



**STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION**

ROADWAY DESIGN DIVISION
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INSTRUCTIONAL BULLETIN NO. 17-3

**Regarding Revised, New and Voided Standard Drawings and Revised Chapter 5 of the
Roadway Design Guidelines**

Effective May 12, 2017 letting (March 1, 2017 Turn-in), the following Standard Drawings have either been revised, are new, or have been voided. Also, Chapter 5 of the Roadway Design Guidelines has been revised to incorporate these changes.

Revised Standard Drawings with New Title:

DRAWING NUMBER	CURRENT REVISION DATE	DESCRIPTION
D-NSD-13	11-01-16	LONGITUDINAL STONE TOE

New Standard Drawings:

DRAWING NUMBER	CURRENT REVISION DATE	DESCRIPTION
D-NSD-21		BOULDER CLUSTERS
D-NSD-22		BOULDER CROSS VANE
D-NSD-23		BOULDER CROSS VANE WITH STEP
D-NSD-24		BOULDER W-WEIR
D-NSD-25		BOULDER VANES AND J-HOOK
D-NSD-26		LOG VANES, ROOT WADS, AND BOULDER J-HOOK
D-NSD-27		LOG AND BOULDER STEP POOLS
D-NSD-28		LOG AND BOULDER RIFFLES
D-NSD-28A		LOG AND BOULDER RIFFLES

D-NSD-29	CONSTRUCTED ALLUVIAL RIFFLE
D-NSD-30	SUBSTRATE RESTORATION
D-NSD-31	CLAY CHANNEL PLUG
D-NSD-32	WOOD AND BOULDER TOE WITH GEO-LIFTS
D-NSD-32A	WOOD AND BOULDER TOE WITH GEO-LIFTS
D-NSD-33	COIR FIBER EROSION CONTROL BLANKET AND COIR FIBER ROLLS
D-NSD-34	LIVE STAKES AND LIVE SILTATION
D-NSD-35	LIVE FASCINES
D-NSD-36	BRUSH MATTRESS
D-NSD-37	SPECIAL NOTES FOR NATURAL STREAM DESIGN

Voided Standard Drawings:

DRAWING NUMBER	CURRENT REVISION DATE	DESCRIPTION
D-NSD-1 (Above replaced with D-NSD-21)		BOULDER CLUSTERS
D-NSD-2 (Above replaced with D-NSD-22)		ROCK VANES
D-NSD-3		LOG DEFLECTORS
D-NSD-4 (Above replaced with D-NSD-27)		LOG DROPS AND STEP POOLS
D-NSD-5 (Above replaced with D-NSD-28 and D-NSD-28A)		BOULDER RIFFLES
D-NSD-6 (Above replaced with D-NSD-29)		CONSTRUCTED RIFFLES
D-NSD-7 (Above replaced with D-NSD-33)		COCONUT FIBER ROLLS AND LIVE SILTATION
D-NSD-8 (Above replaced with D-NSD-34 and d-nsd-35)		LIVE FASCINES AND WILLOW CUTTINGS
D-NSD-9 (Above replaced with D-NSD-36)		BRUSH MATTRESS
D-NSD-10		LARGE WOODY DEBRIS
D-NSD-11		VEGETATED RIPRAP AND GABIONS
D-NSD-12		VEGETATED MSE WALLS

The revised and new standard drawings and revised Chapter 5 of the Roadway Design Guidelines are available online.

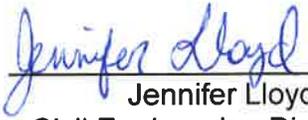
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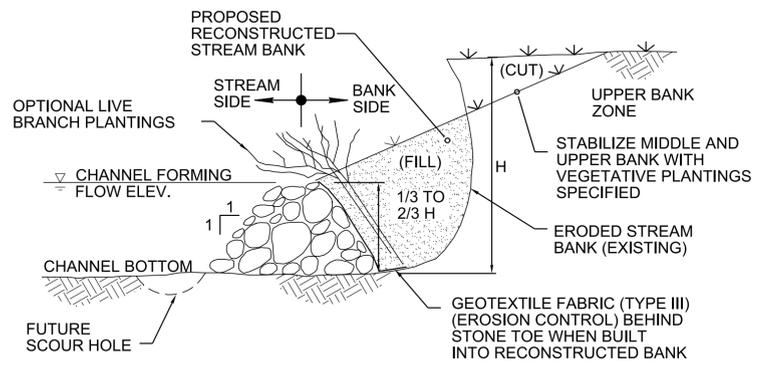
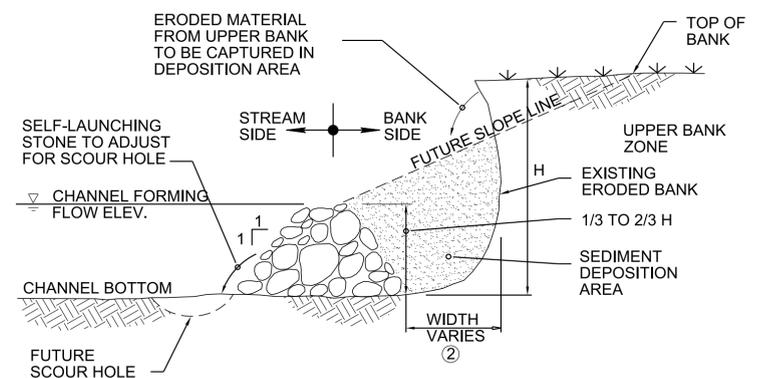
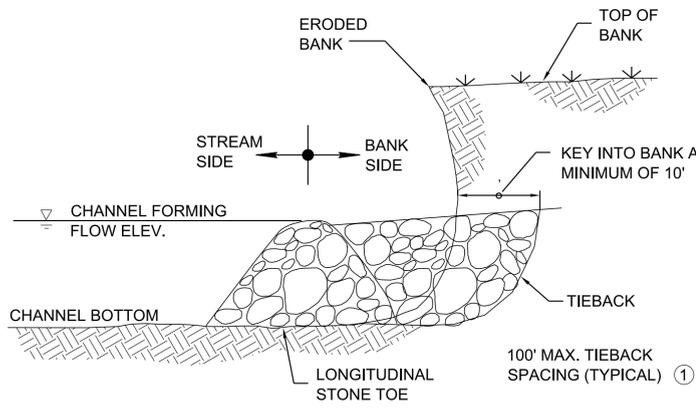
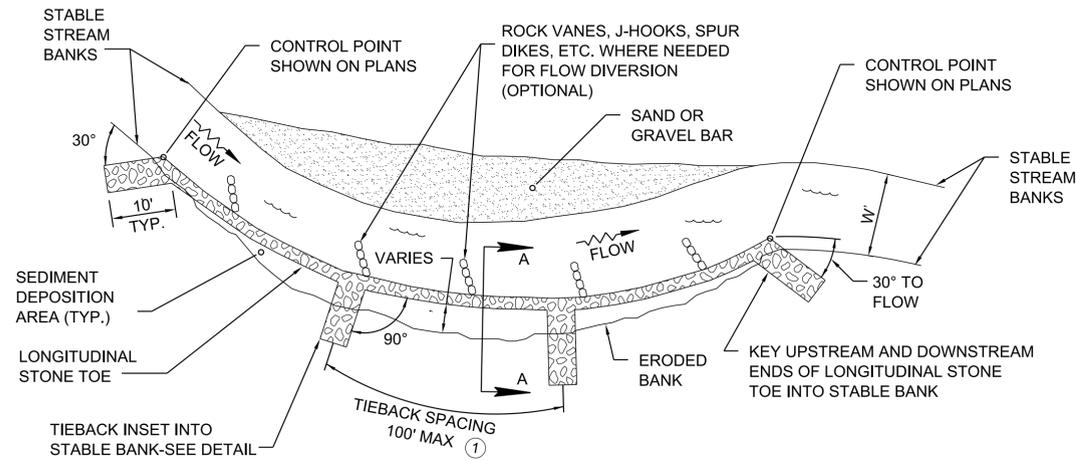
<http://www.tn.gov/tdot/section/chief-engineer-design-standard-drawings-library>

Roadway Design Guidelines:

<http://www.tn.gov/tdot/topic/chief-engineer-design-design-guidelines>

This IB voids IB-16-12 & IB-16-15.


Jennifer Lloyd, PE
Civil Engineering Director
Roadway Design Division



- FOOTNOTES**
- (1) FOR LARGER STREAMS OR RIVERS, TIEBACKS SHALL BE SPACED AT 2X THE CHANNEL FORMING FLOW WIDTH (W)
 - (2) BANKSIDE WIDTH VARIES TO PROVIDE SMOOTH ALIGNMENT THROUGH THE CHANNEL BEND

- LONGITUDINAL STONE TOE NOTES**
- (A) LONGITUDINAL STONE TOE IS A LOWER BANK STABILIZATION MEASURE THAT IS PLACED AT THE TOE OF AN ERODING BANK, OR STREAM SIDE OF THE TOE, TO PROVIDE HARD ARMORING AGAINST FURTHER EROSION, PROVIDE AN AREA FOR SEDIMENT DEPOSITION AND NATURAL RECONSTRUCTION OF THE TOE, AND ENCOURAGE THE GROWTH OF ADDITIONAL VEGETATION AS THE BANK SLOPE STABILIZES.
 - (B) LONGITUDINAL STONE TOE IS ACCEPTABLE FOR USE IN STABLE ALLUVIAL CHANNELS WHERE THE LOWER BANK IS FAILING BUT THE MID AND UPPER SLOPES ARE FAIRLY STABLE.
 - (C) USE OF THIS IN-STREAM MEASURE SHALL NOT ADVERSELY AFFECT THE HYDRAULIC CAPACITY OF THE CHANNEL.
 - (D) LONGITUDINAL STONE TOE SHOULD NOT BE USED IN BEDROCK CHANNELS.
 - (E) LONGITUDINAL STONE TOE MAY BE USED IN COMBINATION WITH OTHER HYDRAULIC CONTROL STRUCTURES (J-HOOKS, VANES, ETC.), AND MOST OTHER BANK STABILIZATION MEASURES.
 - (F) MACHINED RIPRAP CLASS SELECTED FOR CONSTRUCTING LONGITUDINAL STONE TOE SHALL BE SELECTED BASED ON CRITERIA IN SECTION 11.04.6 OF THE DRAINAGE MANUAL.
 - (G) WHEN THE STONE TOE IS BUILT INTO A RECONSTRUCTED BANK, GEOTEXTILE (TYPE III) (EROSION CONTROL) SHALL BE PLACED BEHIND THE ROCK TO PREVENT SOIL MIGRATION THROUGH THE STRUCTURE.
 - (H) THE TOP ELEVATION OF THE STRUCTURE SHALL BE NO LOWER THAN THE CHANNEL FORMING FLOW ELEVATION OF THE STREAM.
 - (I) ACCESS TO THE STREAMBANK AREA SHALL BE PROVIDED FOR HEAVY EQUIPMENT, MONITORING, AND MAINTENANCE.
 - (J) ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED.
 - (K) LONGITUDINAL STONE TOE SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBERS:
209-03.47 STREAM MITIGATION - LONGITUDINAL STONE TOE (DESCRIPTION) PER CUBIC YARD.
740-10.03 GEOTEXTILE (TYPE III) (EROSION CONTROL) PER SQUARE YARD
 - (L) LIVE BRANCH PLANTINGS SHALL BE PAID FOR ACCORDING TO THEIR RESPECTIVE ITEM NUMBERS.
 - (M) PAYMENT FOR LONGITUDINAL STONE TOE SHALL INCLUDE ALL MATERIALS AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE TOE PROTECTION SYSTEM.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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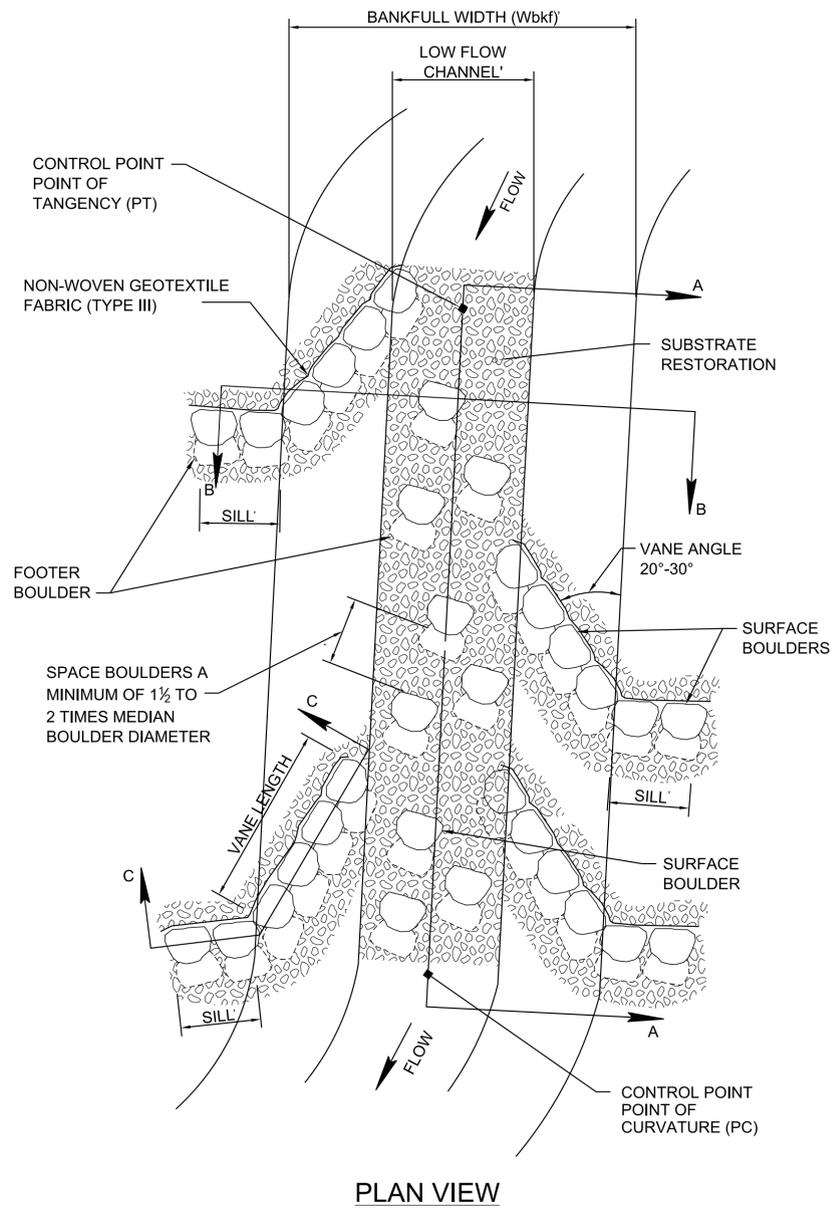
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LONGITUDINAL
STONE TOE

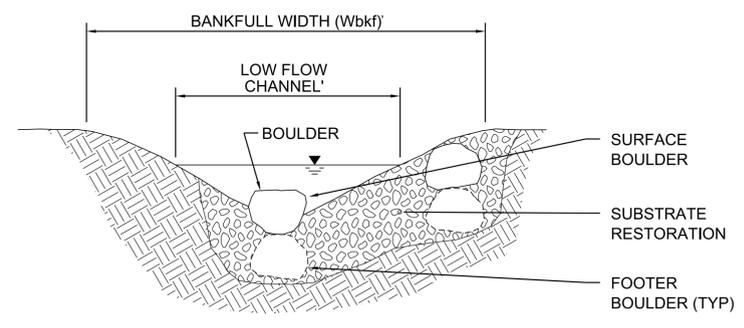
STREAM MITIGATION PLAN LEGEND: ○○○○ TOE ○○○○ TOE ○○○○ TOE ○○○○ LONGITUDINAL STONE TOE

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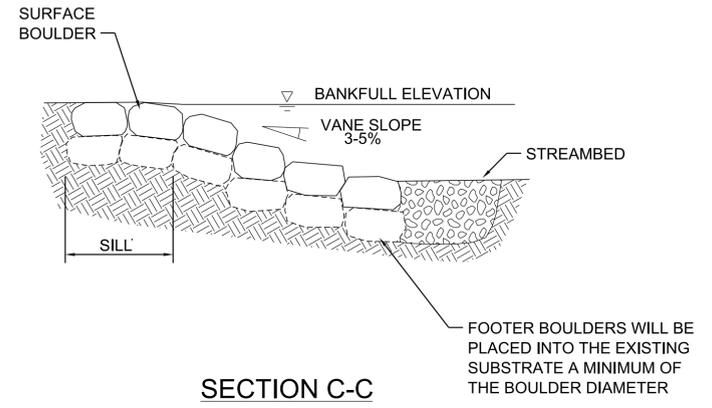
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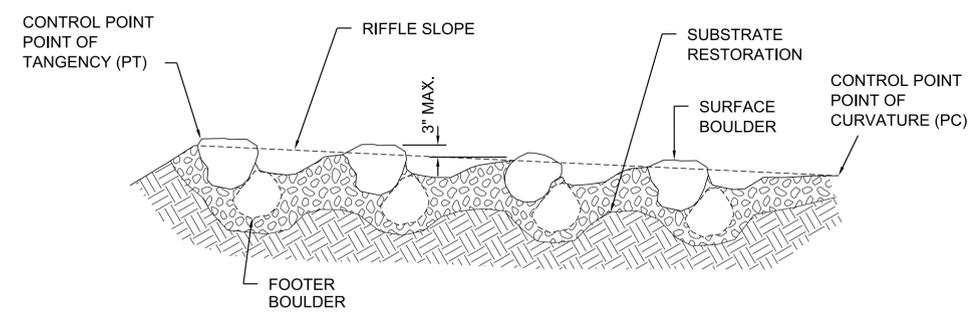
PLAN VIEW



SECTION B-B



SECTION C-C



SECTION A-A

STREAM MITIGATION PLAN LEGEND: BOULDER CLUSTERS

BOULDER CLUSTER NOTES

- (A) CONVERGING BOULDER CLUSTERS ARE HABITAT ENHANCEMENT MEASURES CONSISTING OF A GROUP OF ONE OR MORE LARGE IMMOBILE BOULDERS ARRANGED IN RIFFLE-RUN HABITATS TO CREATE AREAS OF CONCENTRATED CONVERGENT FLOW. THEY SHOULD ONLY BE USED WITH BOULDER MINI-VANES, WHICH PROTECT THE ADJACENT STREAM BANK FROM SCOUR BY REDUCING NEAR-BANK SHEAR STRESS.
- (B) BOULDER CLUSTERS AND MINI-VANES SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND CONFIGURATION INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BEGINNING AND ENDING STATIONS OF THE CONVERGING BOULDER CLUSTERS, THE BANKFULL WIDTH, MEDIAN BOULDER SIZE, VANE AND SILL LENGTHS, SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (E) SURFACE BOULDERS IN BOULDER CLUSTERS SHOULD PROTRUDE A MAXIMUM OF 3 INCHES ABOVE THE RIFFLE SLOPE.
- (F) THE MAXIMUM AMOUNT OF DROP FROM ONE MINI-VANE TO THE NEXT SHALL BE NO GREATER THAN THE HEIGHT SPECIFIED ON THE PROPOSED PROFILE. THE COMBINED AMOUNT OF DROP OVER ALL THE MINI-VANES SHALL NOT EXCEED THE TOTAL AMOUNT OF FALL IN THE RIFFLE SLOPE. THE MINI-VANES AT THE TOP AND BOTTOM OF THE TANGENT SECTIONS SHOULD BE PLACED ON THE OUTSIDE BANK OF THE ADJACENT MEANDER.
- (H) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS IN THE MINI-VANE BOULDERS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (I) CONSTRUCT BOULDER CLUSTERS AND MINI-VANES BY:
 - (1) FIRST SHAPE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADE AND DIMENSIONS.
 - (2) NEXT, EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS FOR MINI-VANES, THE NON-WOVEN GEOTEXTILE FABRIC (TYPE III), AND SELECT MATERIAL FOR BACKFILL AND SUBSTRATE REPLACEMENT.
 - (3) PLACE FOOTER AND SURFACE BOULDERS AT THE INVERTS SPECIFIED IN THE PLANS AND THEN CHECK THE ELEVATIONS OF THE INVERTS WITH SURVEY EQUIPMENT. FOR MINI-VANES, PLACE BOULDERS TO MINIMIZE VOIDS AND TO PRODUCE A SMOOTH COMPACT SURFACE.
 - (4) ONCE THE INVERTS HAVE BEEN ESTABLISHED, FILL THE VOIDS BETWEEN BOULDERS ON THE UPSTREAM SIDE OF THE STRUCTURE.
 - (5) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF THE MINI-VANES, EXTENDING FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED.
 - (6) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE). OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE MINI-VANES. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
 - (7) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (J) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ONSITE CONSTRUCTION OBSERVER.
- (K) BOULDER CLUSTERS SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 209-03.32 STREAM MITIGATION - BOULDER CLUSTER W/ MINI-VANE PER LINEAR FOOT OF STREAM CENTER LINE
 PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE BOULDER CLUSTERS AND MINI-VANES.

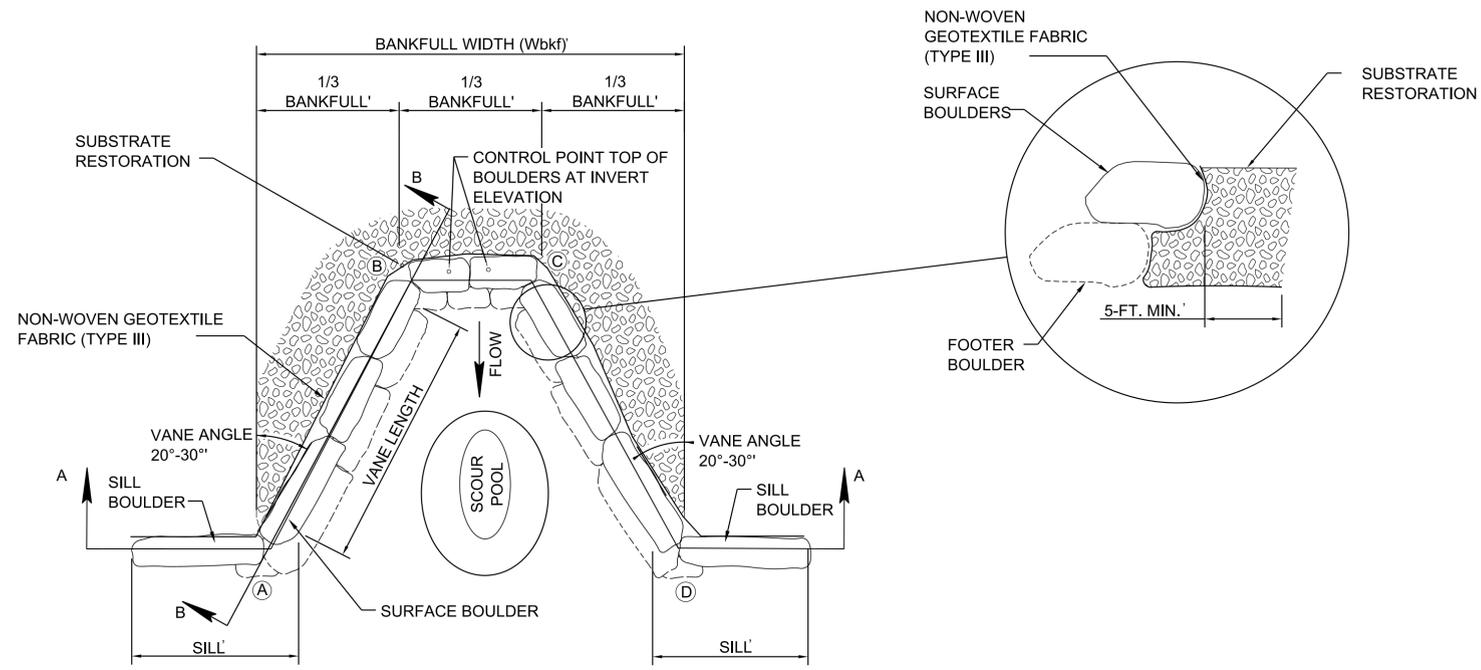
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NOT TO SCALE

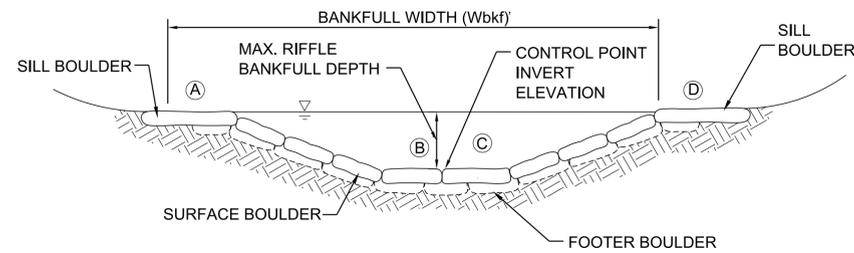
STATE OF TENNESSEE
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BOULDER
CLUSTERS

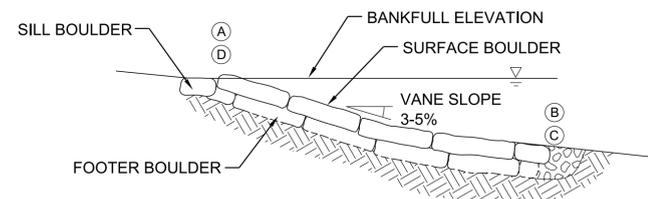
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PLAN VIEW



SECTION A-A



SECTION B-B

STREAM MITIGATION PLAN LEGEND:



BOULDER CROSS VANE

BOULDER CROSS VANE NOTES

- (A) BOULDER CROSS VANES ARE HYDRAULIC AND GRADE CONTROL MEASURES THAT ARE USED TO DIRECT FLOW AWAY FROM THE CHANNEL BANK, CONCENTRATE FLOWS INTO THE CENTER OF THE CHANNEL, AND ENHANCE HABITAT. THEY ARE COMMONLY USED FOR GRADE CONTROL AT THE UPSTREAM AND DOWNSTREAM EXTENT OF STREAM RESTORATION REACHES AND UPSTREAM OF PLANNED RIFFLES TO AID IN RIFFLE DEVELOPMENT AND MAINTENANCE.
- (B) BOULDER CROSS VANES SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND CONFIGURATION INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH, MEDIAN BOULDER SIZE, VANE AND SILL LENGTHS, AND INVERT ELEVATION, SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (E) THE WEIR OF THE BOULDER CROSS VANE IS TYPICALLY LOCATED IN THE CENTER THIRD OF THE STREAM CHANNEL, UNLESS THE STRUCTURE IS DESIGNED WITH OFF-SET VANES TO CONFORM TO BENDS IN THE CHANNEL. THE SURFACE BOULDERS COMPRISING THE WEIR ARE SET AT THE INVERT ELEVATION OF THE STRUCTURE.
- (F) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS IN THE VANE BOULDERS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (G) CONSTRUCT BOULDER CROSS VANE STRUCTURES BY:
 - (1) FIRST SHAPE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADE AND DIMENSIONS.
 - (2) NEXT, EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III) AND SELECT MATERIAL FOR BACKFILL AND SUBSTRATE REPLACEMENT.
 - (3) PLACE FOOTER BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT AND THEN USE SURVEY EQUIPMENT TO CHECK THE ELEVATIONS OF THE INVERTS IN ACCORDANCE WITH THE STREAM MITIGATION PLANS.
 - (4) ONCE THE INVERTS HAVE BEEN ESTABLISHED, THE REMAINDER OF THE FOOTER AND SURFACE BOULDERS SHALL BE PLACED, MINIMIZING VOIDS.
 - (5) FILL THE VOIDS BETWEEN BOULDERS ON THE UPSTREAM SIDE OF THE STRUCTURE.
 - (6) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF THE STRUCTURE, EXTENDING FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED.
 - (7) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
 - (8) ONCE THE STRUCTURE IS INSTALLED, EXCAVATE SCOUR POOL AND PLACE SELECT MATERIAL AS REQUIRED.
 - (9) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (H) THE SURFACE OF CROSS VANES SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS SECTIONS OR ELEVATIONS SHOWN ON THE PLANS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.10 FOOT OF THE GRADES AND ELEVATIONS INDICATED, OR AS DIRECTED BY THE ENGINEER. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH SELECT MATERIAL TO FORM A TIGHT-FITTING SEAL.
- (I) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (J) BOULDER CROSS VANES SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 209-03.37 STREAM MITIGATION - CROSS VANE STRUCTURE PER EACH
 PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE BOULDER CROSS VANE.

