

AASHTO TSP2 BRIDGE PRESERVATION SCOUR

**Scour is the number 1
cause of bridge failure
in the
United States**

Topics:

Scour Program History

Regulations Requiring Action by Owners

Scour Coding

Terminology

Plans Of Action

Inspections

Failures

Mitigation

Scour Program History

In April 1987, a catastrophic failure of the Schoharie Creek Bridge on the New York State Thruway claimed 10 lives



Scour Program History

The National Transportation Safety Board determined that the probable cause was severe **scour** beneath the **spread footings** of the 35-year-old bridge.

Scour Program History

After the Schoharie Creek Bridge failure, the Federal Highway Administration established a national scour evaluation program.

Regulations Requiring Action by Owners

- Requires a bridge owner to identify scour critical bridges
- Report information to FHWA.
- Develop a **Plan Of Action** to monitor known and potential scour deficiencies.
- Address critical findings of these bridges.

Scour Critical Definition

Bridges evaluated as scour critical are those bridges that are scour vulnerable, tidal, or have unknown foundations.

NBI Coding Guide – Item 113

Scour Coding

N - Bridge not over waterway

U - Bridge with "unknown" foundation that has not been evaluated for scour.

T - Bridge over "tidal" waters that has not been evaluated for scour, but considered low risk.

Scour Coding

- 9 - Bridge foundations (including piles) on dry land well above flood water elevations.
- 8 - Bridge foundations determined to be stable for assessed or calculated scour conditions.
- 7 - Countermeasures have been installed to correct a previously existing problem with scour.

Scour Coding

- 6 - Scour calculation/evaluation has not been made.
- 5 - Bridge foundations determined to be stable for calculated scour conditions.
- 4 - Bridge foundations determined to be stable for calculated scour conditions; field review indicates action is required.

Scour Coding (Scour Critical)

3 - Bridge is scour critical; bridge foundations determined to be unstable for calculated scour conditions.

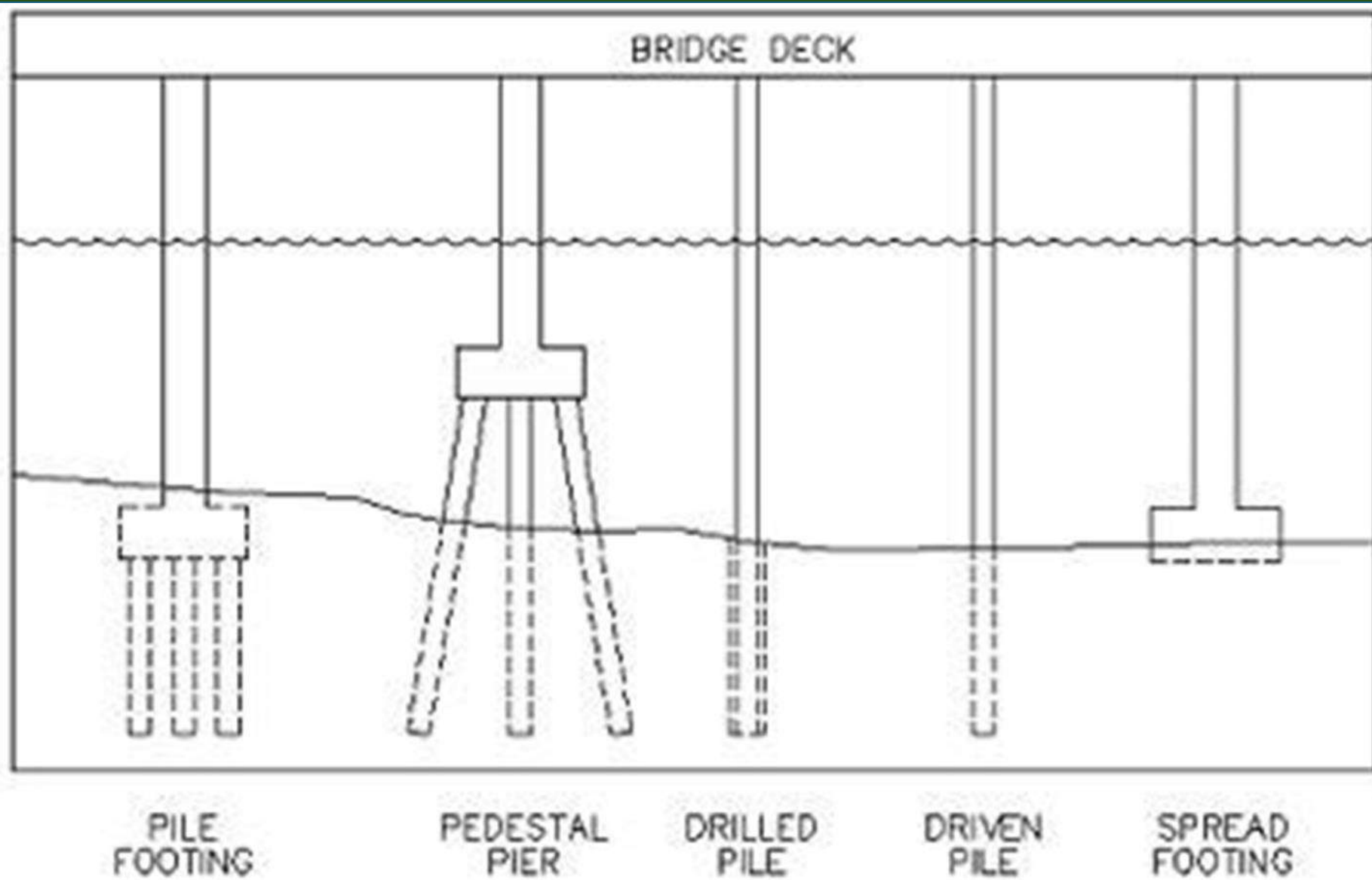
2 - Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations. Immediate action is required.

Scour Coding (Scour Critical)

1 - Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic.

0 - Bridge is scour critical. Bridge has failed and is closed to traffic.

Terminology



Above: Common Bridge Foundation Types

Aggradation



Degradation

Local Scour



Lateral Stream Migration



Angle Of Attack



Purpose of Plan Of Action

Describes procedures for inspectors and engineers to implement before, during, and after a flood event to protect the traveling public.

Describes the countermeasures selected to address the vulnerability of the bridge scour.

Plan Of Action Contents

1. GENERAL INFORMATION
2. RESPONSIBILITY FOR POA
3. SCOUR VULNERABILITY
4. RECOMMENDED ACTION(S) (see Sections 6 and 7)
5. NBIS CODING INFORMATION
6. MONITORING PROGRAM
7. COUNTERMEASURE RECOMMENDATIONS
8. BRIDGE CLOSURE PLAN
9. DETOUR ROUTE
10. ATTACHMENTS

SCOUR CRITICAL BRIDGE - PLAN OF ACTION

1. GENERAL INFORMATION

Structure number: 05C04	City, County, State: Clackamas County, Oregon	Waterway: Still Creek
Structure name: Still Creek, Still Creek Rd	State highway or facility carried: Still Creek Rd	Owner: County Hwy Agency
Year built: 1971	Year rebuilt:	Bridge replacement plans (if scheduled): Anticipated opening date:
Structure type: ☒ Bridge ☐ Culvert Structure size and description: 61ft, Timber, Stringer and Girder		
Foundations: ☒ Known, type: Spread footings poured on bedrock Depth: ☐ Unknown		
Subsurface soil information (check all that apply): ☐ Non-cohesive ☐ Cohesive ☒ Rock		
Bridge ADT: 91	Year/ADT: 2006	% Trucks: 10
Does the bridge provide service to emergency facilities and/or an evacuation route (Y/N)? 		
If so, describe:		

2. RESPONSIBILITY FOR POA

Author(s) of POA (name, title, agency/organization, telephone, pager, email):

Douglas McLain - Clackamas County Department of Transportation and Development, (503) 780-3194, Dougmcl@clackamas.us

Date: 7/17/23

Concurrences on POA (name, title, agency/organization, telephone, pager, email):

ODOT and Road Master

POA updated by (name, title, agency, organization): **Date of update:**

Items update:

POA to be updated every 24 months by (name, title, agency/organization):

Date of next update:2025

3. SCOUR VULNERABILITY

a. Current Item 113 Code: ☒ 3 ☐ 2 ☐ 1 Other:

b. Source of Scour Critical Code: ☐ Observed ☒ Assessment ☐ Calculated Other:

c. **Scour Evaluation Summary:** Field inspected for Item #113, changed from 2 to 3. High velocity flows. Existing countermeasures at each abutment have some undermining. Recommend additional countermeasures be installed to maintain foundation stability. Extensive scour needing immediate intervention not found. 3-28-08

d. **Scour History:** 5/21/2007 - Erosion at E. abutment, 6"-8" deep, no change from previous inspection. Plenty of height between high water and bridge. No drift problems. Scour east abutment, poured apron countermeasure. Scour under apron, but it hasn't reached the footing.

7/20/2021: Removed undermined concrete overpour on east abutment, dug trench in front of abutment, and buried pre-cast concrete panels to resist future scour. Tops of panels were bolted to the abutment and the voids behind the pre-cast panels were filled with grout.

4. RECOMMENDED ACTION(S) (see Sections 6 and 7)

	<u>Recommended</u>		<u>Implemented</u>	
a. Increased Inspection Frequency	☐ Yes	☒ No	☒ Yes	☐ No
b. Fixed Monitoring Device(s)	☐ Yes	☒ No	☐ Yes	☒ No
c. Flood Monitoring Program	☒ Yes	☐ No	☒ Yes	☐ No
d. Hydraulic/Structural Countermeasures	☒ Yes	☐ No	☒ Yes	☐ No

5. NBI CODING INFORMATION

	<u>Current</u>	<u>Previous</u>
Inspection date	<u>3-28-08</u>	<u>06-06-06</u>
Item 113 Scour Critical	<u>3</u>	<u>2</u>
Item 60 Substructure	<u>6</u>	<u>6</u>
Item 61 Channel & Channel Protection	<u>6</u>	<u>6</u>
Item 71 Waterway Adequacy	<u>7</u>	<u>7</u>
Comments: (drift, scour holes, etc. - depict in sketches in Section 10)		

6. MONITORING PROGRAM

☒ **Regular Inspection Program** ☒ w/surveyed cross sections

Items to Watch: Undermining of spread footings

☒ **Increased Inspection Frequency of 12 mo.** ☐ w/surveyed cross sections

Items to Watch: Undermining of spread footings

☒ **Underwater Inspection Required**

Items to Watch: Undermining of spread footings

☐ **Increased Underwater Inspection Frequency of mo.**

Items to Watch:

☒ **Request Additional Underwater Inspection after a flood event**

☐ **Fixed Monitoring Device(s)**

Type of Instrument:

Installation location(s):

Sample Interval: ☐ 30 min. ☐ 1 hr. ☐ 6 hrs. ☐ 12 hrs. ☐ Other:

Frequency of data download and review: ☐ Daily ☐ Weekly ☐ Monthly ☐ Other

Scour alert criteria for each pier/abutment:

Scour critical criteria for each pier/abutment:

Survey ties:

Criteria of termination for fixed monitoring:

☒ **Flood Monitoring Program**

Type:

☒ Visual inspection

☐ Instrument (check all that apply):

☐ Portable

☐ Geophysical

☐ Sonar

☐ Other:

Flood monitoring required:

☒ Yes

☐ No

Flood monitoring event defined by (check all that apply):

☐ Discharge

☒ Stage Bankfull

☐ Elev. measured from

☐ Rainfall

(in/mm) per (hour)

☐ Flood forecasting information:

☐ Flood warning system:

Frequency of flood monitoring:

☐ 1 hr.

☐ 3 hrs.

☐ 6 hrs.

☒ Other:

Daily until water

level recedes

Post-flood monitoring required:

☐ No

☒ Yes, within 1 days

Frequency of post-flood monitoring:

☒ Daily

☐ Weekly

☐ Monthly

☒ Other:

Determine

the need of frequency.

Criteria for termination of flood monitoring: When water drops below the trigger level.

Criteria for termination of post-flood monitoring: After post flood inspection and below bankfull

Scour alert criteria for each pier/abutment:

Scour critical criteria for each pier/abutment:

Note: Additional details for action(s) required may be included in Section 8.

Action(s) required if scour alert criteria detected (include notification and closure procedures):

Action(s) required if scour critical criteria detected (include notification and closure procedures):

Agency and department responsible for monitoring: Bridge Maintenance - Clackamas County
Department of Transportation and Development

Contact person (include name, title, telephone, pager, e-mail): Douglas McLain - Clackamas
County Department of Transportation and Development, (503) 780-3194, dougmcl@clackamas.us

7. COUNTERMEASURE RECOMMENDATIONS

Prioritize alternatives below. Include information on any hydraulic, structural or monitoring countermeasures.

☐ **Monitoring Countermeasure (see Section 6 and Section 10 – Attachment F)**

Estimated cost \$

☐ **Structural/hydraulic countermeasures considered (see Section 10, Attachment F):**

Priority Ranking

Estimated cost

(1)

\$

(2)

(3)

\$

\$

(4)

\$

(5)

\$

Basis for the selection of the preferred scour countermeasure:

Countermeasure implementation project type:

☐ Proposed Construction Project

☐ Maintenance Project

☐ Programmed Construction - Project Lead

Agency:

☐ Bridge Bureau

☐ Road Design

☐

Other

Agency and department responsible for countermeasure program (if different from Section 6 contact for monitoring):

Contact person (*include name, title, telephone, pager, e-mail*):

Target design completion date:

Target construction completion date:

Countermeasures already completed:

8. BRIDGE CLOSURE PLAN

Scour monitoring criteria for consideration of bridge closure:

- ☐ Water surface elevation reaches [] at []
- ☐ Overtopping road or structure
- ☐ Scour measurement results / Monitoring device (See Section 6)
- ☒ Observed structure movement / Settlement
- ☐ Discharge: [] cfs/cms
- ☐ Flood forecast: []
- ☒ Other: ☒ Debris accumulation ☐ Movement of riprap/other armor protection
- ☒ Loss of road embankment

Emergency repair plans (include source(s), contact(s), cost, installation directions): []

Agency and department responsible for closure: Bridge Maintenance - Clackamas County
Department of Transportation and Development

Contact persons (name, title, agency/organization, telephone, pager, email): Douglas McLain -
Clackamas County Department of Transportation and Development, (503) 780-3194,
dougmccl@clackamas.us

Criteria for re-opening the bridge: Water recedes and after post flood inspection

Agency and person responsible for re-opening the bridge after inspection: Douglas McLain -
Clackamas County Department of Transportation and Development, (503) 780-3194

9. DETOUR ROUTE

Detour route description (route number, from/to, distance from bridge, etc.) - Include map in Section 10, Attachment E.

