

## AHEAD OF THE STORM

Site: Hollow Brook Refugia Design

Location: Hollow Brook, Sugarhouse Lane, Starksboro, Vermont



### Primary Problem

Hollow Brook has been straightened, natural riparian vegetation has been reduced, berms built, and structures encroach on the river area. Lazy Brook Mobile Home Park has encroached on the channel with development, roads, homes, and an informal rock berm on the east side of the channel. Alterations have reduced river and floodplain functions. A steep tributary immediately upstream of the mobile home park is receiving runoff collected in the road drainage network on Lincoln Hill Road. The tributary has deep gully erosion and is transporting large amounts of sediment to Hollow Brook. Abandoned bridge abutments are constricting the river and causing floodwaters to leave the channel and flow into the neighborhood. The double culvert passing under Sugarhouse Lane is perched – trapping sediment upstream, increasing flood levels, and blocking fish passage.

Flood water carrying sediment has occasionally spilled out of Hollow Brook and a steep tributary and caused damage and sediment deposition on a neighborhood road, around multiple homes, and on a farm field. This area is the former location of an alluvial fan where the channel slope decreases and sediment deposits. Flow from the fan spilled into the downstream wetland complex before the river was channelized. This area was likely a wetland with meandering channels prior to the channel being moved to the edge of the valley. (*See existing conditions site summary and plan*).

The primary goals are to improve water quality protection and flood resiliency by reducing river encroachments, reducing erosion, and enhancing vegetation. This project will begin to reverse the impacts for historic stream alteration and river corridor encroachment that have impacted Hollow Brook.

### Final Treatment Recommendations

1. Restore river channel and adjacent riparian areas downstream of Sugarhouse Lane. Consider channel restoration, wetland restoration, river corridor easements, large wood additions, and plantings.
2. Replace driveway culverts with a new open bottom structure that is geomorphically compatible and improves aquatic organism passage.
3. Remove remaining abutments and concrete in river at abandoned bridge crossing.
4. Reduce road swale runoff directed to the tributary on Lincoln Hill Road with Town and CCPRC.

### Site Constraints and Design Basis

The design takes a multi-action approach to restore the channel to naturalize the hydraulics, sediment regime, and habitat. Existing infrastructure and homes within the floodprone area have constrained the amount of land recommended for restoration. Sugarhouse Lane structure design includes an open bottom three-sided-box to accommodate the large amount of sediment and abrupt change in channel slope. The design includes a natural stream bottom, a span of 1.2 times the bankfull width, and more than 4 times bankfull height, meeting geomorphic and aquatic habitat compatibility design recommendations. The constricting concrete and fill will be removed to restore bankfull width and overland floodplain flow at the old bridge abutments. An initial removal of accumulated sediment upstream of both crossing constrictions is recommended as a one-time sediment balancing to remove the unnatural piles that were previously unable to pass downstream. Long-term maintenance procedures and costs are minimized by adopting practices that reduce the conflict with the river.

### Cost

Construction and engineering services for the culvert replacement is estimated to cost \$328,000 and the removal of the bridge abutments is estimated to cost \$54,000. Costs include final design, permitting, and construction. (*See attached cost estimates.*) Channel restoration and road swale runoff reduction are recommended for continued project development.

# AHEAD OF THE STORM

## EXISTING CONDITIONS SUMMARY

Location: Hollow Brook, Sugarhouse Lane, Starksboro, Vermont



### Site Description

Hollow Brook has been historically altered near the Lazy Brook Mobile Home Park reducing river and floodplain functions (Existing Conditions Map). Flood water carrying sediment has occasionally spilled out of Hollow Brook and a steep tributary and caused damage and sediment deposition on a neighborhood road, around multiple homes, and on a farm field. This project evaluates channel and floodplain alternatives to improve water quality, habitat, and flood resiliency.

### Drainage Patterns

Upstream of Lazy Brook Mobile Home Park Hollow Brook is in a narrowly confined channel with steep valley walls. Two mass failures and steep gullies exist. The mass failures were found to be naturally stabilizing and not contributing large amounts of sediment. A steep tributary immediately upstream of the mobile home park is receiving runoff collected in the road drainage network on Lincoln Hill Road. The tributary has deep gully erosion and is transporting large amounts of sediment to Hollow Brook. Sediment has been removed from the channel 2-3 times per year and is in need of removal again as it is currently accumulated high above a nearby home and filling the downstream channel creating increased flood risk.

Lazy Brook Mobile Home Park has encroached on the channel with development, roads, homes, and an informal rock berm on the east side of the channel (river left looking downstream). Abandoned bridge abutments are constricting the river and causing floodwaters to leave the channel and flow into the neighborhood. This area is the former location of an alluvial fan where the channel slope decreases and sediment deposits. Flow from the fan spilled into the downstream wetland complex before the river was channelized.

The double culvert passing under Sugarhouse Lane is perched – trapping sediment upstream and blocking fish passage. The landowner reports that they regularly remove wood caught at the culvert and that the culvert has been overtopped by flood waters. This is the only access over the river to private land. A home is located immediately upstream of the culvert and is at risk of flooding and erosion damage if the culvert is clogged.

Hollow Brook has been straightened and natural riparian vegetation has been reduced due to past and current agricultural fields downstream of Sugarhouse Lane. This area was likely a wetland with meandering channels prior to the channel being moved to the edge of the valley. The channel has filled with sediment and is dry during periods of low flow. Flow travels subsurface starting at the culvert and emerges in the middle of the field and downstream of the beaver dams during dry periods. The beaver dams may be capturing excess sediment. The agricultural field is no longer being actively used, but still does not have natural hydrology or riparian vegetation.

### Site Constraints

Existing neighborhood land uses are likely to continue. Landowners may not want to give up potential agricultural land uses. Culvert upgrades will need to consider access during construction.

### Possible Treatment Options Identified

1. Restore river channel and adjacent riparian areas downstream of culvert where Hollow Brook is full of accumulated sediment, has been historically straightened, and placed along field edge to make space for agriculture. Consider channel restoration, wetland restoration, river corridor easements, large wood additions, and plantings.
2. Replace driveway culverts with a new crossing structure that is geomorphically compatible and improves aquatic organism passage.
3. Remove remaining abutments and concrete in river at abandoned bridge crossing.
4. Discuss potential to reduce road swale runoff directed to the tributary on Lincoln Hill Road with Town.







## AHEAD OF THE STORM

Site: Hollow Brook

Location: Sugarhouse Lane, Starksboro, Vermont

## EXISTING CONDITIONS PHOTO LOG



*Figure 1: A former agricultural field is located to the east of Hollow Brook. It is often wet and likely used to be wetland before it was cleared for farmland (October 2, 2020).*



*Figure 3: Hollow Brook has been straightened and is dry portions of the year downstream from the culverts where deposited sediment has filled in the channel bed (October 2, 2020). The channel was observed flowing October 28, 2019 and December 6, 2020 and observed dry August 3, 2020, October 2 and 9, 2020.*



*Figure 2: Small channels wind throughout the field shown in Figure 1. These are potentially the historic flow path (October 2, 2020).*



*Figure 4: Several beaver dams have been built in Hollow Brook near the southern end of the field (October 2, 2020). The beaver dams are collecting sediment upstream, which is now filling the channel up to the culverts, causing subsurface flow during dry periods, and depositing sediment into the field. These low velocity areas combined with large sediment inputs are combining to fill the channel with sediment.*



## AHEAD OF THE STORM

Site: Hollow Brook

Location: Sugarhouse Lane, Starksboro, Vermont



## EXISTING CONDITIONS PHOTO LOG



*Figure 5: Flows left Hollow Brook in several spots and carried materials into the field, as shown on the left side of this photo (October 9, 2020).*



*Figure 7: Some of these deposits are very large. This one is about 30-40 ft wide (October 9, 2020).*



*Figure 6: Gravel deposits have been left by these flows far outside the main channel (October 9, 2020).*



*Figure 8: A berm (image center) runs along the channel bank (image left) downstream of the culverts. It extends approximately 240 ft (October 9, 2020).*



# AHEAD OF THE STORM

Site: Hollow Brook

Location: Sugarhouse Lane, Starksboro, Vermont



## EXISTING CONDITIONS PHOTO LOG



Figure 9: The driveway culverts are perched with a scoured pool at the downstream end of the culverts (December 6, 2020).



