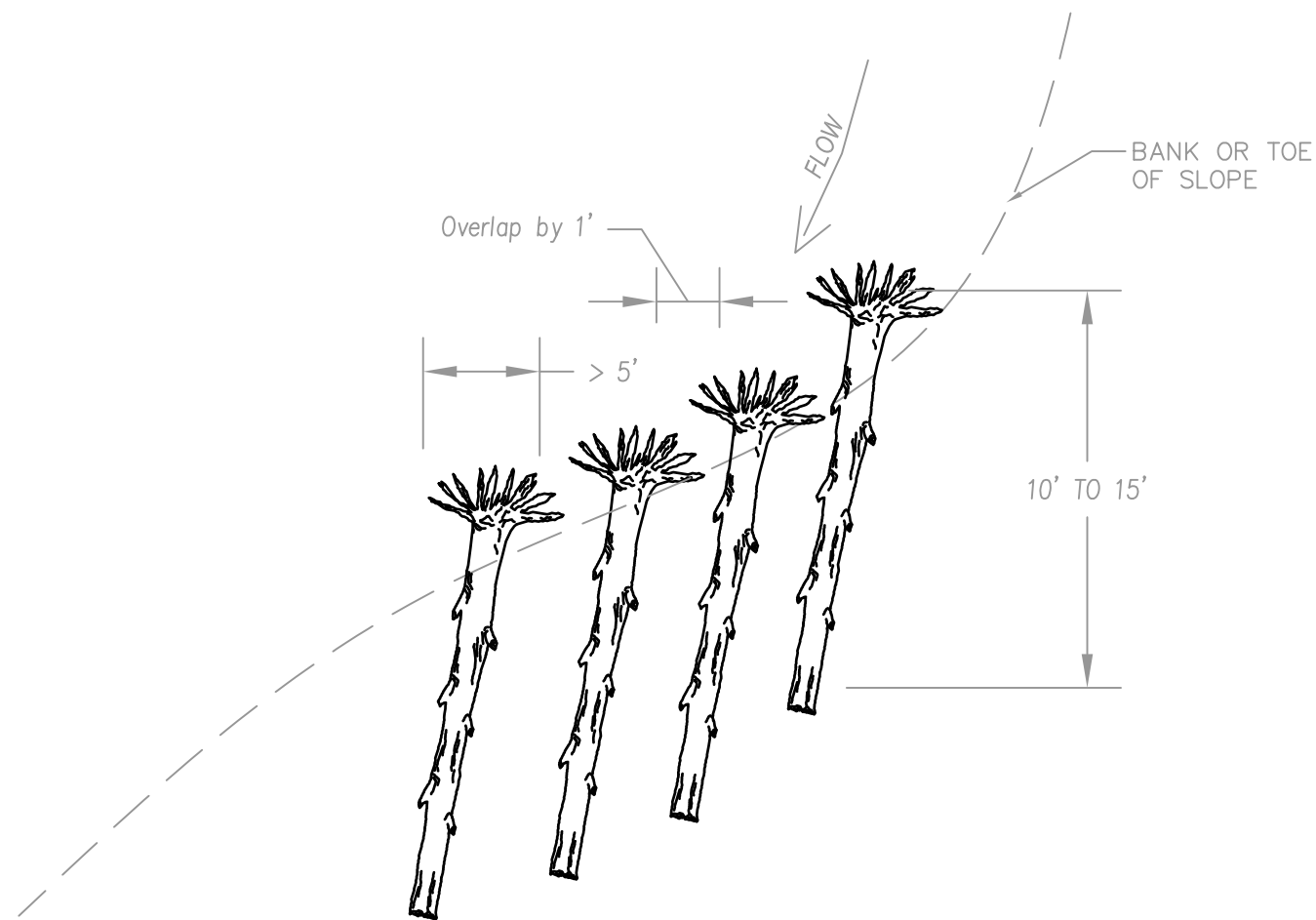
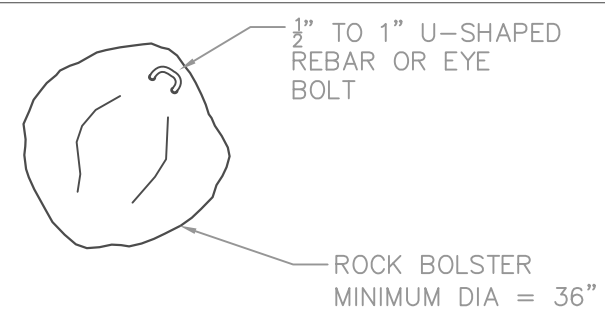


APPENDIX A

Bioengineering Components Schematic Details

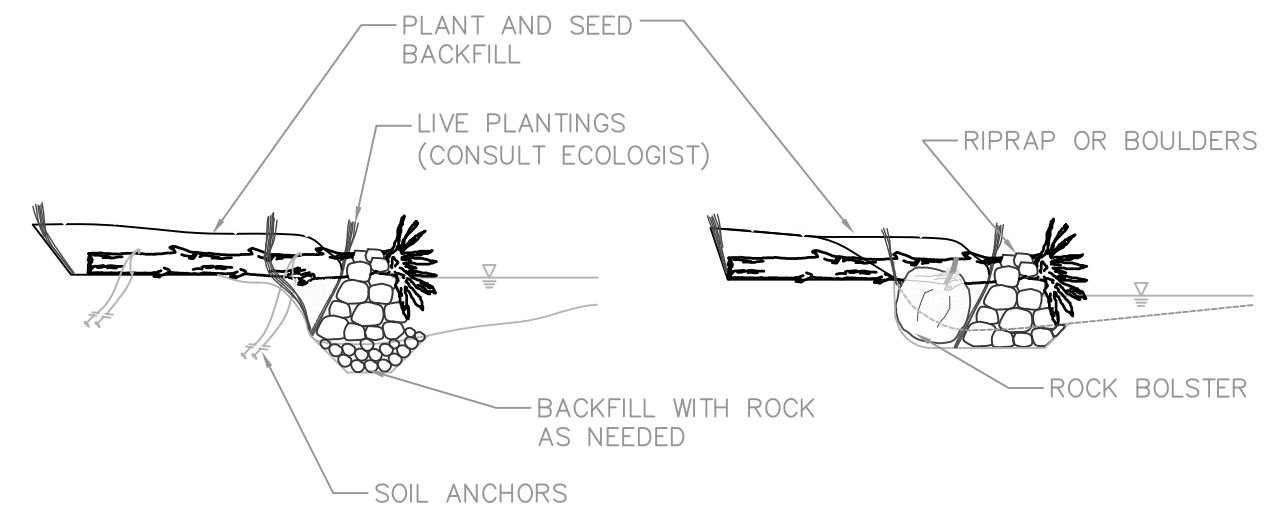


1 ROOTWAD PLACEMENT EXAMPLE PLAN VIEW

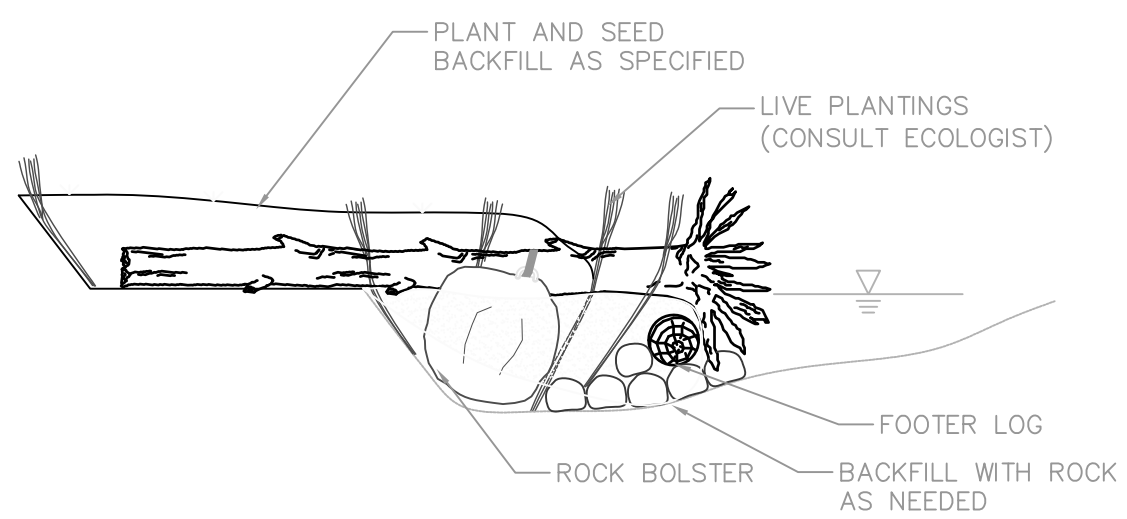


3 ROCK BOLSTER DETAIL

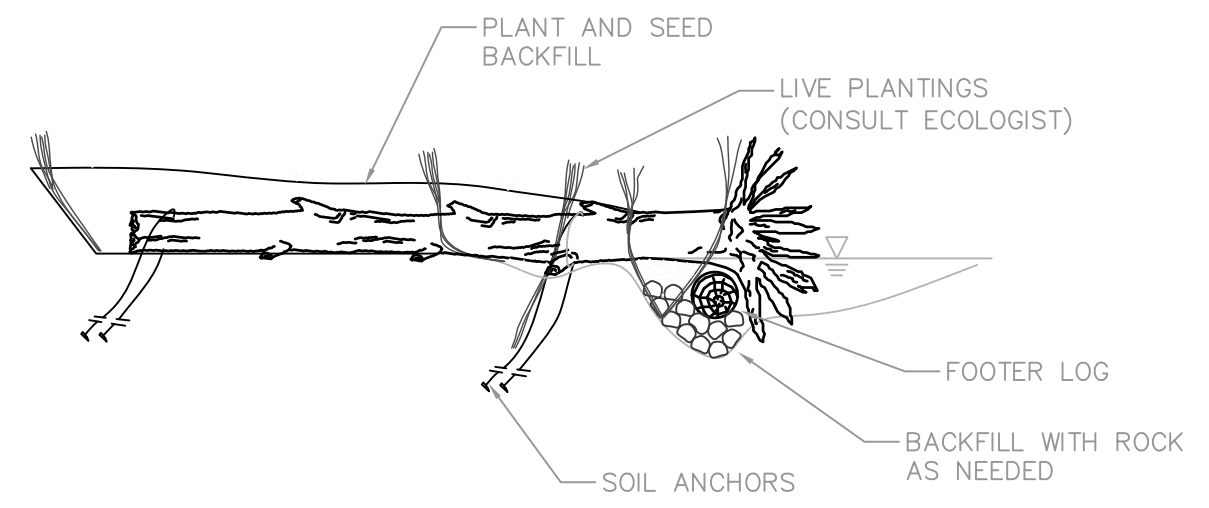
Notes:
 Secure logs to rock bolsters at overlap with a minimum of three wraps of 3/8" diameter galvanized non-greased, wire rope. Drill holes in rock bolsters with gas or pneumatic drill. The min. depth should be 6". Holes must be clean of all dust, debris, oil, and soap following drilling. Insert a U-shaped or eyebolt rebar into holes several times to dispense and completely mix epoxy and eliminate air pockets.
 Epoxy resin systems shall meet the requirements of ASTM C881, Type IV Grade 3. Test strength of bond after minimum cure time recommended by the epoxy manufacturer.