Bridges on Detour Route:

Bridge Number	Waterway	Sufficiency Rating/ Load Limitations	Item 113 Code

Traffic control equipment (detour signing and barriers) and location(s):

Additional considerations or critical issues (susceptibility to overtopping, limited waterway adequacy, lane restrictions, etc.) :

News release, other public notice (include authorized person(s), information to be provided and limitations):

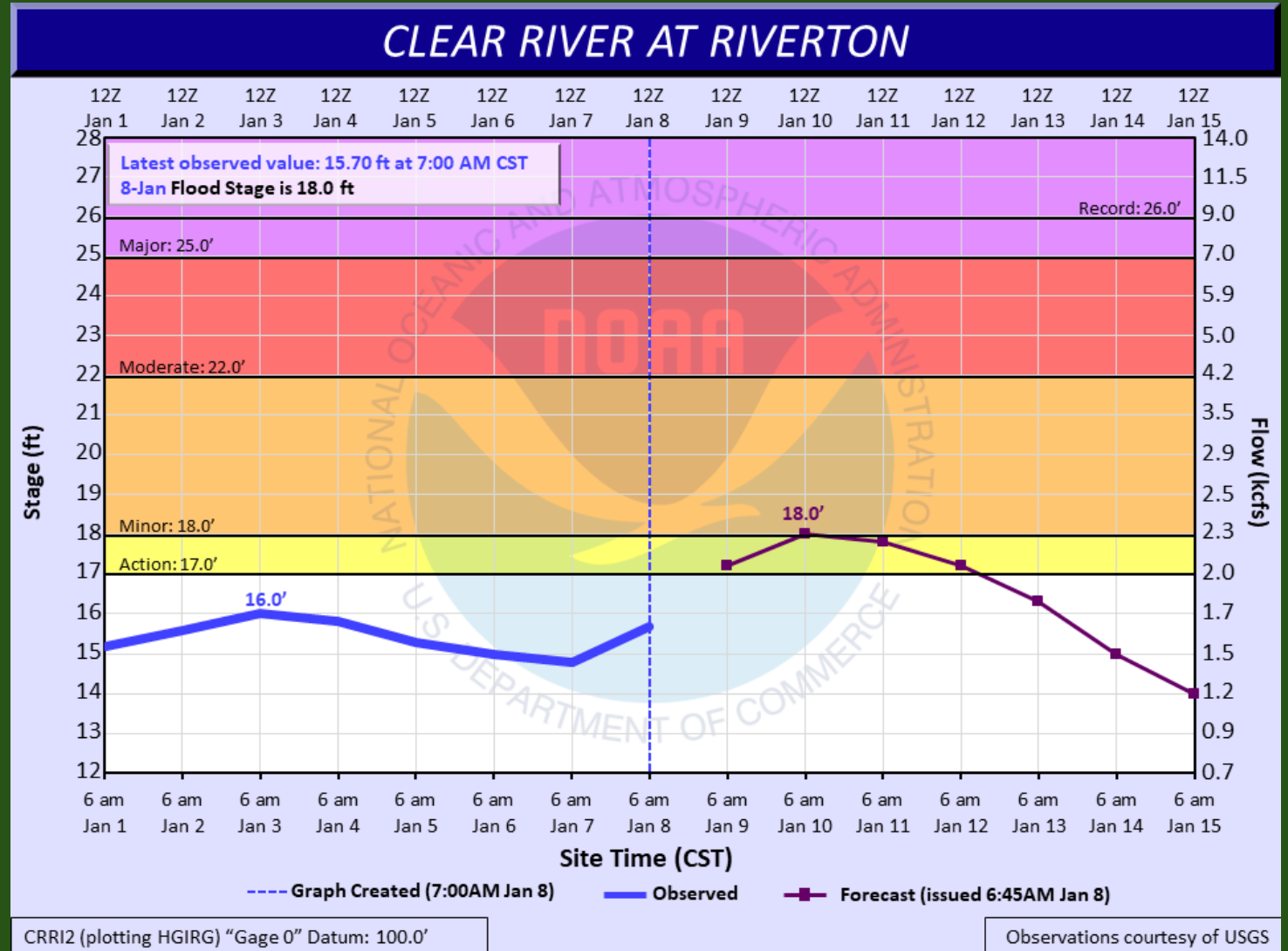
10. ATTACHMENTS

Please indicate which materials are being submitted with this POA:

- ☒ Attachment A: Boring logs and/or other subsurface information
- ☒ Attachment B: Cross sections from current and previous inspection reports
- ☐ Attachment C: Bridge elevation showing existing streambed, foundation depth(s) and observed and/or calculated scour depths
- ☐ Attachment D: Plan view showing location of scour holes, debris, etc.
- ☒ Attachment E: Map showing detour route(s)
- ☐ Attachment F: Supporting documentation, calculations, estimates and conceptual designs for scour countermeasures.
- ☒ Attachment G: Photos
- ☐ Attachment H: Other information:

Inspections

When and how often to monitor?



Rt. #	Drainage	Sub Drainage	Br. #	Br. Alias	SCR	Affected Areas (Piers,Beams,Abutments,Approaches)	Foundation Type	High Water Mark	Date / Time / Comments	Inspectors
	Clackamas Rv.	Eagle Creek	03060A	Eagle Creek / Old State Hwy.	3	Bttm of PW steel encasement is 3' above crk. bttm. expsng 4 piles (channel side of PW). US rock bar directs flows on to bnt 2 steel encasement.	Spread ftng col. bnts except bnt 2. Bnt 2 is PW on piles.			
	Clackamas Rv.	Eagle Creek	05244	Kitzmilller Rd. / Bear Cr.	4	US NE bank scoured & undercut. N BW: Top of ftng xpsd & covered w/ lrg rocks. SE WW ftng xpsd. No undermining present.	Spread footings			
	Clackamas Rv.	Eagle Creek	05246	Kitzmilller Rd. / N. Fk. Eagle Cr.	4	N. Abutment: Ftng & 20"-30" of vert. face are expsd. S. Abutment: Ftng & 1' of vert face (on the US & DS corners) are expsd. Ftng undermined @ BW- WW jct. (small area 4"-6" deep undermined). SE WW undermined (4"	Spread footings poured on rock			
	Clackamas Rv.	Eagle Creek	05295	Heiple Road West			Spread footings			
	Clackamas Rv.	Eagle Creek	05296	Heiple Road East			Spread footings			
	Clackamas Rv.	Rock Creek	06040	Foster Road						
	Clackamas Rv.	Rock Creek	06287	172nd	3	Footings are exposed on both abutments with 4"of vertical footing face exposed on NE WW. Up to 8" of vert. ftng face xpsd on S. abut. @ mid pt. (no undermining present). US & DS banks eroding especially behind wingwalls.	Spead Footing			
	Clackamas Rv.	Deep Creek	06299	Deep Cr.		US & DS S. bank scour. Shear vert. bank wall w/in feet of S. abutment. Bnt 2 col. undermined ftngs filled w/ lrg rock counter measures	End bents on piles. Int column bnts; spread ftngs			
	Clackamas Rv.		06364	Sailing Rd.		Channel scour holes @ NW and SE wingwalls. No footings are expsd. Creek flows against US NW wingwall.	Spread ftngs			
	Clackamas Rv.	Eagle Creek	06424	North Fork Eagle Cr.	8	US & DS bank scour. Hvy abrasion on int. bnts. S. int bnt: PW is undermined 1" deep full length on bank side & 6" deep @ US end on creek side. Bridge over topped with lrg debris, 2008.	Spread ftngs; End & int. bents pour on rock.	Deck overtopped. Apprch GR backfill eroded. (09)		
	Clackamas Rv.	Eagle Creek	06466	Snuffin Rd.	8	S. abutment: US half of the BW ftng & 6"- 8" of vert ftng face expsd. N. abutment: Ftng & 4"- 2' of ftng face expsd from US WW- BW jct to end of DS WW. A 6' L x 1' D x 9" H section of the DS WW is undermin-ed, 4' DS from the BW-WW	Spread footings			
	Clackamas Rv.	Clear Creek	06505	Fishers Mill	8	Bnt 2: DS col; overpour undermined back to col. Bnt 3: US col overpour expsd & undermined. Channel & bank scour (scour hole 3'-5' deep 2' out from US col.in bnt 3). No ftngs expsd on either int bnt. (ftngs 1.5' vert.)	End bents on piles. Int bnts; spread ftngs			
	Clackamas Rv.	Clear Creek	06508	Viola	3	Channel scour holes @ bnt 2 col (no ftngs expsd). Bent 3 col. ftngs & 3.5"-24" of ftng faces exposed. Some ftng bttms expsd but, not undermined. Spn 4: Hvy S. bank erosion @ bnt	Spread footings end and int. bents.			

Drainage	Sub Drainage	Br. #	Br. Alias	SCR	Affected Areas (Piers,Beams,Abutments,Approaches)	Foundation Type
Clackamas Rv.	Rock Creek	06287	172nd	3	Footings are exposed on both abutments with 4"of vertical footing face exposed on NE WW. Up to 8" of vert. ftng face xpsd on S. abut. @ mid pt. (no undermining present). US & DS banks eroding especially behind wingwalls.	Spread Footing

What are we looking for?

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- Overtopping of the bridge deck or approach roadway

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- Pressure flow at the bridge (the low chord mostly or fully submerged)

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- Excessive horizontal or vertical separation at bridge deck joints

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- Overtopping of the bridge deck or approach roadway
- Pressure flow at the bridge (the low chord mostly or fully submerged)
- Vertical or lateral displacement of the superstructure
- Excessive horizontal or vertical separation at bridge deck joints
- Visible damage to the bridge deck, low chord, or substructure

What are we looking for?

- Overtopping of the bridge deck or approach roadway
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- Visible damage to the bridge deck, low chord, or substructure
- Sinkholes in the roadway behind the abutments

What are we looking for?

- Overtopping of the bridge deck or approach roadway
- Pressure flow at the bridge (the low chord mostly or fully submerged)
- Vertical or lateral displacement of the superstructure
- Excessive horizontal or vertical separation at bridge deck joints
- Visible damage to the bridge deck, low chord, or substructure
- Sinkholes in the roadway behind the abutments
- Massive debris buildup, especially if near the low chord





