

GARDEN HOME

Erosion Mitigation Plan



Report

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Project Number: KH-1025



CAMBODIA

designing a world of hope

#2350, Street: 1982, Sangkat Phnom Penh Thmey
Khan Sensok, Phnom Penh, CAMBODIA
+855 087 646 757

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1 Introduction

EMI Cambodia is pleased to provide this conceptual erosion mitigation plan for Garden Home. The purpose of this report is to reiterate the scope of work and to document the notes from the site visit including site conditions and conversations with Garden Home. This report will also provide a brief explanation of the erosion mitigation plan, a cost estimate, and recommendations.

1.1 Ministry Overview

Garden Home was founded in 1998 to meet the physical and spiritual needs of many orphans. Garden Home operates 32 orphanages with about 1500 children.

1.2 Scope of Work

EMI Cambodia was contracted to complete the following as per the proposal signed October 26, 2018:

1. On-site consultation by a civil engineer and engineering intern to assess the current erosion damage and provide a plan to mitigate further erosion of the riverbank on the north side of the site.
2. Meetings with potential local contractors and review the erosion mitigation plan.
3. An estimate of construction costs for fundraising purposes.

Exclusions included:

1. Directing or supervision of construction labourers.
2. Creation of detailed construction documents.
3. Geotechnical analysis.

2 Site Visit and Site Conditions

EMI Cambodia spent 3 days at the Garden Home site. During the site visit, EMI Cambodia walked the property and along the edge of the riverbank with the Director of Garden Home, assessing the severity of the erosion. Approximately 700 feet of the riverbank is eroding and the water levels in the river have been higher than normal due to a dam upstream of the property. EMI Cambodia visited the site during the dry season therefore the water level was low. The director mentioned that in the wet season, the water level rises to 4-6 inches below the existing top of the bank and estimated the water level during the dry season is about 10 feet deep.

2.1 Significant Erosion near the Coffee Shop

EMI Cambodia identified the approximately 80 feet of riverbank directly behind of the Coffee Shop as a critical area because erosion is occurring from both the river flow and poor drainage and it is the only section of riverbank where a building is at risk of toppling (see Photo 1). The Coffee Shop building is a simple concrete slab and roof structure with no electricity or plumbing. It has two sinks where the water poured into the sinks drains directly outside the building, causing more erosion. The rest of the eroding riverbank is a steep edge from the top of the bank to the water surface indicating that the erosion is mostly only occurring from the flow of the river, as seen in Photo 2.



Photo 1 Riverbank eroding near Coffee Shop building (looking upstream)



Photo 2 Riverbank eroding – near vertical drop from top of bank to water

2.2 Scouring

EMI Cambodia noticed significant surface scouring, as seen in Photo 3, near the Coffee Shop building. The director mentioned these holes were new since they've built the concrete road through the property in the last two years. Some scour holes were as big as 5 feet by 2 feet and 1-2 feet deep.



Photo 3 Scouring from surface water runoff on top of the riverbank

2.3 Additional Conversations about the Site

During the conversations that EMI Cambodia had while on site with The director, it was understood that the river has never over topped the river bank but that the water levels are quite high. The director also mentioned that the property experiences some flooding but the buildings haven't been flooded. After the site visit, during conversations regarding the site and the issues, it was Annie's understanding that flooding is an issue in addition to the erosion.

3 Erosion Mitigation Plan

While the EMI Cambodia team was on site, they met with a local engineer and contractor and established an erosion mitigation plan that would suit the local context. The use of gabion baskets was suggested, however, the contractor mentioned that gabion baskets are mostly used for aesthetic purposes and not typically used to stabilize a bank.

As shown in the attached drawing set (C0-C4), the mitigation plan is to cut back the riverbank and build a benched slope using 6-9" diameter rocks. The rocks will be underlain with a compacted gravel and/or sand material, which will be underlain with a non-woven geotextile fabric. The toe of the slope will consist of 3" diameter bakau piles and a hexagonal chain link fence.

