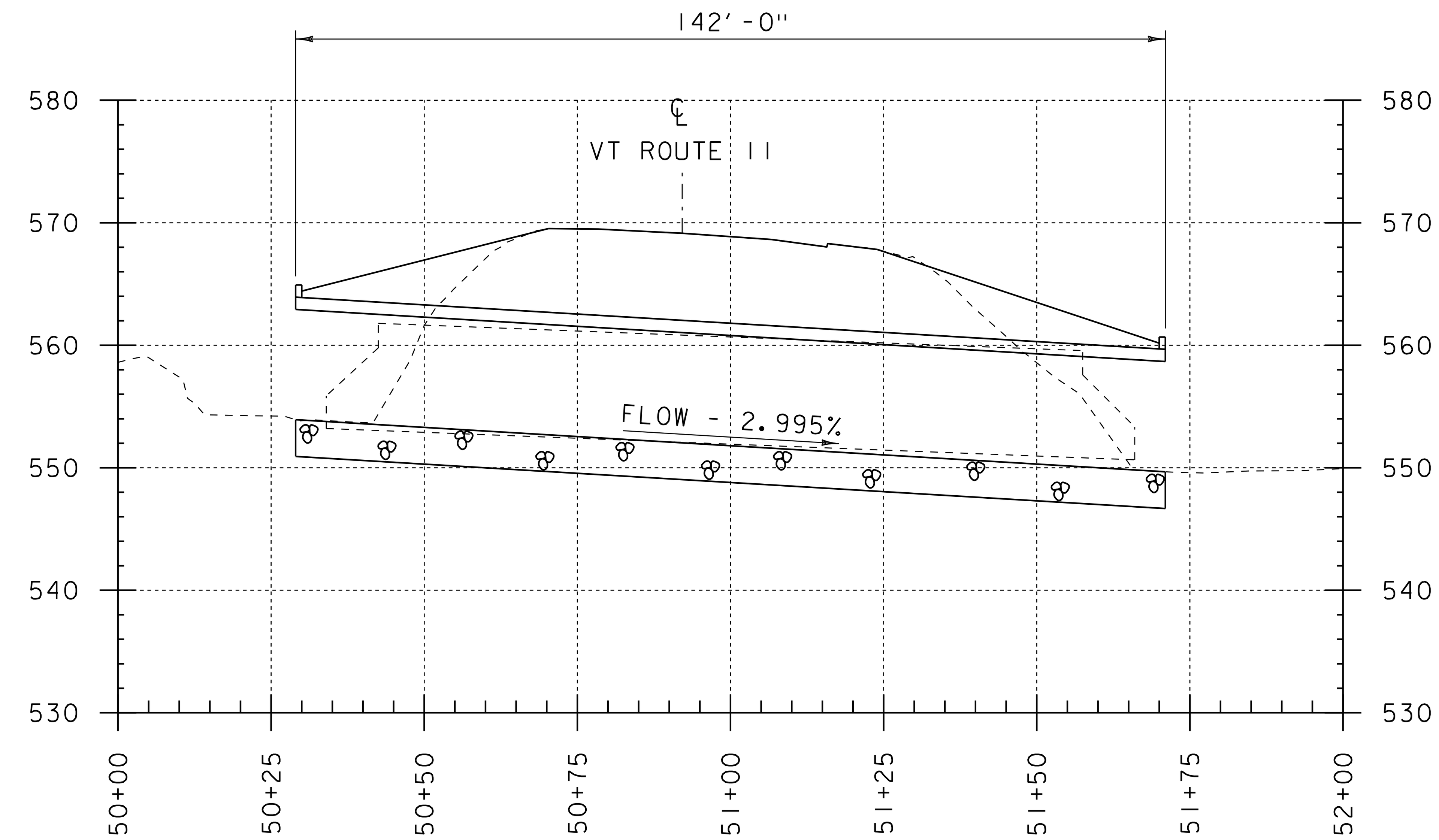
## ALTERNATIVE 2

SCALE 1″ = 20′-0″

20 0 20

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(43)

