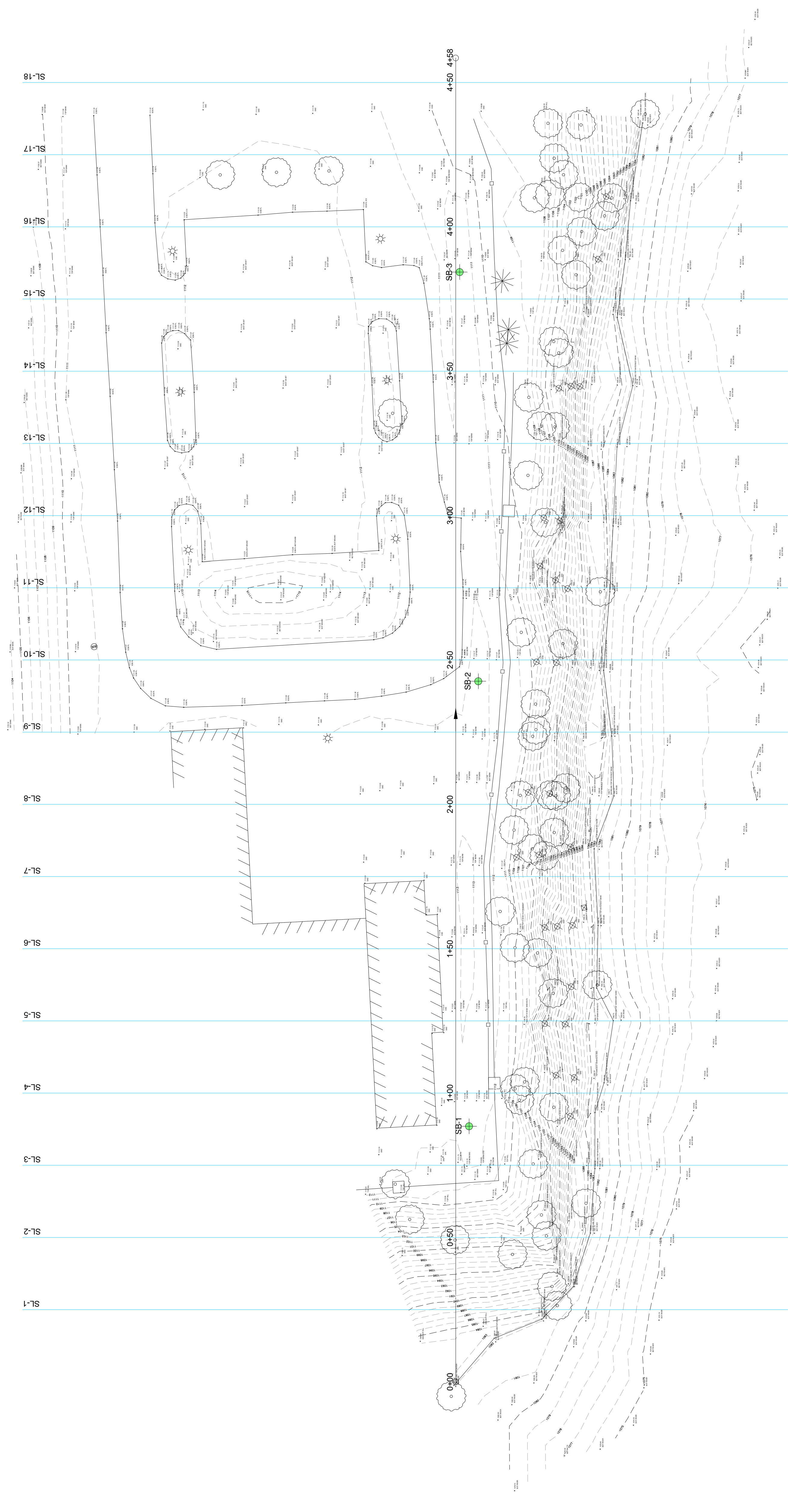


October 7, 2022

Contents of folder with information on the Mississippi River streambank restoration project at the Weyerhaeuser Museum

File	Contents
Existing riverbank topo & cross sections.pdf	Topography of the riverbank at the Weyerhaeuser Museum. The stream banks are 25 to 30-ft high.
B2206910-Draft Boring Logs.pdf	Soil boring logs for the 3 soil borings obtained in August 2022 at the Weyerhaeuser Museum. Boring log locations are shown on the Existing river bank topo pdf file (SB-1 ect).
Geoslope.pdf	Results of geotechnical engineering analysis for what is needed to create a stable slope at two representative cross sections. Factor of safety values are provided adjacent to green dot in center. Factor of safety of at least 1.5 is required where there is a building.
Sta 1+25 – Proposed Layout at Museum.pdf	Proposed cross section at station 1+25 at the museum. Stationing is provided along the baseline found in the Existing river bank topo pdf file.
Sta 2+75 – Proposed Layout at Museum.pdf	Proposed cross section at station 2+75 at the parking lot.
There are 3 *.jpg files	Pictures of bank failures below the museum.
Warzaala_Riverbank_Stabilization_2020.pdf	Information on recent Mississippi River streambank restoration project in Anoka County constructed with support from the Clean Water Fund. The lower right hand photo shows riprap at the toe and the reinforced soil geogrid used to hold topsoil for planting with native vegetation.