Although this design involves cutting back more of the riverbank, the 1.5-2H:1V slope lined with rocks provides a more stable riverbank and also safer access to the river. This solution will also widen the river, which will decrease the water level in this area and limit the potential for the river from overtopping the bank.

Additional detailed design is required prior to construction.

4 Cost Estimate

New Horizon provided a cost estimate for the construction of the recommended revetment design. The estimated cost to complete the revetment is approximately \$250,000 USD (including taxes). No other quotes were obtained at this time; however, EMI Cambodia recommends obtaining quotes from at least two other construction companies in the Yangon area before beginning construction.

5 Recommendations

The scope of work and the attached drawings are a plan to mitigate further erosion. This revetment design will not solve any on-site flooding or scouring. In order to solve any flooding on the property, additional drainage and some grading would be required to direct the water away from buildings and into a channel in order to prevent sheet flow from occurring (which causes the scouring and further erosion).

EMI Cambodia would recommend starting with building a drainage ditch along the edge of the new concrete road and extending the output of the drainage pipes from the Coffee Shop sinks so that the end of the pipe overhangs well into the river. The output of the drainage pipe is currently directly outside of the Coffee Shop with evidence of erosion.

At this time, EMI Cambodia recommends gathering more information regarding the extent, severity, and frequency of flooding at the Garden Home site. The risk of flooding and potential damage should be considered in order to better assess the feasibility of conducting a survey and a more detailed drainage plan.

6 Closing

In closing, EMI Cambodia would like to thank all the staff at Garden Home for their kind hospitality. It was an honour and blessing to witness their love and care for the orphans in, trusting God every step of the way. Thank you!



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KH-1025

DRAWN BY :

ISSUE DATE:
JAN 22 2019

REVISION : DATE :

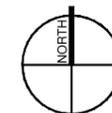
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1

EXISTING RIVER BANK IMAGE

1" = 100' (APPROX.)