4 ROOTWAD PLACEMENT WITH RIPRAP TOE INSTEAD OF FOOTER LOG

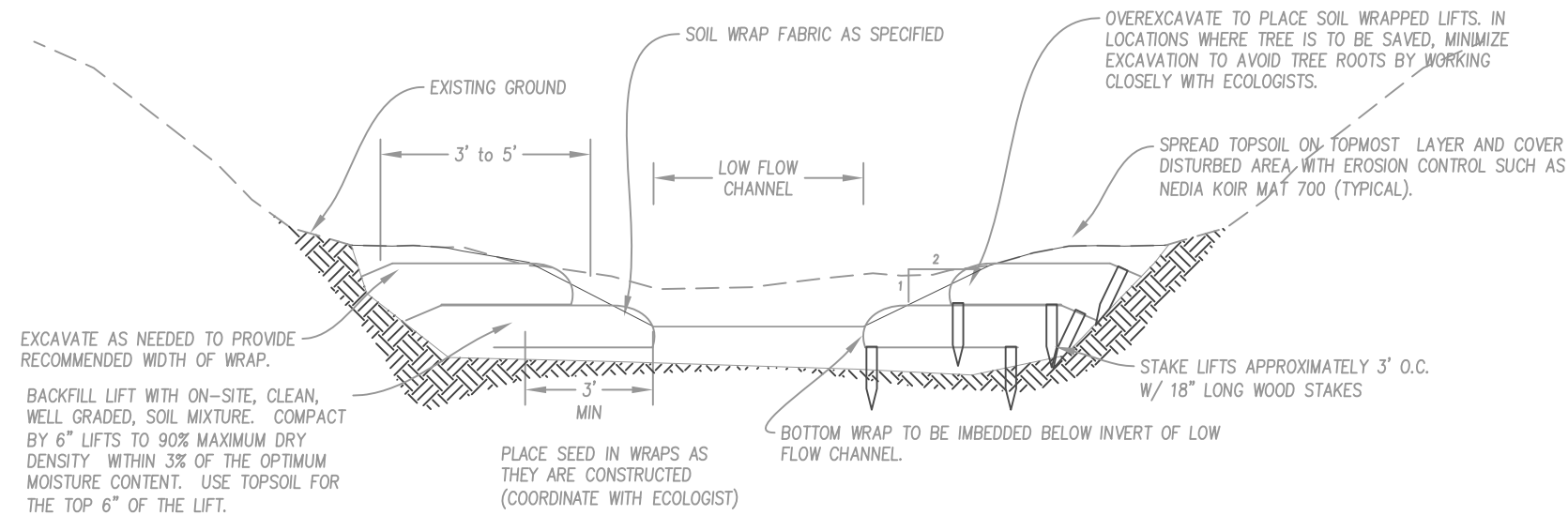


2 ROOTWAD ANCHORED WITH ROCK BOLSTER



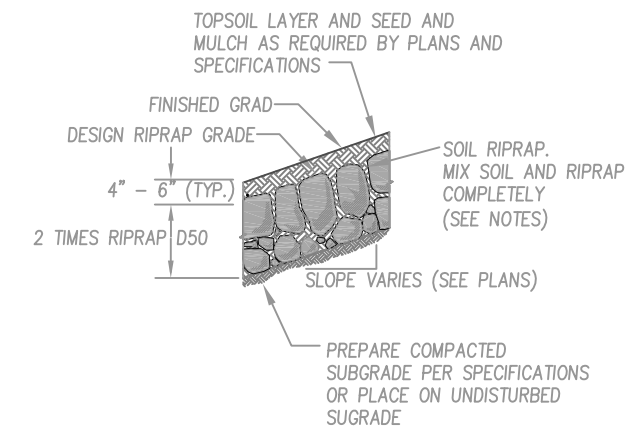
5 ROOTWAD ANCHORED WITH SOIL ANCHORS

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1 SOIL WRAPPED LIFT LOW FLOW CHANNEL EXAMPLE

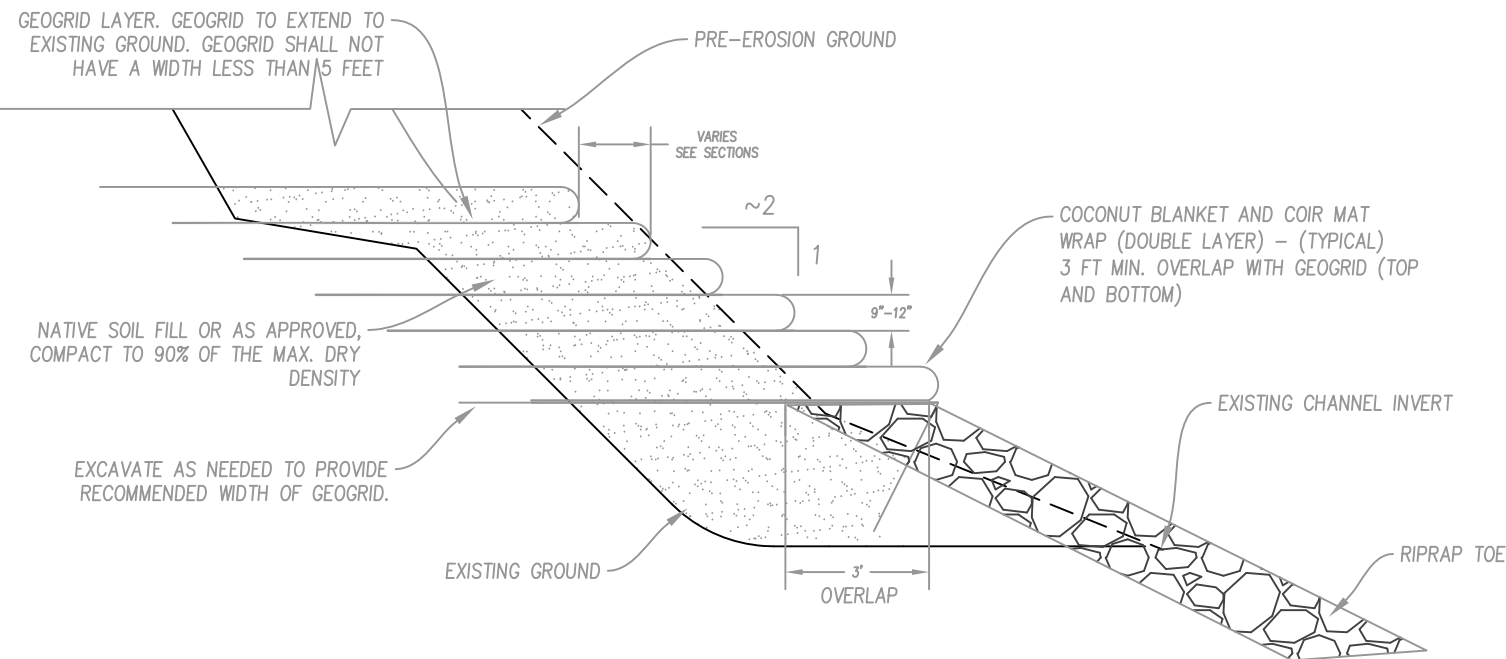
NTS



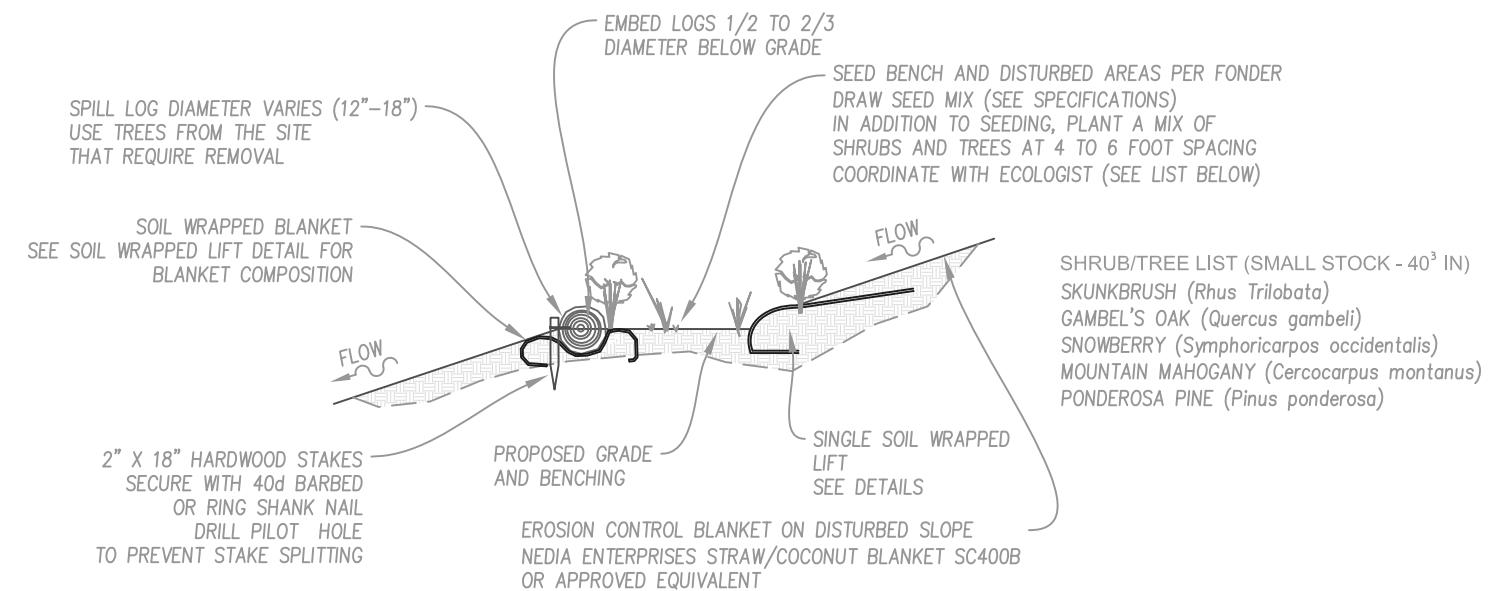
2 SOIL RIPRAP WITH MULCH EXAMPLE

NTS

- NOTES:
1. SOIL RIPRAP DETAILS ARE APPLICABLE TO SLOPED AREAS. REFER TO THE SITE PLAN ACTUAL LOCATION AND LIMITS.
 2. MIX UNIFORMLY 65% RIPRAP BY VOLUME WITH 35% OF APPROVED SOIL BY VOLUME PRIOR TO PLACEMENT.
 3. PLACE STONE-SOIL MIX TO RESULT IN SECURELY INTERLOCKED ROCK AT THE DESIGN THICKNESS AND GRADE. COMPACT AND LEVEL TO ELIMINATE ALL VOIDS AND ROCKS PROJECTING ABOVE DESIGN RIPRAP TOP GRADE.
 4. CRIMP OR TACKIFY MULCH OR USE APPROVED HYDROMULCH AS CALLED FOR IN THE PLANS AND SPECIFICATIONS.
 5. MULCH SHALL NOT BE USED IN THE CHANNEL BOTTOM AND SLOPES EXPOSED TO FREQUENT FLOODING.



3 SOIL WRAP LIFTS FOR STEEP BANKS EXAMPLE

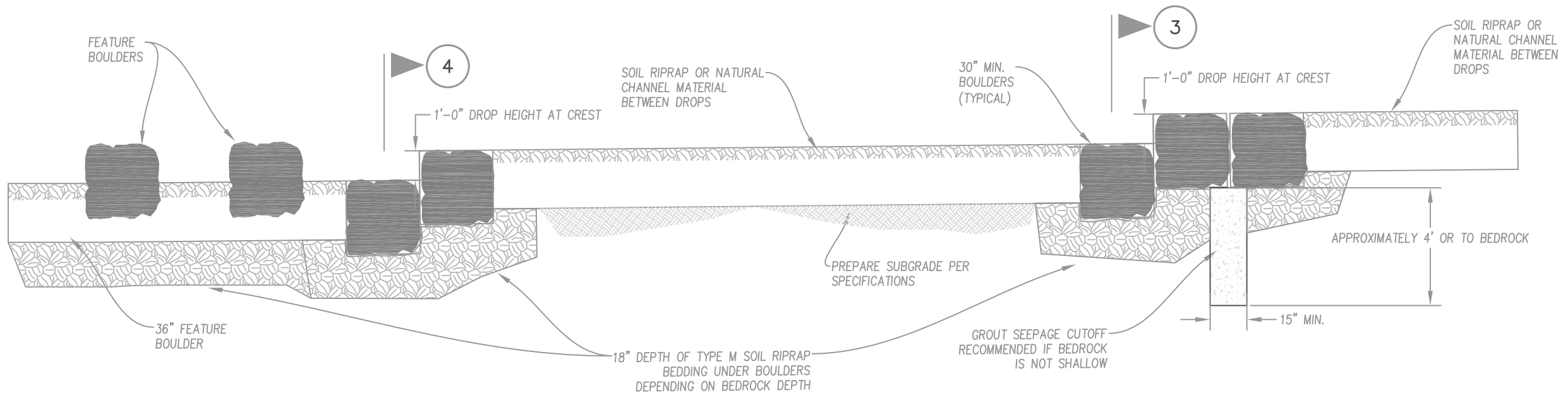


4 LOG GRADE BANK STABILIZATION- EXAMPLE

NTS

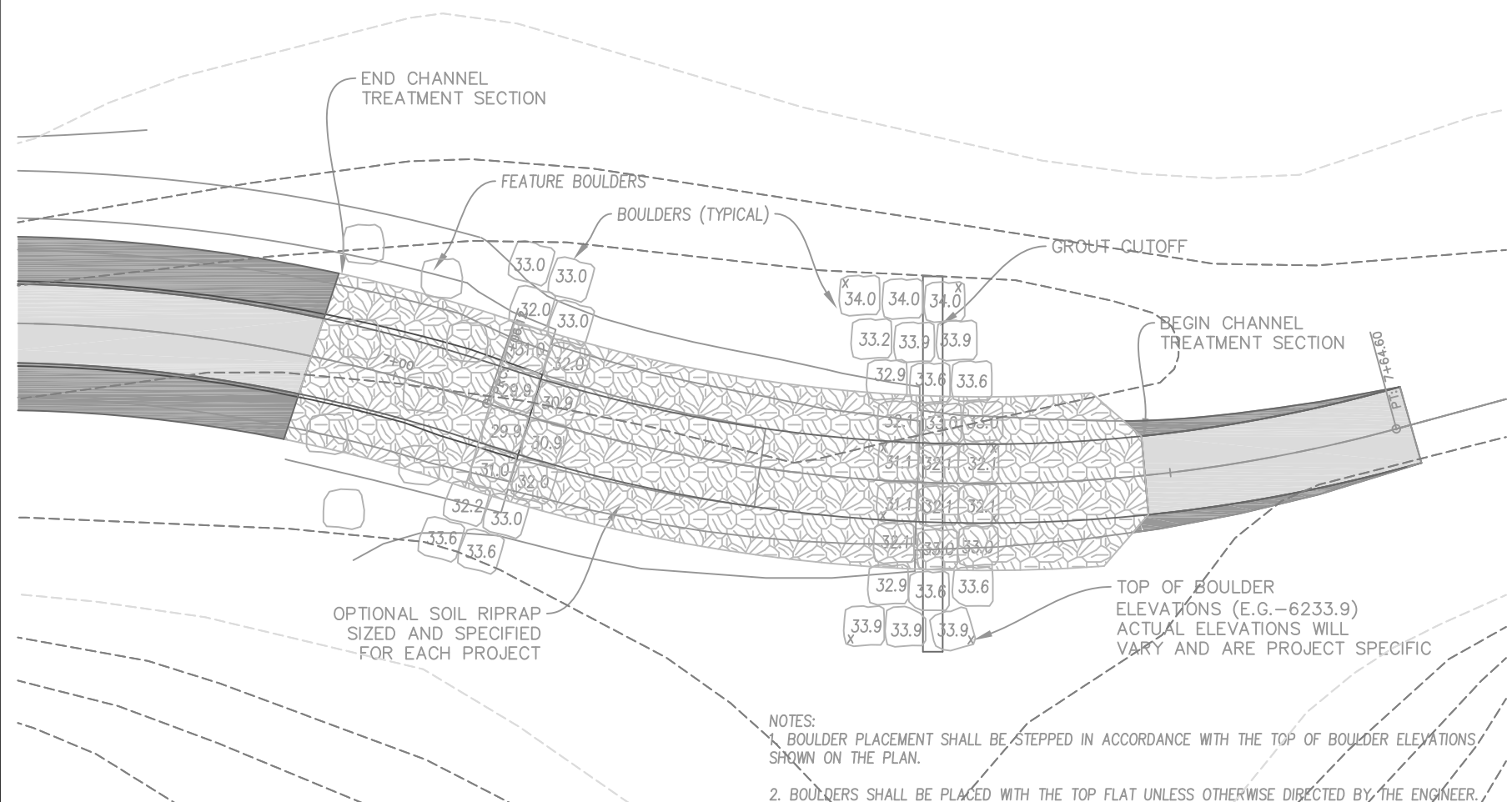
- SHRUB/TREE LIST (SMALL STOCK - 40³ IN)
- SKUNKBRUSH (*Rhus trilobata*)
 - GAMBEL'S OAK (*Quercus gambeli*)
 - SNOWBERRY (*Symphoricarpos occidentalis*)
 - MOUNTAIN MAHOGANY (*Cercocarpus montanus*)
 - PONDEROSA PINE (*Pinus ponderosa*)

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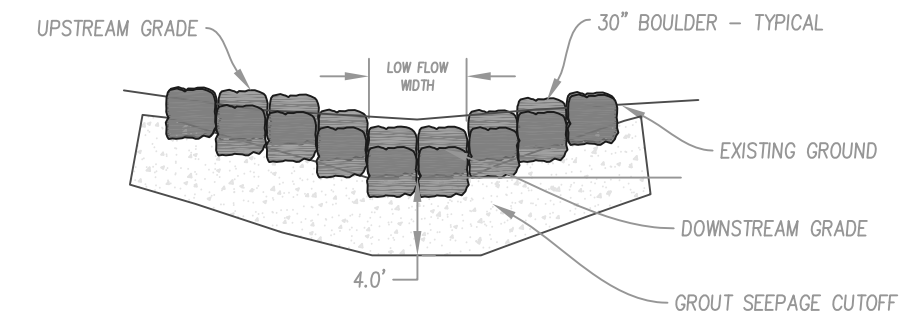
2 CHECK STRUCTURE DROP EXAMPLE – PROFILE

NTS



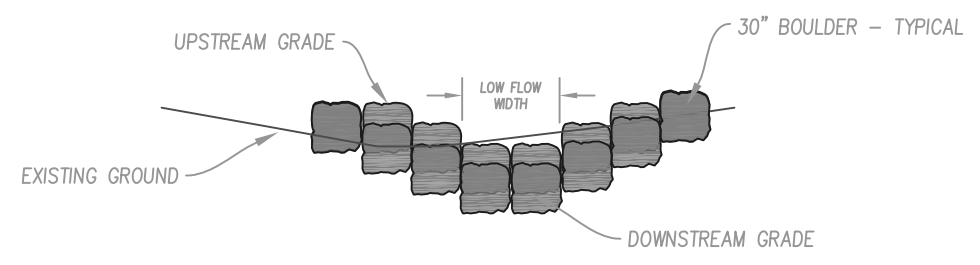
1 CHECK STRUCTURE EXAMPLE PLAN VIEW

- NOTES:
1. BOULDER PLACEMENT SHALL BE STEPPED IN ACCORDANCE WITH THE TOP OF BOULDER ELEVATIONS SHOWN ON THE PLAN.
 2. BOULDERS SHALL BE PLACED WITH THE TOP FLAT UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
 3. BOULDERS SHALL BE PLACED SUCH THAT ADJACENT BOULDERS TOUCH EACH OTHER AND VOIDS ARE MINIMIZED (LIKE A PUZZLE). A MINIMUM VERTICAL OVERLAP OF 6" SHALL BE MAINTAINED FROM ONE BOULDER TO THE NEXT. ALL BOULDER PLACEMENT SHALL BE APPROVED BY THE ENGINEER DURING CONSTRUCTION.



3 UPSTREAM BOULDER DROP SECTION

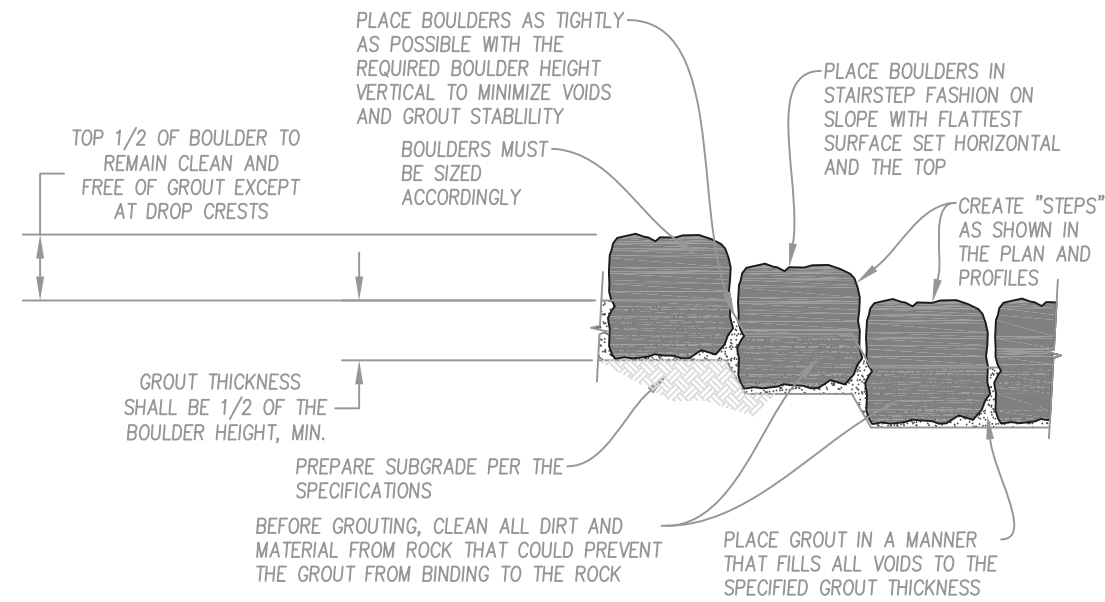
NTS



4 DOWNSTREAM BOULDER DROP SECTION

NTS

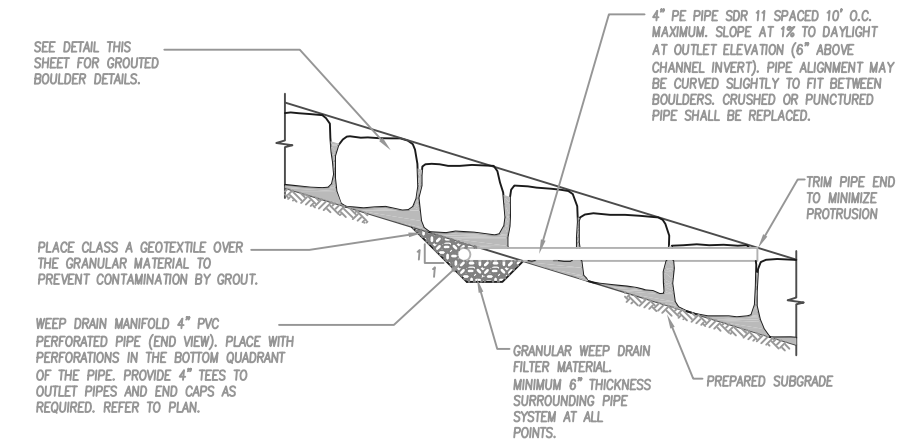
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DRAWN:			
CHECKED:			
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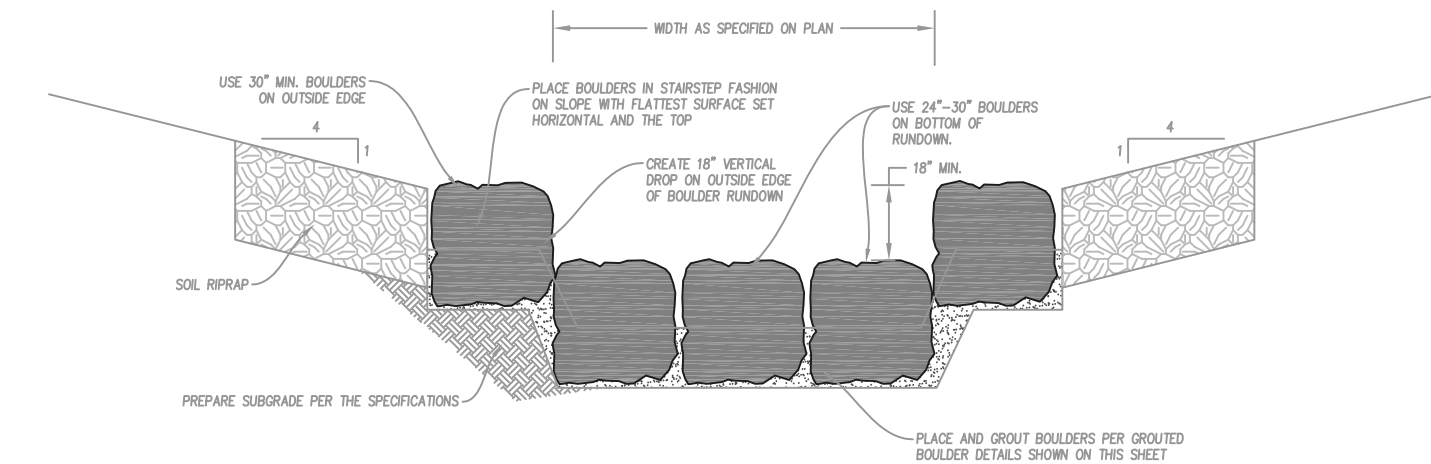
- NOTES:**
1. THE TOPS OF BOULDERS MAY VARY FROM THE DESIGN GRADE BY 4"± AND EXCEPT AT THE DROP CRESTS, UP TO 20% OF THE BOULDERS MAY PROTRUDE ABOVE THE DESIGN GRADE UP TO 8" (OR AS DIRECTED OR INDICATED). AT THE DROP CREST NO BOULDER SHALL VARY FROM THE DRAWING BY MORE THAN 2" OR AS INDICATED ON THE DRAWINGS. THE ENGINEER MAY REQUEST GREATER VARIATION AT SELECT LOCATIONS.
 2. BEFORE GROUTING, CLEAN ALL DIRT AND MATERIALS FROM ROCK THAT COULD PREVENT THE GROUT FROM BONDING TO ROCK. FINAL PLACEMENT OF BOULDERS TO BE APPROVED BY THE ENGINEER PRIOR TO GROUTING.
 3. PLACE GROUT BY INJECTION METHODS TO FILL VOIDS TO THE SPECIFIED GROUT DEPTH. CLEAN EXCESS GROUT FROM ALL EXPOSED SURFACES.
 4. THE CONTRACTOR SHALL CONTROL GROUT MIX AND PLACEMENT PROCEDURES TO ACHIEVE THE SPECIFIED THICKNESS AND GRADE OF THE GROUT LAYER. INTENT IS TO MINIMIZE VISIBILITY OF GROUT, BUT ACHIEVE MINIMUM THICKNESS INDICATED WHERE SPECIFIED, OR ON DRAWING.

