STATE OF VERMONT
AGENCY OF TRANSPORTATION

Scoping Report

FOR

Springfield BM19201

VT Route 106, Bridge 4 over Unnamed Brook

January 31, 2023

I. Table of Contents

I. Site Information

Bridge 4 is a State-owned bridge located on VT Route 106 over an unnamed brook. The bridge is approximately 0.4 miles south of the intersection of VT Route 10. The culvert is located under an average of 20 feet of fill. The existing conditions were gathered from a combination of a Site Visit, the Inspection Report, the Route Log and the existing Survey. See correspondence in the Appendix for more detailed information.

Roadway Classification	Major Collector
Bridge Type	Corrugated Galvanized Metal Plate Pipe (CGMPP)
Culvert Span	13 feet
Culvert Length	176 feet
Year Built	1958
Ownership	State of Vermont

Need

Bridge 4 carries VT Route 106 across an unnamed Brook. The following is a list of deficiencies of Bridge 4 and VT Route 106 in this location:

1. The culvert is in poor condition. The structure has heavy rust scale with deep pitting, moderate to heavy section loss, and scattered varying sized perforations along the rust/water line. The outlet end has perforations with visible piping occurring and measurable undermining of 8 to 9-inches. There are large perforations with much of the lower corrugation gone along the invert.

2. The existing culvert does not meet the state stream equilibrium standards for bankfull width.

Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2025 and 2045.

TRAFFIC DATA	2025	2045
AADT	5,800	6,300
DHV	710	770
ADTT	520	790
%T	8.4	11.7
%D	54	54

Design Criteria

The design standards for this bridge project are the Vermont State Standards, dated October 22, 1997. Minimum standards are based on an ADT of 6300, a DHV of 770, and a design speed of 45 mph for a Major Collector.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 5.3 and VSS Section 5.7	12'/8' (40')	11'/4' (30') [1]	
Clear Zone Distance	VSS Table 5.5	No issues noted	16' fill / 14' cut	
Banking	VSS Section 5.13	e = 5%	8% (max)	
Speed		45 mph	45 mph (Design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	R = 2,975'	R_{min} = 1,650' @ e = 5%	
Vertical Grade	VSS Table 5.6	-5.92%	7% (max) for level terrain	
K Values for Vertical Curves	VSS Table 5.1	K_{sag} = 140	80 crest / 70 sag	
Vertical Clearance	VSS Section 5.8	No Issues Noted	14'-3" (min)	
Stopping Sight Distance	VSS Table 5.1	570'	325'	
Bicycle/Pedestrian Criteria	VSS Table 5.8	8' shoulder	4' Shoulder	
Bridge Railing	Structures Design Manual Section 13	N/A	N/A	
Hydraulics	VTrans Hydraulics Section	• $HW/D_{(2\% AEP)}$ = 0.63 • Clear span: 13.5 feet	• $HW/D_{(2\% AEP)}$ < 1.2 • BFW: 21 feet	Substandard BFW
Structural Capacity	SM, Ch. 3.4.1	Structurally Deficient	Design Live Load: HL-93	Substandard

Inspection Report Summary

Culvert Rating 4 Poor
Channel Rating 6 Satisfactory

12/10/2021 – **Culvert:** Heavy rust scale with deep pitting, moderate to heavy section loss, and scattered varying sized perforations along the rust/water line. The outlet end has perforations with visible piping occurring and measurable undermining of 8"- 9". The structure has no visible settlement or displacement and maintains its shape. **Invert Comment:** Large perforations with much of the lower corrugation gone along the invert. This section loss is hard to see as small and fine aggregates remain in these areas.

11/19/2020 – Structure is in poor condition. Invert has large perforations throughout with heavy rust scaling and pitting along water line. piping is occurring. Barrel has minor distortion at inlet. Concrete invert should be installed. ~MAC/SMP

10/16/2019 – Structure is in poor condition and should have sleeve or concrete invert installed. Undermining on the downstream end should be repaired with cradle and wings installed on both the upstream and downstream side. ~SMP/SEP

[1] Per Chapter 5 of the Vermont State Standards, a 3-foot shoulder is required for adequate safety and service. A 4-foot shoulder is required for shared-use.

11/5/2018 – Structure is in poor condition. Invert is littered with small perforations and has heavy rust scaling and pitting throughout and needs to have a concrete invert installed before further deterioration occurs. Outlet end scour hole should be filled in and banks should be armored with proper size riprap. ~SMP/ABC

11/28/2017 – Pipe has heavy corrosion along the invert with many perforations thru the pipe ribs. Most of the distress is confined to the lower portions and the pipe is a good candidate for a lower sleeve or concrete invert repair. If not addressed however, within the next 5 to 10 years, this pipe has the potential to cause significant roadway problems, due to its size and fill depth. ~ MJ/MC

11/1/2016 – This structure has large perforations scattered throughout varying from 1" to 12" slotted holes. This has caused some moderate piping of the structure. The outlet end has undermining with 1'+/- of depth and runs 14' under the structure. A concrete invert should be installed in the near future. ~JW/TB

Hydraulics

The existing structure meets the current hydraulic standards of the VTrans hydraulic manual. However, the 13.5-foot span does not meet the state stream equilibrium standards for bankfull width of 21-feet. The structure constricts the channel width, resulting in an increased potential for debris blockage.

The VTrans Hydraulics Unit has provided several recommendations for a liner or replacement structure. Any new structure should have a minimum clearspan of 21-feet and clear height of 6-feet.

See the Preliminary Hydraulics Report in Appendix D for additional information.

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

Municipal Utilities

- There are no municipal utilities in the project area.

Public Utilities

Underground:

- There are no underground utilities in the project area.

Aerial:

- There are aerial utilities in the project area. The aerial utilities are owned by Green Mountain Power Corporation (3 Phase Electric), Comcast, LLC, and Firstlight Fiber, INC.

Right-Of-Way

The existing Right-of-Way is plotted on the Existing Conditions Layout Sheet. While the inlet and outlet of the existing pipe are located well within the Right-of-Way, it is anticipated that additional Right-Of-Way will be required for all alternatives for access as well as channel work on the outlet end.

Environmental and Cultural Resources

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

Biological:
Additional information about biological resources can be found in Appendix G.

Wetlands/Watercourses

Bridge No. 4 spans Baltimore Brook.

There is a small wetland complex, presumed Class II in the northwest quadrant of the project.

Rare, Threatened, and Endangered Species

This project is close to, but not within, the regulated zones of several threatened or endangered animals. No impacts from this project are anticipated.

The culvert itself is not good habitat for the federally threatened northern long-eared bat.

Wildlife Habitat

The area around this culvert is highly fragmented and likely does not allow for high quality regional movement of terrestrial wildlife, but does likely contribute to local wildlife movement.

Baltimore Brook is a direct tributary to the Black River. Baltimore Brook adds quality cold-water habitat for several important fish species. Aquatic organism passage should be incorporated into the design of this project.

Agricultural Soils

There are no mapped agricultural soils in the project area.

Hazardous Materials:

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there is a hazardours site generator in the project area; the Springfield Fence Co, Inc.

Historic:

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

Archeological:

There are no archaeologically sensitive areas within the project limits.

Stormwater:

There are no stormwater concerns for this project.

II. Alternatives Discussion

No Action

This alternative is not recommended. The culvert is in poor condition and will continue to deteriorate if no action is taken. Something will have to be done to improve this culvert in the near future. Although the culvert does not appear to be in imminent danger of collapse, it will eventually be posted for lower traffic loads. In the interest of safety to the traveling public, the No Action alternative is not recommended. No cost estimate has been provided for this alternative since there are no immediate costs.

Alternative 1: Rehabilitation

This alternative involves the rehabilitation of the existing corrugated metal plate pipe. The culvert is rated in poor condition, however, there is no visible settlement or displacement, and the culvert maintains its shape making rehabilitation feasible at this location. Since the minimum hydraulic opening would be substandard for all options, and any rehabilitation will reduce the waterway area, it is assumed that an improved beveled inlet would be required for each option to optimize hydraulic performance and to funnel the stream into the culvert.

All rehabilitation options would employ the use of hydroblasting or hydrodemolition 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. The Preliminary Hydraulics Report indicates that a new minimum interior pipe dimension of 13' with fish baffles would meet the hydraulic standard but would have a substandard bankfull width. 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.

Rehabilitation options considered:

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

b. Pipe Liner:
   A pipe liner involves inserting a culvert liner into the existing culvert, and grouting between the two. The outside diameter of the pipe used for sliplining is generally specified to be at least 4 inches smaller than the inside diameter of the host pipe to allow the grout to be injected into the annular space between the two pipes. A greater reduction would be required at this site since the existing pipe is not symmetrical. The reduced waterway would have a substandard bankfull width, but would still pass the design flood event with no roadway overtopping. A liner option is anticipated to have the longest life expectancy of the

rehabilitation alternatives, since the grout provides an increased structural capacity, prevents liner collapse, prevents fatigue failure, stabilizes the pipe, extends the design life from uncertainty to at least 40 years, and resists temperature changes. However, due to the existing shape of the culvert and substandard bankfull width, a pipe liner is not recommended as it would further restrict the waterway opening.

c. Spray-On Liner:
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. Spray-on liners are generally applicable for pipes up to 10-feet in diameter. It would be cost prohibitive to spray-line Bridge 4 due to its size.

Advantages: The rehabilitation alternative would be the most cost-efficient option. It would have minimal impacts to resources and would not interrupt traffic. A repair alternative would address the ongoing deterioration issues with the invert of the existing culvert without affecting traffic flow, and with minimum upfront costs. Additionally, it would have minimal impacts on resources.

Disadvantages: The rehabilitation alternative is only a repair and not a new structure. The life span of the repair work is estimated to be 15 to 40 years. The existing culvert does not meet the minimum bank full width standard, and this option would slightly reduce the bank full width. Wildlife connectivity would not be improved with this alternative. This option would not satisfy aquatic organism passage requirements without construction of several weirs downstream as well as weirs throughout the culvert.

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

Replacement

The preliminary hydraulics report suggests several possible configurations for a new structure, including an open bottom precast concrete arch or frame, or a new bridge with vertical face abutments. The replacement options are discussed below:

Alternative 2: Structure Replacement with a New Culvert Using Open Cut

Culvert replacement using an open cut is considered a more cost-effective solution at this location due to the 21-foot span required for stream equilibrium.

This option involves removing the existing Corrugated Galvanized Metal Plate Pipe and replacing it with a new precast structure having a waterway opening of at least 125 square feet and a span of 21 feet. Since there is approximately 20 feet of fill above the existing culvert, there will be a significant amount of excavation, making an open-cut method costly. Any new structure should have flared wingwalls at the inlet and outlet to make a smooth transition between the channel and the culvert. The various considerations under this option include: the roadway width, structure type, culvert length and skew.

a. Roadway Width

The current roadway width is 40 feet, which includes 12-foot-wide travel lanes and 8-foot-wide shoulders. This exceeds the minimum standard of 30 feet. Since a new 75+ year structure is being proposed, the roadway geometry should meet the minimum standards. A 40-foot width roadway will be proposed through the project area to match the corridor.

b. Structure Type

The most common structure types for the recommended hydraulic opening are a 3-sided open bottom concrete structure, or a structural plate arch. A plate arch is not recommended at this site, since it would have a reduced design life compared to a reinforced concrete structure.

A 4-sided concrete box culvert will not be considered as the required span is outside of the preferred limits for a precast box.

The footing for an open-bottom 3-sided structure would need to be placed six feet below the stream bed or to bedrock. Additionally, full depth headwalls are recommended to prevent piping. There is no visible bedrock in the location of the project. Available information on nearby water wells along with preliminary borings at the site indicate that bedrock is located at approximately 40 to 50 feet below ground surface. Additional borings should be requested early on in design to verify the in-situ condition and determine the appropriate substructure type.

c. Culvert Size, Length and Skew

The existing culvert has a span of 13.5 feet and a height of 14 feet. The 13.5-foot span constricts the natural channel width. If a new 3-sided frame is chosen, Hydraulics has recommended a 3-sided concrete frame with a 21-foot-wide and 6-foot-high inside opening. This type of structure would provide a natural bottom for fish passage. This culvert will have no roadway overtopping up to and including the Q_{100} design flow. In order to accommodate a 40-foot-wide roadway, the proposed barrel length will be approximately 200 feet long. The culvert will have a skew of 55 degrees to the roadway to match the existing skew of the channel.

d. Maintenance of Traffic

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

Advantages: This alternative would address the structural deficiencies of the existing bridge, with a brand-new culvert with a 75-year design life. This option would meet the minimum hydraulic standards and provide adequate AOP as well as address on-going issues with debris blockage. This option would have minimal future maintenance costs.

Disadvantages: This option has the highest upfront costs.

Alternative 3: New Integral Abutment Bridge

The current alignment meets current standards; Therefore, any new structure will be placed on the existing horizontal alignment in order to minimize project limits and impacts to adjacent properties and environmental resources.

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

a. Bridge Width

The current roadway width is 40 feet, which includes 12-foot-wide travel lanes and 8-foot-wide shoulders. This exceeds the minimum standard of 30 feet. Since a new 75+ year structure is being proposed, the roadway geometry should meet the minimum standards. A 40-foot width typical section will be proposed through the project area to match the corridor.

b. Bridge Length and Skew

The existing culvert has a 13.5-foot span with a skew of 55 degrees. The measured bankfull width is 21 feet. The 55 degree skew matches the existing channel. However, the bridge should be lengthened further to reduce the skew of the abutments to the preferred limit of 20 degrees for integral abutments. The preferred substructure type is an integral abutment for scour protection. Based on the layout procedures for integral abutments and hydraulic requirements, the appropriate span at this location for a 20 degree maximum skew for integral abutment bridges is 140 feet. The bridge would have a 20 degree skew, and a span of 140 feet.

c. Superstructure Type

If the bridge is closed during construction, a precast structure would be the preferred choice, due to decreased construction time. The superstructure depth is not critical for hydraulics; therefore, the beam depth is not a controlling factor in choosing a superstructure type. The most economical superstructure type for this span is a steel girder superstructure with a concrete deck.

d. Substructure Type

There is no visible bedrock in the location of the project. Available information on nearby water wells along with preliminary borings at the site indicate that bedrock is located at approximately 40 to 50 feet below ground surface. This depth would be conducive for an integral abutment at this location. If it is determined that driving piles will be difficult, then the substructure should be reinforced concrete abutments on spread footings. Any rapid construction alternative should have sufficient subsurface information to verify the in-situ conditions. In order to reduce construction time, precast abutment components may be used where possible. The preliminary geotechnical report can be found in Appendix E.

e. Maintenance of Traffic:

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

III. Maintenance of Traffic

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

Option 1: Off-Site Detour

This option would close the bridge and reroute VT Route 106 traffic onto a signed detour route. The regional detour route would detour traffic from VT Route 106 to VT Route 10, VT Route 103, and VT Route 11, back to VT Route 106. This regional detour has an end-to-end distance of 19.9 miles and adds 13.3 miles to the through travel distance.

There are several local bypass routes that may see an increase in traffic from local passenger cars. Local bypass routes are not signed detours but may experience higher traffic volumes if Bridge 4 is closed during construction. Local Bypass Routes are typically not appropriate for heavy truck traffic. The most likely local bypass route is as follows:

> Local Bypass Route. VT Route 106 to School St/School Ns, Giddings St/Jack and Jill Ln, and Maple Street back to VT Route 106 (1.3 miles end-to-end)

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

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

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

Option 2: Phased Construction

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

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

Based on the current traffic volumes, it is acceptable to close one lane of traffic, and maintain one lane of traffic, both ways, with a traffic signal. However, some delays would be expected at the peak hours. As such, it is recommended that 2-way traffic be maintained for this option. There is approximately 20 feet of vertical fill over the existing culvert and sheet piling will be required to hold back the fill between phases. In order to reduce the amount of fill to hold back between phases and provide a wider typical section during construction, the roadway grade can be dropped through the project area.

The phasing for this site could be done with 2 phases. The layout of this phasing sequence can be found in the appendix.

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

Disadvantages: Phased construction generally involves higher costs and complexity of construction. Costs are usually higher and construction duration is longer, since many construction activities have to be performed two times. Additionally, since cars are traveling near construction activity, there is decreased safety.

Option 3: Temporary Bridge

From a constructability standpoint, a temporary bridge could be placed either upstream or downstream of the existing structure. Both an upstream and downstream temporary bridge alignment would have limits outside the existing Right-of-Way and would require a large amount of tree cutting. Additionally, a temporary bridge on the upstream (northern) side of VT Route 106 would have a larger impact to aerial utilities.

Due to the steep slopes at the inlet and outlet of the pipe, a large amount of fill would be required for placement of the temporary bridge approaches on either side of the road.

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

A two-way temporary bridge would be required based on the high traffic volumes at this site. See the Temporary Bridge Layout Sheets in Appendix L.

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

Disadvantages: This option would require additional Right-of-Way acquisition for placement of the temporary bridge. This option would have adverse impacts to adjacent land, threatened species, and other environmental and cultural resources. There would be decreased safety to the workers and to vehicular traffic, because of cars driving near the construction site, and construction vehicles entering and exiting the construction site. This traffic control option would be costly, and time consuming, as construction activities would take a second construction season, in order to set up the temporary bridge.

IV. Alternatives Summary

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

Alternative 1a: Invert Repair with Traffic Maintained on Existing Culvert
Alternative 1b: 12.5-foot (min) Culvert Liner with Traffic Maintained on Existing Culvert
Alternative 1c: Cured-In-Place Culvert Liner with Traffic Maintained on Existing Culvert
Alternative 2a: New 3-Sided Frame with Traffic Maintained on Offsite Detour
Alternative 2b: New 3-Sided Frame with Traffic Maintained on a Temporary Bridge
Alternative 2c: New 3-Sided Frame with Traffic Maintained via Phased Construction
Alternative 3a: New integral abutment bridge with Traffic Maintained on an Offsite Detour
Alternative 3b: New integral abutment bridge with Traffic Maintained on a Temporary Bridge
Alternative 3c: New integral abutment bridge with Traffic Maintained via Phased Construction

V. Cost Matrix[2]

Springfield BM19201		Do Nothing	Alternative 1			Alternative 2			Alternative 3		
			a. Invert Repair	b. Liner	c. Cured in place Liner	3-Sided Frame			Integral Abutment Bridge		
			Temporary Lane Closure			a. Offsite Detour	b. Temporary Bridge	c. Phased Construction	a. Offsite Detour	b. Temporary Bridge	c. Phased Construction
COST	Bridge Cost	$0	320,800	547,406	408,800	2,486,094	2,486,094	2,859,009	3,045,800	3,045,800	3,502,700
	Removal of Structure	$0	308,880	320,320	320,320	308,880	308,880	355,212	320,320	320,320	368,368
	Roadway	$0	122,160	140,111	139,760	283,453	283,453	407,463	361,000	361,000	519,000
	Maintenance of Traffic	$0	19,040	19,040	19,040	94,300	184,040	196,600	124,300	214,040	271,600
	Construction Costs	$0	770,880	1,026,877	887,920	3,172,727	3,262,467	3,818,284	3,851,420	3,941,160	4,661,668
	Construction Engineering & Contingencies	$0	154,176	308,063	310,772	634,545	652,493	763,657	654,741	788,232	1,165,417
	Accelerated Premium	$0	0	0	0	0	0	0	0	0	0
	Total Construction Costs w CEC	$0	925,056	1,334,941	1,198,692	3,807,272	3,914,960	4,581,941	4,506,161	4,729,392	5,827,085
	Preliminary Engineering	$0	231,264	205,375	266,376	634,545	652,493	763,657	577,713	1,182,348	1,398,500
	Right of Way	$0	0	0	0	15,000	60,000	10,000	15,000	60,000	10,000
	Total Project Costs	$0	1,156,320	1,540,316	1,465,068	4,456,818	4,627,454	5,355,597	5,098,874	5,971,740	7,235,585
	Annualized Costs	$0	77,088	30,806	48,836	59,424	61,699	71,408	67,985	79,623	96,474
SCHEDULEING	Project Development Duration	NA	1 year	1 year	1 year	2 years	4 years	4 years	2 years	4 years	4 years
	Construction Duration	NA	3 months	3 months	3 months	6 months	9 months	9 months	6 months	9 months	9 months
	Closure Duration (If Applicable)	NA	NA	NA	NA	28 days	NA	NA	28 days	NA	NA
ENGINEERING	Typical Section - Roadway (feet)	40	40	40	40	40	40	40	40	40	40
	Typical Section - Bridge (feet)	NA	NA	NA	NA	NA	NA	NA	8-12-12-8 (40)		
	Geometric Design Criteria	No Change	Meets Minimum Standards			Meets Minimum Standards			Meets Minimum Standards		
	Traffic Safety	No Change	Improved	Improved	Improved	Improved	Improved	Improved	Improved	Improved	Improved
	Alignment Change	No Change	No	No	No	No	No	No	No	No	No
	Bicycle Access	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Pedestrian Access	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Hydraulics	Substandard BFW	Substandard BFW			Meets Minimum Standards			Meets Minimum Standards		
	Utilities	No Change	No Change	No Change	No Change	No Change	Aerial Relocation	No Change	No Change	Aerial Relocation	No Change
OTHER	ROW Acquisition	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
	Road Closure	No	No	No	No	Yes	No	No	Yes	No	No
	Design Life	<10	15	50	30	75	75	75	75	75	75

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

VI. Conclusion

Alternative 2c is recommended; to replace the existing culvert with a new buried structure while maintaining 2-way traffic with phased construction.

Structure:
The existing culvert is in poor condition and needs replacement. The current culvert does not meet the minimum hydraulic standard for bank full width. As such, a culvert replacement with a larger structure is recommended. A new buried structure will have a lower upfront cost as well as lower long-term maintenance costs compared to a new integral abutment bridge.

The proposed structure is a precast 3-sided frame or similar structure with a minimum span of 21-feet and minimum waterway opening of 6-feet high with a natural bottom for fish passage. This is the most economical structure type for a 21-foot span. The footings need to be placed six feet below the stream bed or to bedrock. Additionally, full depth headwalls are recommended to prevent piping,

The proposed roadway will have two 12-foot travel lanes with 8-foot shoulders to match the existing corridor width.

Traffic Control:
The recommended method of traffic control is to maintain 2-way traffic and construct the new structure in phases. The roadway will need to be lowered during construction to accommodate 2-way traffic.