DOT PROJECT NO.	REVISION NO.	SHEET NO.
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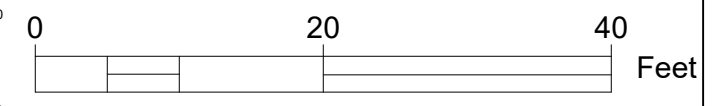
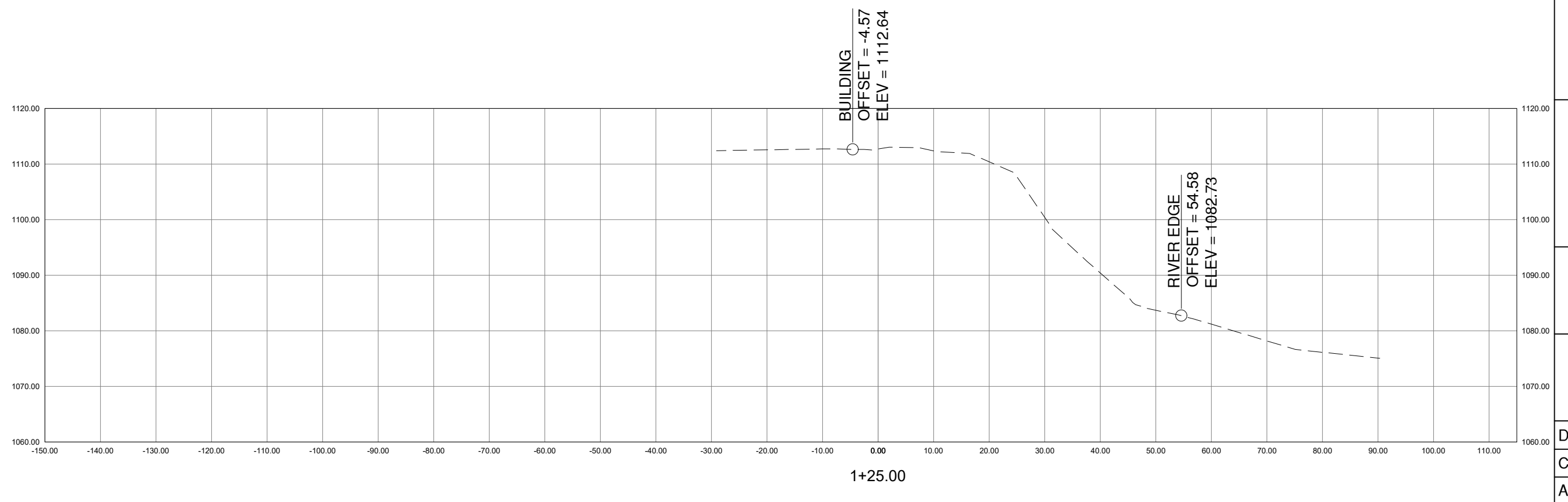
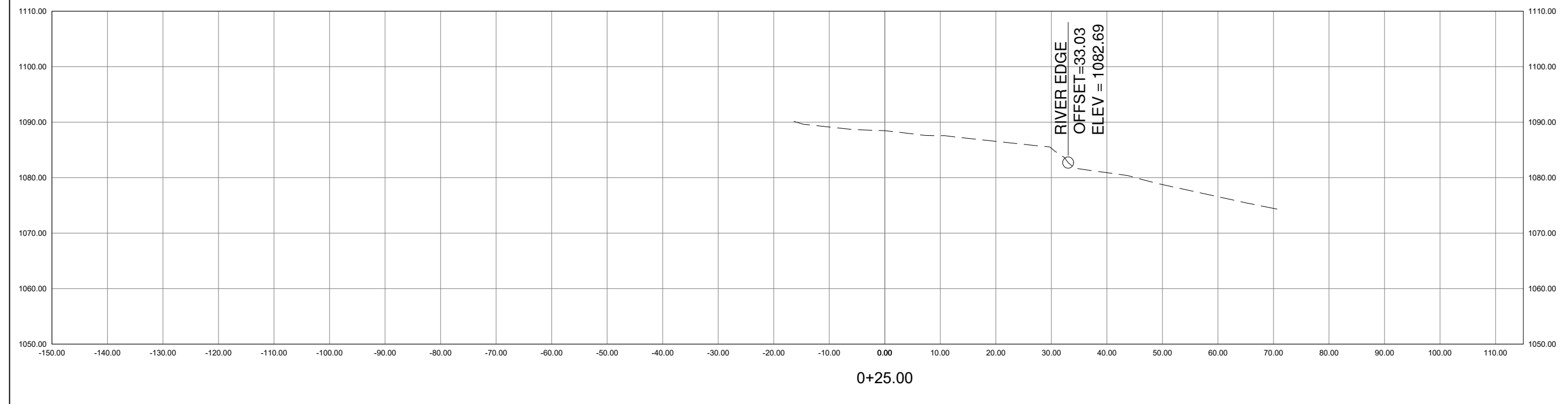
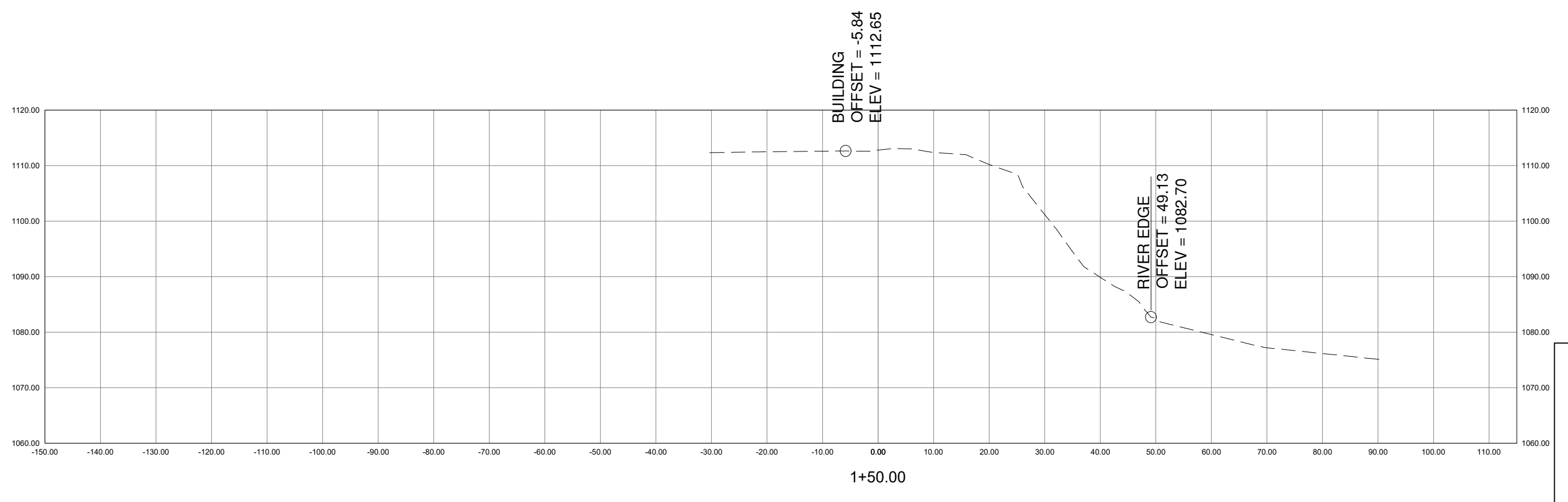
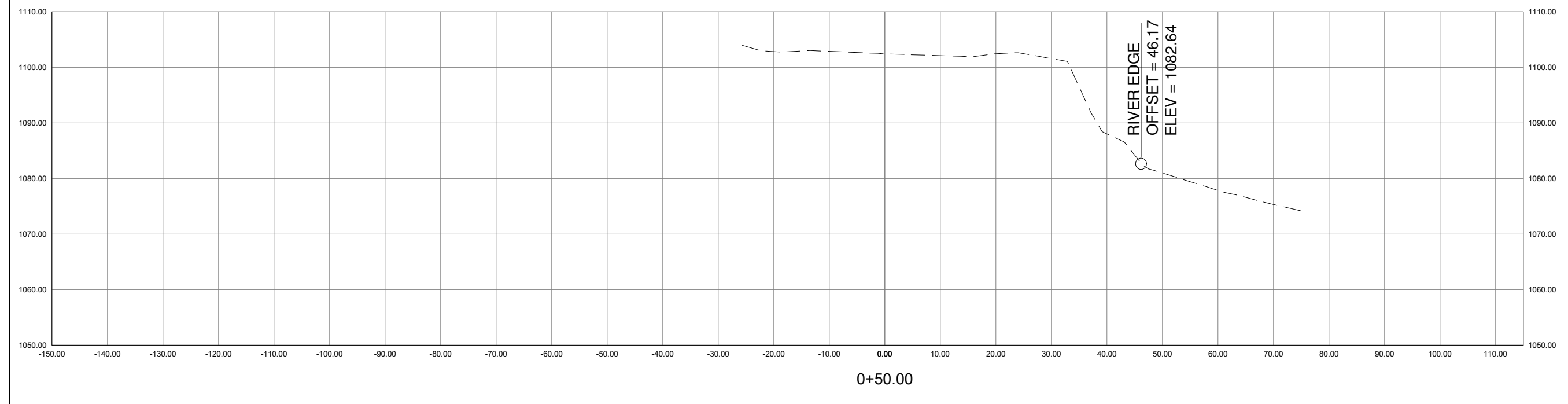