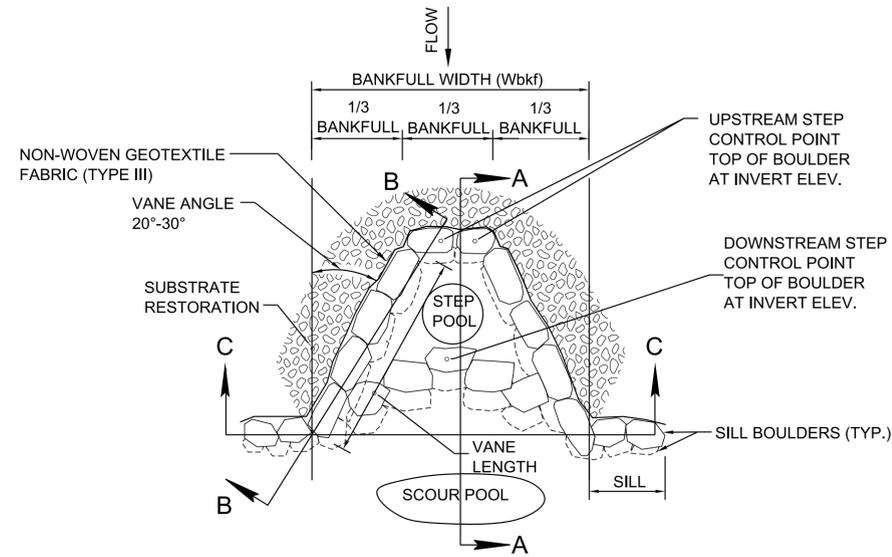
MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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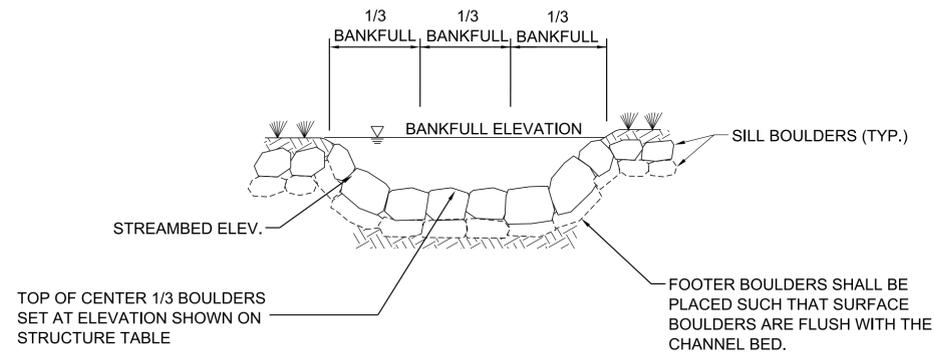
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BOULDER
CROSS VANE

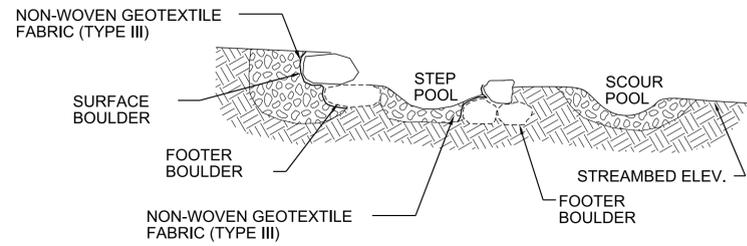
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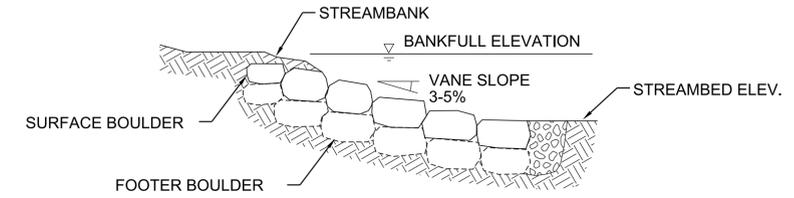
PLAN VIEW



SECTION C-C



SECTION A-A



SECTION B-B

BOULDER CROSS VANE WITH STEP NOTES

- (A) BOULDER CROSS VANES WITH STEPS ARE HYDRAULIC AND GRADE CONTROL MEASURES THAT ARE USED TO DIRECT FLOW AWAY FROM THE CHANNEL BANK, CONCENTRATE FLOWS INTO THE CENTER OF THE CHANNEL, AND ENHANCE HABITAT. THE ADDITION OF A STEP HELPS REDUCE THE ELEVATION DROP ACROSS THE STRUCTURE, THEREBY DISSIPATING ENERGY AND PROMOTING PASSAGE BY AQUATIC ORGANISMS.
- (B) BOULDER CROSS VANES WITH STEPS SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND CONFIGURATION INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH, MEDIAN BOULDER SIZE, VANE AND SILL LENGTHS, AND INVERT ELEVATIONS OF THE WEIR AND STEP, SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (E) THE WEIR AND THE STEP OF THE BOULDER CROSS VANE WITH STEP ARE TYPICALLY LOCATED IN THE CENTER THIRD OF THE STREAM CHANNEL, UNLESS THE STRUCTURE IS DESIGNED WITH OFF-SET VANES TO CONFORM TO BENDS IN THE CHANNEL. THE SURFACE BOULDERS COMPRISING THE WEIR AND STEP ARE SET AT THE INVERT ELEVATIONS OF THE STRUCTURE. THE STEP INVERT SHOULD BE AT OR ABOVE THE TOP OF THE UPSTREAM FOOTER BOULDER.
- (F) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS IN THE VANE BOULDERS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (G) CONSTRUCT BOULDER CROSS VANE WITH STEP STRUCTURES BY
 - (1) FIRST SHAPE THE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) NEXT, EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III) AND SELECT MATERIAL FOR BACKFILL AND SUBSTRATE REPLACEMENT.
 - (3) PLACE FOOTER BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERTS OF THE WEIR AND STEP, AND THEN USE SURVEY EQUIPMENT TO CHECK THE ELEVATIONS OF THE INVERTS IN ACCORDANCE WITH THE STREAM MITIGATION PLANS.
 - (4) ONCE THE INVERTS HAVE BEEN ESTABLISHED, THE REMAINDER OF THE FOOTER AND SURFACE BOULDERS SHALL BE PLACED, MINIMIZING VOIDS.
 - (5) FILL THE VOIDS BETWEEN BOULDERS ON THE UPSTREAM SIDE OF THE STRUCTURE.
 - (6) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF THE STRUCTURE, EXTENDING FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED.
 - (7) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
 - (8) ONCE THE STRUCTURE IS INSTALLED, EXCAVATE SCOUR POOL AND PLACE SELECT MATERIAL AS REQUIRED.
 - (9) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (H) THE SURFACE OF CROSS VANE WITH STEP STRUCTURE SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS SECTIONS OR ELEVATIONS SHOWN ON THE PLANS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.10 FOOT OF THE GRADES AND ELEVATIONS INDICATED, OR AS DIRECTED BY THE ENGINEER. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH SELECT MATERIAL TO FORM A TIGHT-FITTING SEAL.
- (I) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (J) BOULDER CROSS VANES WITH STEPS SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 209-03.54 STREAM MITIGATION - CROSS VANE STRUCTURE WITH STEP PER EACH
 PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE BOULDER CROSS VANE WITH STEP.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

NOT TO SCALE

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BOULDER CROSS
VANE WITH STEP

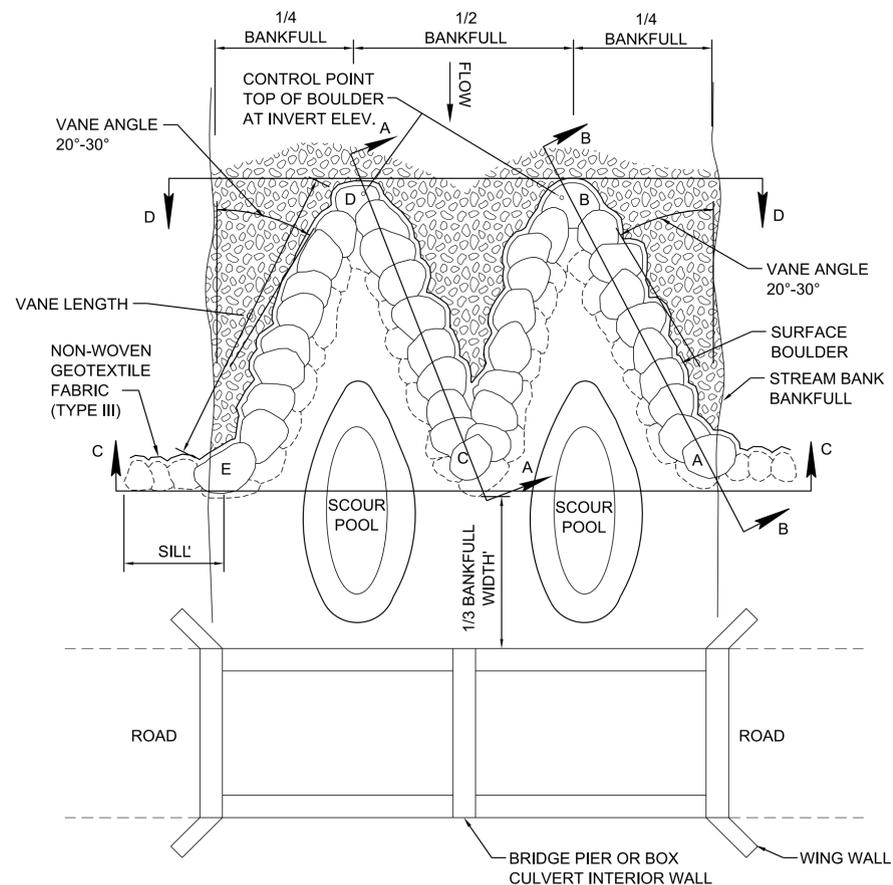
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STREAM MITIGATION PLAN LEGEND:

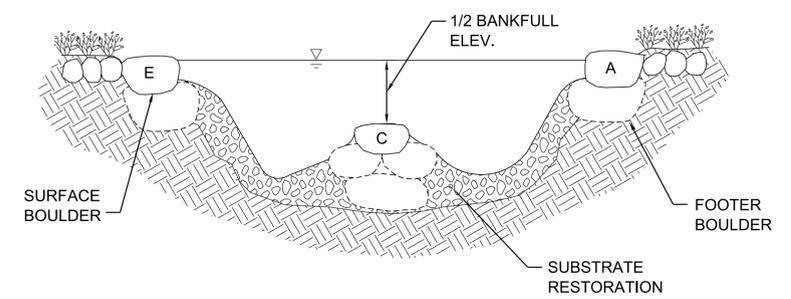


BOULDER CROSS VANE WITH STEP

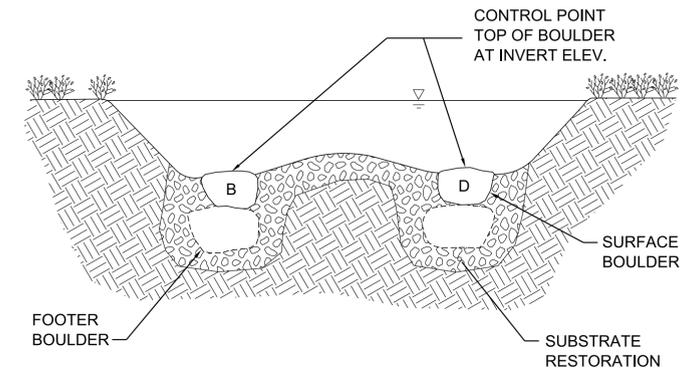
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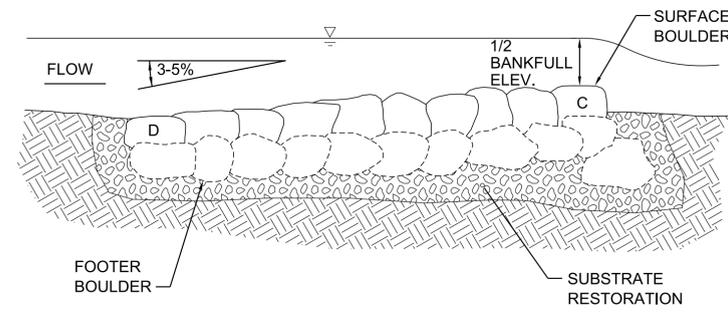
PLAN VIEW



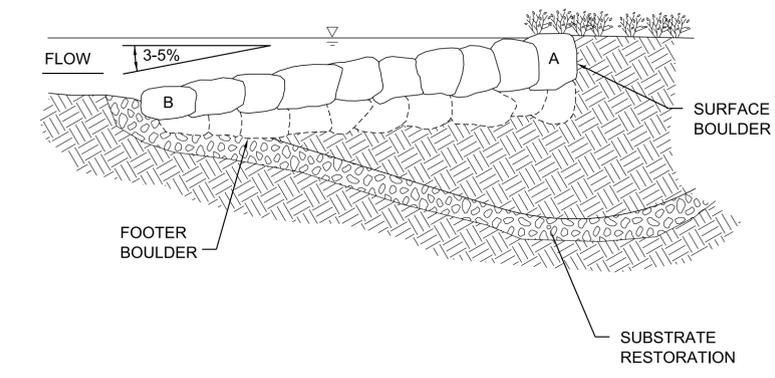
SECTION C-C



SECTION D-D



SECTION A-A



SECTION B-B

BOULDER W-WEIR NOTES

- (A) BOULDER W-WEIRS ARE HYDRAULIC AND GRADE CONTROL MEASURES THAT ARE USED ON LARGER RIVERS TO DIRECT FLOW AWAY FROM THE CHANNEL BANK AND BRIDGE ABUTMENTS, CONCENTRATE FLOW INTO THE CENTER HALVES OF THE CHANNEL, AND ENHANCE HABITAT AND RECREATIONAL USE BY BOATERS.
- (B) BOULDER W-WEIRS SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND CONFIGURATION INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH, MEDIAN BOULDER SIZE, VANE AND SILL LENGTHS, WIDTHS AND INVERT ELEVATIONS OF THE VERTICES, SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (E) THE UPSTREAM VERTICES OF THE BOULDER W-WEIR ARE TYPICALLY LOCATED IN THE CENTER OF EACH HALF OF THE STREAM CHANNEL AND THE DOWNSTREAM VERTEX IS TYPICALLY LOCATED IN THE CENTER OF THE CHANNEL, UNLESS THE STRUCTURE IS DESIGNED WITH OFF-SET VANES TO CONFORM TO BENDS IN THE CHANNEL OR THE LOCATION OF DOWNSTREAM BRIDGE ABUTMENTS OR OTHER PHYSICAL OBSTRUCTIONS. THE SURFACE BOULDERS COMPRISING THE UPSTREAM VERTICES ARE SET AT THE INVERT ELEVATIONS OF THE STRUCTURE.
- (F) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS IN THE VANE BOULDERS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (G) CONSTRUCT BOULDER W-WEIR STRUCTURES BY:
 - (1) FIRST SHAPE CHANNEL AND FLOODPLAN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) NEXT, EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III) AND GRAVEL OVERLAY.
 - (3) PLACE FOOTER BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT FOR THE UPSTREAM VERTICES AND THEN USE SURVEY EQUIPMENT TO CHECK THE ELEVATIONS OF THE INVERTS IN ACCORDANCE WITH THE STREAM MITIGATION PLANS.
 - (4) ONCE THE INVERTS HAVE BEEN ESTABLISHED, THE REMAINDER OF THE FOOTER AND SURFACE BOULDERS SHALL BE PLACED, MINIMIZING VOIDS.
 - (5) FILL THE VOIDS BETWEEN BOULDERS ON THE UPSTREAM SIDE OF THE STRUCTURE.
 - (6) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF THE STRUCTURE, EXTENDING FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED.
 - (7) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
 - (8) ONCE THE STRUCTURE IS INSTALLED, EXCAVATE SCOUR POOL AND PLACE SELECT MATERIAL AS REQUIRED.
 - (9) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (H) THE SURFACE OF THE BOULDER W-WEIR VANE ARMS SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS SECTIONS OR ELEVATIONS SHOWN ON THE PLANS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.10 FOOT OF THE GRADES AND ELEVATIONS INDICATED, OR AS DIRECTED BY THE ENGINEER. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH SELECT MATERIAL TO FORM A TIGHT-FITTING SEAL.
- (I) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (J) BOULDER W-WEIR SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 209-03.39 STREAM MITIGATION - W-WEIR PER EACH
 PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE BOULDER W-WEIR.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

NOT TO SCALE

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BOULDER
 W-WEIR

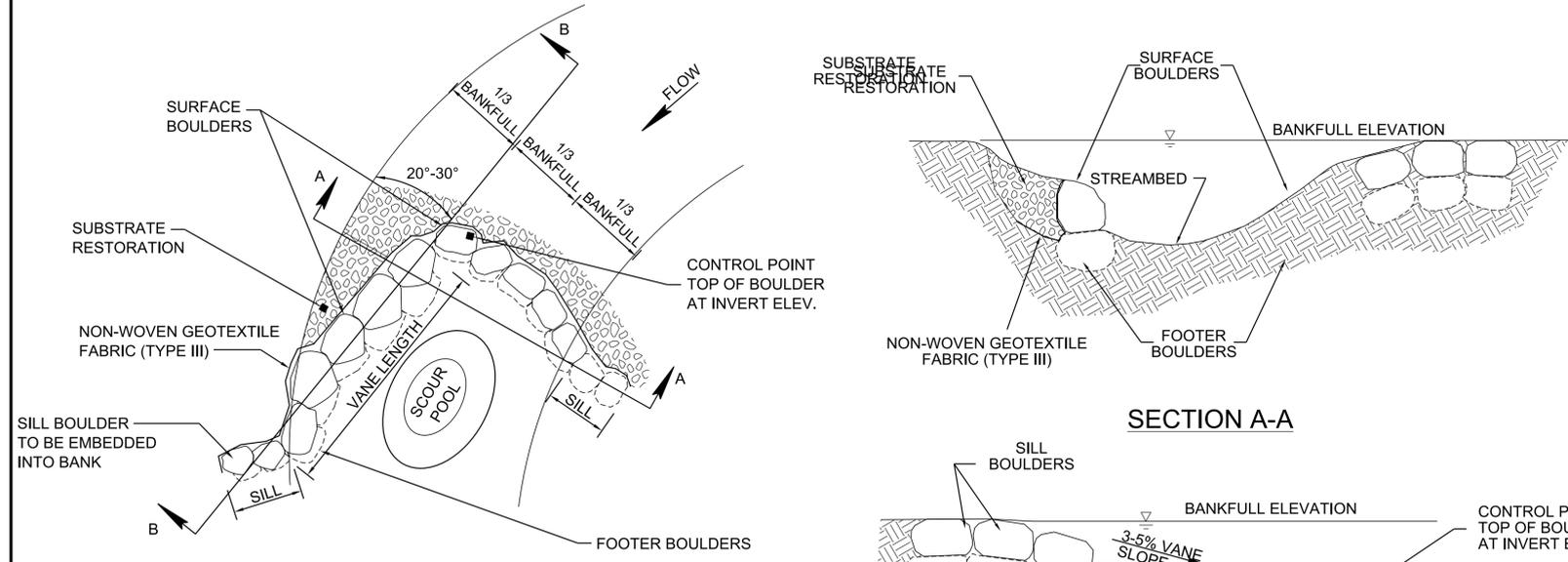
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STREAM MITIGATION PLAN LEGEND:



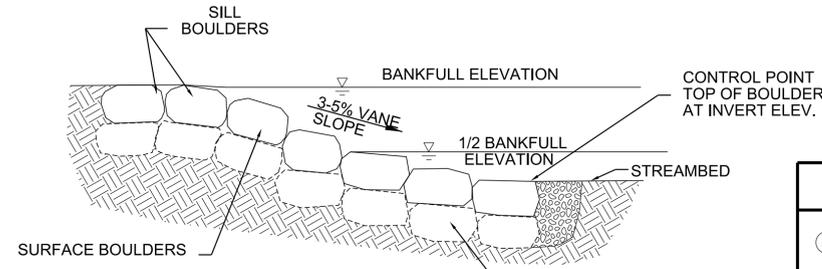
BOULDER W-WIER

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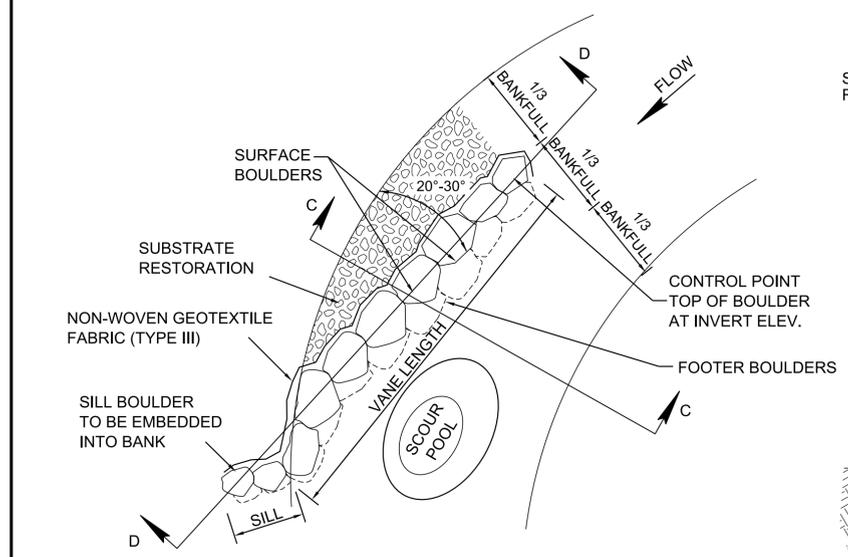


**BOULDER VANE AND J-HOOK
PLAN VIEW**

SECTION A-A

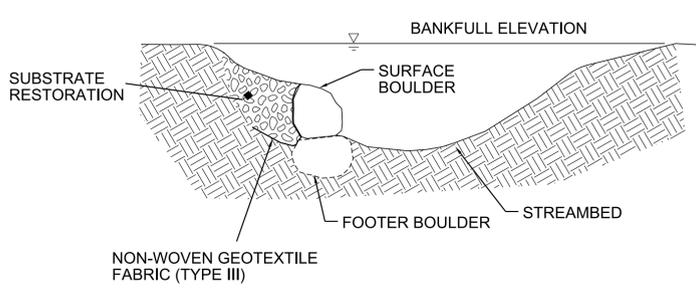


SECTION B-B



**BOULDER VANE
PLAN VIEW**

SECTION C-C



SECTION D-D

BOULDER VANES AND J-HOOK NOTES

- (A) BOULDER VANES AND BOULDER VANES WITH J-HOOKS ARE HYDRAULIC MEASURES THAT ARE USED ALONG THE OUTSIDE BANKS OF MEANDER BENDS TO DIRECT FLOW AWAY FROM THE STREAM BANK, CONCENTRATE FLOWS INTO THE CENTER OF THE CHANNEL, AND ENHANCE HABITAT. WHEN BOULDER J-HOOKS ARE USED IN COMBINATION WITH BOULDER VANES, THEY ALSO PROVIDE GRADE CONTROL.
- (B) BOULDER VANES AND J-HOOKS SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND CONFIGURATION INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH; MEDIAN BOULDER SIZE; VANE, J-HOOK, AND SILL LENGTHS AND INVERT ELEVATIONS; SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (E) THE BOULDER J-HOOK SHOULD BE CONSTRUCTED FROM THE END OF THE BOULDER VANE, ACROSS THE REMAINING TWO-THIRDS OF THE BANKFULL CHANNEL, TERMINATING WITH A BOULDER SILL. THE SURFACE BOULDERS IN THE CENTER OF THE J-HOOK ARE SET AT THE INVERT ELEVATION OF THE STRUCTURE.
- (F) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS IN THE VANE BOULDERS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (G) CONSTRUCT BOULDER VANES AND BOULDER VANES WITH J-HOOKS BY:
 - (1) FIRST SHAPE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) NEXT, EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III) AND SELECT MATERIAL FOR BACKFILL AND SUBSTRATE REPLACEMENT.
 - (3) PLACE FOOTER BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT AND THEN USE SURVEY EQUIPMENT TO CHECK THE ELEVATIONS OF THE INVERTS IN ACCORDANCE WITH THE STREAM MITIGATION PLANS.
 - (4) ONCE THE INVERTS HAVE BEEN ESTABLISHED, THE REMAINDER OF THE FOOTER AND SURFACE BOULDERS SHALL BE PLACED, MINIMIZING VOIDS.
 - (5) FILL THE VOIDS BETWEEN BOULDERS ON THE UPSTREAM SIDE OF THE STRUCTURE.
 - (6) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF THE STRUCTURE, EXTENDING FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED.
 - (7) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
 - (8) ONCE THE STRUCTURE IS INSTALLED, EXCAVATE SCOUR POOL AND PLACE SELECT MATERIAL AS REQUIRED.
 - (9) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (H) THE SURFACE OF BOULDER VANES AND J-HOOKS SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE PLANS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.10 FOOT OF THE GRADES AND ELEVATIONS INDICATED, OR AS DIRECTED BY THE ENGINEER. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH SELECT MATERIAL TO FORM A TIGHT-FITTING SEAL.
- (I) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (J) BOULDER VANES AND J-HOOKS SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 - 209-03.60 STREAM MITIGATION - ROCK VANE PER EACH
 - 209-03.38 STREAM MITIGATION - J-HOOK PER EACH

PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE BOULDER VANE AND J-HOOK.