VII. Appendices

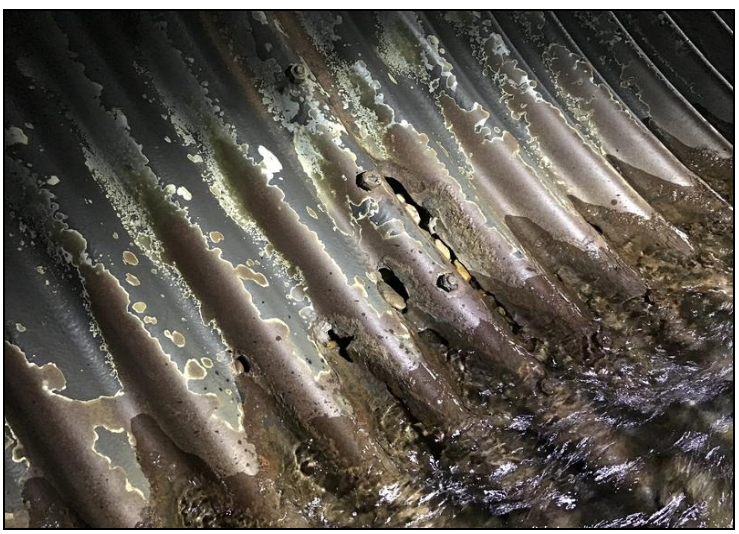
- Appendix A: Site Pictures
- Appendix B: Town Map
- Appendix C: Bridge Inspection Report
- Appendix D: Hydraulics Memo
- Appendix E: Preliminary Geotechnical Information
- Appendix F: Resource ID Completion Memo
- Appendix G: Natural Resources Memo
- Appendix H: Archeology Memo
- Appendix I: Historic Memo
- Appendix J: Stormwater Memo
- Appendix K: Detour and Local Bypass Maps
- Appendix L: Plans

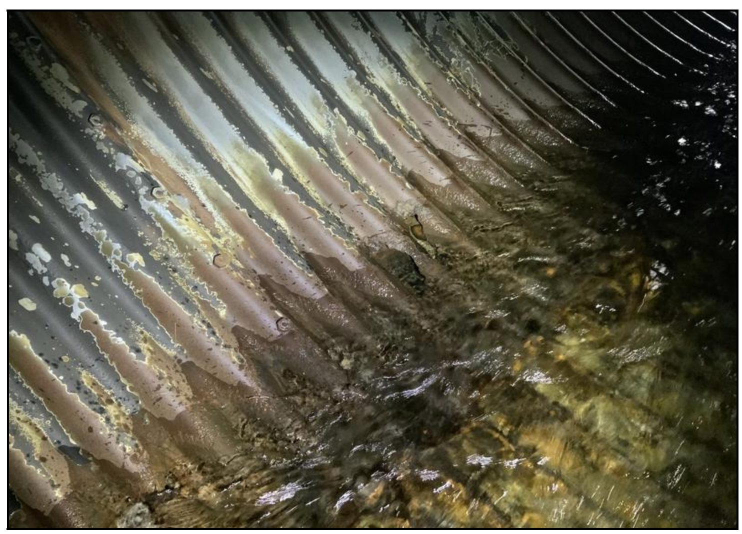
Appendix A: Site Pictures

Outlet

Outlet

Inlet

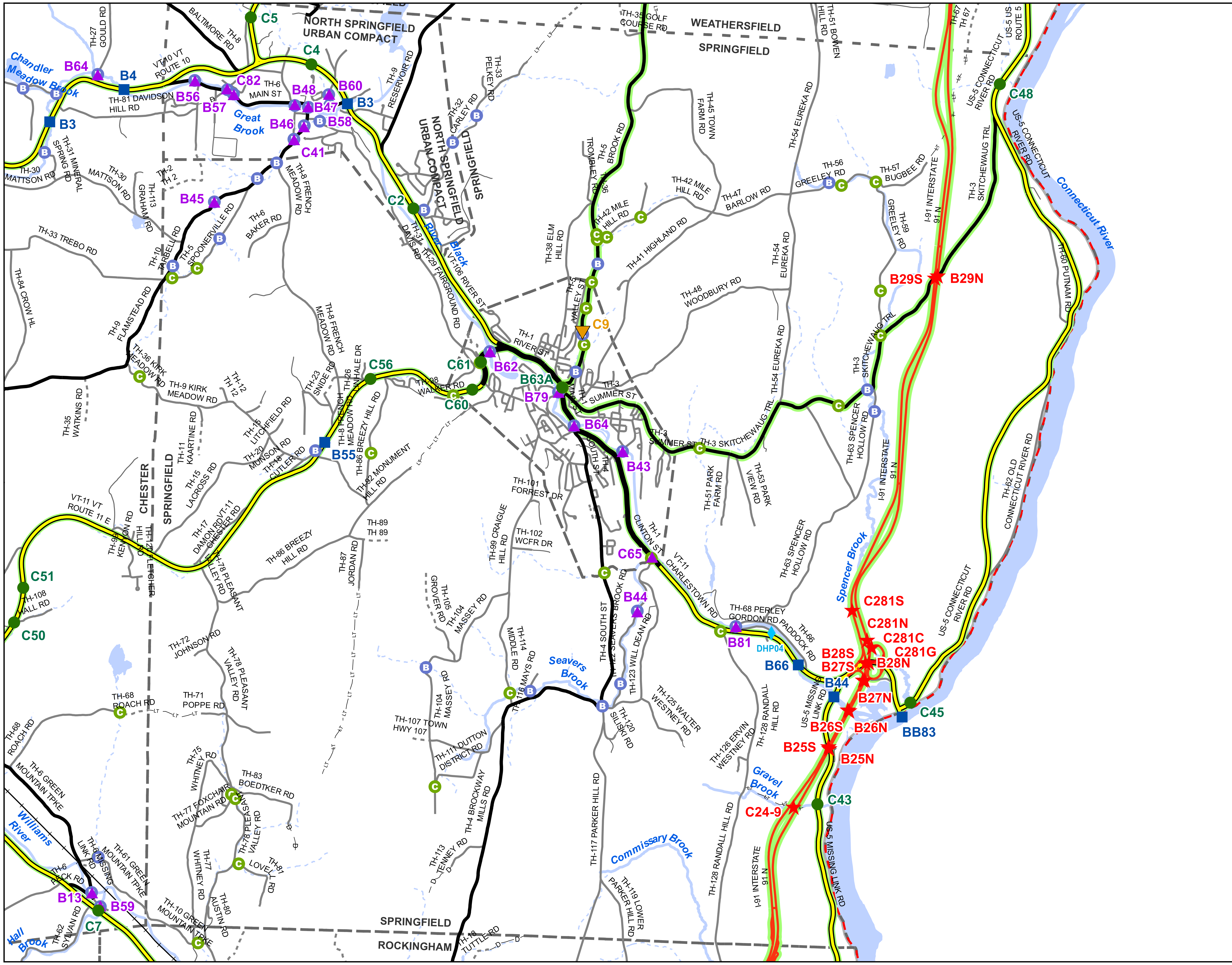




Upstream channel

Downstream

Appendix B: Town Map



Scale: 1:49,390

N

Legend	
★	INTERSTATE
■	STATE LONG
●	STATE SHORT
▲	TOWN LONG
▼	FEDERAL AID
◆	BIKE PATH
	INTERSTATE
	STATE HIGHWAY
	CLASS 1
	CLASS 2
	CLASS 3
	CLASS 4
—LT—LT	LEGAL TRAIL
	PRIVATE
—D—D	DISCONTINUED
	FEDERAL AID
	MAINTENANCE DISTRICT
	POLITICAL BOUNDARY
	VTRANS REGION BOUNDARY
	NAMED RIVER-STREAM
	UNNAMED RIVER-STREAM
B	Point from Local Bridge Data *
C	Point from Local Culvert Data *

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

Produced by:
Mapping Section
Division of Policy, Planning and Intermodal Development
Vermont Agency of Transportation
March 2021

SPRINGFIELD

COUNTY-TOWN CODE: **1418-0**
WINDSOR COUNTY
DISTRICT # 2
District Long Name: Dummerston District
VTrans Four Region: Southeast

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

Appendix C: Bridge Inspection Report

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

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

Inspection Report for : SPRINGFIELD | **bridge no.:** 0004 | **District:** 2

Located on: VT106 **over** BROOK | **approximately** 0.4 MI S JCT VT 10 | **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: 4 POOR

Federal Str. Number: 300162000414181

AGE and SERVICE

Year Built: 1958 **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): 14

ADT: 5700 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 13

Structure Length (ft): 13

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): 428

Skew: 35

Bridge Median: 0 NO MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 114 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CGMPP

Number of Main Spans: 1

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: N NOT APPLICABLE

Type of Wearing Surface: N NOT APPLICABLE

Type of Membrane: N NOT APPLICABLE

Deck Protection: N NOT APPLICABLE

CULVERT GEOMETRIC DATA and INDICATORS

Culvert Barrel Length (ft): 176

Average Cover Over Culvert (ft): 20

Waterway Area Through Culvert (sq.ft.): 143

Wingwall/Headwall Rating: N NOT APPLICABLE

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 122020 **Inspection Frequency (months):** 12

INSPECTION SUMMARY and NEEDS

11/19/2020 Structure is in poor condition. Invert has large perforations throughout with heavy rust scaling and pitting along water line. piping is occurring. Barrel has minor distortion at inlet. Concrete invert should be installed. MAC/SMP

10/16/2019 Structure is in poor condition and should have sleeve or concrete invert installed. Undermining on the downstream end should be repaired with cradle and wings installed on both the upstream and downstream side. SMP & SEP

11/5/2018 Structure is in poor condition. Invert is littered with small perforations and has heavy rust scaling and pitting throughout and needs to have a concrete invert installed before further deterioration occurs. Outlet end scour hole should be filled in and banks should be armored with proper size riprap. SMP & ABC

11/28/2017 - Pipe has heavy corrosion along the invert with many perforations thru the pipe ribs. Most of the distress is confined to the lower portions and the pipe is a good candidate for a lower sleeve or concrete invert repair. If not addressed however, within the next 5 to 10 years, this pipe has the potential to cause significant roadway problems, due to its size and fill depth. ~ MJ/MC

11/1/2016 This structure has large perforations scattered throughout varying from 1" to 12" slotted holes. This has caused some moderate piping of the structure. The outlet end has undermining with 1'+/- of depth and runs 14' under the structure. A concrete invert should be installed in the near future. JW/TB

Appendix D: Hydraulics Memo

VERMONT

State of Vermont
Structures and Hydraulics Section
219 North Main Street
Barre, VT 05641
vtrans.vermont.gov

Agency of Transportation

TO: Laura Stone, Structures, Scoping Engineer

CC: Nick Wark, Hydraulics Engineer

FROM: Jeff DeGraff, Hydraulics Project Engineer

DATE: June 16, 2022

SUBJECT: Springfield BM19201 pin #17b174
Springfield, VT-106 Br4, over Unnamed Brook
Coordinates: 43.33737, -72.52270

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

In an email on 5/6/22 ANR indicated a that an average bankfull width (BFW) of 20-ft was measured. For this project, due to the varying range of BFW, a span of 21-ft was considered.

Design Storm Flow is 2% AEP (Q50).

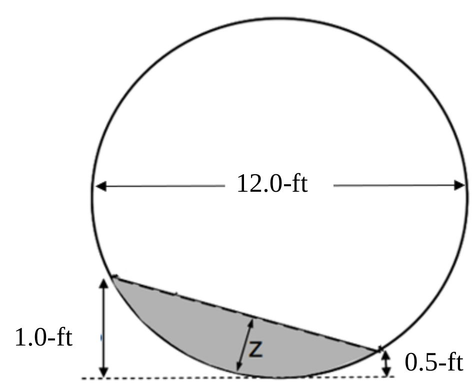
The following options were analyzed:

Existing Conditions: 13.5-ft span by 14.0-ft rise vertical elliptical corrugated metal pipe Culvert

- Provides a Headwater to Depth ratio (HW/D) of 0.63 and 0.7 during the design and check storm event, respectively. Headwater depths of 8.47-ft and 9.41-ft were determined during the design and check storm event, respectively.
- The existing culvert meets the current hydraulic standards.

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

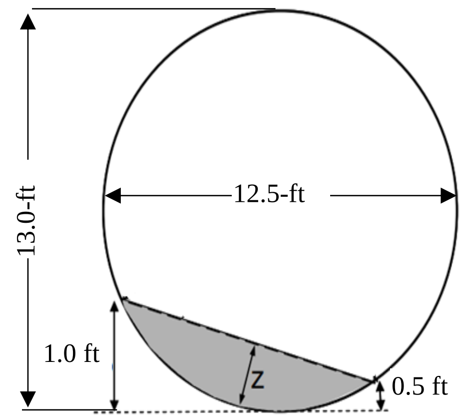
- This analysis assumed that the culvert is to be slip lined with a 12.0-ft CMP.
- Assumes that four (4) rock weirs or a rock ramp/step pool system will be constructed.
- The analysis assumed that fish baffles to be installed at 16.5-ft spacing with minimum and maximum height of 0.5-feet and 1.0-feet, respectively (as seen in Option 1).
- The installation of fish baffles would allow for adequate fish passage for Adult Brook Trout.
- The HW/D ratio would increase to 0.80 and 0.90 during the 2% and 1 % AEP, respectively. Headwater depths of 9.6-ft and 10.76-ft were determined during the design and check storm event, respectively.



Option 1: Typical Section

Option 2: Rehabbed Existing Culvert (Spray Lined w/ Fish Baffles)

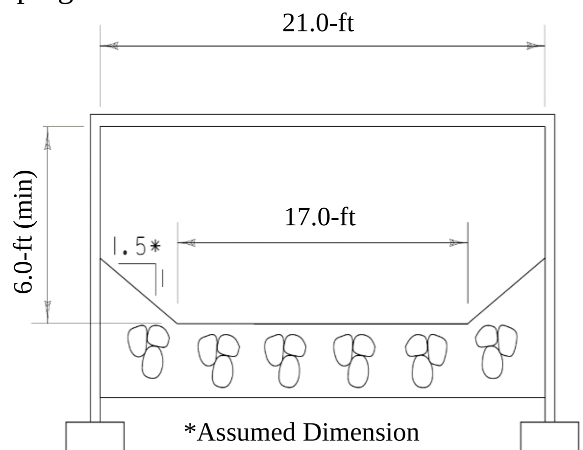
- This analysis assumed that the culvert is to be lined with a 6.0-inch thick liner which would provide a 12.5-ft span by 13.0-ft rise.
- Assumes that four (4) rock weirs or a rock ramp/step pool system will be constructed.
- The analysis assumed that fish baffles to be installed at 16.25-ft spacing with minimum and maximum height of 0.5-feet and 1.0-feet, respectively (as seen in Option 2).
- The installation of fish baffles would allow for adequate fish passage for Adult Brook Trout
- The HW/D ratio would increase to 0.71 and 0.80 during the 2% and 1 % AEP, respectively. Headwater depths of 8.91-ft and 9.94-ft were determined during the design and check storm event, respectively.



Option 2: Typical Section

Option 3: Bridge (3 sided), 21.0-foot span x 6.0-foot clear rise w/sloping fill

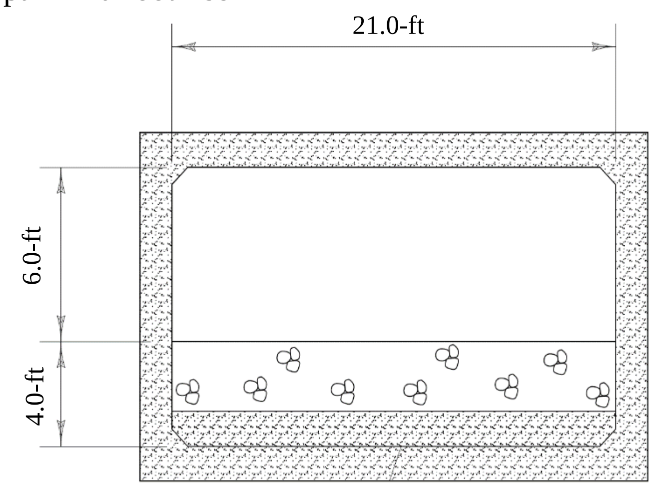
- There is approximately 1.25-feet of freeboard at the design AEP, providing a minimum waterway area of 123.3 sq. ft ±.
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew or slope.



Option 3: Typical Section

Option 4: Four-Sided Concrete Box (closed bottom) 21-foot span x 10-foot rise

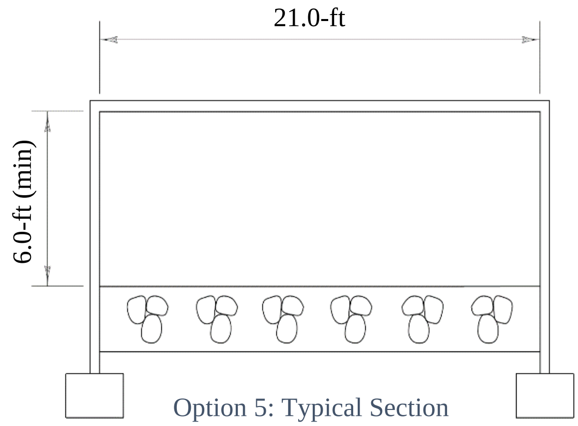
- There is approximately 1.25-feet of freeboard at the design AEP.
- Structure invert is to be buried 4-feet and provide a minimum waterway opening of 21-foot span x 6-foot clear height with a waterway area of 126.0 sq. ft.
- Bed retention sills should be added in the bottom of the structure. Sills should be 12 inches high across the full width of the box. Sills should be spaced no more than 8 feet apart throughout the structure with one sill placed at both the inlet and the outlet
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew or slope.



Option 4: Typical Section

Option 5: Bridge (3-sided) 21-foot span x 6.0-foot clear rise

- There is approximately 1.25-feet of freeboard at the design AEP, providing a minimum waterway area of 126.0 sq. ft.
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew or slope.



Option 5: Typical Section

For options 3 through 5, E-Stone, Type IV will need to be used to grade the channel through the respective structures. Stone Fill, Type IV shall be used to protect any disturbed channel banks or roadway slopes at the structure's inlet and outlet. **Note that smaller Stone Fill may be viable and will be further analyzed during final hydraulics.**

If the Existing crossing were to be slip~~-~~ or spray lined and retrofitted with baffles (Option 1 and 2), fish passage standards may be met. Based on correspondence with ANR, this crossing appears to be a viable candidate for rehabilitation.

Debris loading did not appear to be high based on our site visit alone. However, sediment loading may be highly abrasive and reduce the service life of the fish baffles. In addition, the retrofit options may also significantly decrease the sediment transport through the crossing and will increase 100-yr base flood elevations. For these reasons, the liner/retrofit options may be considered as an alternative but is not recommended.

For Option 1, the hydraulic conditions are difficult to estimate. The invert elevation and culvert size (and type) may increase or decrease depending on the means and methods during construction (contractor, fabricator, installation obstacles, etc.). For these reasons, the ~~h~~Hydraulics unit tried to maximize the liner sizing and setting a new invert elevation. This analysis assumed that the invert would increase by 1.5-inches to account for the installation of the round 12.0-ft CMP culvert.

Options 3, 4, and 5 meet or surpass the current hydraulic standards, as well as minimum bankfull width criteria.

Historical borings and geomorphic assessments are not available for this site. A preliminary scour analysis was performed as part of this study for Options 3 and 5 assuming a D50 of 0.2-mm. Based on the analysis contraction scour is minimal. However, if the downstream scour pool is not filled in as part of this project, a head cut could occur and produce a scour depth of 8.3-ft (elevation 488-ft +/-). If the pool is not filled in, for preliminary design assume that the bottom of footing elevation is below 488-ft or founded on ledge. If the pool is filled in, for preliminary design assume the bottom of footing elevation is 6-ft below the streambed or founded on ledge. A final scour analysis and countermeasure design will be performed during final design.

If Options 3 or 5 are chosen as the preferred alternative, streambed grab samples are suggested to be obtained at the following depths: 0-1 foot and 1-2 feet below the stream bed.

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

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

Appendix E: Preliminary Geotechnical Information

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Laura Stone, P.E., P.I.I.T. Project Manager

END

From: Eric Denardo, P.E., Geotechnical Engineer

Date: April 5, 2022

Subject: Springfield BM19201 - Preliminary Geotechnical Information

1.0 INTRODUCTION

As requested, we have completed our preliminary geotechnical investigation for Bridge 4 on Vermont Route 106 over an unnamed brook as part of the Springfield BM19201 project. Bridge 4, a corrugated galvanized metal plate pipe, is located approximately 0.4 miles east from the junction of VT Route 106 and VT Route 10 in the town of Springfield, VT. This review included examination of record plans, a subsurface investigation, the examination of hazardous site information on file at the Vermont Agency of Natural Resources (ANR), as well as published surficial and bedrock geologic maps. The subject project is currently in the scoping phase.

2.0 SUBSURFACE INFORMATION

2.1 Published Geologic Data

Mapping conducted in 1970 for the Surficial Geologic Map of Vermont shows the project site consists of glaciolacustrine deposits of delta sand and delta gravel (Doll, 1970).

According to the Bedrock Map of Vermont from 2011, published by the USGS and State of Vermont, the project site is underlain with bedrock consisting of gneiss of the Baileys Mills Tonalitic Gneiss Formation (Ratliffe, et. al, 2011).

2.2 Hazardous Materials and Underground Storage Tanks

The ANR Atlas also maintains a database of all known hazardous waste sites and underground storage tanks. According to their published data there is one site within a 500 ft radius of the project site. The hazardous site is located on the property adjacent to the project to the west and is classified as a waste oil spill. The site is not anticipated to impact the project. The project is not on the Hazardous Site List. No impact from other hazardous waste sites is anticipated.

2.3 Record Plans

A review of historical record plans was also a part of this investigation; however, no record plans were available for this project.

3.0 FIELD INVESTIGATION

A field investigation was conducted between February 22, 2022, and March 4, 2022. Two standard penetration borings were advanced in the roadway at opposite corners of the culvert to evaluate the subsurface profile and aid in design and construction of a replacement structure. During drilling operations for B-101, split spoon samples and standard penetration tests (SPT) were taken at 5 ft intervals to a depth of 30 ft below ground surface (bgs), then continuously to a depth of 40 ft bgs, then at 5 ft intervals to bedrock. Bedrock was encountered at 50 ft bgs. When bedrock was encountered, NX rock cores were taken 10 ft into rock to collect 5 ft core sample runs to confirm the presence of bedrock.

In boring B-102, split spoon samples and SPTs were taken at 5 ft intervals to a depth of 30 ft bgs then continuously to bedrock. Bedrock was believed to be encountered at a depth of 39 ft bgs and coring began at this depth; however, subsequent analysis of the recovered material leads us to believe this was likely boulders. To confirm bedrock, 10 ft of core was attempted. In the first 5 ft core run, R-1, only 0.9 ft of core was recovered. A second 5 ft core run, R-2, was attempted but the core barrel would not advance past 39 ft. For this reason, R-2 was advanced from 39 to 44 ft again. R-2 yielded 1.0 ft of recovery.

Soil samples were visually identified in the field and SPT blow counts were recorded on the boring logs. 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 results.

Upon further review of the recovered rock cores, it is believed that the rock encountered in B-102 is likely boulders due to the rock condition and type as compared to the recovered cores from B-101 and geologic mapping of the area. Potential bedrock was encountered in the bottom 0.5 ft of R-2. As noted on the logs, 25 feet of drilling augers were lost during drilling operations and remain in the ground. The augers are believed to be 13 to 15 ft bgs under the roadway and will likely be encountered during construction.

4.0 SOIL PROFILE

The field investigation indicates that the soil strata of the project site generally consist of loose to dense granular soils consisting primarily of sand and sandy gravel likely fill material to a depth of approximately 30 ft bgs. Below this depth, the material transitions to a mixture of sand, gravel, and silt, likely native material due to the depth and increase in fine grain material. A layer of boulders is believed to be present just above bedrock at the location of B-102.

5.0 RECOMMENDATIONS

Based on this information, possible foundation options for replacement include the following:

- Reinforced concrete box culvert with new wingwalls and headwalls with spread footings founded on soil/rock
- Precast or steel arch with spread footings founded on soil/rock
- Concrete rigid frame supported on H-piles, micro-piles, or spread footings

Based on the uncertainty of the bedrock elevation on the south side of the culvert, an additional subsurface investigation may be required. When a design alternative has been chosen, the Geotechnical Engineering Section can review the preferred alternative and assist with any further geotechnical analyses and review of foundation elements required.

6.0 CONCLUSION

If you have any questions, or you would like to discuss this report, please contact us via email. Typed boring logs are attached and are available in the CADD design files:
M:\Projects\17b174\MaterialsResearch

Attachments: Boring Layout
Boring Logs (4 pages)

Reviewed by: Stephen Madden, Geotechnical Engineer SPM

7.0 REFERENCES

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

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

Vermont Agency of Natural Resources Department of Environmental Conservation, Natural Resources Atlas, www.anr.vermont.gov/maps/nr-atlas%20, accessed 4/1/21.

cc: Electronic Read File/MG
Project File/CEE
END

SOIL CLASSIFICATION

AASHTO

A1	Gravel and Sand
A3	Fine Sand
A2	Silty or Clayey Gravel and Sand
A4	Silty Soil - Low Compressibility
A5	Silty Soil - Highly Compressible
A6	Clayey Soil - Low Compressibility
A7	Clayey Soil - Highly Compressible

ROCK QUALITY DESIGNATION

R.Q.D. (%)	ROCK DESCRIPTION
<25	Very Poor
25 to 50	Poor
51 to 75	Fair
76 to 90	Good
>90	Excellent

SHEAR STRENGTH

UNDRAINED SHEAR STRENGTH IN P.S.F.	CONSISTENCY
<250	Very Soft
250-500	Soft
500-1000	Med. Stiff
1000-2000	Stiff
2000-4000	Very Stiff
>4000	Hard

CORRELATION GUIDE OF "N" TO DENSITY/CONSISTENCY

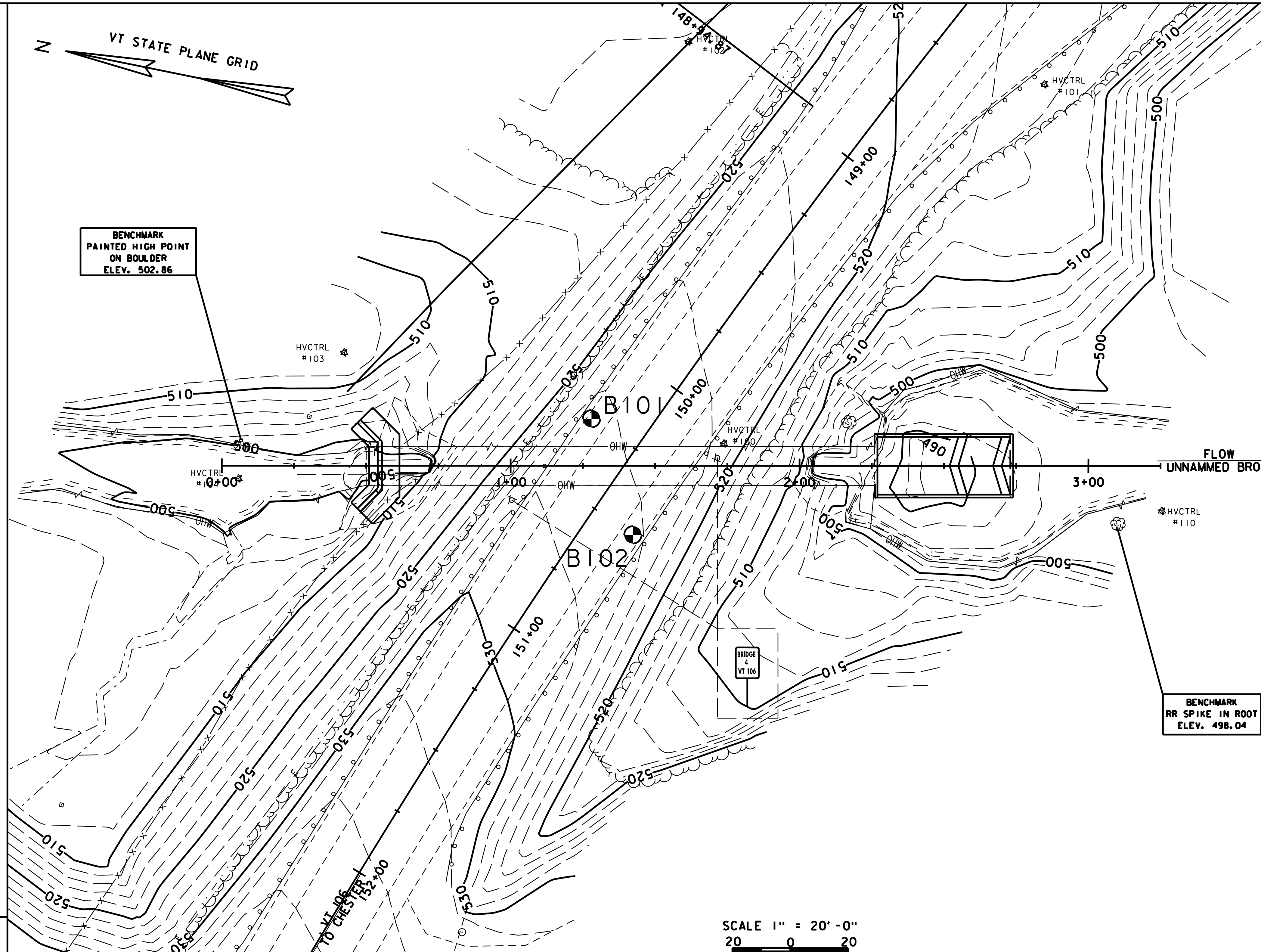
DENSITY (GRANULAR SOILS) N	DESCRIPTIVE TERM	CONSISTENCY (COHESIVE SOILS) N	DESCRIPTIVE TERM
<5	Very Loose	<2	Very Soft
5-10	Loose	2-4	Soft
11-24	Med. Dense	5-8	Med. Stiff
25-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

COMMONLY USED SYMBOLS

▼	Water Elevation
⊘	Standard Penetration Boring
⊕	Auger Boring
⊙	Rod Sounding
S	Sample
N	Standard Penetration Test Blow Count Per Foot For: 2" O.D. Sampler 1⅜" I.D. Sampler Hammer Weight Of 140 Lbs. Hammer Fall Of 30"
VS	Field Vane Shear Test
US	Undisturbed Soil Sample
B	Blast
DC	Diamond Core
MD	Mud Drill
WA	Wash Ahead
HSA	Hollow Stem Auger
AX	Core Size 1⅛"
BX	Core Size 1⅝"
NX	Core Size 2⅛"
M	Double Tube Core Barrel Used
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
NP	Non Plastic
w	Moisture Content (Dry Wgt. Basis)
D	Dry
M	Moist
MTW	Moist To Wet
W	Wet
Sat	Saturated
Bo	Boulder
Gr	Gravel
Sa	Sand
Si	Silt
Cl	Clay
HP	Hardpan
Le	Ledge
NLTD	No Ledge To Depth
CNPF	Can Not Penetrate Further
TLOB	Top of Ledge Or Boulder
NR	No Recovery
Rec.	Recovery
%Rec.	Percent Recovery
ROD	Rock Quality Designation
CBR	California Bearing Ratio
<	Less Than
>	Greater Than
R	Refusal (N > 100)
VTSPG	NAD83 - See Note 7

COLOR

blk	Black	pnk	Pink
bl	Blue	pu	Purple
brn	Brown	rd	Red
dk	Dark	tn	Tan
gry	Gray	wh	White
gn	Green	yel	Yellow
lt	Light	mltc	Multicolored
or	Orange		



DEFINITIONS (AASHTO)

BEDROCK (LEDGE) - Rock in its native location of indefinite thickness.