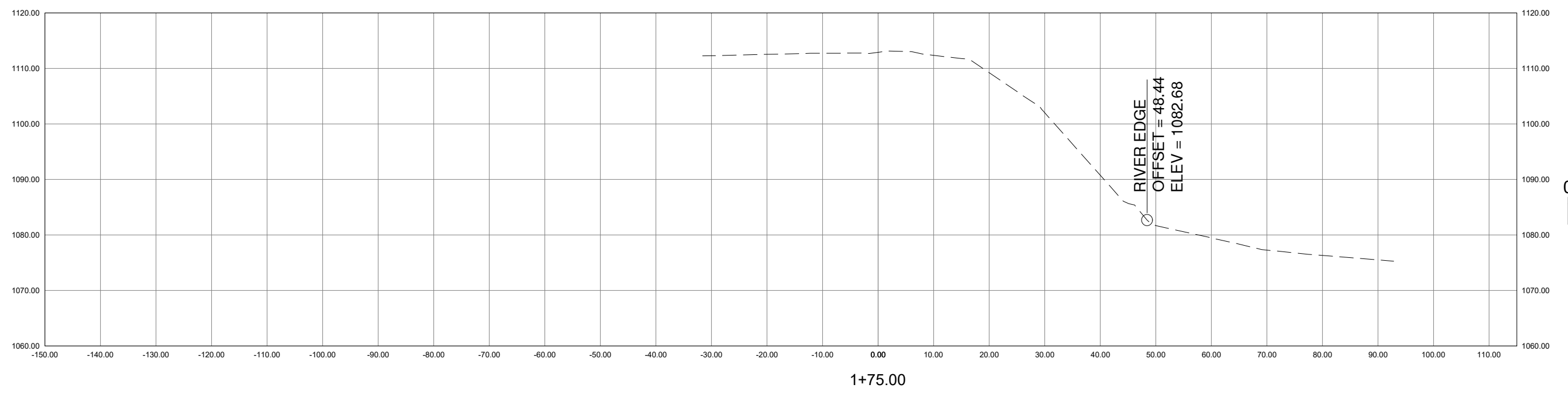
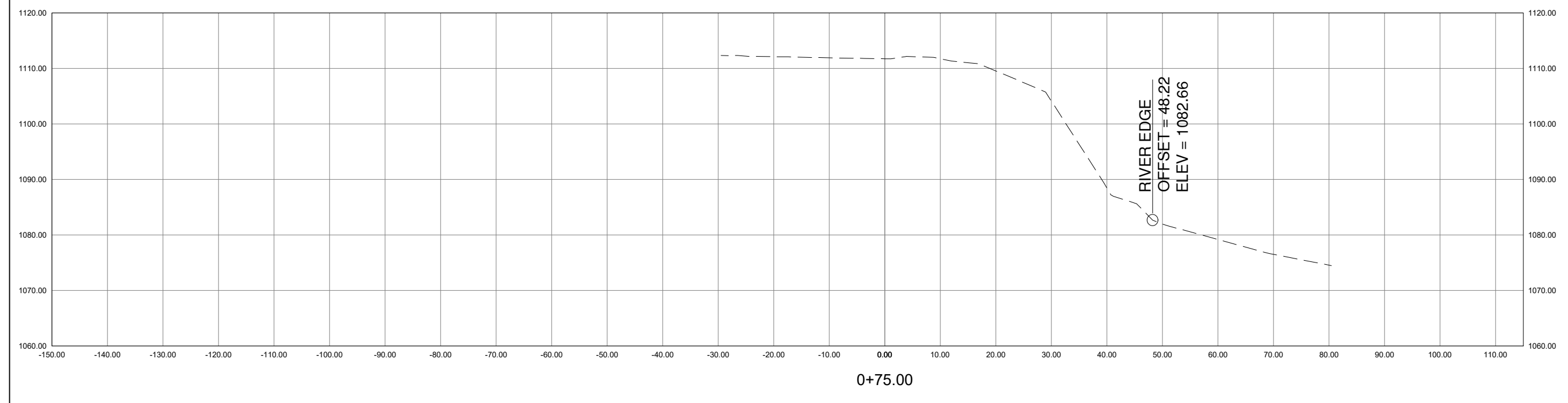
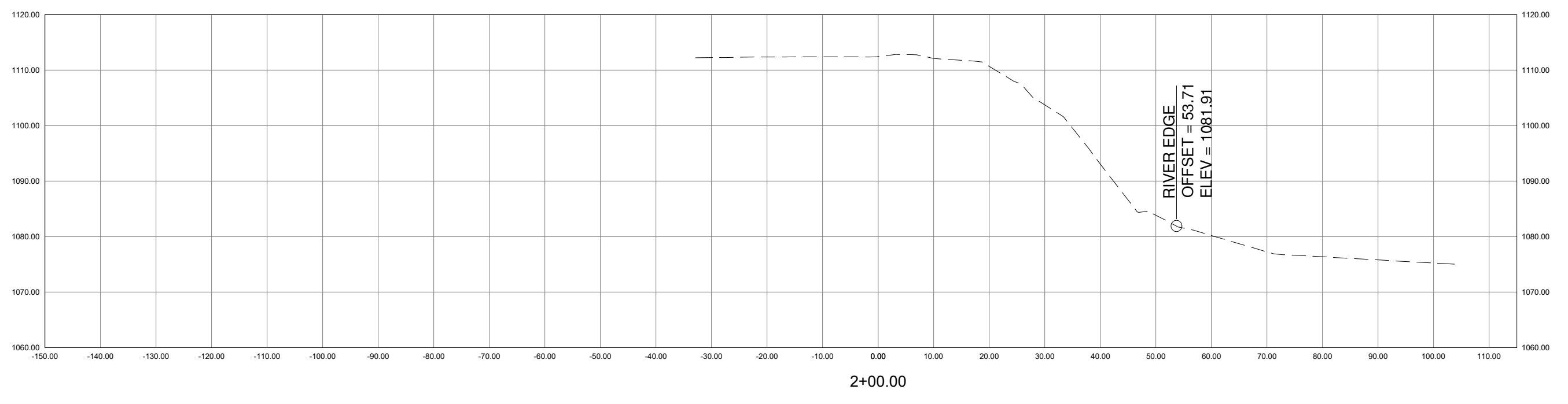
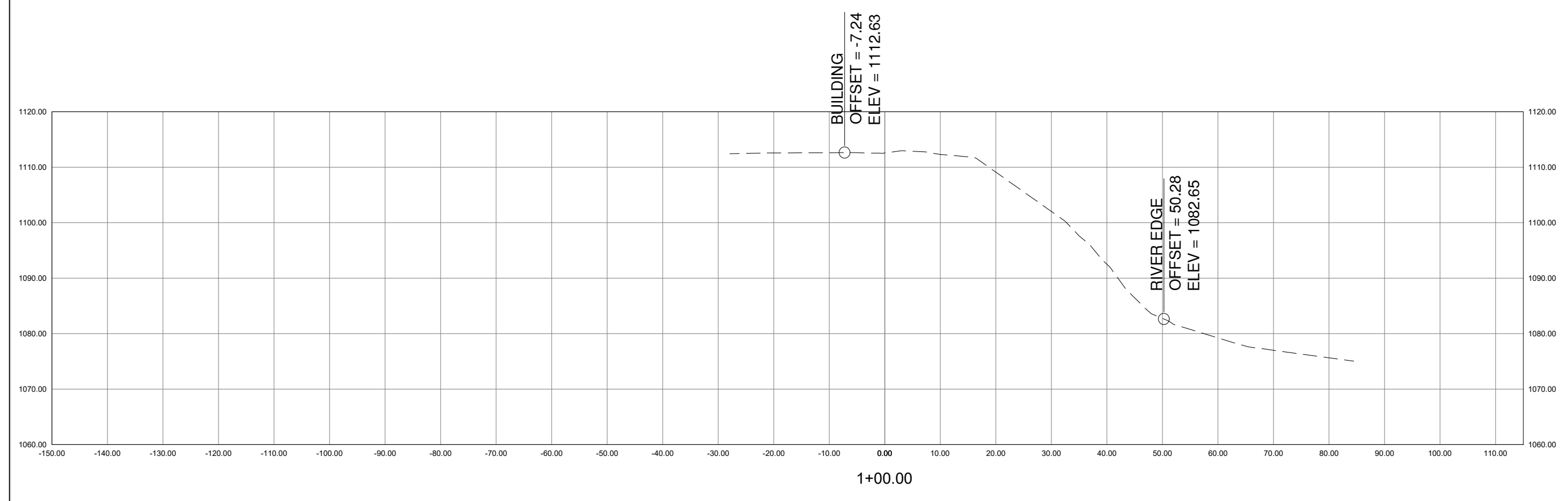
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13445 Hwy 10 West  
 Detroit Lakes, Minnesota 56502  
 Phone: 701.280.8500  
 Web: www.ulteig.com