Figure 11: A view of the channel looking downstream from on top of the culverts (October 9, 2020).



Figure 10: The channel begins to go dry at the culverts (October 9, 2020). A view of the culverts from upstream.



Figure 12: A view of the channel looking upstream from on top of the culverts (December 6, 2020). Large sediment deposits fill the channel, covering tree bases.



# AHEAD OF THE STORM

Site: Hollow Brook

Location: Sugarhouse Lane, Starksboro, Vermont



## EXISTING CONDITIONS PHOTO LOG



Figure 13: When flow backs up at the old abutment constriction, the water flows out onto nearby Elm Lane, damaging homes, and carrying sediment (October 9, 2020).



Figure 15: View of old bridge abutments looking upstream. There is a steep riffle and sediment deposit filling the river channel and contributing to flows leaving the channel (December 12, 2020).



Figure 14: A concrete sill crosses the river at an abandoned crossing. Abutments constrict channel to 12.5' wide. View of old bridge abutments looking upstream (December 6, 2020).



Figure 16: View of old bridge abutments looking downstream (October 2, 2020).



# AHEAD OF THE STORM

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## EXISTING CONDITIONS PHOTO LOG



Figure 17: Stormwater from Lincoln Hill Road is collected in road ditches and directed to a Hollow Brook tributary (October 9, 2020).



Figure 19: Gully erosion is causing large amounts of sediment to move down the very steep Hollow Brook tributary and into Hollow Brook (October 2, 2020).



Figure 18: Stormwater from Lincoln Hill Road flows over erosion stone and then enters to top of the steep gully channel (October 9, 2020).



Figure 20: Runoff from uphill along Lincoln Hill Road flows down this steep tributary, contributing large amounts of sediment which have been cleaned out often and now bermed up to protect nearby home (October 2, 2020).



## AHEAD OF THE STORM

Site: Hollow Brook

Location: Sugarhouse Lane, Starksboro, Vermont



## EXISTING CONDITIONS PHOTO LOG



*Figure 21: Sediment has washed down into the Hollow Brook channel and has been bermed up on both sides to recreate the path to the river where sediment has deposited (October 2, 2020).*



*Figure 23: Many homes along Elm Lane and Lazy Brook Drive are vulnerable to damages from inundation or sediment deposition. Several have already experienced damages (October 2, 2020).*



*Figure 22: Sediment has washed down into the Hollow Brook channel (October 2, 2020).*



*Figure 24: Upstream mass failures were investigated and found to be naturally healing and not contributing large amounts of sediment to the channel (October 2, 2020).*



## AHEAD OF THE STORM

Site: Hollow Brook

Location: Sugarhouse Lane, Starksboro,  
Vermont



## EXISTING CONDITIONS PHOTO LOG

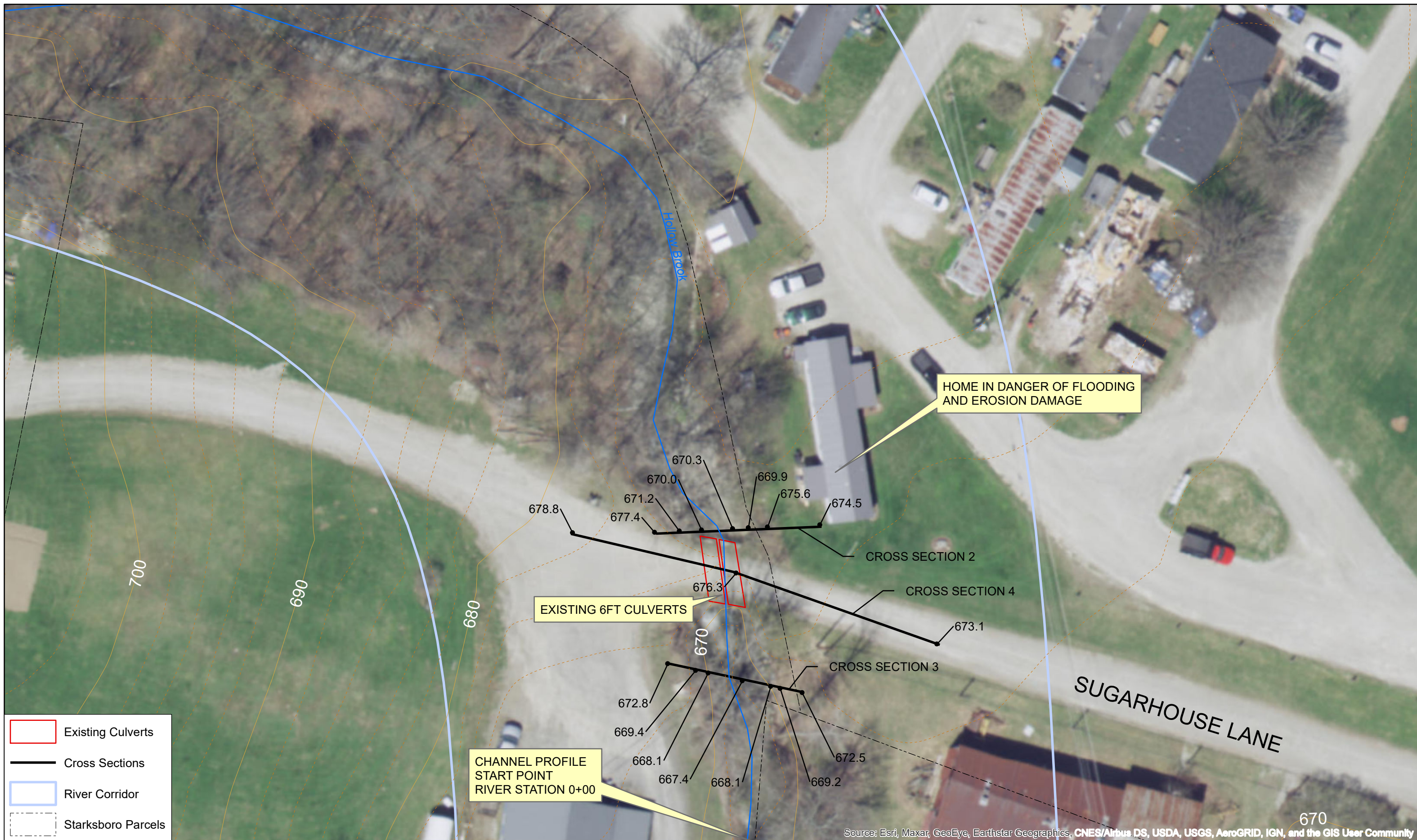


*Figure 25: Upstream mass failures naturally healing with vegetation (October 2, 2020).*



*Figure 26: Upstream mass failures naturally healing with vegetation (October 2, 2020).*









- Existing Culverts
- Proposed Structure
- Proposed Road and Shoulder
- Proposed Stacked Stone Wall
- Temporary Crossing
- Temporary Crossing Culvert
- Removal
- River Corridor
- Starksboro Parcels