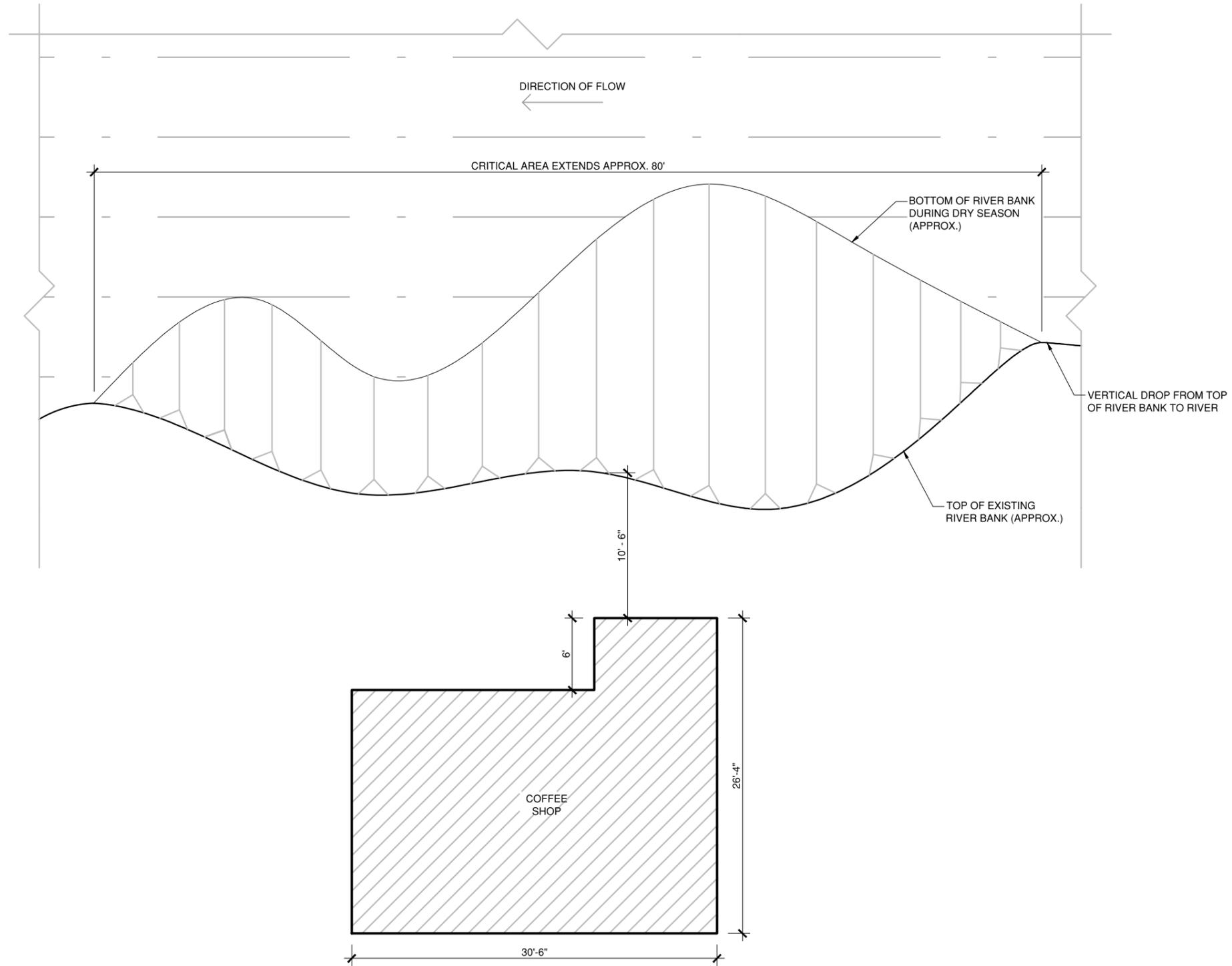
GOOGLE EARTH IMAGERY DATE: APR 10 2018



C0

NOTES:

1. A SURVEY OF THE SITE WAS NOT PERFORMED FOR THE PURPOSE OF THIS DESIGN.
2. THE BOUNDARY OF THE RIVER BANK AND GROUND ARE DRAWN BASED ON VISUAL FIELD OBSERVATIONS.
3. DIMENSIONS PROVIDED WERE DETERMINED USING A TAPE MEASURE.
4. THE CRITICAL AREA IS APPROXIMATELY 80' OF THE RIVER BANK IN FRONT OF THE COFFEE SHOP. THE ERODED RIVER BANK IN THIS AREA IS 10' 6" FROM UNDERTAKING THE COFFEE SHOP. THE RUNOFF FROM THE COFFEE SHOP AND THE CONCRETE ROAD NEARBY IS ALSO CONTRIBUTING TO THE EROSION IN THIS AREA.
5. THE RIVER BANK ON BOTH SIDES OF THIS CRITICAL AREA ALSO HAS SIGNIFICANT EROSION; HOWEVER, NO BUILDINGS ARE AT RISK.
6. IN THIS CRITICAL AREA, DURING DRY SEASON, THE LOWER GROUND SURFACE IS VISIBLE. HOWEVER, IN OTHER AREAS ALONG THE RIVER, THE TOP OF THE RIVER BANK DROPS VERTICALLY TO THE RIVER.