EXISTING CONDITIONS
SLOPE STABILIZATION EXISTING TOPO
DRAWN BY: M. JOOS
CHECKED BY: R. CLAY
APPROVED BY: T.B.D.
DATE: JULY 28, 2022   UJI PROJ. NO: 22.11615

DOT PROJECT NO.	REVISION NO.	SHEET NO.
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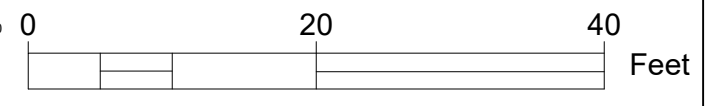
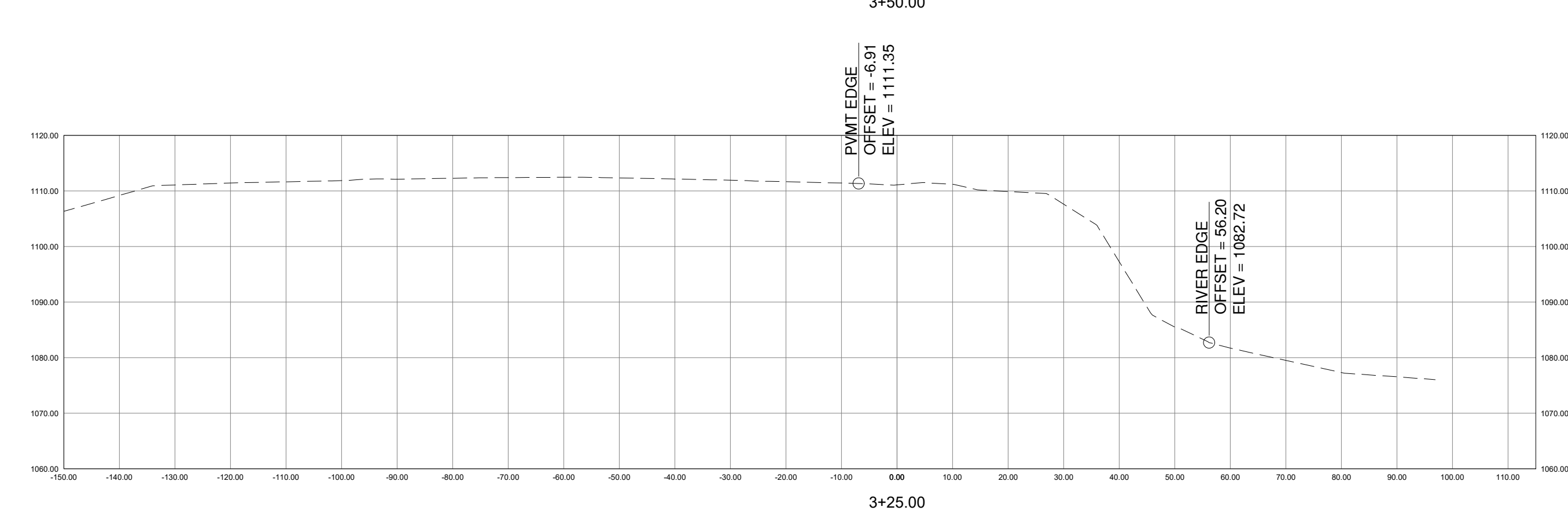
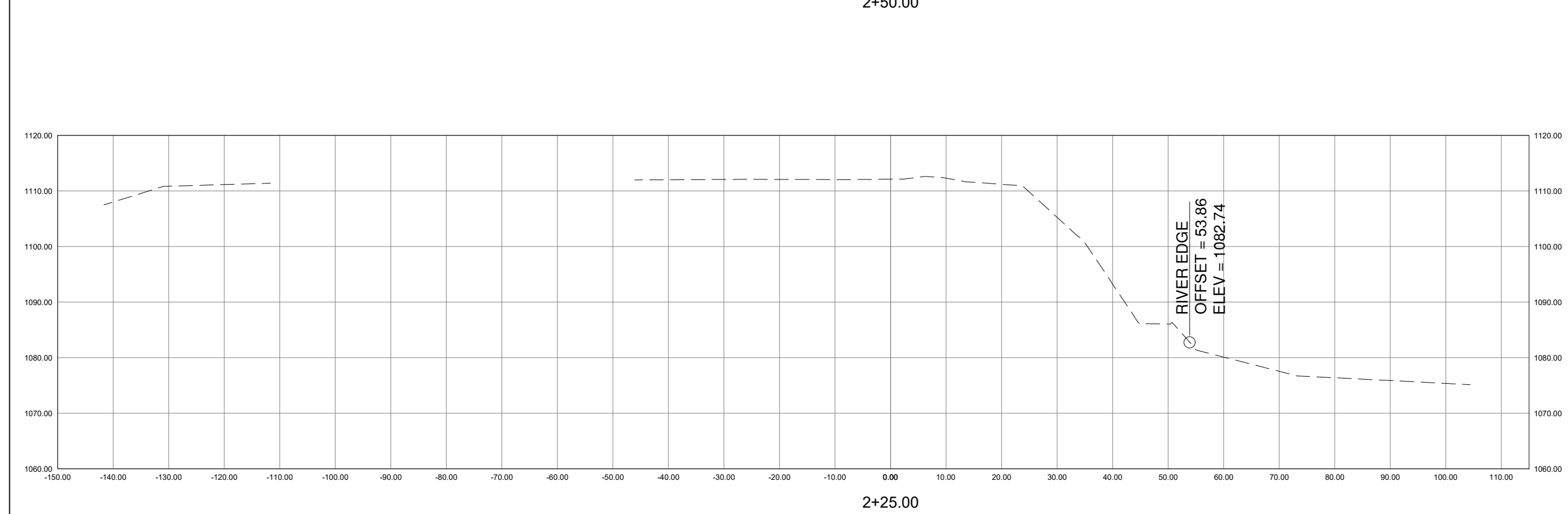
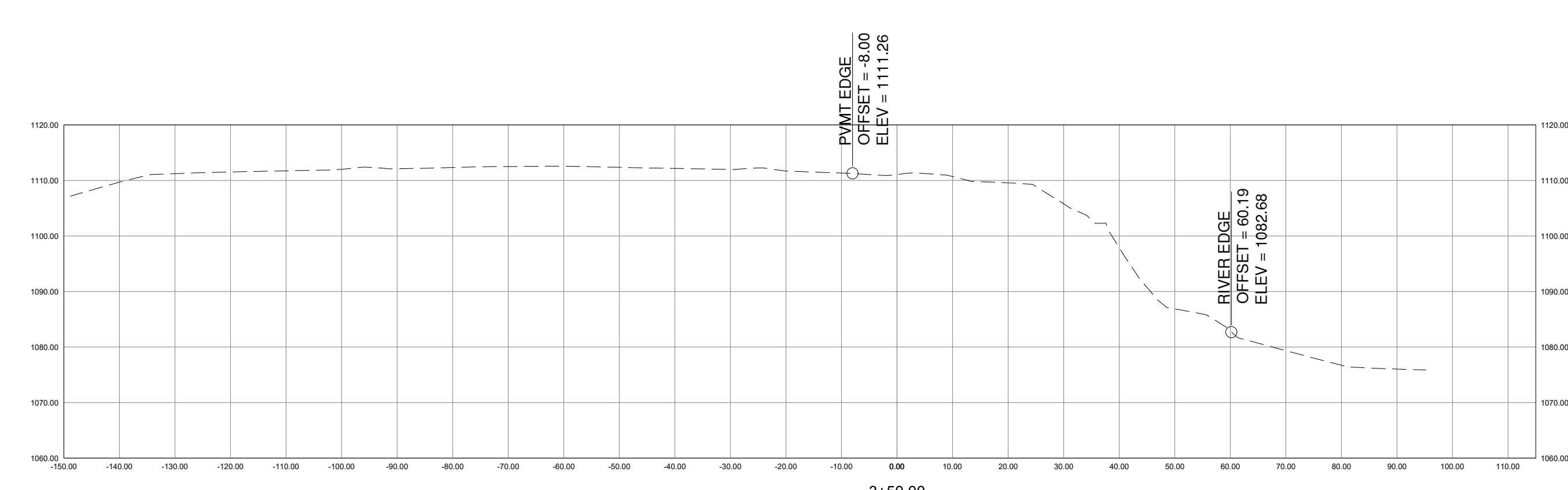
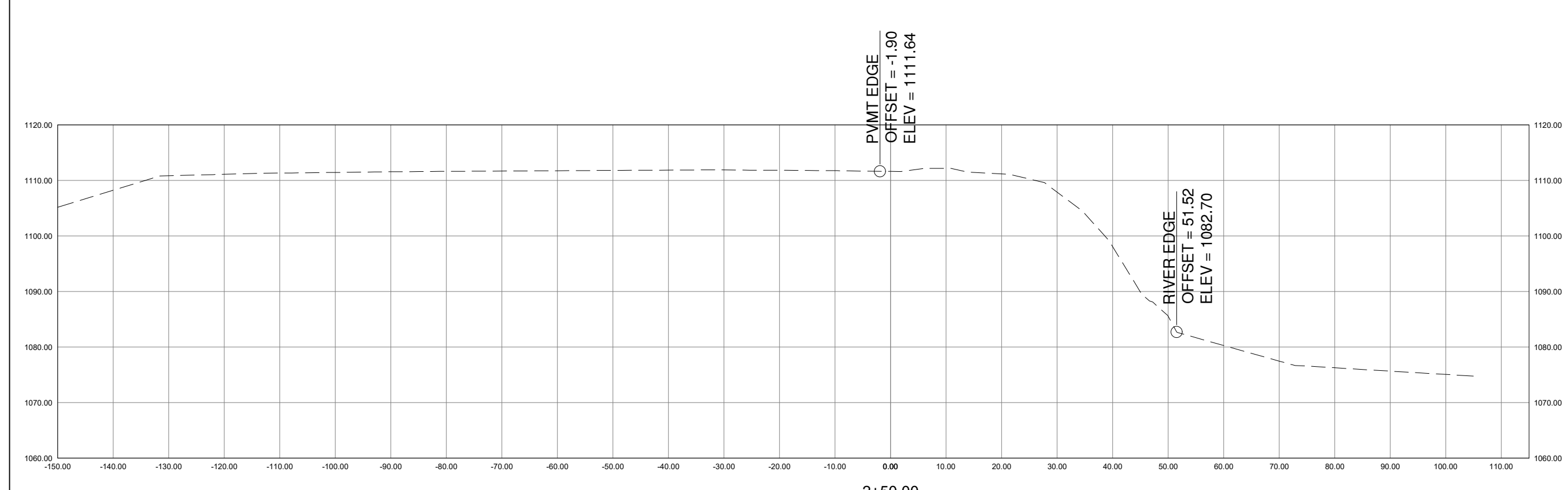