Post Event



Failures

Baker County 2010



Umatilla County 2020



Umatilla County 2020



Umatilla County 2020



Umatilla County 2020



Umatilla County 2020



Tillamook County 2007



Mitigation







Bridge ID: 19951

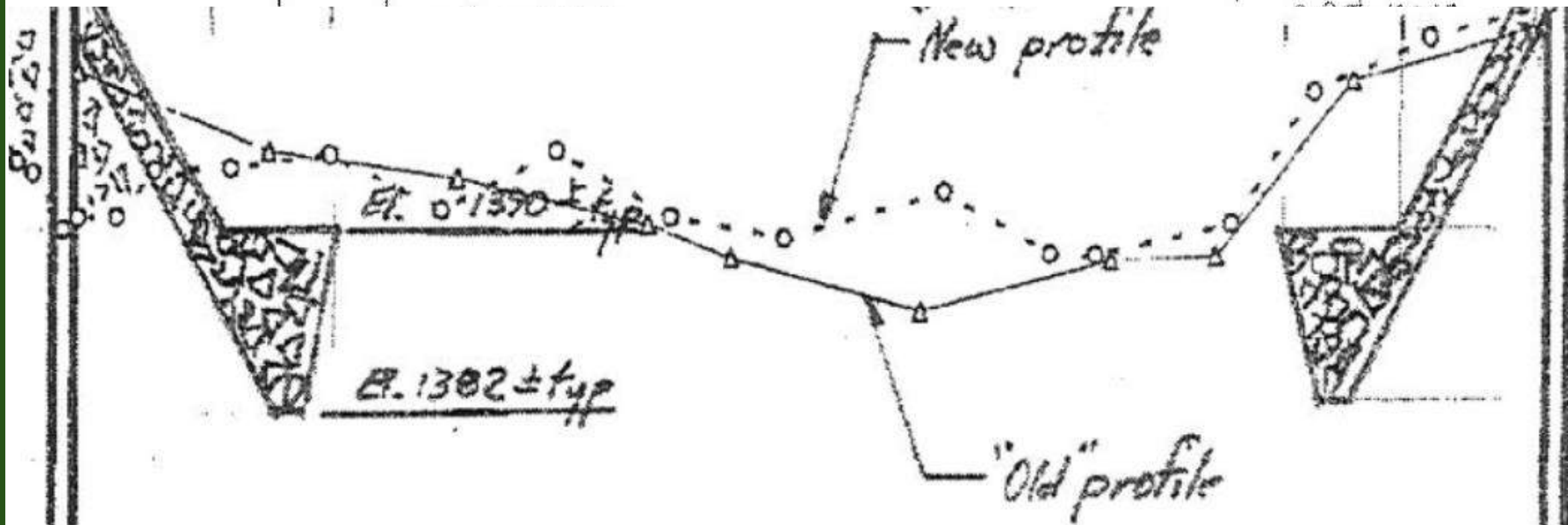
Lolo Pass Road

Zigzag River Bridge - Upstream

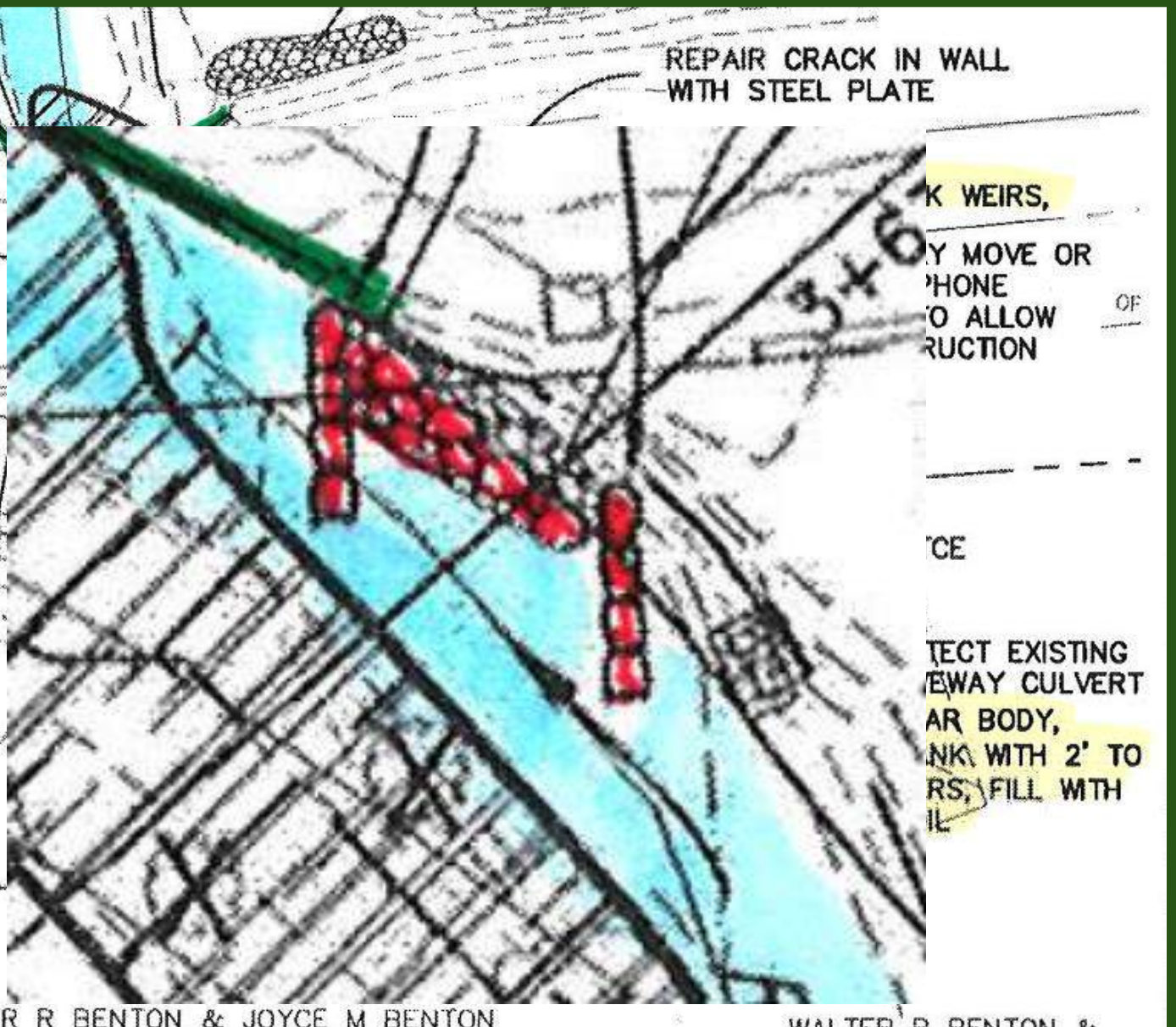
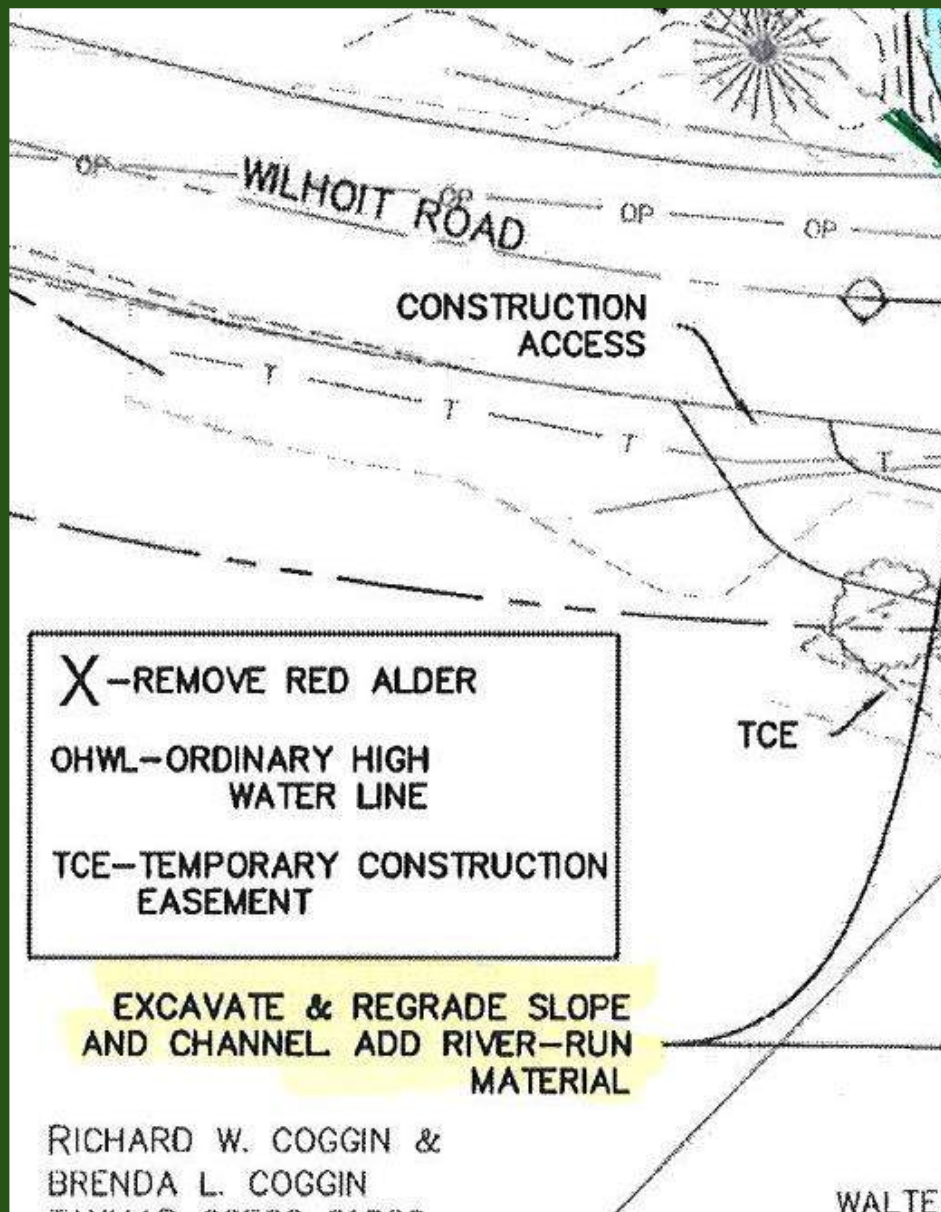
⊕ Bent 1

⊕ Bent 2

1420









WATER FLOW DIFFUSER,
6" PVC WITH 3/4"
HOLES AND PLASTIC
SHEETING

DISCHARGE LINE

DISCHARGE LINE
ATTACH TO BRIDGE

WILHOIT ROAD

3+16.7

3+63.5

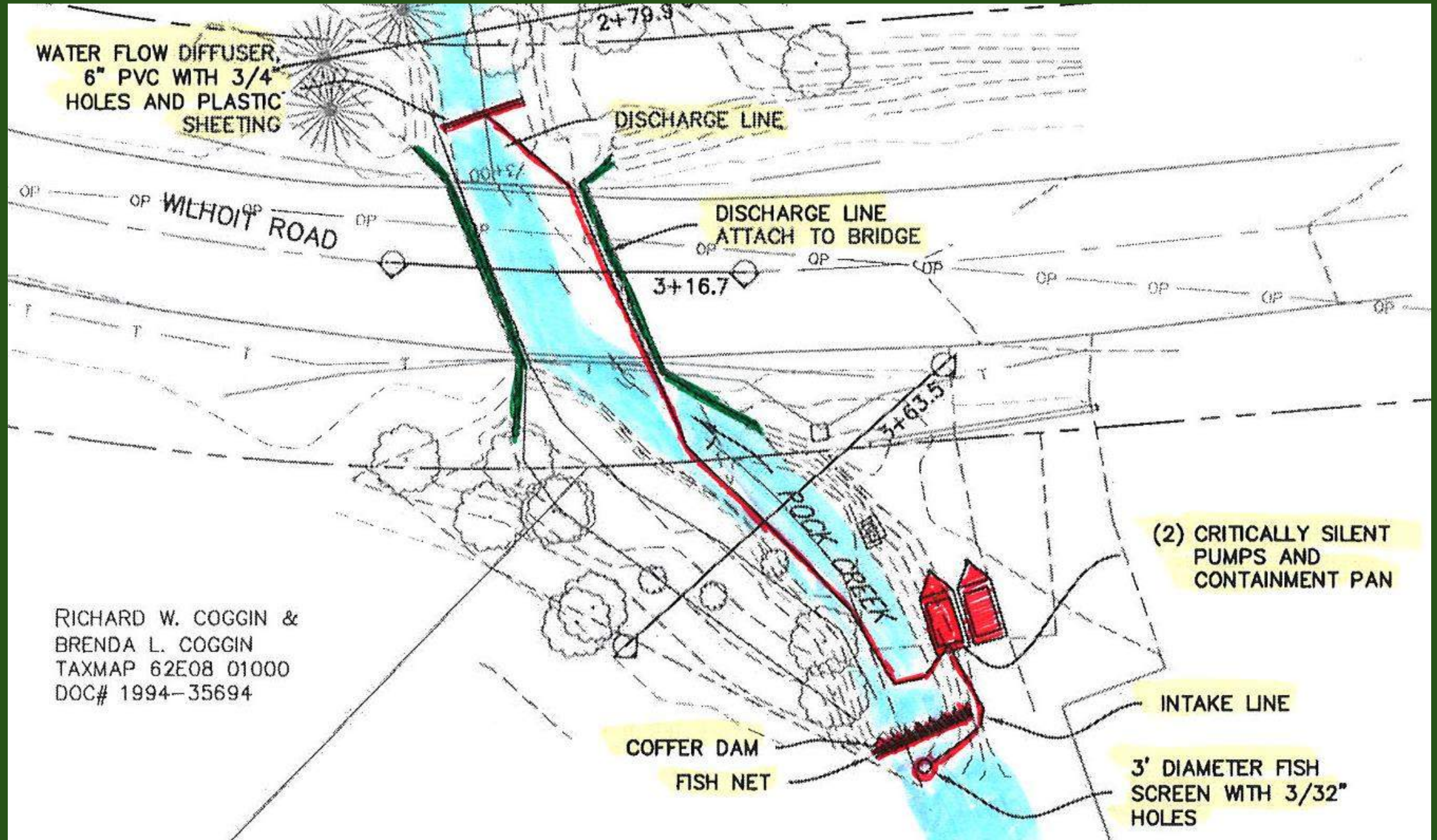
(2) CRITICALLY SILENT
PUMPS AND
CONTAINMENT PAN

INTAKE LINE

3' DIAMETER FISH
SCREEN WITH 3/32"
HOLES

COFFER DAM
FISH NET

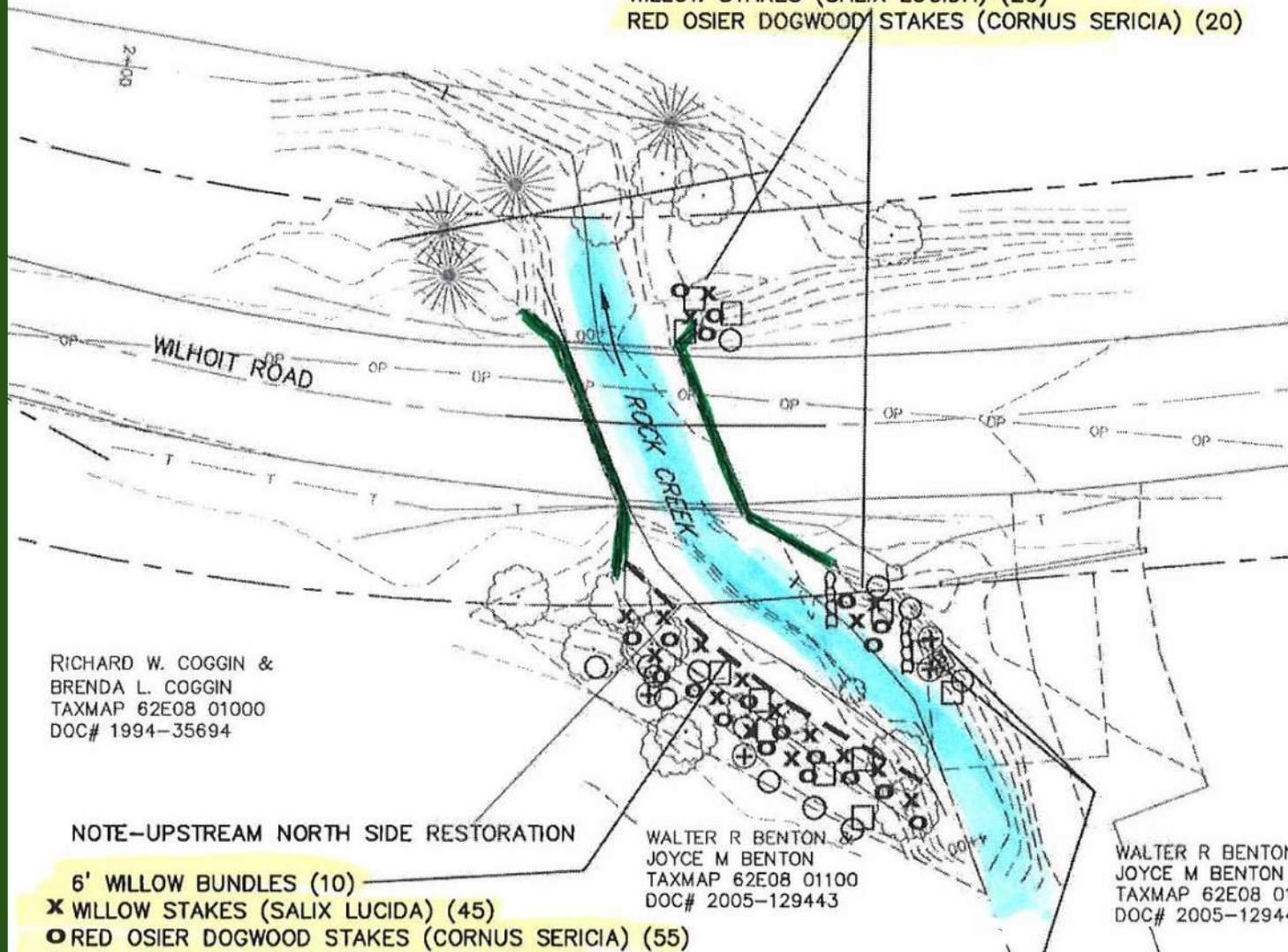
RICHARD W. COGGIN &
BRENDA L. COGGIN
TAXMAP 62E08 01000
DOC# 1994-35694



NOTE—SOUTH SIDE RESTORATION

WILLOW STAKES (*SALIX LUCIDA*) (20)

RED OSIER DOGWOOD STAKES (*CORNUS SERICIA*) (20)



RICHARD W. COGGIN &
BRENDA L. COGGIN
TAXMAP 62E08 01000
DOC# 1994-35694

NOTE—UPSTREAM NORTH SIDE RESTORATION

6' WILLOW BUNDLES (10)

x WILLOW STAKES (*SALIX LUCIDA*) (45)

o RED OSIER DOGWOOD STAKES (*CORNUS SERICIA*) (55)

o BIG LEAF MAPLE (*ACER MACROPHYLLUM*) (2)

o OREGON ASH (*FRAXINUS LATIFOLIA*) (6)

o WHITE ALDER (*ALNUS RHOMBIFOLIA*) (11)

□ SWORD FERN (*POLYSTICHUM MUNITUM*) (20)