BOULDER - A rock fragment with an average dimension > 12 inches.

COBBLE - Rock fragments with an average dimension between 3 and 12 inches.

GRAVEL - Rounded particles of rock < 3" and > 0.0787" (#10 sieve).

SAND - Particles of rock < 0.0787" (#10 sieve) and > 0.0029" (#200 sieve).

SILT - Soil < 0.0029" (#200 sieve), non or slightly plastic and exhibits no strength when air-dried.

CLAY - Fine grained soil, exhibits plasticity when moist and considerable strength when air-dried.

VARVED - Alternate layers of silt and clay.

HARDPAN - Extremely dense soil, cemented layer, not softened when wet.

MUCK - Soft organic soil (containing > 10% organic material.

MOISTURE CONTENT - Weight of water divided by dry weight of soil.

FLOWING SAND - Granular soil so saturated (loose) that it flows into drill casing during extraction of wash rod.

STRIKE - Angle from magnetic north to line of intersection of bed with a horizontal plane.

DIP - Inclination of bed with a horizontal plane.

GENERAL NOTES

1. The subsurface explorations shown herein were made between February 22, and March 4, 2022 by the Agency.

2. Soil and rock classifications, properties and descriptions are based on engineering interpretation from available subsurface information by the Agency and may not necessarily reflect actual variations in subsurface conditions that may be encountered between individual boring or sample locations.

3. Observed water levels and/or conditions indicated are as recorded at the time of exploration and may vary according to the prevailing rainfall, methods of exploration and other factors.

4. Engineering judgment was exercised in preparing the subsurface information presented herein. Analysis and interpretation of subsurface data was performed and interpreted for Agency design and estimating purposes. Presentation of the information in the Contract is intended to provide the Contractor access to the same data available to the Agency. The subsurface information is presented in good faith and is not intended as a substitute for personal investigation, independent interpretation, independent analysis or judgment by the Contractor.

5. Pictorial structure details shown on the boring plan layout or soils profile are for illustrative purposes only and may not accurately portray final contract details.

6. Terminology used on boring logs to describe the hardness, degree of weathering, and spacing of fractures, joints and other discontinuities in the bedrock is defined in the AASHTO Manual on Subsurface Investigations, 1988.

7. Northing and Easting coordinates are shown in Vermont State Plane Grid North American Datum 1983 in meters and survey feet.

BORING CHART

HOLE NO.	SURV. STATION	OFFSET	GROUND ELEV.	ELEV. TLOB
B-101	150+25	18.5 RT	526.4	476.4
B-102	150+50	16.1 LT	526.1	482.6

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BMI9201

FILE NAME: 17b174/s17b174borings.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: J.SALVATORI
BORING INFORMATION SHEET
PLOT DATE: $$$$DATE$$$
DRAWN BY: D.D.BEARD
CHECKED BY: J.SALVATORI
SHEET S OF T

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

BORING LOG

Springfield
BM19201
VT 106 BR 4

Boring No.: **B-101**

Pin No.: 17b174
Checked By: END

Boring Crew: McGinley, Aubut, Monette, Zottola
Date Started: 3/02/22 Date Finished: 3/04/22
VTSPG NAD83: N 305195.30 ft E 1634392.10 ft
Station: 150+25.00 Offset: 18.50
Ground Elevation: 526.4 ft

	Casing	Sampler
Type:	WASH BORE	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 AUTO C_E = 1.45

Groundwater Observations

Date	Depth (ft)	Notes
03/04/22	11.0	WT after 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 %
0		Field Note:, Asphalt 0.0-0.4', Rollercone cleanout 3.0-4.5'								
5		A-2-4, GrSa, brn, Moist, Rec. = 1.0 ft				10-10-13-15 (23)	8.6	27.6	55.5	16.9
10		Field Class:, Gravelly Sand, brn, Moist, Rec. = 0.9 ft, Rollercone cleanout 13.5-14.5'				12-9-13-19 (22)				
15		Field Class:, Gravelly Sand w/ trace Si, brn, Moist, Rec. = 1.0 ft, Rollercone cleanout 19.4-19.5'				12-11-13-14 (24)				
20		A-1-b, GrSa, brn, Moist, Rec. = 0.4 ft				10-8-10-20 (18)	9.3	33.7	53.4	12.9
25		Field Class:, Gravelly Sand, brn, Moist, Rec. = 0.8 ft				7-9-9-11 (18)				
30		A-2-4, SiSa, brn, Wet, Rec. = 0.4 ft				7-10-25-34 (35)	14.8	10.4	59.6	30.0

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

Springfield
BM19201
VT 106 BR 4

Pin No.: 17b174
Checked By: END

Boring Crew:	McGinley, Aubut, Monette, Zottola
Date Started:	3/02/22
Date Finished:	3/04/22
VTSPG NAD83:	N 305195.30 ft E 1634392.10 ft
Station:	150+25.00
Offset:	18.50
Ground Elevation:	526.4 ft

	Casing	Sampler
Type:	WASH BORE	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 AUTO	C_E = 1.45	

Groundwater Observations

Date	Depth (ft)	Notes
03/04/22	11.0	WT after 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 %
		Field Class:, Sandy Gravel w/ some Si, brn, Moist, Rec. = 0.8 ft, R @ 32.8' (50 blows/ 6") Rollercone cleanout 32.6-34.0'				46-R (R)				
35		Field Class:, Gravelly Silty Sand, Dark brown, Moist, Rec. = 1.2 ft, R @ 35.2' (100 blows)				39-37-R (R)				
		A-2-4, GrSiSa, brn, Moist, Rec. = 0.6 ft, R @ 37.1' (100 blows) Rock in end of sampler, Rollercone cleanout 37.3-38.0'				31-50-R (R)	13.7	25.4	42.4	32.2
		Field Class:, Silty Gravelly Sand, brn, Moist, Rec. = 0.5 ft, R @ 39.2' (100 blows) Rollercone cleanout 44.2-45.0'				14-50-R (R)				
40										
45		A-2-4, SiSa, brn-gry, Moist, Rec. = 0.5 ft, R @ 46.3' (100 blows)				17-47-R (R)	13.5	16.9	58.8	24.3
50		Field Class:, Gravel w/ Rock, gry, Wet, Rec. = 0.2 ft, R @ 50.2' (50 blows/ 6")				R (R) Top of Bedrock @ 50.0 ft				
		50.0 ft - 55.0 ft, Gray/white to black, GNEISS, Gray/white layers are composed of quartz, plagioclase and biotite. Moderately foliated. Black layers are amphibolite and biotite rich zones. Some brown staining and rust on joints and weathered amphibolite/biotite layers. Moderately hard, Slightly weathered, Fair rock, NXDC, A healed fracture infilled with quartz cuts across foliation and is present from 50.7 ft to 50.8 ft and at 51.1 ft to 51.5 ft. RMR=49	R-1 (50)	96 (62)	3 3 3 2 3					
55		55.0 ft - 60.0 ft, Gray/white to black, GNEISS, Gray/white layers are composed of quartz, plagioclase and biotite. Moderately foliated. Black layers are amphibolite and biotite rich zones. Healed fracture infilled with quartz cuts across foliation and is present from 55.1 ft to 55.5 ft. Moderately hard, Very slightly weathered, Fair rock, NXDC, Some dulling of mica's on fresh breaks and joints. RMR=56	R-2 (45-50)	92 (88)	3 3 2 2 1					
60		Hole stopped @ 60.0 ft								

Remarks:
Hole collapsed @ 22.4'

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** **BM19201** **VT 106 BR 4**	Boring No.: **B-102** Page No.: 1 of 2 Pin No.: 17b174 Checked By: END

Boring Crew: McGinley, Aubut, Monette, Zottola

Date Started: 2/22/22 Date Finished: 2/23/22

VTSPG NAD83: N 305173.30 ft E 1634355.60 ft

Station: 150+50.00 Offset: -16.10

Ground Elevation: 526.1 ft

	Casing	Sampler
Type:	H.S.A.	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 AUTO	C_E = 1.45	

Groundwater Observations

Date	Depth (ft)	Notes
02/22/22	27.1	WT after drilling.
02/23/22	5.5	WT after drilling.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
0		Field Note:, Asphalt 0.0-0.4'							
5		A-1-b, GrSa, brn, Moist, Rec. = 1.1 ft, Refusal @ 6.6' (10 blows no movement) continued drilling auger on obstruction (possible boulder or concrete @ 6.6').			7-9-11-R (20)	6.3	24.4	62.2	13.4
10		A-1-b, GrSa, brn, Moist, Rec. = 0.9 ft			2-2-6-7 (8)	4.8	29.6	59.4	11.0
15		Field Class:, Sand w/ some Gravel, brn, Moist, Rec. = 1.1 ft			5-6-7-10 (13)				
20		A-1-b, GrSa, brn, Moist, Rec. = 0.3 ft, Rock in tip of sampler			8-12-16-21 (28)	5.0	40.4	47.9	11.7
25		Field Class:, Sand w/ trace Gravel & Silt, brn-gry-blk, Moist, Rec. = 1.0 ft			6-13-21-24 (24)				
30		A-2-4, SiSa, brn, Wet, Rec. = 1.7 ft			16-25-34-35 (59)				

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

Springfield
BM19201
VT 106 BR 4

Boring No.: **B-102**

Pin No.: 17b174
Checked By: END

Boring Crew: McGinley, Aubut, Monette, Zottola
Date Started: 2/22/22 Date Finished: 2/23/22
VTSPG NAD83: N 305173.30 ft E 1634355.60 ft
Station: 150+50.00 Offset: -16.10
Ground Elevation: 526.1 ft

	Casing	Sampler
Type:	H.S.A.	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 AUTO C_E = 1.45

Groundwater Observations

Date	Depth (ft)	Notes
02/22/22	27.1	WT after drilling.
02/23/22	5.5	WT after drilling.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Class:, Silty Sand, brn, Wet, Rec. = 2.0 ft, Refusal @ 32.8', recovery > 0.8 because sampler pounded to reset @ 33.0'			30-R (R)	17.2	1.7	74.4	23.9
35		Field Class:, Silty Sand w/ trace Gravel, brn, Wet, Rec. = 1.0 ft, Refusal @ 35.5' (100 blows)			24-38-R (R)				
		Field Class:, Sandy Gravel w/ some Silt, brn, Wet, Rec. = 0.8 ft, Refusal @ 35.7' (50 blows/ 6") advanced sampler to 36.5' to obtain sample			87-100 (R)				
		Field Note:, No Recovery, Rec. = 0.0 ft, Refusal @ 37.0' (10 blows) weathered Rock in tip of sampler, auger bounce @ 39.0'			R (R)				
40		39.0 ft - 43.5 ft, Core run consists of multiple rock types with angularity ranging between sub-rounded to sub-angular. Rock type present include quartzite, schist, quartz, and gneiss. NXDC, Due to lack of recovery, varying rock types present and roundness of rocks, suspect that this represents a BOULDER or BOULDERS.	R-1	18 (0)					
		43.5 ft - 44.0 ft, Beginning of run consists of subrounded gray quatize and gray mica schist, and gray/white micaceous quartizte. At 0.5 ft of recovered run to end, gray/white micaceous GNEISS. NXDC	R-2	20 (0)	Top of Bedrock @ 43.5 ft				
45		Hole stopped @ 44.0 ft							

Remarks:
Augers dettached & separated from each other at some point during drilling or while pulling augers after drilling. 25 feet of augers (5x 5' lengths) remained in the ground and were not retrieved. The top of the 25' of augers is assumed to be approximately 13-15' below the roadway surface.

Hole collapsed @ 22.2'

50

55

60

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: Resource ID Completion Memo

OFFICE MEMORANDUM

AOT - PDB - ENVIRONMENTAL SECTION

RESOURCE IDENTIFICATION COMPLETION MEMO

To:		, Project Manager
From:		
Date:		
Project:		

Environmental Resources:

	Yes	No	
Archaeological Site:			See Archaeological Resource ID Memo:
Historic/Historic District:			See Historic Resource ID Memo:
4(f) Property:			
Wetlands:			See Natural Resource ID Memo:
Agricultural Land:			
Fish & Wildlife Habitat:			
Wildlife Habitat Connectivity:			
Endangered Species:			
Invasive Species:			
Stormwater:			
Landscaping:			
6(f) Property:			
Hazardous Waste:			
Contaminated Soils:			
USDA-Forest Service Lands:			

	Yes	No	
Scenic Highway/Byway:			
Act 250 Permits:			
FEMA Floodplains:			
Flood Hazard Area/River Corridor:			
US Coast Guard:			
Lakes and Ponds:			
Environmental Justice:			
303D List/ Class A Water/ Outstanding Resource Water:			
Source Protection Area:			
Public Water Sources/ Private Wells:			
Other:			

CC: Project File

Appendix G: Natural Resources Memo

VERMONT

State of Vermont
Program Development Division
One National Life Drive
Montpelier, VT 05633-5001
vtrans.vermont.gov

[phone] 802-279-2562
[fax] 802-828-2334
[ttd] 800-253-0191

Agency of Transportation

To: Lee Goldstein, VTrans Environmental Specialist

From: James Brady, VTrans Environmental Biologist

Date: May 29, 2018

Subject: Springfield BM 19201 - Natural Resource ID

I have completed my natural resource report for the above referenced project. My evaluation has included wetlands, wildlife habitat, agricultural soils and rare, threatened and endangered species.

Project Springfield BM 19201 will address issues at a deficient culvert (Bridge No. 4) on VT Route 106.

Wetlands/Watercourses
Bridge No. 4 spans Baltimore Brook.

There is a small wetland complex, presumed Class II in the northwest quadrant of the project. Please see attached.

Wildlife Habitat
The area around this culvert is highly fragmented and likely does not allow for high quality regional movement of terrestrial wildlife, but does likely contribute to local wildlife movement.

Baltimore Brook is a direct tributary to the Black River. Baltimore Brook adds quality cold-water habitat for several important fish species. Aquatic organism passage should be incorporated into the design of this project.

Rare, Threatened and Endangered Species
This project is close to, but not within, the regulated zones of several threatened or endangered animals. No impacts from this project are anticipated.

The culvert itself is not good habitat for the federally threatened northern long-eared bat.

Agricultural Soils
There are no mapped agricultural soils in the project area.

Vermont
Feet
0
37.5
75
150
N
Legend
WetlandResourceID
SPRINGFIELD
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Appendix H: Archeology Memo

VERMONT

Brennan Gauthier
VTrans Archaeologist
Vermont Agency of Transportation
Project Delivery Bureau
Environmental Section
1 National Life Drive
Montpelier, VT 05633
tel. 802-279-1460
Brennan.Gauthier@Vermont.gov

To: Lee Goldstein, VTrans Environmental Specialist
From: Brennan Gauthier, VTrans Senior Archaeologist
Date: 3/30/2018
Subject: Springfield BM19201 Resource ID

Dear Lee,

I have completed my resource identification for the proposed invert repair of a 13'x13' corrugated metal tube culvert that spans an unnamed brook and carries Vermont Route 106 in the town of Springfield, Windsor County, Vermont. Bridge #4 was constructed in 1958, repaired in 1996 and has since deteriorated significantly to the point where a major repair or replacement is necessary. In order to identify archaeological sensitivity in the project area, I combined background research and predictive modeling with a field inspection on March 28th to assess prior disturbance in the four quadrants surrounding Bridge #4.

The field visit was conducted on a warm afternoon in late March when the majority of snow around the culvert had melted. Although some snow cover was present, the landscape and topography of the area was adequately visible to determine previous land use. Upon researching the history of this section of Route 106, it became evident that the likelihood of undisturbed soils in a generalized APE was very low. Created in 1958, this crescent-shaped portion of Route 106 was devised to funnel traffic away from the residential neighborhoods adjacent to Great Brook. This disturbance was clearly evidenced with a soil core that showed heavy fill in the NE and NW project quadrants. Currently, the NE quadrant is slated to be the only point of access for the culvert liner installation. With this in mind, I spent considerable time testing the area and concluded that the entire area was built up with fill during or after construction. Also, project ROW plans show a large waterline running through this area, which could have been the cause of much of the soil fill and disturbance.

Additional site disturbance was likely due in part to the straightening of the brook before the installation of the culvert in 1958. Original project plans show that engineers straightened a braided brook in order to avoid roadway slope erosion at this location. Additionally, it is likely that they added the downstream backwater weir to avoid a plunge pool at the outlet. This weir is constructed of river cobbles and is located roughly 40 feet downstream. Interesting to note, modern debris and a small footpath indicate that this location may be currently used as a local swimming hole.

This location is unlikely to yield precontact archaeological remains due in part to the obvious disturbance and manmade landscape features that dominate this portion of Vermont Route 106. As mentioned earlier, the waterline that runs through the northern quadrants, when combined with the 1958 construction fill, has rendered the area completely disturbed within the ROW. It is possible that undisturbed precontact sites may be present along the original river banks that are visible through LiDAR imagery (See Figure #3), but these are far from the proposed access road and likely on private property that is not considered part of the project APE.

In conclusion, there are no mappable archaeologically sensitive areas located within the project APE. Disturbance from roadway slope construction and waterline installation have rendered the access location unlikely to contain undisturbed soils, as was evidenced in soil cores taken during the field inspection. As always, feel free to reach out to me with any questions or concerns that may arise. For reference, I've included a series of historic maps and current imagery to help illustrate this document. Additional information can be provided if required.

Sincerely,

Brennan

Images and Illustrations

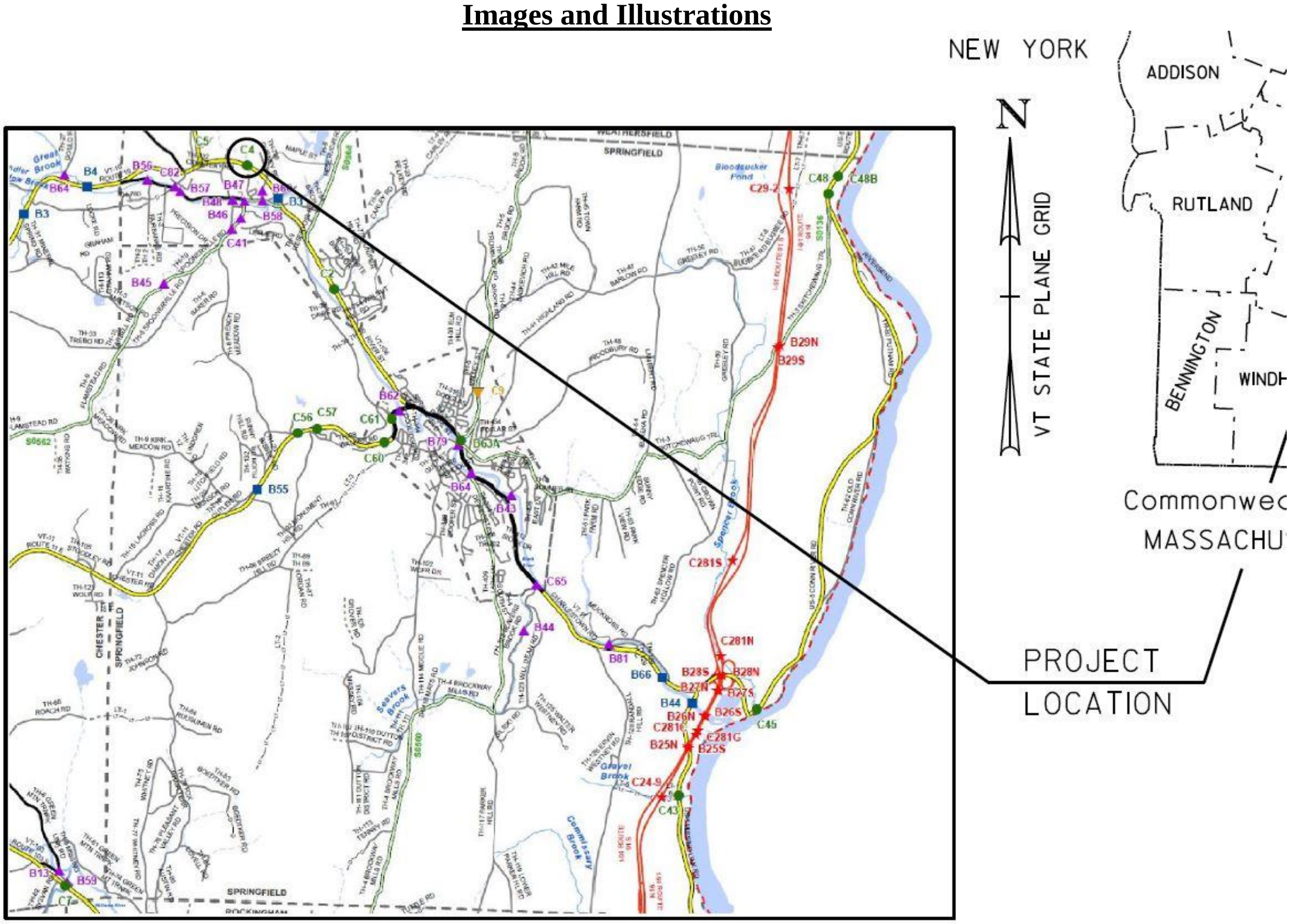


Figure 1: Project Location

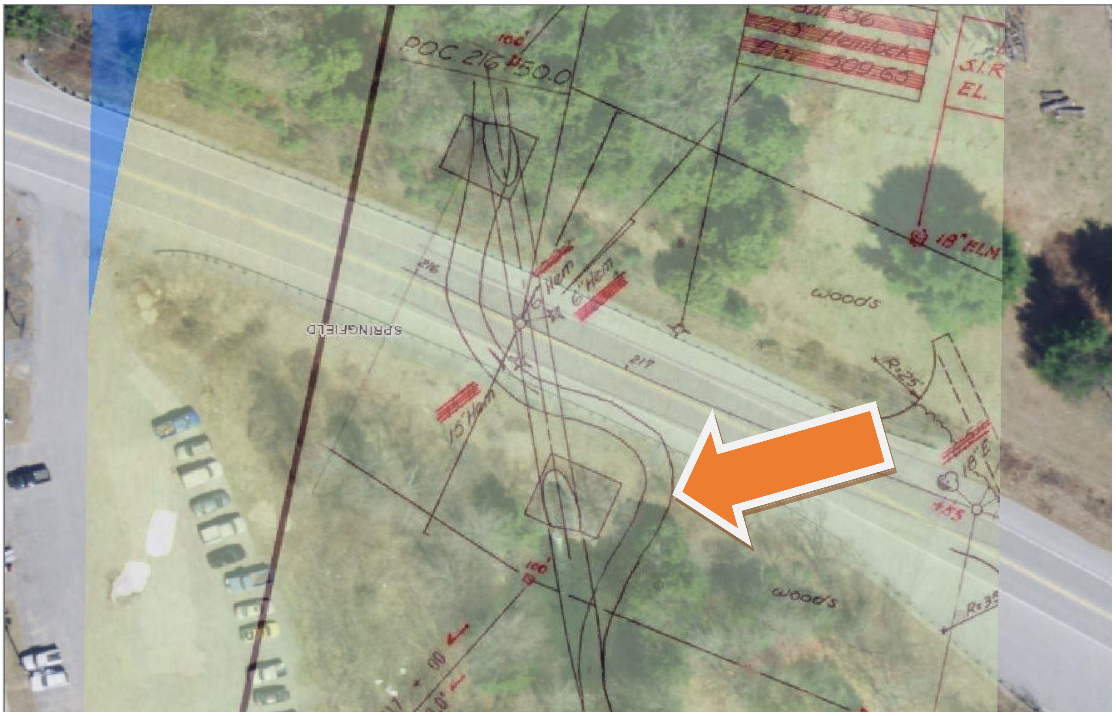


Figure 2: Original 1958 Roadway Plans Overlaid (note cut-off brook meander)