REPLACE EXISTING 6FT DIAMETER CULVERTS WITH 1.2 TIMES BANKFULL WIDTH OPEN BOTTOM STRUCTURE, 24 FEET WIDE

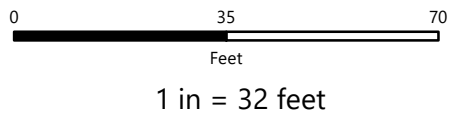
REMOVE SEDIMENT DEPOSITION

PROPOSED STACKED STONE WALL

MAINTAIN 12 FOOT TRAVEL LANE, REALIGN TO CROSS RIVER PERPENDICULAR

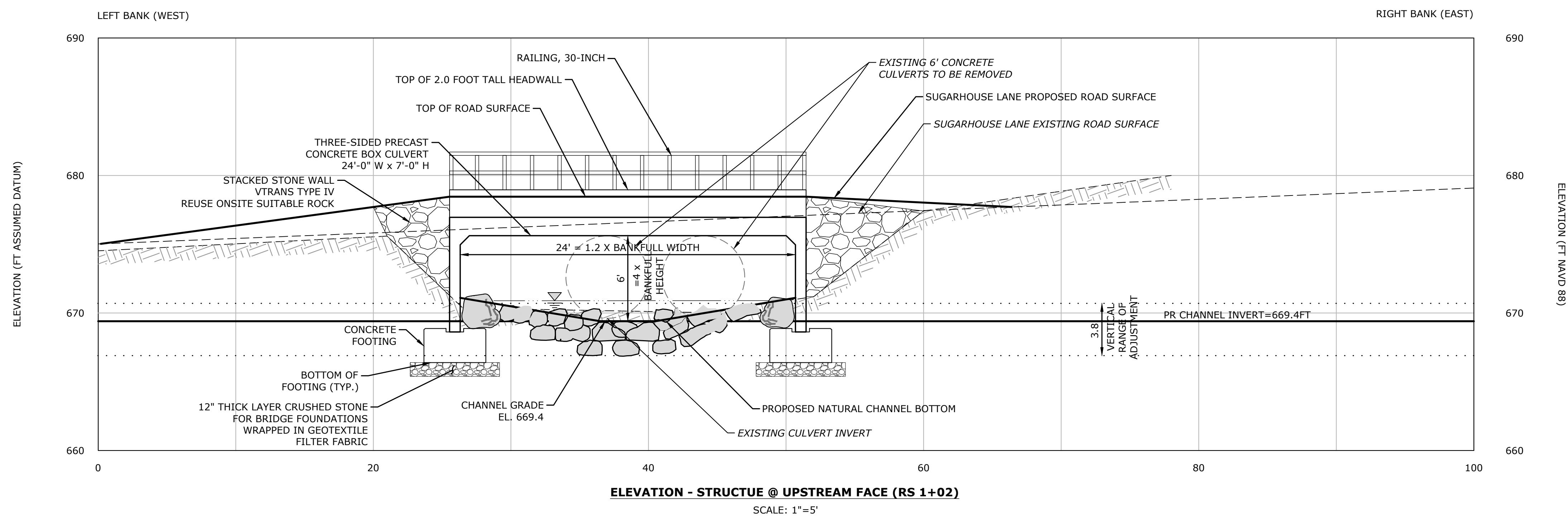
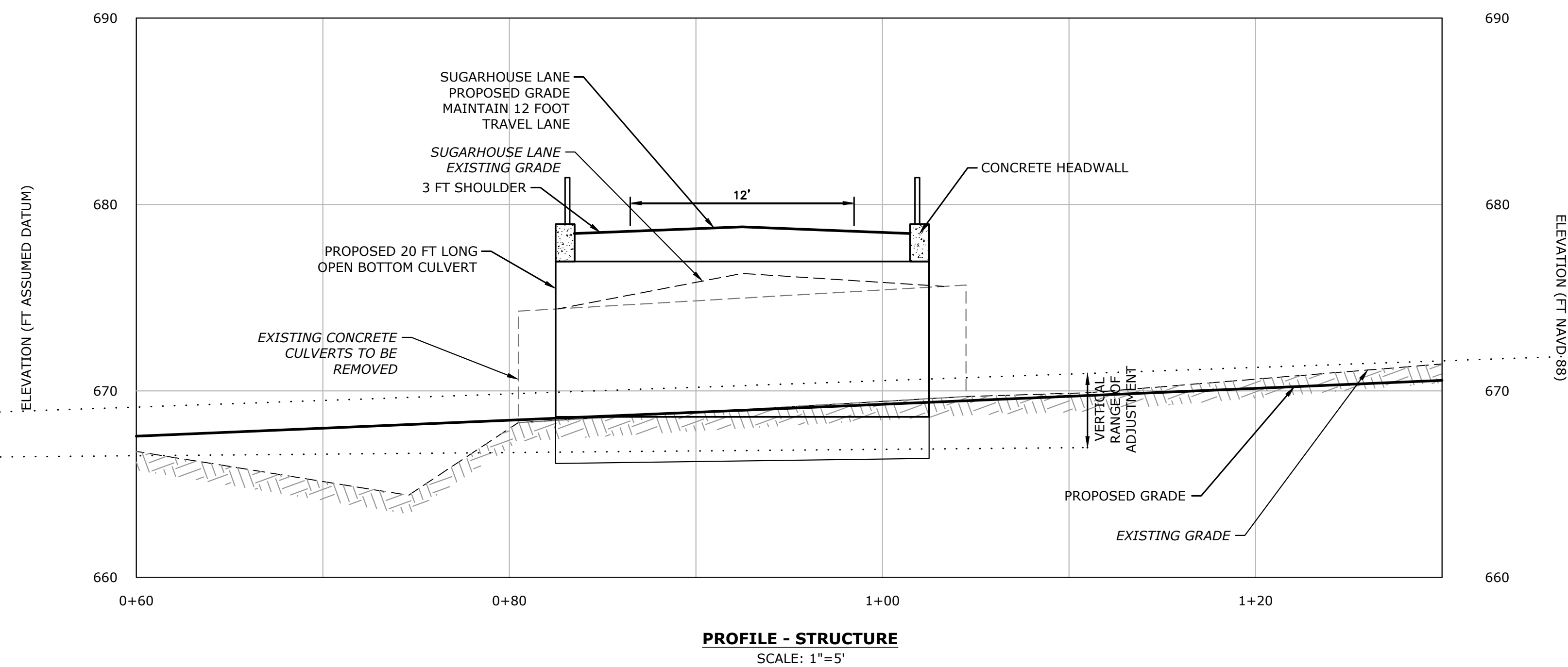
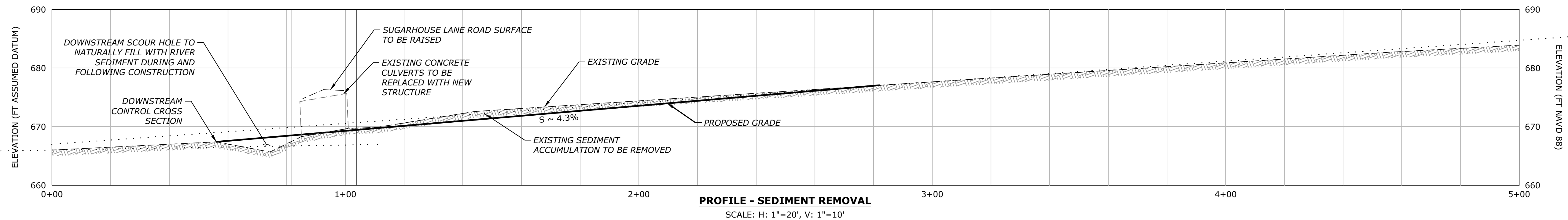
CONSTRUCT TEMPORARY CROSSING DURING CONSTRUCTION TO ACCESS HOMES USING SECTIONS OF EXISTING 6 FOOT CULVERT