1 GRouted BOULDER PLACEMENT EXAMPLE

NTS

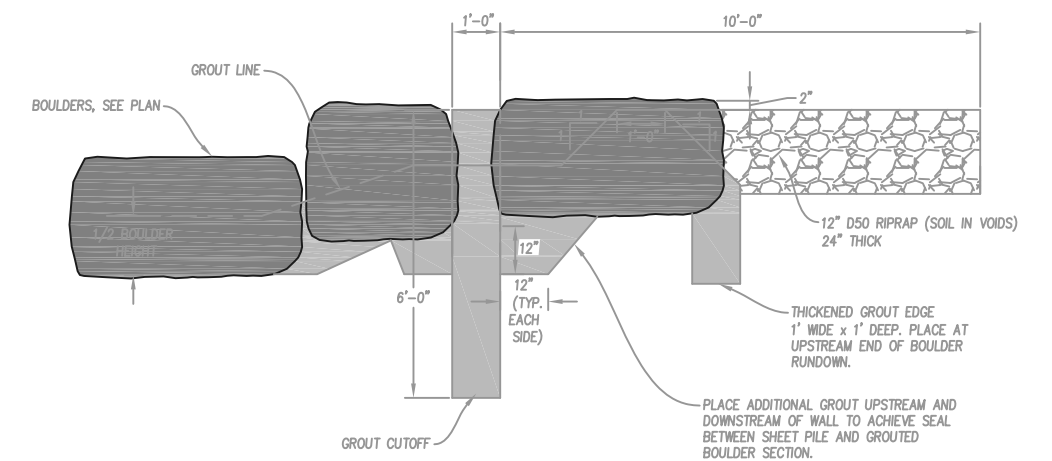


2 TYPICAL WEEP DRAIN SYSTEM



3 EXAMPLE OF GROUTED BOULDER RUNDOWN SECTION

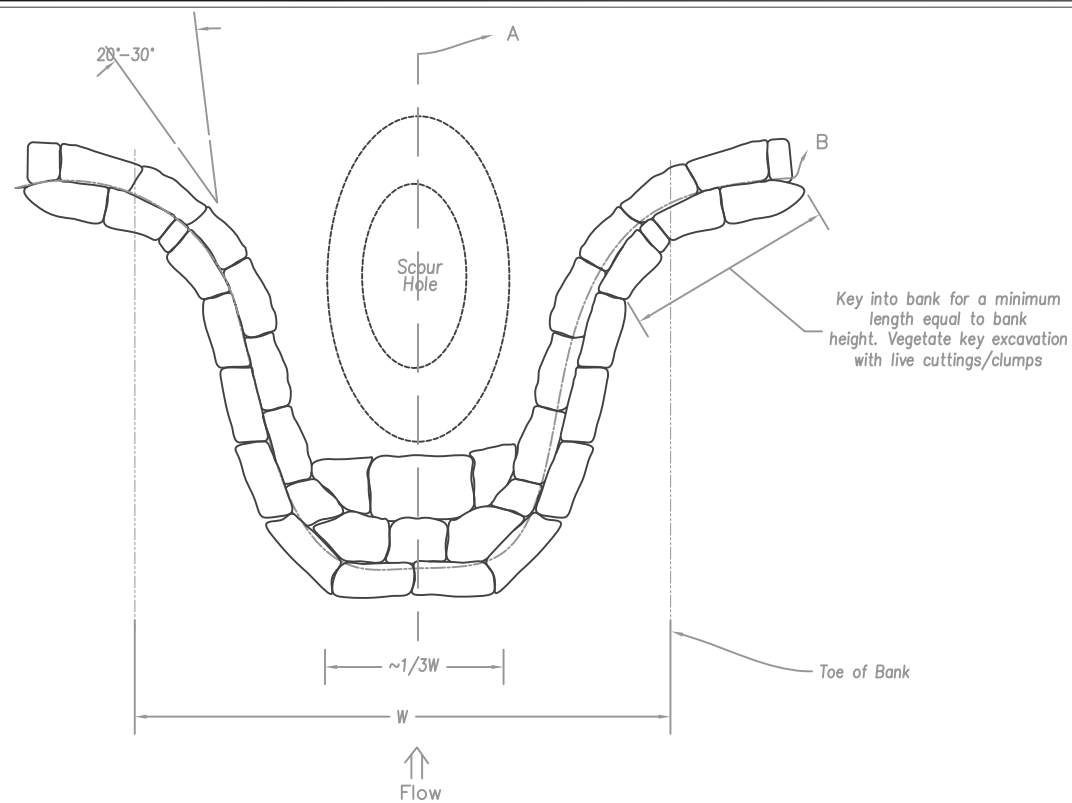
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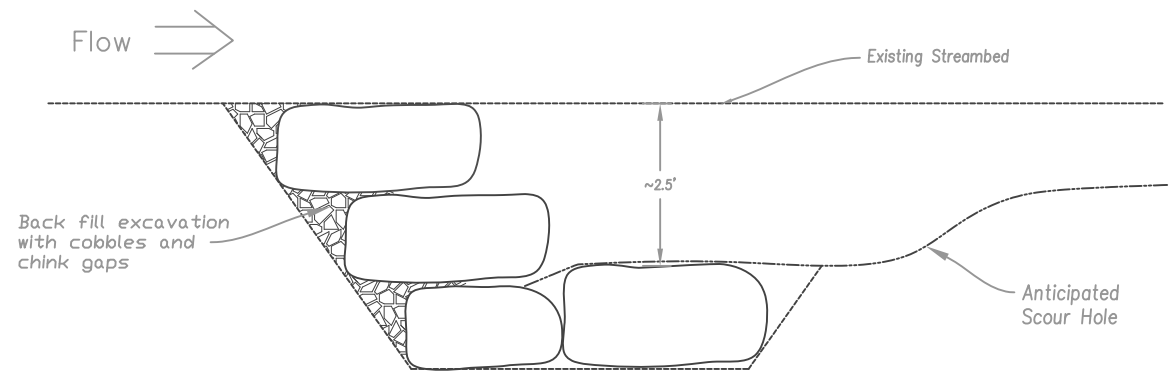
4 GENERAL GROUT CUTOFF DETAIL FOR UPSTREAM SECTION

NTS

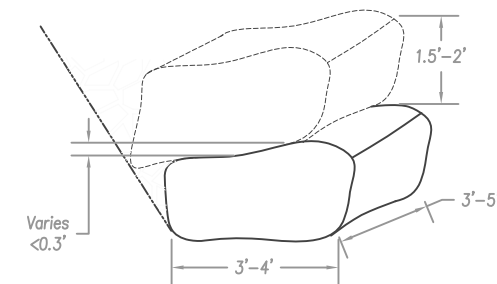
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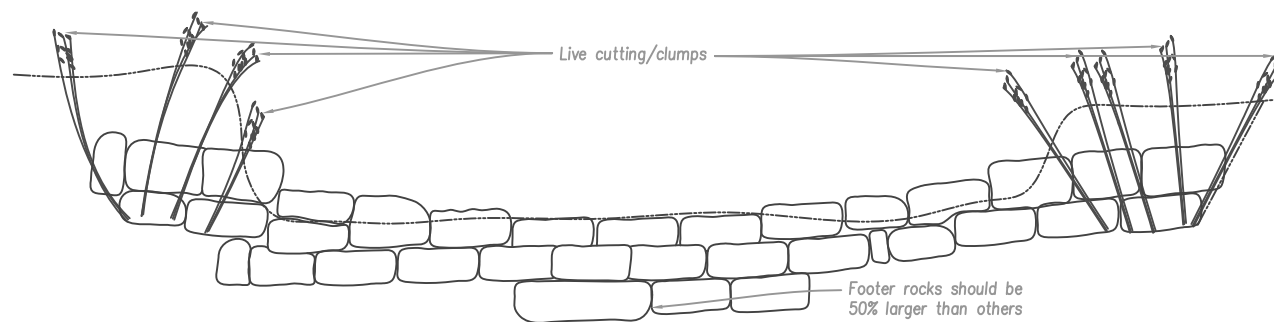
1 ROCK VANE PLAN VIEW



3 ROCK BOLSTER DETAIL

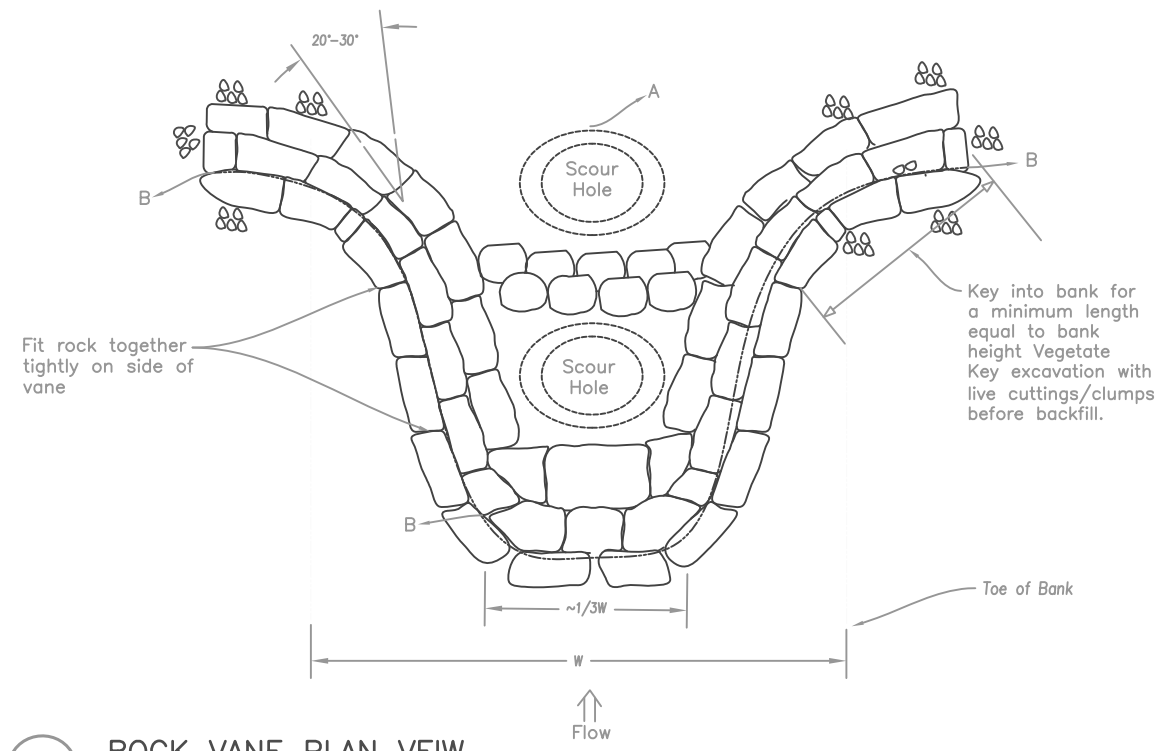


4 TYPICAL ROCK DIMENSIONS AND PLACEMENTS



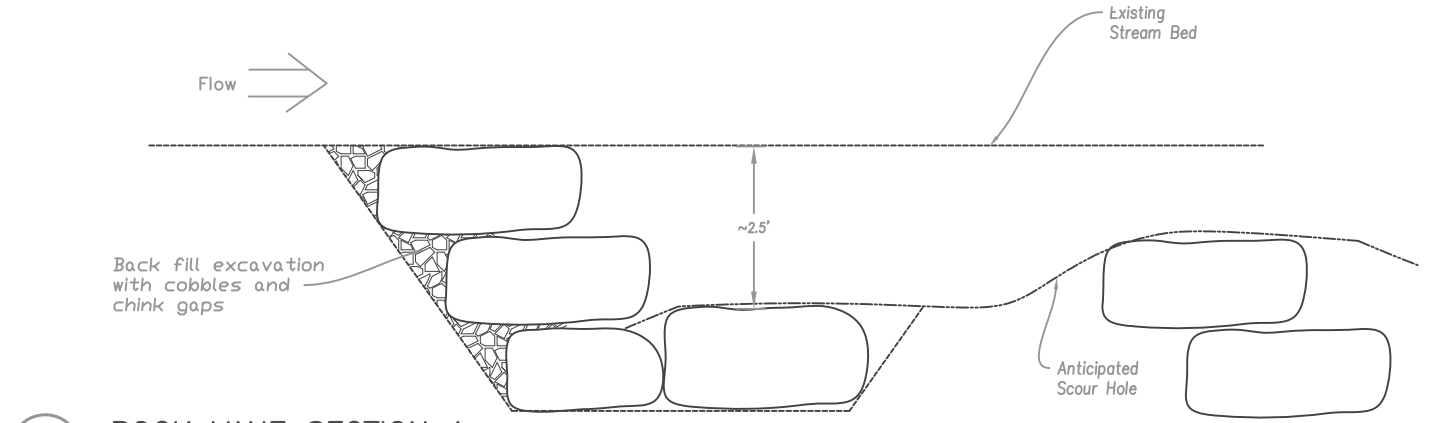
5 ROCK VANE SECTION B

Notes: The rocks should be rectangular or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream.



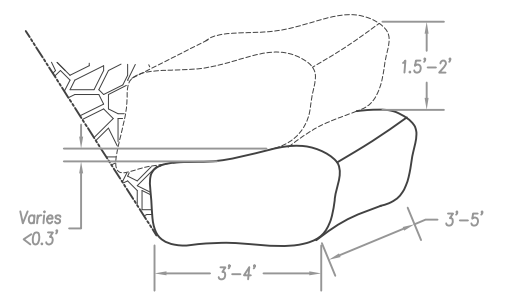
1 ROCK VANE PLAN VIEW

*Notes (1): Total drop not to exceed 6 inches for warm water fish species

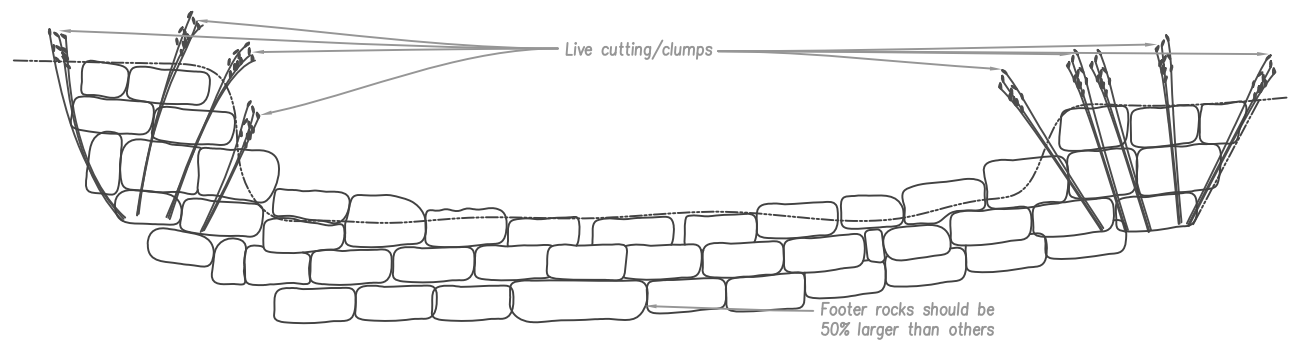


2 ROCK VANE SECTION A

Notes (3): Stone sized to be stable at highest design discharge



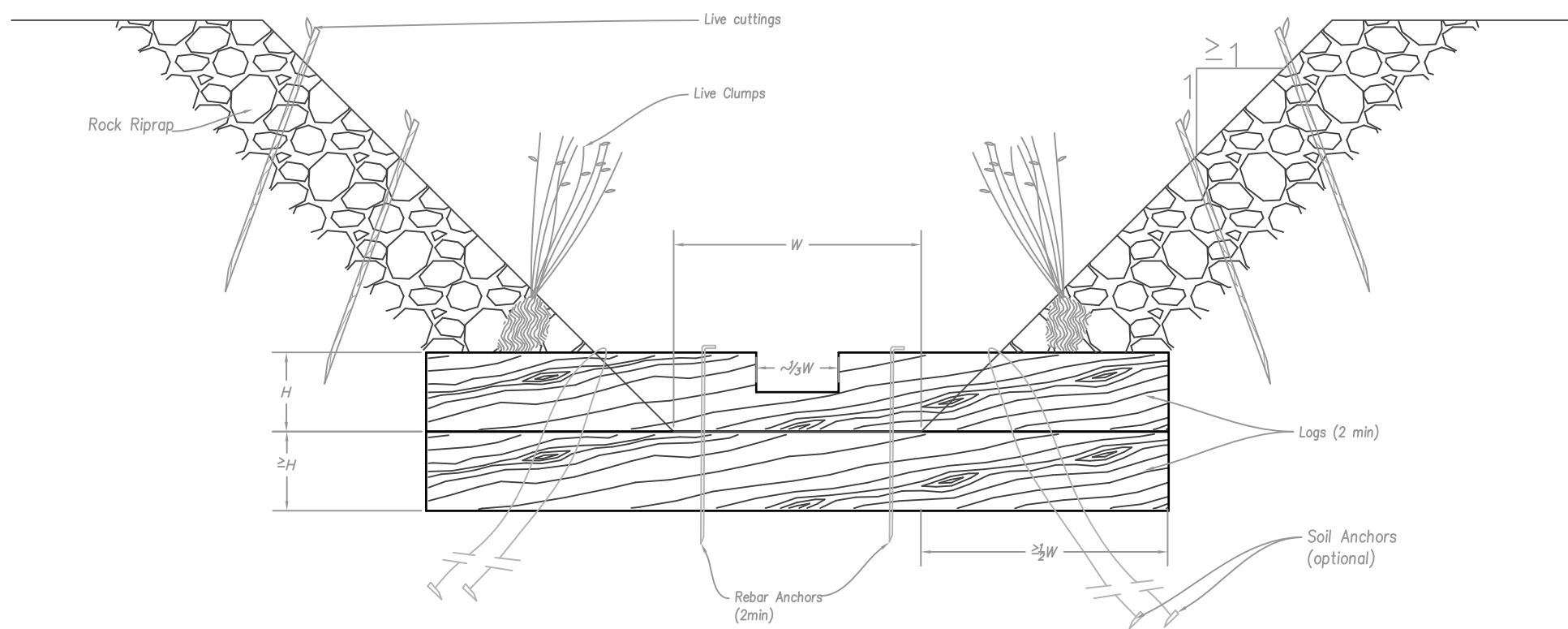
4 TYPICAL ROCK DIMENSIONS AND PLACEMENTS