Figure 3: 2017 LiDAR Hillshade (Access as Red Dashed Line)

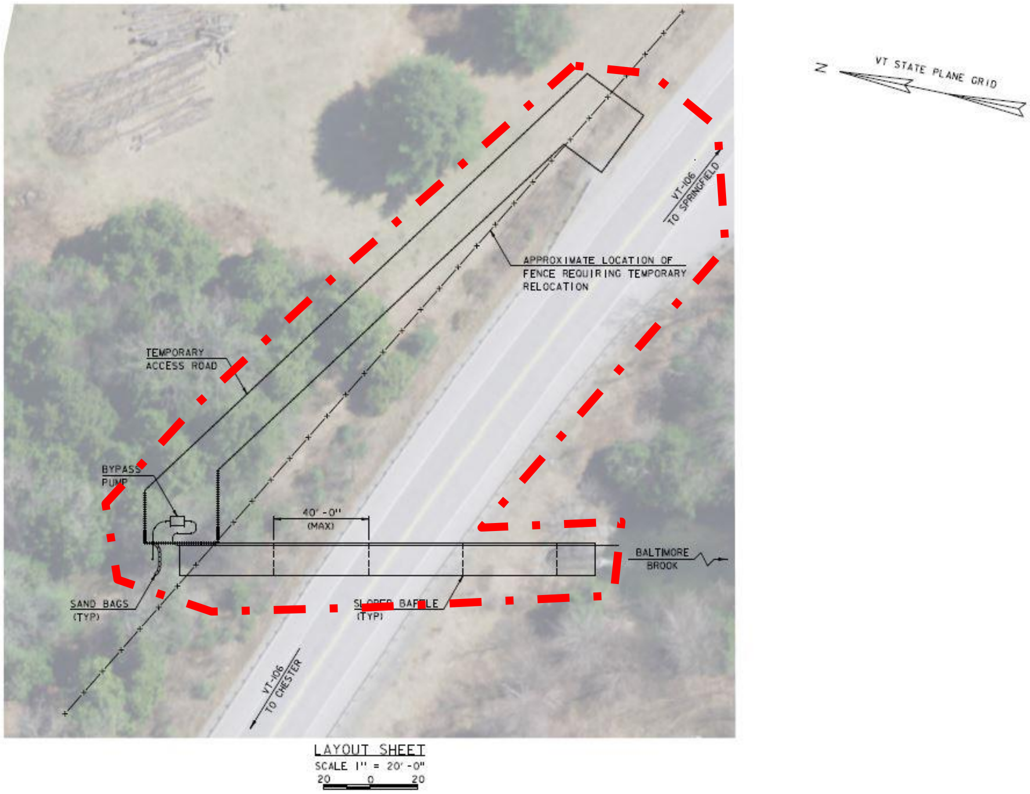


Figure 4: Project Access and APE

Figure 5: Culvert Outlet

Figure 6: Culvert Inlet

Figure 7: Inlet at Low Flow

Figure 8: Project Location ca. 1870

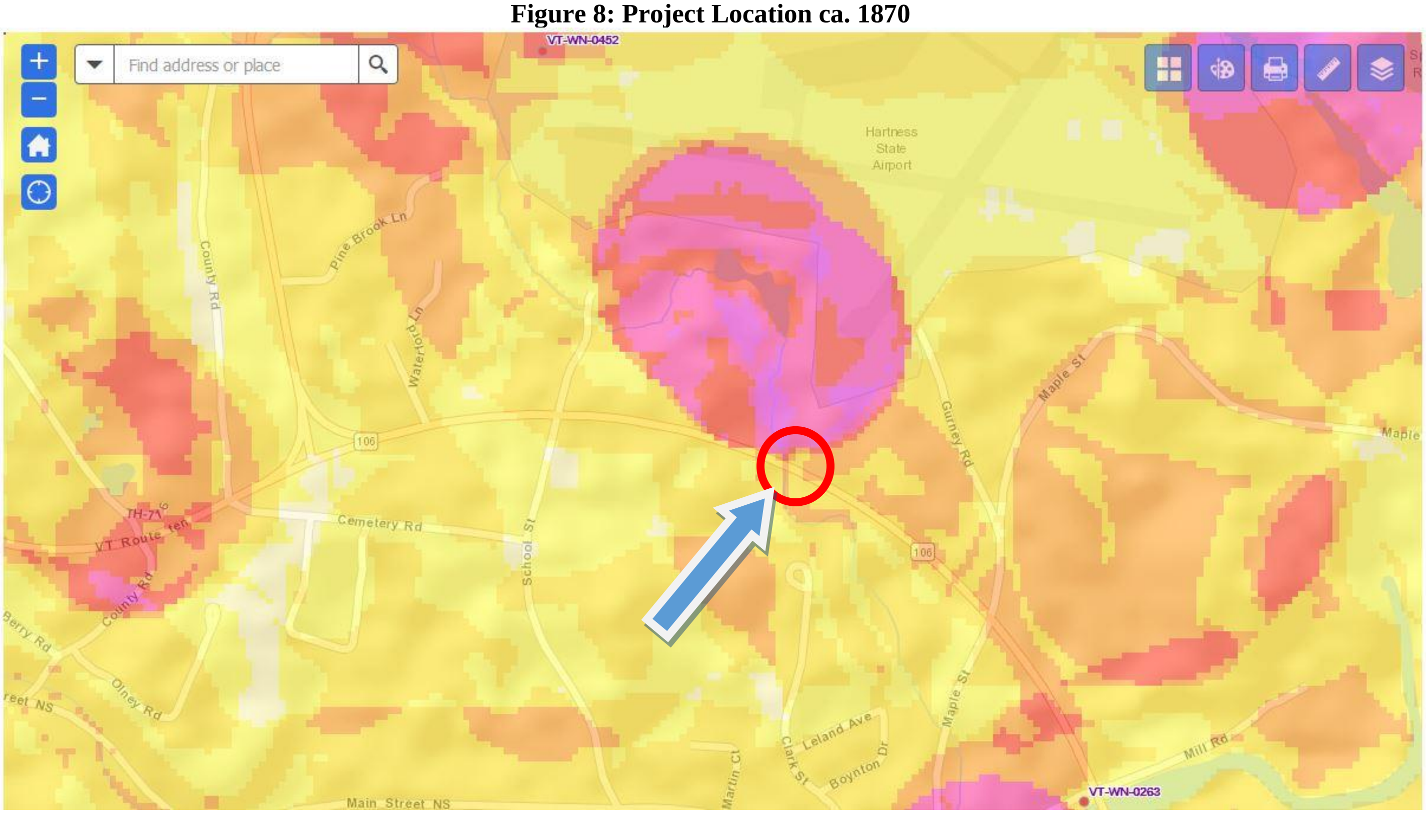


Figure 9: VDHP Predictive Model

Figure 10: Access Entrance

Appendix I: Historic Memo

Kyle Obenauer
Historic Preservation Specialist

Vermont Agency of Transportation

Project Delivery Bureau - Environmental Section
One National Life Drive
Montpelier, VT 05633-5001

kyle.obenauer@vermont.gov
(802) 279-7040
www.vtrans.vermont.gov

Historic Preservation Resource Identification Memo

To: Lee Goldstein, VTrans Environmental Specialist
Via: Judith Ehrlich, VTrans Historic Preservation Officer
Cc: Brennan Gauthier, VTrans Archaeologist
Karen Spooner, VTrans Administrative Assistant

Date: April 18, 2018

Subject: Springfield BM19201

Lee,

This Resource Identification effort is being undertaken to identify cultural resources within a broad preliminary survey area that could possibly be impacted by a future culvert liner project at Bridge No. 4 on Vermont Route 106 (VT 106) in Springfield, Windsor County, Vermont (Figures 1-3). Once a project has been defined at the conceptual design phase, VTrans Cultural Resources staff will be able to determine a formal APE for purposes of Section 106 and 22 VSA § 14.

Within the broad survey area delineated below at Figure No. 7, no historic or Section 4(f) properties were identified through background research or during a site visit conducted March 28th, 2018.

Constructed in 1958, Bridge No. 4 is a large corrugated metal tube surrounded by scattered stones of various sizes and type, some with quarry marks (Figures 5-6). Carrying VT 106 over Baltimore Brook in Springfield, VTrans has determined that this culvert is common in materials, design, and construction. Consequently, it does not possess any qualities of significance necessary for inclusion in the National Register of Historic Places (NRHP).

Please, let me know if there are any questions.

Sincerely,
Kyle

<u>Images and Illustrations</u>

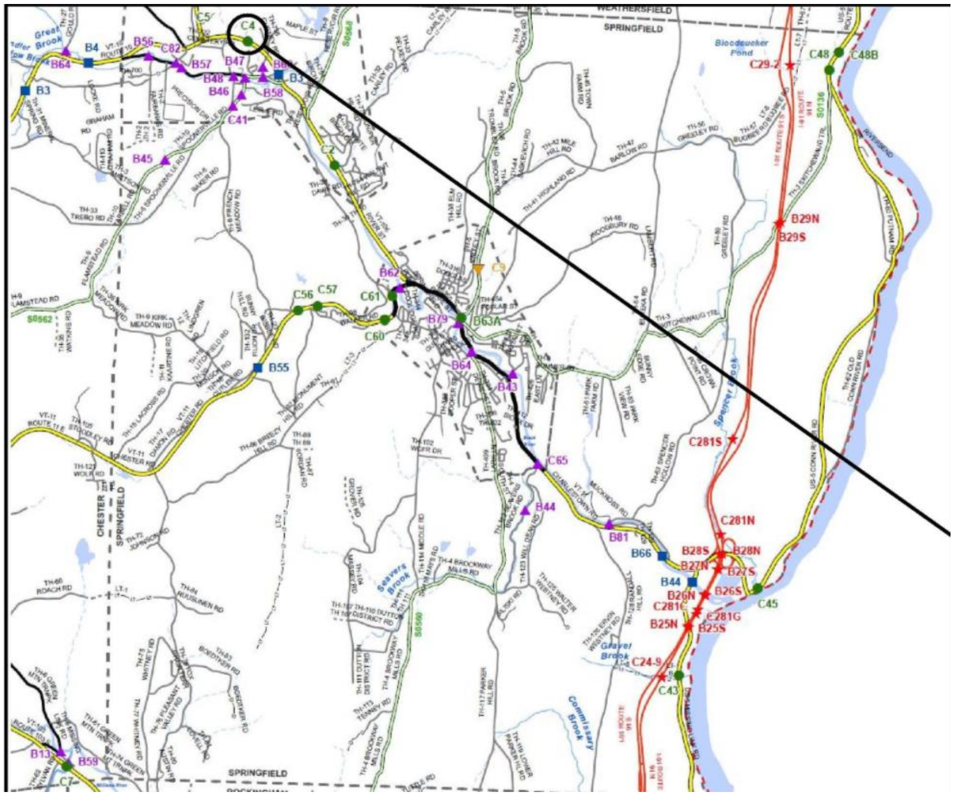


Figure 1. Project Location

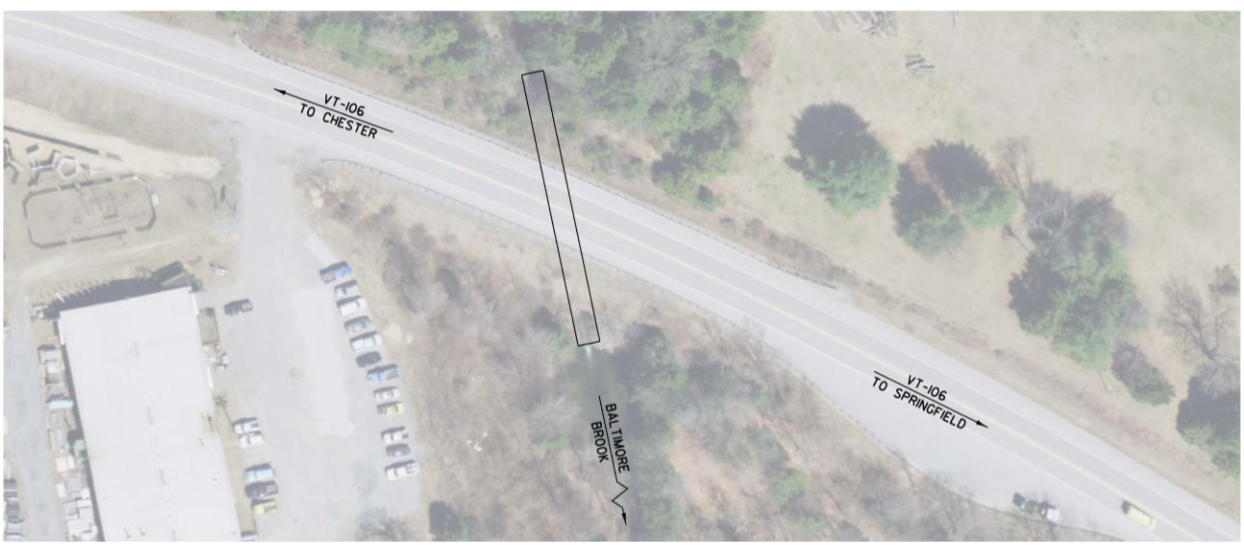


Figure 2. Culvert location below VT 106.

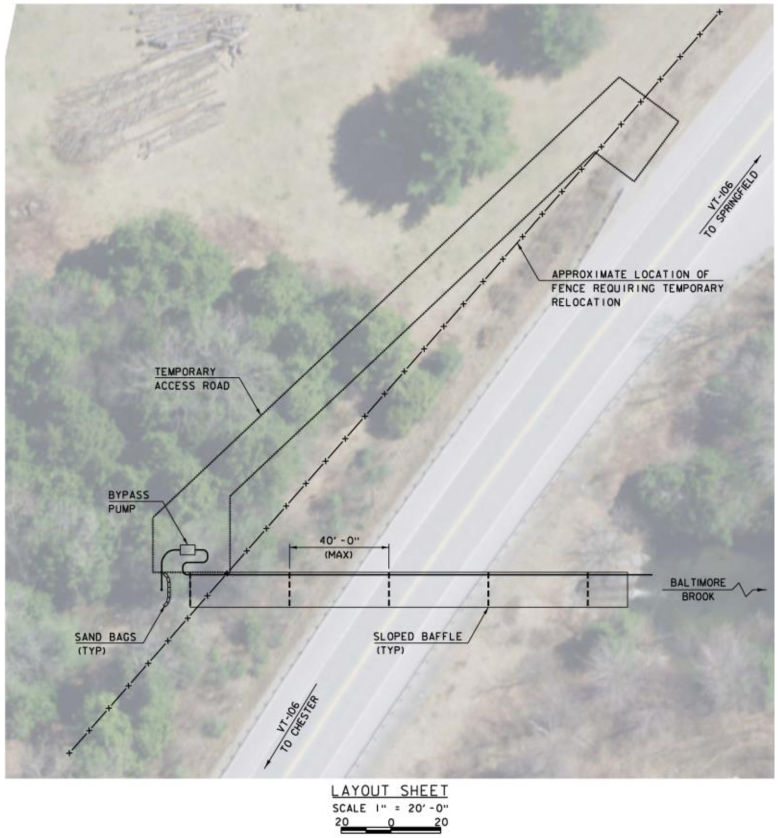


Figure 3. Culvert location with proposed access road delineated.

Figure 4. Proposed access road location, looking west on VT 106.

Figure 5. Bridge No. 4 inlet.

Figure 6. Bridge No. 4 outlet.

Figure 7. Broad preliminary survey area.

Appendix J: Stormwater Memo

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

Agency of Transportation

[phone] 802-279-0583
[fax] 802-828-2334
[ttd] 800-253-0191

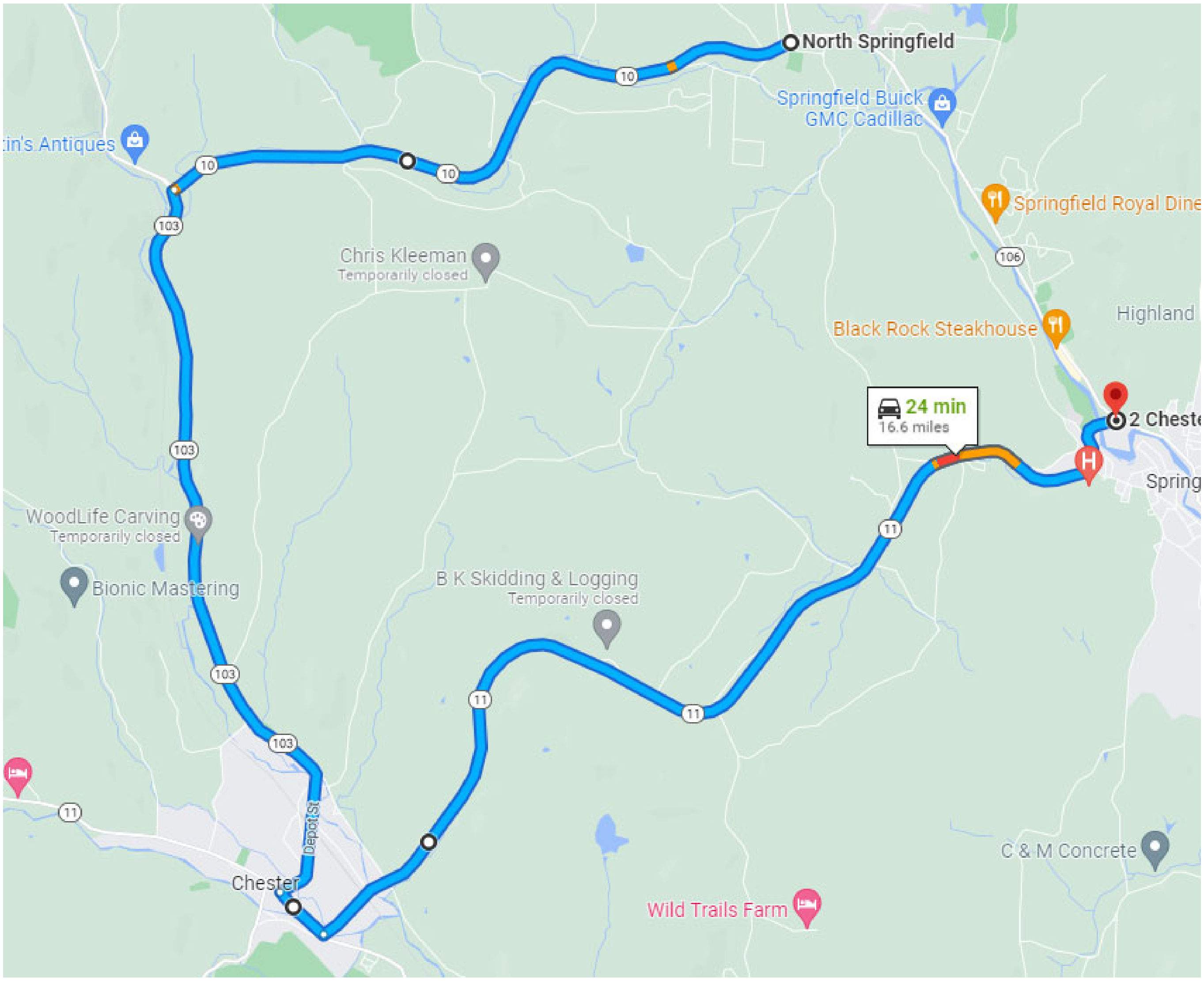
To: Lee Goldstein, VTrans Environmental Specialist
From: Emily Peck, VTrans Assistant Stormwater Management Engineer
Date: Tuesday, May 1st, 2018
Subject: Springfield BM 19201 - Stormwater Resource ID Review

I have reviewed this future culvert liner project at MM 2.847 along VT Route 106 in Springfield, VT for potential water quality concerns including regulatory stormwater considerations. There are no stormwater concerns at this time.