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





SHEET 3 OF 4  
 PROJECT NO. 3452-36  
 DATE NOVEMBER 17, 2021  
 DRAWN BY CMN  
 CHECKED BY JCL  
 DESIGNED BY CMN  
 SCALE VARIES  
 SHEET NAME XS



DESCRIPTION	DATE	BY

CONCEPT DESIGN

TYPICAL SECTIONS - CULVERT  
 HOLLOW BROOK REFUGIA DESIGN  
 SUGARHOUSE LANE  
 STARKSBORO, VERMONT

DESIGNED BY	CMN
DRAWN BY	CMN
CHECKED BY	JCL
SCALE	VARIES
DATE	NOVEMBER 17, 2021
PROJECT NO.	3452-36
SHEET NO.	3 OF 4
SHEET NAME	XS



SEDIMENT REMOVAL



SEDIMENT REMOVAL IMMEDIATELY UPSTREAM OF CULVERTS

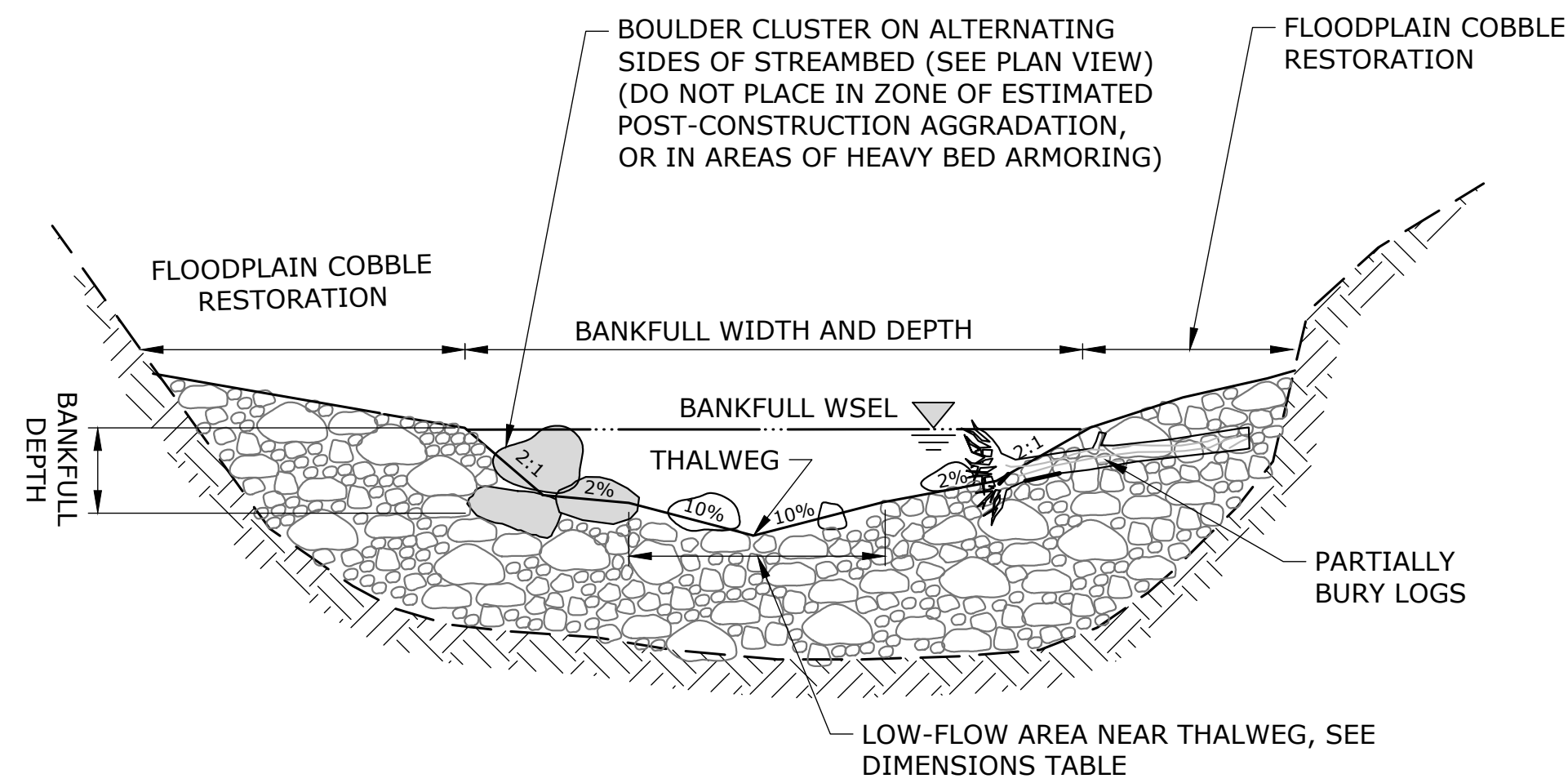
SEDIMENT REMOVAL



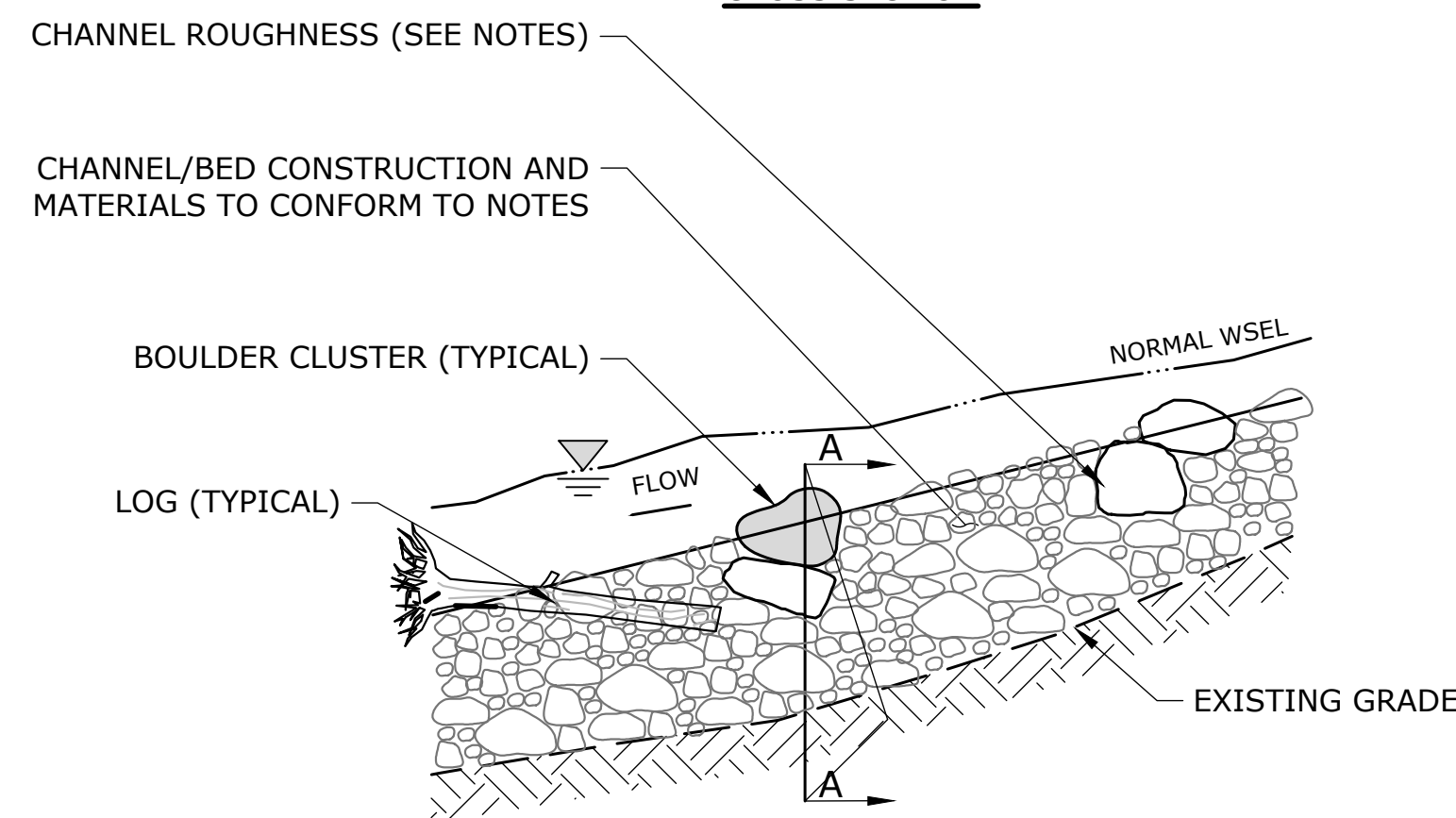
SEDIMENT REMOVAL AT UPSTREAM END OF CULVERT AREA