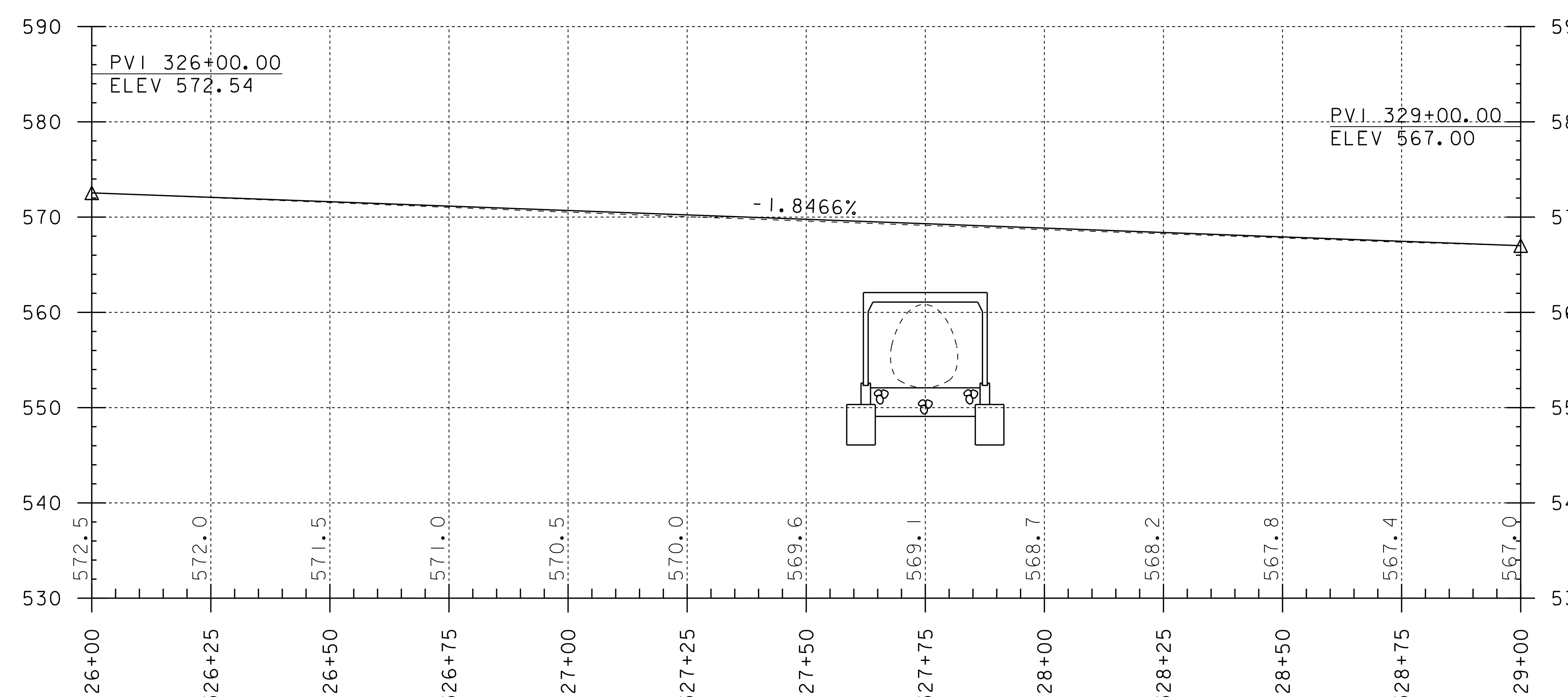
| | |
|---|---|
| FILE NAME: l3c334/sl3c334border.dgn | PLOT DATE: 23-FEB-2017 |
| PROJECT LEADER: ----- | DRAWN BY: D.D.BEARD |
| DESIGNED BY: G.SWEENY | CHECKED BY: G.SWEENY |
| ALTERNATIVE 2 LAYOUT | SHEET 7 OF 11 |