Cc. ________________________________, VTrans Project Manager; Stormwater Resource Files

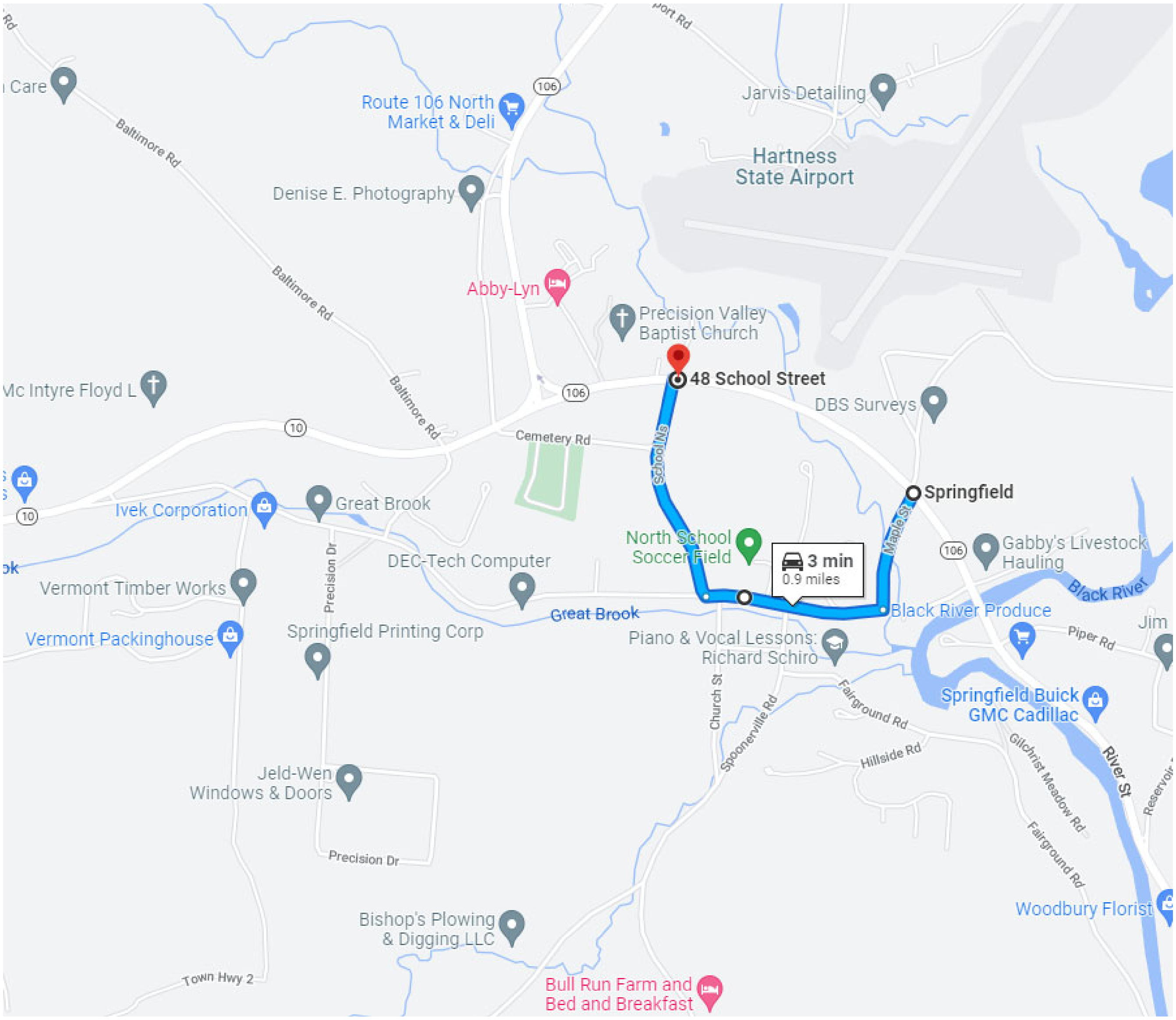
Project Setting (urban vs. rural, etc)

Appendix K: Detour and Local Bypass Maps



Regional Detour Route: VT Route 106 to VT Route 10, VT Route 103, and VT Route 11, back to VT Route 106

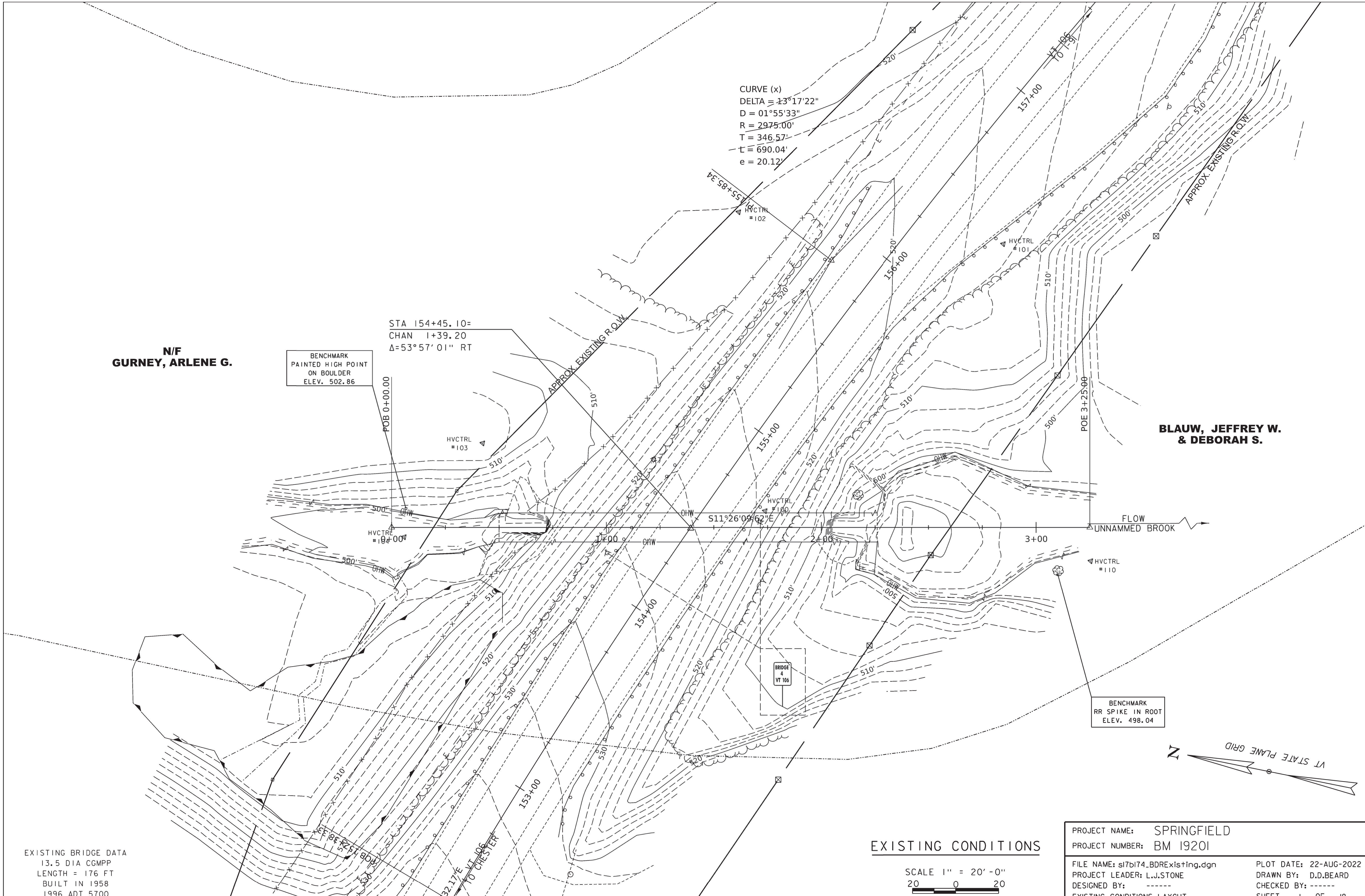
Through Route: 3.3 miles
Detour Route: 16.6 miles
End-to-end Distance: 19.9 miles
Added Distance: 13.3 miles



Local Bypass Route: VT Route 106 to School St/School Ns, Giddings St/Jack and Jill Ln, and Maple Street back to VT Route 106

Through Route: 0.4 miles
Detour Route: 0.9 miles
End-to-end Distance: 1.3 miles
Added Distance: 0.5 miles

Appendix L: Plans



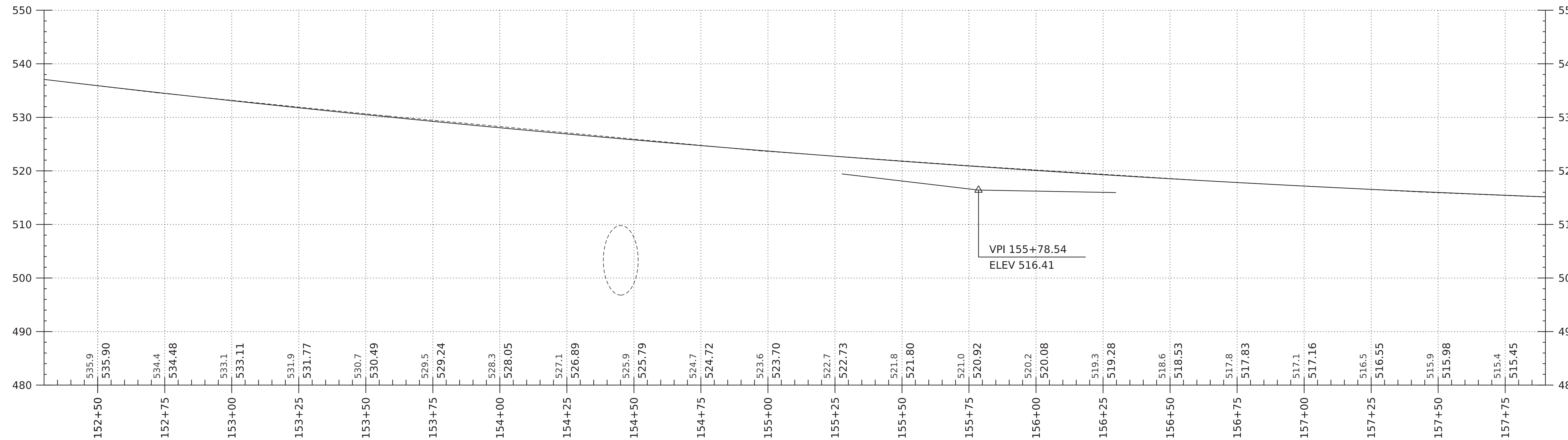
EXISTING BRIDGE DATA
13.5 DIA CGMPP
LENGTH = 176 FT
BUILT IN 1958
1996 ADT 5700

EXISTING CONDITIONS

SCALE 1" = 20'-0"

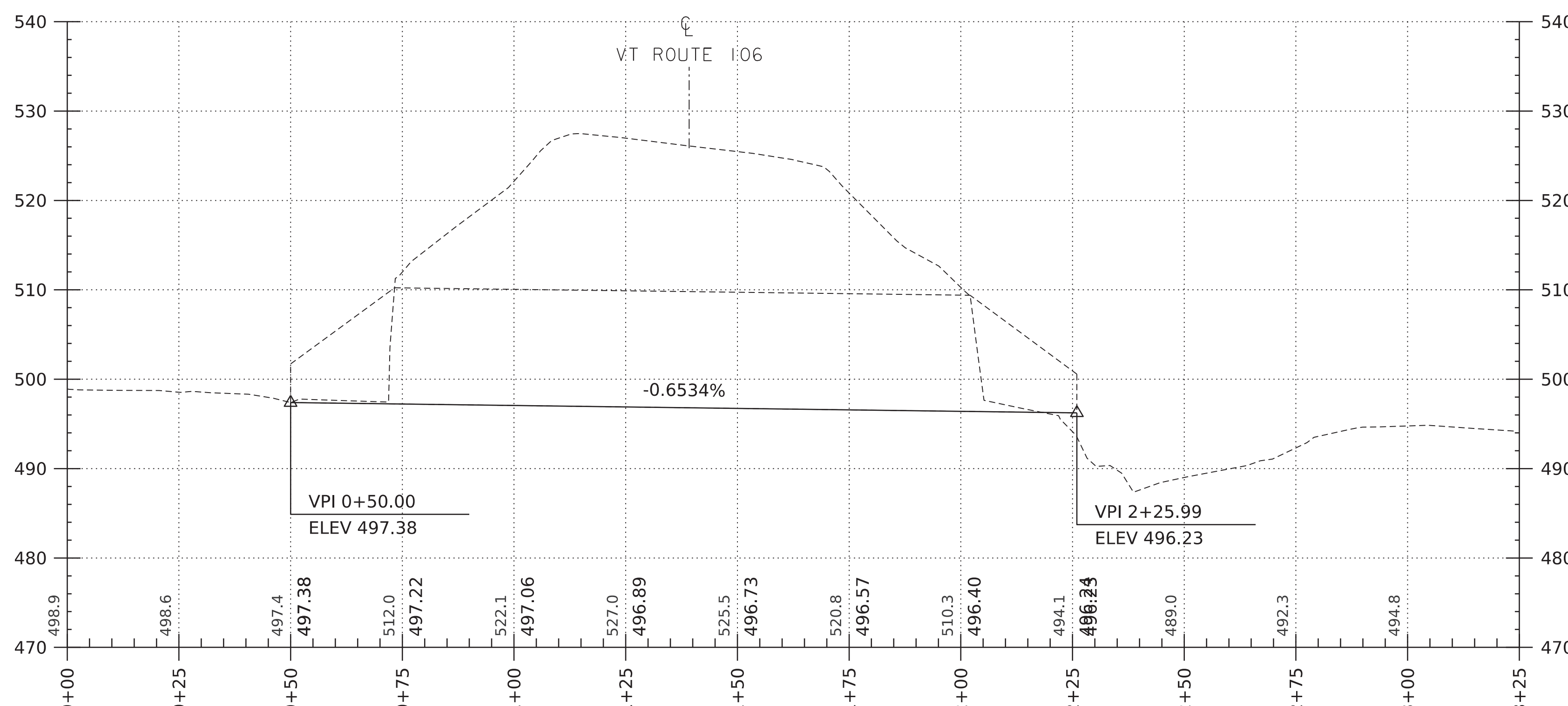
PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BM 19201

FILE NAME: s17b174_BDRExisting.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
EXISTING CONDITIONS LAYOUT
PLOT DATE: 22-AUG-2022
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 1 OF 18



VT ROUTE 106 PROFILE

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

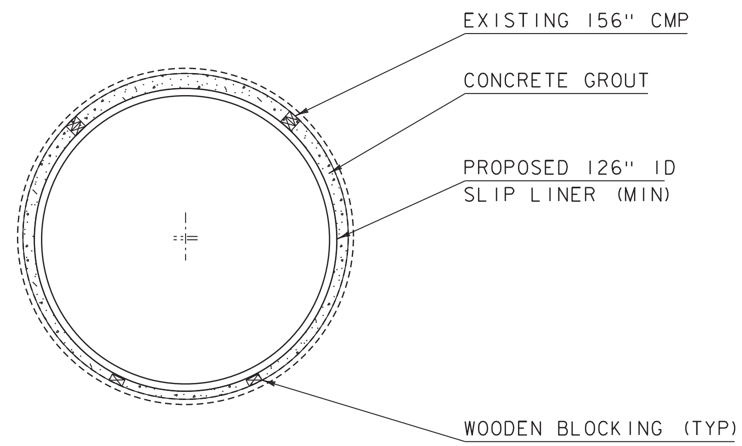


CHANNEL PROFILE

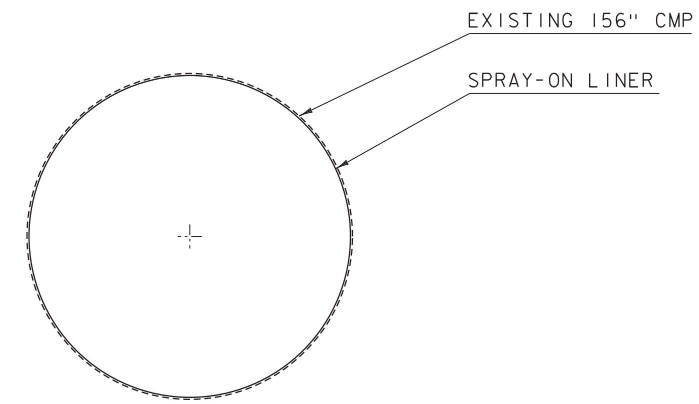
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

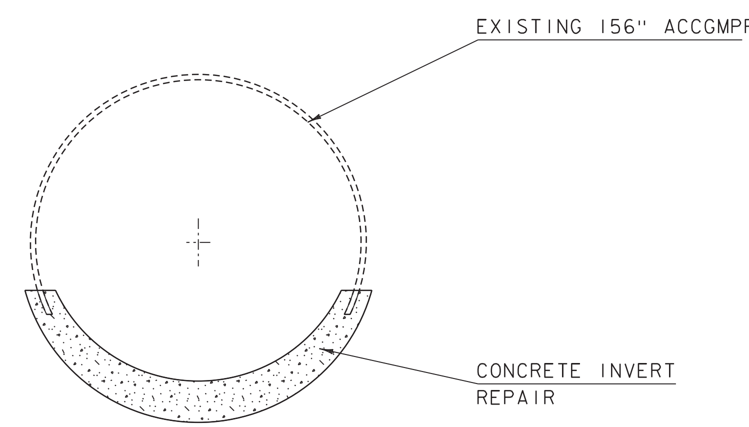
PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BM 19201	
FILE NAME: s17b174profile.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
PROFILE SHEET	SHEET 2 OF 18



PIPE LINER TYPICAL SECTION



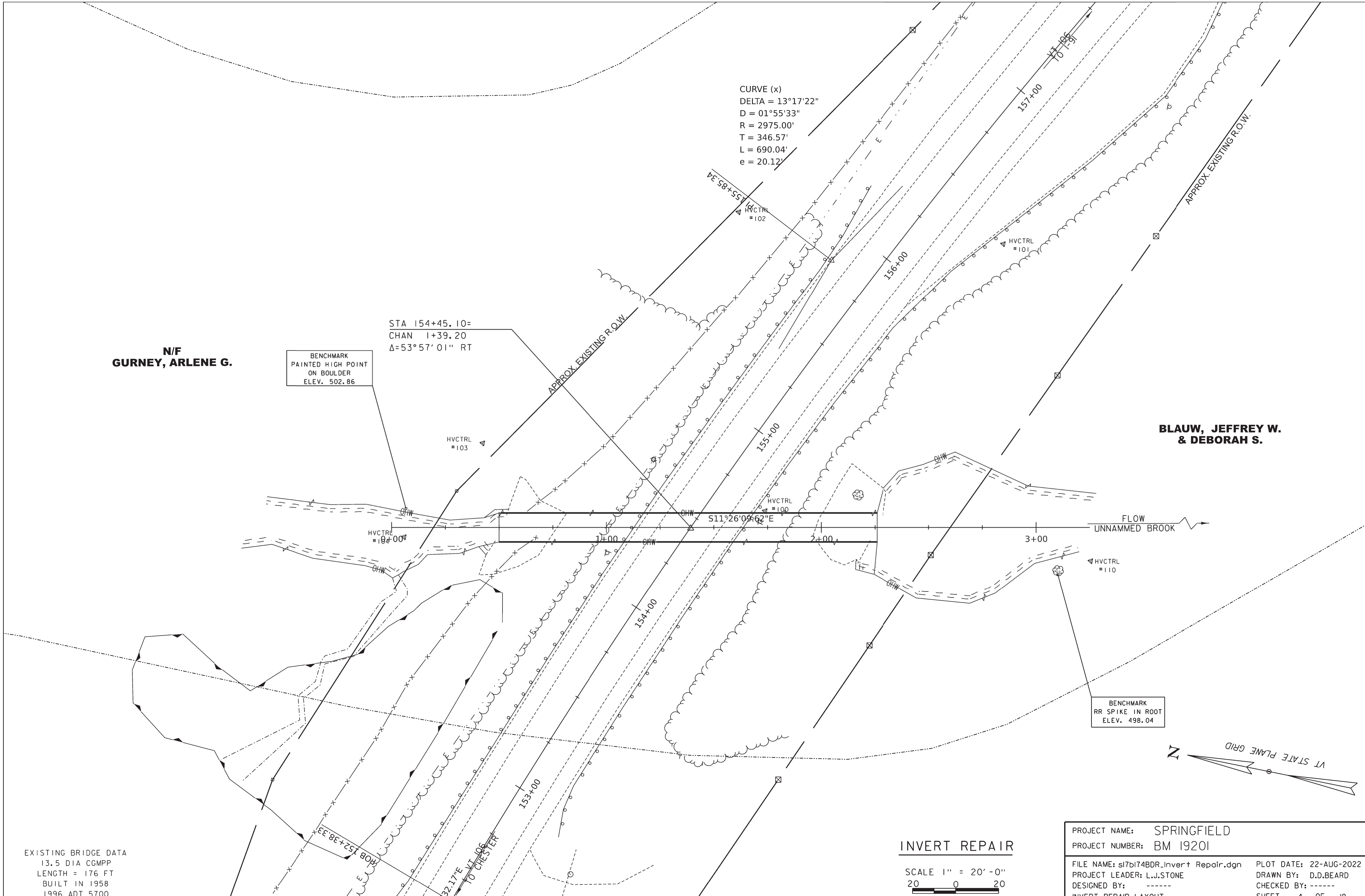
SPRAY ON LINER TYPICAL SECTION



INVERT REPAIR TYPICAL SECTION

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BM 19201

FILE NAME: 17b174/sl7b174typ.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ----------	CHECKED BY: ----------
REHABILITATION TYPICAL SECTIONS	SHEET 3 OF 18

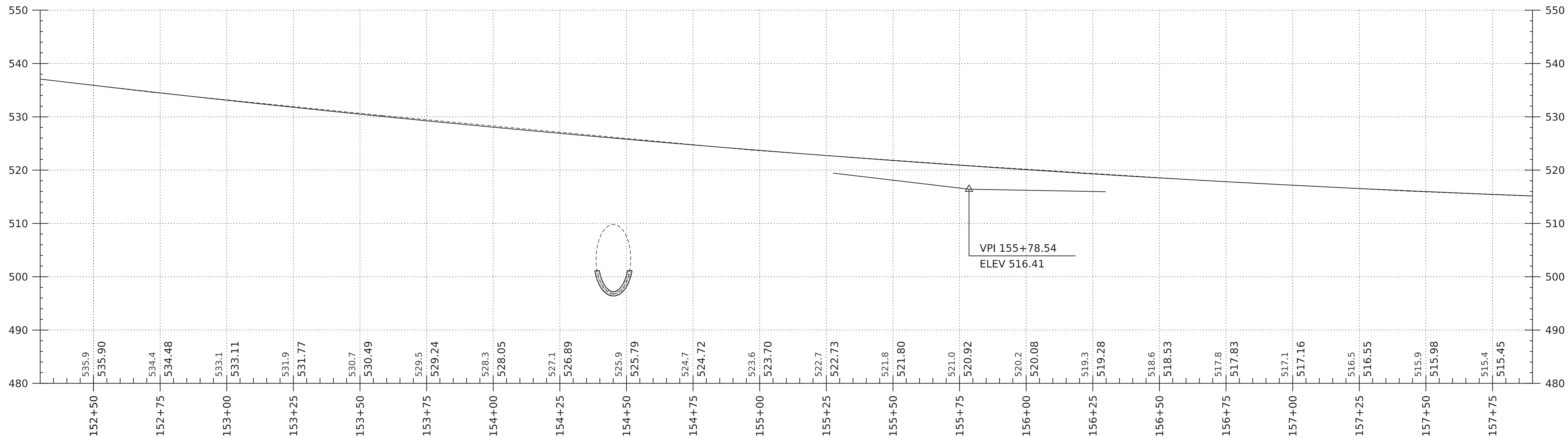


EXISTING BRIDGE DATA
13.5 DIA CGMPP
LENGTH = 176 FT
BUILT IN 1958
1996 ADT 5700

INVERT REPAIR

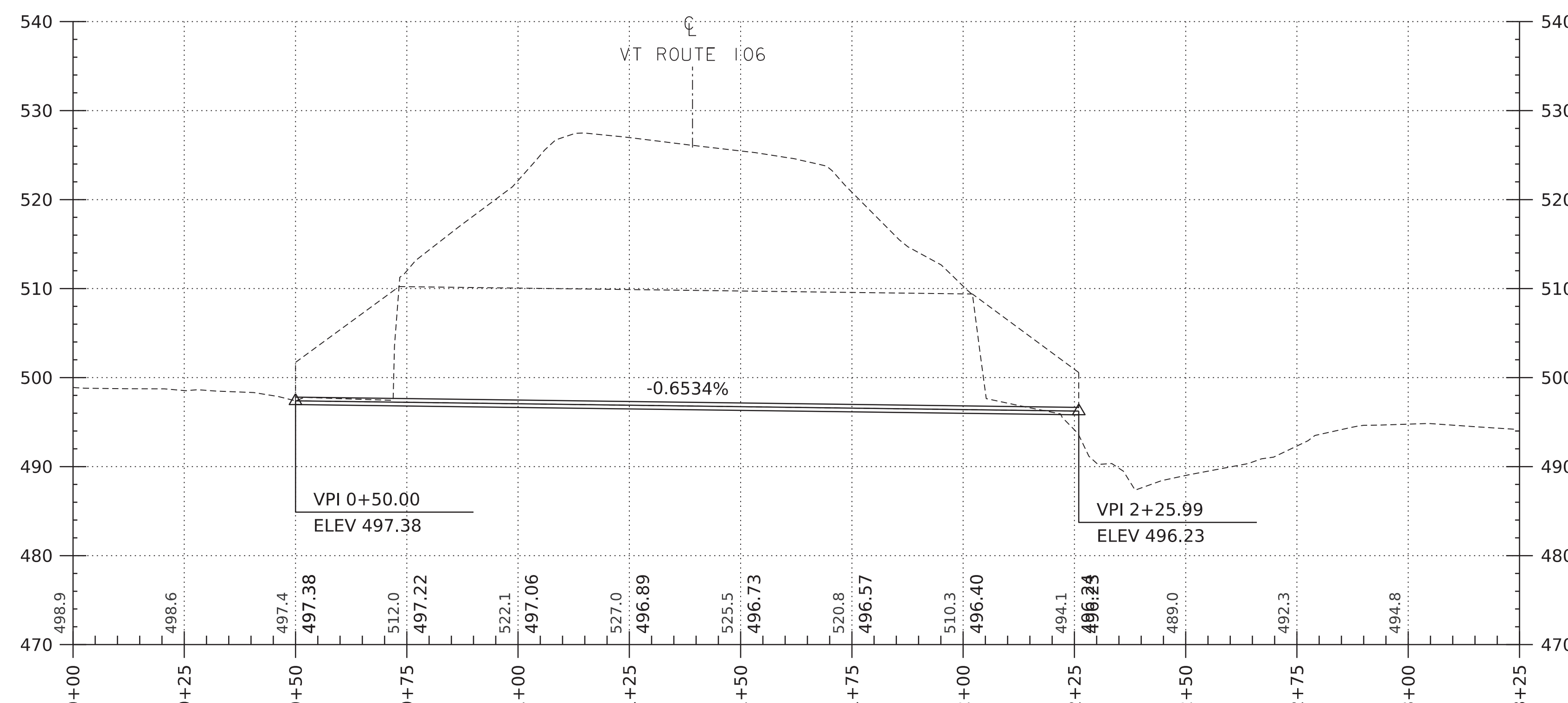
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BM 19201	
FILE NAME: s17b174BDR_Invert Repair.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
INVERT REPAIR LAYOUT	SHEET 4 OF 18