**OPERATION & MAINTENANCE NOTES**

1. ANNUALLY AFTER SNOW MELT AND FOLLOWING LARGE STORM EVENTS WITH MORE THAN 2.5 INCHES OF RAINFALL, INSPECT STRUCTURE.
2. REMOVE ACCUMULATED LARGE WOOD AT STRUCTURE ENTRANCE.
3. USE STONE TO STABILIZE ANY AREA SHOWING EROSION ON THE EMBANKMENT OR CHANNEL BANKS AT THE STRUCTURE.
4. SEDIMENT IS EXPECTED TO CONTINUE TO ACCUMULATE IN THIS ALLUVIAL FAN AREA. CONSULT WITH VTANR RIVER ENGINEERS AND CONSIDER REMOVAL OF SEDIMENT IF SEDIMENT INSIDE OR UPSTREAM OF THE CULVERT HAS ACCUMULATED TO MORE THAN 3 FEET ABOVE THE CONCRETE FOOTERS.
5. STRUCTURE REPLACEMENT AND INITIAL SEDIMENT REMOVAL ARE INTENDED TO RESTORE STREAM DYNAMIC EQUILIBRIUM TO ALLOW THE STREAM TO NATURALIZE OVER TIME. THE CHANNEL WILL CONTINUE TO MOVE SEDIMENT THROUGH THIS LOCATION AND MAY CHANGE SHAPE OVER TIME. ONGOING DREDGING OR REMOVAL OF ACCUMULATED SEDIMENT IS NOT ANTICIPATED AS A REGULAR MAINTENANCE TASK.



CROSS SECTION



PROFILE VIEW

**RESTORED CHANNEL BED**

NOT TO SCALE

**CHANNEL BED GRADING AND RESTORATION NOTES:**

**1. REMOVAL OF EXISTING BED:**

- 1.1. REMOVE AND STOCKPILE ALL EXISTING SAND, GRAVEL, COBBLE, AND BOULDER TO MINIMUM 12" DEPTH WITHIN EXISTING BANKFULL CHANNEL. REUSE MATERIAL ON TOP 12" OF FINAL CHANNEL BED. ALL BOULDERS LOCATED PARTIALLY OR FULLY WITHIN THE 12" SHALL BE REMOVED FOR REUSE.
- 1.2. SAVE AND STOCKPILE ALL LOGS FOR REUSE IN FINAL BED.

**2. CHANNEL FORMATION:**

- 2.1. PERFORM ROUGH GRADING OF CHANNEL.
- 2.2. DO NOT REUSE FINE-GRAINED SILTS, CLAYS, OR ORGANIC MATERIAL WITHIN THE BANKFULL CHANNEL.
- 2.3. TO ESTABLISH PILOT CHANNEL IN FILL SITUATION: FILL TO WITHIN 12" OF FINAL GRADE WITH NATURAL SAND & GRAVEL/COBBLE/BOULDER RE-USED FROM ON-SITE EXCAVATION. DO NOT USE SILTS, CLAYS, OR ORGANICS. DO NOT USE STOCKPILED BED ARMORING AS GENERAL FILL TO RAISE BED. PLACE FINAL 12" OF MATERIAL FROM STOCKPILED MATERIAL, AND SUPPLEMENT WITH BED ARMORING AS DESCRIBED BELOW.
- 2.4. TO ESTABLISH PILOT CHANNEL IN CUT SITUATION, IN SUITABLE SOIL: PLACE FINAL 12" OF MATERIAL FROM STOCKPILED MATERIAL, AND SUPPLEMENT WITH ROUGHNESS AS DESCRIBED BELOW.
- 2.5. TO ESTABLISH PILOT CHANNEL IN CUT SITUATION, IN UNSUITABLE SOIL: REMOVE MATERIAL TO 24" BELOW FINAL GRADE. PLACE 12" OF SUITABLE SAND/GRAVEL FILL. PLACE FINAL 12" OF MATERIAL FROM STOCKPILED MATERIAL, AND SUPPLEMENT WITH BED ARMORING AS DESCRIBED BELOW.

**3. LOW-FLOW CHANNEL:**

- 3.1. SHALL BE A V-SHAPED CHANNEL WITH 10% SLOPE FROM DEEPEST POINT TO BANKS, SEE DIMENSIONS TABLE.

**4. BANKFULL CHANNEL:**

- 4.1. SHALL CONSIST OF A 30-FOOT WIDE FLOW AREA UPLAND OF THE LOW-FLOW CHANNEL. IT SHALL GENERALLY SLOPE AT 2% TOWARDS THE LOW FLOW CHANNEL, AND BANKFULL DEPTH HEIGHT BANKS AT 2:1 SLOPE ALONG THE OUTER LIMITS. SEE PLAN AND DETAIL.

**5. CHANNEL ROUGHNESS:**

- 5.1. PLACE 18"-48" NATIVE BOULDER, SEE PLANS FOR SPACING AND LOCATIONS. SEE CHANNEL ROUGHNESS DETAIL FOR ROCK PLACEMENT AND ORIENTATION.
- 5.2. CHANNEL BED SHOULD BE ROUGH AND "MESSY". SEE UNDAMMED CHANNEL FOR LOCAL EXAMPLE.
- 5.3. INSTALL SAVED LOGS, STUMPS, AND ROOT WADS. PARTIALLY BURY IN BED OR BANKS TO CREATE HABITAT FEATURES.