WALTER R BENTON
JOYCE M BENTON
TAXMAP 62E08 01100
DOC# 2005-129443

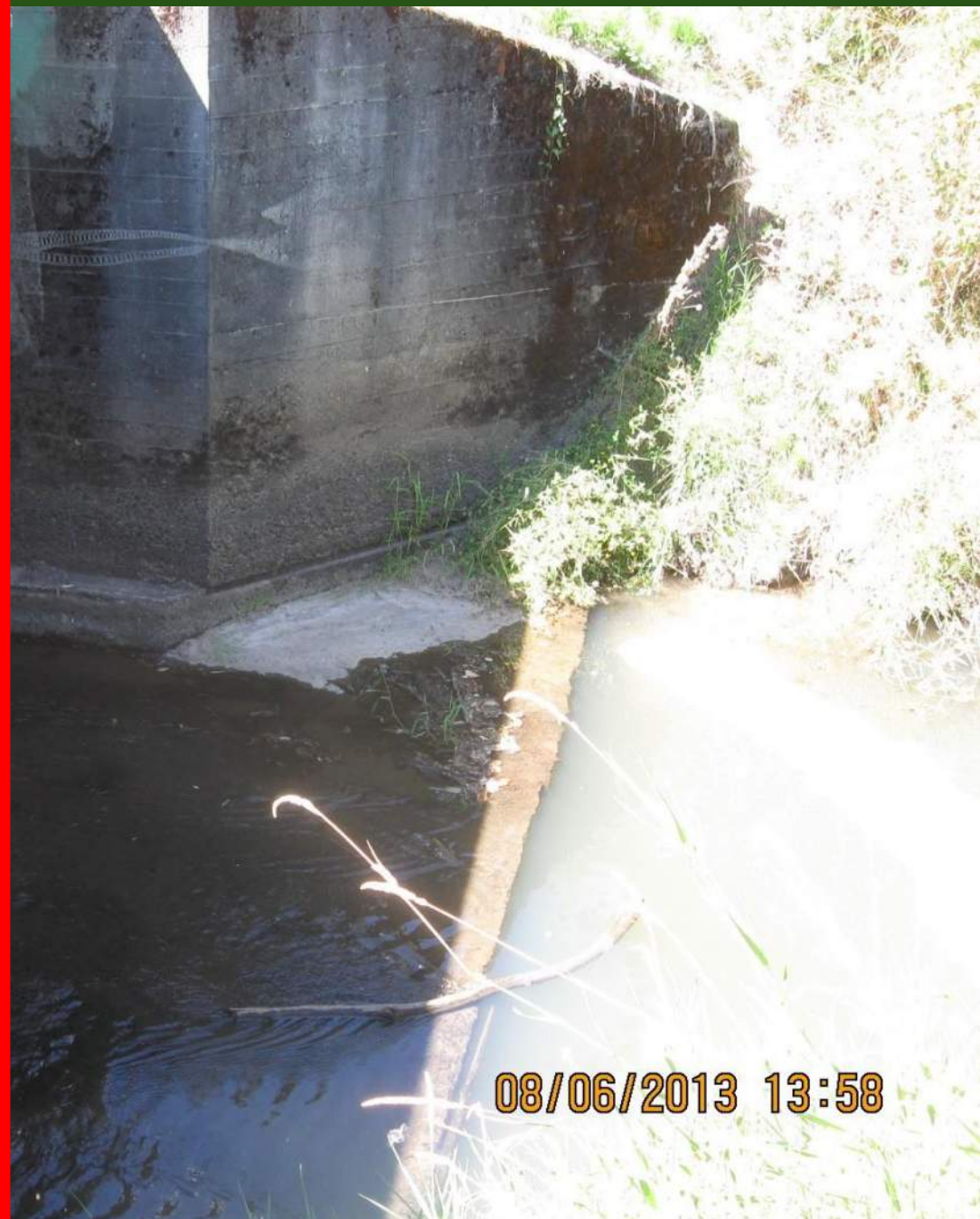
WALTER R BENTON
JOYCE M BENTON
TAXMAP 62E08 01100
DOC# 2005-129444

NOTE—UPSTREAM SOUTH SIDE RESTORATION

BIG LEAF MAPLE (*ACER MACROPHYLLUM*) (2)









60' ROAD
RIGHT OF WAY

CONCRETE HEADWALLS

FILL WITH 1 1/2 TO 3 FOOT
BOULDERS AND RIVERRUN
FINISH ELEVATION ONE FOOT
ABOVE CONCRETE FLOOR

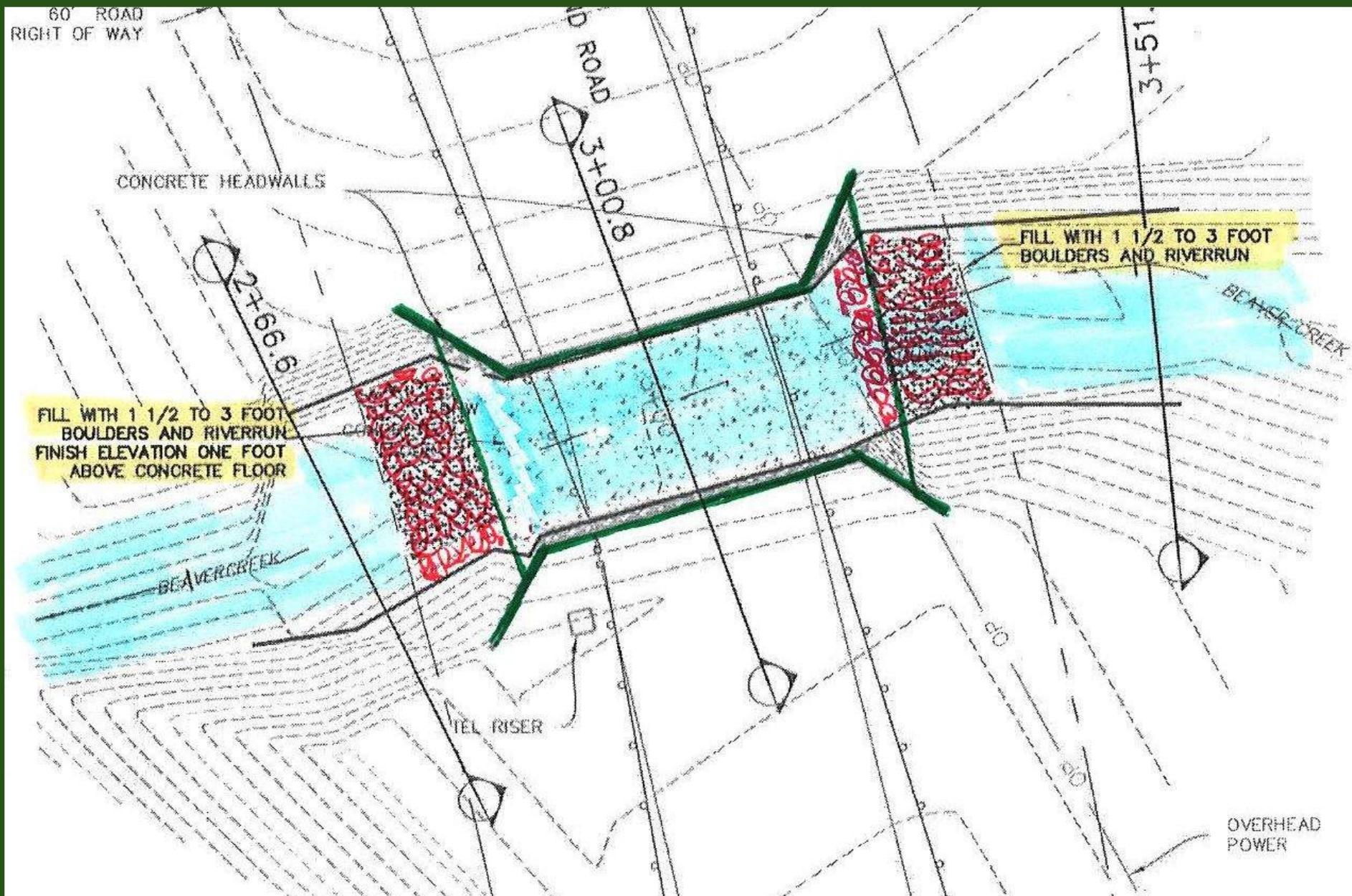
FILL WITH 1 1/2 TO 3 FOOT
BOULDERS AND RIVERRUN