VT ROUTE 106 PROFILE

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

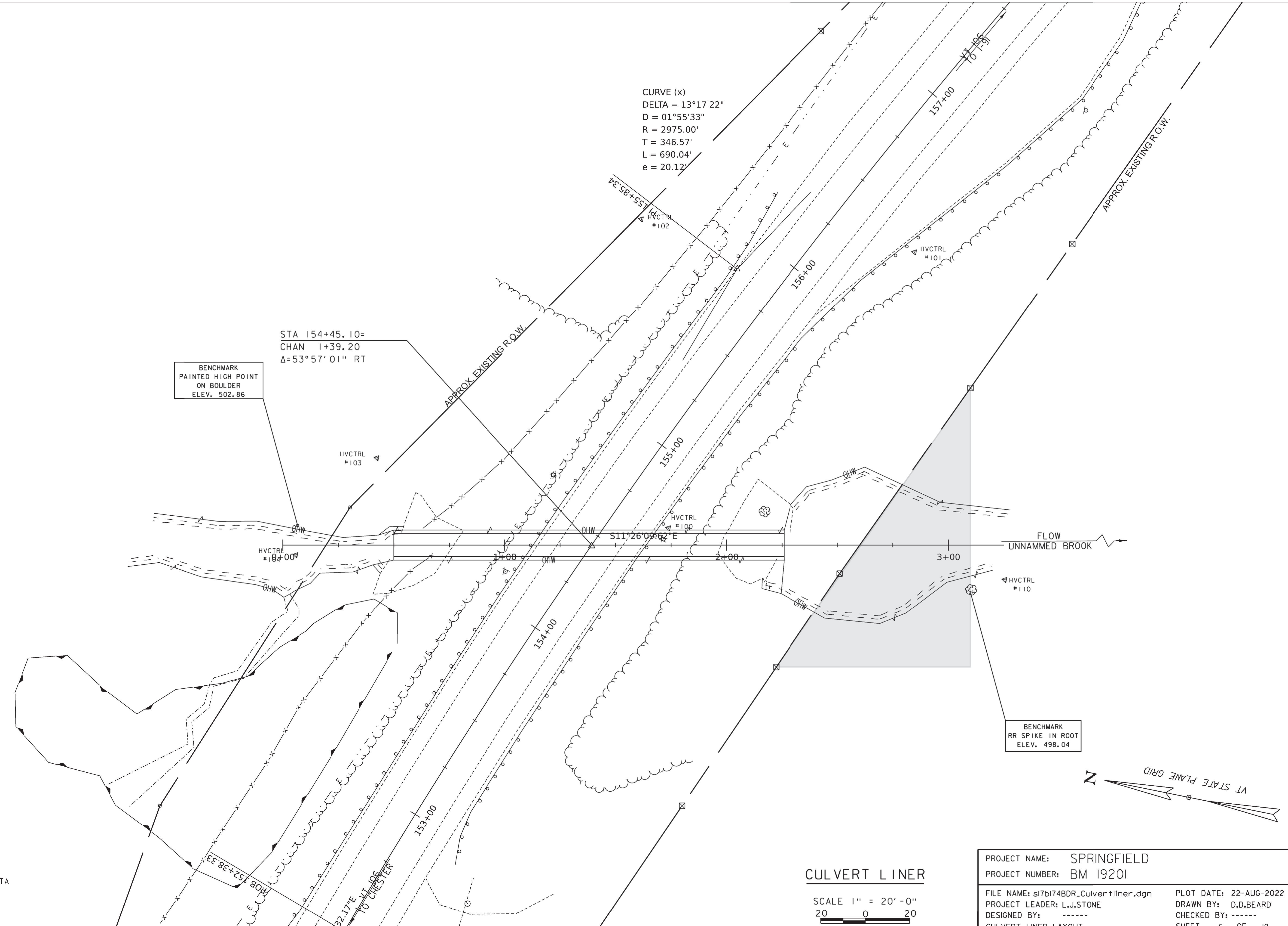


INVERT REPAIR CHANNEL PROFILE

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: BM 19201	
FILE NAME: s17b174profile.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
INVERT REPAIR PROFILE SHEET	SHEET 5 OF 18

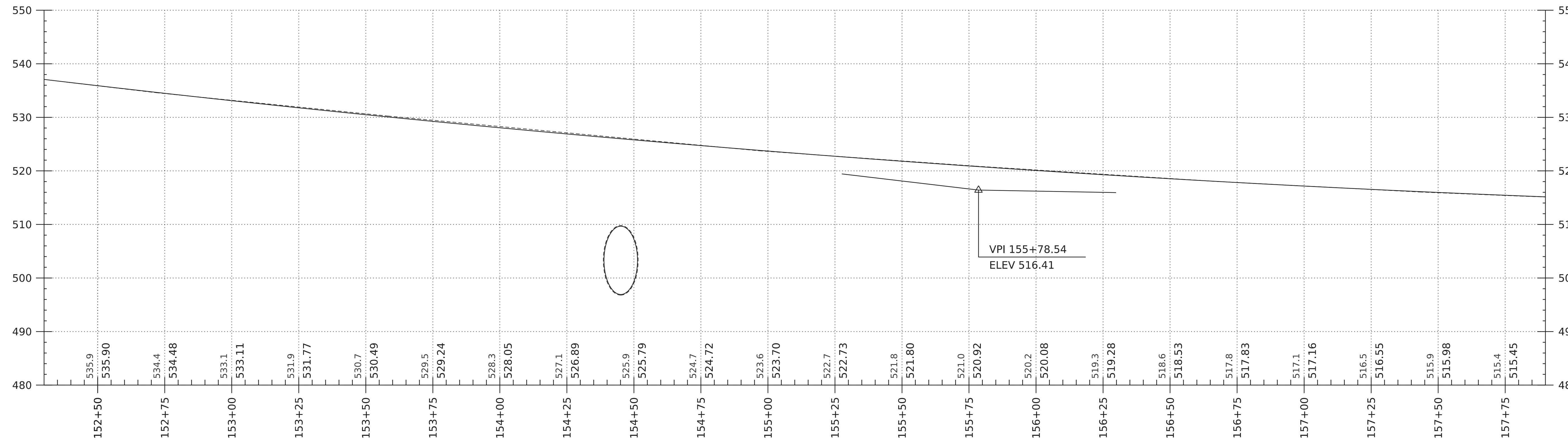


EXISTING BRIDGE DATA
13.5 DIA CGMPP
LENGTH = 176 FT
BUILT IN 1958
1996 ADT 5700

CULVERT LINER

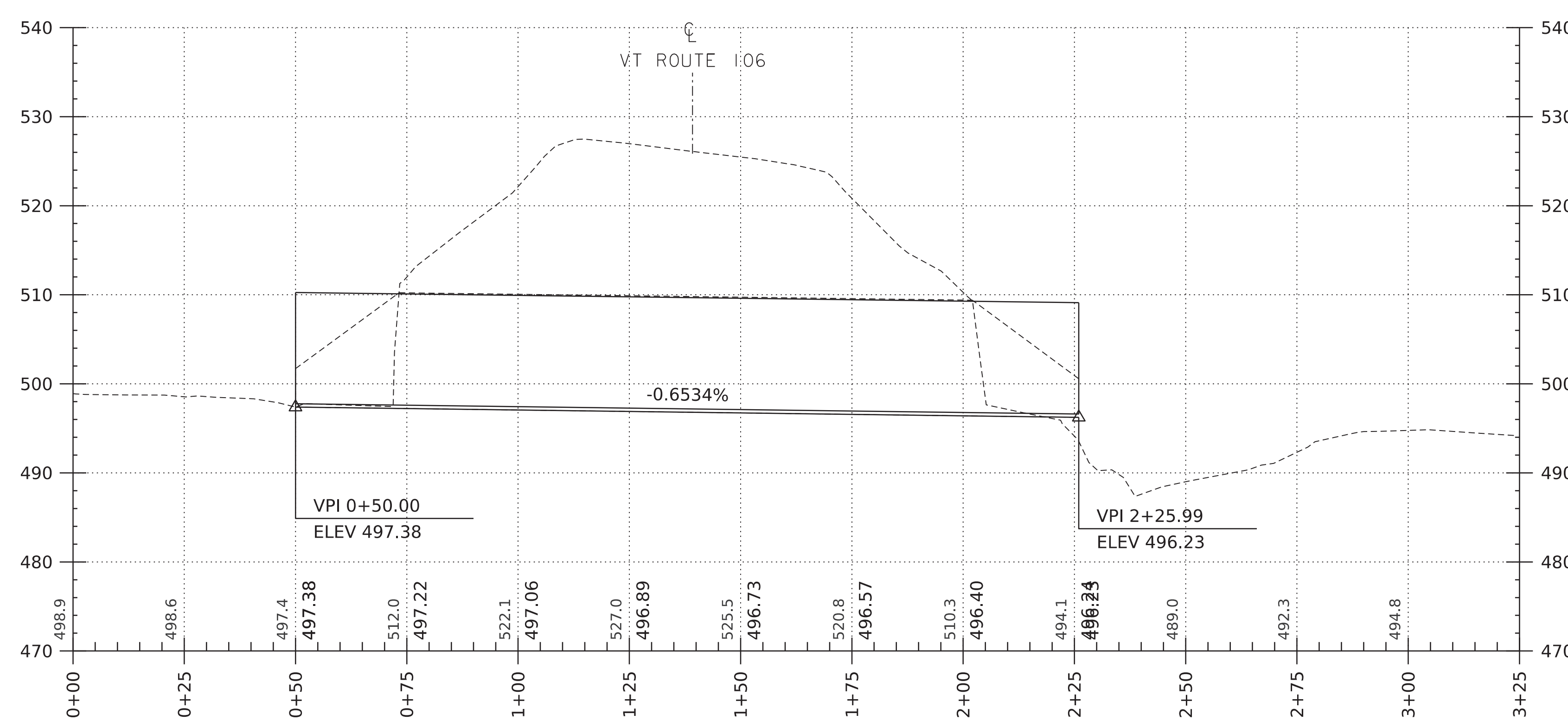
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BM 19201	
FILE NAME: s17b174BDR_Culvertliner.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
CULVERT LINER LAYOUT	SHEET 6 OF 18



VT ROUTE 106 PROFILE

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

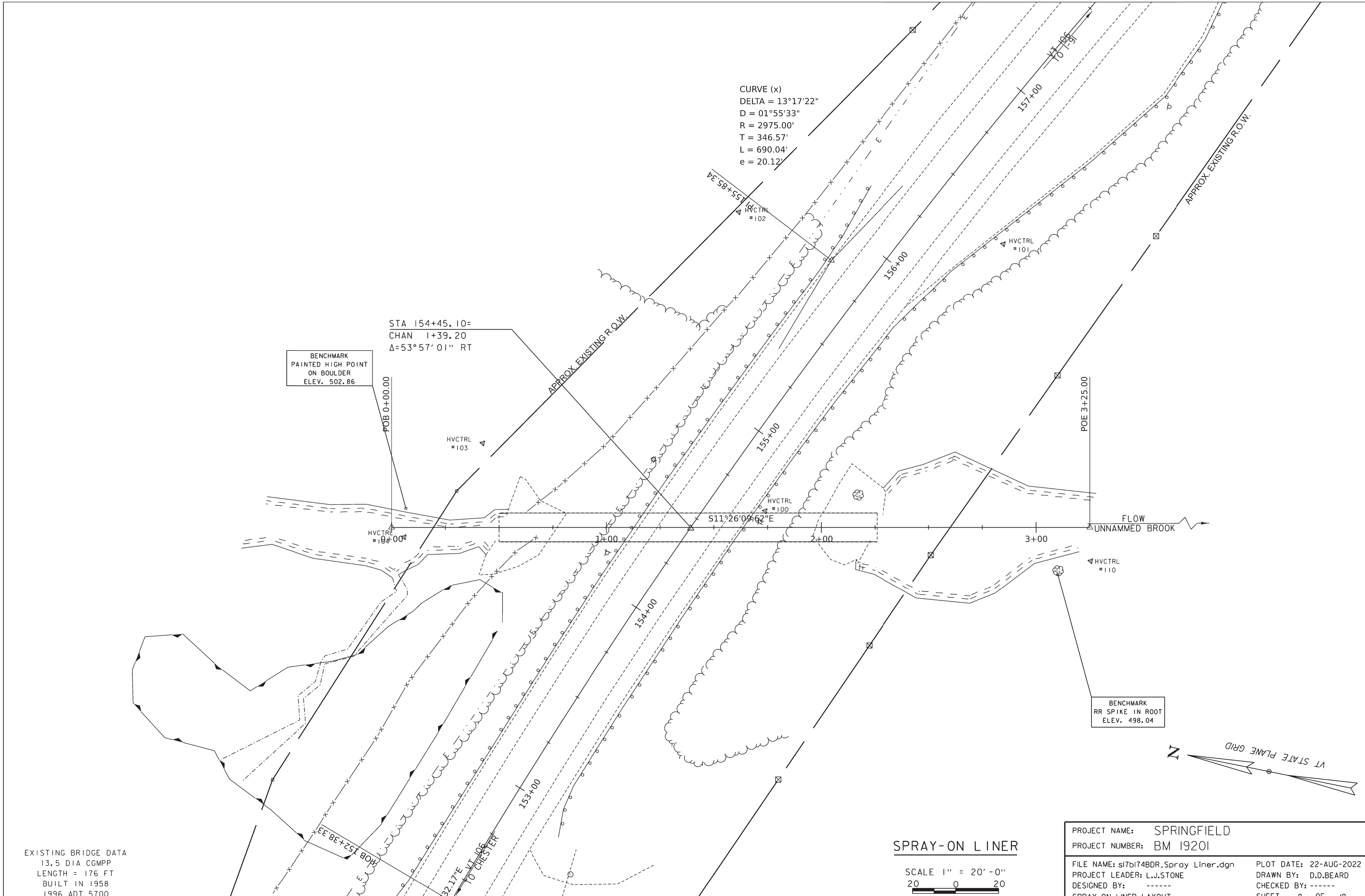


CULVERT LINER CHANNEL PROFILE

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: BM 19201	
FILE NAME: s17b174profile.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
CULVERT LINER PROFILE SHEET	SHEET 7 OF 18



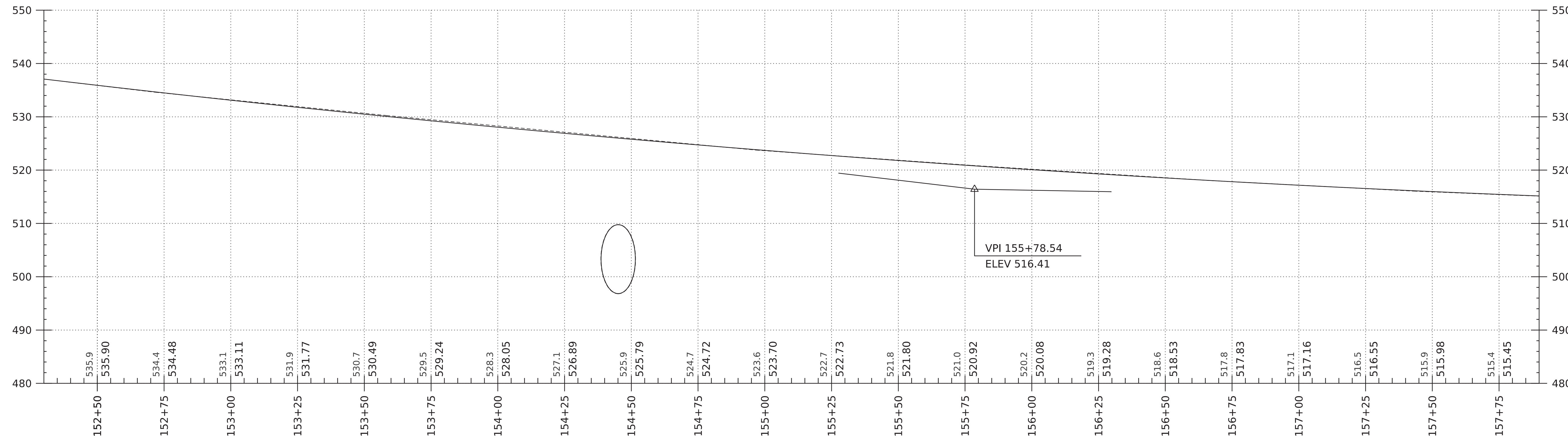
EXISTING BRIDGE DATA
13.5 DIA CGMPP
LENGTH = 176 FT
BUILT IN 1958
1996 ADT 5700

SPRAY-ON LINER

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

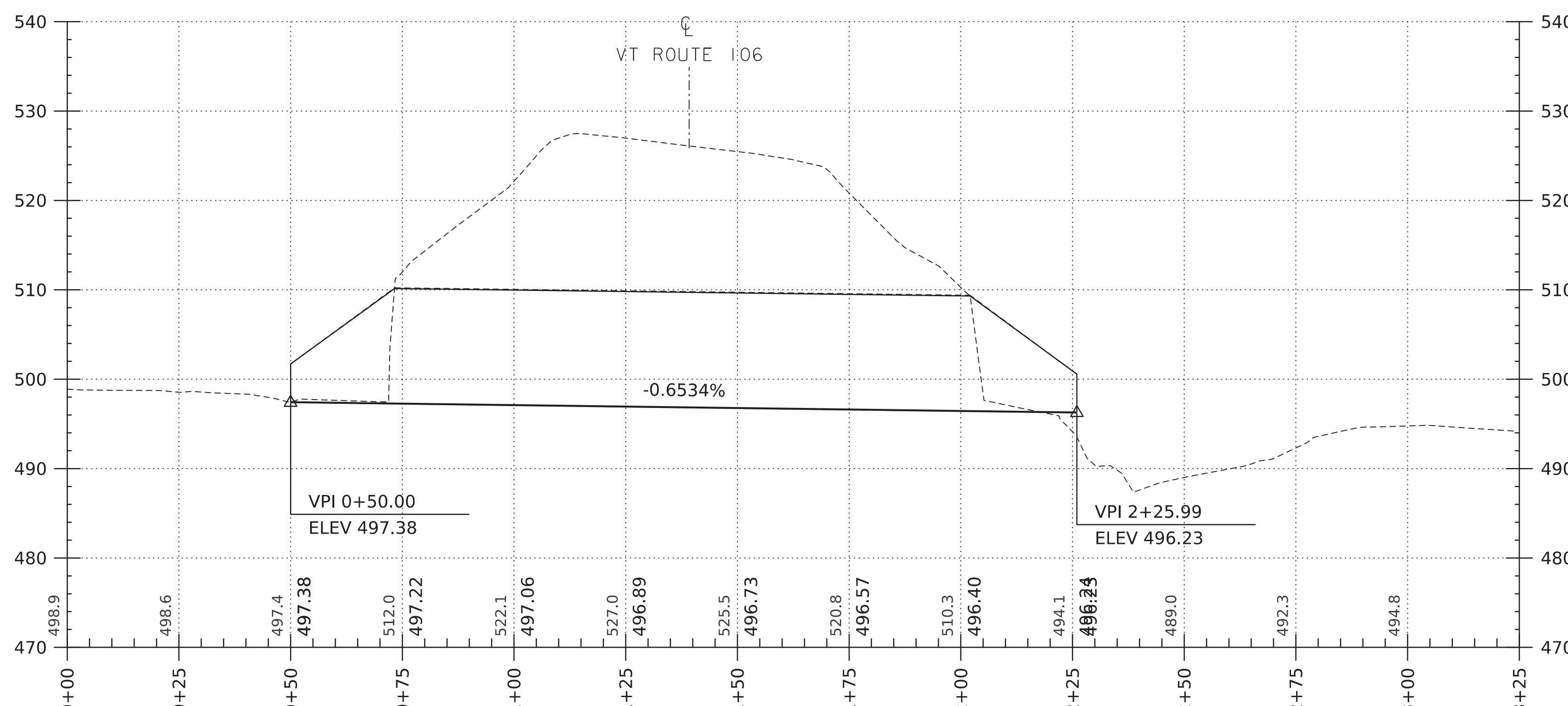
PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BM 19201

FILE NAME: s17b174BDR_Spray Liner.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
SPRAY-ON LINER LAYOUT
PLOT DATE: 22-AUG-2022
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 8 OF 18



VT ROUTE 106 PROFILE

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

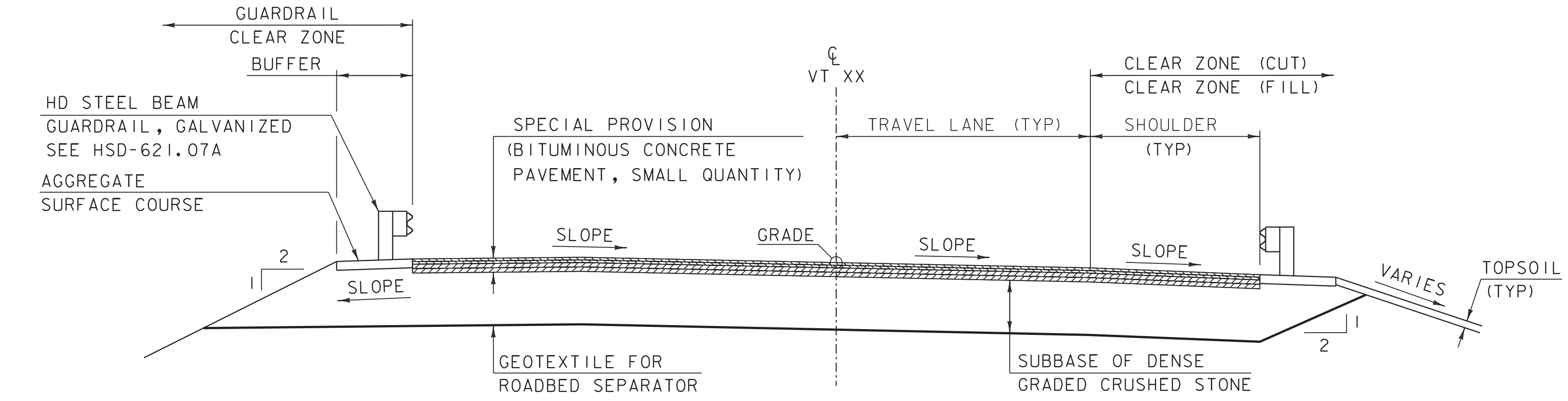


SPRAY-ON-LINER CHANNEL PROFILE

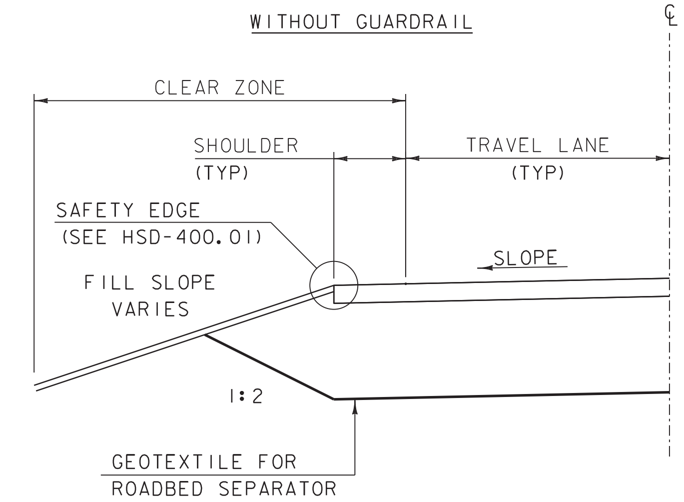
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

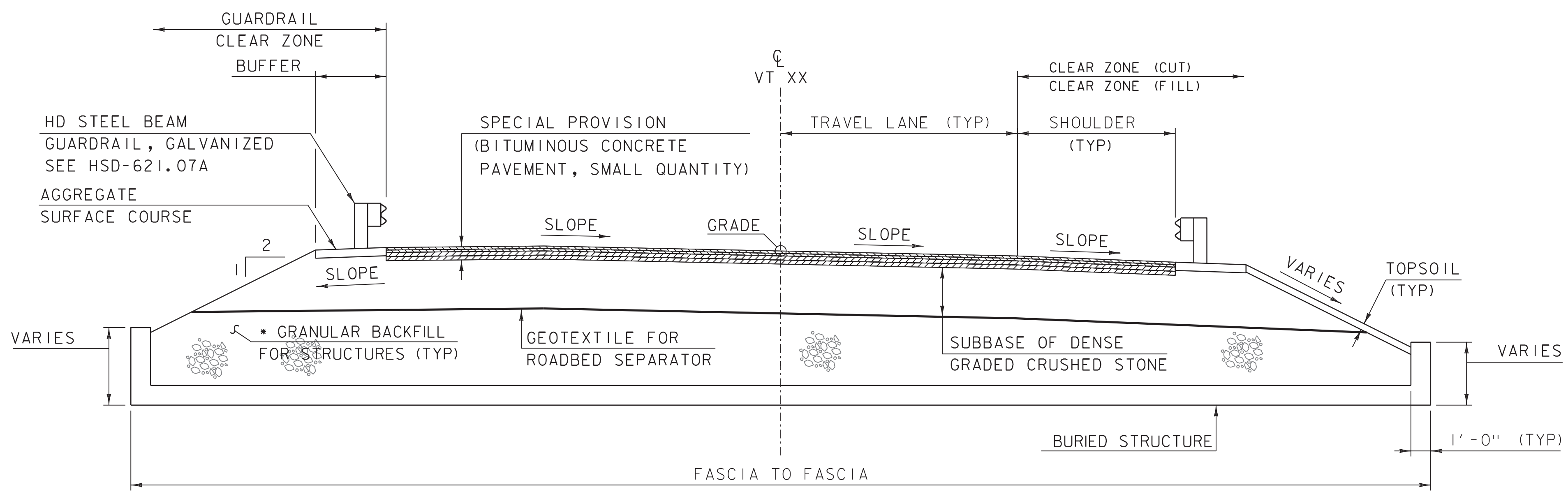
PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BM 19201	
FILE NAME: s17b174profile.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
SPRAY ON LINER PROFILE SHEET	SHEET 9 OF 18



VTXX TYPICAL SECTION
SCALE: 1/4" = 1'-0"



ROADWAY TYPICAL SECTION
NOT TO SCALE



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

ROAD TYPICAL INFORMATION

	LEFT		RIGHT	
	WIDTH	SLOPE	WIDTH	SLOPE
TRAVEL LANE	12'-0"	VARIES	12'-0"	VARIES
SHOULDER	8'-0"	VARIES	8'-0"	VARIES
BUFFER	3'-9"	-0.060	3'-9"	-0.060
FILL SLOPE	---	VARIES	---	VARIES
CLEAR ZONE (CUT)	14'-0"	---	14'-0"	---
CLEAR ZONE (FILL)	16'-0"	---	16'-0"	---
CLEAR ZONE (GUARDRAIL)	4'-9"	---	4'-9"	---