1 SOUTH MAIN STREET  
SUGARHOUSE LANE  
STARKSBORO, VT 05776  
802.882.8335  
SLRCONSULTING.COM

DESCRIPTION	DATE	BY

DETAILS - CULVERT  
 HOLLOW BROOK REFUGIA DESIGN  
 SUGARHOUSE LANE  
 STARKSBORO, VERMONT  
 CONCEPT DESIGN

CMN DESIGNED	CMN DRAWN	JCL CHECKED
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NOT TO SCALE

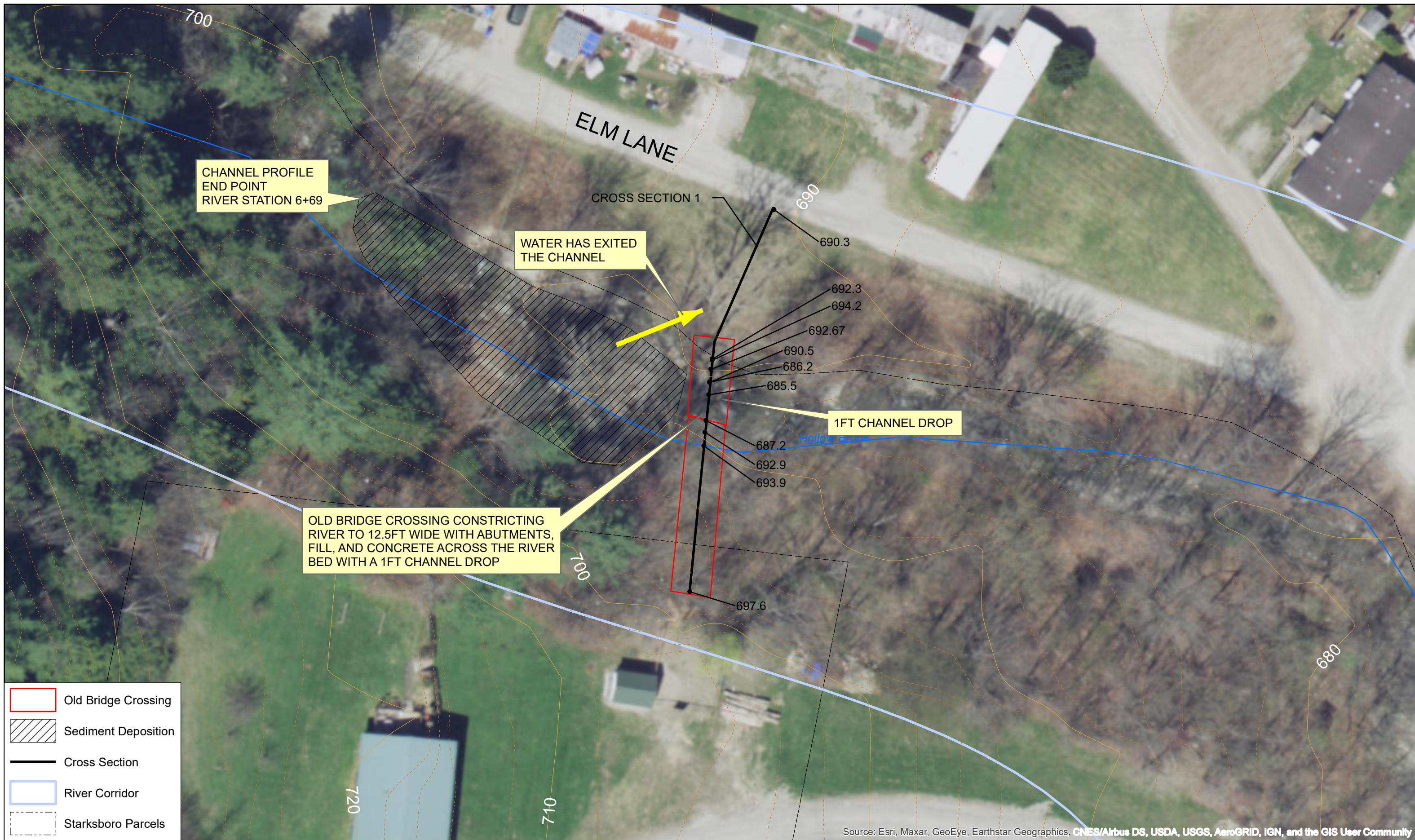
NOVEMBER 17, 2021

PROJECT NO. 3452-36

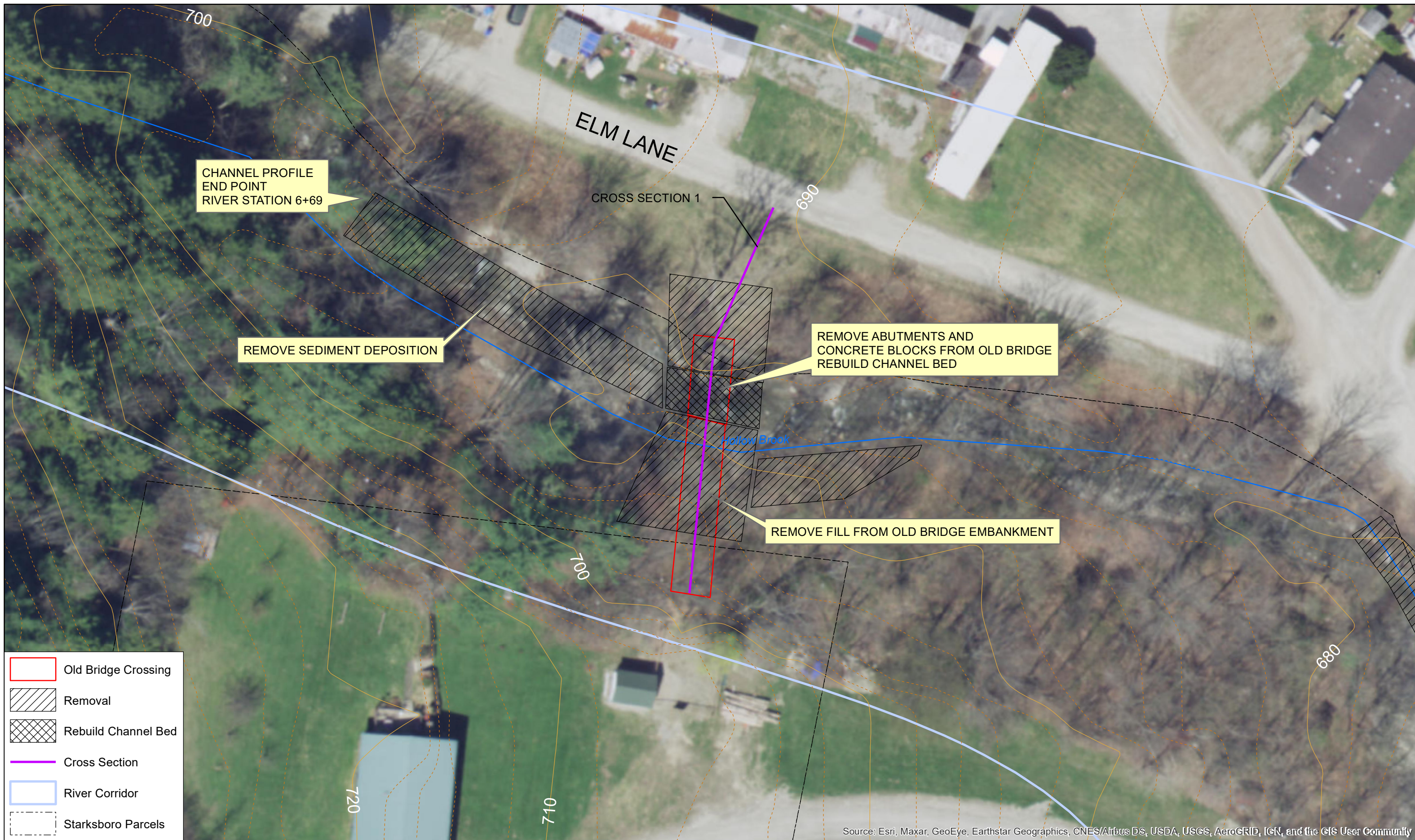
SHEET NO. 4 OF 4

DET





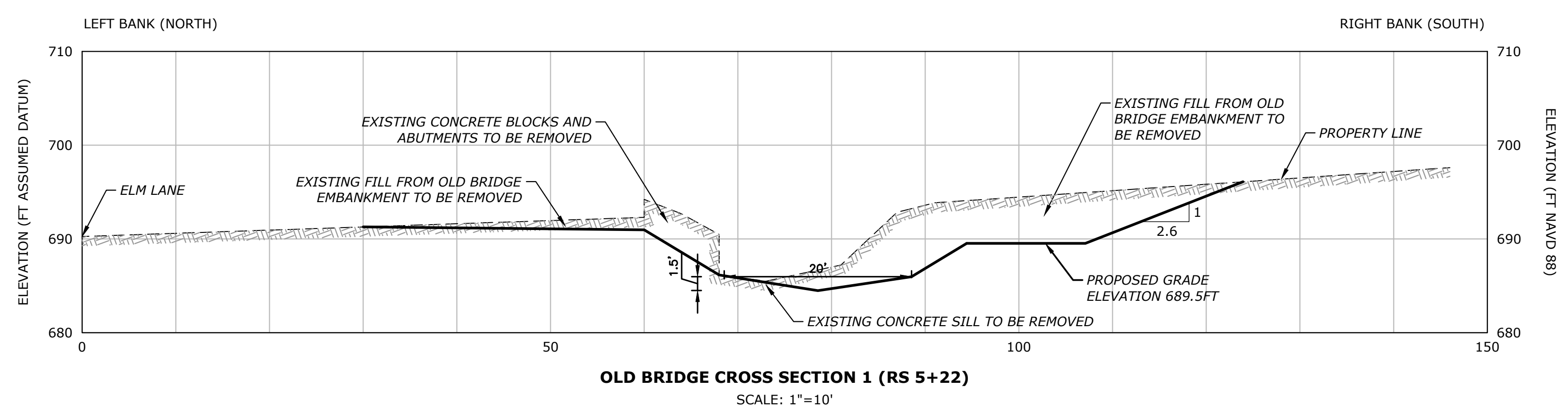
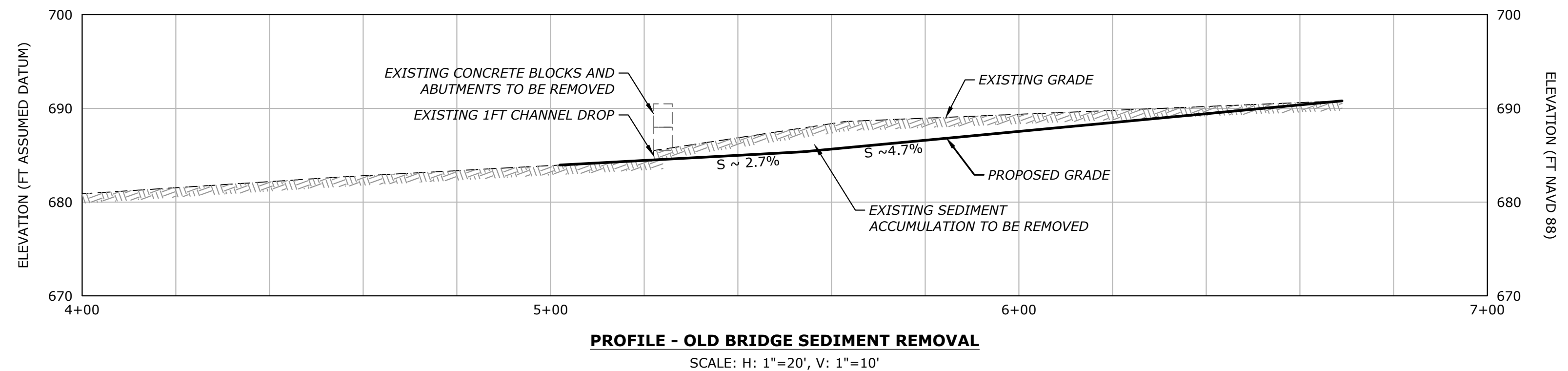




PROPOSED CONDITIONS: OLD BRIDGE  
HOLLOW BROOK REFUGIA DESIGN  
LEWIS CREEK ASSOCIATION