STREAM MITIGATION PLAN LEGEND:

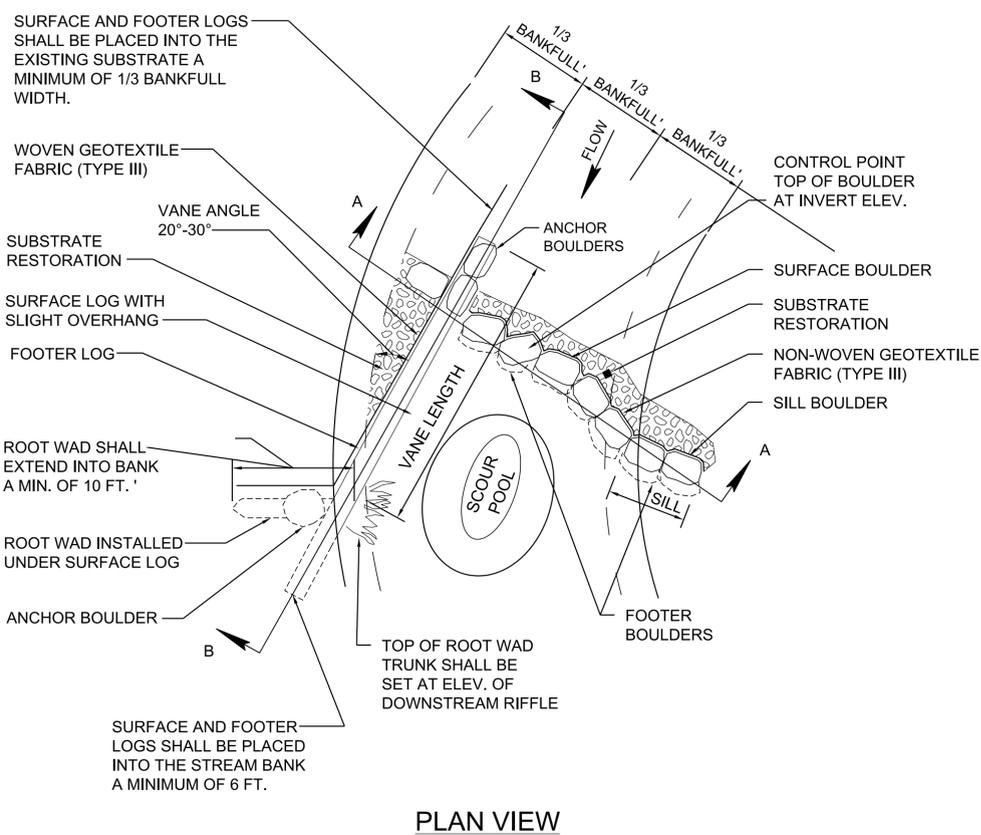


MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

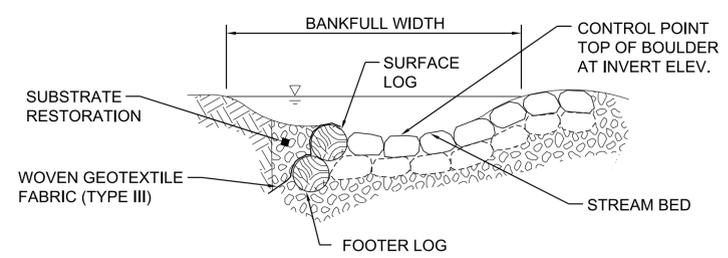
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TRANSPORTATION

**BOULDER VANES
AND J-HOOK**

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PLAN VIEW

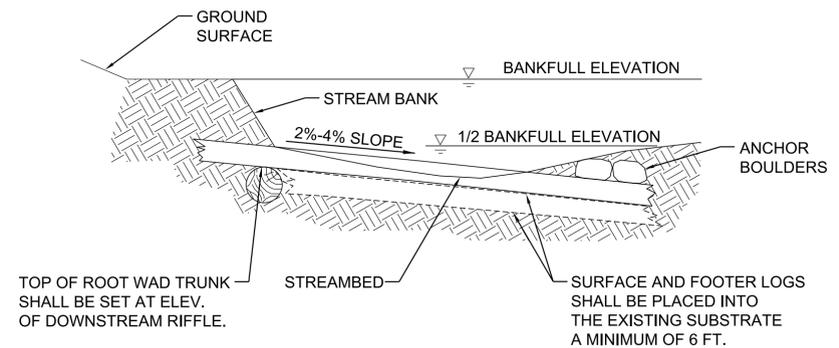


SECTION A-A

STREAM MITIGATION PLAN LEGEND:



LOG VANES, ROOT WADS AND BOULDER J-HOOK



SECTION B-B

LOG VANES, ROOT WADS AND BOULDER J-HOOK NOTES

- (A) LOG VANES AND LOG VANES WITH J-HOOKS ARE HYDRAULIC CONTROL MEASURES THAT ARE USED ALONG THE OUTSIDE BANKS OF MEANDER BENDS TO DIRECT FLOW AWAY FROM THE STREAM BANK, CONCENTRATE FLOWS INTO THE CENTER OF THE CHANNEL, AND ENHANCE HABITAT. WHEN BOULDER J-HOOKS ARE USED IN COMBINATION WITH LOG VANES, THEY ALSO PROVIDE GRADE CONTROL. ROOT WADS ARE USED AS A SILL TO PREVENT FLOW DIVERSION AND TO PROVIDE COVER HABITAT FOR FISH AND OTHER AQUATIC ORGANISMS IN THE DOWNSTREAM SCOUR POOL.
- (B) LOG VANES, ROOT WADS, AND J-HOOKS SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND CONFIGURATION INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH; MINIMUM LOG AND BOULDER DIMENSIONS; VANE, J-HOOK, AND SILL LENGTHS AND INVERT ELEVATIONS; SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) LOGS SHALL BE RELATIVELY STRAIGHT, RECENTLY HARVESTED AND DECAY RESISTANT SPECIES SUCH AS CEDAR, WHITE OAK, ETC.
- (E) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (F) THE LOG VANE SHALL EXTEND FROM THE STREAM BOTTOM ELEVATION AT ITS INSERTION INTO THE STREAM BED 1/3 BANKFULL WIDTH TO HALF THE BANKFULL ELEVATION AT ITS INSERTION INTO THE STREAM BANK (6-FOOT MINIMUM). THE SURFACE LOG SHALL BE PLACED ON ONE OR MORE FOOTER LOGS ALONG ITS LENGTH AND A ROOT WAD AT ITS INSERTION INTO THE BANK. ROOT WAD SHALL BE PLACED BENEATH THE SURFACE LOG AND PLACED SO THAT IT LOCKS THE SURFACE LOG INTO THE BANK SURFACE AND FOOTER LOGS AND ROOT WAD SHALL BE TIED SECURELY INTO THE BANK ALONG WITH A CUT-OFF SILL (6-FOOT MINIMUM) TO PREVENT THE POSSIBILITY OF STREAM FLOW DIVERTING AROUND THEM.
- (G) ANCHOR THE UPSTREAM END OF THE LOG VANE WITH BOULDERS PLACED ON TOP OF THE SURFACE LOG AND AT THE CHANNEL INVERT ELEVATION.
- (H) THE BOULDER J-HOOK SHOULD BE CONSTRUCTED FROM THE UPSTREAM END OF THE LOG VANE, ACROSS THE REMAINING TWO-THIRDS OF THE BANKFULL CHANNEL, TERMINATING WITH A BOULDER SILL. THE SURFACE BOULDERS IN THE CENTER OF THE J-HOOK ARE SET AT THE INVERT ELEVATION OF THE STRUCTURE.
- (I) CONSTRUCT LOG VANES, ROOT WADS, AND BOULDER J-HOOK BY:
 - (1) FIRST SHAPE THE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) NEXT, EXCAVATE ENOUGH BED MATERIAL TO PLACE THE LOGS AND/OR BOULDERS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III) AND ALLUVIUM OR SELECT MATERIAL BACKFILL.
 - (3) PLACE FOOTER LOG OR BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT, WITH THE SURFACE LOG OR BOULDERS SLIGHTLY UPSTREAM OF THE FOOTER LOG OR BOULDERS. SURFACE AND FOOTER LOGS SHOULD EXTEND A MINIMUM OF SIX FEET INTO EACH BANK AND THE STREAM BED.
 - (4) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF THE STRUCTURE, EXTENDING FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED. FOR LOGS, NAIL GEOTEXTILE FABRIC (TYPE III) TO THE SURFACE LOG APPROXIMATELY ONE QUARTER OF THE CIRCUMFERENCE DOWN FROM THE TOP OF THE SURFACE LOG USING TWO-INCH GALVANIZED ROOFING NAILS ON ONE-FOOT SPACING ALONG THE ENTIRE LENGTH OF THE LOG.
 - (5) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE, WHILE CREATING A SMALL ALLUVIAL BAR BETWEEN THE LOG VANE AND THE OUTSIDE BANK. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
 - (6) ONCE THE STRUCTURE IS INSTALLED, EXCAVATE THE DOWNSTREAM SCOUR POOL AND PLACE SELECT MATERIAL AS REQUIRED.
 - (7) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS IN THE VANE LOGS AND J-HOOK BOULDERS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (J) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (K) THE SURFACE OF LOG VANES, ROOT WADS, AND J-HOOKS SHALL BE FINISHED TO A NEAT AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE PLANS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.10 FOOT OF THE GRADES AND ELEVATIONS INDICATED, OR AS DIRECTED BY THE ENGINEER. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH SELECT MATERIAL TO FORM A TIGHT-FITTING SEAL.
- (L) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (M) LOG VANES, ROOT WADS AND BOULDER J-HOOK SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 - 209-03.34 STREAM MITIGATION - LOG VANE PER LINEAR FOOT
 - 209-03.38 STREAM MITIGATION - J-HOOK PER EACH
 - 209-03.62 STREAM MITIGATION - ROOT WAD PER EACH
 PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR TO CONSTRUCT THE LOG VANES, ROOT WADS AND BOULDER J-HOOK.

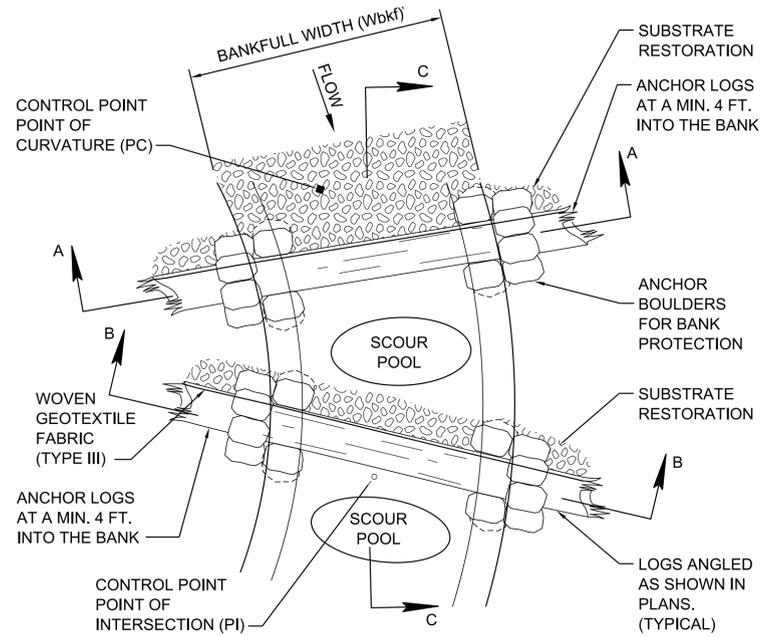
MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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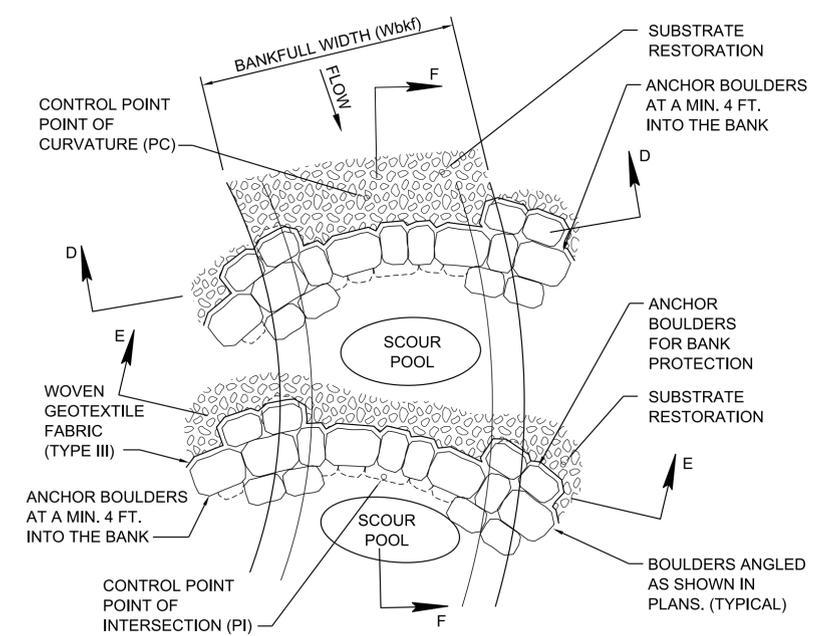
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LOG VANES,
ROOT WADS,
AND BOULDER
J-HOOK

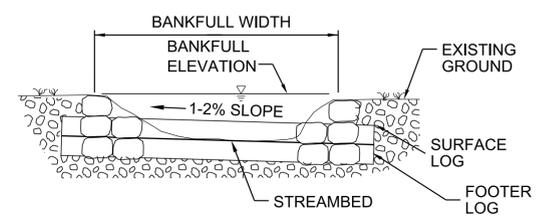
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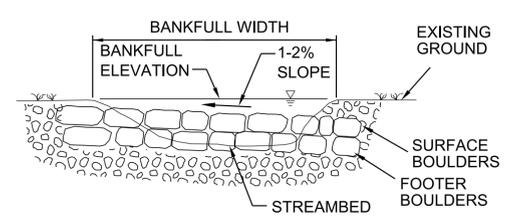
**LOG STEP POOL
PLAN VIEW**



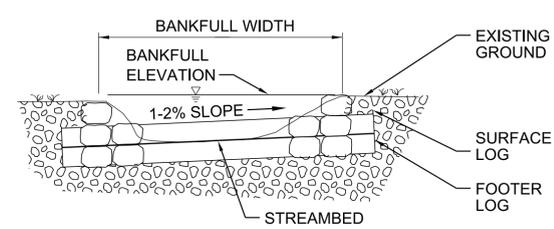
**BOULDER STEP POOL
PLAN VIEW**



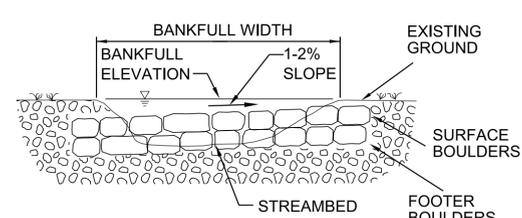
SECTION A-A



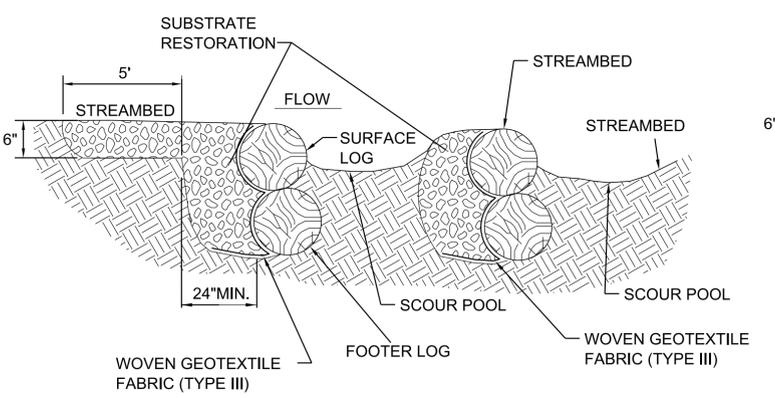
SECTION D-D



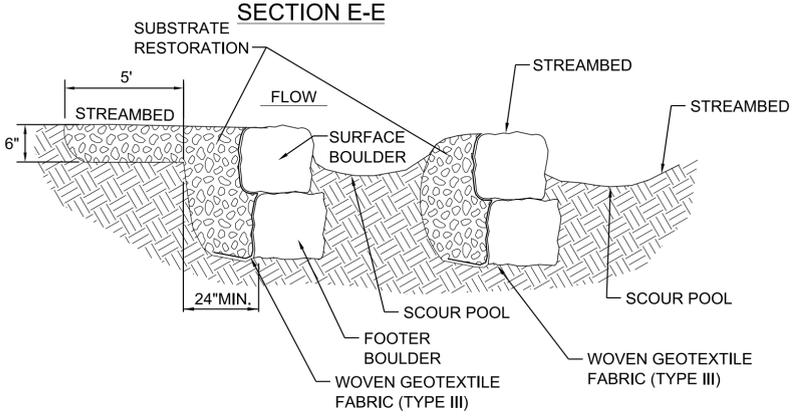
SECTION B-B



SECTION E-E



SECTION C-C



SECTION F-F

STREAM MITIGATION PLAN LEGEND: LOG STEP POOLS BOULDER STEP POOLS

*BOULDER SHOWN ARE A GRAPHICAL REPRESENTATION AND DOES NOT REPRESENT ACTUAL # OF BOULDERS TO BE USED.

LOG AND BOULDER STEP POOLS NOTES

- (A) LOG AND BOULDER STEP POOLS ARE HYDRAULIC AND GRADE CONTROL MEASURES THAT ARE USED TO MAINTAIN GRADE, CONTROL FLOW VELOCITY, DISSIPATE ENERGY, AND DEVELOP RIFFLE-RUN-STEP POOL HABITAT IN STREAMS WITH SLOPES GREATER THAN 2%. THIS DETAIL CAN BE USED FOR CONSTRUCTING A SINGLE LOG OR BOULDER STEP POOL OR A SERIES OF MULTIPLE STEP POOLS.
- (B) LOG AND BOULDER STEP POOL STRUCTURES AND ASSOCIATED POOL HABITAT ENHANCEMENTS AND BANK STABILIZATION MEASURES (ROOT WADS, BRUSH LAYERING, LIVE STAKING, ETC.) SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND GEOMORPHIC POSITIONS INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH, MINIMUM LOG AND BOULDER DIMENSIONS, INVERT ELEVATIONS, ESTIMATED SCOUR DEPTH AND SELECT MATERIAL CLASSIFICATION SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) LOGS SHALL BE RELATIVELY STRAIGHT, RECENTLY HARVESTED AND DECAY RESISTANT SPECIES SUCH AS CEDAR, WHITE OAK, ETC.
- (E) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (F) LOCATE LOG OR BOULDER STEP STRUCTURES IN THE CHANNEL AT THE POINTS OF CURVATURE AND TANGENCY IN MEANDER BENDS, AND ALIGN THE STRUCTURE ALONG THE AXIS OF THE RADIUS.
- (G) CONSTRUCT STEP STRUCTURES WITH A MAXIMUM DROP OF A HALF FOOT (SIX INCHES) AND A SLOPE BETWEEN ONE PERCENT (1%) AND FOUR PERCENT (4%).
- (H) CONSTRUCT LOG OR BOULDER STEPS STRUCTURES BY:
 - (1) FIRST SHAPE THE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) NEXT, EXCAVATE ENOUGH BED MATERIAL TO PLACE THE LOGS AND/OR BOULDERS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III) AND ALLUVIUM OR SELECT MATERIAL BACKFILL.
 - (3) PLACE FOOTER LOG OR BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT, WITH THE SURFACE LOG OR BOULDERS SLIGHTLY UPSTREAM OF THE FOOTER LOG OR BOULDERS. SURFACE AND FOOTER LOGS SHOULD EXTEND A MINIMUM OF FOUR FEET INTO EACH BANK AND LOG STEPS SHOULD BE PINCHED OR ANCHORED INTO THE BANKS WITH BOULDERS.
 - (4) THE FOLLOWING GUIDELINES APPLY WHEN INSTALLING MULTIPLE STEP POOL STRUCTURES IN SEQUENCE:
 - (a) THE INVERT ELEVATION OF THE DOWNSTREAM STEP SHALL BE AT OR ABOVE THE TOP OF THE FOOTER FOR THE UPSTREAM STRUCTURE.
 - (b) ALTERNATE INVERTS OF THE STRUCTURES FROM SIDE TO SIDE IN THE CHANNEL TO CREATE A MEANDERING FLOW PATH ACROSS THE STRUCTURES.
 - (5) USE SURVEY EQUIPMENT TO CHECK THE ELEVATIONS OF THE INVERTS IN ACCORDANCE WITH THE STREAM MITIGATION PLANS.
 - (6) ONCE THE INVERTS HAVE BEEN ESTABLISHED, FILL THE VOIDS BETWEEN LOGS OR BOULDERS ON THE UPSTREAM SIDE OF THE STRUCTURE.
 - (7) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF THE STRUCTURE, EXTENDING FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED. FOR LOGS, NAIL GEOTEXTILE FABRIC (TYPE III) TO THE SURFACE LOG APPROXIMATELY ONE QUARTER OF THE CIRCUMFERENCE DOWN FROM THE TOP OF THE SURFACE LOG USING TWO-INCH GALVANIZED ROOFING NAILS ON ONE-FOOT SPACING ALONG THE ENTIRE LENGTH OF THE LOG.
 - (8) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
 - (9) ONCE THE STRUCTURE IS INSTALLED, EXCAVATE THE DOWNSTREAM SCOUR POOL AND PLACE SELECT MATERIAL AS REQUIRED.
 - (10) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (I) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS IN THE VANE BOULDERS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (J) THE SURFACE OF LOG AND BOULDER STEP POOL SHALL BE FINISHED TO A NEAT AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS SECTIONS OR ELEVATIONS SHOWN ON THE PLANS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.10 FOOT OF THE GRADES AND ELEVATIONS INDICATED, OR AS DIRECTED BY THE ENGINEER. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH SELECT MATERIAL TO FORM A TIGHT-FITTING SEAL.
- (K) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (L) LOG AND BOULDER STEP POOLS SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
209-03.36 STREAM MITIGATION - STEP POOL PER EACH
PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR TO CONSTRUCT LOG AND BOULDER STEP POOLS.

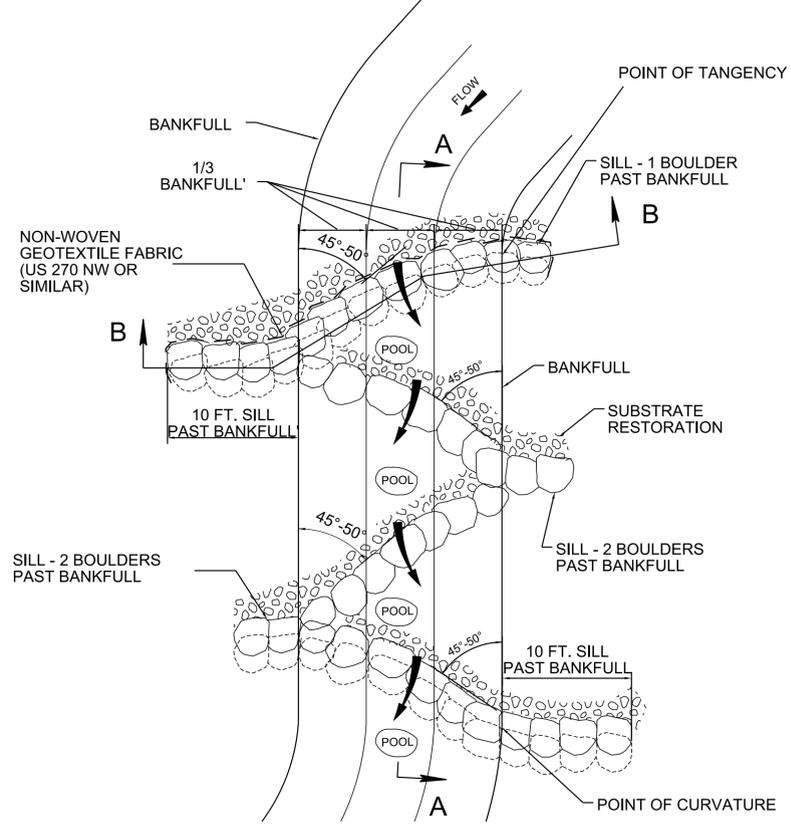
MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

NOT TO SCALE

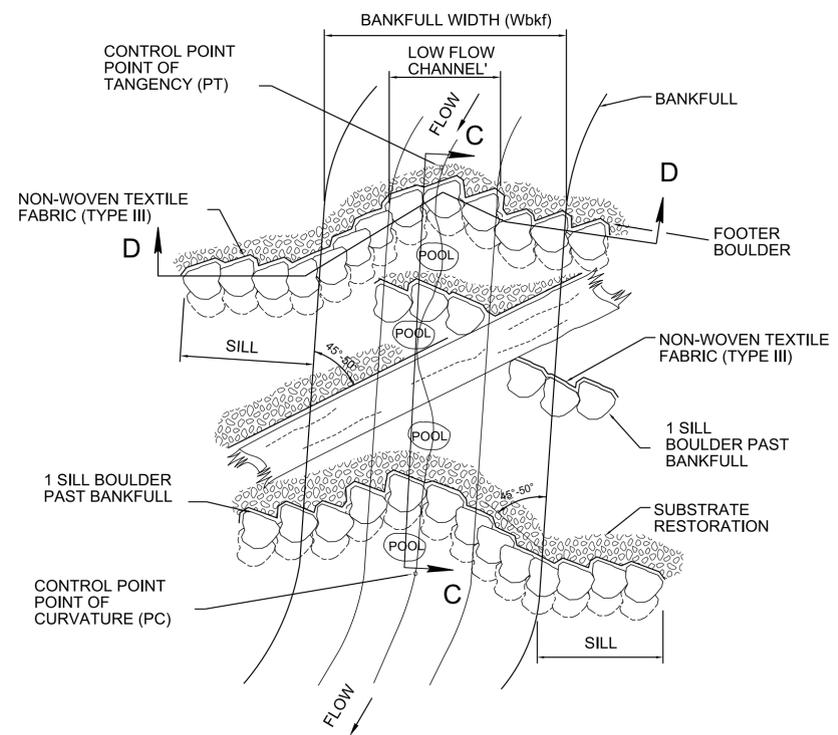
**STATE OF TENNESSEE
DEPARTMENT OF
TRANSPORTATION**

**LOG AND
BOULDER
STEP POOLS**

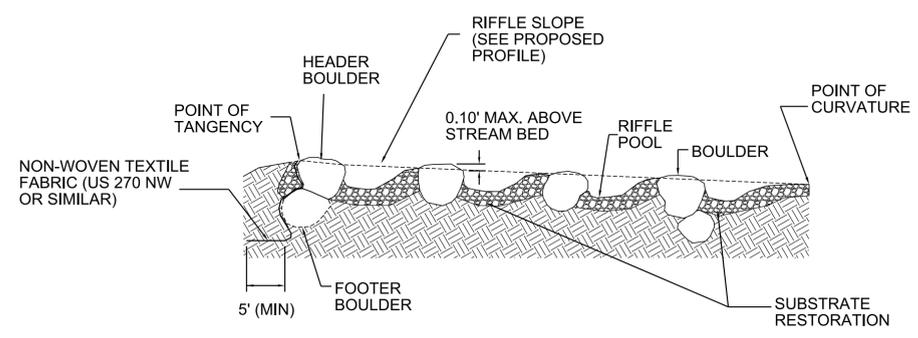
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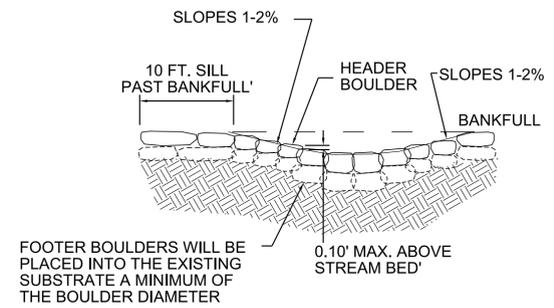
BOULDER RIFFLE PLAN VIEW



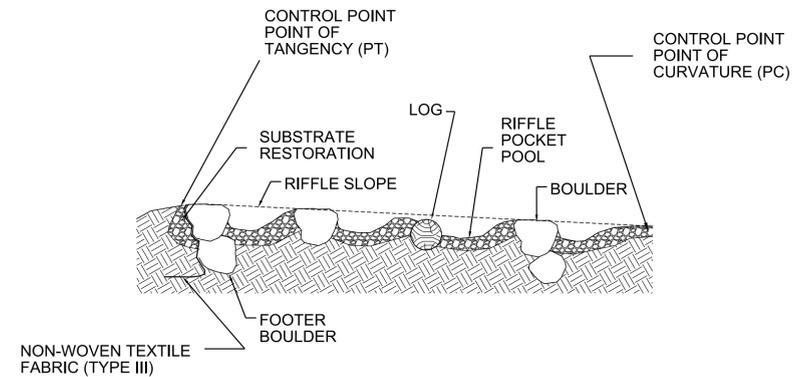
BOULDER AND LOG RIFFLE PLAN VIEW



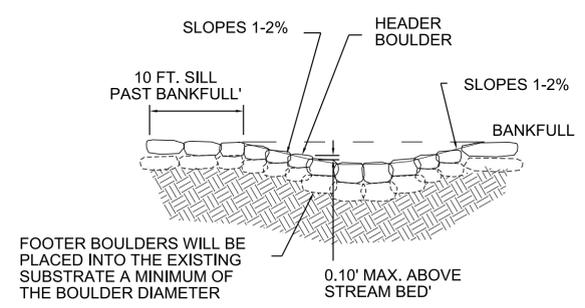
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

SEE D-NSD-28A FOR NOTES

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STATE OF TENNESSEE
DEPARTMENT OF
TRANSPORTATION

LOG AND
BOULDER
RIFFLES

11-01-16 D-NSD-28

STREAM MITIGATION PLAN LEGEND:

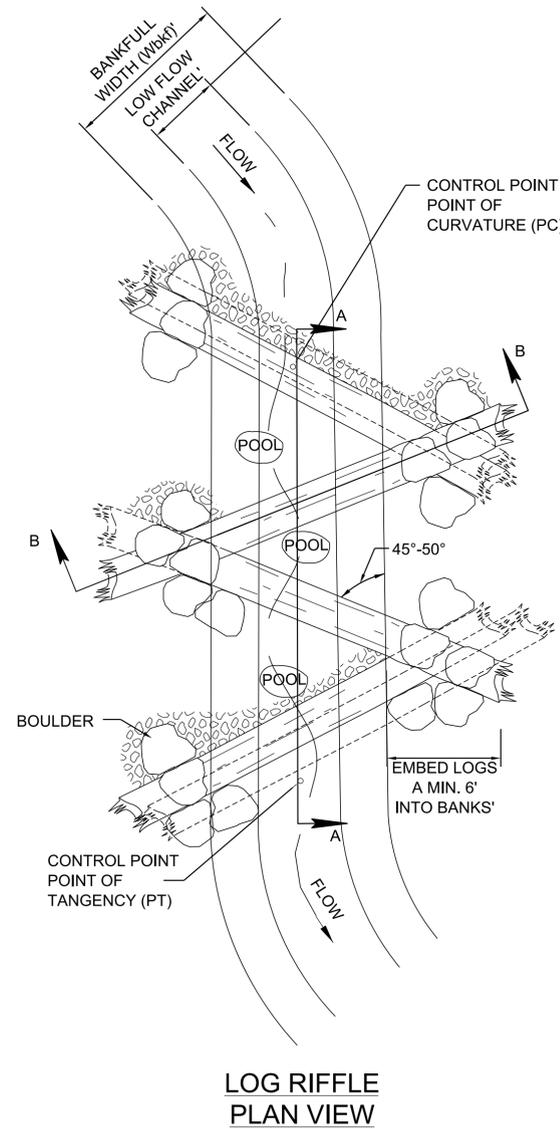


BOULDER RIFFLE

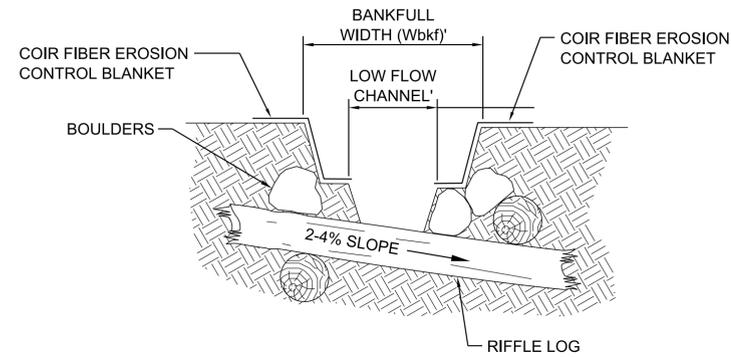
BOULDER AND LOG RIFFLE

*BOULDER SHOWN ARE A GRAPHICAL REPRESENTATION AND DOES NOT REPRESENT ACTUAL # OF BOULDERS TO BE USED.