MATERIAL INFORMATION

	THICKNESS	TYPE
WEARING COURSE	1½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IVS)
BINDER COURSE	1½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IVS)
BASE COURSE #2	2½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IIS)
BASE COURSE #1	2½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IIS)
BUFFER	8"	AGGREGATE SURFACE COURSE
SUBBASE	XX"	SUBBASE OF DENSE GRADED CRUSHED STONE
TOPSOIL	4"	TOPSOIL

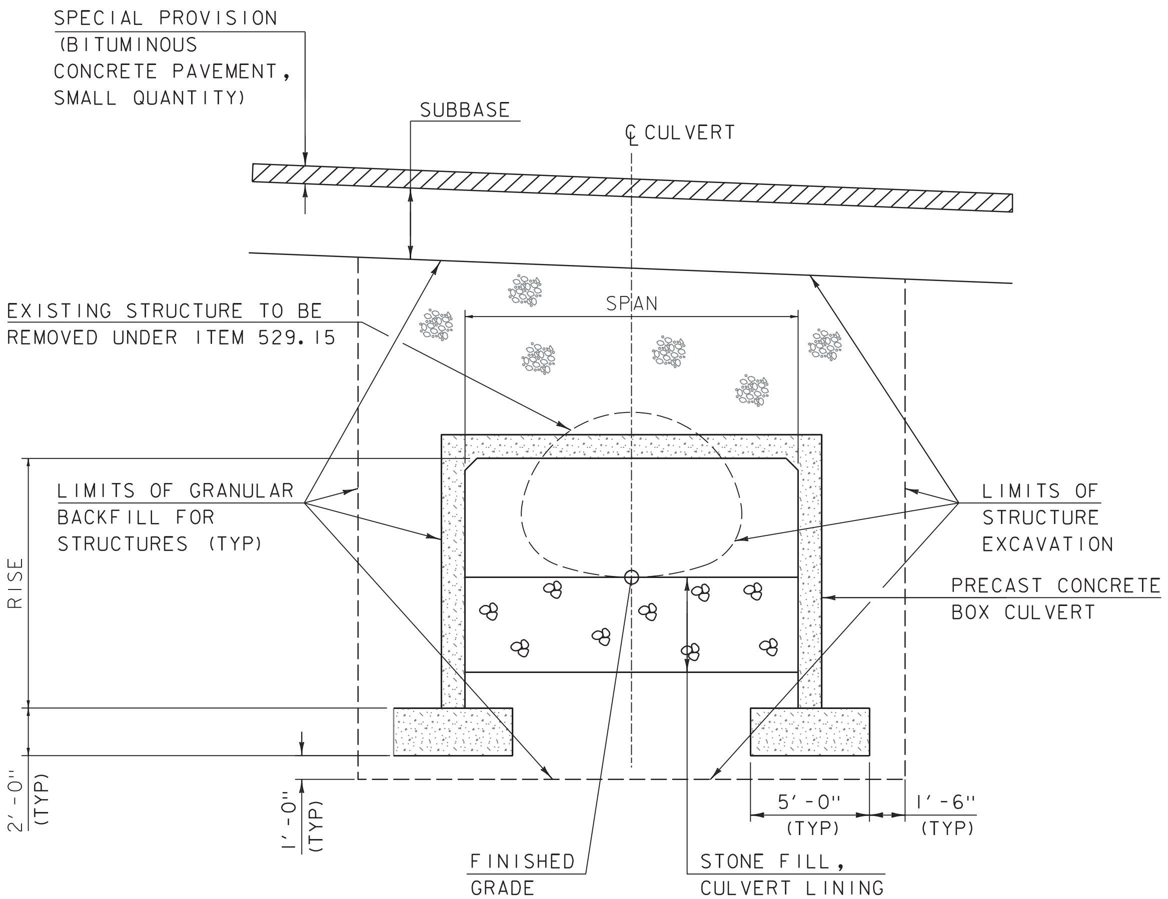
TACK COAT: EMULSIFIED ASPHALT IS TO BE APPLIED AT A RATE OF 0.025 GAL/SY BETWEEN SUCCESSIVE COURSES OF PAVEMENT AND 0.080 GAL/SY ON COLD PLANED SURFACES AS DIRECTED BY THE ENGINEER.

MATERIAL TOLERANCES
(IF USED ON PROJECT)

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BM 19201

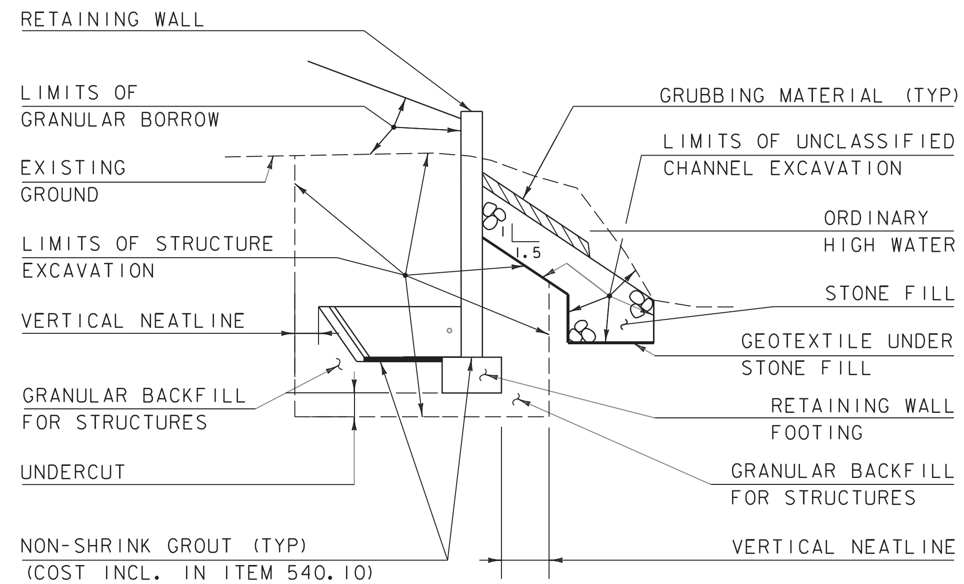
FILE NAME: 17b174/s17b174typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
NEW CULVERT TYPICAL SECTION SHEET 1
PLOT DATE: 22-AUG-2022
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 10 OF 18



SPAN	21'-0"
RISE	12'-0"
LENGTH	200'-0"

CULVERT TYPICAL SECTION

NOT TO SCALE



RETAINING WALL EARTHWORK TYPICAL SECTION

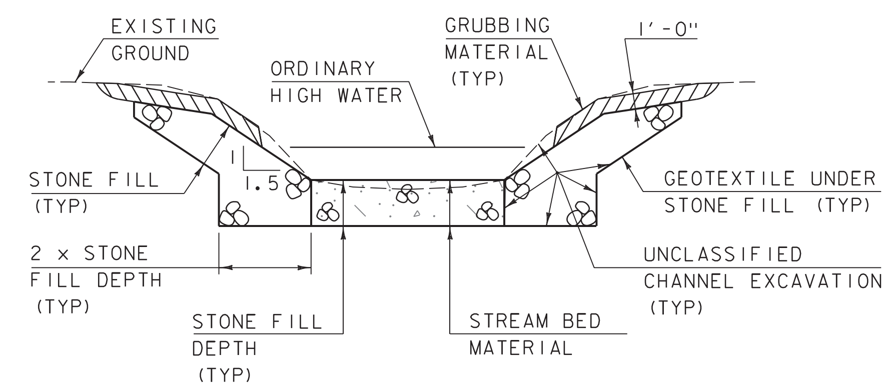
NOT TO SCALE

NOTE:

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

RETAINING WALL - ASSUMED DIMENSIONS

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



TYPICAL CHANNEL SECTION

(NOT TO SCALE)

1) WHENEVER CHANNEL SLOPE INTERSECTS ROADWAY SUBBASE, GRUBBING MATERIAL SHALL BEGIN AT THE BOTTOM OF SUBBASE.

2) THE CONTRACTOR SHALL CREATE A LOW FLOW CHANNEL IN THE STREAM BED MATERIAL AS DIRECTED BY THE ENGINEER.

3) GRUBBING MATERIAL SHALL BE PLACED UNDERNEATH STRUCTURES WHERE THERE IS MORE THAN 6 FEET VERTICALLY FROM ORDINARY HIGH WATER (OHW) TO THE BOTTOM OF SUPERSTRUCTURE AND MORE THAN 6 FEET HORIZONTALLY FROM OHW LINE TO FRONT FACE OF ABUTMENT. THIS MATERIAL SHALL START JUST ABOVE THE OHW ELEVATION AND TERMINATE 3 FEET HORIZONTALLY FROM THE FRONT FACE OF THE ABUTMENT. THIS MATERIAL SHALL NOT BE PLACED UNDERNEATH DOWNSPOUTS. SEE THE CHANNEL SECTIONS FOR ADDITIONAL DETAILING.

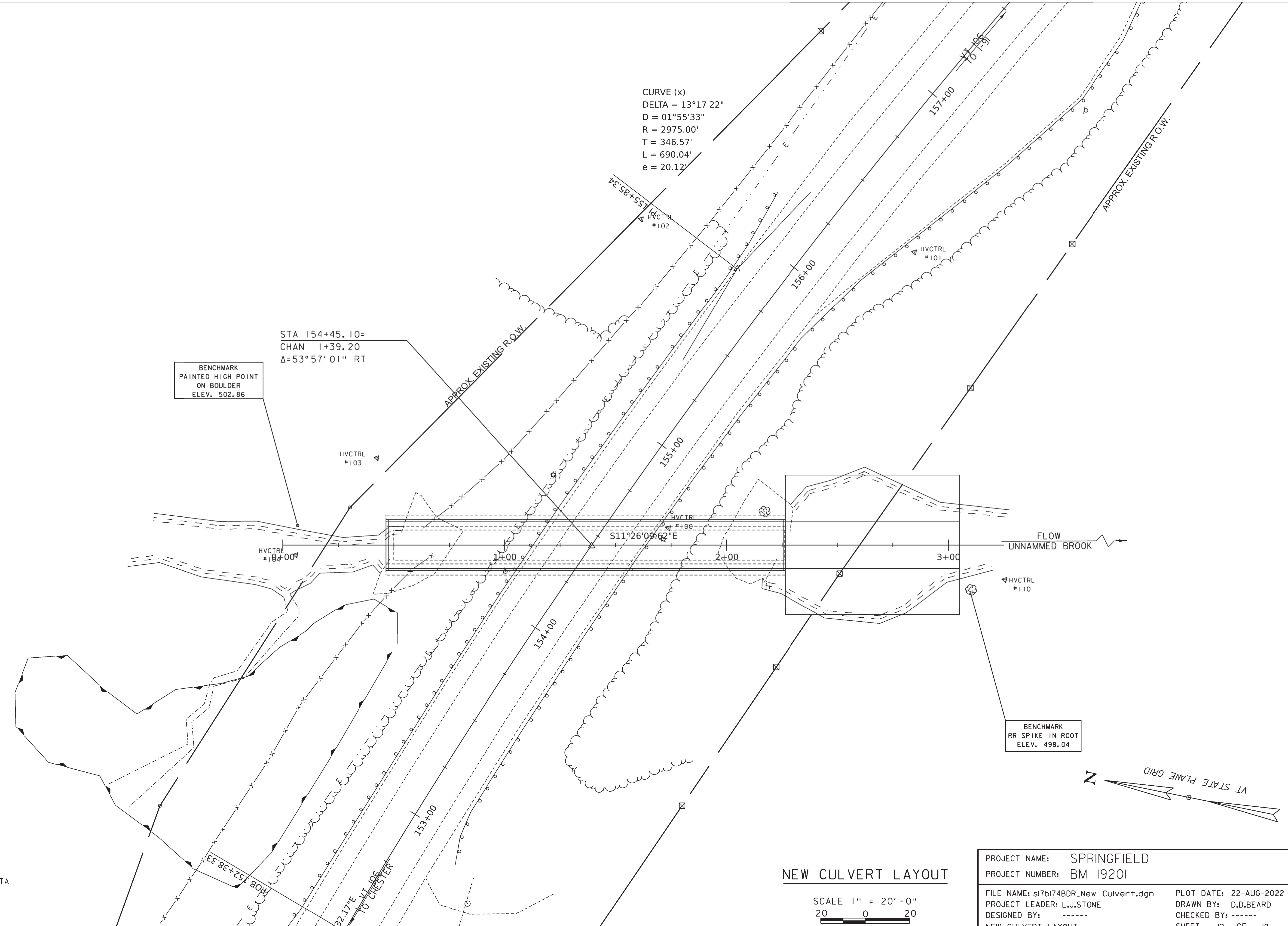
MATERIAL INFORMATION

	THICKNESS	TYPE
STONE FILL	4'-0"	TYPE IV
STONE FILL, CULVERT LINING	4'-0"	E-STONE TYPE IV
STONE FILL, STREAM BED MATERIAL	4'-0"	E-STONE TYPE IV

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BM 19201

FILE NAME: 17b174/s17b174typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
NEW CULVERT TYPICAL SECTION SHEET 2

PLOT DATE: 22-AUG-2022
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 11 OF 18

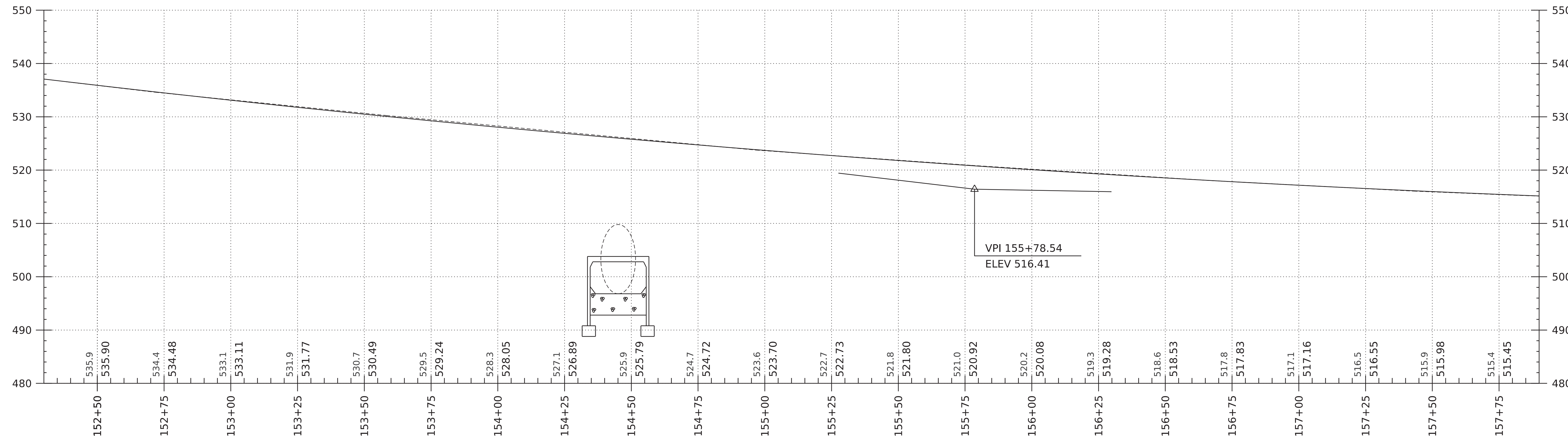


EXISTING BRIDGE DATA
13.5 DIA CGMPP
LENGTH = 176 FT
BUILT IN 1958
1996 ADT 5700

NEW CULVERT LAYOUT

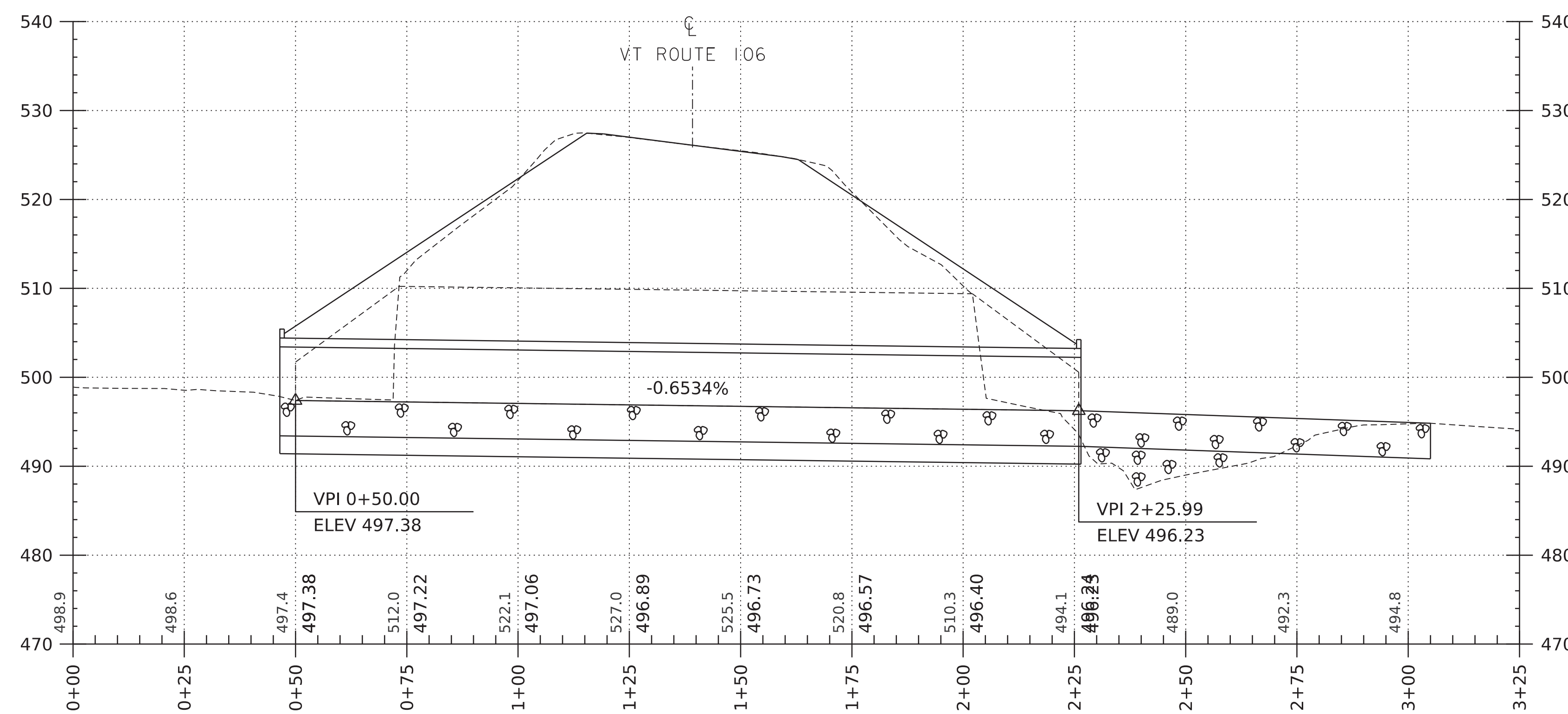
SCALE 1" = 20'-0"

PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BM 19201	
FILE NAME: s17b174BDR_New Culvert.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW CULVERT LAYOUT	SHEET 12 OF 18



VT ROUTE 106 PROFILE

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

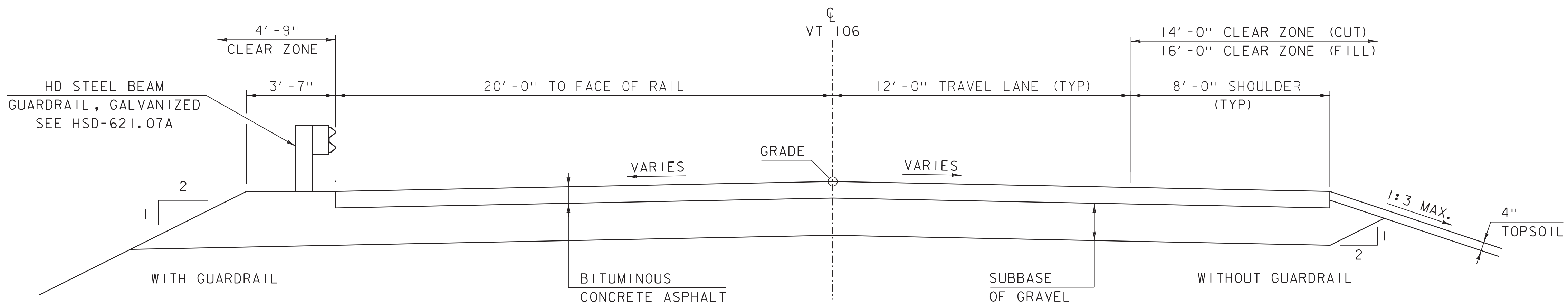


CULVERT REPLACEMENT CHANNEL PROFILE

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

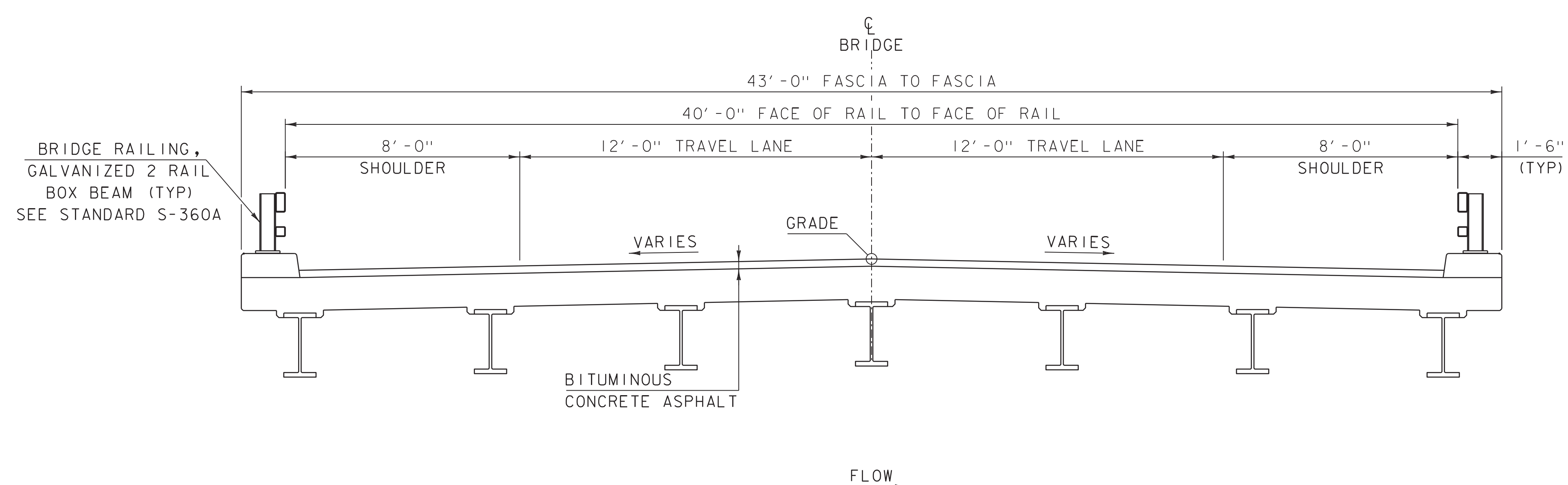
NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BM 19201	
FILE NAME: s17b174profile.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
CULVERT REPLACMENT PROFILE SHEET	SHEET 13 OF 18