SHEET 11.1 - 5.0 - 2021  
 DATE: 11/05/21  
 DRAWN BY: JCL  
 CHECKED BY: CMN  
 DESIGNED BY: CMN



DESCRIPTION	DATE	BY

**TYPICAL SECTIONS - OLD BRIDGE**  
**HOLLOW BROOK REFUGIA DESIGN**  
 SUGARHOUSE LANE  
 STARKSBORO, VERMONT  
**CONCEPT DESIGN**

DESIGNED	DRAWN	CHECKED
CMN	CMN	JCL
VARIES		
NOVEMBER 5, 2021		
PROJECT NO. 3452-36		
SHEET NO. 3 OF 4		
<b>XS</b>		



03/2021, U.S. ENVIRONMENTAL PROTECTION AGENCY, 833 N. RIVER ST., WASHINGTON, DC 20560  
 U.S. ENVIRONMENTAL PROTECTION AGENCY, 833 N. RIVER ST., WASHINGTON, DC 20560



**SEDIMENT REMOVAL OLD BRIDGE**



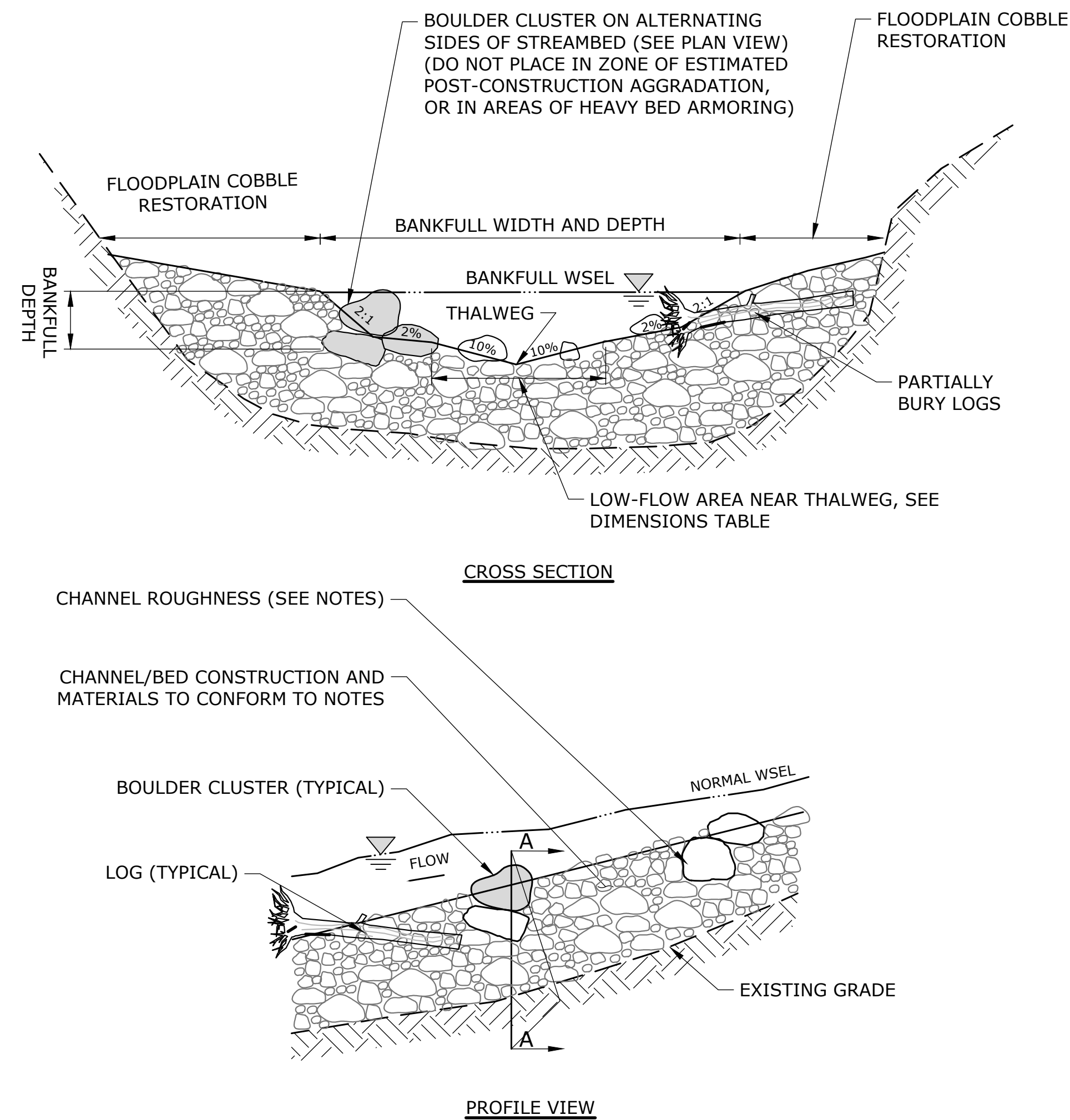
**CONCRETE, FILL, AND ABUTMENT REMOVAL OLD BRIDGE**