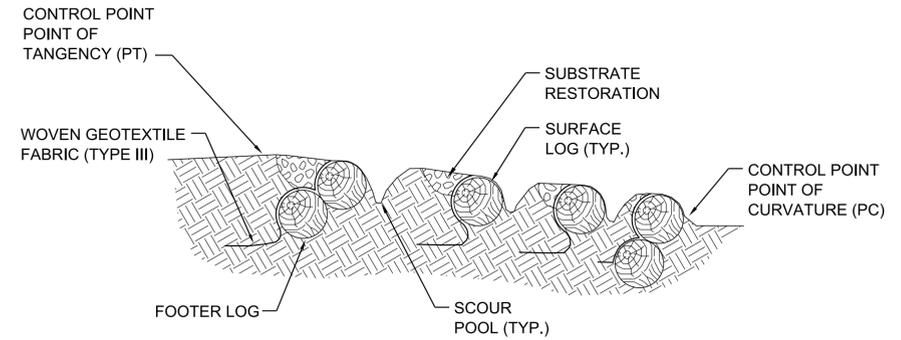
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LOG RIFFLE PLAN VIEW



SECTION B-B



SECTION A-A

LOG AND BOULDER RIFFLES NOTES

- (A) LOG AND BOULDER RIFFLES ARE GRADE CONTROL AND HABITAT ENHANCEMENT MEASURES THAT ARE USED TO MAINTAIN GRADE OF UPSTREAM POOLS, OXYGENATE WATER, AND PROVIDE HABITAT FOR EPIFAUNA AND FISH. THESE STRUCTURES ARE TYPICALLY USED IN LOWER GRADIENT STREAMS WITH SLOPES LESS THAN 3%. THIS DETAIL CAN BE USED FOR CONSTRUCTING RIFFLES USING BOULDERS, LOGS, OR A COMBINATION OF BOULDERS AND LOGS.
- (B) LOG AND BOULDER RIFFLES SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND GEOMORPHIC POSITIONS INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH, MINIMUM LOG AND/OR BOULDER DIMENSIONS, INVERT ELEVATIONS, AND SELECT MATERIAL CLASSIFICATION SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR NATURAL STREAM DESIGN".
- (D) LOGS SHALL BE RELATIVELY STRAIGHT, RECENTLY HARVESTED AND DECAY RESISTANT SPECIES SUCH AS CEDAR, WHITE OAK, ETC.
- (E) BOULDERS PRESENT IN THE EXISTING STREAM MEETING THE SPECIFIED TYPE AND SIZE SHOULD BE USED IN THE RESTORED CHANNEL SEGMENT.
- (F) LOCATE LOG OR BOULDER RIFFLE STRUCTURES (RIFFLE LOGS AND BOULDER MINI-VANES) AT EQUALLY SPACED INTERVALS IN THE STRAIGHT SECTIONS OF THE CHANNEL BETWEEN MEANDER BENDS (I.E., BETWEEN UPSTREAM POINT OF TANGENCY AND DOWNSTREAM POINT OF CURVATURE), AS INDICATED ON THE STREAM MITIGATION PLANS.
- (G) THE MAXIMUM AMOUNT OF DROP IN INVERT FROM ONE RIFFLE LOG OR BOULDER MINI-VANE TO THE NEXT SHALL BE NO GREATER THAN 0.10 FOOT. THE COMBINED AMOUNT OF DROP OVER ALL THE MINI-VANES SHALL NOT EXCEED THE TOTAL AMOUNT OF FALL IN THE RIFFLE SLOPE. THE INVERT IN RIFFLE LOGS AND MINI-VANES SHALL ALTERNATE LEFT AND RIGHT OF CENTERLINE TO PRODUCE A MEANDERING FLOW PATTERN IN THE RIFFLE.
- (H) CONSTRUCT LOG RIFFLE STRUCTURES BY:
 - (1) SHAPE THE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) LOG RIFFLE STRUCTURES ARE BUILT STARTING WITH THE DOWNSTREAM LOG AND PROCEEDING UPSTREAM. LOGS ARE SLOPED DOWN TWO PERCENT (2%) TO FOUR PERCENT (4%) AT THEIR UPSTREAM END.
 - (3) RIFFLE LOGS SHALL OVERLAP IN THE STREAM BANK, WITH THE DOWNSTREAM END OF THE UPSTREAM LOG PLACED ON TOP OF THE UPSTREAM END OF THE DOWNSTREAM LOG, THEREBY HELPING TO ANCHOR THE DOWNSTREAM LOG. ADDITIONALLY, THE RIFFLE LOGS ARE ANCHORED WITHIN THE BANKS BY PINCHING BOTH SIDES OF THE LOG WITH BOULDERS.
 - (4) EXCAVATE ENOUGH BED AND BANK MATERIAL TO PLACE THE RIFFLE LOGS, ANCHOR BOULDERS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III), AND ALLUVIUM OR SELECT MATERIAL BACKFILL. SURFACE AND FOOTER LOGS SHOULD EXTEND A MINIMUM OF SIX FEET INTO EACH BANK.
 - (5) THE UPSTREAM RIFFLE LOG IS BUILT WITH A LOG FOOTER. THE DOWNSTREAM RIFFLE LOGS ARE INSTALLED WITHOUT FOOTERS.
 - (6) LOG RIFFLES SHALL ALL BE DESIGNED TO BE SUBMERGED OR COVERED AT LOW FLOWS TO REDUCE THE RATE OF WOOD DECOMPOSITION. INSTALL LOGS AT THE INVERTS SPECIFIED IN THE PLANS AND THEN CHECK THE ELEVATIONS OF THE INVERTS WITH SURVEY EQUIPMENT. PLACE THE FOOTER AND SURFACE LOGS AT THE UPSTREAM END OF THE RIFFLE TO MINIMIZE VOIDS AND TO PRODUCE A SMOOTH COMPACT SURFACE.
 - (7) ONCE THE INVERTS HAVE BEEN ESTABLISHED, FILL THE VOIDS BETWEEN THE UPSTREAM FOOTER AND SURFACE LOG ON THE UPSTREAM SIDE WITH COARSE ALLUVIUM OR SPECIFIED SELECT MATERIAL.
 - (8) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF EACH RIFFLE LOG. THE GEOTEXTILE SHALL EXTEND FROM THE BOTTOM OF THE FOOTER (WHERE PRESENT) TO THE FINISHED GRADE ELEVATION OF THE SURFACE LOG. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED. NAIL GEOTEXTILE FABRIC (TYPE III) TO THE SURFACE LOG APPROXIMATELY ONE QUARTER OF THE CIRCUMFERENCE DOWN FROM THE TOP OF THE SURFACE LOG USING TWO-INCH GALVANIZED ROOFING NAILS ON ONE-FOOT SPACING ALONG THE ENTIRE LENGTH OF THE LOG.
 - (9) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
- (I) CONSTRUCT BOULDER AND LOG-BOULDER RIFFLE STRUCTURES BY:
 - (1) SHAPE THE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDER MINI-VANES, RIFFLE LOGS, NON-WOVEN GEOTEXTILE FABRIC (TYPE III) AND ALLUVIUM OR SELECT MATERIAL BACKFILL.
 - (3) FOR THE UPSTREAM BOULDER MINI-VANE, PLACE FOOTER AND SURFACE BOULDERS. THE DOWNSTREAM MINI-VANES AND RIFFLE LOGS ARE INSTALLED WITHOUT FOOTERS. INSTALL VANES AND LOGS AT THE INVERTS SPECIFIED IN THE PLANS AND THEN CHECK THE ELEVATIONS OF THE INVERTS WITH SURVEY EQUIPMENT. PLACE BOULDERS TO MINIMIZE VOIDS AND TO PRODUCE A SMOOTH COMPACT SURFACE.
 - (4) ONCE THE INVERTS HAVE BEEN ESTABLISHED, FILL THE VOIDS BETWEEN BOULDERS ON THE UPSTREAM SIDE OF THE STRUCTURES.
 - (5) PLACE NON-WOVEN GEOTEXTILE FABRIC (TYPE III) ALONG THE ENTIRE UPSTREAM FACE OF EACH MINI-VANE OR RIFFLE LOG. THE GEOTEXTILE SHALL EXTEND FROM THE BOTTOM OF THE FOOTER (WHERE PRESENT) TO THE FINISHED GRADE ELEVATION OF THE SURFACE BOULDERS OR LOG. ONLY GEOTEXTILE FABRIC (TYPE III) LISTED ON THE QUALIFIED PRODUCTS LIST SHALL BE USED. FOR RIFFLE LOGS, NAIL GEOTEXTILE FABRIC (TYPE III) TO THE SURFACE LOG APPROXIMATELY ONE QUARTER OF THE CIRCUMFERENCE DOWN FROM THE TOP OF THE SURFACE LOG USING TWO-INCH GALVANIZED ROOFING NAILS ON ONE-FOOT SPACING ALONG THE ENTIRE LENGTH OF THE LOG.
 - (6) BACKFILL STRUCTURE AND NON-WOVEN GEOTEXTILE FABRIC (TYPE III) WITH EXCAVATED ON-SITE STREAM ALLUVIUM (IF AVAILABLE), OTHERWISE USE THE SPECIFIED SELECT MATERIAL. SOIL SHALL BE COMPACTED WELL AROUND BURIED PORTIONS OF THE STRUCTURE. TRIM ANY EXPOSED NON-WOVEN GEOTEXTILE FABRIC (TYPE III).
- (J) THE SURFACE OF LOG AND BOULDER RIFFLES SHALL BE FINISHED TO A NEAT AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE PLANS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.10 FOOT OF THE GRADES AND ELEVATIONS INDICATED, OR AS DIRECTED BY THE ENGINEER. ALL GAPS OR VOIDS BETWEEN FOOTER AND SURFACE BOULDERS AND LOGS SHALL BE PLUGGED WITH SELECT MATERIAL TO FORM A TIGHT-FITTING SEAL.
- (K) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (L) A MIXTURE OF SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE RESTORATION IN RIFFLE AND RUN HABITATS AND TO FILL GAPS BETWEEN LOGS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (M) COIR FIBER EROSION CONTROL BLANKET SHALL BE INSTALLED ABOVE THE INNER-BERM STAGE AND NOT IN THE LOW-FLOW CHANNEL OF THE RIFFLE. SEE TYPICAL CROSS-SECTION DATA IN STREAM MITIGATION PLANS FOR INNER BERM INFORMATION.
- (N) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (O) LOG AND BOULDER RIFFLES SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 - 209-03.40 STREAM MITIGATION - LOG RIFFLE PER LINEAR FOOT
 - 209-03.41 STREAM MITIGATION - BOULDER RIFFLE PER LINEAR FOOT
 PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR TO CONSTRUCT THE LOG RIFFLE, BOULDER RIFFLE, OR LOG AND BOULDER RIFFLES.

STREAM MITIGATION PLAN LEGEND:



LOG RIFFLE

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

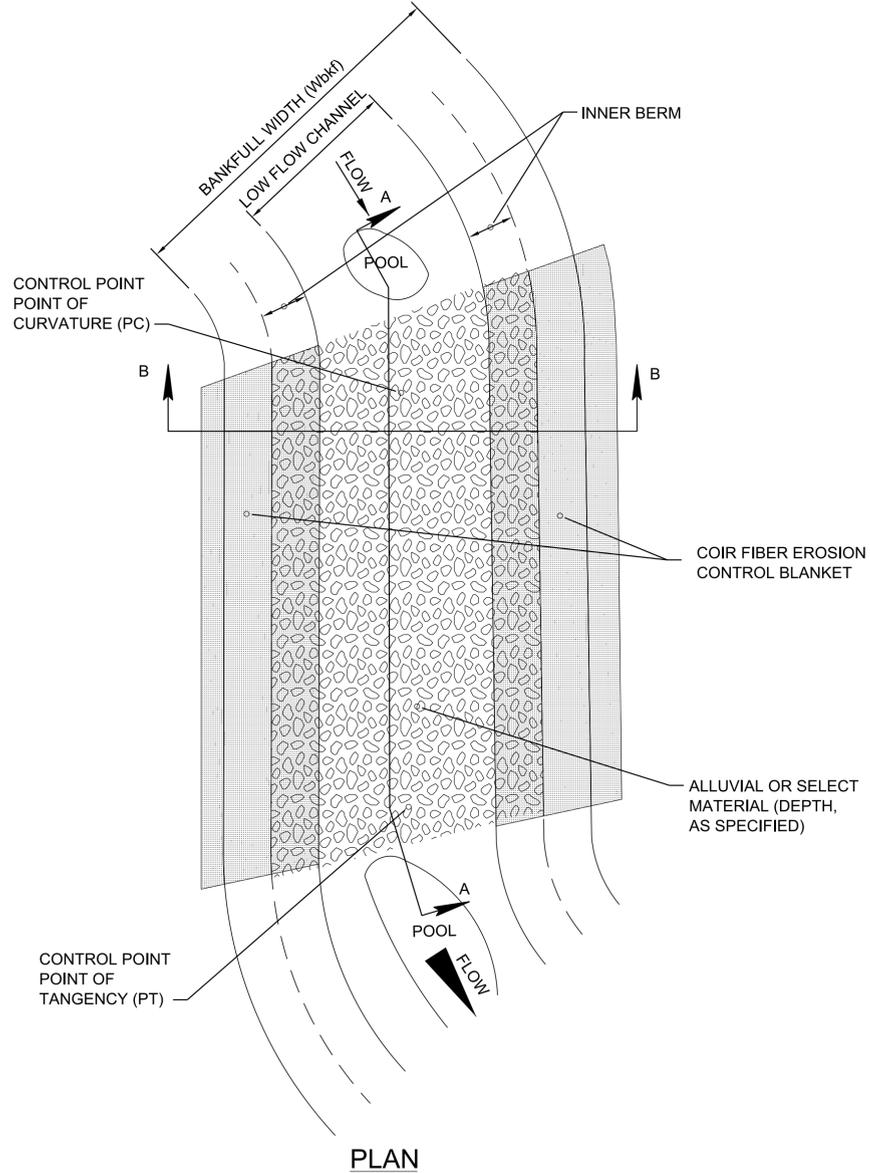
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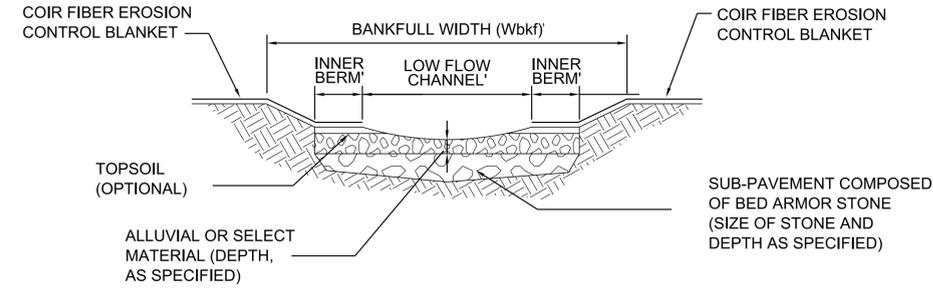
LOG AND
BOULDER
RIFFLES

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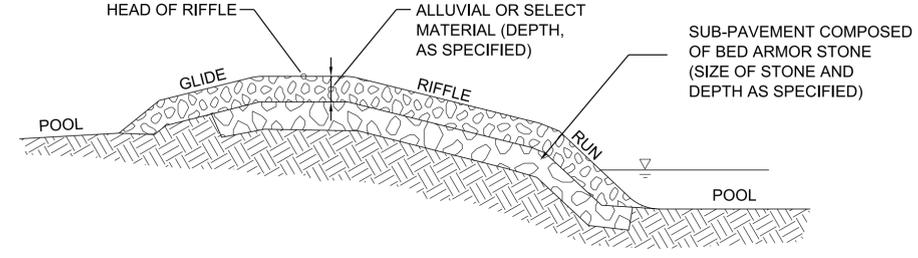
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PLAN



SECTION B-B



SECTION A-A

CONSTRUCTED ALLUVIAL RIFFLE NOTES

- (A) CONSTRUCTED ALLUVIAL RIFFLES ARE GRADE CONTROL AND HABITAT ENHANCEMENT MEASURES THAT ARE USED TO MAINTAIN GRADE OF UPSTREAM POOLS, OXYGENATE WATER, AND PROVIDE HABITAT FOR EPIFAUNA AND FISH. THESE STRUCTURES ARE TYPICALLY USED IN LOWER GRADIENT STREAMS WITH OVERALL SLOPES LESS THAN 2% THIS DETAIL CAN BE USED FOR CONSTRUCTING RIFFLES USING NATURAL ALLUVIUM CONSISTING OF BOULDERS, COBBLES, AND GRAVEL OR SPECIFIED SELECT MATERIAL.
- (B) CONSTRUCTED ALLUVIAL RIFFLES SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND GEOMORPHIC POSITIONS INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL, INNER BERM, AND LOW-FLOW CHANNEL WIDTHS; INVERT ELEVATIONS AT HEAD AND BOTTOM OF RIFFLE; ESTIMATED ROCK THRESHOLD SIZE; AND ALLUVIUM OR SELECT MATERIAL CLASSIFICATION AND DEPTH SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
- (C) REFER TO D-NSD-37 "SPECIAL NOTES FOR STREAM DESIGN".
- (D) CONSTRUCTED ALLUVIAL RIFFLES ARE PLACED IN THE STRAIGHT SECTIONS OF THE CHANNEL BETWEEN MEANDER BENDS (I.E., BETWEEN UPSTREAM POINT OF TANGENCY AND DOWNSTREAM POINT OF CURVATURE), AS INDICATED ON THE STREAM MITIGATION PLANS.
- (E) ALLUVIUM OR SELECT MATERIAL FOR CONSTRUCTED RIFFLES SHALL CONSIST OF COARSE SUBSTRATE (GRAVEL, COBBLE, AND BOULDER). A MIXTURE OF SIZES OF ALLUVIUM OR SELECT MATERIALS, AS SPECIFIED ON THE STREAM MITIGATION PLAN SHEETS, SHOULD BE USED FOR SUBSTRATE IN RIFFLE AND RUN HABITATS. COARSE ALLUVIUM EXCAVATED FROM THE EXISTING STREAM BED, WHICH MEETS THE SPECIFIED SIZE CLASSIFICATION, IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE RESTORATION. REFER TO D-NSD-30 AND D-NSD-37 FOR ADDITIONAL SUBSTRATE RESTORATION INFORMATION.
- (F) CONSTRUCT ALLUVIAL RIFFLES BY:
 - (1) SHAPE THE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) EXCAVATE ENOUGH BED MATERIAL TO PLACE SUBPAVEMENT ARMOR STONE, AND COARSE ALLUVIUM OR SELECT MATERIAL FOR THE RIFFLE TO ACHIEVE THE SPECIFIED INVERT ELEVATIONS. IF THE CHANNEL IS DESIGNED WITH AN INNER BERM, KEY THE COARSE ALLUVIUM OR SELECT MATERIAL INTO THE BANKS EXTENDING ENTIRELY UNDER THE INNER BERM. IF THE CHANNEL LACKS AN INNER BERM, KEY THE COARSE ALLUVIUM OR SELECT MATERIAL INTO THE BANKS EXTENDING TO HALF BANKFULL.
 - (3) PLACE THE COARSE ALLUVIUM OR SELECT MATERIAL IN SIX-INCH LIFTS AND COMPACT EACH LIFT WITH THE BUCKET OF THE EXCAVATOR.
 - (4) INSTALL THE ALLUVIAL RIFFLE AT THE INVERTS SPECIFIED IN THE PLANS AND THEN CHECK THE ELEVATIONS OF THE INVERTS WITH SURVEY EQUIPMENT.
 - (5) PLACE SOIL OVER THE TOP OF THE COARSE ALLUVIUM OR SELECT MATERIAL KEYED INTO THE INNER BERM OR STREAM BANK AND GRADE THE INNER BERM/BANKS TO THE SPECIFIED ELEVATIONS.
- (G) THE CONSTRUCTED ALLUVIAL RIFFLE MATERIAL SHALL BE FINISHED TO CREATE A SMOOTH PROFILE, WITHOUT AN ABRUPT JUMP/TRANSITION BETWEEN THE UPSTREAM POOL-GLIDE AND THE RIFFLE, OR AN ABRUPT DROP/TRANSITION BETWEEN THE RIFFLE AND THE DOWNSTREAM RUN-POOL. THE FINISHED CROSS SECTION OF THE RIFFLE MATERIAL SHALL GENERALLY MATCH THE SHAPE AND DIMENSIONS SHOWN ON THE RIFFLE TYPICAL SECTION WITH SOME VARIABILITY OF THE THALWEG LOCATION AS A RESULT OF PLACEMENT OF LARGER SUBSTRATE, SUCH AS BOULDERS.
- (H) THE END OF RIFFLE CONTROL POINT MAY TIE IN TO A DRAINAGE STRUCTURE OR OTHER IN-STREAM STRUCTURE (E.G. - J-HOOK VANE, LOG OR BOULDER SILL, ETC.).
- (I) RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (J) COIR FIBER EROSION CONTROL BLANKET SHALL BE INSTALLED ABOVE THE INNER-BERM STAGE AND NOT IN THE LOW-FLOW CHANNEL OF THE RIFFLE. SEE TYPICAL CROSS-SECTION DATA IN STREAM MITIGATION PLANS FOR INNER BERM INFORMATION.
- (K) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (L) CONSTRUCTED ALLUVIAL RIFFLES SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 709-05.81 ROCK RIFFLES PER LUMP SUM
 PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR TO CONSTRUCT THE ALLUVIAL RIFFLE.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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CONSTRUCTED
ALLUVIAL
RIFFLE

11-01-16 D-NSD-29

STREAM MITIGATION PLAN LEGEND:



CONSTRUCTED ALLUVIAL RIFFLE

SUBSTRATE RESTORATION NOTES

THE FOLLOWING SPECIFICATION IS DESIGNED TO REPLACE AND RESTORE COARSE (GRAVEL, COBBLE, BOULDER AND BEDROCK) SUBSTRATE TO THE STREAM CHANNEL IN CASES WHERE COARSE SUBSTRATES ARE ABSENT FOLLOWING CHANNEL EXCAVATION. THE PURPOSE OF THIS RESTORATION MEASURE IS TO PROVIDE NATURAL SUBSTRATE AND EROSION AND SCOUR PROTECTION IN THE CHANNEL.

1. SUBSTRATES COMPRISED PREDOMINANTLY OF GRAVEL (0.08-2.5 INCHES), COBBLE (2.5-10.1 INCHES) AND/OR BOULDER (10.1-80 INCHES), ALSO REFERRED TO IN THIS SPECIFICATION AS COARSE SUBSTRATE OR ALLUVIUM, THAT ARE REMOVED FROM THE STREAM DURING CHANNEL EXCAVATION WILL BE TEMPORARILY STOCKPILED IN A NON-WETLAND/AQUATIC SITE FOR POSSIBLE REPLACEMENT IN THE CHANNEL.
2. IMMEDIATELY FOLLOWING CHANNEL EXCAVATION, PERFORM AND RECORD THE RESULTS OF A PEBBLE COUNT (HARRELSON ET AL. 1994) IN THE EXCAVATED CHANNEL TO DETERMINE THE PERCENT COMPOSITION OF SILT/CLAY, SAND, GRAVEL, COBBLE, BOULDER AND BEDROCK SIZE CLASSES.
3. IF THE IN-PLACE STREAM SUBSTRATE IS COMPRISED OF GREATER THAN 70% GRAVEL, COBBLE, BOULDER, AND/OR BEDROCK, THE STREAM SUBSTRATE WILL BE DEEMED ACCEPTABLE AS IS AND SUBSTRATE REPLACEMENT WILL NOT BE PERFORMED.
4. IF THE IN-PLACE STREAM SUBSTRATE IS COMPRISED OF LESS THAN 70% GRAVEL, COBBLE, BOULDER, AND/OR BEDROCK, THE CHANNEL WILL BE OVER-EXCAVATED TO A DEPTH OF 6 TO 8 INCHES AND BACKFILLED WITH COARSE SUBSTRATE TO MEET THE >70% SPECIFICATION, AS VERIFIED BY A PEBBLE COUNT.
5. COARSE ALLUVIUM EXCAVATED FROM THE CHANNEL AND TEMPORARILY STOCKPILED IS THE PREFERRED MATERIAL TO USE FOR SUBSTRATE REPLACEMENT.
6. IF THE QUANTITY OF EXCAVATED COARSE ALLUVIUM IS INSUFFICIENT OR CONTAINS TOO HIGH A PERCENTAGE OF FINES (SAND, SILT, AND CLAY), THEN THE FOLLOWING MIXTURE OF MATERIALS CAN BE USED AS SUBSTRATE:
 - a. CLEAN, NON-ACID FORMING ROUNDED NATURAL ROCK AND STONE, SUCH AS RIVER GRAVEL, LIMESTONE OR SANDSTONE;
 - b. USE AND MIX THE SPECIFIED QUANTITIES (% BY WEIGHT) OF THE FOLLOWING NATIONAL STONE ASSOCIATION SIZE CLASSES OF ROCK AND STONE

NSA#(a)	GRADE ROCK SIZE (IN.)			QUANTITY (BY WEIGHT)
	MIN.	AVG.	MAX.	
R-1	NO. 8	0.75	1.5	SPECIFY (b)
R-2	1	1.5	3	SPECIFY (b)
R-3	2	3	6	SPECIFY (b)
R-4	3	6	12	SPECIFY (b)
R-5	5	9	18	SPECIFY (a)
R-6	7	12	24	SPECIFY (a)
R-7	12	15	30	SPECIFY (a)

PEBBLE COUNT REFERENCE: HARRELSON, CHERYL C; RAWLINS, C.L.; POTYONDY, JOHN P. 1994. STREAM CHANNEL REFERENCE SITES: AN ILLUSTRATED GUIDE TO FIELD TECHNIQUE. GEN. TECH. REP. RM-245. FORT COLLINS, STATION. 61 P. [HTTP://216.48.37.142/PUBS/20753](http://216.48.37.142/PUBS/20753).