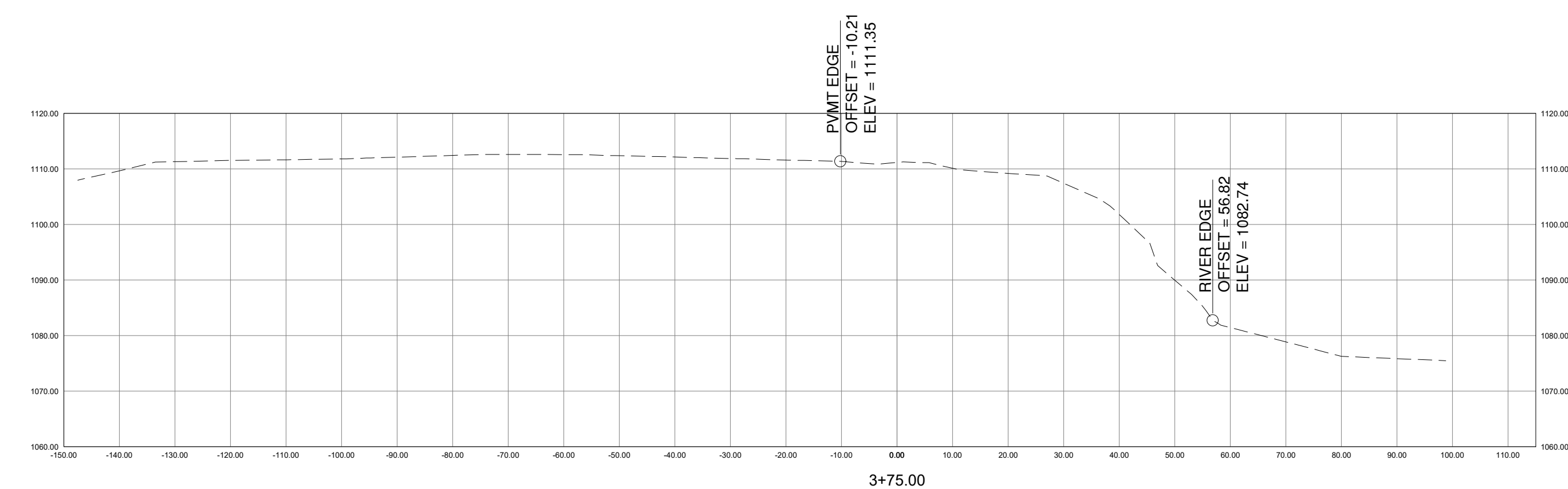
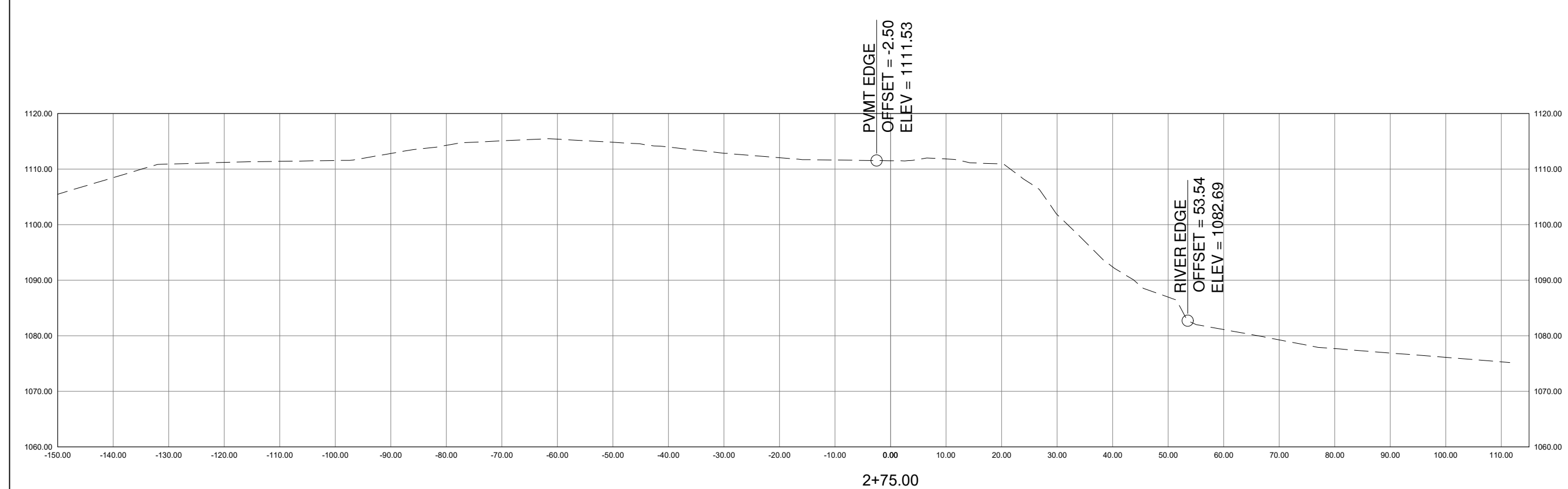
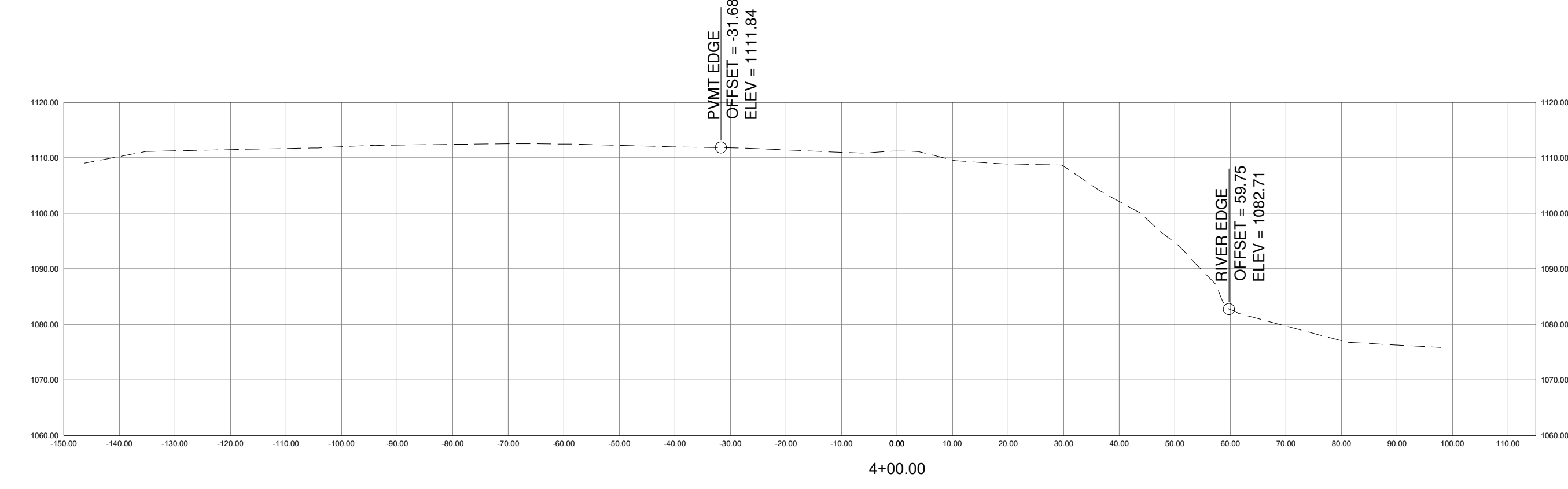
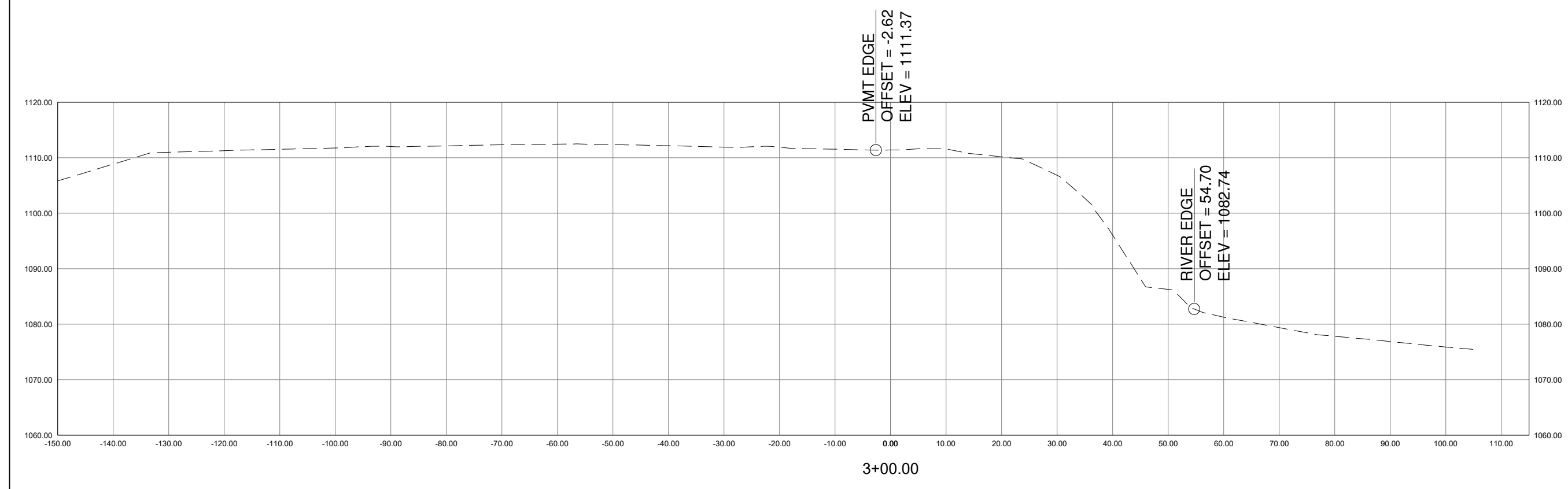
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Web: www.ulteig.com  
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CROSS SECTIONS
SLOPE STABILIZATION EXISTING TOPO
DRAWN BY: M. JOOS
CHECKED BY: R. CLAY
APPROVED BY: T.B.D.
DATE: JULY 28, 2022 UEI PROJ. NO: 22.11615