2 ROCK VANE SECTION B

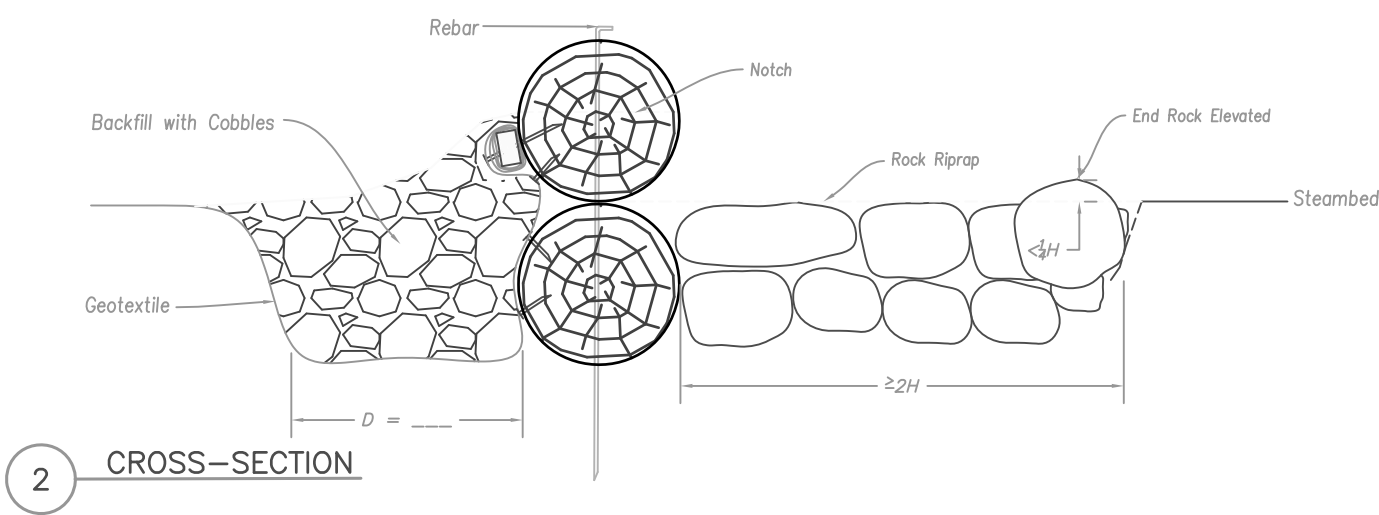
General Notes: The rocks should be rectangular or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream. Fill gaps with smaller stones.

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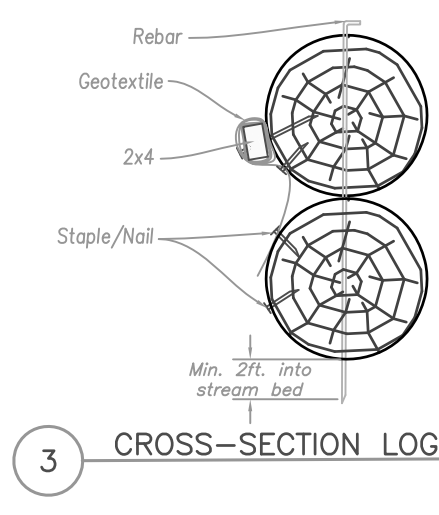


Notes: Install live clumps and live cuttings into adjacent protection during construction. Extend to below stream bed. Use logs that are straight, uniform diameter and free of rot, disease or insect infestation.

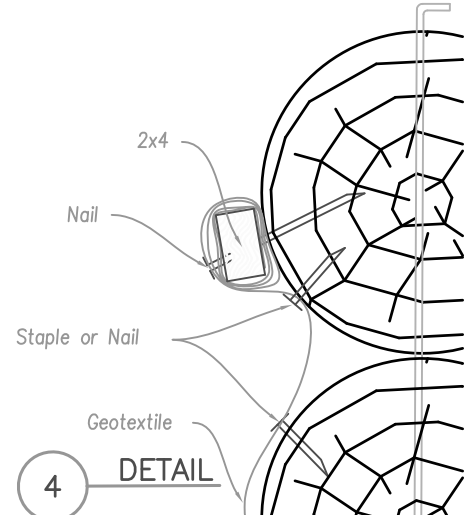
1 FRONT VIEW OF LOG CHECK



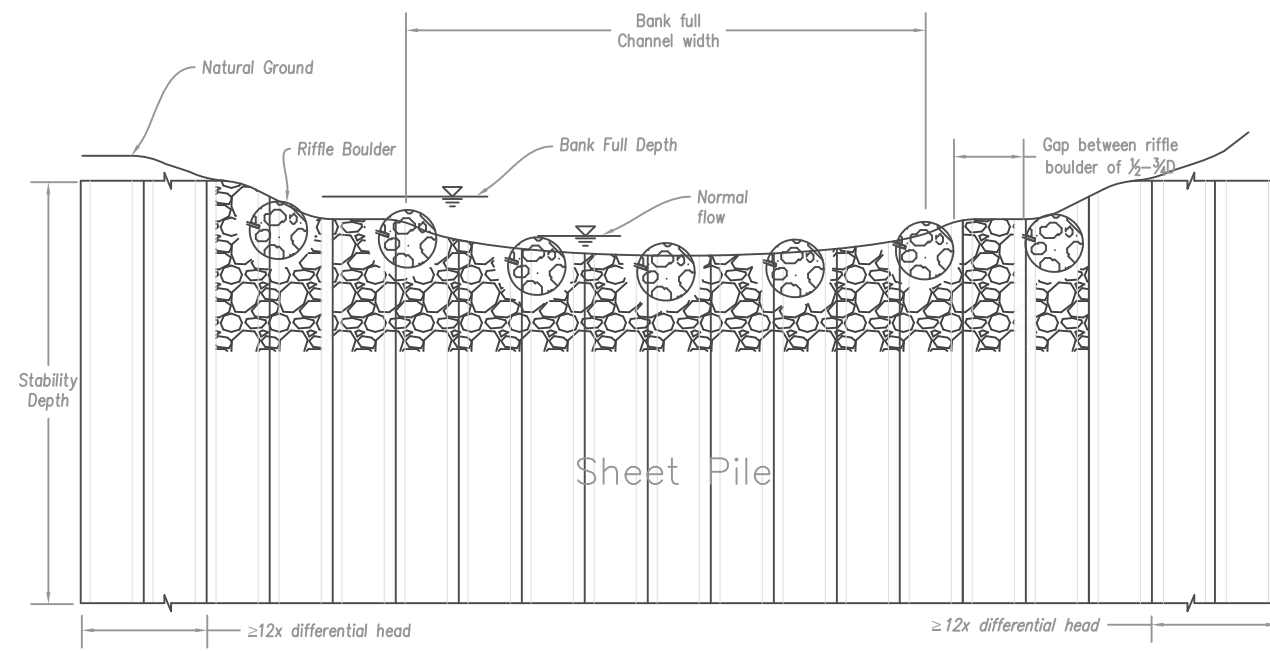
2 CROSS-SECTION



3 CROSS-SECTION LOG



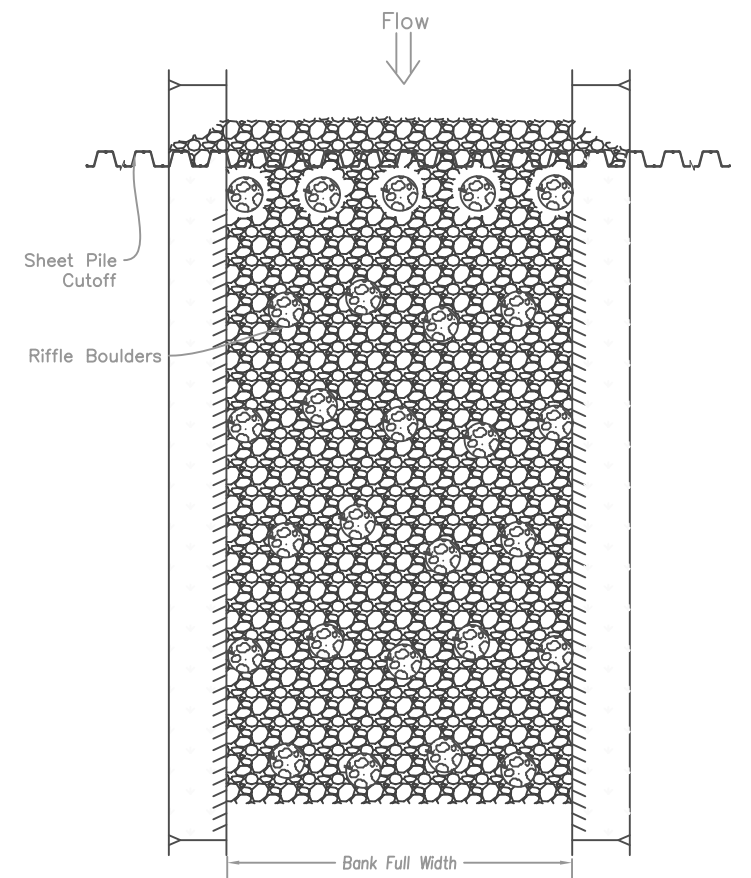
4 DETAIL



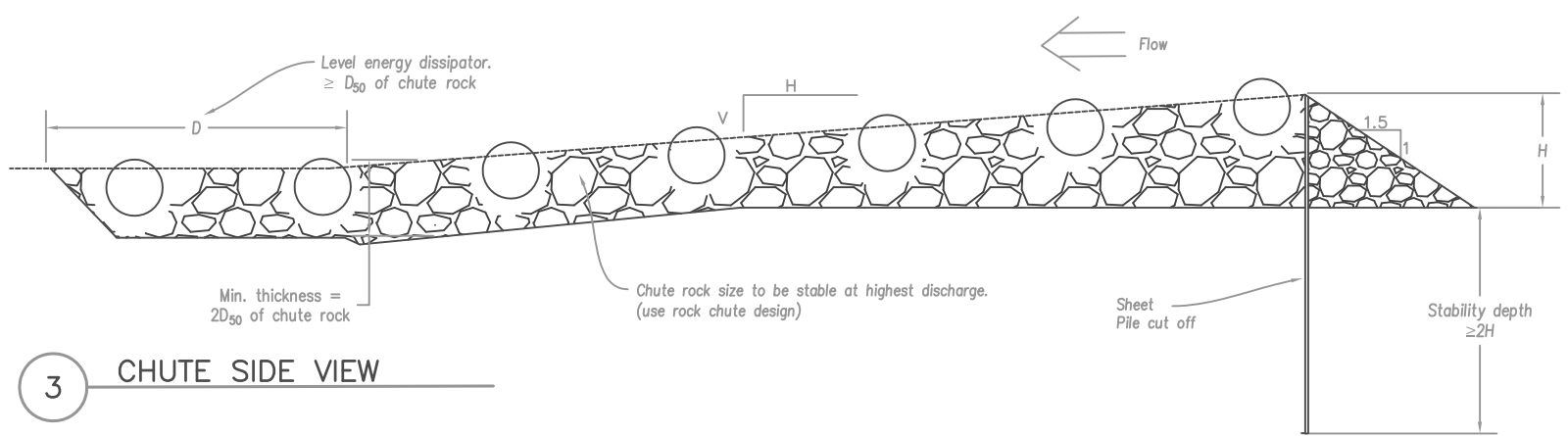
1 CHUTE SECTION VIEW

Notes (1): Sheet pile to follow natural ground to high bank.

Notes (2): Plant edge with live cuttings. Offset riffle boulders so flow is circuitous.



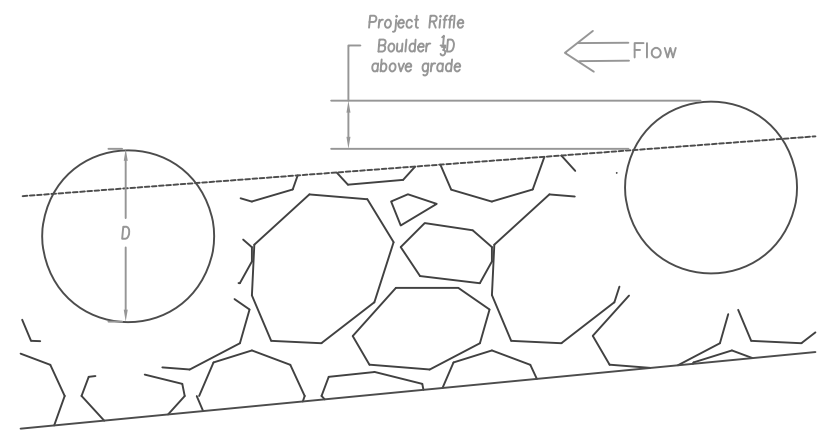
2 CHUTE PLAN VIEW



3 CHUTE SIDE VIEW

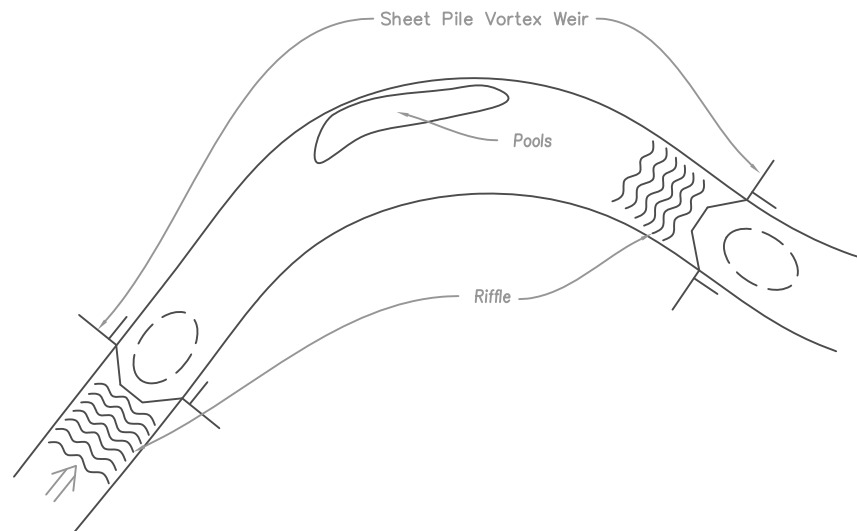
General Note: Maximum slope for warm water species is 5%. Maximum slope for salmonids is 10%.

Notes (4): Riffle boulder typical 1.5 to 2.5x Dia. of rock in chute. Riffle boulders should be seated in the rock mantle of the chute.