NOTES TO DESIGNER:

- (a) NATIONAL STONE ASSOCIATION; SUBSTITUTE ALTERNATIVE ROCK SIZE CLASSIFICATIONS AS NEEDED
- (b) SPECIFY SUBSTRATE THRESHOLD SIZE BASED ON CRITICAL SHEAR STRESS (T=GRS) AND STREAM POWER (W=QGS/W)¹.

7. USE THE FOLLOWING PAY ITEM FOR SUBSTRATE RESTORATION:

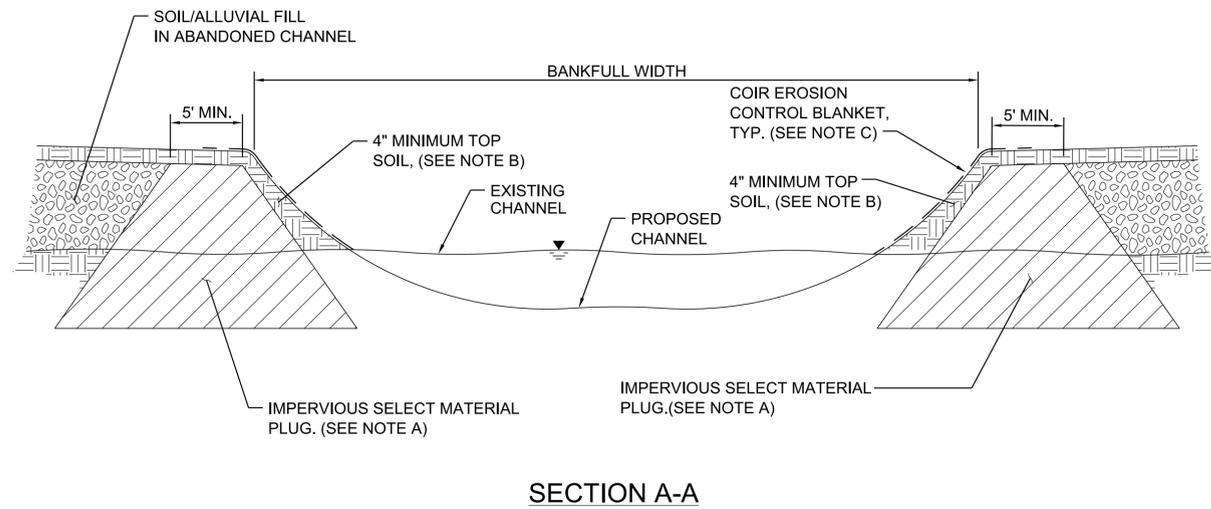
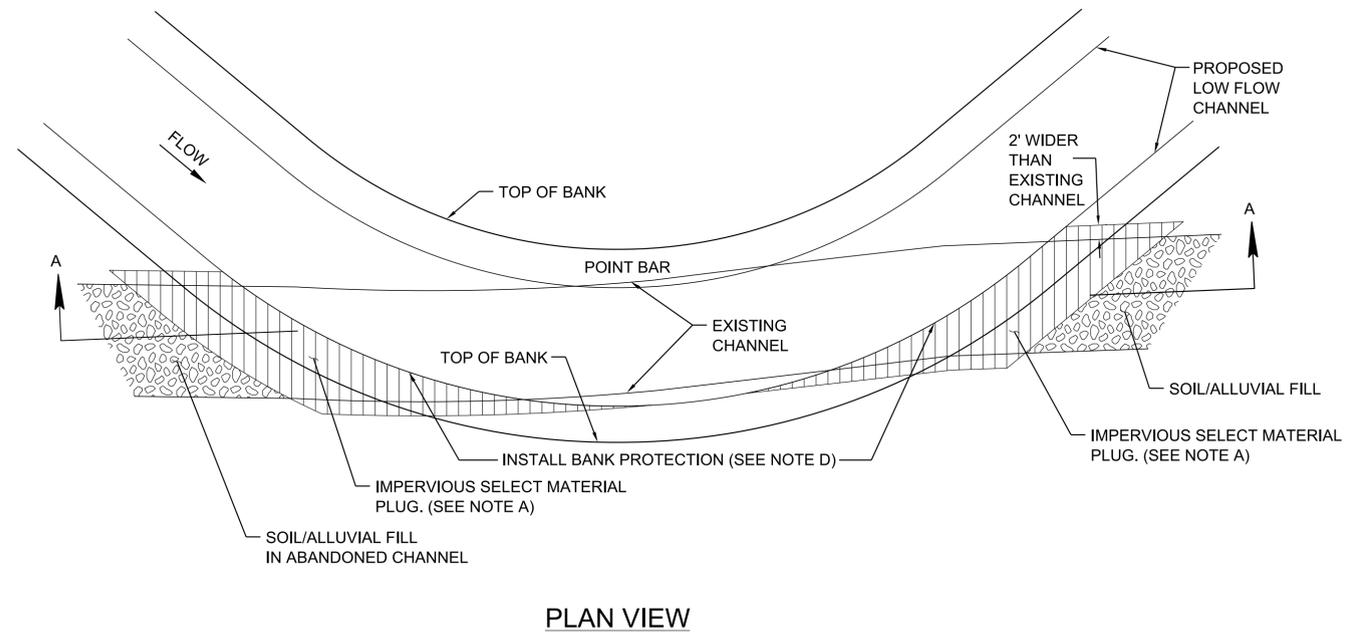
203-20.01 CHANNEL SUBSTRATE PER CY

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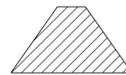
SUBSTRATE
RESTORATION

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CLAY CHANNEL PLUG NOTES	
(A)	CLAY CHANNEL PLUGS ARE USED TO BLOCK ABANDONED SECTIONS OF CHANNEL WHEN A STREAM IS RE-ALIGNED AND THE NEW CHANNEL INTERSECTS THE EXISTING CHANNEL. THE CLAY CHANNEL PLUG ALSO PREVENTS SUBSURFACE FLOW LOSS TO THE EXISTING CHANNEL.
(B)	PLACE IMPERVIOUS SELECT MATERIAL PLUG (CLAY, CRUSHED LIMESTONE, ETC., AS SPECIFIED) TO MAXIMUM DEPTH OF PROPOSED CHANNEL AND COMPACT WITH EXCAVATOR BUCKET IN 6-INCH LIFTS.
(C)	PLACE MINIMUM OF 4 INCHES OF TOPSOIL ON STREAM BANKS AND TILL INTO SURFACE OF PLUG, SEED WITH TEMPORARY AND PERMANENT SEED MIXES, AND MULCH LIGHTLY WITH STRAW.
(D)	FOR SHORT-TERM BANK PROTECTION, MULCH SEEDED STREAM BANKS LIGHTLY WITH STRAW AND INSTALL COIR EROSION CONTROL BLANKETS.
(E)	FOR LONG-TERM BANK PROTECTION, INSTALL BANK STABILIZATION (VANE, WOODYTOE, GEOLIFTS, ETC., AS SPECIFIED) AND PLANT WITH WOODY VEGETATION (LIVE STAKES, BRUSH LAYERING, ROOTED PLANTS, ETC., AS SPECIFIED).
(F)	USE THE FOLLOWING PAY ITEM FOR CLAY CHANNEL PLUG: 203-15.03 COMPACTED CLAY PER CY

STREAM MITIGATION PLAN LEGEND:



CLAY CHANNEL PLUG

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

NOT TO SCALE

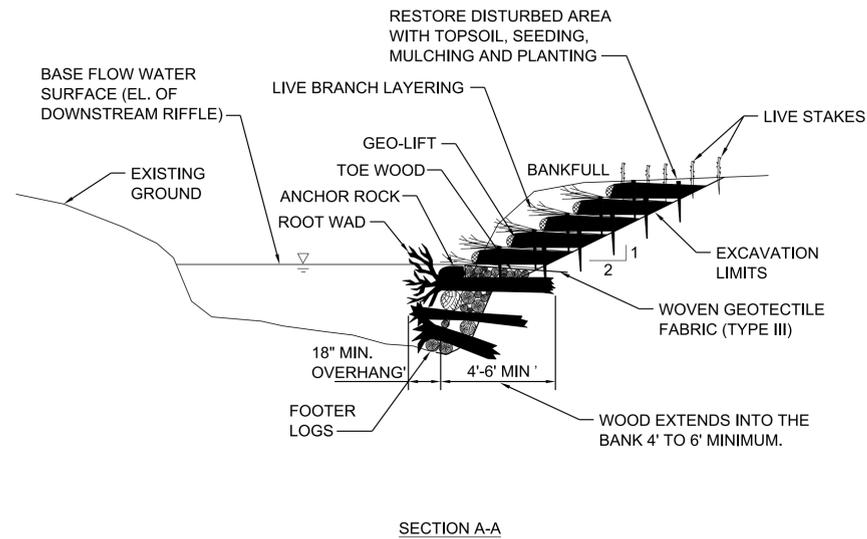
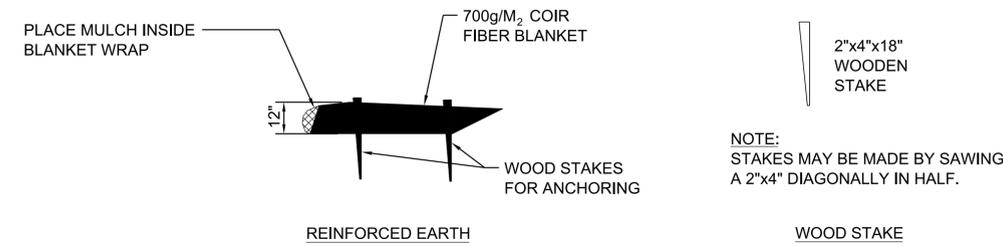
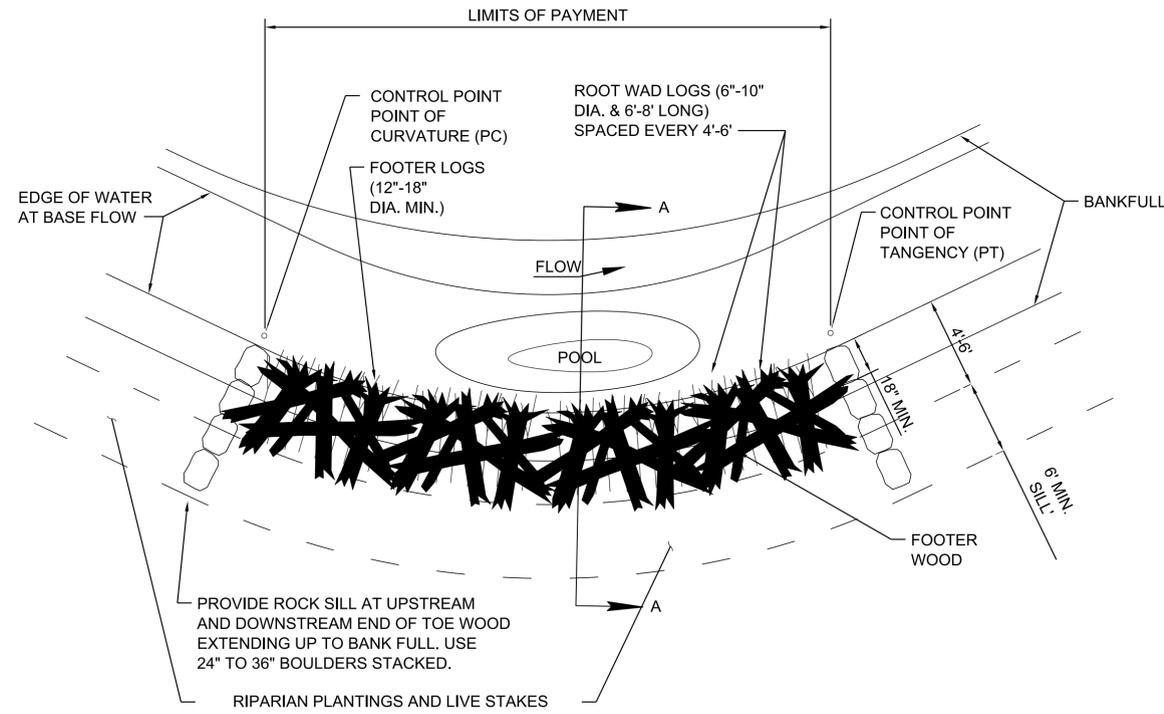
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CLAY CHANNEL
PLUG

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WOOD AND BOULDER TOE WITH GEO-LIFTS NOTES

- (A) WOOD AND BOULDER TOE WITH GEO-LIFTS AND LIVE BRUSH LAYERING ARE BANK STABILIZATION MEASURES THAT PROTECT THE STREAM BANK ALONG OUTSIDE MEANDER BENDS FROM EROSION AND ENHANCE THE ESTABLISHMENT AND GROWTH OF NATIVE VEGETATION USING LIVE BRANCHES AND CUTTINGS. WOOD TOE ALSO PROVIDES HABITAT FOR INVERTEBRATES AND FISH AND HELPS TO MAINTAIN POOL DEPTH BY CREATING TURBULENT FLOW AND SCOUR ALONG THE STREAM BED.
 - (B) WOOD AND BOULDER TOE WITH LIVE BRUSH LAYERING SHOULD BE PLACED AT THE STATIONS, OFFSETS, ELEVATIONS, AND GEOMORPHIC POSITIONS INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE BANKFULL WIDTH, WOOD AND BOULDER DIMENSIONS AND ELEVATIONS, NUMBER AND DIMENSIONS OF GEO-LIFTS, AND LENGTH AND NUMBER OF LIVE BRUSH AND CUTTINGS SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
 - (C) WOOD TOE SHALL CONSIST OF A MIX OF ROOT WADS, LOGS, BRANCHES, BRUSH, AND OTHER WOODY VEGETATION INSTALLED AT VARIOUS ANGLE, BUT NOT PARALLEL TO THE FLOW.
 - (D) BOULDER TOE SHALL BE DURABLE LIMESTONE OF THE SIZE(S) INDICATED ON THE STREAM MITIGATION DATA TABLE, OR AS DIRECTED BY THE ENGINEER.
 - (E) A HYDRAULIC EXCAVATOR WITH A HYDRAULIC THUMB SHALL BE USED TO PLACE WOOD AND BOULDERS.
 - (F) CONSTRUCT WOOD OR BOULDER TOE, GEO-LIFTS, AND LIVE BRUSH LAYERING BY:
 - (1) SHAPE THE CHANNEL AND FLOODPLAIN TO THE SPECIFIED GRADES AND DIMENSIONS.
 - (2) EXCAVATE THE POOL AND GRADE EXISTING BANK SUBGRADE TO 2:1 (MIN).
 - (3) FOR WOOD TOE, LAYER THE WOOD WITH LARGER MATERIAL ON THE BOTTOM AND A MAT OF BRANCHES AS THE TOP LAYER. IF USED, ANGLE ROOT WADS SLIGHTLY UPSTREAM INTO THE FLOW. FILL GAPS BETWEEN LARGER MATERIAL WITH A MIX OF BRANCHES AND WOODY DEBRIS. THE TOP LAYER OF WOOD SHALL BE AT THE ESTABLISHED NORMAL BASE FLOW ELEVATION (I.E., ELEVATION OF THE DOWNSTREAM RIFFLE). PLACE TYPE III WOVEN GEOTEXTILE FABRIC ON TOP OF WOOD TOE.
 - (4) FOR BOULDER TOE, EXCAVATE BANK TO KEY IN BOULDERS AND PLACE TYPE III WOVEN GEOTEXTILE FABRIC ALONG THE EXCAVATED BANK. PLACE BOULDERS IN OVERLAPPING LAYERS AND IMBRICATE EACH LAYER. BACKFILL AREA BEHIND BOULDER WITH SOIL OR ALLUVIUM AND COMPACT WITH EXCAVATOR BUCKET.
 - (5) CONSTRUCT GEO-LIFTS AND LIVE BRUSH LAYERING ABOVE WOOD OR BOULDER TOE, AS FOLLOWS:
 - (a) FOR EACH LIFT, PLACE BRUSH CUTTINGS PERPENDICULAR TO THE BANK AT A DENSITY OF 10-12 STEMS PER FOOT AND COVER WITH TWO INCHES OF SOIL.
 - (b) LAY 700G COIR BLANKETS OVER THE LIVE CUTTINGS PARALLEL TO THE BANK AND SHINGLED IN A DOWNSTREAM DIRECTION.
 - (c) PLACE SPECIFIED SOIL LIFT OVER THE BACK HALF OF THE COIR BLANKET AND COMPACT WITH THE EXCAVATOR BUCKET.
 - (d) PLACE CLEAN STRAW OR MULCH ALONG THE FACE OF THE SOIL LIFT. WRAP THE LIFT WITH THE FRONT HALF OF THE COIR BLANKET AND STAKE IN PLACE WITH A MINIMUM OF TWO ROWS OF 2"x4"x18" WOOD STAKES AT FIVE-FOOT SPACING.
 - (e) REPEAT STEPS (a) THROUGH (d) FOR EACH GEO-LIFT SPECIFIED.
 - (f) PLACE LIVE STAKES OR WOODY PLANTINGS, AS SPECIFIED, ON THE TOP LIFT.
 - (G) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ONSITE CONSTRUCTION OBSERVER.
 - (H) WOOD TOE WITH REINFORCED EARTH AND LIVE BRUSH LAYERING SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 - 209-03.67 STREAM MITIGATION - TOE WOOD WITH REINFORCED EARTH PER LINEAR FOOT
 - 209-03.42 STREAM MITIGATION - LIVE BRUSH LAYERING PER LINEAR FOOT
- BOULDER TOE SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
- 209-03.68 STREAM MITIGATION - BOULDER TOE PER LINEAR FOOT
- PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE TOE WOOD WITH REINFORCED EARTH AND LIVE BRUSH LAYERING.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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WOOD AND
BOULDER TOE
WITH GEO-LIFTS

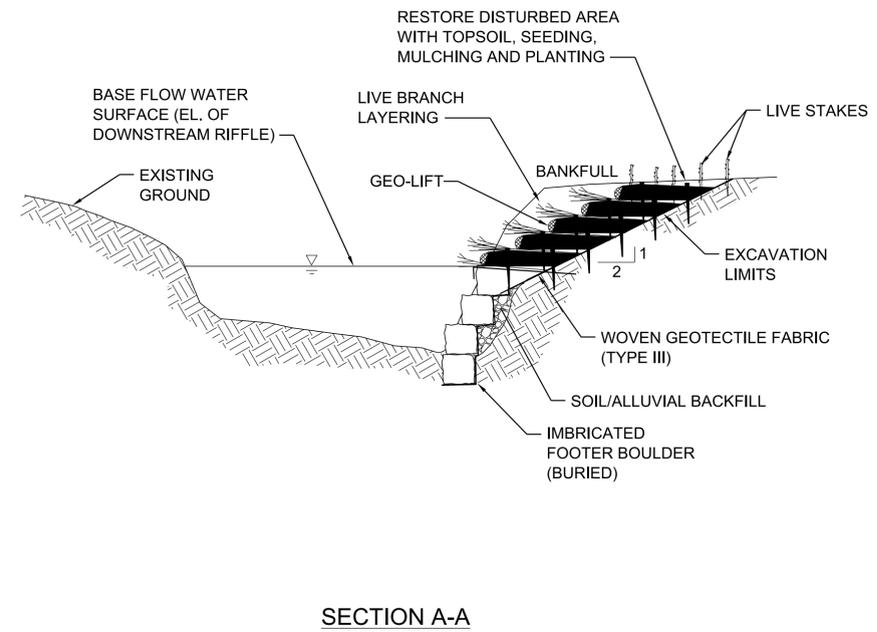
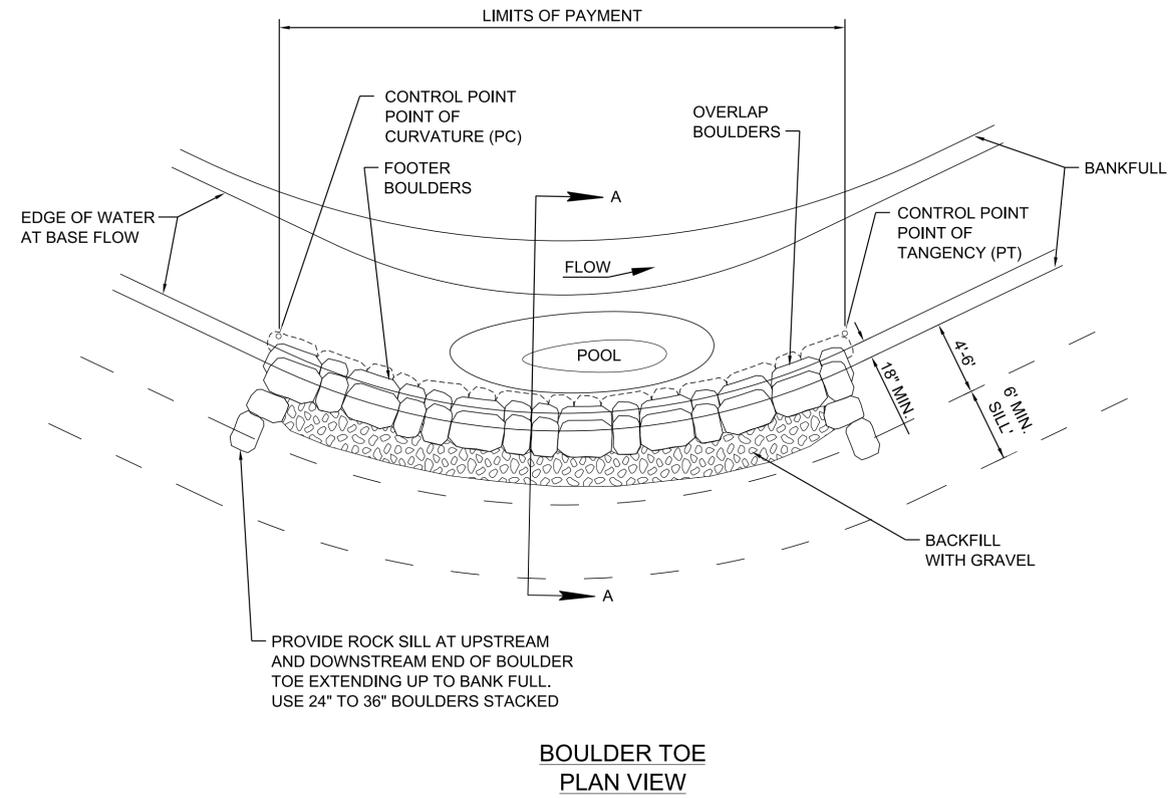
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STREAM MITIGATION PLAN LEGEND:



WOOD AND BOULDER TOE WITH GEO-LIFTS

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STREAM MITIGATION PLAN LEGEND:



WOOD AND BOULDER TOE WITH GEO-LIFTS

SEE D-NSD-32 FOR NOTES

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

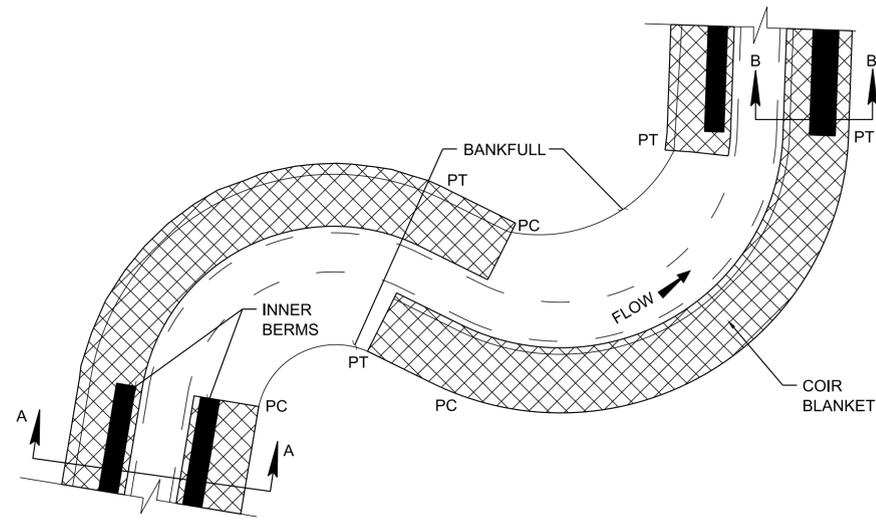
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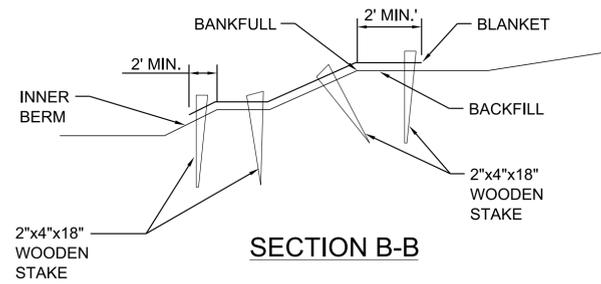
WOOD AND
BOULDER TOE
WITH GEO-LIFTS

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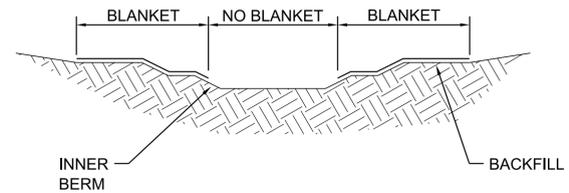
**COIR EROSION CONTROL BLANKET
PLAN**



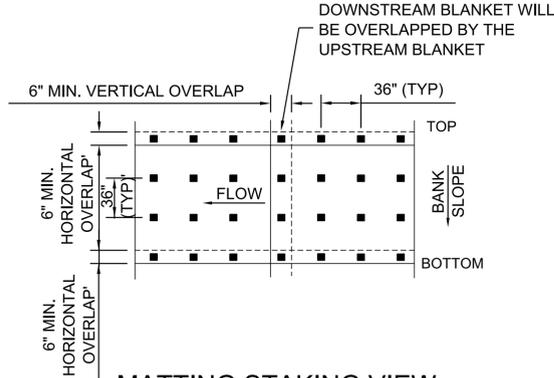
SECTION B-B

NOTE:
STAKES MAY BE MADE BY SAWING
A 2"x4" DIAGONALLY IN HALF.