PROPOSED VT ROUTE 106 TYPICAL SECTION

SCALE ⅜″ = 1′-0″



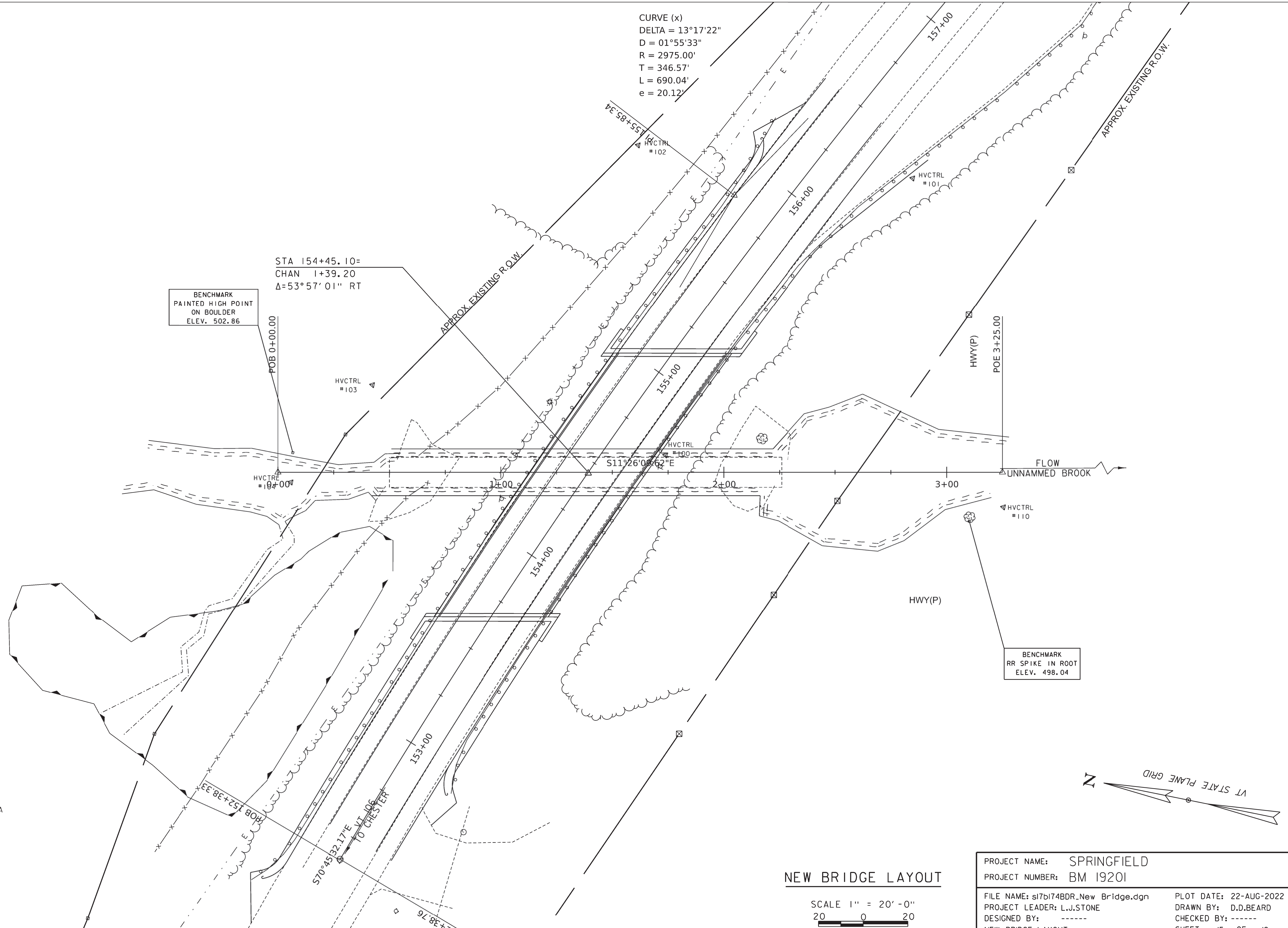
PROPOSED BRIDGE TYPICAL SECTION

SCALE ⅜″ = 1′-0″

MATERIAL TOLERANCES
(IF USED ON PROJECT)

SURFACE	
- PAVEMENT (TOTAL THICKNESS)	+/- ¼″
- AGGREGATE SURFACE COURSE	+/- ½″
SUBBASE	+/- 1″
SAND BORROW	+/- 1″

PROJECT NAME: SPRINGFILED	
PROJECT NUMBER: BM 19201	
FILE NAME: 17b174\s17b174typ.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: -------------	CHECKED BY: ------
NEW BRIDGE TYPICAL SECTIONS	SHEET 14 OF 18



EXISTING BRIDGE DATA
13.5 DIA CGMPP
LENGTH = 176 FT
BUILT IN 1958
1996 ADT 5700

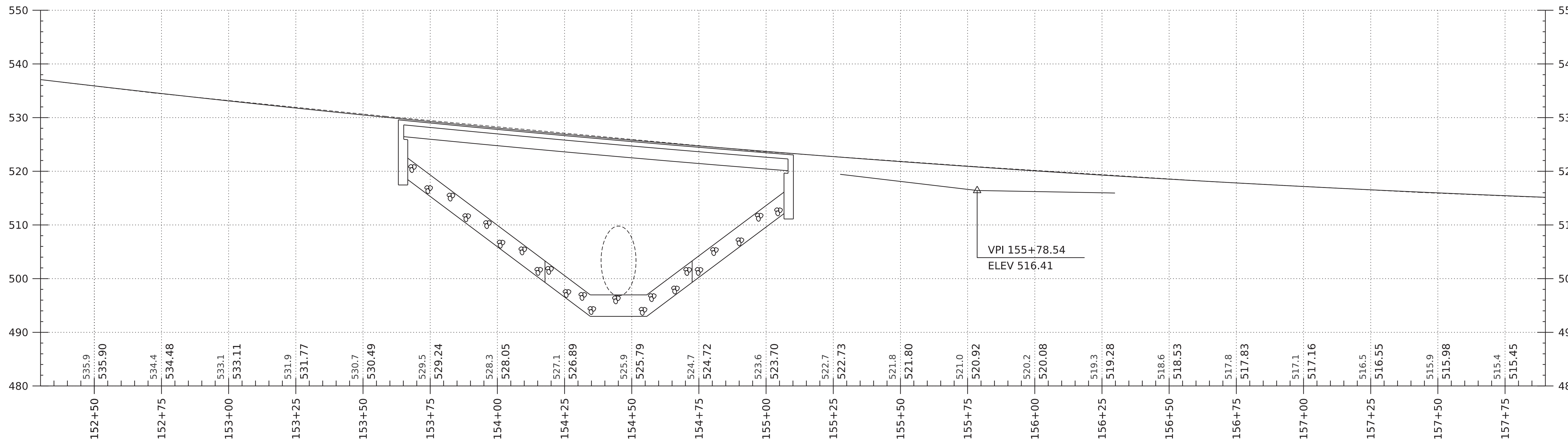
NEW BRIDGE LAYOUT

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BM 19201

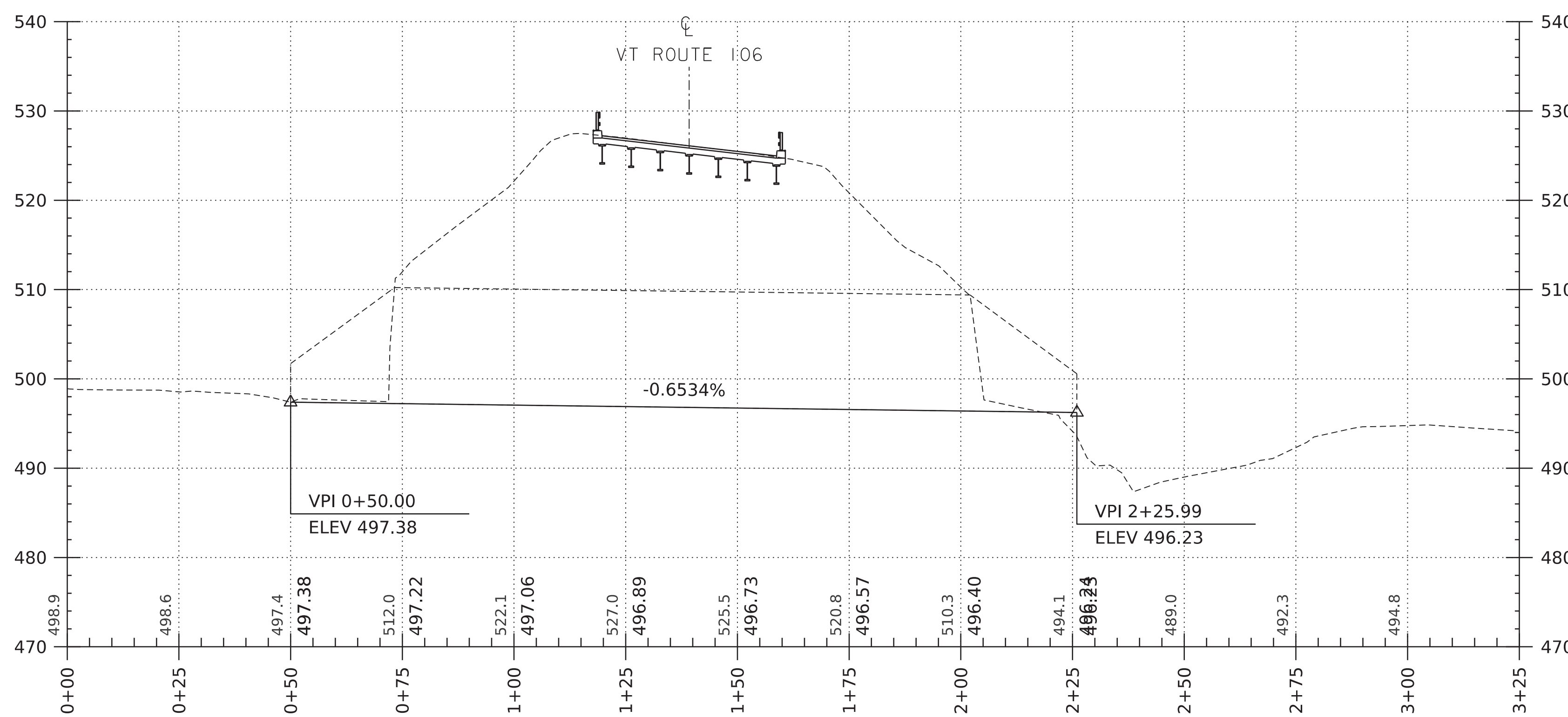
FILE NAME: s17b174BDR_New Bridge.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
NEW BRIDGE LAYOUT

PLOT DATE: 22-AUG-2022
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 15 OF 18



VT ROUTE 106 PROFILE

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

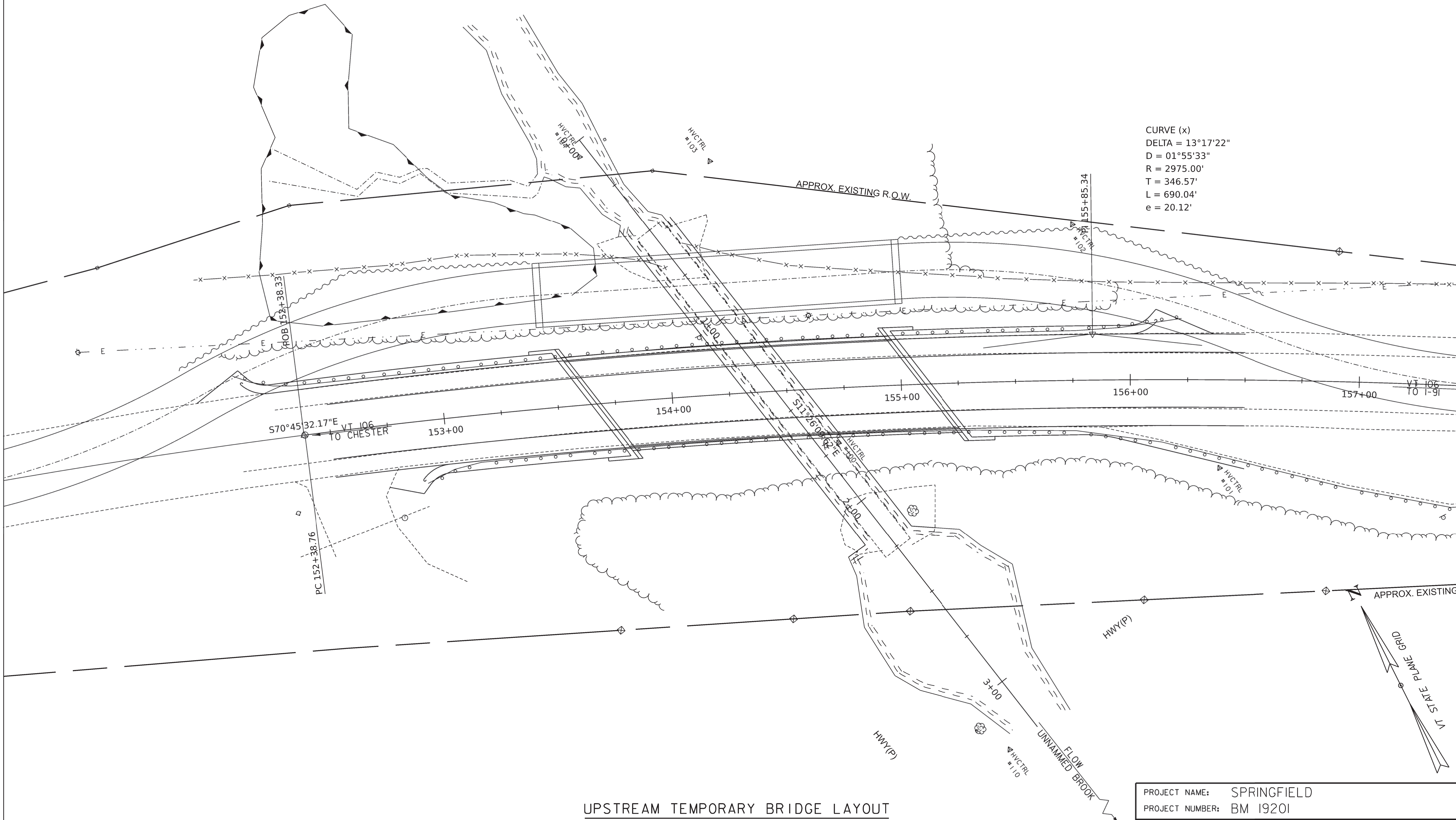


BRIDGE REPLACEMENT CHANNEL PROFILE

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: BM 19201	
FILE NAME: s17b174profile.dgn	PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
BRIDGE REPLACEMENT PROFILE SHEET	SHEET 16 OF 18

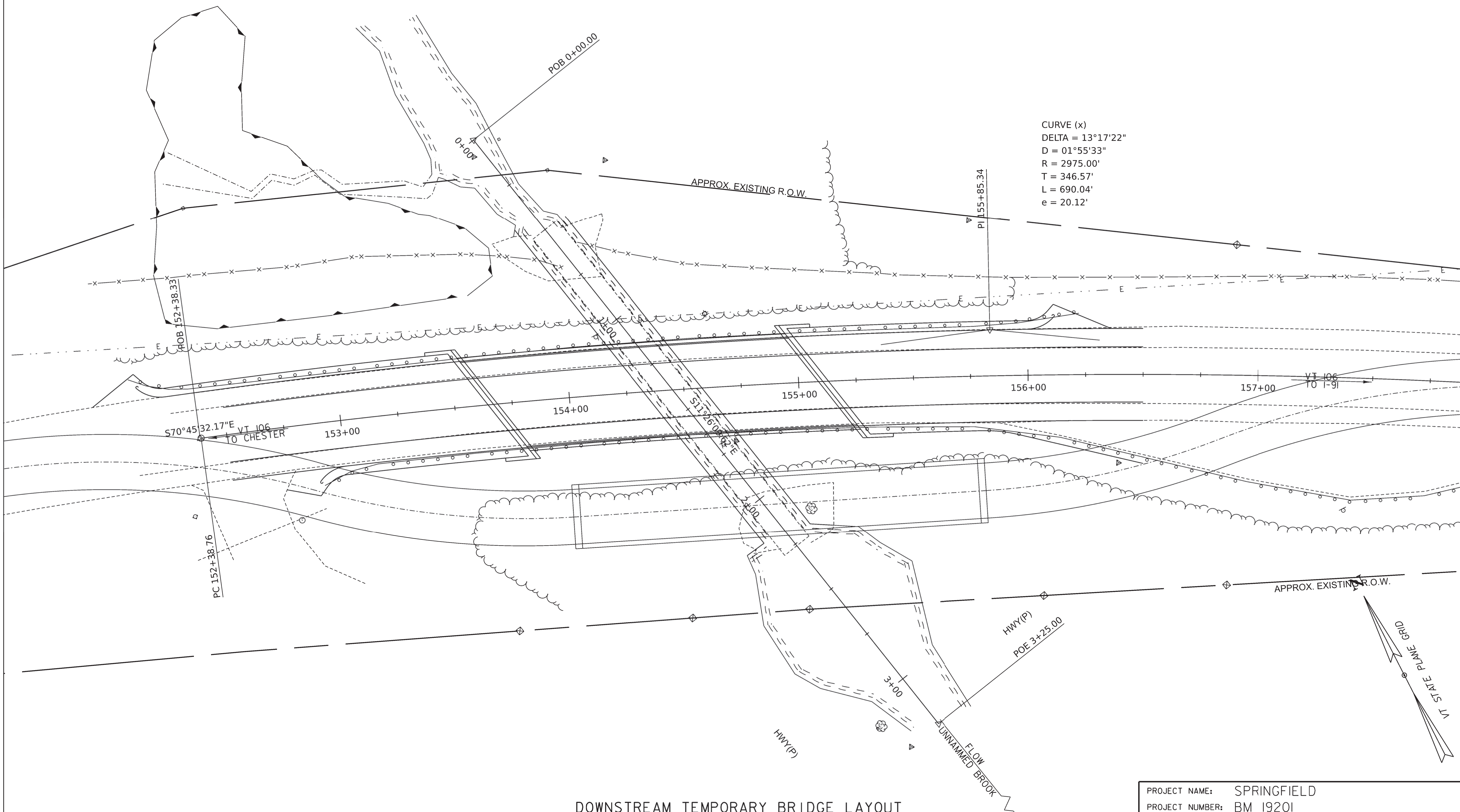


UPSTREAM TEMPORARY BRIDGE LAYOUT

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BM 19201

FILE NAME: s17b174BDR_Upstream Temp Bridge.dgn
PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE
DRAWN BY: D.D.BEARD
DESIGNED BY: ------
CHECKED BY: ------
UPSTREAM TEMPORARY BRIDGE LAYOUT
SHEET 17 OF 18

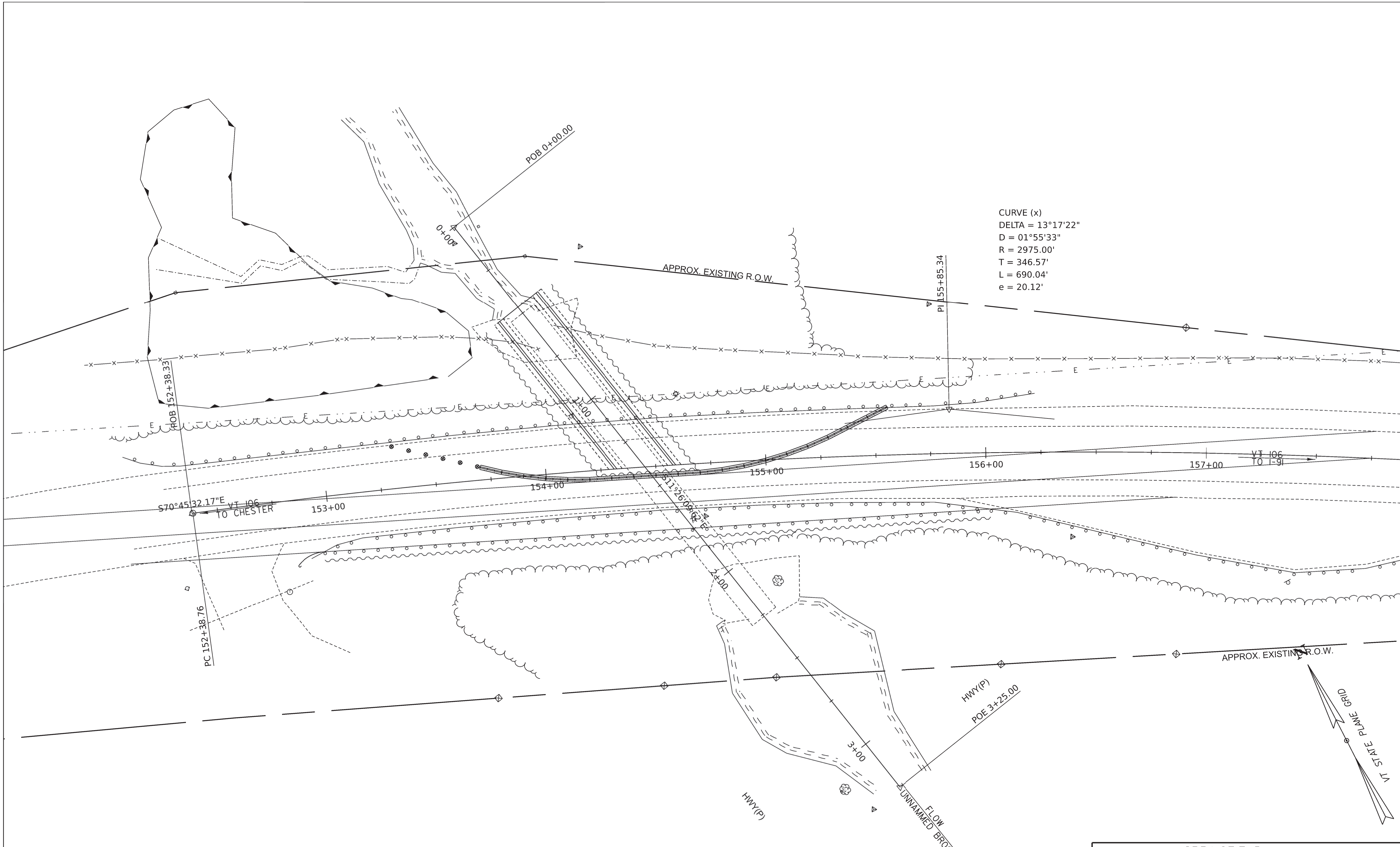


DOWNSTREAM TEMPORARY BRIDGE LAYOUT

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

PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BM 19201

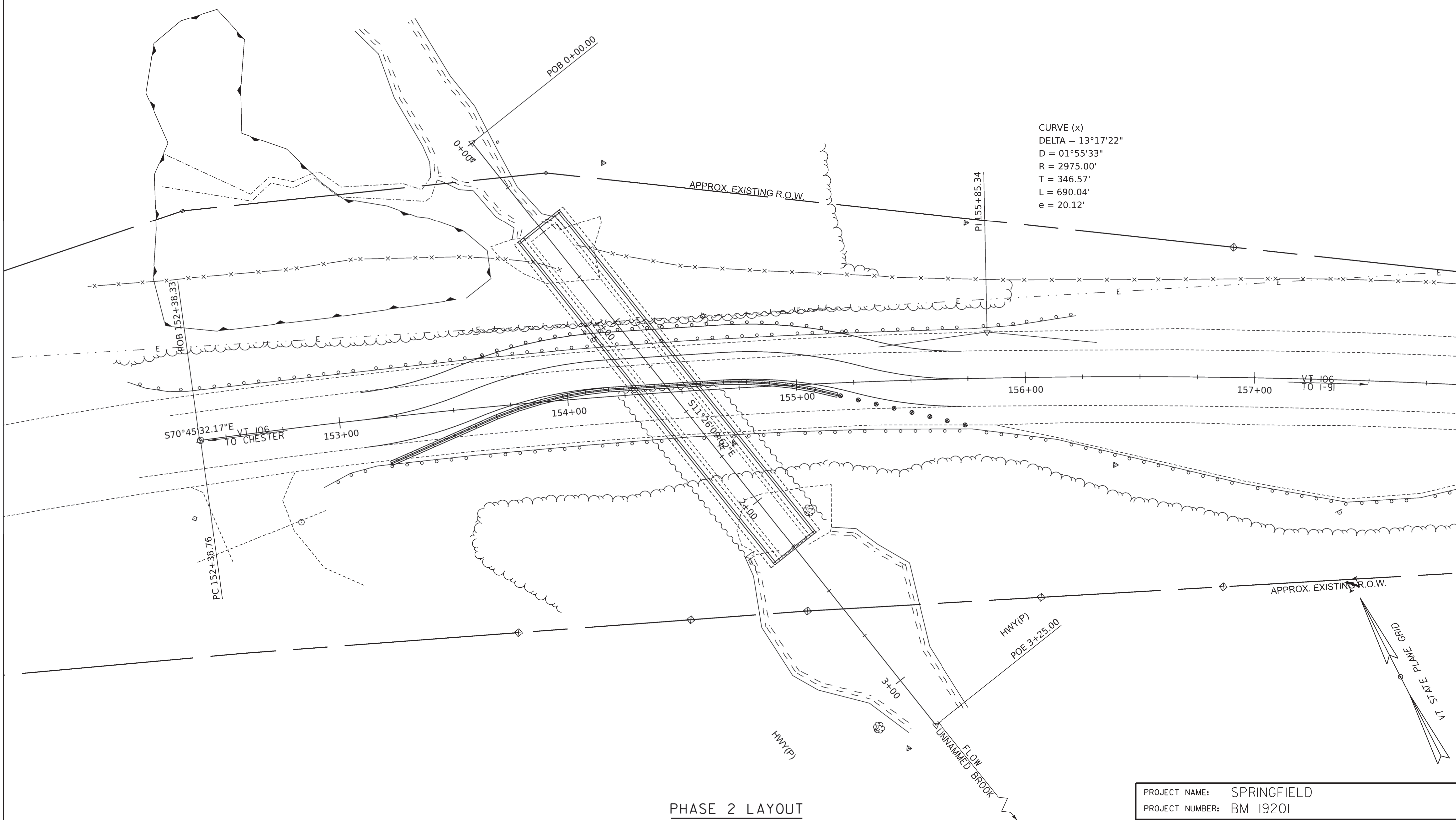
FILE NAME: s17b174BDR_Downstream Temp Bridge.dgn PLOT DATE: 22-AUG-2022
PROJECT LEADER: L.J.STONE DRAWN BY: D.D.BEARD
DESIGNED BY: ------ CHECKED BY: ------
DOWNSTREAM TEMP BRIDGE LAYOUT SHEET 18 OF 18



PHASE I LAYOUT

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

PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BM 19201	
FILE NAME: s17b174BDR_Phase 1.dgn	PLOT DATE: 29-DEC-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
PHASE I LAYOUT	SHEET 19 OF 20



PHASE 2 LAYOUT

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

PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BM 19201

FILE NAME: s17b174BDR_Phase 2.dgn	PLOT DATE: 29-DEC-2022
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
PHASE 2 LAYOUT	SHEET 20 OF 20