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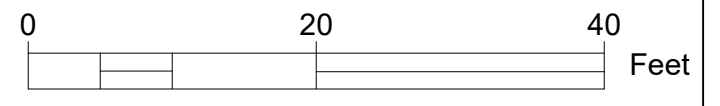
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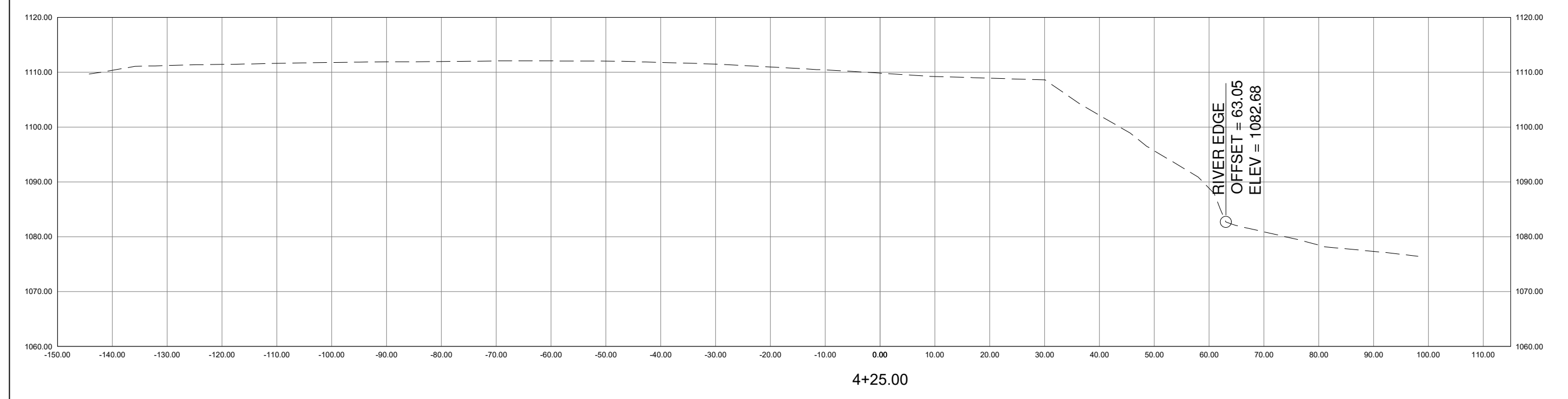
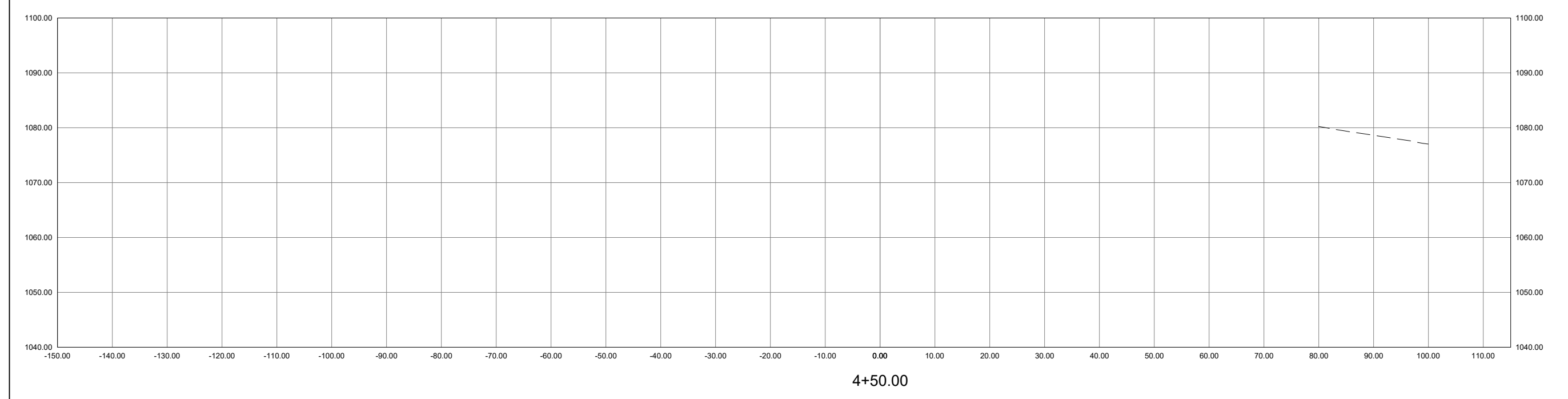
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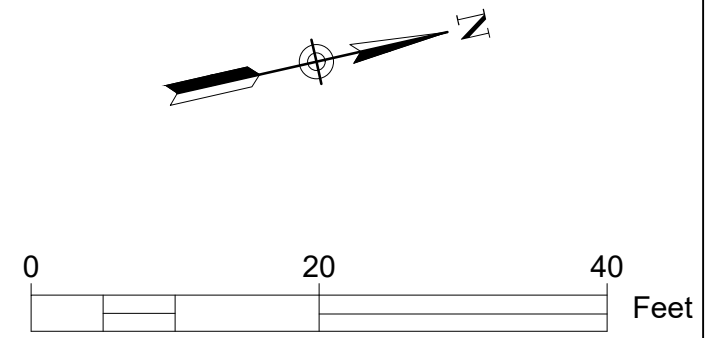
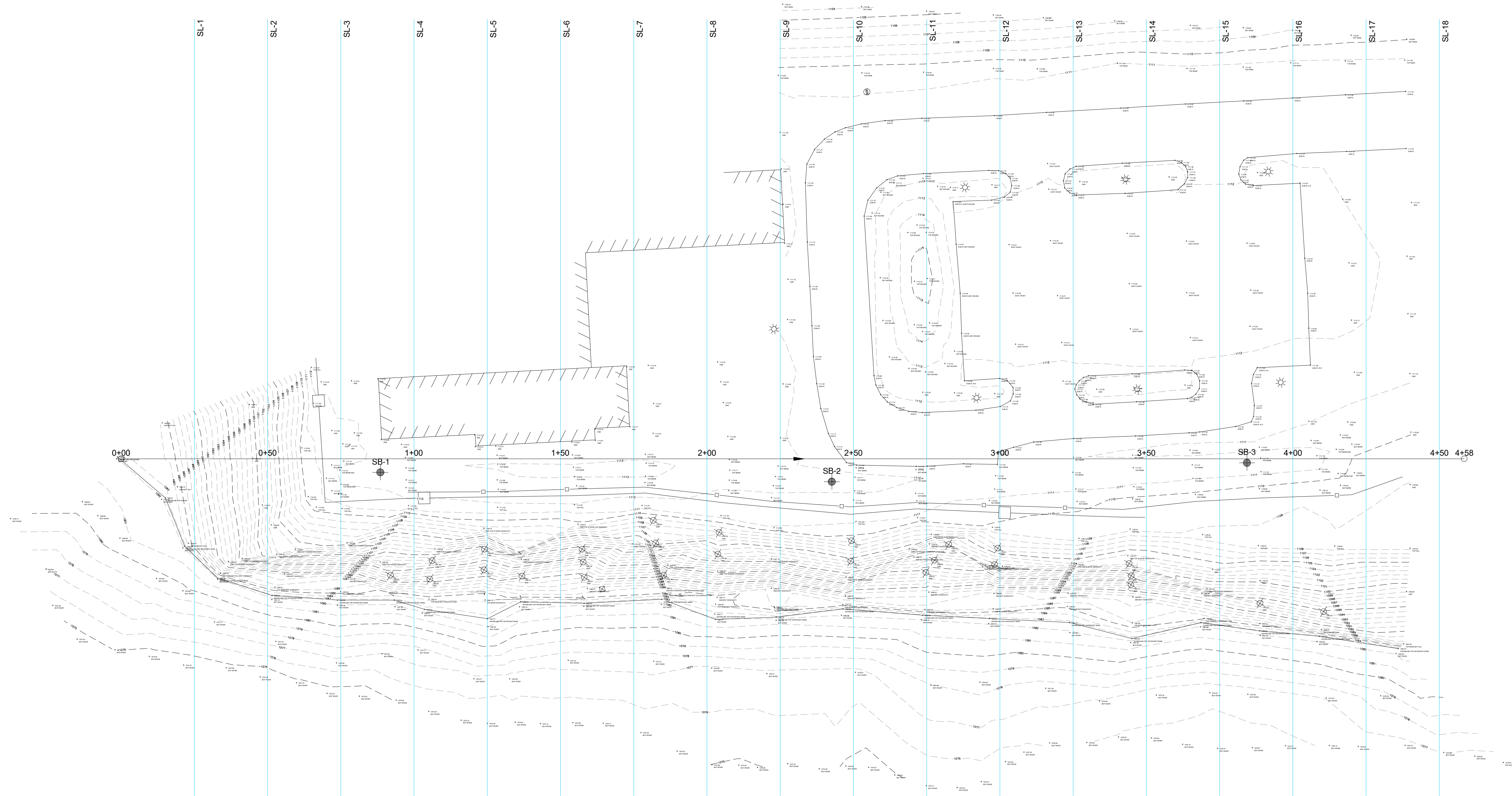
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EXISTING CONDITIONS
SLOPE STABILIZATION EXISTING TOPO
DRAWN BY: M. JOOS
CHECKED BY: R. CLAY
APPROVED BY: T.B.D.
DATE: JULY 28, 2022    UEI PROJ. NO: 22.11615