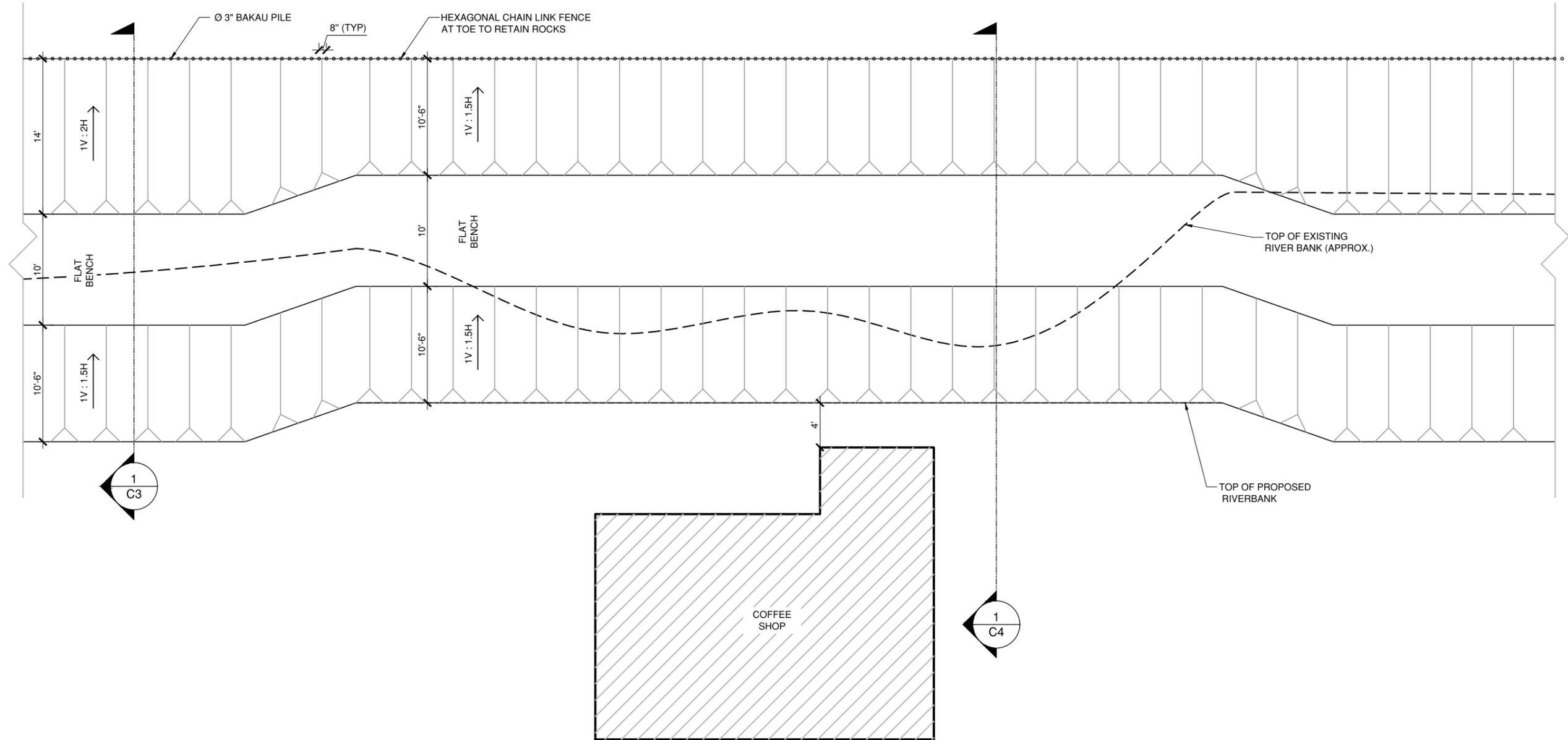
LEGEND	
RIVER HATCH	
EXISTING GROUND	
SLOPE SYMBOL	
EXISTING BUILDING	
EXISTING BUILDING HATCH	

1 EXISTING RIVER BANK IN CRITICAL AREA - PLAN VIEW
1"=10'



NOTES:

1. THE EXISTING TOP OF THE RIVERBANK SHOULD BE CUT BACK APPROXIMATELY 5' TO 15' (DEPENDING ON THE AREA) IN ORDER TO CREATE A SLOPED AND BENCHED RIVER BANK DOWN TO THE RIVER.
2. THE FLAT BENCH IS IMPORTANT TO STABILIZE THE SLOPE AND TO REDUCE THE VELOCITY OF ANY WATER FLOWING INTO THE RIVER.
3. TO HELP STABILIZE THE PROPOSED SLOPED AND BENCHED RIVERBANK, BAKAU PILES AND A CHAINLINK FENCE SHOULD BE INSTALLED AT THE TOE.
4. THE CHAINLINK FENCE SHOULD BE INSTALLED ON RIVERBANK SIDE OF THE POSTS AS SEEN IN C3 AND C4.