BEAVER CREEK

BEAVER CREEK

TEL RISER

OVERHEAD
POWER

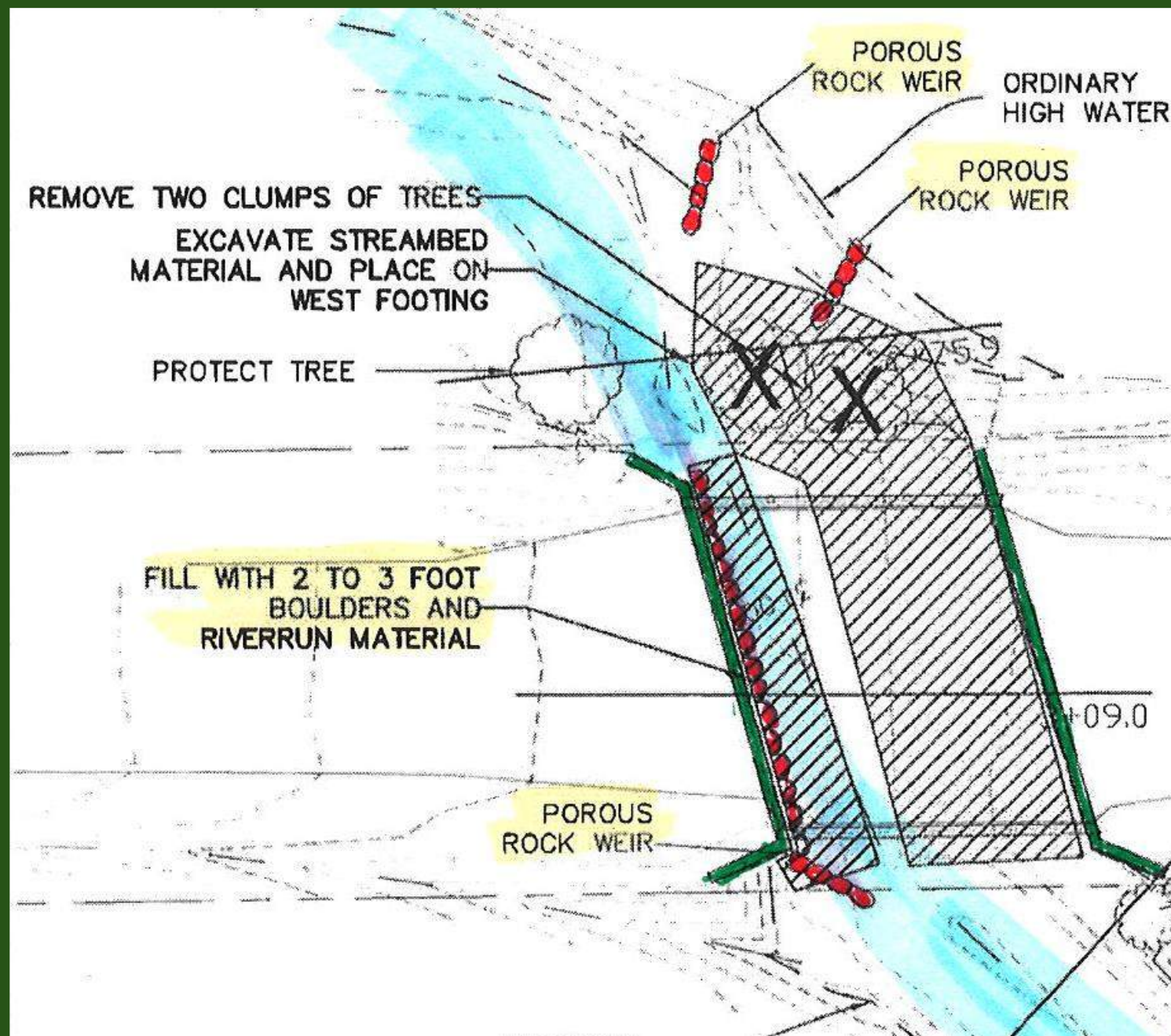










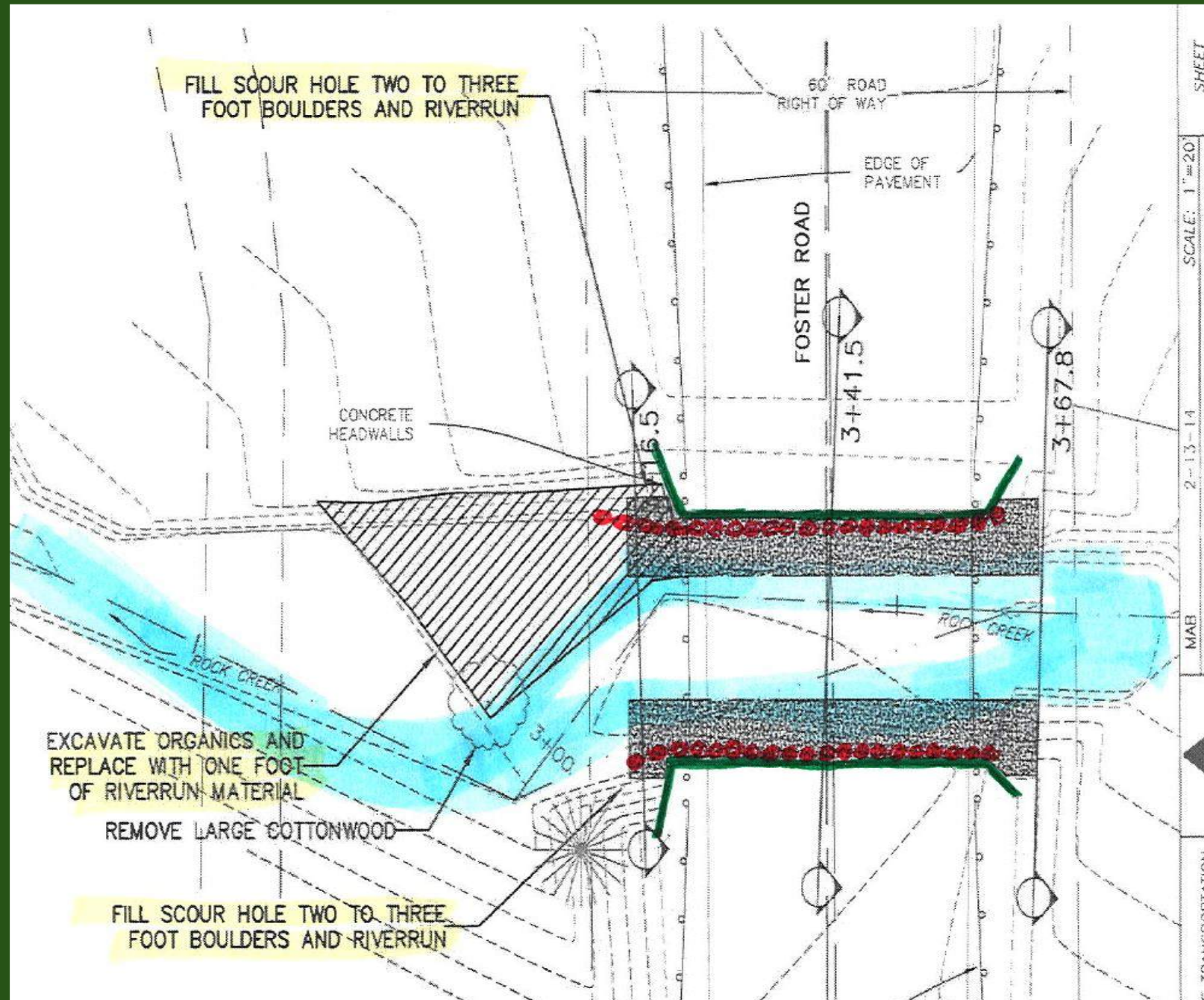














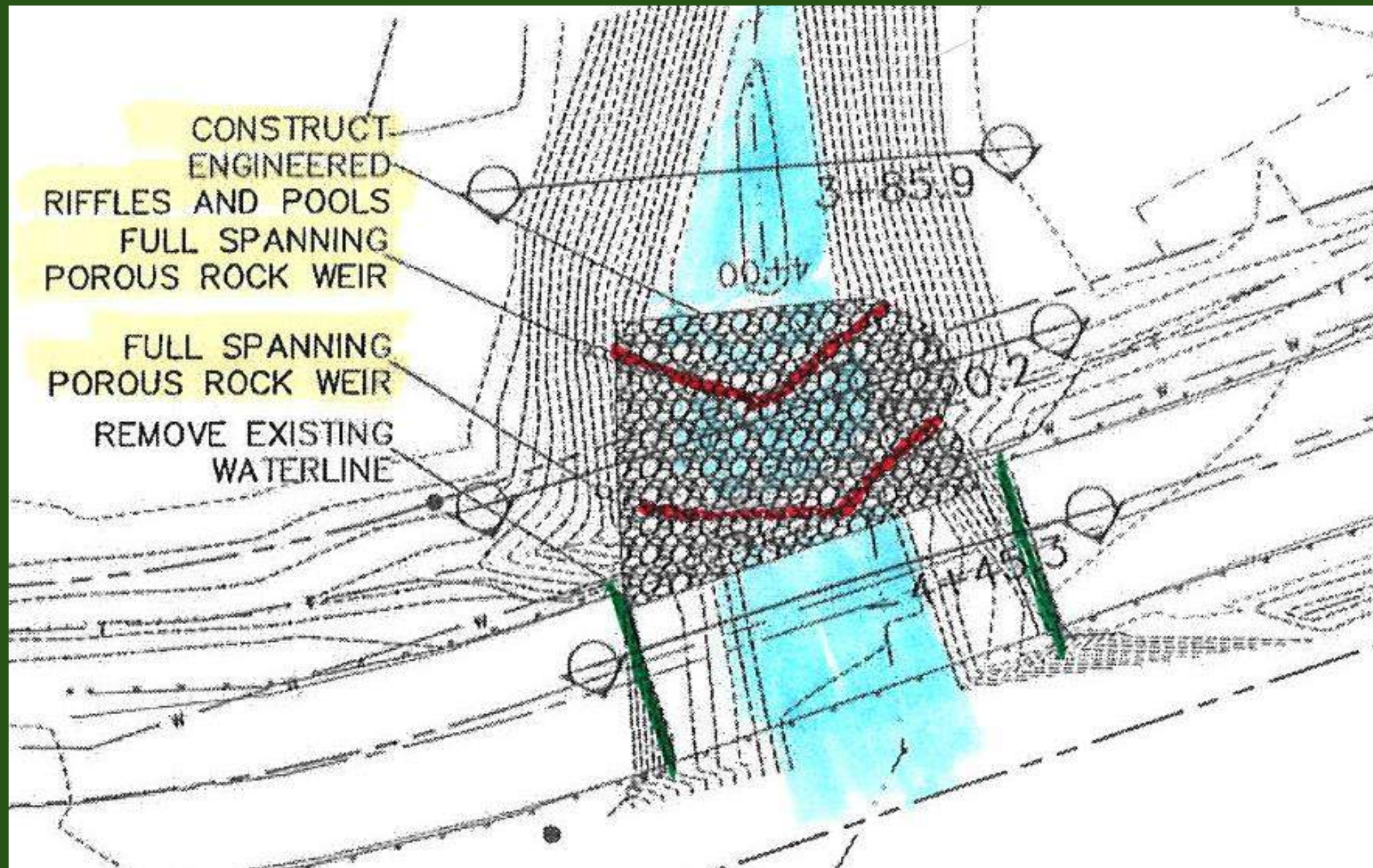




CONSTRUCT
ENGINEERED
RIFFLES AND POOLS
FULL SPANNING
POROUS ROCK WEIR

FULL SPANNING
POROUS ROCK WEIR

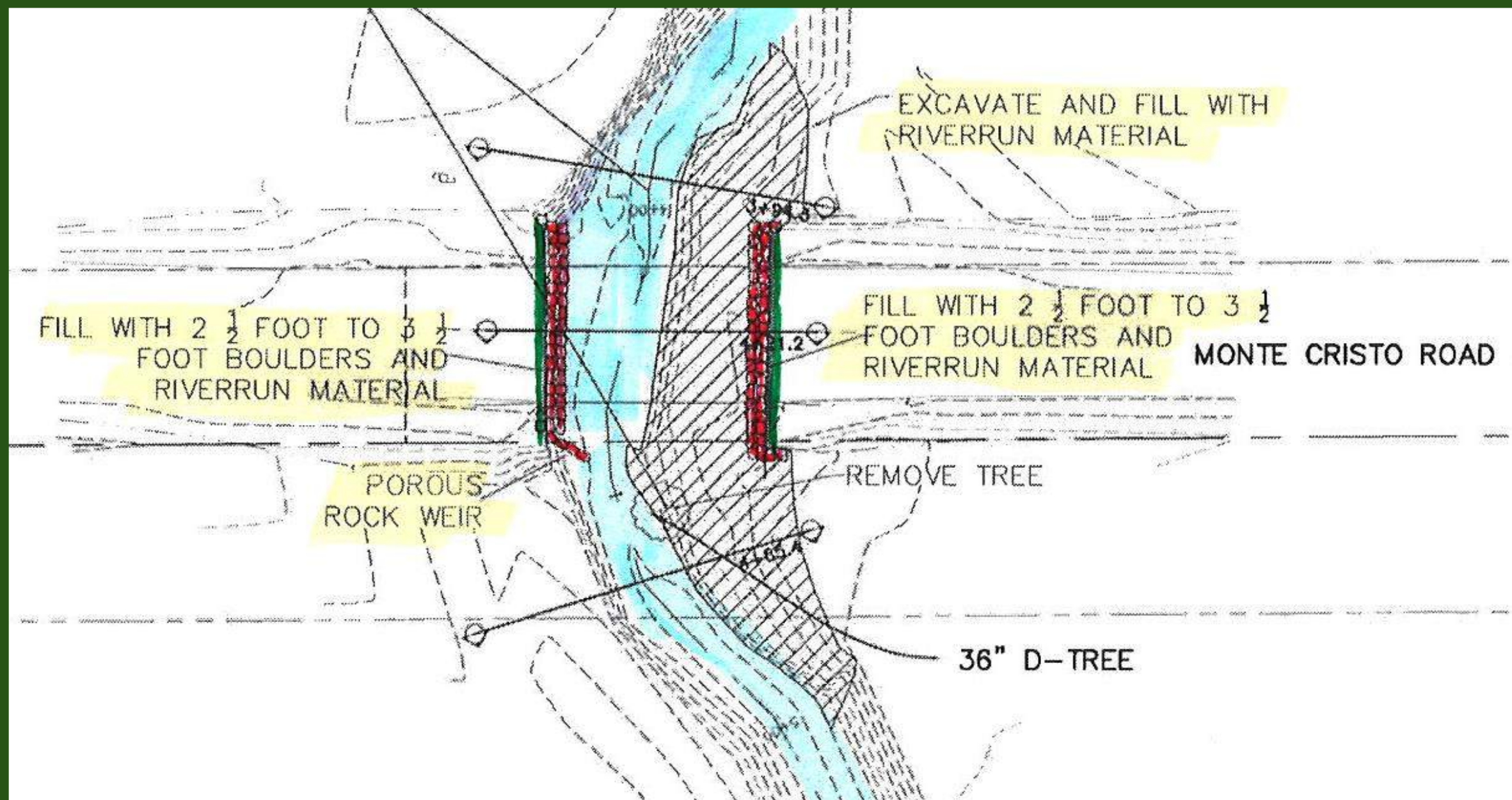
REMOVE EXISTING
WATERLINE







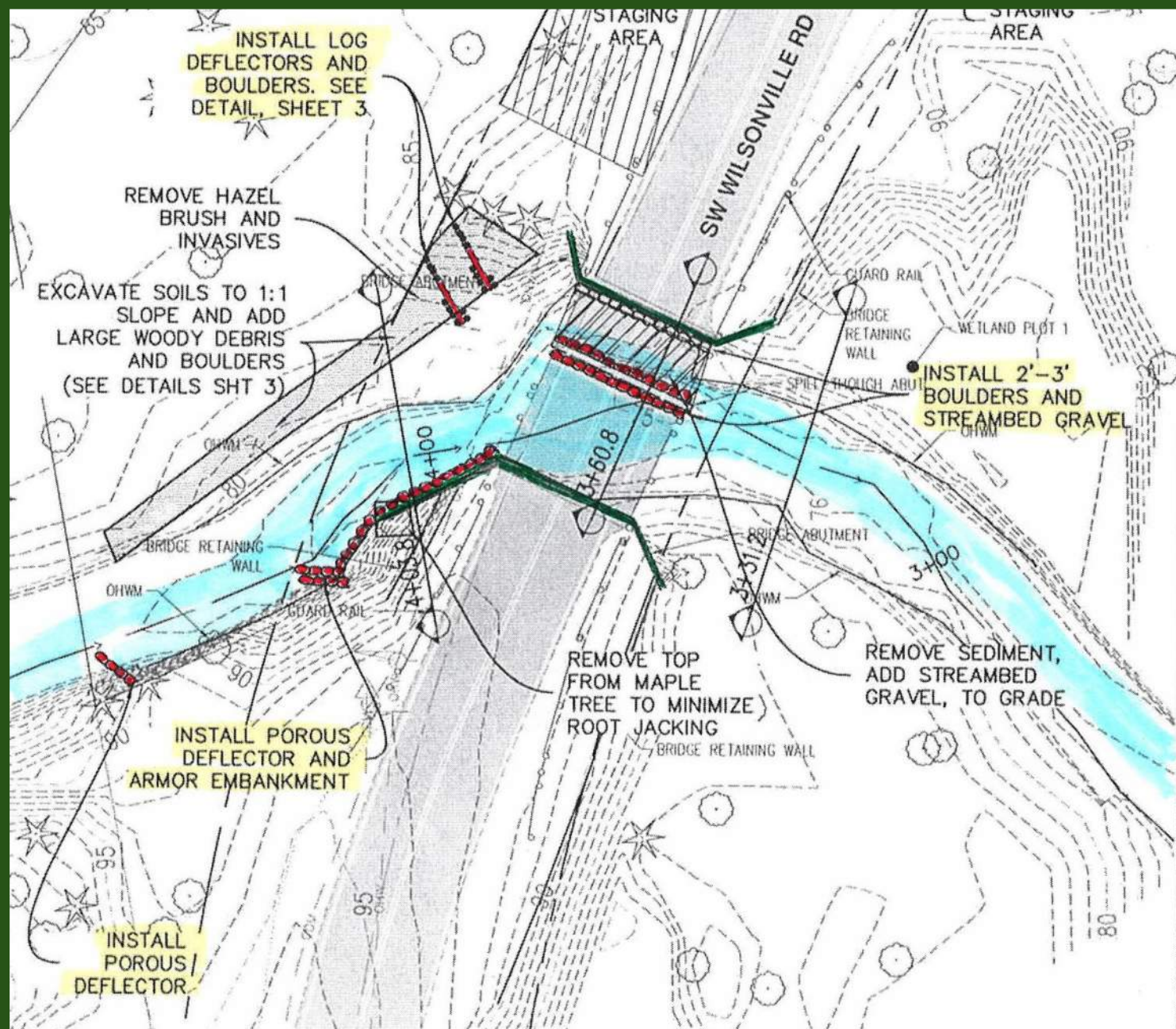






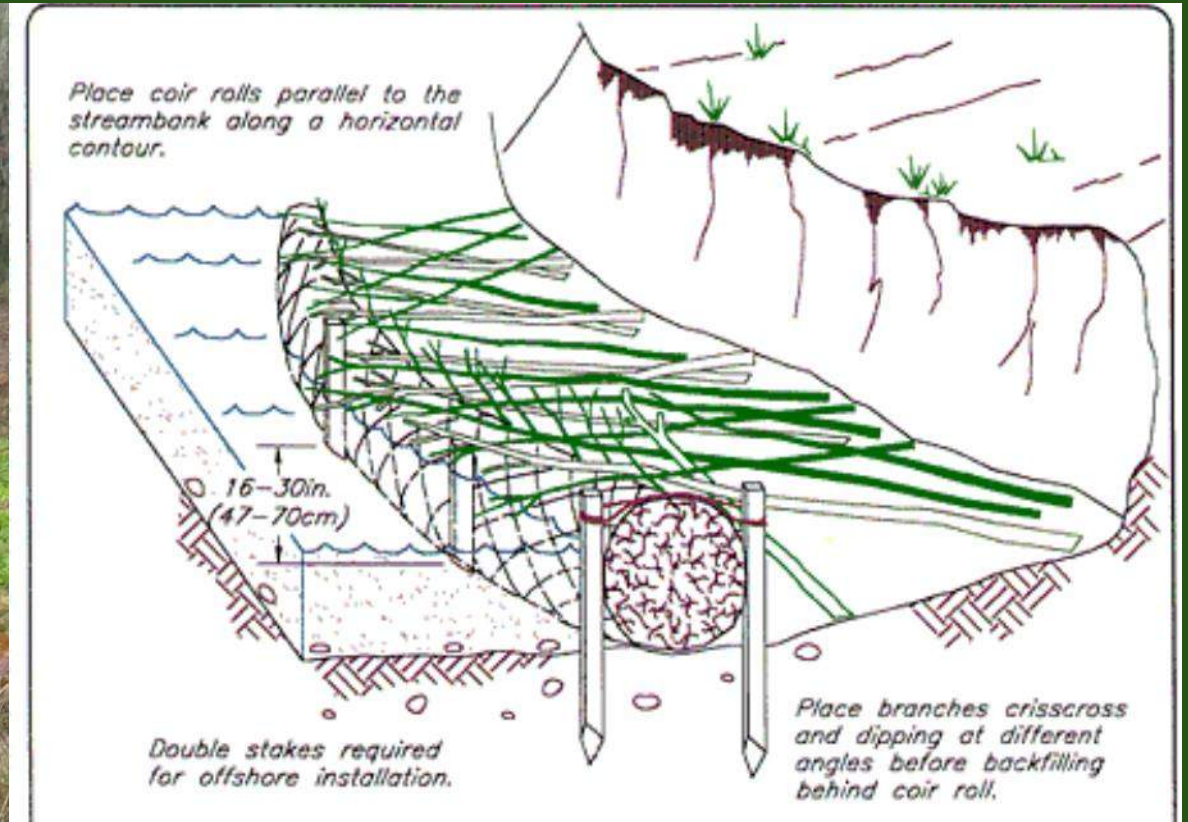


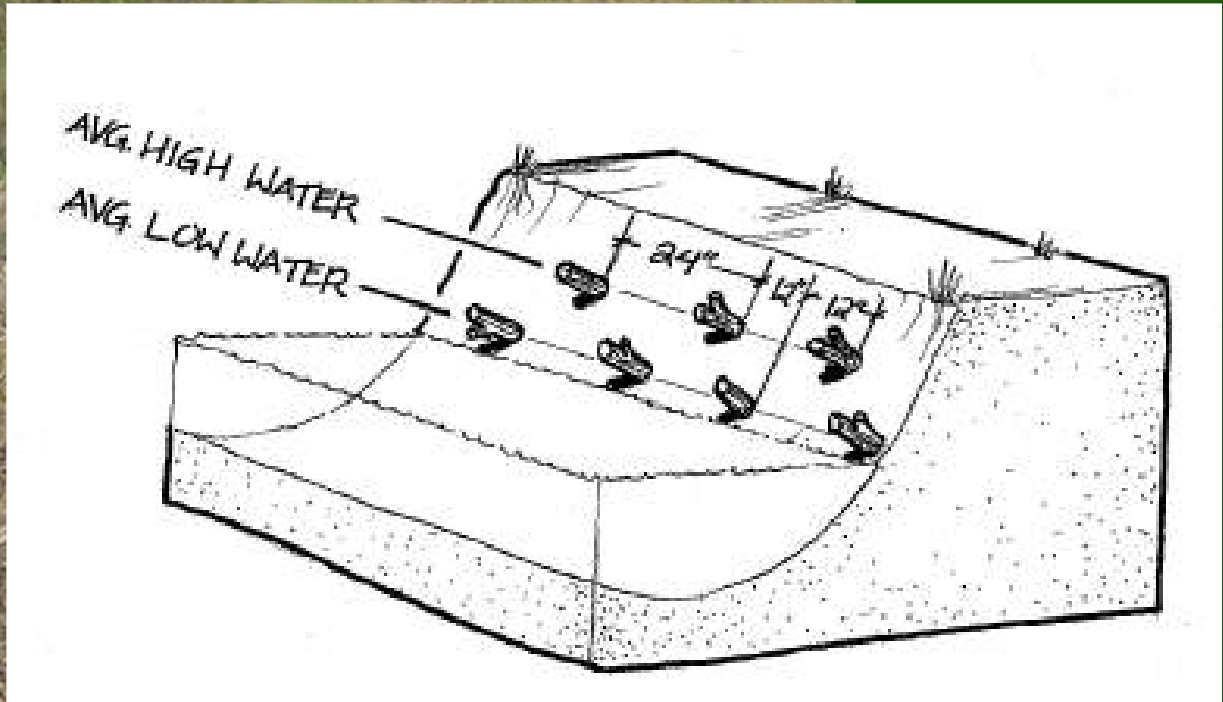












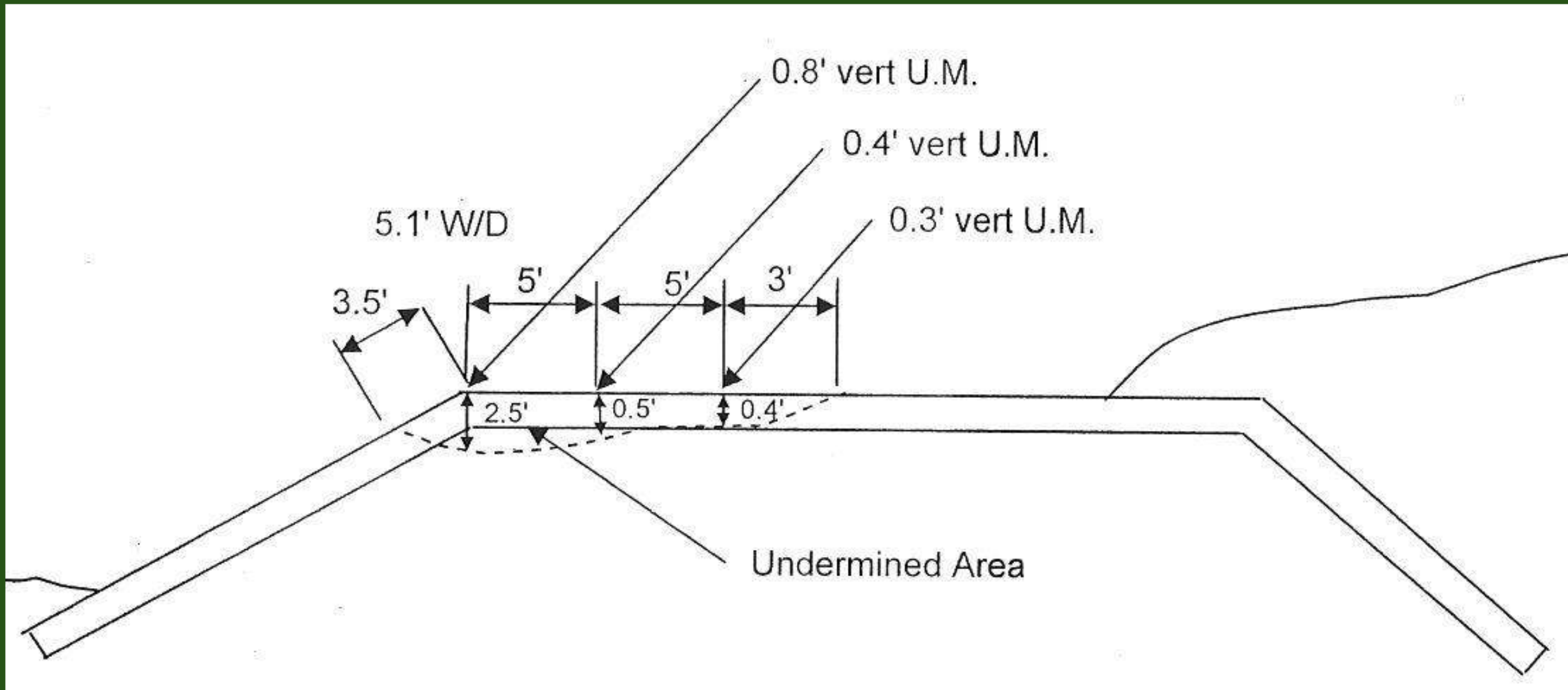
Meadowbrook Bridge Over Milk Creek

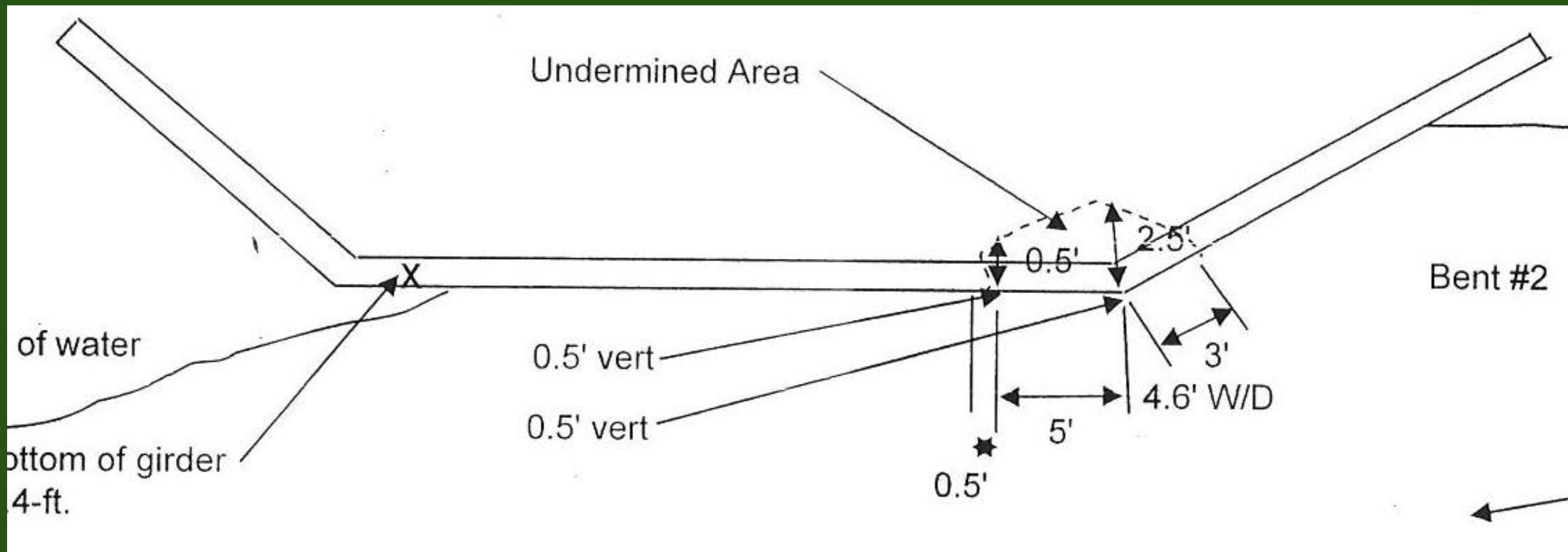
Undermining found 2006

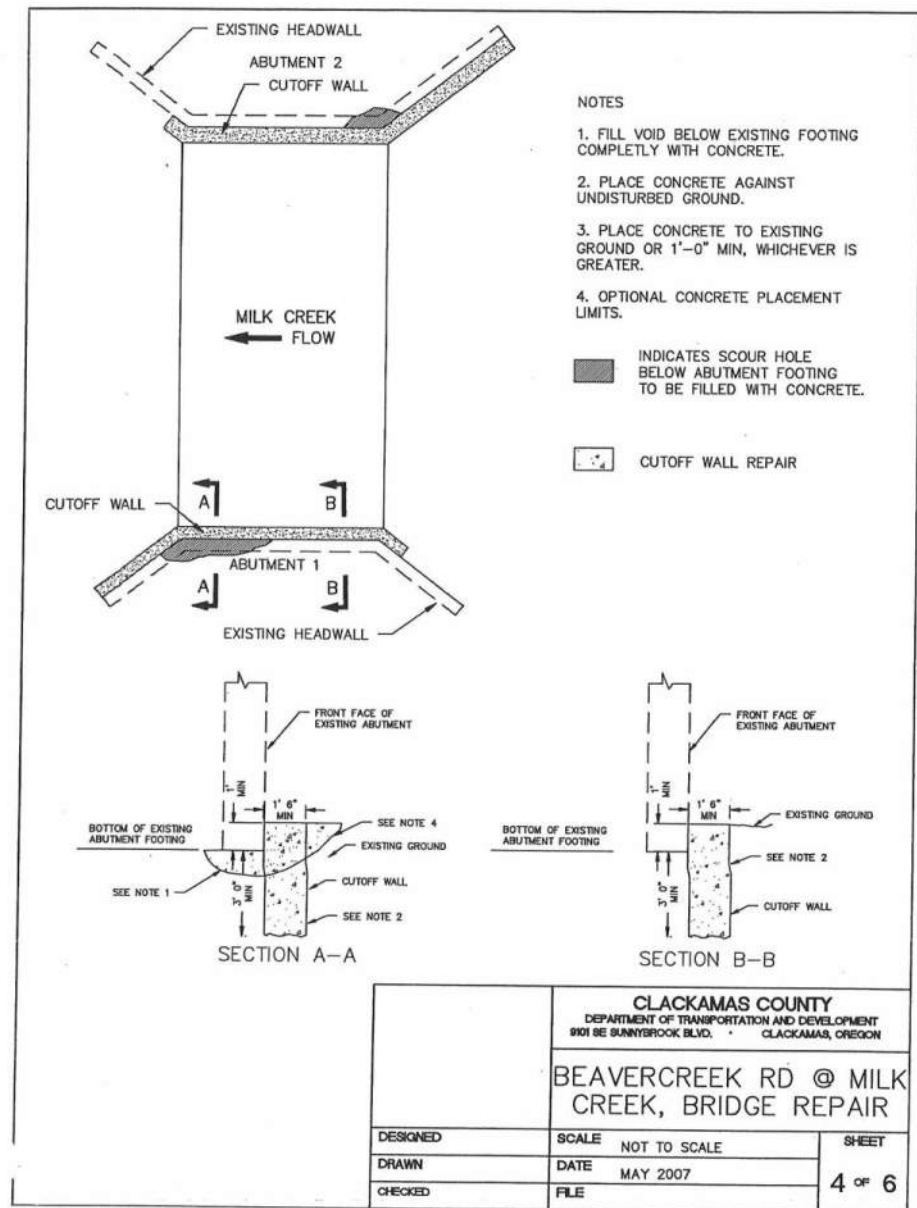