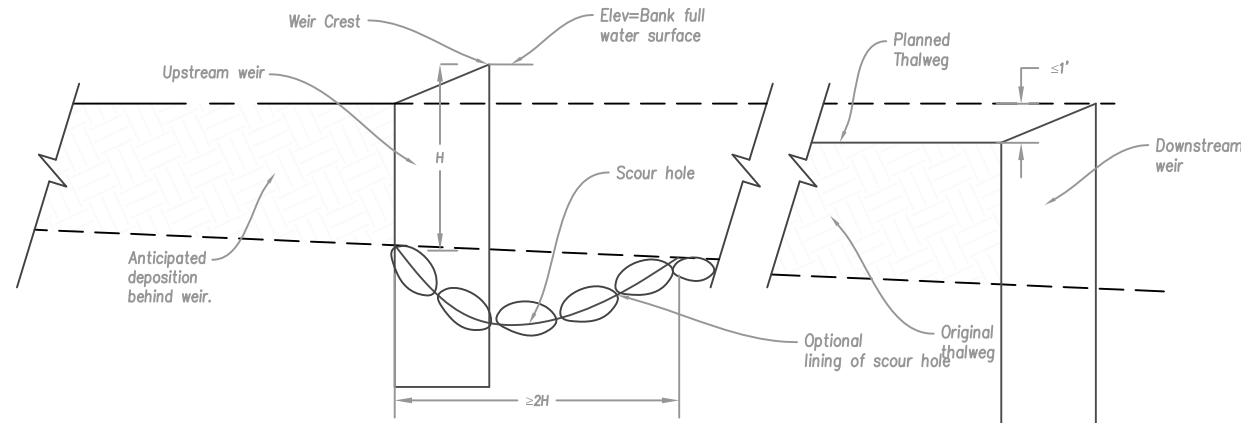


4 CLOSE UP CHUTE SIDE VIEW

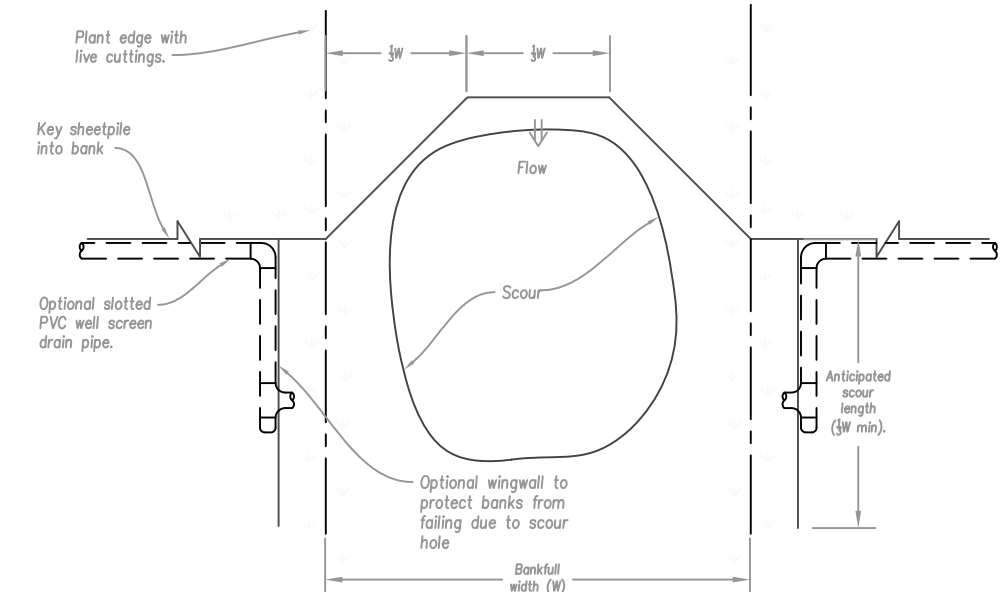
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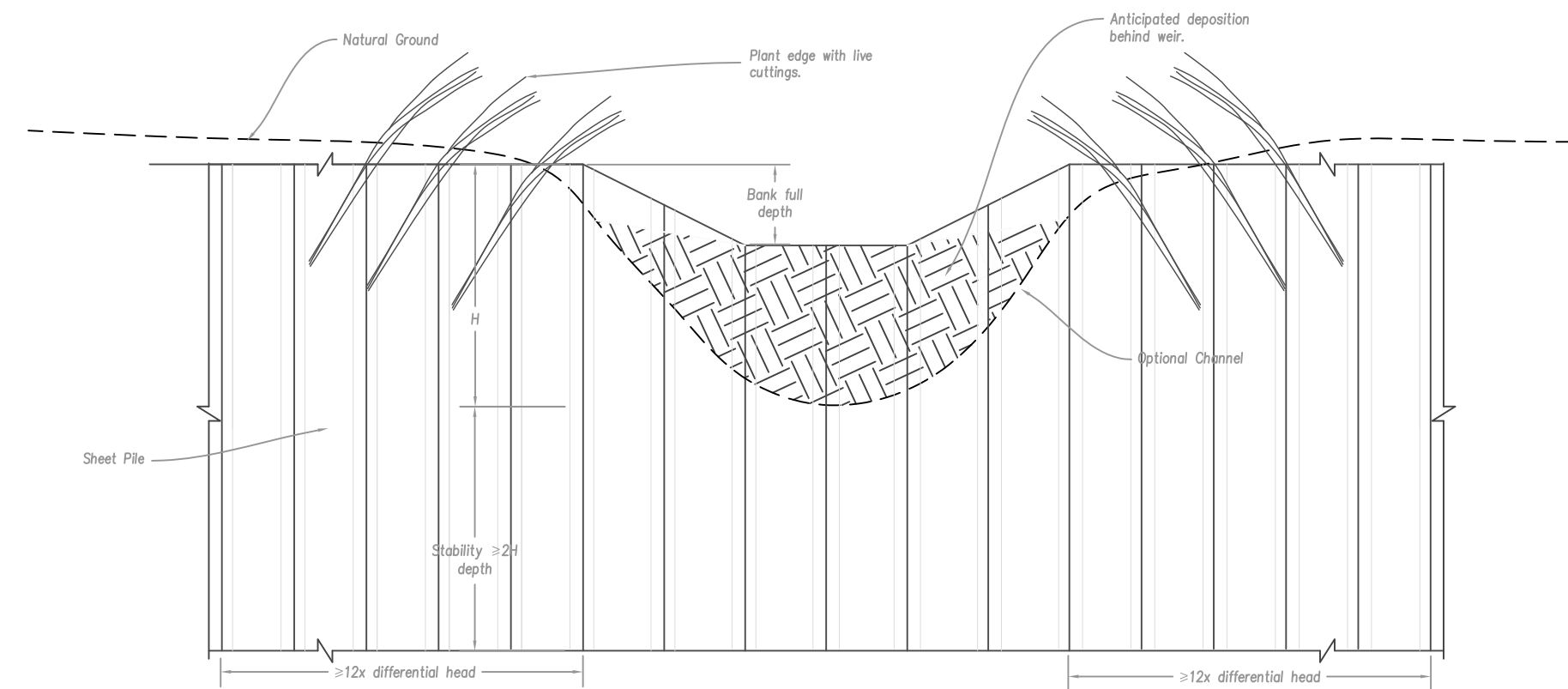
1 WEIR LAYOUT



2 WEIR PROFILE VIEW

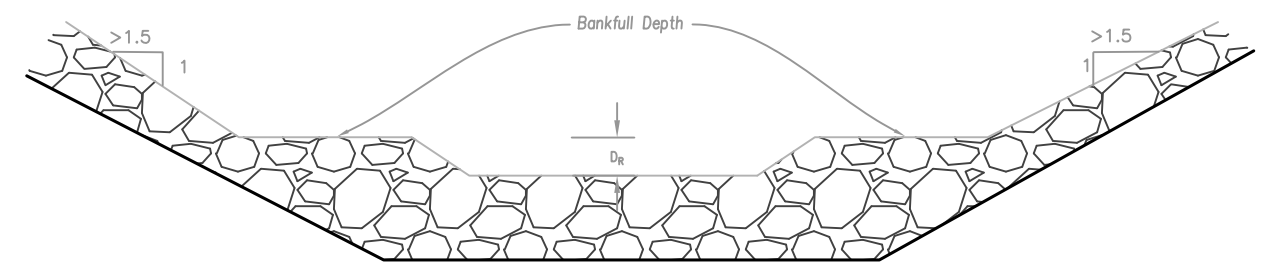
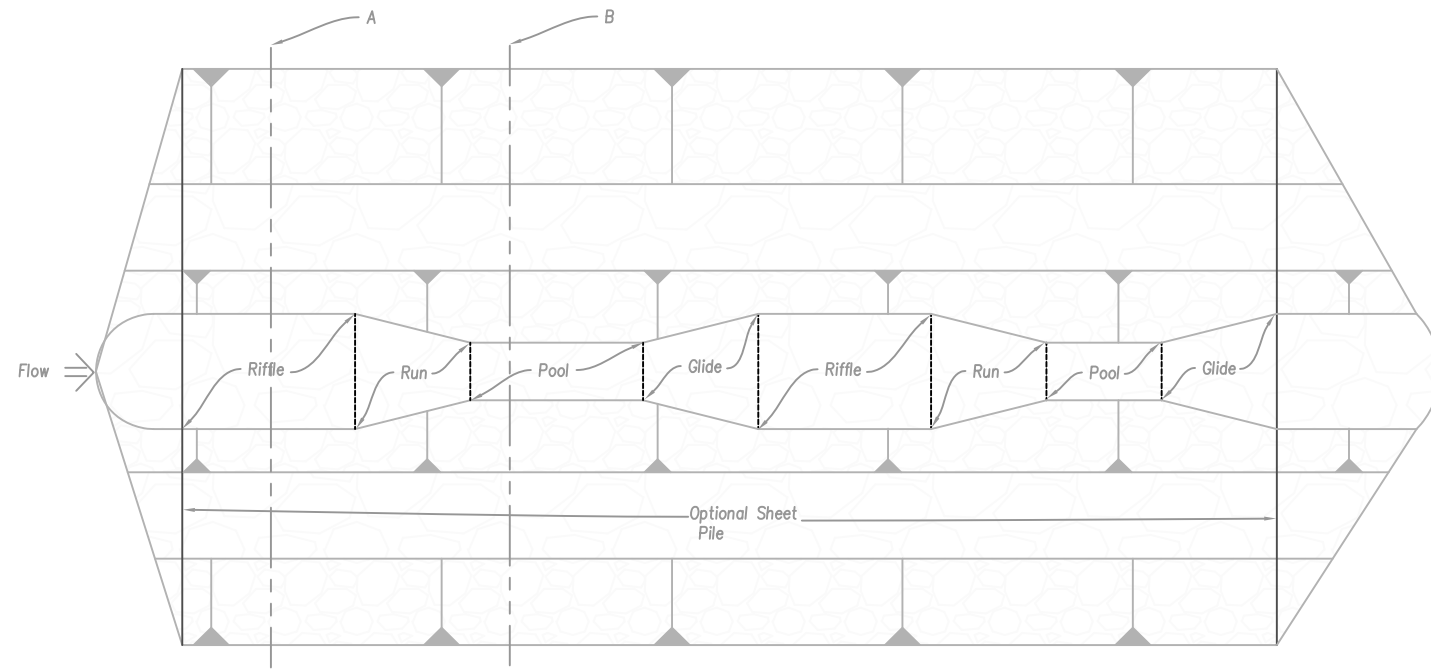


3 WEIR PLAN VIEW

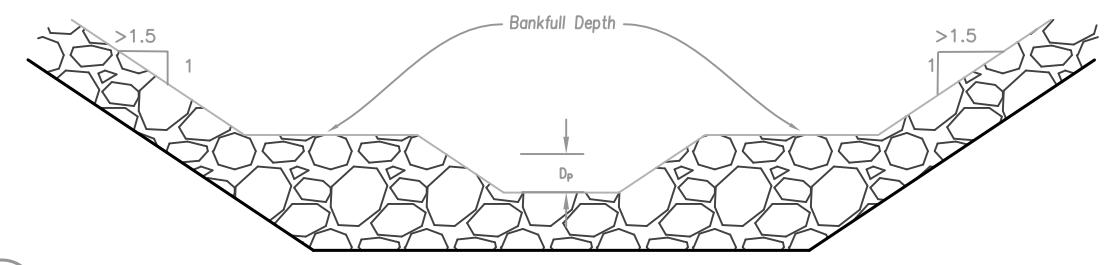


4 WEIR SECTION VIEW

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2 SECTION A-RIFFLE



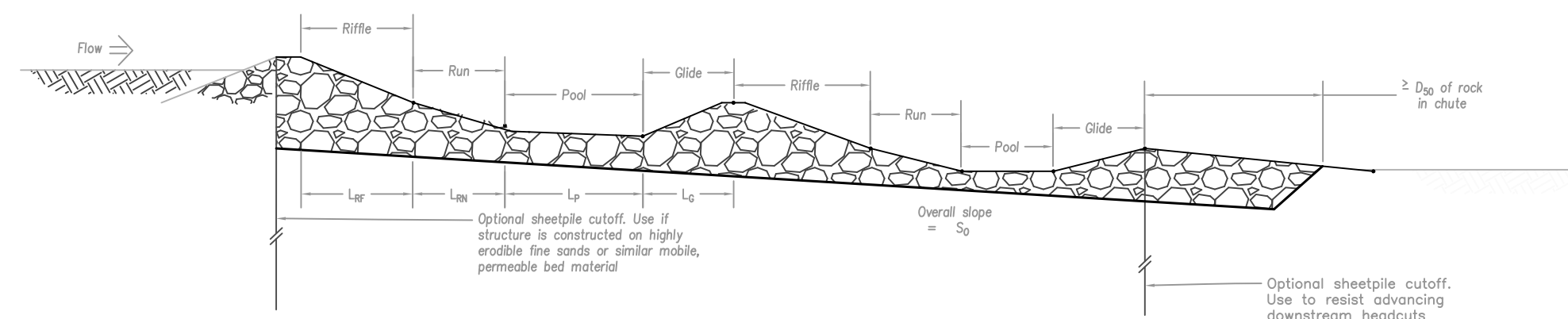
3 SECTION B-POOL

1 PLAN VIEW

Notes (1):
 Slope Riffle (S_{RF}) = _____ ($\sim 1.5S_0$ to $2S_0$)
 Slope Run (S_{RN}) = _____ ($\sim 2S_0$)
 Slope Pool (S_P) = _____ (0 to $\frac{1}{2}S_0$)
 Slope Glide (S_G) = _____ ($-S_{RN}$)
 (Slope from beginning of run to the end of the glide should be $\leq \frac{1}{2}$ of riffle slope)

Notes (1): Bottom width of pool is $\sim \frac{1}{2}$ the bottom width of riffle

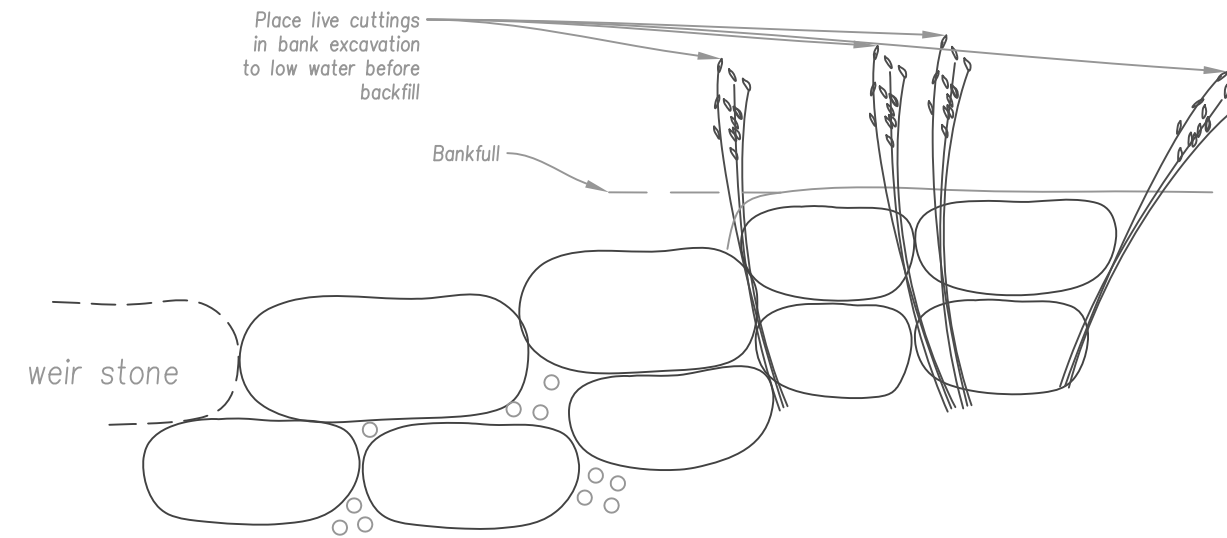
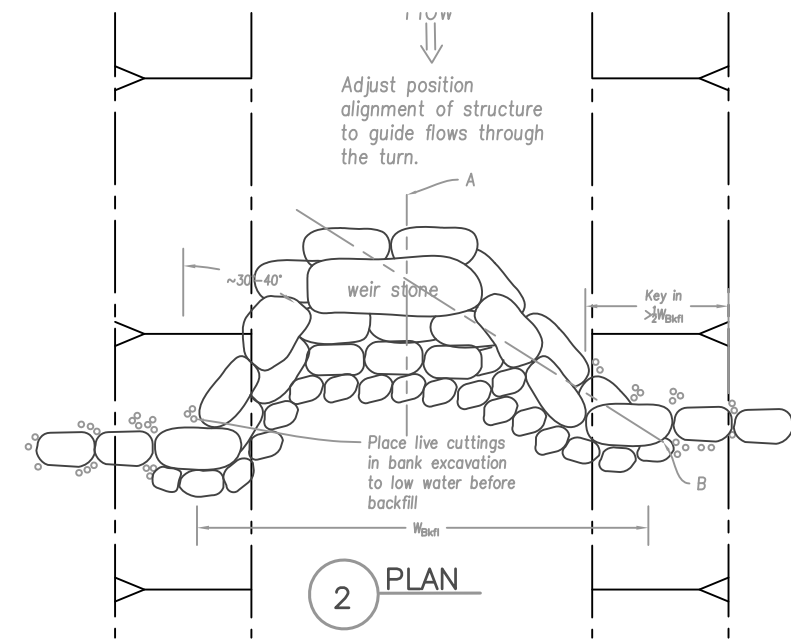
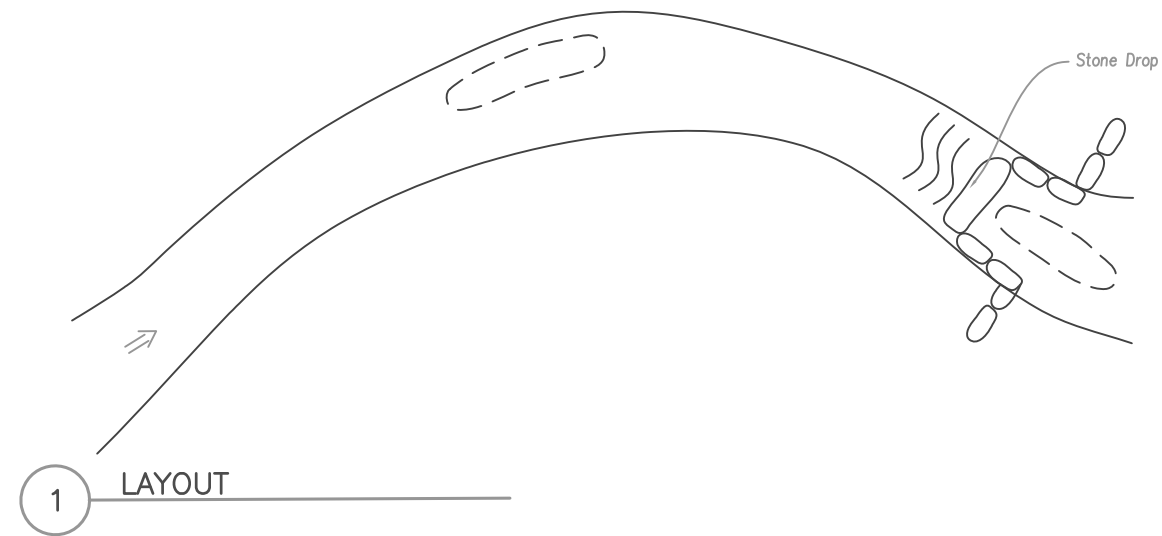
Notes (3 and 4):
 D_R = _____ (Bankfull depth)
 D_P = _____ (~ 2 to $3D_R$)



4 PROFILE (CENTERLINE)

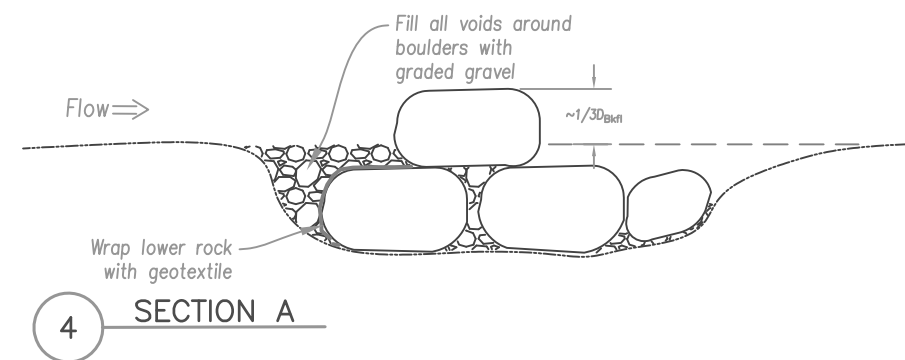
Notes (2):
 L_{RF} = _____
 L_{RN} = _____ ($\sim \frac{2}{3}L_{RF}$)
 L_P = _____ ($\sim L_{RF}$)
 L_G = _____ ($\sim L_{RN}$)
 (Length of riffle $\sim \frac{1}{2}$ length of entire pool including run, pool and glide as shown on the plans)
 $L_{RF} \approx \frac{1}{2} (L_{RN} + L_P + L_G)$

General Notes:
 • Chute rock size to be stable at highest design discharge (use rock chute design and apply results to riffle slope)
 • Minimum rock thickness shall not be less than $2D_{50}$
 • Design was originally developed for a Rosgen C stream

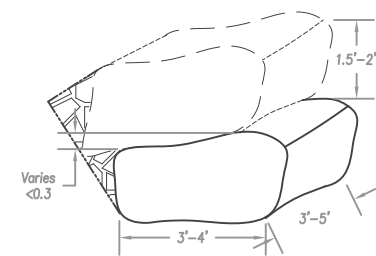


3 SECTION B

General Notes: The rocks should be rectangular or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream. Fill gaps with smaller stones.