LEGEND	
EXISTING GROUND	-----
EXISTING BUILDING	—————
EXISTING BUILDING HATCH	
SLOPE SYMBOL	
FUTURE FENCE	-x-x-x-
FUTURE EMBANKMENT	—————
BAKAU PILE FENCEPOST	○

1 PROPOSED RIVER BANK - PLAN VIEW
1" = 10'



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PROPOSED RIVER BANK - PLAN VIEW

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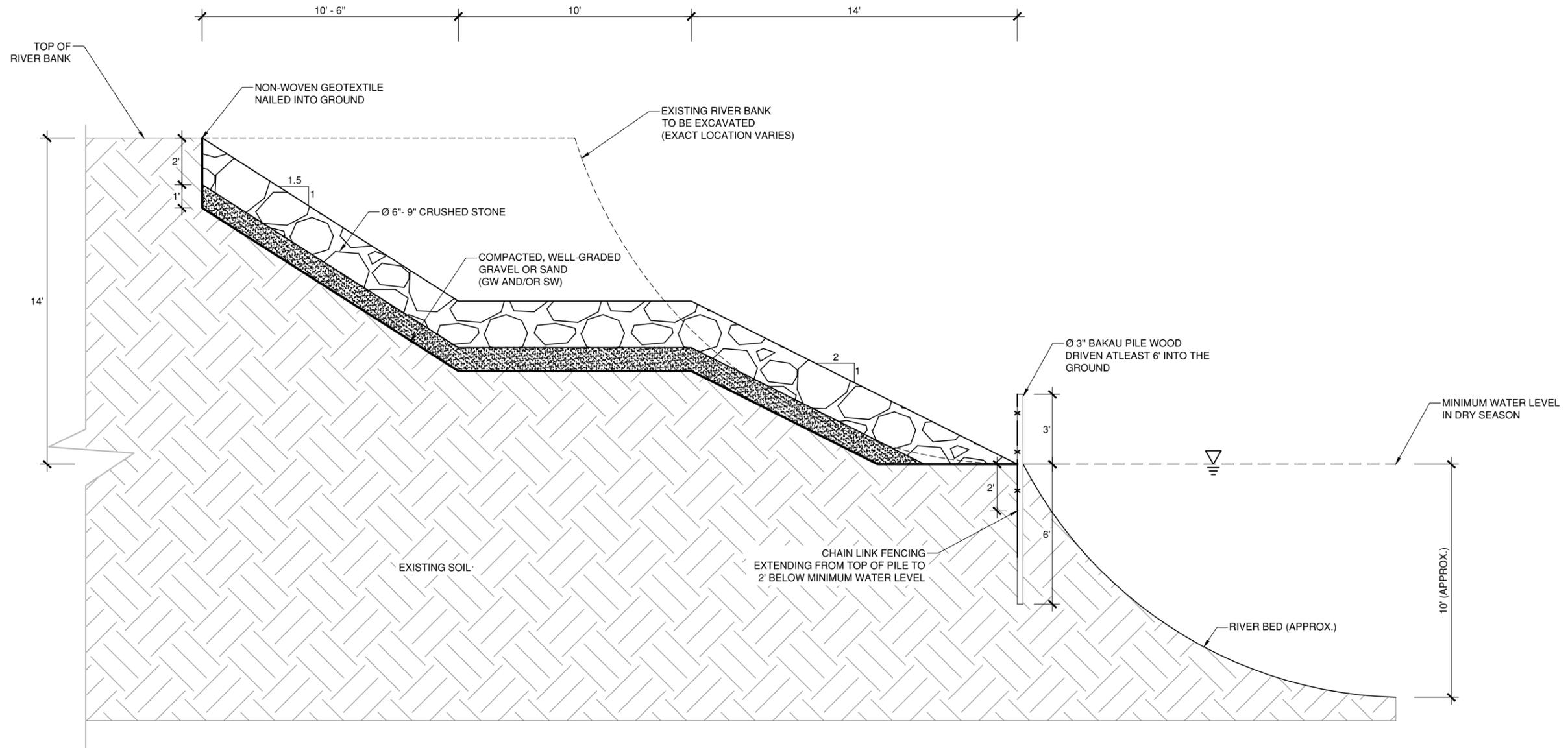
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C2