Temporary Mitigation installed 2007

Permit Application process started June, 2007

Work started July, 2008



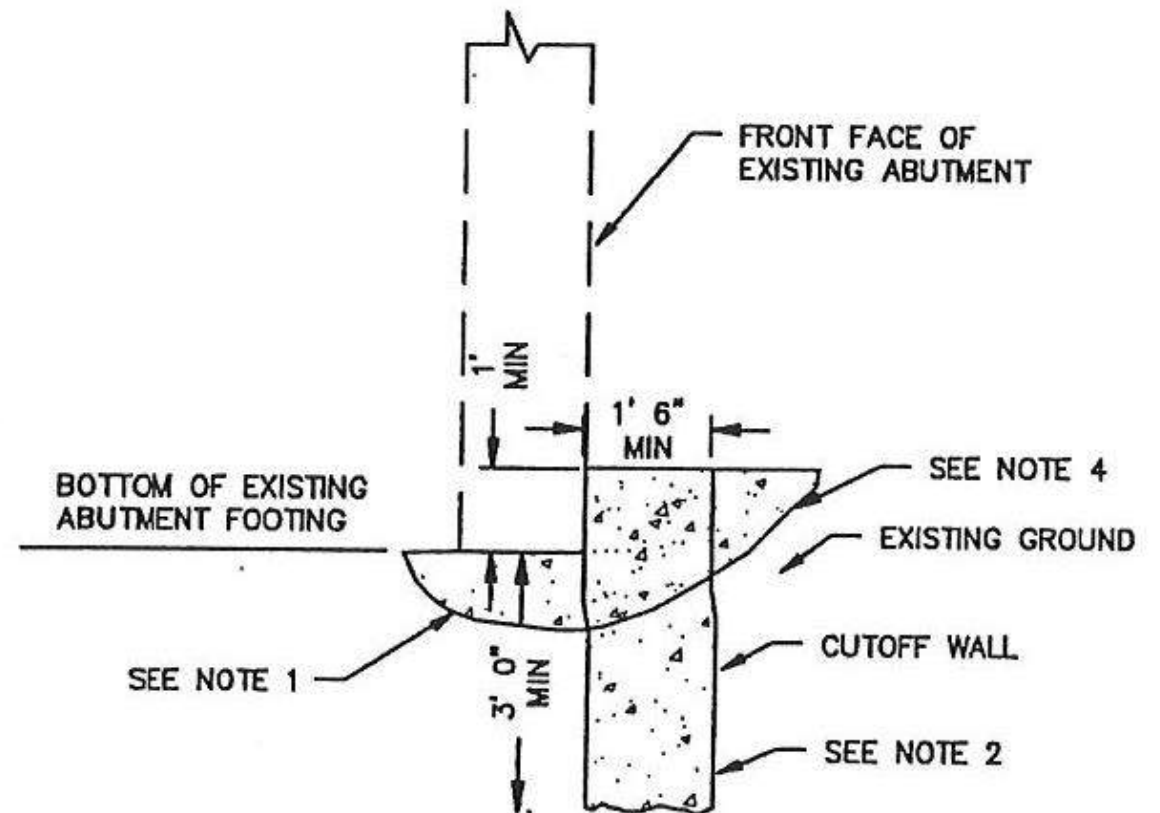




1. FILL VOID BELOW EXISTING FOOTING COMPLETELY WITH CONCRETE.

2. PLACE CONCRETE AGAINST UNDISTURBED GROUND.

3. PLACE CONCRETE TO EXISTING GROUND OR 1'-0" MIN, WHICHEVER IS GREATER.









































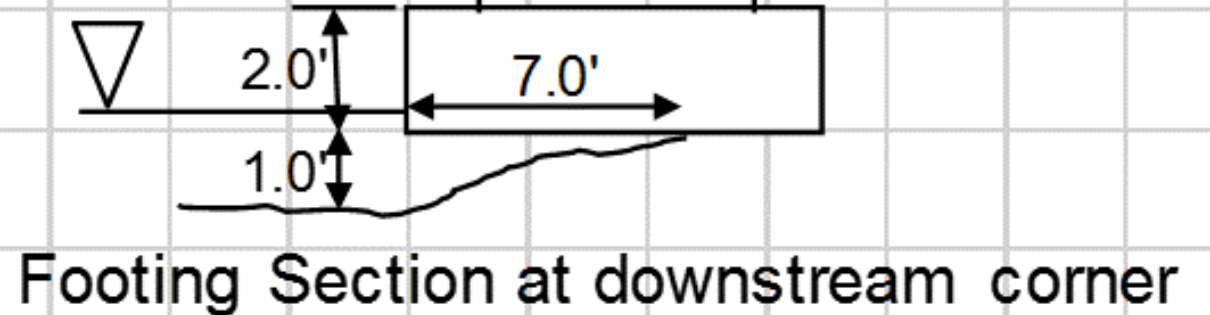
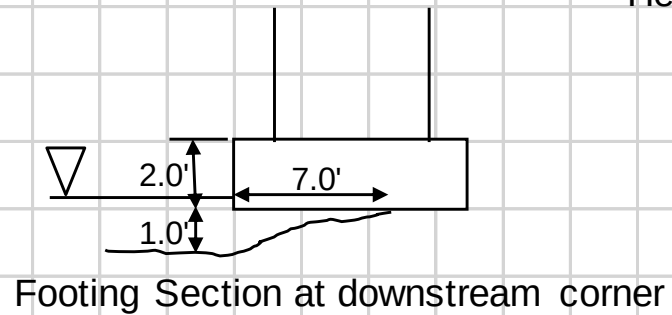
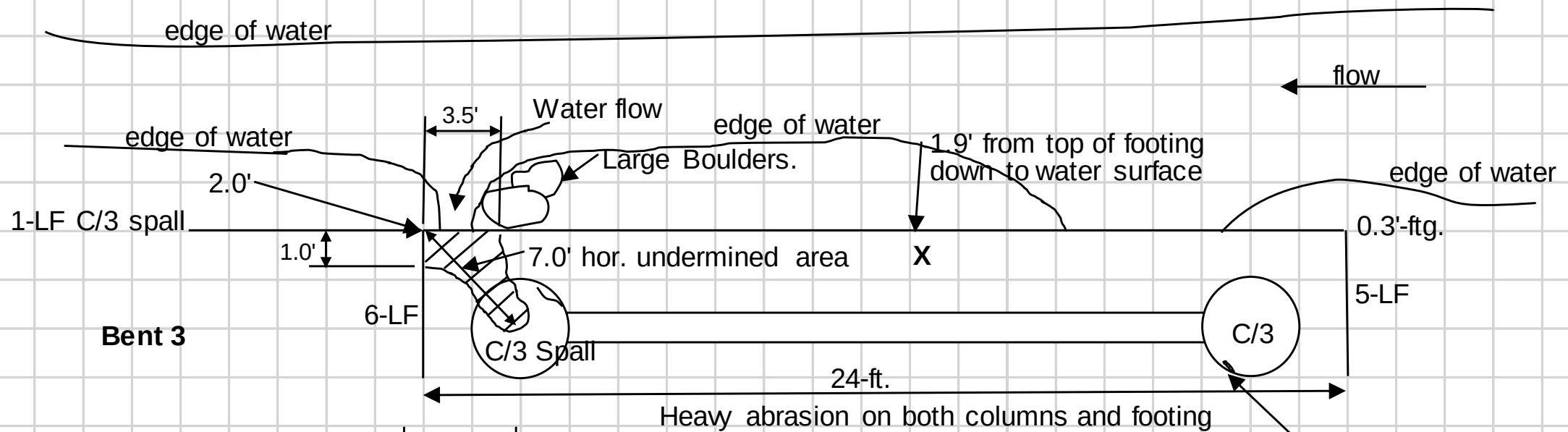


Salmon River Bridge Brightwood Loop Road

Undermining found SEP, 2018

Emergency Permit Application
process started SEP, 2018

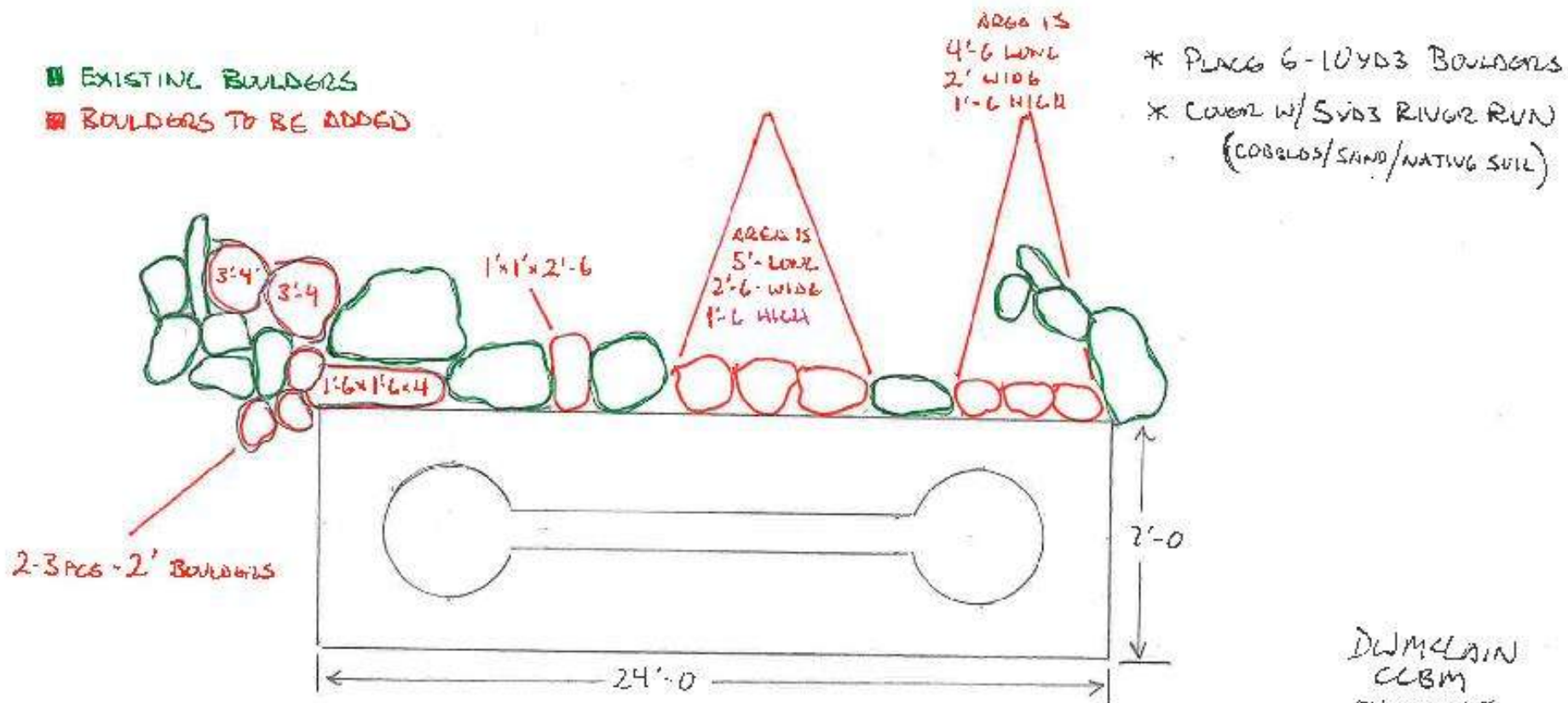
Work started FEB, 2019





SALMON RIVER BRIDGE, # 01438