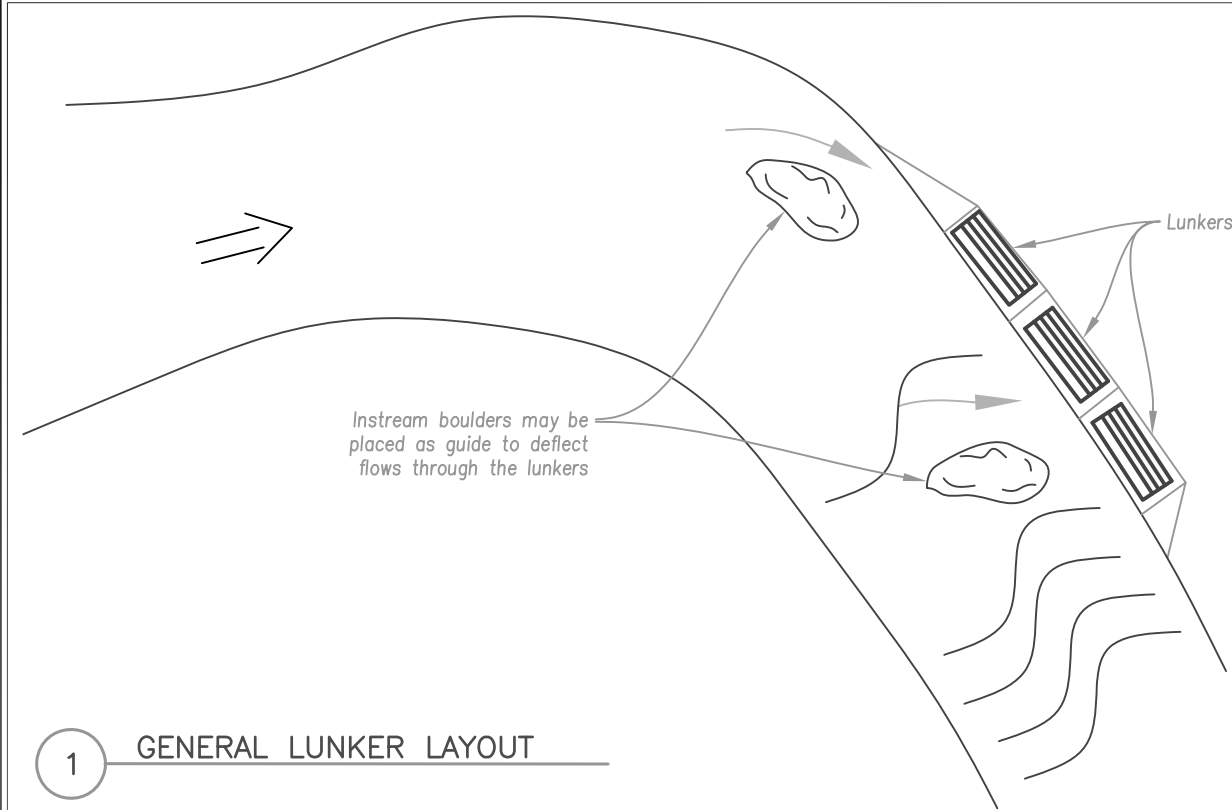
4 SECTION A



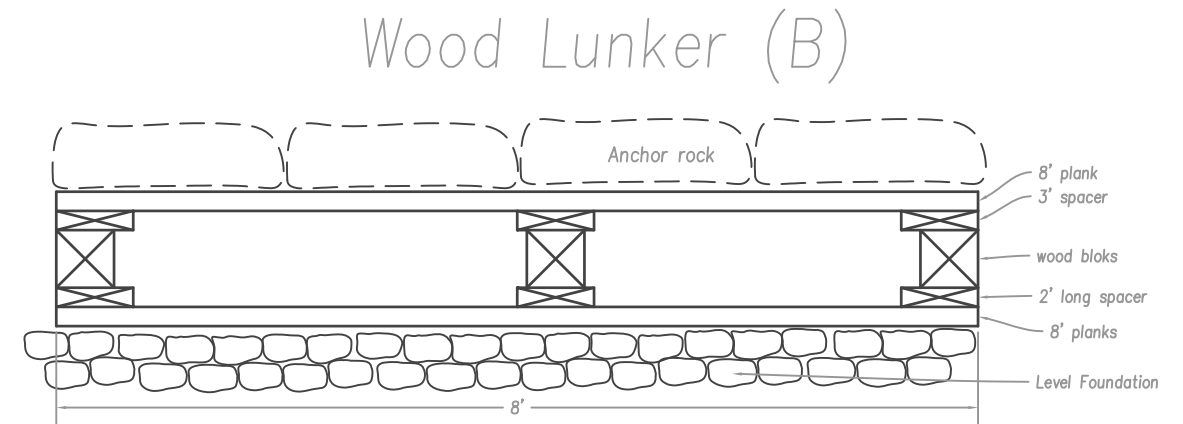
5 TYPICAL ROCK DIMENSIONS AND PLACEMENTS

Notes (4): Stone size to be stable at highest design discharge.

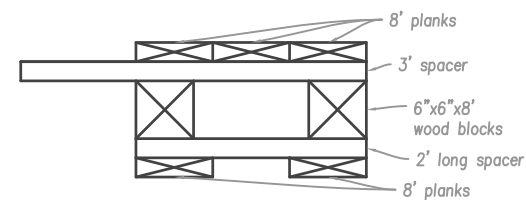
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Notes (1): Typically place lunkers in sets of three on the outer and lower 1/3 of the channel bend. Final alignment and placement should be determined in the field at low water. The designer should observe the current patterns to assure that flow will pass into and out of the structures. The designer should also assure that the Lunkers are placed below low water elevation.



1B FRONT

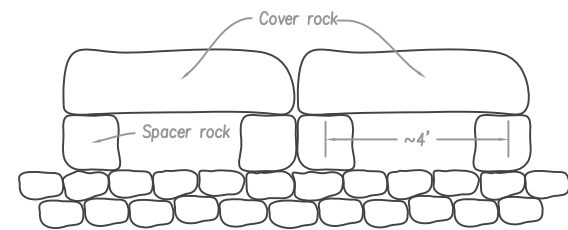


1B SIDE

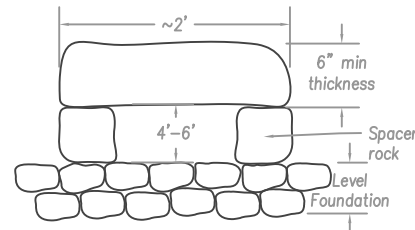
Wood Lunker Notes:
Lunker material is rough cut hard wood at least 2" thick

1 GENERAL LUNKER LAYOUT

Stone Lunker (A)

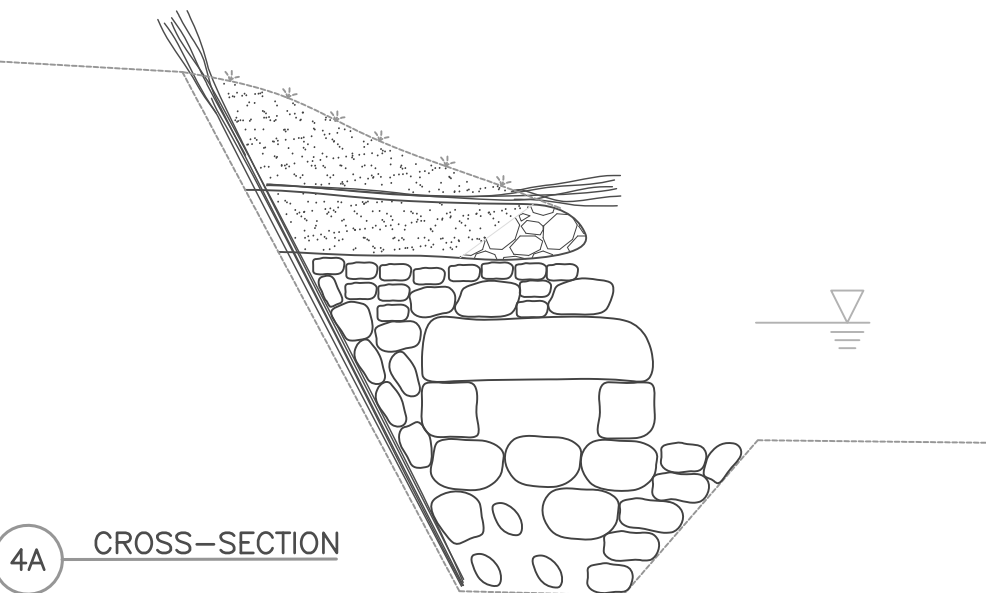


3A FRONT

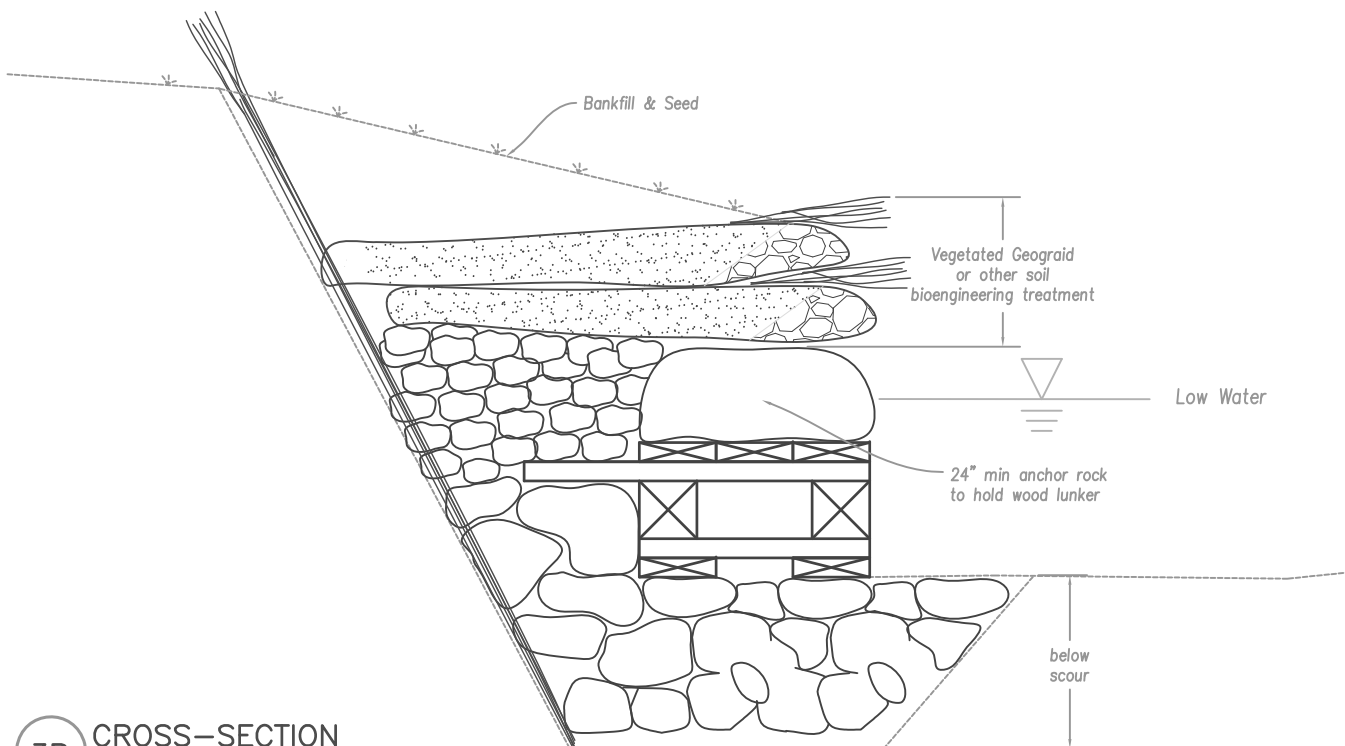


2A SIDE

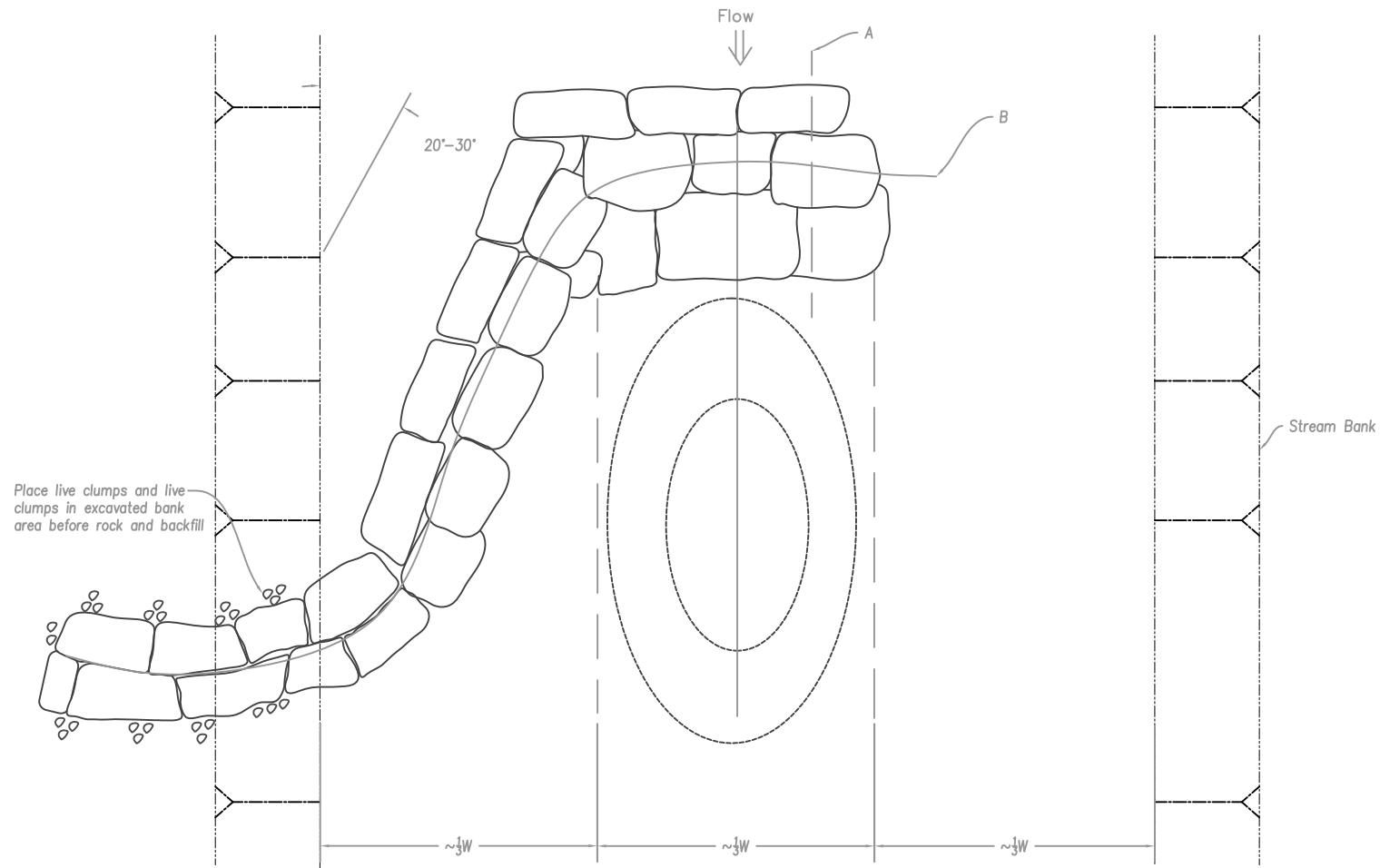
Stone Lunker Notes: Use sound rock. Place so that there is solid contact and no movement