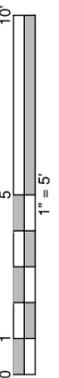
NOTES:

1. THE RIVERBANK SHOULD BE EXCAVATED AND SLOPED AS SHOWN IN THIS DRAWING.
2. THE EXISTING RIVERBANK SOIL WAS OBSERVED TO HAVE A HIGH CLAY CONTENT WITH SOME SAND. IF NEEDED, THE CUT MATERIAL CAN BE USED AS FILL UNDER THE GEOTEXTILE. THE FILL MUST BE COMPACTED BEFORE THE GEOTEXTILE IS PLACED.
3. A LAYER OF NON-WOVEN GEOTEXTILE SHOULD BE PLACED (ROLLED OUT BY HAND) ON THE PREPARED SLOPED SURFACE SECURED BY NAILING THE FABRIC INTO THE GROUND.
4. A 1' THICK LAYER OF WELL GRADED GRAVEL OR SAND SHOULD BE PLACED OVER THE GEOTEXTILE IN TWO 6" LIFTS AND COMPACTED TO 90-95% DENSITY.
5. A 2' THICK LAYER OF CRUSHED STONE (6"-9" DIAMETER) SHOULD BE PLACED ON TOP OF THE WELL-GRADED GRAVEL OR SAND. LARGER ROCKS SHOULD BE PLACED NEAR THE TOE OF THE RIVERBANK SLOPE TO ENSURE THE ROCKS DON'T GO THROUGH THE CHAINLINKED FENCE OPENINGS.



LEGEND	
EXISTING RIVER BANK TO BE EXCAVATED	-----
Ø 6"-9" CRUSHED STONE	
COMPACTED FREE-DRAINING SOIL	
GEOTEXTILE LAYER	—————
EXISTING SOIL (HIGH CLAY CONTENT)	
WATER LEVEL	

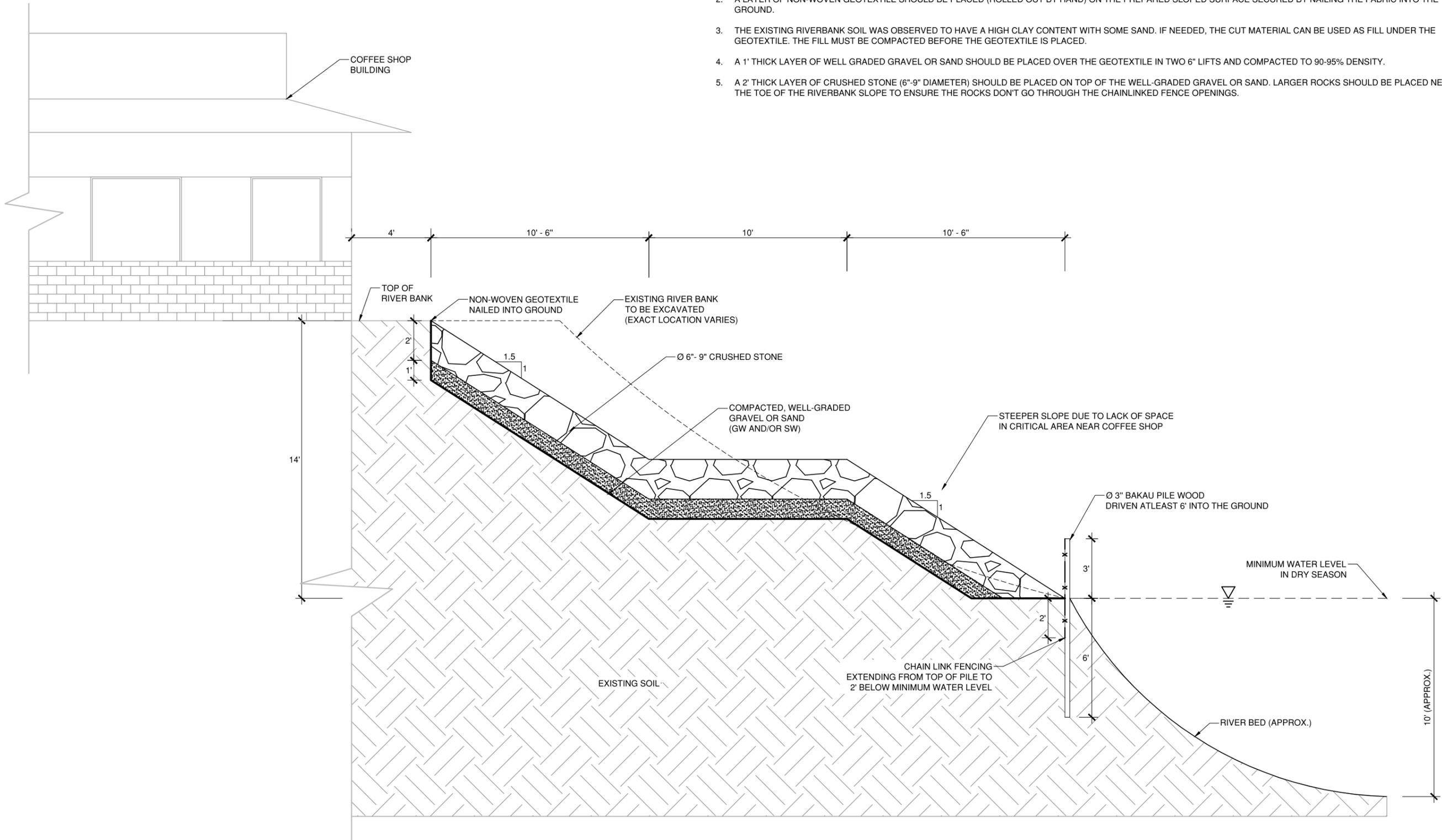
1 TYPICAL PROPOSED RIVER BANK SECTION VIEW
1" = 5'