<b>Project Number B2206910</b>			<b>BORING: ST-1</b>	
<b>Geotechnical Evaluation</b>			LOCATION: See attached sketch	
<b>Charles Weyerhaeuser Memorial Museum</b>			DATUM:	
<b>2151 Lindbergh Drive South</b>			NORTHING:	EASTING:
<b>Little Falls, Minnesota</b>			START DATE: 08/17/22	END DATE: 08/17/22
DRILLER: B. Kammermeier/N. Swanson	LOGGED BY: R. Bipp	SURFACING: Soil WEATHER: Clear		
SURFACE ELEVATION:	RIG: 7506	METHOD: 3 1/4" HSA		

Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or Remarks
2.0		SILTY CLAY (CL-ML), dark brown, moist (TOPSOIL FILL)					
6.5		SILTY CLAY (CL-ML), with Gravel, brown, moist, medium (GLACIOFLUVIUM)	5	4-5-6 (11) 13"		3	
11.7		SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense (GLACIOFLUVIUM)	10	4-6-14 (20) 13"		8	P200=44%
				12-13-21 (34) 15"			
				TW			
		SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense to very dense (GLACIOFLUVIUM)	15	13-25-41 (66) 4"		7	
			20	31-50/5" (REF) 12"		7	
			25	24-50/4" (REF) 4"			
			30	50/3" (REF) 0"			
				50/2" (REF) 0"			

Continued on next page

See Descriptive Terminology sheet for explanation of abbreviations

<b>Project Number B2206910</b>				<b>BORING: ST-1</b>	
<b>Geotechnical Evaluation</b>				LOCATION: See attached sketch	
<b>Charles Weyerhaeuser Memorial Museum</b>				DATUM:	
<b>2151 Lindbergh Drive South</b>				NORTHING:	EASTING:
<b>Little Falls, Minnesota</b>				START DATE: 08/17/22	END DATE: 08/17/22
DRILLER: B. Kammermeier/N. Swanson	LOGGED BY: R. Bipp	SURFACE ELEVATION:		SURFACING: Soil	WEATHER: Clear
RIG: 7506	METHOD: 3 1/4" HSA				

Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or Remarks
38.0		SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense to very dense (GLACIOFLUVIUM)		34-50/5" (REF) 1"			
41.0		SILTY CLAY (CL-ML), gray, moist, hard (GLACIAL TILL)		40-15-27 (42) 10"		9	LL=18, PL=12, PI=6
		END OF BORING					

See Descriptive Terminology sheet for explanation of abbreviations

<b>Project Number B2206910</b>				<b>BORING: ST-2</b>	
<b>Geotechnical Evaluation</b>				LOCATION: See attached sketch	
<b>Charles Weyerhaeuser Memorial Museum</b>				DATUM:	
<b>2151 Lindbergh Drive South</b>				NORTHING:	EASTING:
<b>Little Falls, Minnesota</b>				START DATE: 08/17/22	END DATE: 08/17/22
DRILLER: B. Kammermeier/N. Swanson	LOGGED BY: R. Bipp		SURFACING: Soil WEATHER: Clear		
SURFACE ELEVATION:	RIG: 7506	METHOD: 3 1/4" HSA			

Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or Remarks
2.0		SILTY CLAY (CL-ML), dark brown, moist (TOPSOIL FILL)					
6.5		SILTY CLAY (CL-ML), with Gravel, brown, moist, medium to hard (GLACIOFLUVIUM)	5	10-18-17 (35) 11"		0	LL=20, PL=14, PI=6
			10	12-12-20 (32) 10"			
17.5		SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense to very dense (GLACIOFLUVIUM)	15	16-22-50/4" (REF) 13"		9	
				21-26-42 (68) 13"		7	
		SILTY, CLAYEY SAND (SC-SM), with Gravel, gray, moist, dense to very dense (GLACIOFLUVIUM)	20	11-19-20 (39) 14"		8	
			25	13-21-28 (49) 16"			
			30	18-22-30 (52) 14"			

Continued on next page

See Descriptive Terminology sheet for explanation of abbreviations

<b>Project Number B2206910</b>				<b>BORING: ST-2</b>	
<b>Geotechnical Evaluation</b>				LOCATION: See attached sketch	
<b>Charles Weyerhaeuser Memorial Museum</b>				DATUM:	
<b>2151 Lindbergh Drive South</b>				NORTHING:	EASTING:
<b>Little Falls, Minnesota</b>				START DATE: 08/17/22	END DATE: 08/17/22
DRILLER: B. Kammermeier/N. Swanson	LOGGED BY: R. Bipp		SURFACING: Soil WEATHER: Clear		
SURFACE ELEVATION:	RIG: 7506	METHOD: 3 1/4" HSA			

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or Remarks
41.0		SILTY, CLAYEY SAND (SC-SM), with Gravel, gray, moist, dense to very dense (GLACIOFLUVIUM)				7	
			35	15-27-42 (69) 18"			
			40	12-18-34 (52) 14"			
		END OF BORING					
			45				
			50				
			55				
			60				

<b>Project Number B2206910</b>				<b>BORING: ST-3</b>	
<b>Geotechnical Evaluation</b>				LOCATION: See attached sketch	
<b>Charles Weyerhaeuser Memorial Museum</b>				DATUM:	
<b>2151 Lindbergh Drive South</b>				NORTHING:	EASTING:
<b>Little Falls, Minnesota</b>				START DATE: 08/18/22	END DATE: 08/18/22
DRILLER: B. Kammermeier/N. Swanson	LOGGED BY: R. Bipp	SURFACE ELEVATION:		SURFACING: Soil	WEATHER: Clear
RIG: 7506	METHOD: 3 1/4" HSA				

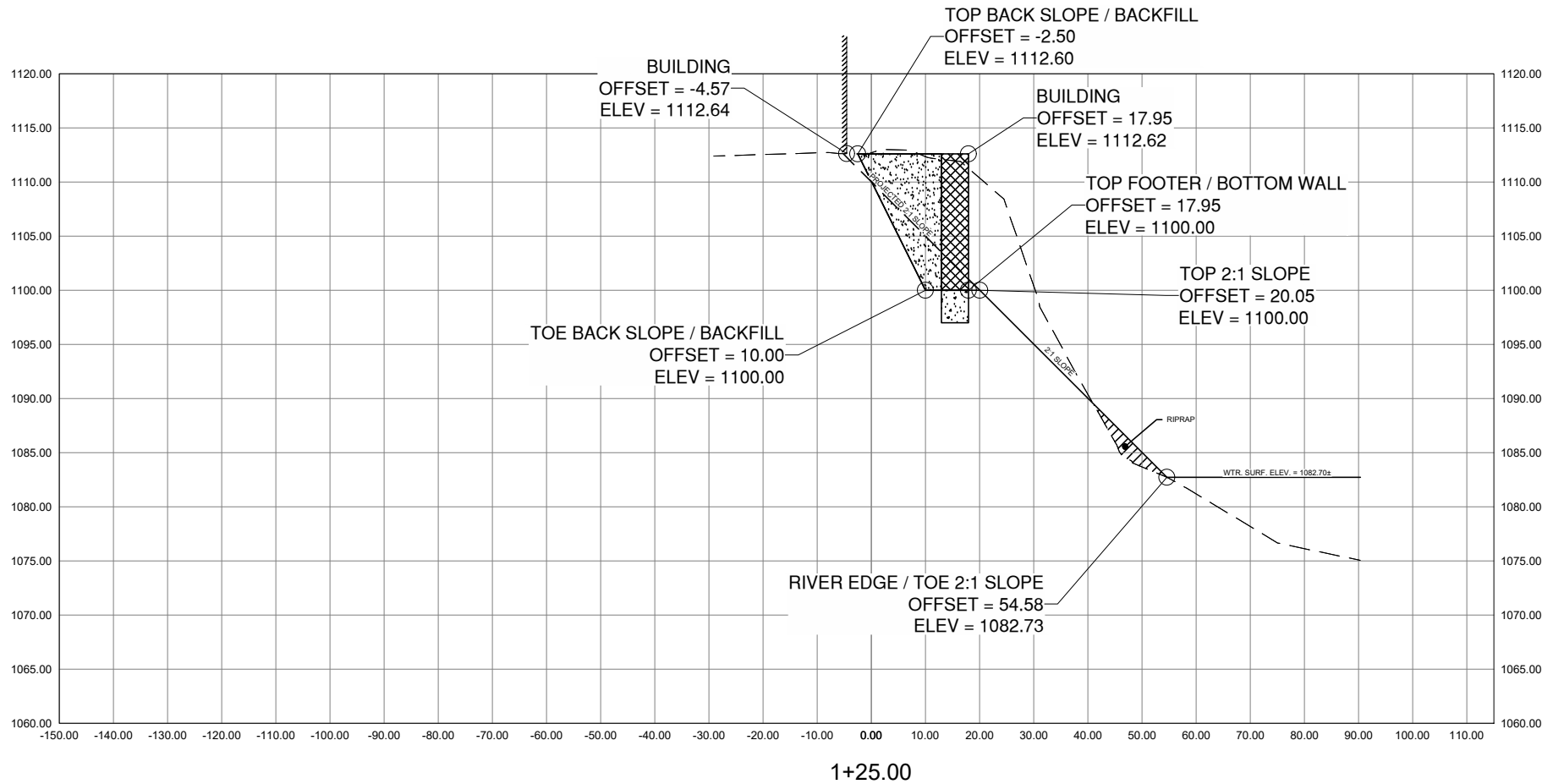
Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or Remarks
1.5		SILTY CLAY (CL-ML), dark brown, moist (TOPSOIL FILL)					
		SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, loose to medium dense (GLACIOFLUVIUM)		2-2-2 (4) 13"			
			5	5-5-9 (14) 10"		12	P200=29%
9.5				7-10-14 (24) 11"			
		SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense to very dense (GLACIOFLUVIUM)	10	13-19-30 (49) 15"		7	
				12-20-39 (59) 14"			
			15	13-29-50/2" (REF) 14"		9	
		<i>Becomes brown and gray below 19 feet</i>	20	12-20-28 (48) 18"			
22.5		SILTY, CLAYEY SAND (SC-SM), with Gravel, gray, moist, dense (GLACIOFLUVIUM)		14-18-23 (41) 18"			
			25				
			30	50/1" (REF) 11"			