SCOUR MITIGATION PROJECT, BM2018.17



DWMCLAIN
CCBM
04 OCT 18

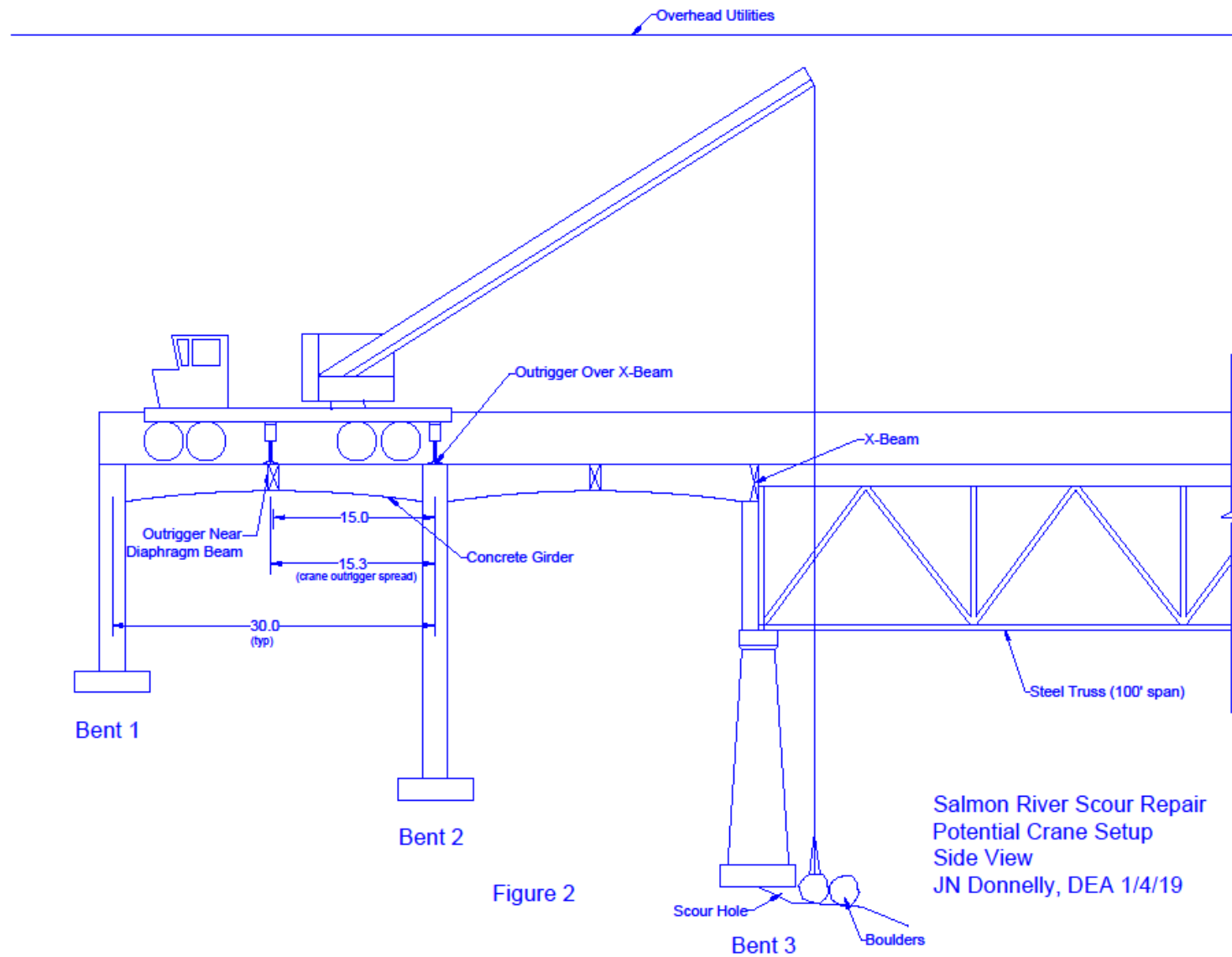


Figure 2

Salmon River Scour Repair
Potential Crane Setup
Side View
JN Donnelly, DEA 1/4/19



RAM100N Multi-Use Anchor

Performance:

Static tensile strength: 10,000-lbf
(44kN) minimum.

Working Load Limit: 2000-lbs

Dimensions:

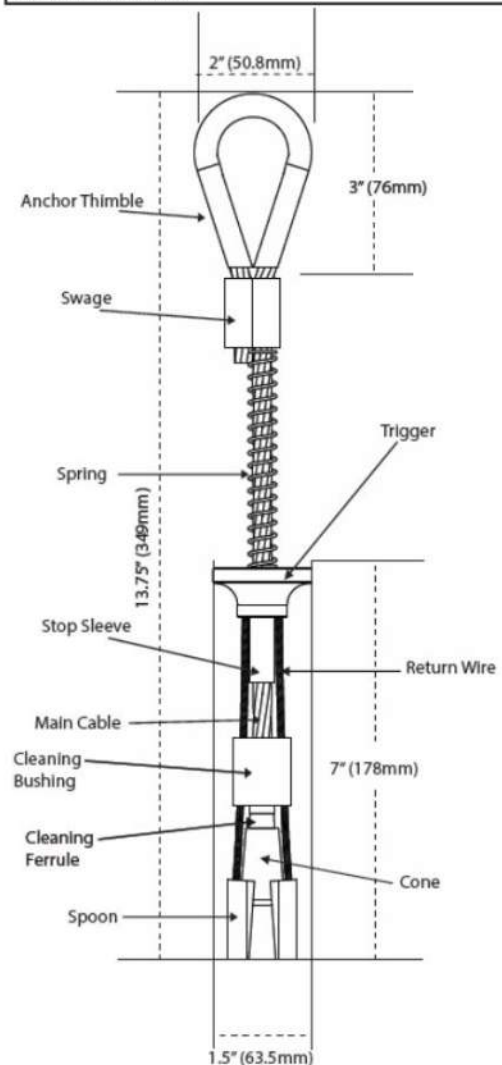
Weight: 0.5-lbs (.22kg)

Length: 13.75" (349mm)

Diameter: 1" (25.4mm)

Component Materials:

Main Cable: Aircraft Cable. End Termination: Stainless Steel. Spoons:
Stainless Steel. Stop Sleeve: Stainless Steel. Trigger: Aluminum. Spring: Zinc
Plated Steel. Swage: Zinc Plated Copper. Return Wire: Aircraft Cable. Anchor
Thimble: Zinc Plated Steel.