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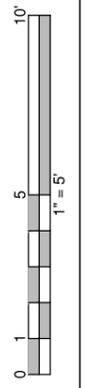
NOTES:

1. THE RIVERBANK SHOULD BE EXCAVATED AND SLOPED AS SHOWN IN THIS DRAWING.
2. A LAYER OF NON-WOVEN GEOTEXTILE SHOULD BE PLACED (ROLLED OUT BY HAND) ON THE PREPARED SLOPED SURFACE SECURED BY NAILING THE FABRIC INTO THE GROUND.
3. THE EXISTING RIVERBANK SOIL WAS OBSERVED TO HAVE A HIGH CLAY CONTENT WITH SOME SAND. IF NEEDED, THE CUT MATERIAL CAN BE USED AS FILL UNDER THE GEOTEXTILE. THE FILL MUST BE COMPACTED BEFORE THE GEOTEXTILE IS PLACED.
4. A 1' THICK LAYER OF WELL GRADED GRAVEL OR SAND SHOULD BE PLACED OVER THE GEOTEXTILE IN TWO 6" LIFTS AND COMPACTED TO 90-95% DENSITY.
5. A 2' THICK LAYER OF CRUSHED STONE (6"-9" DIAMETER) SHOULD BE PLACED ON TOP OF THE WELL-GRADED GRAVEL OR SAND. LARGER ROCKS SHOULD BE PLACED NEAR THE TOE OF THE RIVERBANK SLOPE TO ENSURE THE ROCKS DON'T GO THROUGH THE CHAINLINKED FENCE OPENINGS.



LEGEND	
EXISTING RIVER BANK TO BE EXCAVATED	
Ø 6"-9" CRUSHED STONE	
COMPACTED FREE-DRAINING SOIL	
GEOTEXTILE LAYER	
EXISTING SOIL (HIGH CLAY CONTENT)	
WATER LEVEL	

1 PROPOSED RIVER BANK SECTION VIEW IN CRITICAL AREA ONLY (IN FRONT OF COFFEE SHOP)
1" = 5'



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