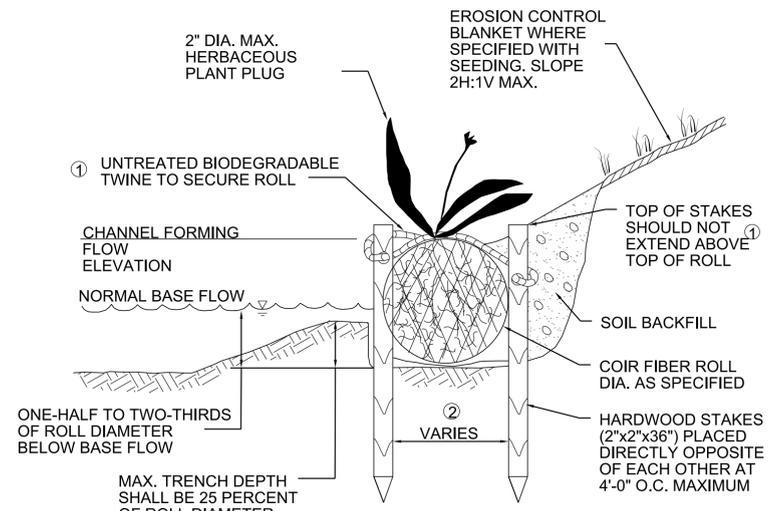
WOOD STAKE



SECTION A-A

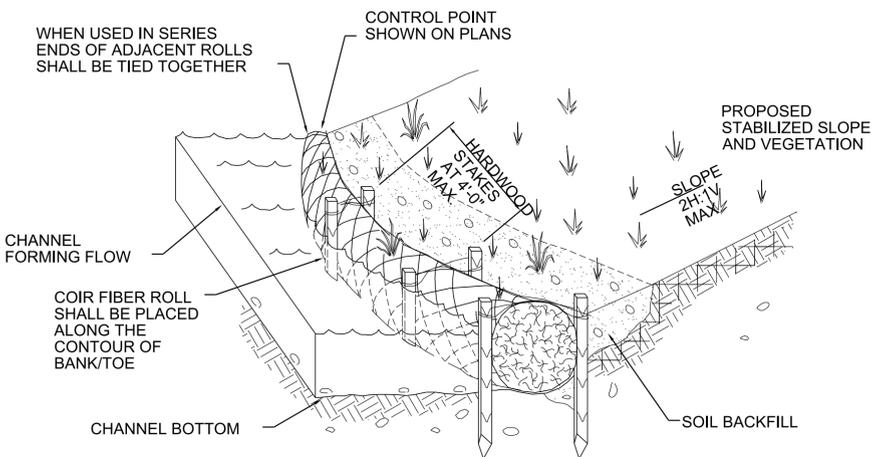


MATTING STAKING VIEW



**SECTION VIEW
COIR FIBER ROLL**

NOTE ①: DRIVE STAKES AS NEEDED SO TWINE IS SECURED AGAINST TOP OF ROLL.
NOTE ②: SPACING VARIES BASED ON ROLL DIAMETER 8, 12, 16, 18, 20-INCH (TYP.)



**ISOMETRIC VIEW
COIR FIBER ROLL**

FULL OR PARTIAL SUN
REQUIRED FOR USE

COIR FIBER ROLL NOTES

- (A) COIR FIBER ROLLS ARE A FLEXIBLE BANK STABILIZATION MEASURE CONSISTING OF INTERWOVEN COCONUT HUSK FIBERS THAT CAN BE FITTED TO THE CURVATURE OF A STREAM BANK PROVIDING IMMEDIATE TOE PROTECTION AND BANK STABILIZATION. COIR FIBER ROLLS ARE USED TO ENHANCE THE ESTABLISHMENT AND GROWTH OF NATIVE VEGETATION ALONG THE STREAM BANK BY TRAPPING SEDIMENT BEHIND THE ROLL PROVIDING A SUBSTRATE FOR PLANT GROWTH. EFFECTIVE LIFE 2 TO 3 YEARS.
- (B) COIR FIBER ROLLS ARE AN ACCEPTABLE MITIGATION PRACTICE FOR USE IN STREAMS AND ALONG THE SHORELINE OF PONDS AND WETLANDS.
- (C) COIR FIBER ROLLS MAY BE USED IN COMBINATION WITH LONGITUDINAL STONE TOES, ROOT WADS, LIVE SILTATION, OR OTHER BANK STABILIZATION MEASURES.
- (D) COIR FIBER ROLLS SHOULD NOT BE USED WHEN CHANNEL FLOW VELOCITY EXCEEDS 10 FEET PER SECOND, WHERE CHANNEL SHEAR STRESSES ARE MODERATE TO HIGH ALONG THE BANK, IN BEDROCK CHANNELS, IN CHANNELS WHERE SCOUR IS PRESENT OR EXPECTED, OR IN STREAMS WHERE SIGNIFICANT DEBRIS LOAD IS EXPECTED.
- (E) COIR FIBER ROLLS SHOULD BE CONSTRUCTED AT THE TOE OF A STREAM BANK TO A HEIGHT EQUAL TO THE CHANNEL FORMING FLOW ELEVATION.
- (F) COIR FIBER ROLLS SHALL BE SEATED IN A SHALLOW HAND-CUT TRENCH SLIGHTLY BELOW THE CHANNEL BOTTOM ELEVATION. COIR FIBER ROLL SHALL BE IN CONTACT WITH THE WATER, SUBMERGED FROM ONE-HALF TO TWO-THIRDS OF THE ROLL DIAMETER.
- (G) ENDS OF COIR FIBER ROLLS SHALL BE TURNED IN AND BURIED WITHIN THE BANK TO PREVENT WATER FROM INTRUDING BEHIND THE ROLL.
- (H) VEGETATION (SPECIES) USED FOR HERBACEOUS PLUGS TO BE INSTALLED IN THE TOP OF COIR FIBER ROLLS SHALL BE APPROVED BY THE ENVIRONMENTAL DIVISION. LIVE DORMANT STAKES MAY BE USED FOR PLUGS.
- (I) COIR FIBER ROLLS SHALL BE KEPT DRY PRIOR TO INSTALLATION.
- (J) COIR FIBER ROLLS SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
209-03.31 STREAM MITIGATION - COCONUT FIBER ROLLS PER LINEAR FOOT

EROSION CONTROL BLANKETS AND HERBACEOUS PLANT PLUGS SHALL BE PAID FOR ACCORDING TO THEIR RESPECTIVE ITEM NUMBERS.

PAYMENT FOR COIR FIBER ROLLS SHALL INCLUDE ALL MATERIALS AND LABOR NECESSARY FOR THE INSTALLATION OF THE COIR FIBER ROLL.

COIR FIBER EROSION CONTROL BLANKET NOTES

- (A) COIR FIBER EROSION CONTROL BLANKETS PROVIDE TEMPORARY BANK STABILIZATION FOLLOWING BANK GRADING, UNTIL PERMANENT VEGETATION CAN BE ESTABLISHED.
- (B) COIR FIBER EROSION CONTROL BLANKETS SHALL BE 700 GRAMS PER SQUARE METER.
- (C) BEFORE INSTALLING COIR BLANKETS, RAKE OR TILL THE UPPER THREE TO FOUR INCHES OF THE SOIL ON THE STREAM BANKS, SEED WITH TEMPORARY AND PERMANENT SEED MIXES, RAKE SOIL LEVEL, AND LIGHTLY MULCH WITH CLEAN STRAW.
- (D) COIR BLANKETS SHALL BE INSTALLED ON THE OUTSIDE OF BANKS OF MEANDERS AND ON BOTH BANKS ALONG RIFFLES, FROM THE INNER BERM OF THE CHANNEL TO TWO FEET (MIN.) BEYOND BANKFULL. BLANKET MAY BE ELIMINATED FROM THE INNER BERM AT THE DISCRETION OF THE ENGINEER.
- (E) PLACE COIR BLANKETS PARALLEL TO THE CHANNEL. WHERE MULTIPLE PANELS OF BLANKETS ARE USED, PANELS SHALL BE OVERLAPPED A MINIMUM OF SIX INCHES, IN A DOWNSTREAM AND DOWNSLOPE DIRECTION.
- (F) PULL BLANKETS TIGHT, BUT MAINTAIN CONTACT WITH THE SOIL. USE 2-INCH X 4-INCH X 18-INCH WOODEN STAKES ON THREE-FOOT CENTERS TO SECURE COIR BLANKETS.
- (G) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
- (H) COIR FIBER EROSION CONTROL BLANKETS SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
805-12.08 COIR FIBER EROSION CONTROL BLANKETS PER SY

SEED AND MULCH SHALL BE PAID FOR ACCORDING TO THEIR RESPECTIVE ITEM NUMBERS. PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR TO INSTALL THE COIR FIBER EROSION CONTROL BLANKETS.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

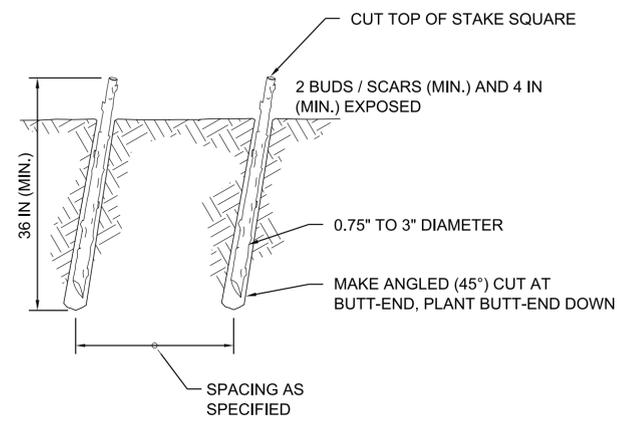
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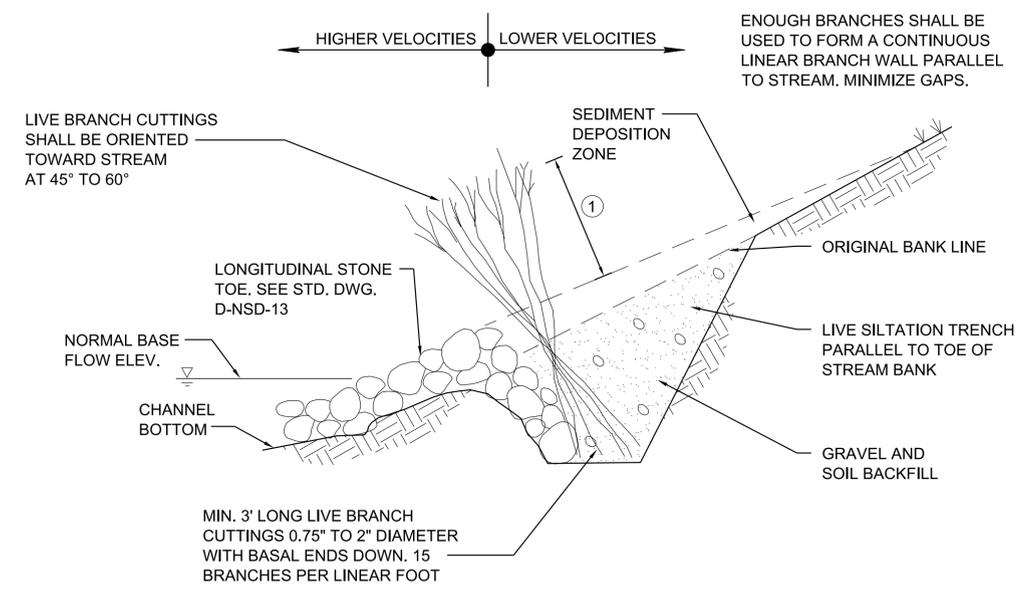
**COIR FIBER
EROSION CONTROL
BLANKET AND COIR
FIBER ROLLS**

STREAM MITIGATION PLAN LEGEND: **ROLL**ROLL**ROLL** COCONUT FIBER ROLLS

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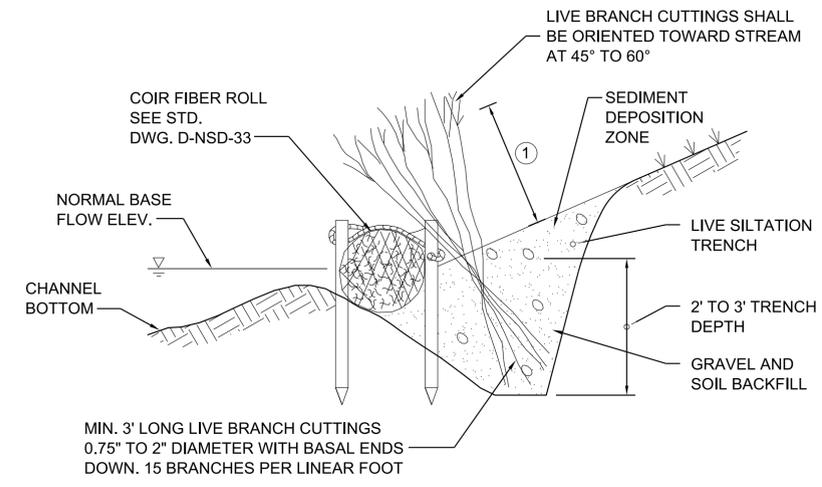


LIVE STAKE



SECTION VIEW - LIVE SILTATION WITH STONE TOE

NOTE ①: 1/3 OF THE BRANCH LENGTH SHALL BE ABOVE TRENCH



SECTION VIEW - LIVE SILTATION WITH COIR FIBER ROLL

NOTE ①: 1/3 OF THE BRANCH LENGTH SHALL BE ABOVE TRENCH

LIVE STAKES NOTES

- (A) LIVE STAKES ARE USED FOR VEGETATIVE STREAM BANK STABILIZATION AND RIPARIAN HABITAT RESTORATION.
 - (B) LIVE STAKES SHOULD BE PLACED AT THE STATIONS, OFFSETS, AND ELEVATIONS INDICATED ON THE STREAM MITIGATION DATA TABLE IN THE PROJECT PLANS, STREAM MITIGATION PLAN, OR AS DIRECTED BY THE ENGINEER. AT A MINIMUM, THE TYPE (SPECIES), SIZE, SPACING, AND QUANTITY OF LIVE STAKES SHOULD BE SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
 - (C) LIVE STAKES SHALL CONSIST OF WOODY LIVE CUTTINGS OF FAST-GROWING SHRUBS AND TREES (SUCH AS WILLOWS, DOGWOODS, BUTTONBUSH, ETC.), WHICH ARE CAPABLE OF GENERATING ROOTS FROM CUTTINGS WHEN PLACED IN WET OR MOIST SOIL.
 - (D) LIVE STAKES SHALL BE AT LEAST ONE YEAR OLD, 0.75 INCH TO 3 INCHES IN DIAMETER, AND A MINIMUM OF 3 FEET LONG, WITH MOIST, GREEN, AND HEALTHY CAMBIUM AND GROWING LEAF BUDS LESS THAN 0.25 INCH. THE MAXIMUM LENGTH OF LIVE STAKES DEPENDS ON THE APPLICATION, AND SHALL BE AS SPECIFIED. WHEN LIVE STAKES ARE INSERTED IN RIP RAP OR STONE FILL, THEY SHALL BE LONG ENOUGH TO EXTEND THROUGH THE SURFACE OF THE RIP RAP OR STONE FILL AND AT LEAST HALF THE LENGTH SHALL BE INSERTED INTO THE SOIL, BELOW THE RIP RAP OR STONE FILL.
 - (E) INSTALLING LIVE STAKES:
 - (1) LIVE STAKES HARVESTED DURING DORMANCY SHALL BE MAINTAINED IN COLD STORAGE UNDER MOIST CONDITIONS. SOAK THE BASE OF DORMANT-HARVESTED LIVE STAKES IN WATER AT LEAST 24 HOURS BEFORE PLANTING.
 - (2) LIVE STAKES HARVESTED ON SITE SHOULD BE INSTALLED THE SAME DAY THEY ARE PREPARED.
 - (3) PRIOR TO PLANTING, LIVE STAKES SHALL BE MAINTAINED IN A CONTINUOUSLY COOL, COVERED, AND MOIST STATE, WITH THE BASES SOAKING IN WATER.
 - (4) CARE SHALL BE TAKEN NOT TO DAMAGE LIVE STAKES DURING INSTALLATION. THOSE DAMAGED SHALL BE LEFT IN PLACE AND SUPPLEMENTED WITH AN INTACT LIVE CUTTING/LIVE STAKE.
 - (5) USE A DIGGING BAR, DIBBLE, OR SIMILAR TOOL TO MAKE A PILOT HOLE IN THE BANK 15 TO 18 INCHES DEEP.
 - (6) PLACE THE LIVE STAKE IN THE PILOT HOLE, SO THAT A MINIMUM OF 4 INCHES AND TWO LIVE BUDS OF THE LIVE STAKE ARE EXPOSED.
 - (7) TAMP THE SOIL AROUND LIVE STAKES.
 - (F) ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ON-SITE CONSTRUCTION OBSERVER.
 - (G) LIVE STAKES SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
 - 802-02.40 CUTTINGS: SALIX NIGRA (24-48IN LENGTH) PER EACH
 - 802-02.41 CUTTINGS: SALIX SERICEA (24-48IN) PER EACH
 - 802-02.42 CUTTINGS: CORNUS AMOMUM (24-48IN) PER EACH
 - 802-02.43 CUTTINGS: SAMBUCUS CANADENSIS (24-48IN) PER EACH
 - 802-02.44 CUTTINGS: SALIX INTERIOR (24-48IN) PER EACH
 - 802-02.45 CUTTINGS: CEPHALANTHUS OCCIDENTALIS (24-48IN) PER EACH
 - 802-02.46 CUTTINGS: CORNUS SERICEA (24-48IN) PER EACH
 - 802-02.47 CUTTINGS: ALNUS SERRULATA (24-48IN) PER EACH
- PAYMENT SHALL INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR TO INSTALL THE LIVE STAKES.

LIVE SILTATION NOTES

- (A) LIVE SILTATION IS A BANK STABILIZATION MEASURE THAT NATURALLY REBUILDS A STREAM BANK THAT HAS ERODED BY SLOWING THE FLOW VELOCITY RESULTING IN THE DEPOSITION OF SEDIMENT DURING HIGH FLOWS. LIVE SILTATION ALSO ENHANCES THE ESTABLISHMENT AND GROWTH OF NATIVE VEGETATION ALONG THE STREAM BANK BY TRAPPING SEED AND ORGANIC MATERIAL ALONG THE SHORE LINE.
 - (B) LIVE SILTATION SHOULD BE CONSTRUCTED AT THE TOE OF A STREAM BANK BEHIND ANY OTHER TOE OF SLOPE PROTECTION AND AT THE NORMAL BASE FLOW ELEVATION.
 - (C) LIVE SILTATION SHOULD BE USED IN COMBINATION WITH LONGITUDINAL STONE TOE, ROOT WADS, OR COIR FIBER ROLLS.
 - (D) ALLOWABLE VELOCITY OF FLOW FOR USING LIVE SILTATION SHALL BE 0.8 FT/SEC TO A MAXIMUM OF 6.6 FT/SEC WHEN USED WITH OTHER TOE STABILIZATION MEASURES. LIVE SILTATION MAY BE USED FOR FLOWS UP TO 12 FT/SEC MAXIMUM.
 - (E) LIVE SILTATION MAY BE USED AT THE INSIDE OF A MEANDER BEND, WITHIN A SIDE CHANNEL, IN AREAS WHERE BANK SCOUR HAS OCCURRED, OR AT LOCATIONS WHERE THE FORMATION OF A NEW BANK IS DESIRED.
 - (F) MULTIPLE ROWS OF LIVE SILTATION MAY BE USED PARALLEL TO THE STREAM BANK AND TO EACH OTHER. SPACING OF ROWS SHALL BE 5 TO 10 FEET.
 - (G) CONSTRUCTION OF LIVE SILTATION SHOULD BE PERFORMED DURING THE DORMANT SEASON AND DURING LOW FLOW CONDITIONS.
- LIVE SILTATION SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
- 209-03.46 STREAM MITIGATION - LIVE SILTATION (SPECIES) PER CUBIC YARD
- (H) LONGITUDINAL STONE TOE AND COIR FIBER ROLLS SHALL BE PAID FOR ACCORDING TO THEIR RESPECTIVE STANDARD DRAWING.
- PAYMENT FOR LIVE SILTATION SHALL INCLUDE ALL MATERIALS AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE LIVE SILTATION SYSTEM.

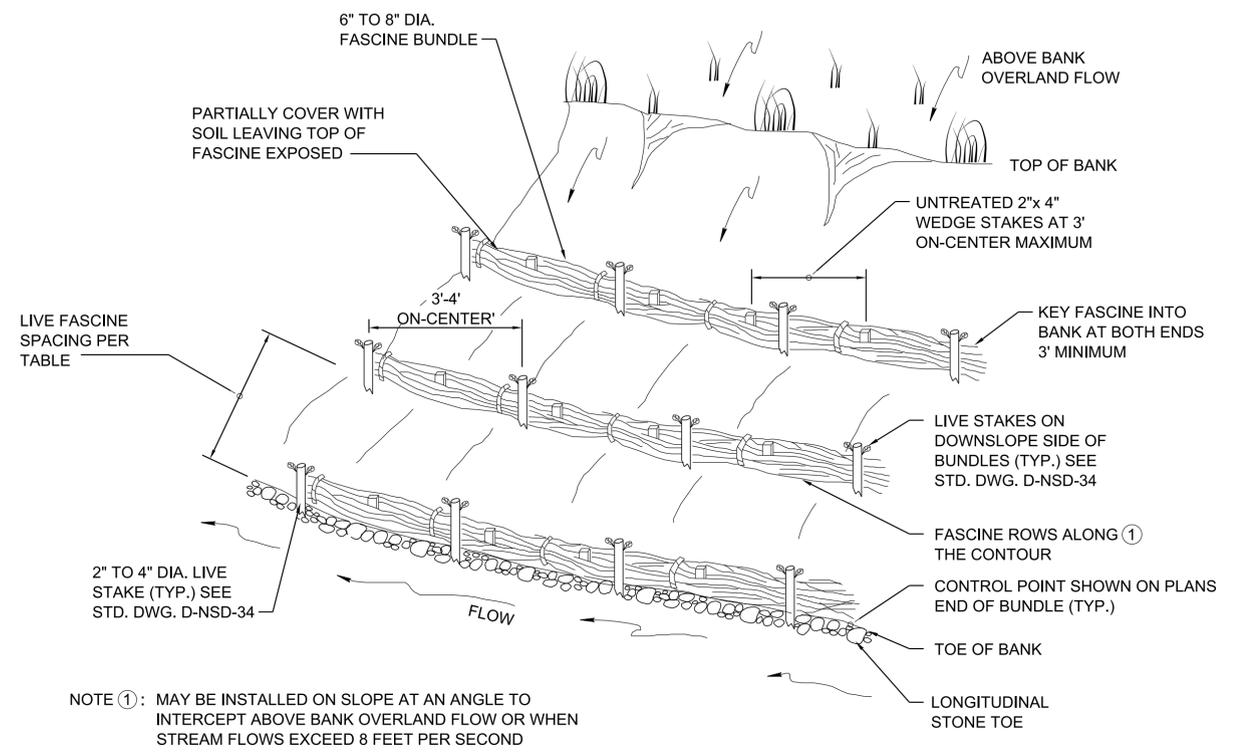
MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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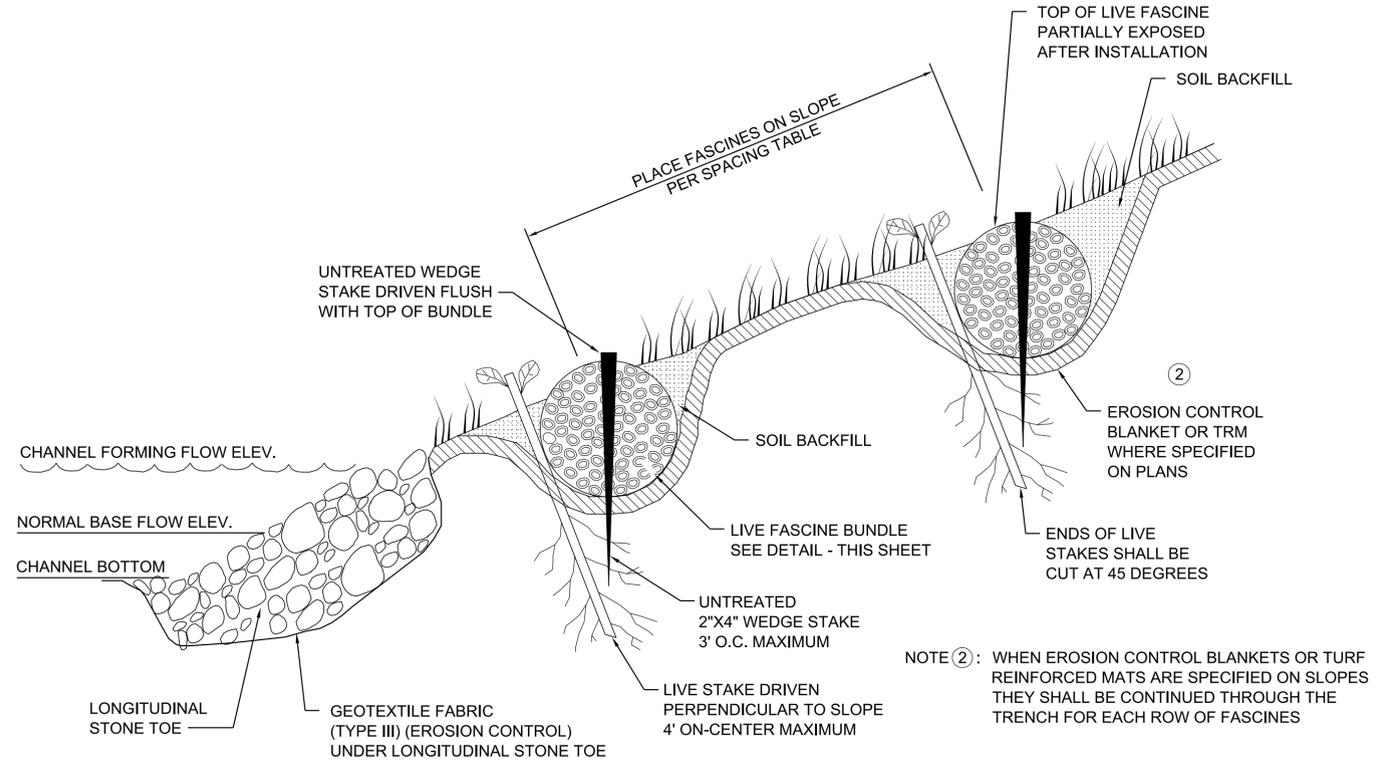
LIVE STAKES AND
LIVE SILTATION

STREAM MITIGATION PLAN LEGEND: ↓ ↓ LS ↓ ↓ LS ↓ ↓ LS ↓ ↓ LIVE SILTATION

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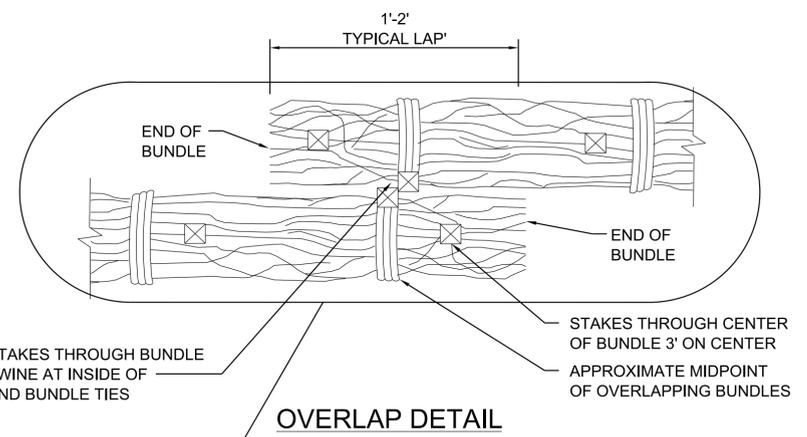
ISOMETRIC VIEW
SHOWN ON SURFACE FOR CLARITY FASCINES SHALL BE TRENCHED IN AS SHOWN IN SECTION VIEW



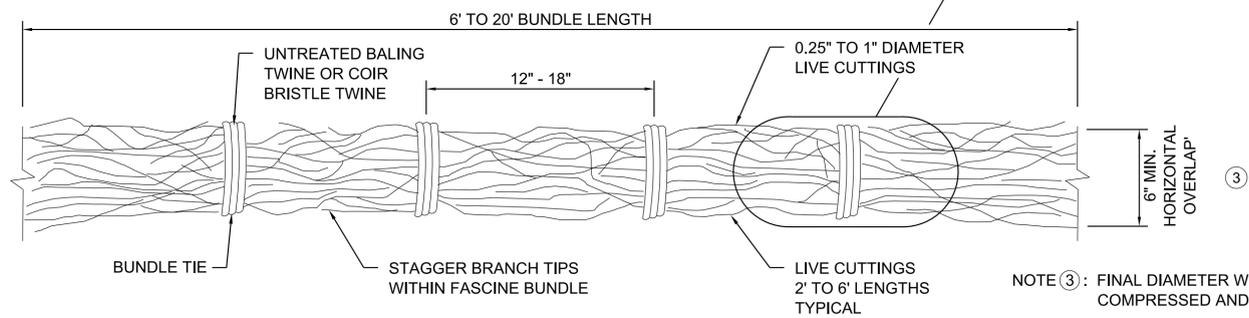
SECTION VIEW

LIVE FASCINE SPACING (FEET)		
SLOPE	SOIL TYPE	
	COHESIVE	NON-COHESIVE
1H:1V	3*	NA
1H:1V-2H:1V	3-4*	NA
2H:1V-3H:1V	4-5*	3-4*
3H:1V-4H:1V	5-6	4-5*
4:1 OR FLATTER	6-8	5-7

* USE OF AN EROSION CONTROL BLANKET BETWEEN THE LIVE FASCINE AND BANK RECOMMENDED



OVERLAP DETAIL



LIVE FASCINES DETAIL

STREAM MITIGATION PLAN LEGEND: $\nabla \nabla \nabla$ LF $\nabla \nabla \nabla$ LF $\nabla \nabla \nabla$ LIVE FASCINE

LIVE FASCINES NOTES

(A) LIVE FASCINES ARE CYLINDRICAL BUNDLES OF LIVE BRANCH CUTTINGS USED AS A BANK STABILIZATION MEASURE TO PROTECT A BANK AND TOE FROM SURFACE EROSION, TRAP SEDIMENTS, AND INCREASE SLOPE STABILITY WITH A DEVELOPED ROOT SYSTEM. FASCINES ARE USED ABOVE THE BASE FLOW ELEVATION OF A SLOPE TO TRAP SEED AND SEDIMENT AND TO ENHANCE CONDITIONS FOR COLONIZATION OF NATIVE VEGETATION USED IN THE BUNDLES.