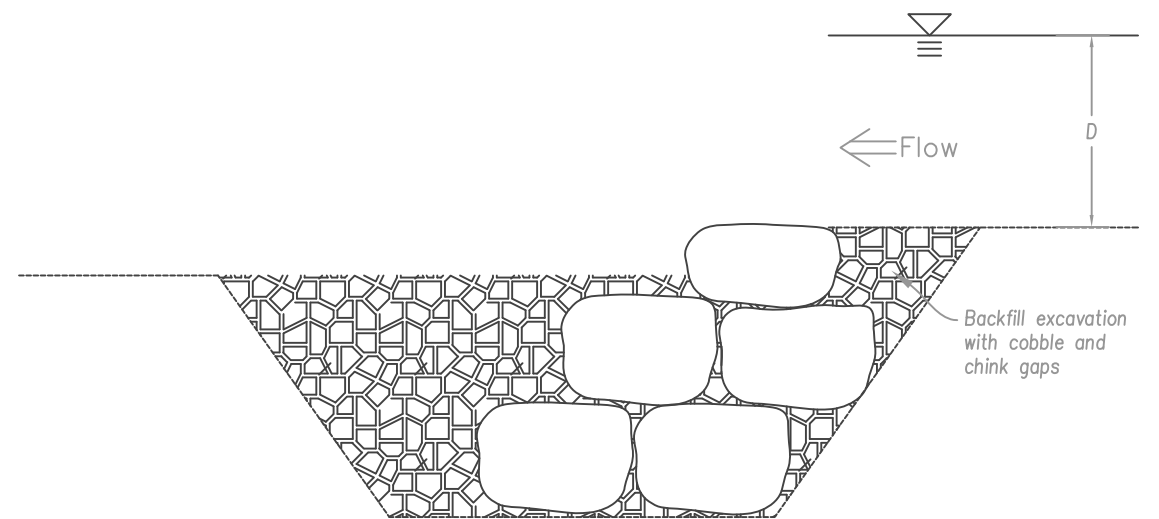
4A CROSS-SECTION



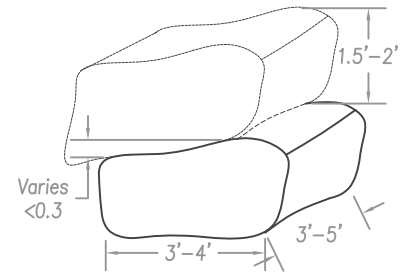
3B CROSS-SECTION



1 HOOK VANE PLAN VIEW

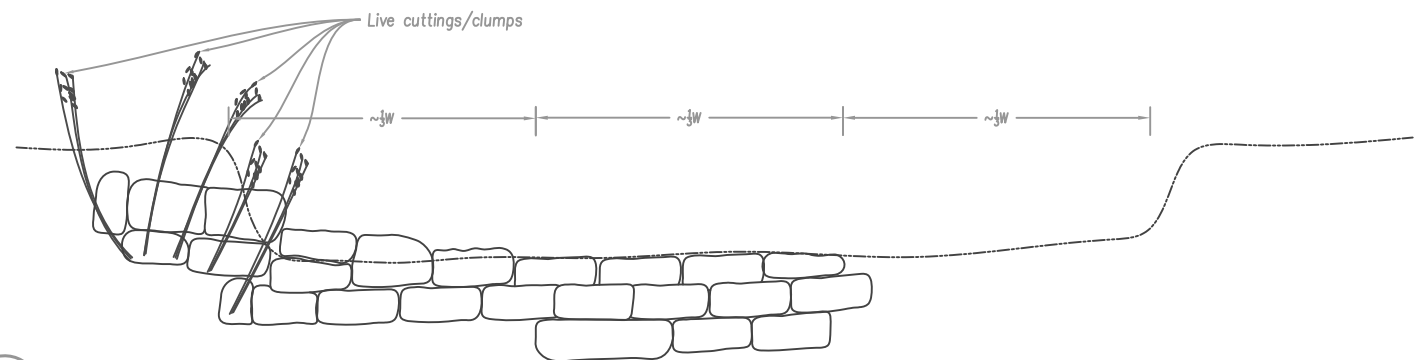


2 ROCK VANE SECTION A



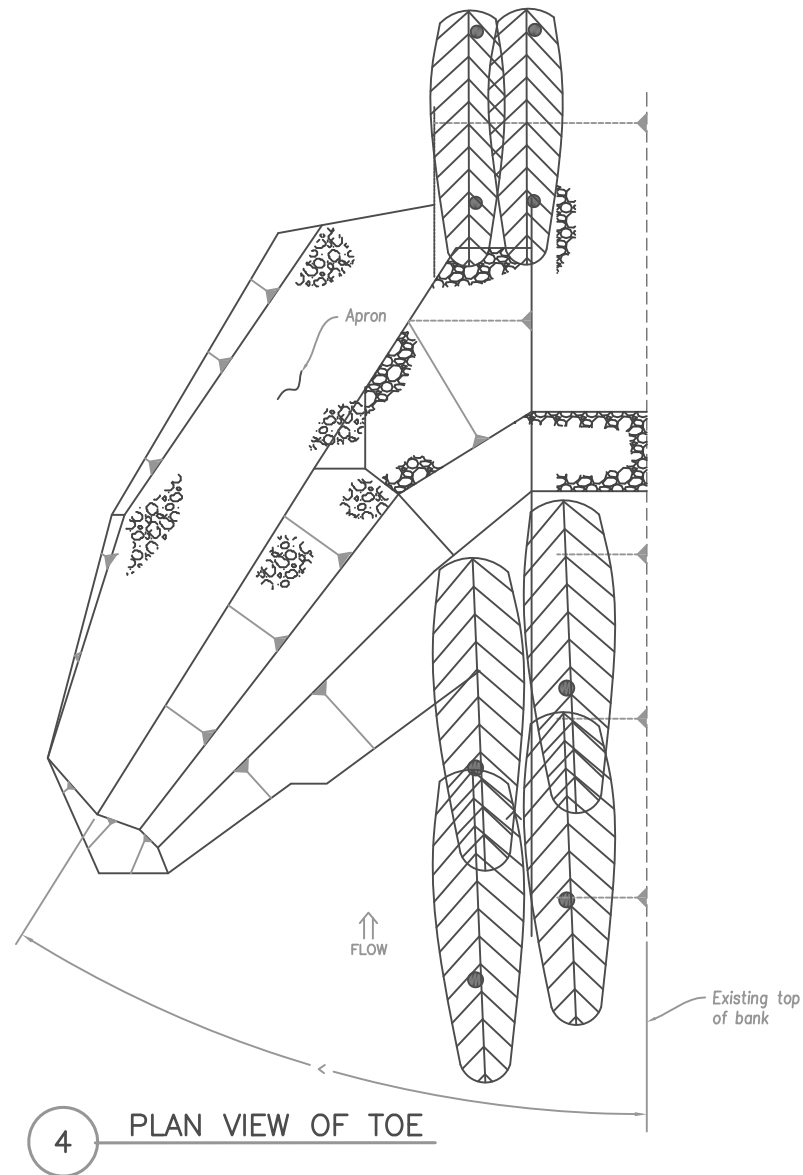
3 TYPICAL ROCK DIMENSIONS AND PLACEMENTS

Notes (3): Stone sized to be stable highest design discharge



4 HOOK VANE SECTION B

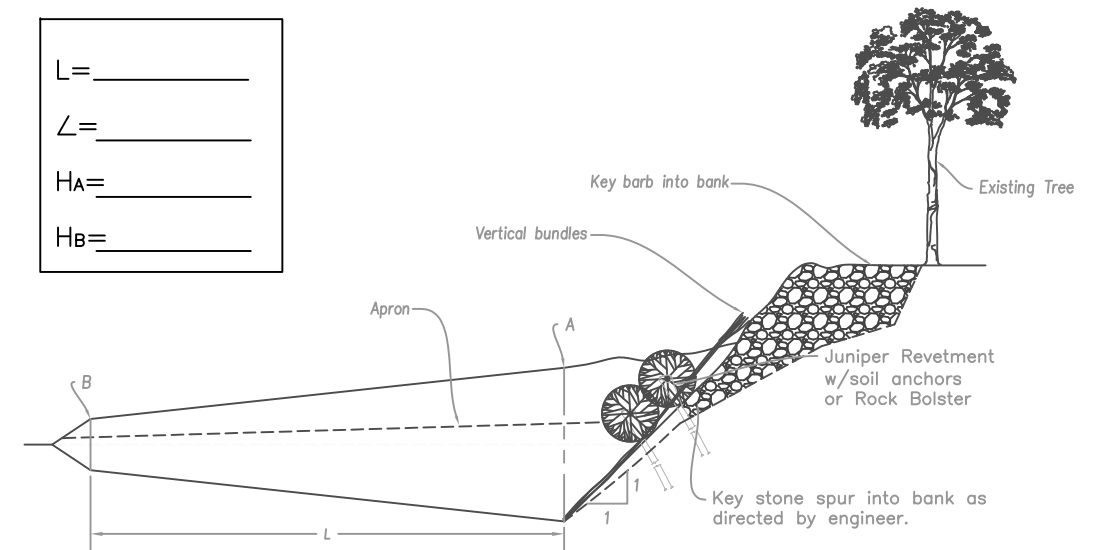
General Notes: The rocks should be rectangular or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream.



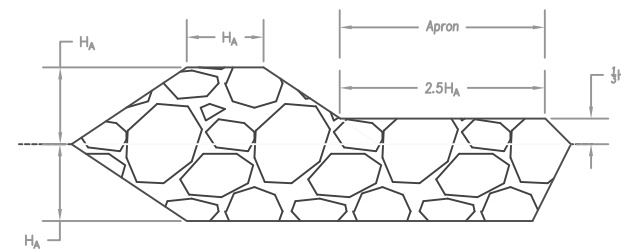
4 PLAN VIEW OF TOE

Notes (1):
 Install vertical bundles as directed in field. Base of bundles need to be at or below phreatic line. Install with rock.

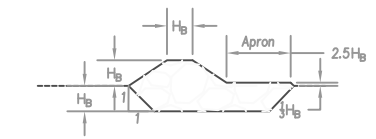
L= _____
 L= _____
 H_A= _____
 H_B= _____



4 STONE SPUR WITH ROCK TOE

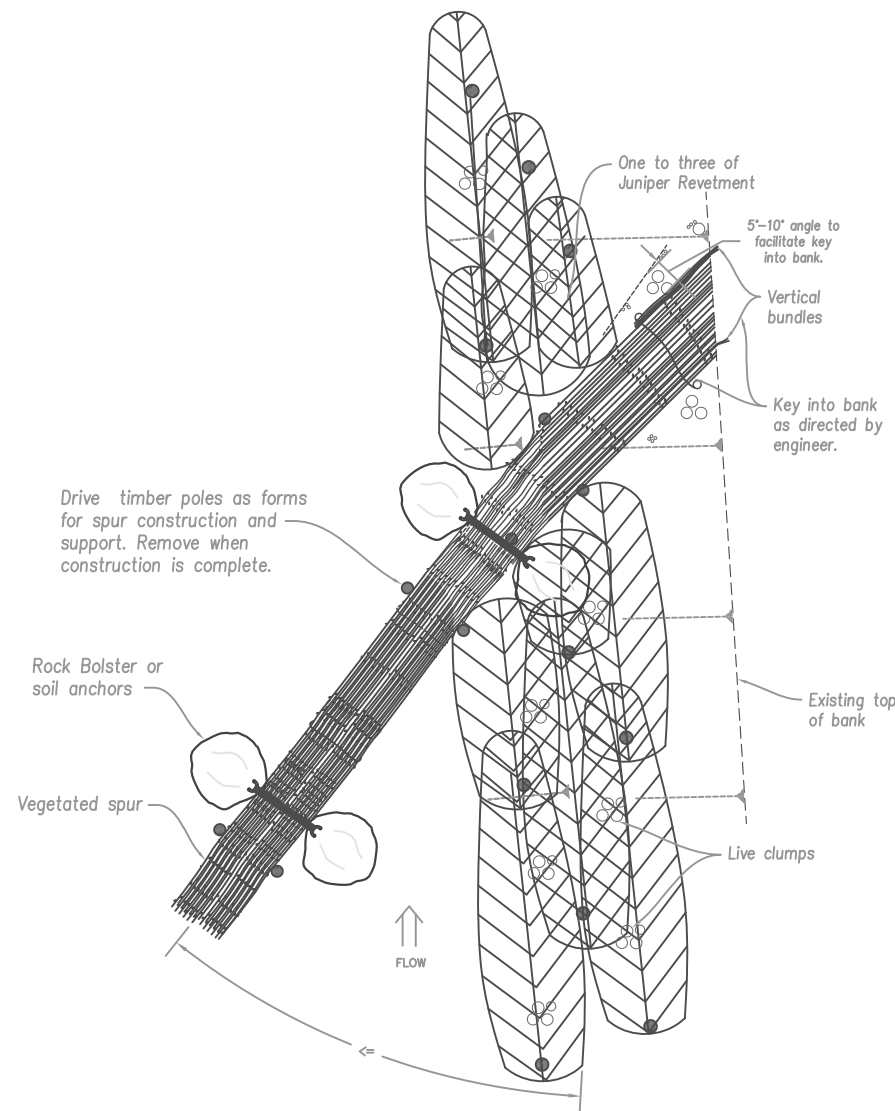


4 SECTION A

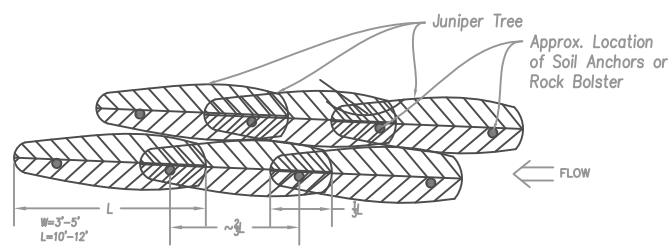


4 SECTION B

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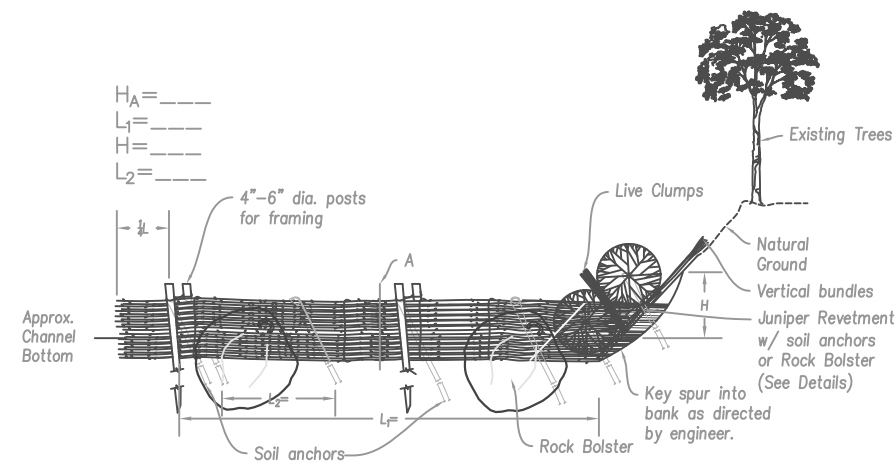
1 VEGETATIVE SPUR WITH JUNIPER REVETMENT



2 JUNIPER REVETMENT

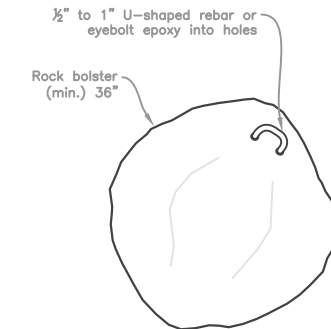
Notes (1): Trees in revetment shall be tightly secured to bank and in firm contact with spur. Trees are continuous over spur and are shown as ending only for clarity of drawing.

Notes (2): Overlap juniper by $\frac{1}{4}$ to $\frac{1}{3}$ length in a shingle-like arrangement. Secure at overlap with three wraps of 12 gage wire or $\frac{1}{8}$ " cable and clamp securely. Anchor with a minimum of two sets of soil anchors or rock bolsters per trunk as per specifications. Start at toe of bank. If additional rows are required, offset by not more than tree width. Press rows tight together. Cable rows together with 12 gage wire or $\frac{1}{8}$ " cable and clamp.



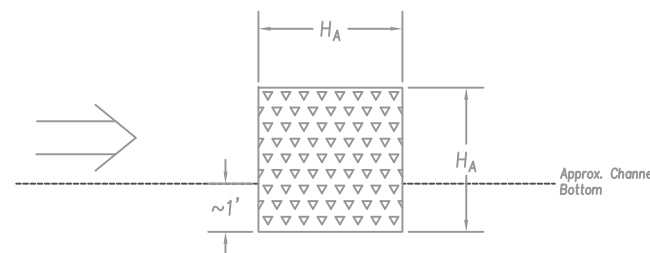
3 VEGETATED SPUR

Notes (3):
 1) Remove loose and failing bank material, excavate key into bank as shown
 2) Excavate trench along alignment of spur at depth as shown. Trench should be a minimum of $\frac{1}{4}$ thickness of vegetated spur at section A.
 3) Install two pairs of framing posts at width of spur.
 4) Place live material tightly between anchor posts. Butt ends shall be firmly into bank as length of material permits. Material shall overlap by $\frac{1}{3}$ - $\frac{1}{2}$ L.
 5) Install soil anchors in pairs or Rock Bolster as specified.
 6) Tightly secure live material to soil anchors with ratcheting cable clamps.
 7) Place vertical bundles into key area as shown. Butt ends of live material must extend firmly to soil.
 8) Backfill over key.
 9) Install juniper revetment over spur at bank if specified.



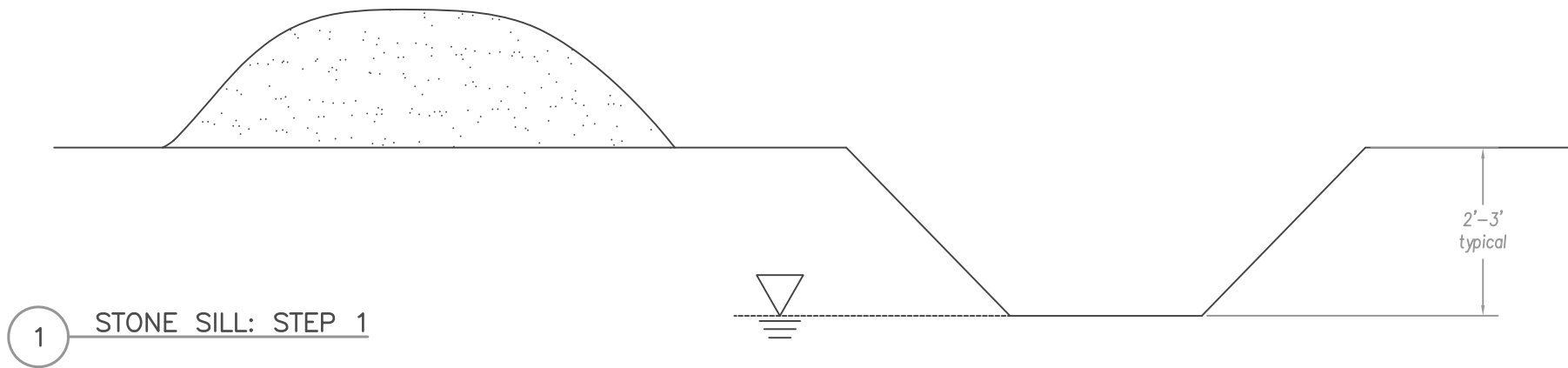
4 ROCK BOLSTER

Notes (4): Secure logs to rock bolsters at overlap with a minimum of three wraps of $\frac{1}{8}$ - $\frac{1}{4}$ " diameter galvanized non-greased, wire rope. If constructing in or near water drill holes in rock bolsters with gas or pneumatic drill. Holes must be clean of all dust, debris, oil, and soap following drilling. Insert a U-shaped 1" rebar into holes several times to dispense and completely mix epoxy and eliminate air pockets. Epoxy resin systems shall meet the requirements of ASTM C881, Type IV Grade 3. Test strength of bond after minimum cure time recommended by the epoxy manufacturer.