## ALTERNATIVE 2 CULVERT PROFILE

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

NOTE: STREAM BED ELEVATION TO BE DETERMINED AT A LATER TIME WITH CONSIDERATION TO IMPROVED AOP




## VT ROUTE 11 ALTERNATIVE 2 PROFILE

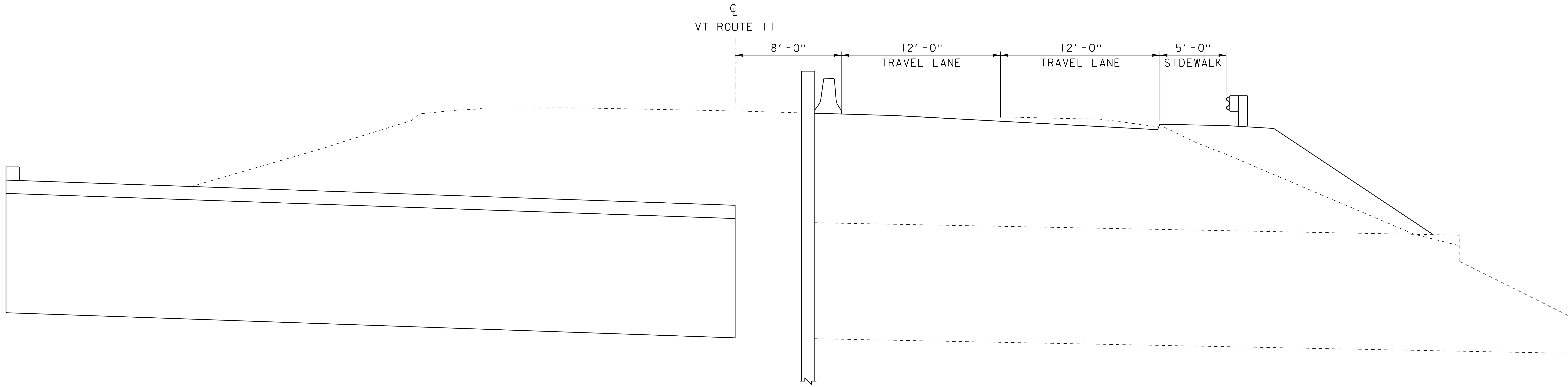
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(43)

FILE NAME: 13c344/s13c344profile.dgn
PROJECT LEADER: -----
DESIGNED BY: G.SWEENY
ALTERNATIVE 2 PROFILE SHEET

PLOT DATE: 23-FEB-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 8 OF 11




PHASE 1 TYPICAL SECTION

SCALE 1/4" = 1'-0"