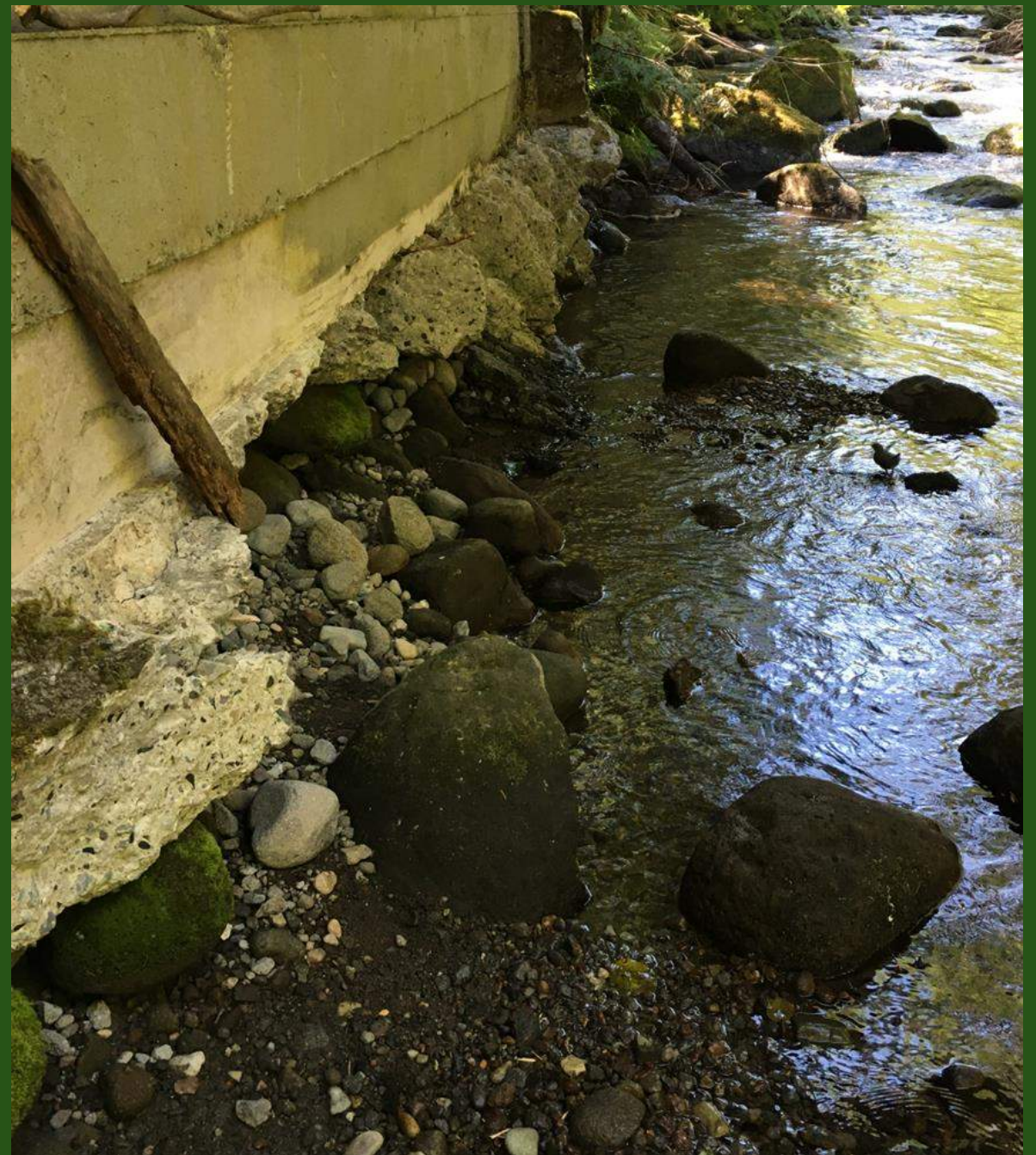
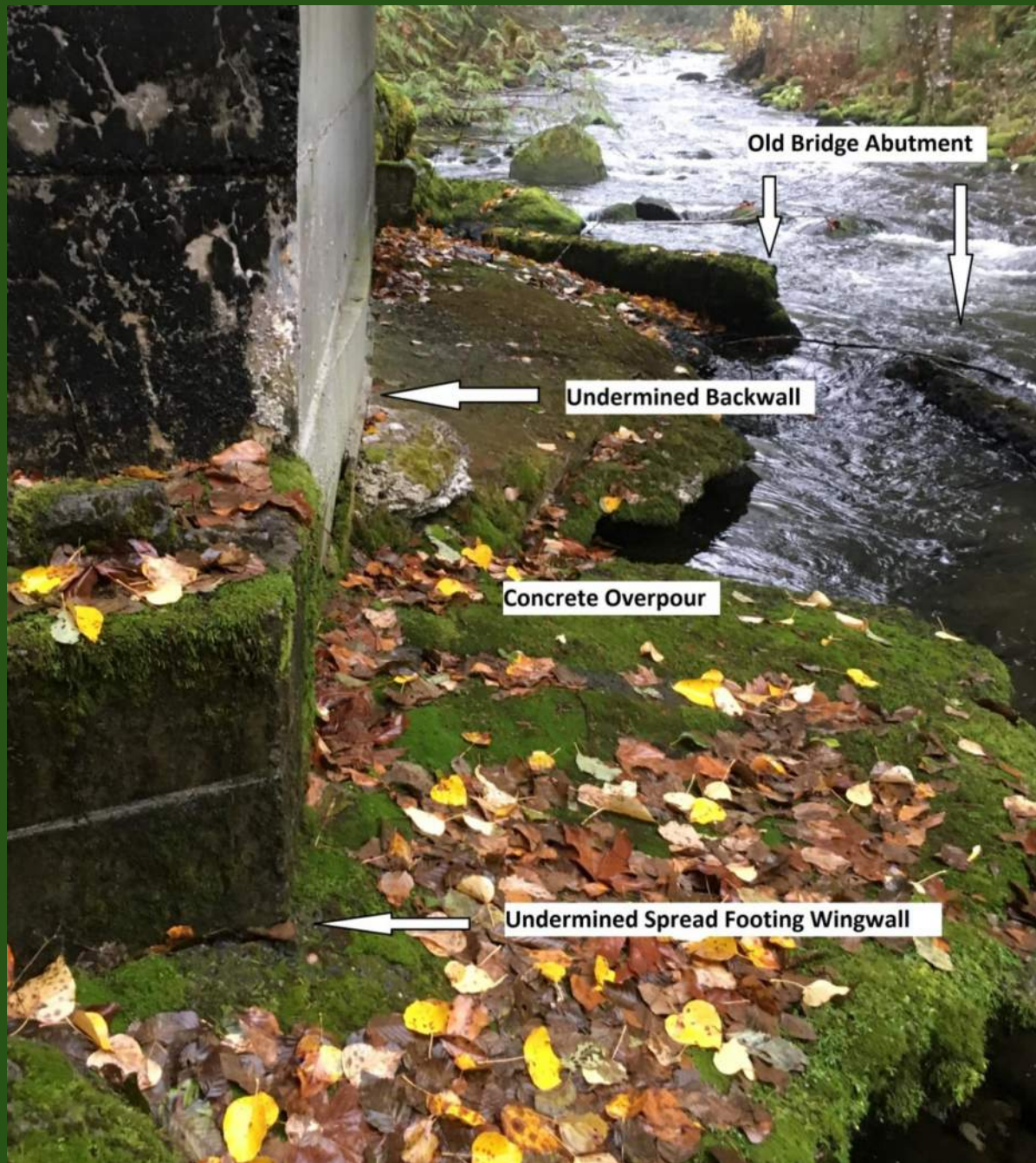




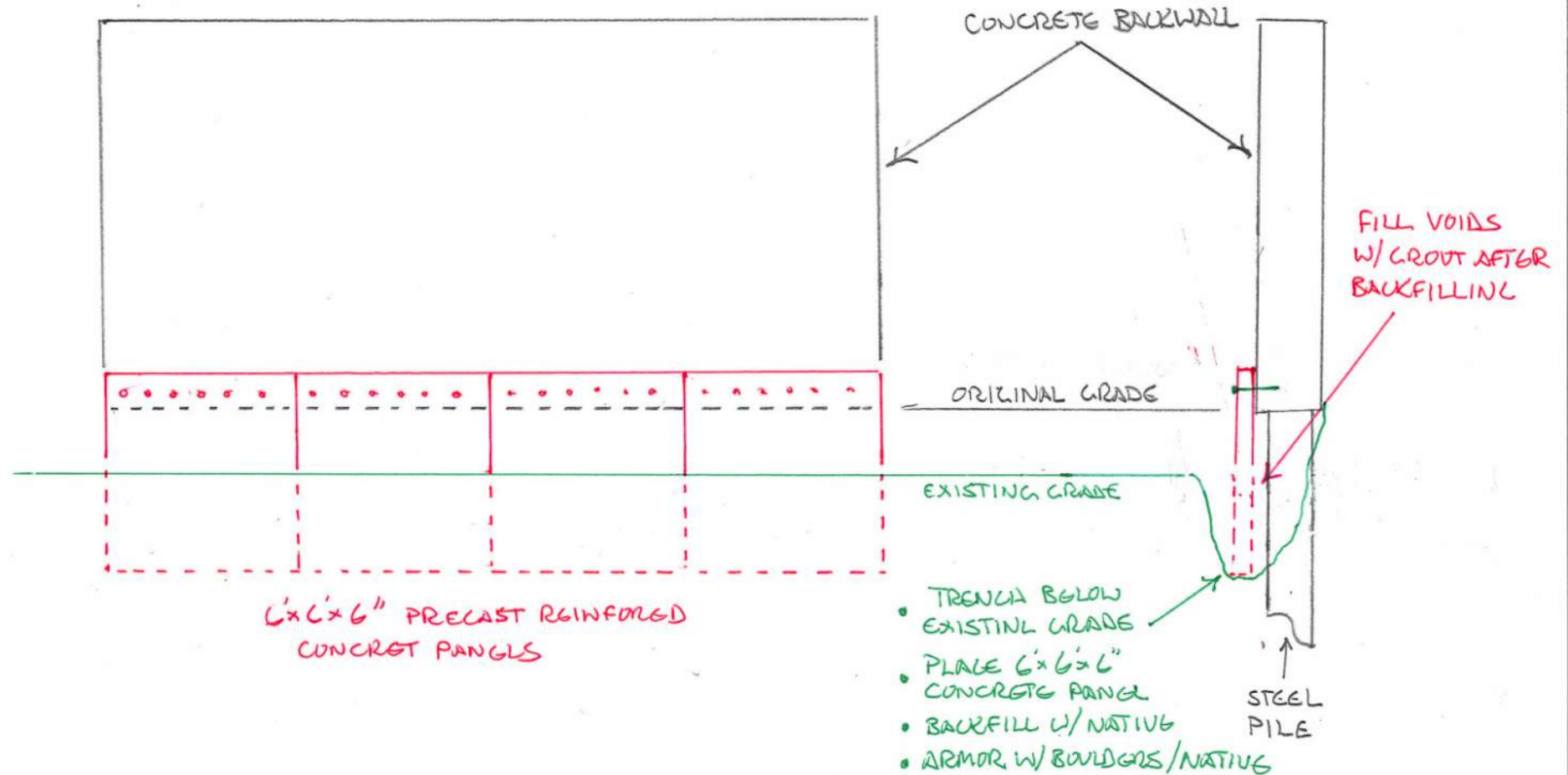




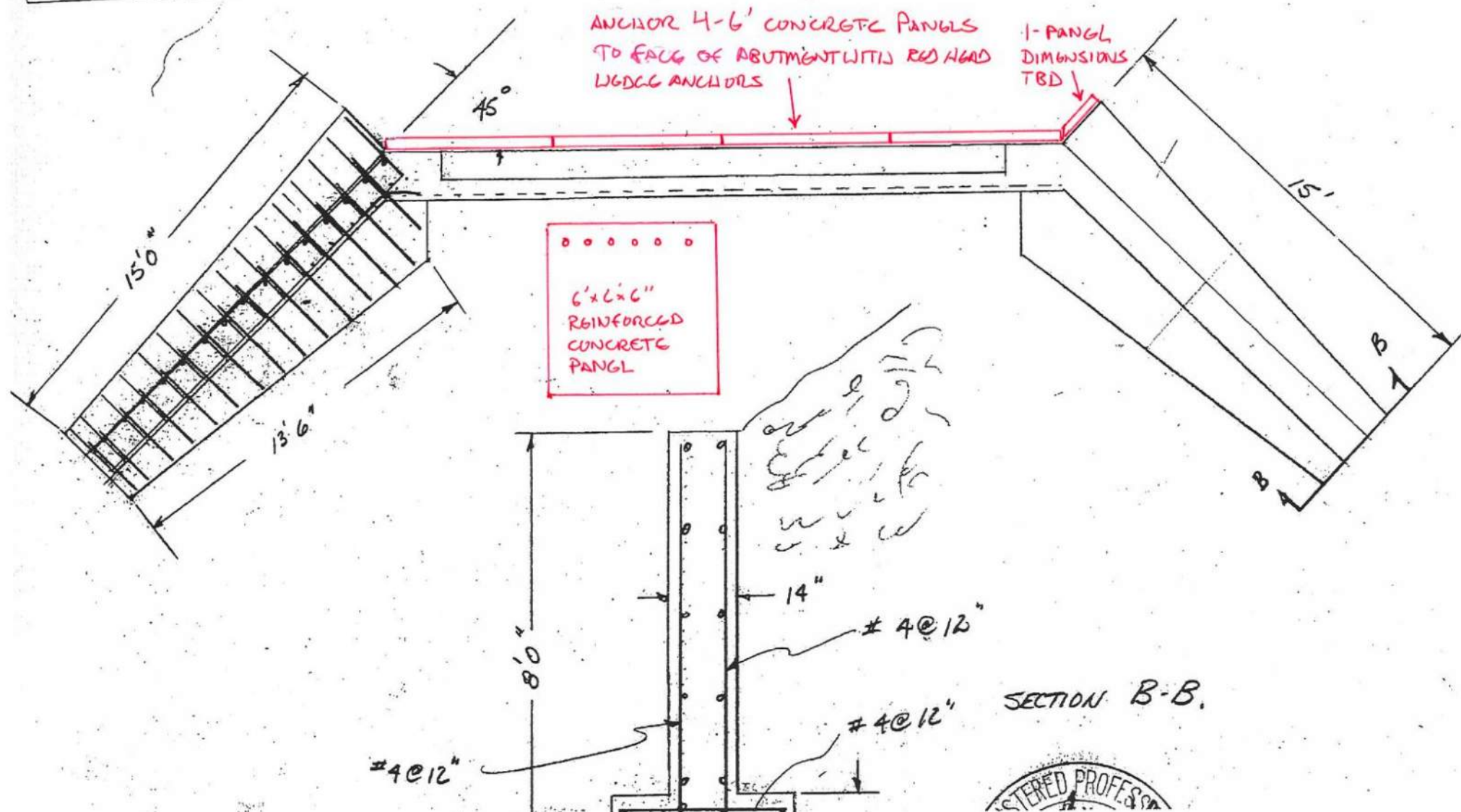
Still Creek Bridge



STILL CREEK BRIDGE SCOUR REPAIR BM2017-22



STILL CREEK BRIDGE
SCOUR REPAIR 'BM 2017-22





Questions?

Comments?

AASHTO TSP2 BRIDGE PRESERVATION

Douglas McLain
503 780-3194
dougmccl@clackamas.us