(B) CONSTRUCTION OF FASCINES ON SLOPES SHALL CONFORM TO ASTM D6599.

(C) THIS MEASURE MAY BE COMBINED WITH OTHER SLOPE STABILIZATION MEASURES INCLUDING LIVE STAKES, EROSION CONTROL BLANKET, TURF REINFORCED MAT, BRUSH MATTRESSES, AND LONGITUDINAL STONE TOE.

(D) NOT SUITABLE FOR USE ON SLOPES COMPRISED OF SAND, GRAVEL, OR ROCK, OR ON SLOPES THAT ARE NOT IN FULL SUNLIGHT. FASCINES SHALL NOT BE USED WHERE THEY WILL BE SUBJECTED TO CONCENTRATED FLOW FROM ABOVE THE STREAMBANK OR WHERE CHANNEL FLOW VELOCITIES EXCEED 12 FEET PER SECOND.

(E) FASCINES SHALL BE PLACED ON A SLOPE ALONG THE CONTOUR AND SHALL BE KEYED INTO BANK AT BOTH ENDS OF THE FASCINE ROW A MINIMUM OF 3 FEET.

(F) FASCINE BUNDLES SHALL BE CONSTRUCTED OF LIVE DORMANT BRANCH CUTTINGS RANDOMLY BOUND TOGETHER WITH UNTREATED TWINE EVERY 12 TO 18 INCHES. BASAL (CUT) ENDS OF BRANCHES SHALL BE ALTERNATING WITHIN THE FASCINE BUNDLE.

(G) FASCINES SHALL BE OVERLAPPED AT THE ENDS A MINIMUM OF ONE FOOT WITH THE UPSTREAM FASCINE OVERLAPPING BELOW THE DOWNSTREAM FASCINE.

(H) UNTREATED 2"x4" WEDGE STAKES SHALL BE INSTALLED FLUSH WITH THE TOP OF THE FASCINE BUNDLES AND SHALL BE SPACED AT 3 FEET ON-CENTER MAXIMUM.

(I) LIVE DORMANT BRANCH CUTTINGS SHALL BE OBTAINED FROM LOCAL SOURCES APPROVED BY THE ENGINEER.

(J) LIVE FASCINES SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:
209-03.45 STREAM MITIGATION - LIVE FASCINES (SPECIES) PER LINEAR FOOT

LIVE STAKES, LONGITUDINAL STONE TOE, EROSION CONTROL BLANKETS AND TURF REINFORCED MATS SHALL BE PAID FOR ACCORDING TO THEIR RESPECTIVE ITEM NUMBERS.

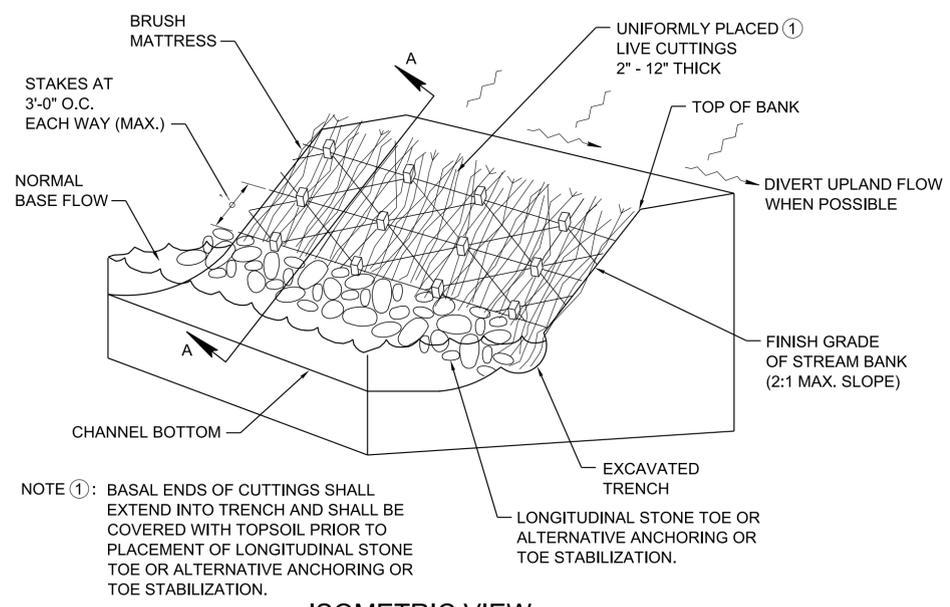
PAYMENT FOR LIVE FASCINES SHALL INCLUDE ALL MATERIALS AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE LIVE FASCINE.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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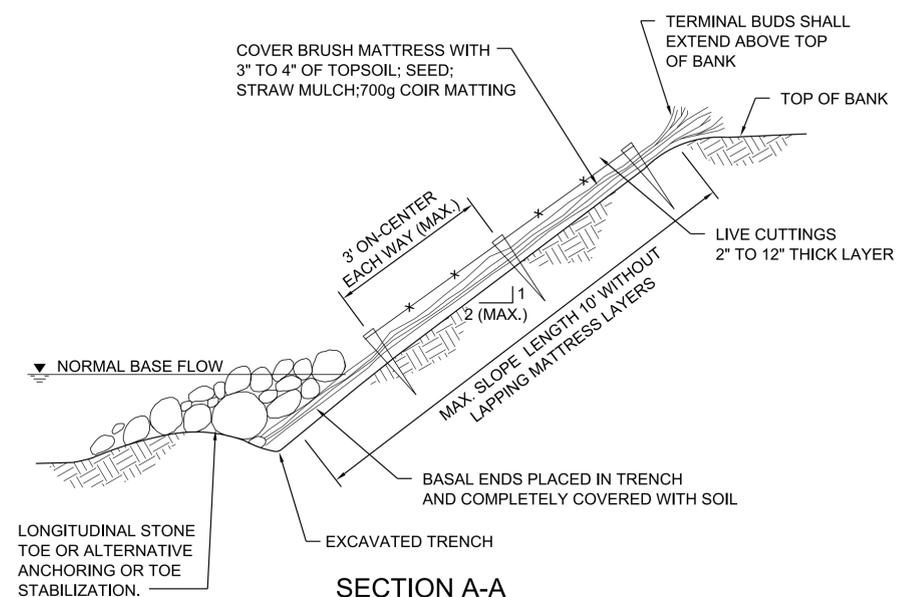
LIVE FASCINES

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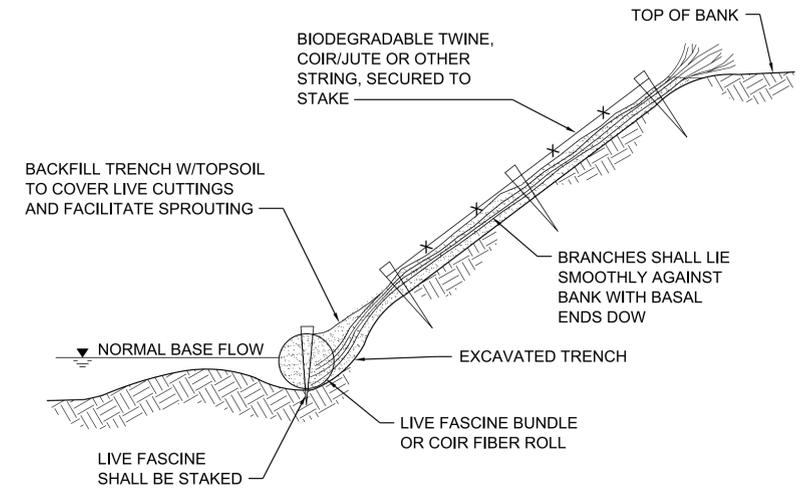


NOTE ①: BASAL ENDS OF CUTTINGS SHALL EXTEND INTO TRENCH AND SHALL BE COVERED WITH TOPSOIL PRIOR TO PLACEMENT OF LONGITUDINAL STONE TOE OR ALTERNATIVE ANCHORING OR TOE STABILIZATION.

ISOMETRIC VIEW

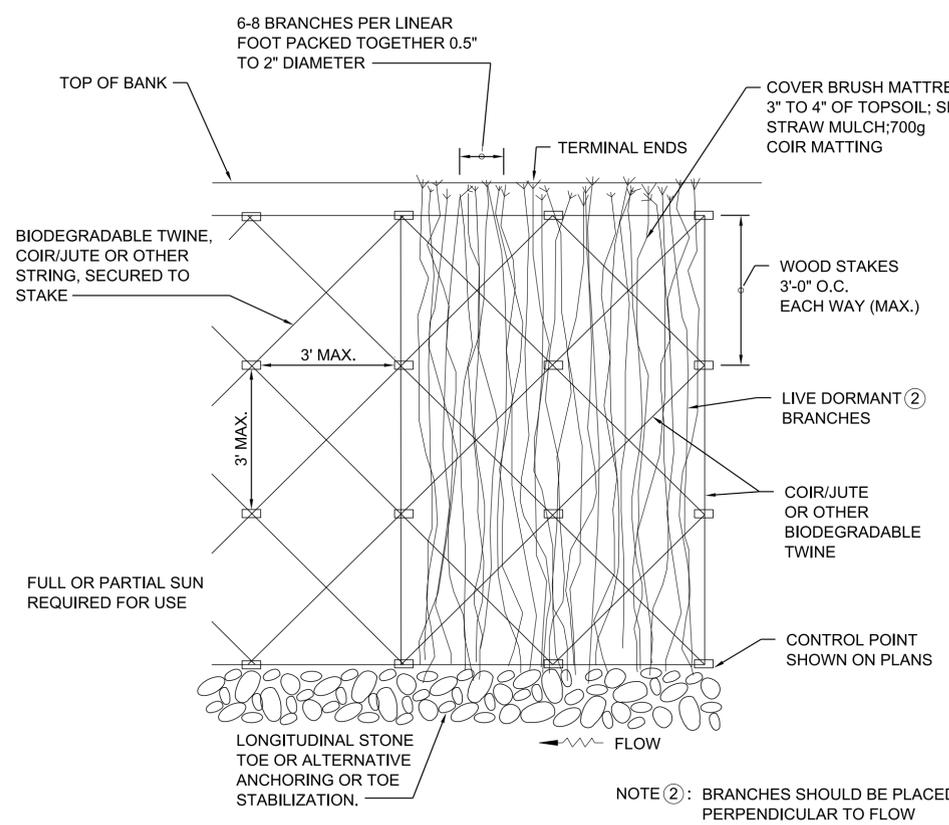


SECTION A-A



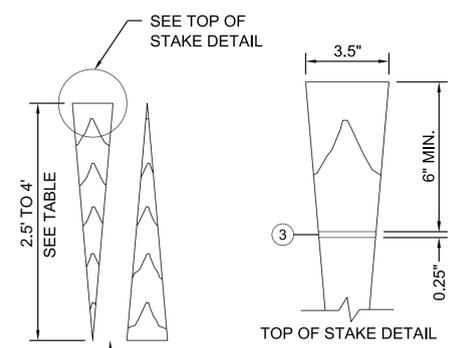
EXAMPLE OF ALTERNATIVE STABILIZATION AT TOE OF SLOPE

STREAM MITIGATION PLAN LEGEND: BRUSH MATTRESS



NOTE ②: BRANCHES SHOULD BE PLACED PERPENDICULAR TO FLOW

PLAN VIEW



BRUSH MATTRESS STAKE DETAIL

STAKE LENGTH	
SOIL TYPE	LENGTH (FEET)
CLAY	2.5
SILT	3.0
SAND	4.0
LOAM	2.5

BRUSH MATTRESS NOTES

- (A) BRUSH MATTRESS IS A BANK STABILIZATION PRACTICE THAT PROTECTS A STREAMBANK FROM EROSION, CAPTURES SEDIMENT DURING HIGH FLOWS, AND ENHANCES THE ESTABLISHMENT AND GROWTH OF NATIVE VEGETATION USING LIVE BRANCHES AND CUTTINGS ANCHORED TO THE STREAM BANK.
- (B) BRUSH MATTRESSES SHOULD NOT BE USED WHERE PERENNIAL (YEAR ROUND) STREAM FLOW IS NOT PRESENT OR ALONG STREAMS WITH ANTICIPATED HIGH SEDIMENT LOADS.
- (C) LIVE DORMANT CUTTINGS SHALL BE PLACED ON THE SLOPE PERPENDICULAR TO THE STREAM AND THE MATTRESS SHALL BE BETWEEN 2 INCHES AND 12 INCHES THICK. CUTTINGS SHALL BE STRAIGHT, FLEXIBLE BRANCHES OF WILLOW, SHRUB DOGWOOD, OR OTHER APPROVED SPECIES.
- (D) LIVE DORMANT CUTTINGS OR BRANCHES SHALL BE A MINIMUM OF 0.5-INCHES IN DIAMETER AT THE BASAL END AND NO GREATER THAN 2 INCHES. BASAL ENDS OF THE BRANCHES SHOULD BE CUT AT A 30 TO 45 DEGREE ANGLE AND SHALL BE INSTALLED BELOW THE NORMAL BASE FLOW ELEVATION IN THE TRENCH.
- (E) MAXIMUM GRADE OF SLOPE FOR BRUSH MATTRESS SHALL BE 2H:1V OR FLATTER AND SHALL BE UNIFORMLY GRADED AND SHAPED TO PROVIDE ADEQUATE SOIL TO STEM CONTACT. MAXIMUM FACE LENGTH OF SLOPE SHALL BE 10 FEET. WHERE LONGER SLOPES ARE PRESENT, USE MULTIPLE ROWS OF BRUSH MATTRESS WITH MINIMUM 1 FOOT OVERLAP. TERMINAL ENDS OF LOWER ROW SHALL LAP OVER THE BASAL ENDS OF UPPER ROW.
- (F) CARE SHOULD BE TAKEN WHEN INSTALLING LONGITUDINAL STONE TOE, COIR FIBER ROLLS OR LIVE FASCINES IN TRENCH TO AVOID PUTTING THE BRANCHES IN TENSION AND LIFTING THEM FROM THE STREAMBANK.
- (G) ROCK FOR LONGITUDINAL STONE TOE OR ALTERNATIVE TOE STABILIZATION SHALL BE SIZED ACCORDING TO COMPUTED FLOW VELOCITY AND SHEAR STRESS ALONG THE BANK. FOR ADDITIONAL DETAILS OF LONGITUDINAL STONE TOE SEE STANDARD DRAWING D-NSD-13. FOR DETAILS OF LIVE FASCINES SEE STANDARD DRAWING D-NSD-35.
- (H) WOOD STAKES MAY BE STANDARD COMMERCIAL GRADE UNTREATED LUMBER CUT TO LENGTH, RIPPED LENGTHWISE TO PRODUCE TWO WEDGE SHAPED STAKES, AND NOTCHED AT THE TOP TO ACCEPT 1 TURN OF THE TWINE, STRING, OR BIODEGRADABLE WIRE WITHIN THE NOTCH. WHERE DORMANT LIVE STAKES ARE USED INSTEAD OF DEAD STAKES, NOTCH FOR TWINE SHALL BE OMITTED. NON-BIODEGRADABLE STAKES ARE NOT PERMITTED FOR USE WITH BRUSH MATTRESS.
- (I) TYPICAL INSTALLATION SEQUENCE:
 - (1) COLLECT AND SOAK LIVE BRANCHES A MINIMUM OF 24 HOURS. 5-7 DAYS PREFERRED. LEAVE SIDE BRANCHES INTACT.
 - (2) EXCAVATE BANK TO DESIRED GRADE CLEARING AWAY LARGE DEBRIS.
 - (3) EXCAVATE AN 8 TO 12-INCH DEEP HORIZONTAL TRENCH AT THE TOE OF SLOPE. LAY CUTTINGS FLAT AGAINST THE SLOPE WITH BASAL ENDS PLACED DEEPLY IN THE TRENCH EXPOSED TO MOIST SOIL.
 - (4) INSTALL WEDGE STAKES OR LIVE STAKES LEAVING APPROXIMATELY 12 INCHES OF THE TOP OF STAKE EXPOSED. DISCARD AND REPLACE SHATTERED STAKES.
 - (5) TIE TWINE, STRING, OR OTHER BIODEGRADABLE WIRE AROUND STAKES IN A DIAGONAL PATTERN BETWEEN EACH ROW OF STAKES.
 - (6) DRIVE THE STAKES IN FURTHER TO COMPRESS THE MATTRESS AGAINST THE SLOPE LEAVING A MINIMUM OF 6 INCHES OF THE STAKE ABOVE THE MATTRESS.
 - (7) INSTALL LONGITUDINAL STONE TOE OR OTHER APPROVED ALTERNATE IN TRENCH.
 - (8) BACKFILL IN AND BETWEEN THE BRANCHES WITH LOOSE MATERIAL UNTIL APPROXIMATELY HALF THE MATTRESS REMAINS EXPOSED. WET THE SURFACE TO WASH SOIL DOWN BETWEEN THE BRANCHES.
 - (9) COVER BRUSH MATTRESS WITH 3-4 INCHES OF TOPSOIL TO PROVIDE ROOTING MEDIUM. SPREAD TEMPORARY AND PERMANENT SEED MIX, STRAW MUCH AND MEDIUM. INSTALL COIR MATTING OVER BRUSH MATTRESS.
- (J) ALL TWINE, STRING, WIRE OR OTHER MEASURES USED FOR SECURING MATTRESS TO STAKES SHALL BE BIODEGRADABLE. WHERE COIR TWINE IS USED, IT SHALL BE MACHINE SPUN BRISTLE COIR OF 0.2 TO 0.25-INCH THICKNESS WITH BREAK STRENGTH OF 70 TO 100 POUNDS. JUTE OR OTHER BIODEGRADABLE MATERIAL IS ACCEPTABLE. BRANCHES SHALL BE FLEXIBLE ENOUGH TO CONFORM TO ANY SLOPE SURFACE IRREGULARITIES AND SHOULD BE INSTALLED DURING DORMANT SEASON.
- (K) BRUSH MATTRESS SHALL BE PAID FOR UNDER THE FOLLOWING ITEM NUMBER:

209-03.59 STREAM MITIGATION - BRUSH MATTRESS PER SQUARE YARD

LONGITUDINAL STONE TOE, COIR FIBER ROLL, AND LIVE FASCINE BUNDLES SHALL BE PAID FOR ACCORDING TO THEIR RESPECTIVE STANDARD DRAWINGS.

PAYMENT FOR BRUSH MATTRESS SHALL INCLUDE ALL MATERIALS AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE MATTRESS.

MATERIAL SHOWN ARE ONLY A GRAPHICAL REPRESENTATION AND DO NOT DEPICT THE ACTUAL DEPTH OR QUANTITY OF MATERIALS TO APPROPRIATELY CONSTRUCT OR STABILIZE THE CHANNEL.

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BRUSH MATTRESS

- (A) AS-BUILT DRAWINGS - DURING CONSTRUCTION, THE CONTRACTOR AND THE ENGINEER SHALL WORK TOGETHER TO MAINTAIN A SET OF PRINTS SHOWING ANY CHANGES OR CORRECTIONS IN RED. THESE PRINTS SHALL BE SUBMITTED TO THE ENGINEER AT THE COMPLETION OF THE WORK.
- (B) STREAM MITIGATION DEFINITIONS:
- (1) BANKFULL ELEVATION - BANKFULL ELEVATION IS THE POINT OF INCIPIENT FLOODING IN AN ALLUVIAL CHANNEL.
 - (2) FLOODPLAIN SILL - A FLOODPLAIN SILL IS THE BURIED EXTENSION OF THE STRUCTURE AND IS PERPENDICULAR TO THE FLOW DIRECTION OF THE BANKFULL CHANNEL ACROSS THE BANKFULL BENCH OR FLOODPLAIN.
 - (3) FOOTER BOULDERS - FOOTER BOULDERS ARE PLACED TO PROVIDE A FOUNDATION FOR THE SURFACE BOULDERS IN EACH HYDRAULIC STRUCTURE. THE LOWEST COURSE OF FOOTER BOULDERS ARE BURIED IN THE CHANNEL TO A DEPTH BELOW THE CALCULATED OR MEASURED SCOUR DEPTH. FOOTER BOULDERS SHALL BE DURABLE LIMESTONE WITH DIMENSIONS SHOWN IN THE DETAILS. TYPICALLY, FOOTER BOULDERS ARE BURIED IN THE CHANNEL BOTTOM AND NOT SEEN WHEN THE STRUCTURE IS COMPLETED. ALL SURFACE BOULDERS FOR ALL STRUCTURES REQUIRE FOOTER BOULDERS UNLESS BEDROCK IS ENCOUNTERED AT THE PROPOSED ELEVATION OF FOOTER BOULDERS.
 - (4) SURFACE BOULDERS - SURFACE BOULDERS ARE THE TOP-MOST COURSE OF BOULDERS USED IN EACH CROSS VANE OR OTHER ROCK STRUCTURE. ALL SURFACE BOULDERS CAN BE SEEN PROTRUDING FROM THE WATER SURFACE DURING EXTREMELY LOW FLOWS. SURFACE BOULDERS SHALL BE DURABLE LIMESTONE WITH DIMENSIONS SHOWN IN THE DETAILS.
 - (5) THALWEG - THE THALWEG IS THE LOWEST POINT OF THE BANKFULL CHANNEL DESCRIBED BY THE STREAM PROFILE. THIS ELEVATION IS THE REFERENCE FOR ALL ELEVATIONS ON OR ALONG THE CHANNEL AND HYDRAULIC STRUCTURES DESCRIBED IN THIS SECTION AND IN THE PROJECT DRAWINGS.
 - (6) VANE ANGLE - THE VANE ANGLE IS THE SMALLEST ANGLE MEASURED BETWEEN A VANE AND A LINE TANGENT TO THE BANKFULL ELEVATION AT THE POINT WHERE THE VANE INTERSECTS THE BANK. THE VANE ANGLE SHALL BE BETWEEN TWENTY PERCENT (20%) AND THIRTY PERCENT (30%), OR AS SPECIFIED IN THE STREAM MITIGATION DATA TABLE.
 - (7) VANE LENGTH - THE VANE LENGTH IS THE DISTANCE BETWEEN THE UPSTREAM LIMIT OF THE VANE ARM AT THE CHANNEL BED TO THE DOWNSTREAM INSERTION POINT OF THE VANE ARM INTO THE STREAM BANK.
 - (8) VANE SLOPE - THE VANE SLOPE IS THE SLOPE OF THE VANE ARM FROM THE UPSTREAM LIMIT AT THE CHANNEL BED TO THE DOWNSTREAM INSERTION POINT OF THE VANE ARM INTO THE STREAM BANK. THE VANE SLOPE SHALL BE BETWEEN TWO PERCENT (2%) AND FIVE(5%) FOR BOULDERS OR FOUR PERCENT (4%) FOR LOGS AND THE VANE ARMS SHALL TIE INTO THE BANKS AT HALF TO THREE QUARTERS OF THE BANKFULL ELEVATION. SLOPE AND ELEVATION INFORMATION INDICATED IN THE STREAM MITIGATION TABLE OR AS DIRECTED BY THE ENGINEER SHALL BE FOLLOWED IF PRESENT.
 - (9) SUBSTRATE RESTORATION - SUBSTRATE RESTORATION IS DESIGNED TO REPLACE AND RESTORE COARSE SUBSTRATE (GRAVEL, COBBLE, AND BOULDER) TO THE STREAM CHANNEL IN CASES WHERE COARSE SUBSTRATES OR BEDROCK ARE ABSENT FOLLOWING CHANNEL EXCAVATION. THE PURPOSE OF SUBSTRATE RESTORATION IS TO PROVIDE NATURAL SUBSTRATE AND EROSION AND SCOUR PROTECTION IN THE CHANNEL.
 - (10) BASE FLOW - FOR THE PURPOSE OF THESE STREAM DESIGN SPECIFICATIONS, A FLOW EQUAL TO ONE CUBIC FOOT PER SECOND PER SQUARE MILE OF DRAINAGE AREA.
- (C) FLOODPLAIN AND CHANNEL CONSTRUCTION
- (1) CHANNEL RELOCATION WORK SHALL BE COMPLETED AND RESTORED PRIOR TO ALLOWING FLOW TO ENTER INTO THE NEWLY CONSTRUCTED STREAM CHANNEL. A TEMPORARY DAM AND PUMP-AROUND SHALL BE INSTALLED TO FACILITATE CONSTRUCTION OF THE CHANNEL "IN THE DRY". DIVERSION PUMP SHALL BE CAPABLE OF MAINTAINING DRY CONDITIONS FOR CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT THE PUMP, OR PUMPS, AVAILABLE HAVE SUFFICIENT CAPACITY. THE DAM SHALL BE PLACED SUCH THAT IT CAN BE OVERTOPPED DURING HIGH FLOWS WITHOUT RESULTING IN FLOODING. THE CONTRACTOR MAY PHASE CHANNEL CONSTRUCTION TO ALLOW FOR PORTIONS OF THE CHANNEL TO BE CONSTRUCTED "IN THE DRY", REDUCING PUMP-AROUND NEEDS.
 - (2) THE CONTRACTOR SHALL STAKE OUT THE PROPOSED STREAM CENTERLINE AND STRUCTURE LOCATIONS FOR APPROVAL BY THE ENGINEER BEFORE INITIATING EXCAVATION. DEPENDING ON THE SITE CONDITIONS, SOME SHIFTING OF THE STREAM CHANNEL AND VANE STRUCTURES MAY BE NECESSARY. ANY COST ASSOCIATED WITH CHANGING CHANNEL ALIGNMENT AND STRUCTURE LOCATIONS SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION. IF CHANNEL ALIGNMENT AND/OR STRUCTURE LOCATIONS ARE CHANGED IN THE FIELD, THE TDOT ENVIRONMENTAL DIVISION SHALL BE CONTACTED FOR A REVIEW OF PERMITS.
 - (3) THE PROPOSED STREAM CHANNEL SHALL BE CONSTRUCTED BY FIRST EXCAVATING THE FLOODPLAIN TO THE ELEVATIONS AND DIMENSIONS SPECIFIED ON THE STREAM MITIGATION GRADING PLAN. THE PROPOSED STREAM CHANNEL SHALL THEN BE EXCAVATED TO THE PROPER DEPTHS INDICATED ON THE PROFILE AND CROSS SECTIONS. THIS SHALL BE DONE AS UNCLASSIFIED EXCAVATION AND IS TYPICALLY ACCOMPLISHED WITH A TRACK EXCAVATOR WITH HYDRAULIC THUMB. ANY STOCKPILING OR DOUBLE-HANDLING OF MATERIALS NECESSARY TO BUILD THE CHANNEL SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
- (D) QUALIFICATIONS
- THE CONTRACTOR SHALL SUBMIT WRITTEN EVIDENCE OF THE FOLLOWING MINIMUM QUALIFICATIONS AND EXPERIENCE REQUIREMENTS TO BE CONSIDERED FOR THIS PROJECT:
- (1) AT LEAST ONE OF THE CONTRACTOR'S ON-SITE CONSTRUCTION PERSONNEL (SITE SUPERINTENDENT, FOREMAN, OR EQUIPMENT OPERATOR) SHALL HAVE COMPLETED ROSGEN NATURAL STREAM RESTORATION COURSEWORK TO LEVEL II (APPLIED FLUVIAL GEOMORPHOLOGY) OR ABOVE, OR HAVE COMPLETED EQUIVALENT COURSEWORK AS APPROVED BY THE ENVIRONMENTAL DIVISION AT TDOT.
 - (2) AT LEAST ONE OF THE CONTRACTOR'S ON-SITE PERSONNEL (SITE SUPERINTENDENT, FOREMAN, OR EQUIPMENT OPERATOR) SHALL HAVE COMPLETED TENNESSEE LEVEL I AND LEVEL II EROSION PREVENTION AND SEDIMENT CONTROL TRAINING.