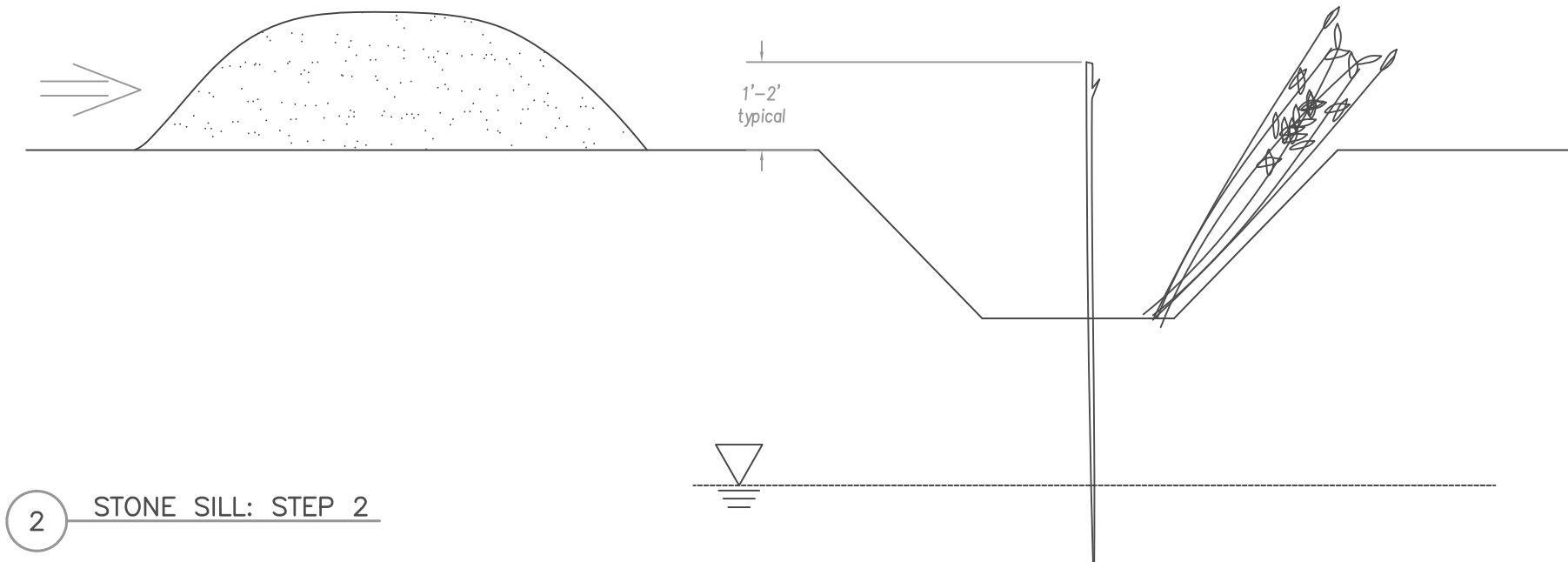


4 SECTION A

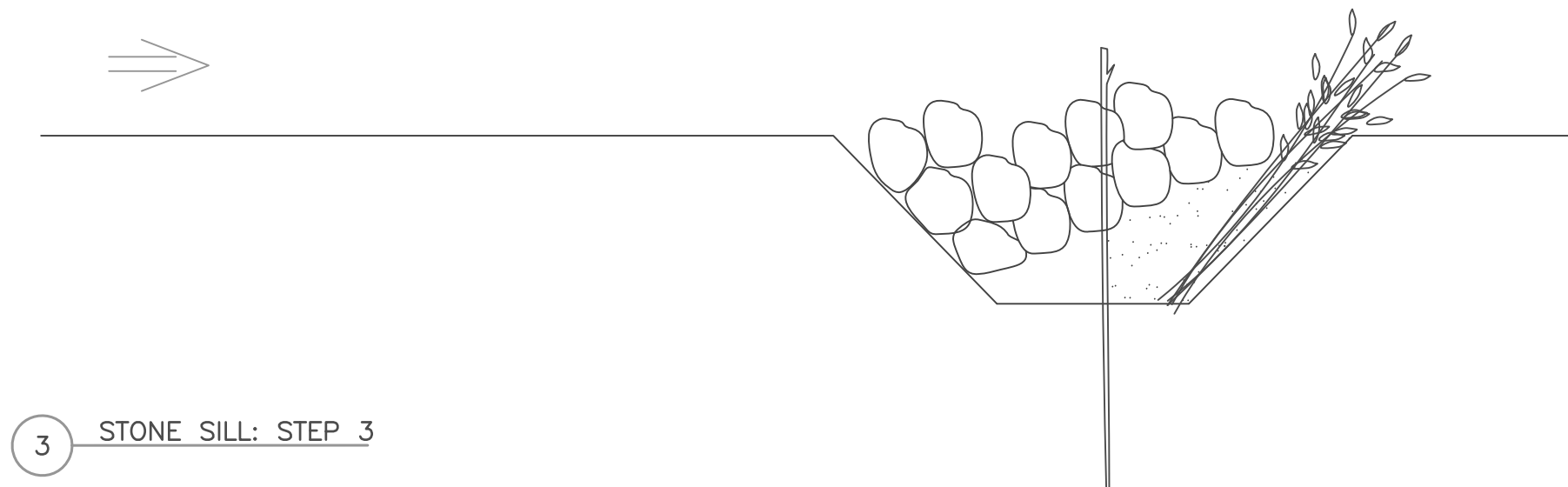
Cross-Sectional Views Describing Installation



- Notes (1):
- Excavate trench ideally to low water

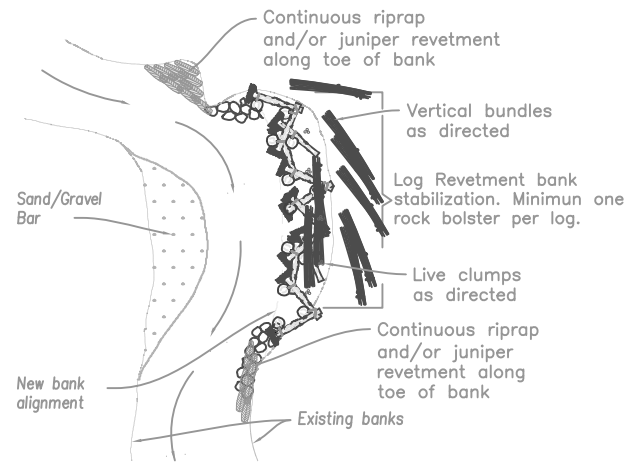


- Notes (2):
- Install live poles on 4 to 8 ft. centers if trench may not reach reliable water table.
 - Place a mix of live and dead cuttings along downstream side of trench (approximately 12-15 per ft of trench).

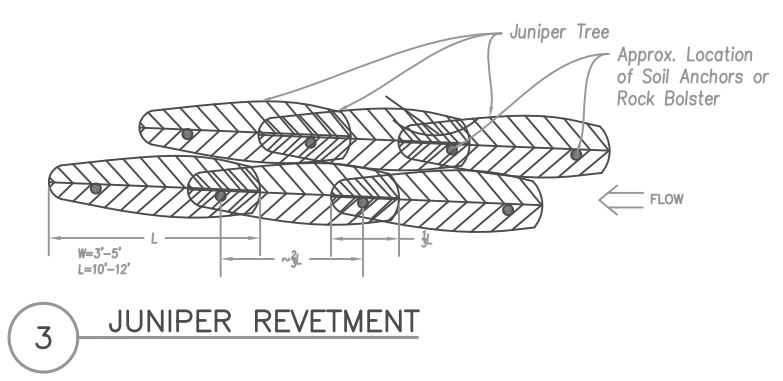


- Notes (3):
- Cover cuttings with soil and wash in to achieve good soil to stem contact.
 - Place appropriately sized stone in trench (12" minus typical). Irrigate live cuttings for establishment if trench does not reach reliable water table.

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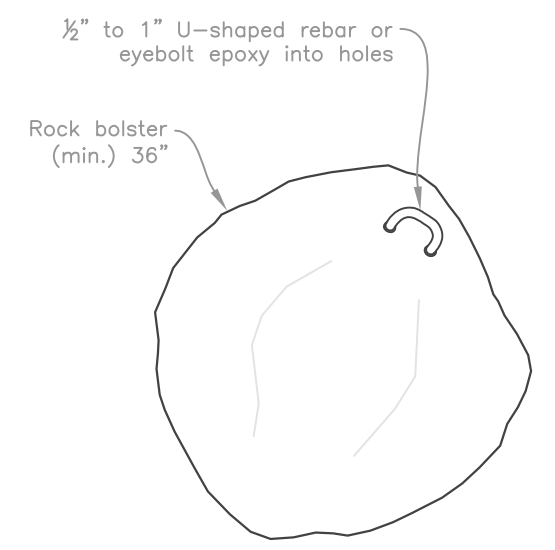


1 FULL REVETMENT LAYOUT

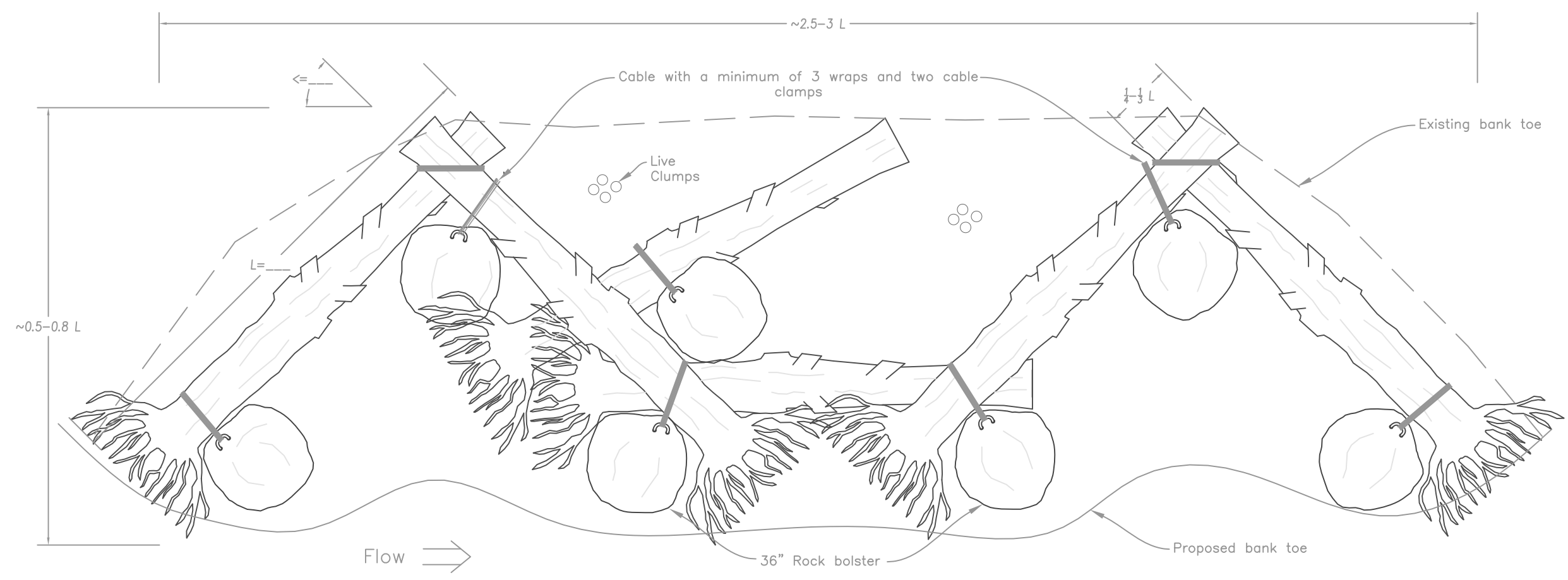


3 JUNIPER REVETMENT

Notes (3):
 Overlap juniper by 1/4 to 1/3 length in a shingle-like arrangement. Secure at overlap with three wraps of 12 gage wire or 1/8" cable and clamp securely. Anchor with a minimum of two sets of soil anchors per trunk as per specifications. Start at toe of bank. If additional rows are required, offset by not more than tree width. Press rows tight together. Cable rows together with 12 gage wire or 1/8" cable and clamp.

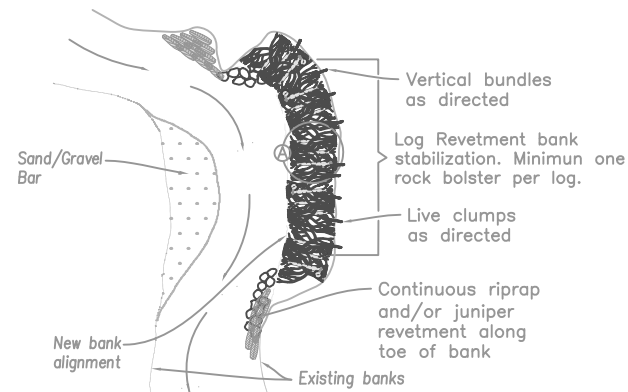


4 ROCK BOLSTER

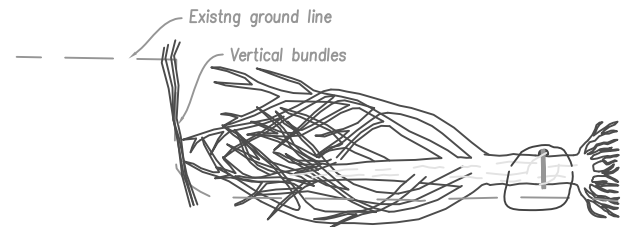


2 LOG REVETMENT

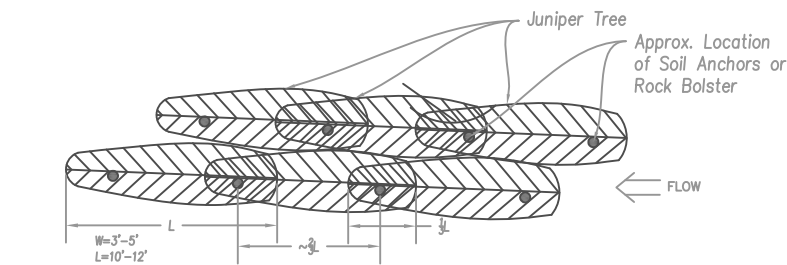
Notes (2):
 Secure logs to rock bolsters at overlap with a minimum of three wraps of 3/8" diameter galvanized non-greased, wire rope. Drill holes in rock bolsters with gas or pneumatic drill. The min. depth should be 6". Holes must be clean of all dust, debris, oil, and soap following drilling. Insert a U-shaped or eyebolt rebar into holes several times to dispense and completely mix epoxy and eliminate air pockets. Epoxy resin systems shall meet the requirements of ASTM C881, Type IV Grade 3. Test strength of bond after minimum cure time recommended by the epoxy manufacturer.



1 TREE REVETMENT FULL LAYOUT



2 CROSS-SECTION

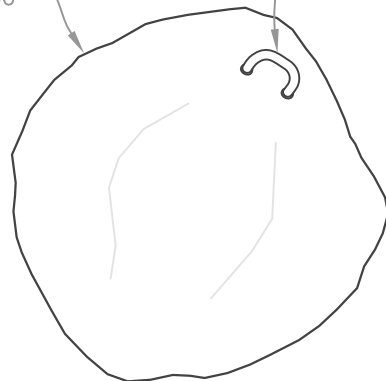


3 JUNIPER REVETMENT

Notes (3): Overlap juniper by $\frac{1}{4}$ to $\frac{1}{3}$ length in a shingle-like arrangement. Secure at overlap with three wraps of 12 gage wire or $\frac{1}{8}$ " cable and clamp securely. Anchor with a minimum of two sets of soil anchors per trunk as per specifications. Start at toe of bank. If additional rows are required, offset by not more than tree width. Press rows tight together. Cable rows together with 12 gage wire or $\frac{1}{8}$ " cable and clamp.

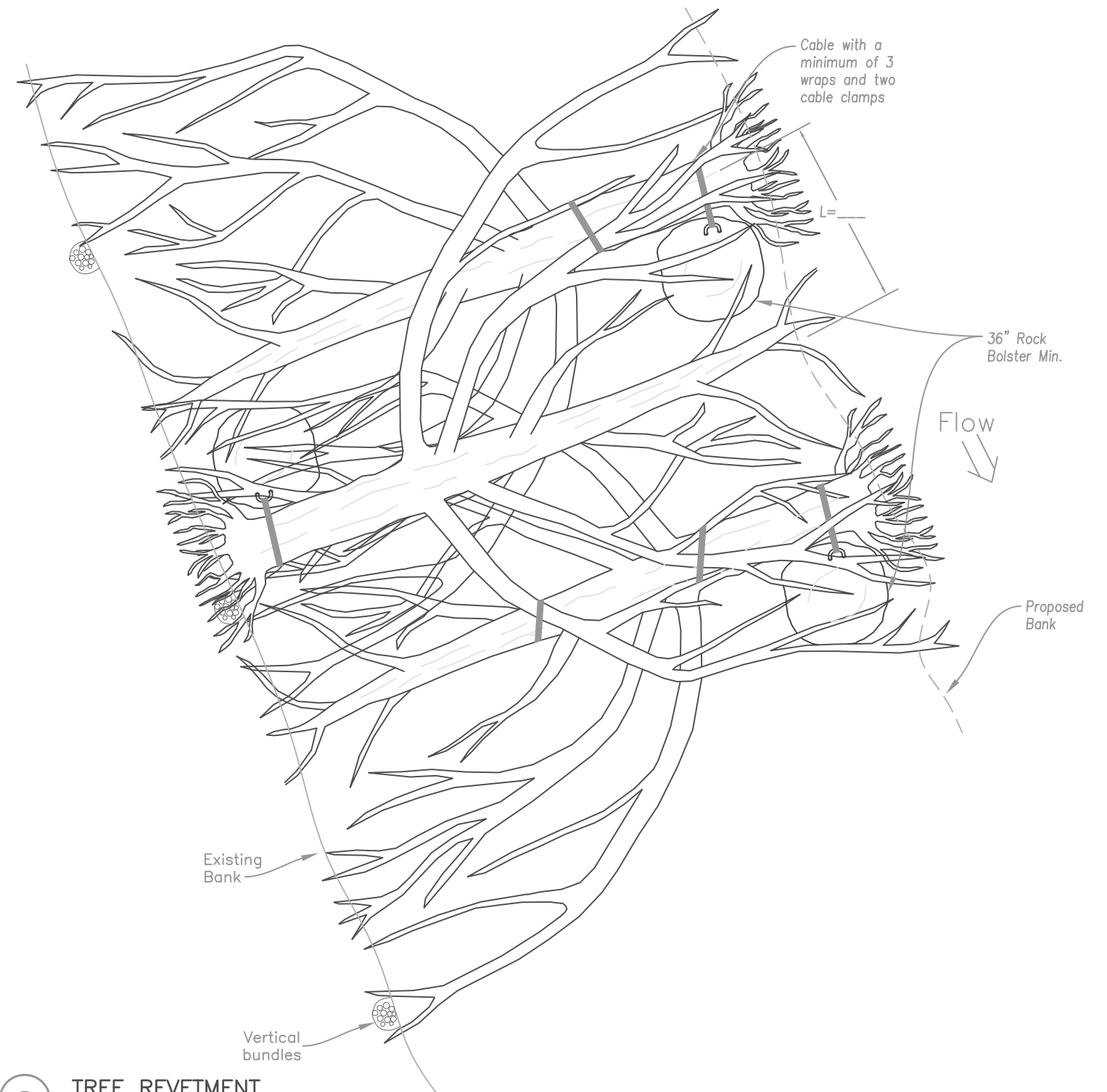
$\frac{1}{2}$ " to 1" U-shaped rebar or eyebolt epoxy into holes

Rock bolster (min.) 36"



4 ROCK BOLSTER

Notes (4): Secure to rock bolsters at overlap with a minimum of three wraps of $\frac{1}{8}$ - $\frac{1}{4}$ " diameter galvanized non-greased, wire rope. If constructing in or near water drill holes in rock bolsters with gas or pneumatic drill. Holes must be clean of all dust, debris, oil, and soap following drilling. Insert a U-shaped 1" rebar into holes several times to dispense and completely mix epoxy and eliminate air pockets. Epoxy resin systems shall meet the requirements of ASTM C881, Type IV Grade 3. Test strength of bond after minimum cure time recommended by the epoxy manufacturer.



5 TREE REVETMENT

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