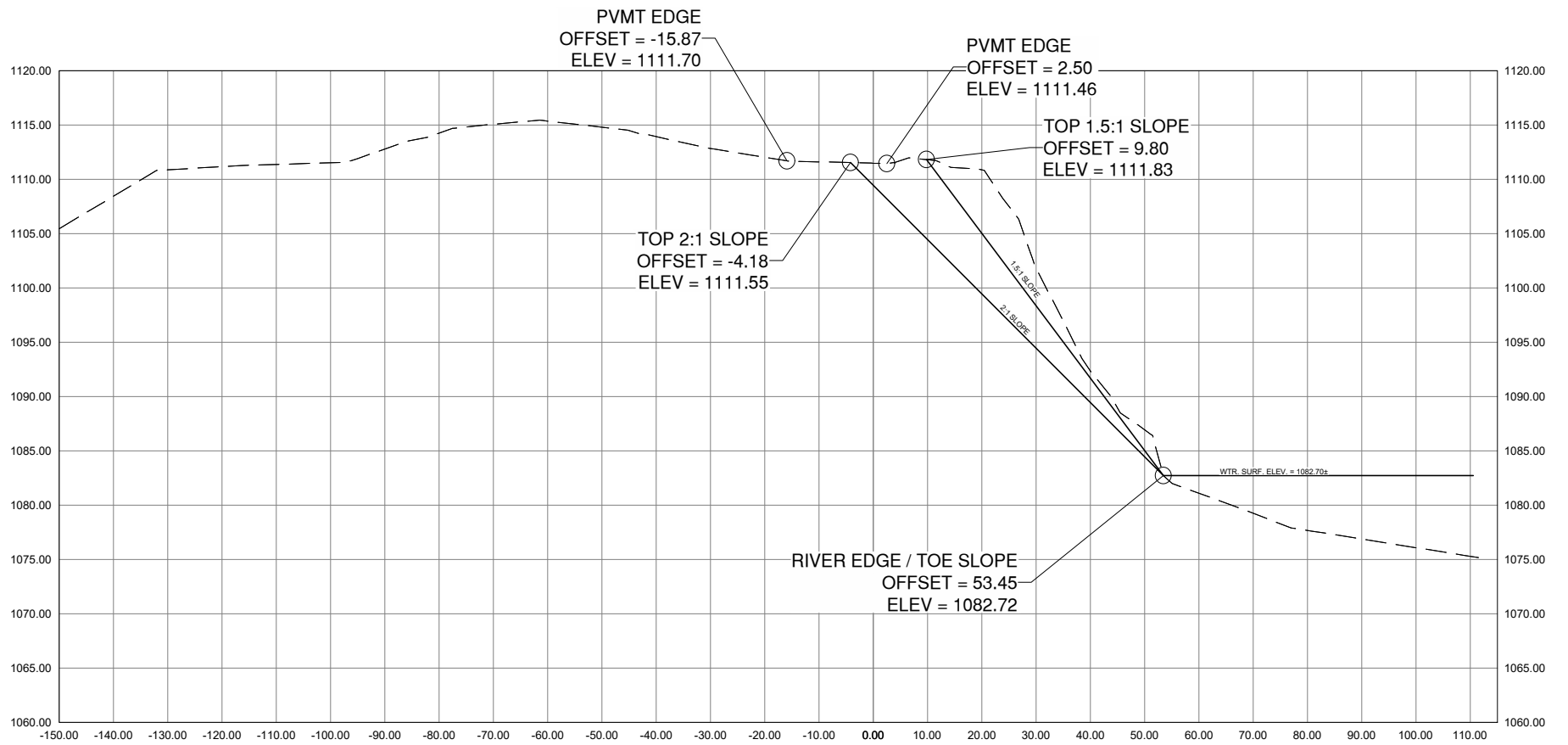
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See Descriptive Terminology sheet for explanation of abbreviations

<b>Project Number B2206910</b>				<b>BORING: ST-3</b>	
<b>Geotechnical Evaluation</b>				LOCATION: See attached sketch	
<b>Charles Weyerhaeuser Memorial Museum</b>				DATUM:	
<b>2151 Lindbergh Drive South</b>				NORTHING:	EASTING:
<b>Little Falls, Minnesota</b>				START DATE: 08/18/22	END DATE: 08/18/22
DRILLER: B. Kammermeier/N. Swanson	LOGGED BY: R. Bipp		SURFACING: Soil WEATHER: Clear		
SURFACE ELEVATION:	RIG: 7506	METHOD: 3 1/4" HSA			

Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or Remarks
32.5		SILTY, CLAYEY SAND (SC-SM), with Gravel, gray, moist, dense (GLACIOFLUVIUM)					
		LEAN CLAY (CL), with Gravel, gray, wet, hard (GLACIAL TILL)					
			35	26-27-43 (70) 18"		10	
41.0			40	13-22-30 (52) 18"			
		END OF BORING					
			45				
			50				
			55				
			60				





2+75.00

# WARZALA RESIDENCE BANK STABILIZATION RAMSEY, MN



Riverbank  
Stabilization



## Project Summary

Anoka Conservation District (ACD) partnered with a private landowner in Ramsey to stabilize 100 linear feet of severely eroding Mississippi riverbank. The bank was approximately 25 feet tall and nearly vertical. The site was identified as a high priority in a riverbank erosion inventory completed by ACD. Final site selection included targeted outreach to high priority property owners and prioritization of erosion severity at interested properties. The stabilization approach included riprap at the bottom of the slope, significant regrading, a reinforced soil slope using a geogrid with anchors to preserve as many mature trees at the top of the slope as possible, and native seed and plants across the entire slope. Stabilization of the bank will prevent 112 tons of sediment and 112 pounds of phosphorus from entering the Mississippi River annually. Funding was provided by a Clean Water Fund Projects and Practices grant, Metro Conservation Districts Enhanced Technical Assistance funds, and the landowner.



Riverbank conditions before (left) and after (right) the project.

## Project Specifications

Date Installed ..... September 2020  
Project Length ..... 100 feet  
Bank Height ..... ~25 feet  
TSS Reduction (lbs/yr) ..... 224,109  
TP Reduction (lbs/yr) ..... 112

## Project Cost

Administration, Outreach, Site Prioritization, Design, and Construction Oversight ..... \$62,218.56  
Riverbank Stabilization.. \$113,440.28  
Total Project Cost ..... \$175,658.84

## Project Funding

CWF Grant ..... \$127,534.42  
MCD ETA ..... \$14,092.34  
Landowner Funds ..... \$34,032.08  
Total Project Funding .... \$175,658.84

## Project Details



Pre-project conditions consisted of a nearly vertical bare bank with severe vegetative overhang, many exposed tree roots, fallen trees, and slumps or slips. Therefore, the lateral recession rate was estimated to be 0.7 ft/yr.



Significant grading was necessary to establish slopes that could be stabilized using the reinforced soil slope geogrid. Final slopes above the riprap were ~1.5:1 (horizontal : vertical).



Riprap at the toe of the slope within the zone of frequent water level fluctuation, a reinforced soil slope geogrid, seeding with native vegetation, and installation of an erosion control blanket stabilized the eroding bank.