**RESTORATION NOTES**

- RESTORE CONSTRUCTION AREA TO EXISTING CONDITIONS OR BETTER.
- PLANT FLOODPLAIN AND RIVER EDGE AREAS WITH NATIVE SHRUBS, TREES, AND SEED MIX

**OPERATION & MAINTENANCE NOTES**

- REMOVALS ARE INTENDED TO RESTORE STREAM DYNAMIC EQUILIBRIUM TO ALLOW THE STREAM TO NATURALIZE OVER TIME. THE CHANNEL WILL CONTINUE TO MOVE SEDIMENT THROUGH THIS LOCATION AND MAY CHANGE SHAPE OVER TIME.
- VEGETATION IS TO BE MONITORED DURING THE GROWING SEASON FOR TWO YEARS TO EVALUATE A SUCCESSFUL VEGETATION ESTABLISHMENT OF 80% AERIAL COVERAGE.
- ANY AREAS OF POOR VEGETATIVE COVER SHALL BE REPLANTED ACCORDINGLY.



**CHANNEL BED GRADING AND RESTORATION NOTES:**

- REMOVAL OF EXISTING BED:**
  - REMOVE AND STOCKPILE ALL EXISTING SAND, GRAVEL, COBBLE, AND BOULDER TO MINIMUM 12" DEPTH WITHIN EXISTING BANKFULL CHANNEL. REUSE MATERIAL ON TOP 12" OF FINAL CHANNEL BED. ALL BOULDERS LOCATED PARTIALLY OR FULLY WITHIN THE 12" SHALL BE REMOVED FOR REUSE. SAVE AND STOCKPILE ALL LOGS FOR REUSE IN FINAL BED.
- CHANNEL FORMATION:**
  - PERFORM ROUGH GRADING OF CHANNEL.
  - DO NOT REUSE FINE-GRAINED SILTS, CLAYS, OR ORGANIC MATERIAL WITHIN THE BANKFULL CHANNEL.
  - TO ESTABLISH PILOT CHANNEL IN FILL SITUATION: FILL TO WITHIN 12" OF FINAL GRADE WITH NATURAL SAND & GRAVEL/COBBLE/BOULDER RE-USED FROM ON-SITE EXCAVATION. DO NOT USE SILTS, CLAYS, OR ORGANICS. DO NOT USE STOCKPILED BED ARMORING AS GENERAL FILL TO RAISE BED. PLACE FINAL 12" OF MATERIAL FROM STOCKPILED MATERIAL, AND SUPPLEMENT WITH BED ARMORING AS DESCRIBED BELOW.
  - TO ESTABLISH PILOT CHANNEL IN CUT SITUATION, IN SUITABLE SOIL: PLACE FINAL 12" OF MATERIAL FROM STOCKPILED MATERIAL, AND SUPPLEMENT WITH ROUGHNESS AS DESCRIBED BELOW.
  - TO ESTABLISH PILOT CHANNEL IN CUT SITUATION, IN UNSUITABLE SOIL: REMOVE MATERIAL TO 24" BELOW FINAL GRADE. PLACE 12" OF SUITABLE SAND/GRAVEL FILL. PLACE FINAL 12" OF MATERIAL FROM STOCKPILED MATERIAL, AND SUPPLEMENT WITH BED ARMORING AS DESCRIBED BELOW.
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**RESTORED CHANNEL BED**

NOT TO SCALE



DESCRIPTION	DATE	BY

CONCEPT DESIGN  
 DETAILS - OLD BRIDGE  
 HOLLOW BROOK REFUGIA DESIGN  
 WHETSTONE BROOK AT MELROSE TERRACE  
 BRATTLEBORO HOUSING PARTNERSHIPS  
 BRATTLEBORO, VERMONT

CMN DESIGNED	CMN DRAWN	JCL CHECKED
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NOT TO SCALE

NOVEMBER 5, 2021

PROJECT NO. 3452-36

SHEET NO. 4 OF 4

DET



**CONCEPT DESIGN PROBABLE CONSTRUCTION COST  
HOLLOW BROOK - CULVERT REPLACEMENT**

**AHEAD OF THE STORM**

**Starksboro, Vermont**

SLR #3452-36

November 16, 2021



<b>Item</b>	<b>ITEM/DESCRIPTION</b>	<b>UNIT</b>	<b>QUANTITY</b>	<b>UNIT PRICE</b>	<b>COST</b>
	Mobilization	LS	1	\$15,000	\$15,000
	Water Control	LS	1	\$10,000	\$10,000
	Temporary Crossing	LS	1	\$20,000	\$20,000
	Remove Existing Structure	LS	1	\$10,000	\$10,000
	Crossing Structure, 24 ft	LS	1	\$150,000	\$150,000
	Boulder Wall	LS	1	\$15,000	\$15,000
	Remove Sediment	LS	1	\$2,000	\$2,000
	River Bed Restoration	LS	1	\$3,000	\$3,000
	Restoration of Disturbed Areas	LS	1	\$5,000	\$5,000
	Riparian Plants and Planting Labor	LS	1	\$1,000	\$1,000
	Demobilization	LS	1	\$5,000	\$5,000
	<b>Construction Subtotal</b>				<b>\$236,000</b>
	<b>Construction Contingency (15%)</b>				<b>\$35,400</b>
	<b>Final Design</b>				<b>\$25,000</b>
	<b>Permitting</b>				<b>\$7,000</b>
	<b>Construction Oversight</b>				<b>\$25,000</b>
	<b>TOTAL (round)</b>				<b>\$328,000</b>



**CONCEPT DESIGN PROBABLE CONSTRUCTION COST  
HOLLOW BROOK - OLD BRIDGE REMOVAL**

**AHEAD OF THE STORM  
Starksboro, Vermont  
MMI #3452-36  
November 5, 2021**



<b>Item</b>	<b>ITEM/DESCRIPTION</b>	<b>UNIT</b>	<b>QUANTITY</b>	<b>UNIT PRICE</b>	<b>COST</b>
	Mobilization	LS	1	\$4,000	\$4,000
	Labor	LS	1	\$2,500	\$2,500
	Excavator / Operator	LS	1	\$5,000	\$5,000
	Haul Fill Off Site	LS	1	\$4,000	\$4,000
	River Bed Restoration	LS	1	\$1,000	\$1,000
	Restoration of Disturbed Areas	LS	1	\$2,000	\$2,000
	Riparian Plants and Planting Labor	LS	1	\$2,000	\$2,000
	Demobilization	LS	1	\$2,000	\$2,000
	<b>Construction Subtotal</b>				<b>\$22,500</b>
	<b>Construction Contingency (15%)</b>				<b>\$3,375</b>
	<b>Final Design</b>				<b>\$10,000</b>
	<b>Permitting</b>				<b>\$6,000</b>
	<b>Construction Oversight</b>				<b>\$12,000</b>
	<b>TOTAL (round)</b>				<b>\$54,000</b>