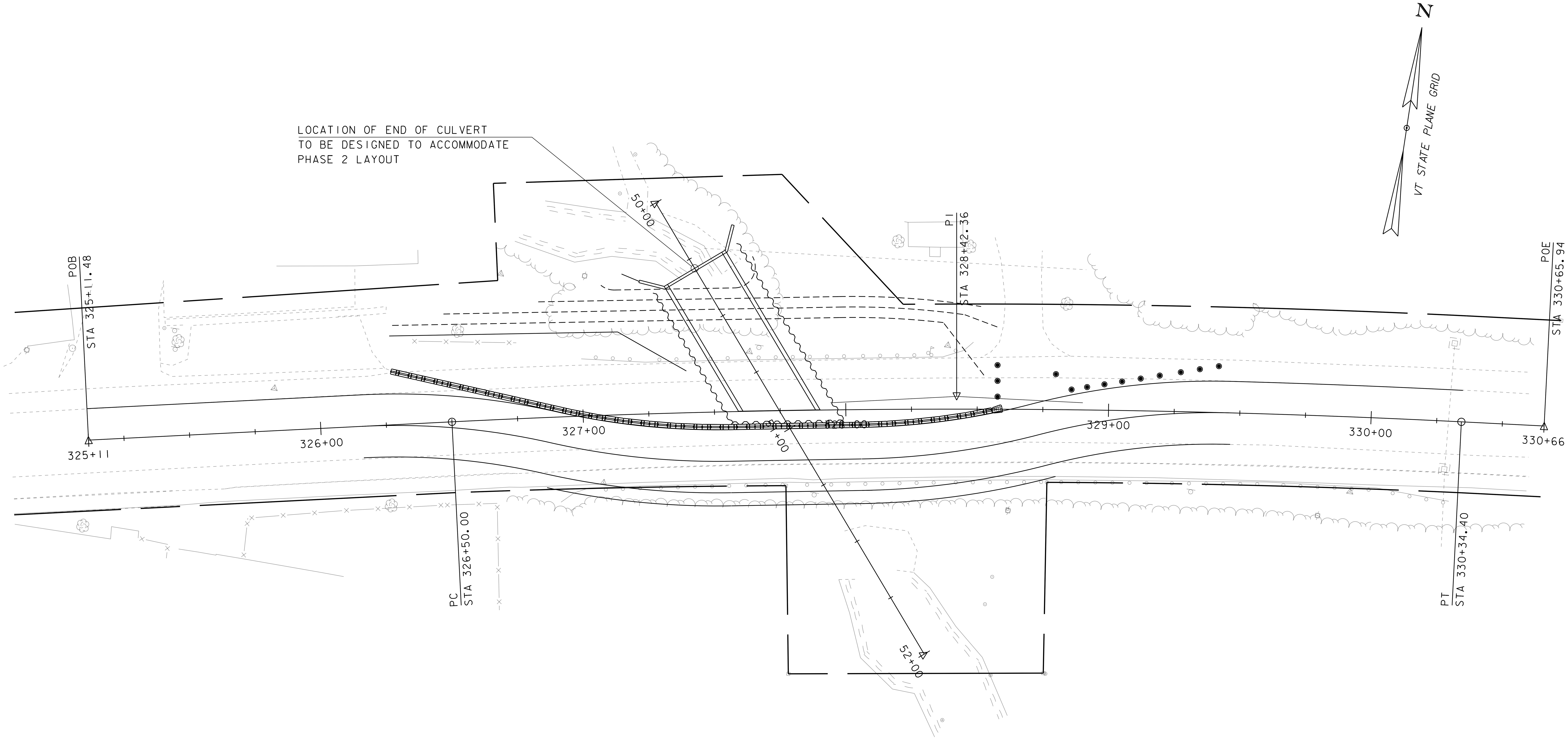

PHASE 2 TYPICAL SECTION

SCALE 1/4" = 1'-0"

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(43)

FILE NAME: 13c334/s13c334phasing.dgn
PROJECT LEADER: -----
DESIGNED BY: G.SWEENY
PHASING TYPICAL SECTIONS

PLOT DATE: 23-FEB-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 9 OF 11




PHASE I LAYOUT

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(43)

FILE NAME: 13c334/s13c334TCborder.dgn
PROJECT LEADER: -----
DESIGNED BY: G.SWEENY
PHASE I LAYOUT

PLOT DATE: 23-FEB-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 10 OF 11


EXISTING 132'-0" LONG CGMPPA
14'-1" SPAN X 8'-9" RISE
BUILT 1961
7' AVERAGE COVER

## PHASE 2 LAYOUT

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

| | |
|---|---|
| PROJECT NAME: SPRINGFIELD | |
| PROJECT NUMBER: BF 0134(43) | |
| FILE NAME: 13c334/s13c334TCborder.dgn | PLOT DATE: 23-FEB-2017 |
| PROJECT LEADER: ----- | DRAWN BY: D.D.BEARD |
| DESIGNED BY: G.SWEENY | CHECKED BY: G.SWEENY |
| PHASE 2 LAYOUT | SHEET 11 OF 11 |