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English

Revised: 02/03/2017

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CHAPTER 5 - LIST OF CURRENT STANDARD DRAWINGS

SECTION 1 - STANDARD ROADWAY DRAWINGS

5-100.00 ROADWAY DESIGN STANDARDS

5-100.01 STANDARD ABBREVIATIONS AND LEGENDS

DRAWING	REVISION DATE	DESCRIPTION
RD-A-1	12-18-99	STANDARD ABBREVIATIONS
RD-L-1	10-26-94	STANDARD LEGEND
RD-L-2	09-05-01	STANDARD LEGEND FOR UTILITY INSTALLATIONS
RD-L-3	04-15-04	STANDARD LEGEND FOR SIGNALIZATION AND LIGHTING
RD-L-4	04-15-04	STANDARD LEGEND FOR SIGNALIZATION AND LIGHTING
RD-L-5	05-01-08	STANDARD LEGEND FOR EROSION PREVENTION AND SEDIMENT CONTROL
RD-L-6	03-30-10	STANDARD LEGEND FOR EROSION PREVENTION AND SEDIMENT CONTROL
RD-L-7	05-24-12	STANDARD LEGEND FOR EROSION PREVENTION AND SEDIMENT CONTROL
RD-L-8		STANDARD LEGEND FOR NATURAL STREAM DESIGN

5-100.02 TYPICAL SECTIONS AND DESIGN CRITERIA

DRAWING	REVISION DATE	DESCRIPTION
RD01-TS-1	02-05-16	DESIGN STANDARDS FOR LOCAL ROADS AND STREETS
RD01-TS-1A	02-05-16	DESIGN STANDARDS FOR LOW-VOLUME LOCAL ROADS (ADT<=400)

TDOT ROADWAY DESIGN GUIDELINES

English

Revised: 02/03/2017

RD01-TS-2	10-15-02	DESIGN STANDARDS FOR COLLECTOR ROADS AND STREETS
RD01-TS-2A	10-15-02	DESIGN STANDARDS 4 AND 6 LANE COLLECTOR HIGHWAYS WITH DEPRESSED MEDIANS
RD01-TS-2B	10-15-02	DESIGN STANDARDS 4 AND 6 LANE COLLECTOR HIGHWAYS WITH FLUSH MEDIANS
RD01-TS-3	10-15-02	DESIGN STANDARD FOR 2-LANE ARTERIAL HIGHWAYS
RD01-TS-3A	10-15-02	DESIGN STANDARDS 4 AND 6 LANE ARTERIAL HIGHWAYS WITH DEPRESSED MEDIANS
RD01-TS-3B	10-15-02	DESIGN STANDARDS 4 AND 6 LANE ARTERIALS WITH INDEPENDENT ROADWAYS
RD01-TS-3C	10-15-02	DESIGN STANDARDS 4 AND 6 LANE ARTERIAL HIGHWAYS WITH FLUSH MEDIANS
RD01-TS-4	07-23-13	DESIGN STANDARDS 1 AND 2 LANE RAMPS
RD01-TS-5	10-15-02	DESIGN STANDARDS FREEWAYS WITH DEPRESSED MEDIANS
RD01-TS-5A	10-15-02	DESIGN STANDARDS FREEWAYS WITH INDEPENDENT ROADWAYS
RD01-TS-5B	10-15-02	DESIGN STANDARDS FREEWAYS WITH MEDIAN BARRIER
RD01-TS-5W		TYPICAL DETAIL FOR INSIDE LANE WIDENING OF FREEWAYS
RD01-TS-6	10-10-16	TYPICAL CURB AND GUTTER SECTIONS WITH SHOULDER
RD01-TS-6A	07-31-13	TYPICAL CURB AND GUTTER SECTIONS WITHOUT SHOULDER
RD01-TS-6B		TYPICAL CURB AND GUTTER FOR HIGH SPEED SUBURBAN ROADWAYS
RD01-TS-7	10-15-02	DESIGN STANDARDS 2-LANE HIGHWAY WITH CONTINUOUS 2-WAY LEFT-TURN LANE
RD01-TS-7A	10-15-02	DESIGN STANDARDS 2-LANE CURB AND GUTTER WITH CONTINUOUS 2-WAY LEFT-TURN LANE
RD01-TS-8	04-08-16	SHARED USE PATH TYPICAL SECTIONS
RD01-TS-9	06-15-12	DESIGN STANDARDS FOR SINGLE LANE URBAN AND RURAL ROUNDABOUTS

RD01-TS-10	06-15-12	DESIGN STANDARDS FOR MULTI-LANE URBAN AND RURAL ROUNDABOUTS
RD01-SE-2	10-15-02	URBAN SUPERELEVATION DETAILS
RD01-SE-3	10-15-02	RURAL SUPERELEVATION DETAILS

5-100.03 SLOPE DEVELOPMENT

DRAWING	REVISION DATE	DESCRIPTION
RD01-S-11	04-04-03	DESIGN AND CONSTRUCTION DETAILS FOR ROADSIDE SLOPE DEVELOPMENT
RD01-S-11A	10-15-02	ROADSIDE DITCH DETAILS FOR DESIGN AND CONSTRUCTION
RD01-S-11B	10-15-02	DESIGN AND CONSTRUCTION DETAILS FOR ROCK CUT SLOPE AND CATCHMENT
RD01-SA-1	10-15-02	SAFETY APPROACH TO UNDERPASSES GRADING DESIGN AND SLOPE PROTECTION

5-100.04 INTERSECTION SIGHT DISTANCE

DRAWING	REVISION DATE	DESCRIPTION
RD01-SD-1		INTERSECTION SIGHT DISTANCE DESIGN AND GENERAL NOTES
RD01-SD-2		INTERSECTION SIGHT DISTANCE LANDSCAPE AND OBSTRUCTION
RD01-SD-3		INTERSECTION SIGHT DISTANCE 2-LANE ROADWAYS
RD01-SD-4		INTERSECTION SIGHT DISTANCE 5-LANE AND 4- LANE UNDIVIDED ROADWAYS
RD01-SD-5		INTERSECTION SIGHT DISTANCE 4-LANE DIVIDED HIGHWAYS
RD01-SD-6		INTERSECTION SIGHT DISTANCE 6-LANE DIVIDED HIGHWAYS

RD01-SD-7 INTERSECTION SIGHT DISTANCE FOR PASSIVE RAILROAD
HIGHWAY GRADE CROSSINGS

5-100.05 UNDERDRAINS

DRAWING	REVISION DATE	DESCRIPTION
RD-UD-3	09-05-96	UNDERDRAIN DETAILS
RD-UD-4	01-25-16	UNDERDRAIN LATERAL DETAILS
RD-UD-6	12-18-94	LATERAL UNDERDRAIN ENDWALL DETAIL FOR 1:1 & 2:1 SLOPES
RD-UD-7	12-18-94	LATERAL UNDERDRAIN ENDWALL DETAIL FOR 3:1 & 4:1 SLOPES
RD-UD-8		LATERAL UNDERDRAIN ENDWALL DETAIL FOR 5:1 SLOPES
RD-UD-9	12-18-94	LATERAL UNDERDRAIN ENDWALL DETAIL FOR 6:1 SLOPES

5-110.00 PIPE CULVERTS AND ENDWALLS

5-110.01 PIPE CULVERTS AND FLUME

DRAWING	REVISION DATE	DESCRIPTION
D-FLU-1		FLUME DETAILS
D-PB-1	01-02-13	STANDARD DETAILS FOR CONCRETE PIPE INSTALLATION
D-PB-2	01-29-14	STANDARD DETAILS FOR FLEXIBLE PIPE INSTALLATION
D-PB-3		INDUCED TRENCH SOIL EMBANKMENT FOR PIPE CULVERT INSTALLATION
D-PG-3	04-15-97	FERROUS AND ALUMINUM CORRUGATED METAL PIPE
D-PG-4	07-29-94	FERROUS AND ALUMINUM CORR. METAL PIPE- ARCHES
D-PO-1	05-27-01	STANDARD OVAL & FLAT BASE CONCRETE CULVERT PIPE
D-PS-1	03-15-76	STRUTTING DETAILS FOR CORR. METAL & STRUCTURAL PLATE ROUND PIPE

5-110.02 SAFETY CROSS DRAIN ENDWALLS

DRAWING	REVISION DATE	DESCRIPTION
D-PE-15A	06-14-13	15" CONCRETE ENDWALL CROSS DRAIN (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-15B		15" CONCRETE ENDWALL CROSS DRAIN (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-18A	01-06-15	18" CONCRETE ENDWALL CROSS DRAIN (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-18B		18" CONCRETE ENDWALL CROSS DRAIN (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-24A	01-21-16	24" CONCRETE ENDWALL CROSS DRAIN (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-24B		24" CONCRETE ENDWALL CROSS DRAIN (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-30A	10-10-16	30" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-30B		30" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-36A	06-14-13	36" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-36B		36" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-42A	06-14-13	42" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-42B		42" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-48A	06-14-13	48" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-48B		48" CONCRETE ENDWALL CROSS DRAIN WITH STEEL PIPE GRATE (FOR 3:1, 4:1 & 6:1 SLOPES)
D-PE-99	11-01-13	PIPE GRATE & SKEWED CONNECTION DETAILS FOR "U" ENDWALLS (FOR 3:1, 4:1 & 6:1 SLOPES)

5-110.03 SAFETY SIDE DRAIN ENDWALLS

DRAWING	REVISION DATE	DESCRIPTION
D-SEW-1A	06-14-13	SIDE DRAIN CONCRETE ENDWALL WITH STEEL PIPE GRATE FOR 15" THRU 48" PIPES – 6:1 SLOPE
D-SEW-12D	06-14-13	CONCRETE ENDWALL TYPE "SD" WITH STEEL PIPE GRATE FOR 15" THRU 48" PIPES – 12:1 SLOPE

5-110.04 PROTECTED ENDWALLS*

DRAWING	REVISION DATE	DESCRIPTION
D-PE-1	02-12-76	TYPE "A" CONCRETE ENDWALL 2:1 SLOPE, 36" TO 78"
D-PE-4	10-10-16	STRAIGHT CONCRETE ENDWALL
D-PE-5	05-27-01	STANDARD WINGWALLS HORIZONTAL OVAL CONCRETE PIPES
D-PE-7	05-27-01	STANDARD STRAIGHT ENDWALLS FLATBASE CONCRETE PIPES
D-PE-7A	05-27-01	STANDARD WINGWALLS FLATBASE CONCRETE PIPES
D-PE-8	01-19-97	DETAIL OF STANDARD PIPE AND PIPE-ARCH CULVERT WITH BEVELED ENDS AND RIP-RAP
D-PE-9	04-25-90	CONCRETE ENDWALLS TYPE "B" (FOR ROUND & SIDE TAPERED INLETS, PIPE SIZES 15" TO 78", ALL SKEWS, 2:1 AND 4:1 SLOPES) 1976
D-PE-9A	10-25-82	GENERAL DIMENSION QUANTITIES ROUND PIPE CONCRETE ENDWALLS TYPE "B" (PIPE SIZES 15" TO 78", ALL SKEWS, 2:1 AND 4:1 SLOPES) 1976
D-PE-9B		GEN. DIMENSIONS AND QUANTITIES SIDE TAPER INLETS CONCRETE ENDWALLS - TYPE "B" (PIPE SIZES 15" TO 78", ALL SKEWS, 2:1 AND 4:1 SLOPES) 1976
D-PE-9C		BILL OF STEEL (SHEET 1 OF 4) CONCRETE ENDWALLS TYPE "B" (FOR CONCRETE ROUND AND SIDE TAPERED INLET, PIPE SIZES 15" TO 78", ALL SKEWS, 2:1 SLOPE) 1976

D-PE-9D	BILL OF STEEL (SHEET 2 OF 4) CONCRETE ENDWALLS TYPE "B" (FOR CONCRETE ROUND AND SIDE TAPERED INLET, PIPE SIZES 15" TO 78", ALL SKEWS, 4:1 SLOPE) 1976
D-PE-9E	BILL OF STEEL (SHEET 3 OF 4) CONCRETE ENDWALLS TYPE "B" (FOR STEEL ROUND AND SIDE TAPERED INLET, PIPE SIZES 15" TO 78", ALL SKEWS, 2:1 SLOPE) 1976
D-PE-9E	BILL OF STEEL (SHEET 4 OF 4) CONCRETE ENDWALLS TYPE "B" (FOR STEEL ROUND AND SIDE TAPERED INLET, PIPE SIZES 15" TO 78", ALL SKEWS, 4:1 SLOPE) 1976

*NOTE: THE PROTECTED ENDWALLS MAY NOT BE USED INSIDE THE CLEAR ZONE UNLESS SHIELDED BY GUARDRAIL OR OTHER SAFETY DEVICE.

5-120.00 CATCH BASINS AND MANHOLES

5-120.01 CATCH BASINS

DRAWING	REVISION DATE	DESCRIPTION
D-CB-10LPC	08-01-12	LOW PROFILE LOWERED CURB 32" X 26" RECTANGULAR CONCRETE NO. 10LPC CATCH BASIN
D-CB-10RA	03-11-14	STANDARD PRECAST 48" CIRCULAR NO. 10 CATCH BASIN (FOR USE WITH 6" NONMOUNTABLE CURB)
D-CB-10S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 10 CATCH BASIN
D-CB-10SB	03-11-14	STANDARD 4' X 4' SQUARE CONCRETE NO. 10 CATCH BASIN
D-CB-12LP	08-01-12	LOW PROFILE 32" X 32" SQUARE CONCRETE NO. 12LP CATCH BASIN (FOR USE WITH 6" NON-MOUNTABLE CURB)
D-CB-12P	03-11-14	STANDARD PRECAST RECTANGULAR CONCRETE NO.12 CATCH BASIN
D-CB-12RA	03-11-14	STANDARD PRECAST 48" CIRCULAR NO. 12 CATCH BASIN (FOR USE WITH 6" NONMOUNTABLE CURB)
D-CB-12RB	03-11-14	STANDARD PRECAST 60" AND 72" CIRCULAR NO. 12 CATCH BASIN (FOR USE WITH 6" NONMOUNTABLE CURB)
D-CB-12RC	03-11-14	STANDARD PRECAST 84" THRU 120" CIRCULAR NO. 12 CATCH BASIN (FOR USE WITH 6" NONMOUNTABLE CURB)

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D-CB-12S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 12 CATCH BASIN
D-CB-12SB	03-11-14	STANDARD 4' X 4' SQUARE CONCRETE NO. 12 CATCH BASIN
D-CB-12SC	03-11-14	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 12 CATCH BASIN
D-CB-12SD	03-11-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 12 CATCH BASIN
D-CB-12SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 12 CATCH BASIN
D-CB-13P	03-11-14	STANDARD PRECAST RECTANGULAR CONCRETE NO. 13 CATCH BASIN
D-CB-13RA	03-11-14	STANDARD PRECAST 48" CIRCULAR NO. 13 CATCH BASIN (FOR USE WITH 6" NONMOUNTABLE CURB)
D-CB-13RB	03-11-14	STANDARD PRECAST 60" AND 72" CIRCULAR NO. 13 CATCH BASIN (FOR USE WITH 6" NONMOUNTABLE CURB)
D-CB-13RC	03-11-14	STANDARD PRECAST 84" THRU 120" CIRCULAR NO. 13 CATCH BASIN (FOR USE WITH 6" NONMOUNTABLE CURB)
D-CB-13S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 13 CATCH BASIN
D-CB-14P	03-11-14	STANDARD PRECAST RECTANGULAR CONCRETE NO. 14 CATCH BASIN
D-CB-14RB	03-11-14	STANDARD PRECAST CIRCULAR NO. 14RB CATCH BASIN
D-CB-14S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 14 CATCH BASIN
D-CB-14SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 14 CATCH BASIN
D-CB-16S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 16 CATCH BASIN
D-CB-17S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 17 CATCH BASIN
D-CB-25LP	08-01-12	LOW PROFILE 32" X 32" SQUARE CONCRETE NO. 25LP CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)

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D-CB-25P	03-11-14	STANDARD PRECAST RECTANGULAR CONCRETE NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-25RA	01-27-16	STANDARD PRECAST 48" CIRCULAR NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-25RB	01-27-16	STANDARD PRECAST CIRCULAR NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-25S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-25SB	03-11-14	STANDARD 4' X 4' SQUARE CONCRETE NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-25SC	03-11-14	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-25SD	03-11-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-25SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 25 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-26P	03-11-14	STANDARD PRECAST RECTANGULAR CONCRETE NO. 26 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-26S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 26 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-27S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 27 CATCH BASIN (FOR USE WITH 6" MOUNTABLE CURB)
D-CB-28LP	08-01-12	LOW PROFILE 32" X 32" SQUARE CONCRETE NO. 28LP CATCH BASIN (FOR USE WITH 4" MOUNTABLE CURB)
D-CB-28P	03-11-14	STANDARD PRECAST RECTANGULAR CONCRETE NO. 28 CATCH BASIN (FOR USE WITH 4" MOUNTABLE CURB)
D-CB-28RA	04-12-16	STANDARD PRECAST 48" CIRCULAR NO. 28 CATCH BASIN (FOR USE WITH 4" SLOPING CURB)
D-CB-28RB	04-12-16	STANDARD PRECAST CIRCULAR NO. 28 CATCH BASIN (FOR USE WITH 4" SLOPING CURB)
D-CB-28S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 28 CATCH BASIN (FOR USE WITH 4" MOUNTABLE CURB)
D-CB-29P	03-11-14	STANDARD PRECAST RECTANGULAR CONCRETE NO. 29 CATCH BASIN (FOR USE WITH 4" MOUNTABLE CURB)

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D-CB-29S	03-11-14	STANDARD RECTANGULAR CONCRETE NO. 29 CATCH BASIN (FOR USE WITH 4" MOUNTABLE CURB)
D-CB-31R	03-11-14	STANDARD PRECAST CIRCULAR NO. 31 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-31SD	03-11-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 31 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-31SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 31 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-32LP	08-01-12	STANDARD 80" X 32" RECTANGULAR CONCRETE NO. 32 CATCH BASIN (FOR USE UNDER CONCRETE MEDIUM BARRIER WALL)
D-CB-38RB	03-11-14	STANDARD PRECAST CIRCULAR NO. 38 CATCH BASIN
D-CB-38S	08-01-12	STANDARD 32" X 32" SQUARE CONCRETE NO. 38 CATCH BASIN
D-CB-38SB	03-11-14	STANDARD 4' X 4' SQUARE CONCRETE NO. 38 CATCH BASIN
D-CB-38SC	03-11-14	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 38 CATCH BASIN
D-CB-39RB	03-11-14	STANDARD PRECAST CIRCULAR NO. 39 CATCH BASIN
D-CB-39S	08-01-12	STANDARD 4' X 4' SQUARE CONCRETE NO. 39 CATCH BASIN
D-CB-39SC	03-11-14	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 39 CATCHBASIN
D-CB-39SD	03-11-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 39 CATCH BASIN
D-CB-39SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 39 CATCH BASIN
D-CB-40S	08-01-12	STANDARD 4' X 8' RECTANGULAR CONCRETE NO. 40 CATCH BASIN
D-CB-40SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 40. CATCH BASIN

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D-CB-41LP	08-01-12	LOW PROFILE 32" X 32" SQUARE CONCRETE NO. 41LP CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-41P	03-11-14	STANDARD 4' X 3' PRECAST RECTANGULAR CONCRETE NO. 41 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-41RB	03-11-14	STANDARD PRECAST CIRCULAR NO. 41 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-41S	03-11-14	STANDARD 4' X 3' RECTANGULAR CONCRETE NO. 41 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-41SB	03-11-14	STANDARD 4' X 4' SQUARE CONCRETE NO. 41 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-41SC	03-11-14	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 41 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-41SD	03-11-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 41 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-41SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 41 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-42RB	03-11-14	STANDARD PRECAST CIRCULAR NO. 42 CATCH BASIN
D-CB-42S	08-01-12	STANDARD 32" X 32" SQUARE CONCRETE NO. 42 CATCH BASIN
D-CB-42SB	03-11-14	STANDARD 4' X 4' SQUARE CONCRETE NO. 42 CATCH BASIN
D-CB-42SC	03-11-14	STANDARD 5'2" X 5'2" SQUARE CONCRETE NO. 42 CATCH BASIN
D-CB-42SD	03-11-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 42 CATCH BASIN
D-CB-43R	03-11-14	STANDARD PRECAST CIRCULAR NO. 43R CATCH BASIN
D-CB-43SB	03-11-14	STANDARD 8' X 4' RECTANGULAR CONCRETE NO. 43SB CATCH BASIN

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D-CB-43SC	03-11-14	STANDARD 8' X 5' 2" RECTANGULAR CONCRETE NO. 43SC CATCH BASIN
D-CB-44SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 44 CATCH BASIN
D-CB-45S	03-11-14	STANDARD 8' X 4' RECTANGULAR CONCRETE NO. 45 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-46SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 46 CATCH BASIN (FOR USE UNDER CONCRETE MEDIAN BARRIER WALL)
D-CB-51SC	03-11-14	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 51 CATCH BASIN (FOR USE IN FRONT OF CONCRETE RETAINING WALL)
D-CB-51SD	03-11-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 51 CATCH BASIN (FOR USE IN FRONT OF CONCRETE RETAINING WALL)
D-CB-51SE	03-11-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 51 CATCH BASIN
D-CB-52SE	03-11-14	STANDARD 9' x 9' SQUARE CONCRETE NO. 52 CATCH BASIN
D-CB-99	05-20-14	MISCELLANEOUS DETAILS FOR RECTANGULAR STRUCTURES
D-CB-99R	03-11-14	MISCELLANEOUS DETAILS FOR ROUND STRUCTURES
D-CB-99RA	03-19-14	BILL OF STEEL FOR ROUND CATCH BASIN LIDS
D-CB-99RB		ROUND JUNCTION BOX SPRING DRAIN BOX
D-CBB-12A	05-27-01	TYPE 'B' CAST IRON FRAME, GRATE & NONMOUNTABLE INLET DETAILS FOR NOS. 10, 12, 14, 16, & 17 TYPE CATCH BASINS
D-CBB-12B	05-27-01	TYPE 'B' CAST IRON FRAME, GRATE & 6" MOUNTABLE INLET DETAILS FOR NOS. 25, 26 & 27 TYPE CATCH BASINS
D-CBB-12C	05-27-01	TYPE 'B' CAST IRON FRAME, GRATE & 4" MOUNTABLE INLET DETAILS FOR NOS. 28 & 29 TYPE CATCH BASINS
D-CBB-13	05-27-01	TYPE 'B' CAST IRON FRAME, GRATE & NONMOUNTABLE INLET DETAILS FOR NO. 13 TYPE CATCH BASINS

D-CBB-31	05-27-01	TYPE 'B' CAST IRON FRAME, GRATE & INLET DETAILS FOR NOS. 31, 41, 45, 46, & 51 TYPE CATCH BASINS
D-CBB-42	05-27-01	CAST IRON GRATE DETAILS FOR NOS. 42, 43 & 44 TYPE CATCH BASINS

5-120.02 JUNCTION BOXES

DRAWING	REVISION DATE	DESCRIPTION
D-JBS-1	08-01-12	STANDARD 32" X 32" SQUARE CONCRETE NO. 1 JUNCTION BOX
D-JBS-2	08-01-12	STANDARD 4' X 4' SQUARE CONCRETE NO. 2 JUNCTION BOX
D-JBS-3	08-01-12	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 3 JUNCTION BOX
D-JBS-4	08-01-12	STANDARD 7' X 7' SQUARE CONCRETE NO. 4 JUNCTION BOX
D-JBS-5	08-01-12	STANDARD 9' X 9' SQUARE CONCRETE NO. 5 JUNCTION BOX

5-120.03 MANHOLES

DRAWING	REVISION DATE	DESCRIPTION
D-MH-2	02-02-16	STANDARD MASONRY & PRECAST NO. 3 MANHOLE
D-MH-3	04-21-14	TYPICAL DESIGN OF LIDS FOR NO. 3 MANHOLE
D-MH-4	08-01-12	STANDARD NO. 3 MANHOLE CASTINGS AND STEPS
D-MH-5	04-01-14	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 3 MANHOLE
D-MH-6	04-01-14	STANDARD 7' X 7' SQUARE CONCRETE NO. 3 MANHOLE
D-MH-7	04-01-14	STANDARD 9' X 9' SQUARE CONCRETE NO. 3 MANHOLE
D-RF-1	02-02-16	STANDARD PRECAST RISER

5-120.04 SPRING DRAIN BOXES

DRAWING	REVISION DATE	DESCRIPTION
D-SDS-1	08-01-12	STANDARD 32" X 32" SQUARE CONCRETE NO. 1 SPRING DRAIN BOX
D-SDS-2A	08-01-12	STANDARD 4' X 4' SQUARE CONCRETE NO. 2A SPRING DRAIN BOX
D-SDS-2B	08-01-12	STANDARD 4' X 4' SQUARE CONCRETE NO. 2B SPRING DRAIN BOX
D-SDS-3A	08-01-12	STANDARD 5' 2" X 5' 2" SQUARE CONCRETE NO. 3A SPRING DRAIN BOX

5-120.05 SLOTTED AND TRENCH DRAINS

DRAWING	REVISION DATE	DESCRIPTION
D-SLD-1	02-02-16	SLOTTED DRAINS
D-SLD-2	05-27-01	SLOTTED DRAINS
D-SLD-3	02-02-16	SLOTTED DRAINS
D-TD-1		TRENCH DRAIN

5-130.05 NATURAL STREAM DESIGN

5-130.01 DEFLECTORS, VANES & ENERGY DISSIPATORS

DRAWING	REVISION DATE	DESCRIPTION
D-NSD-13	11-01-16	LONGITUDINAL STONE TOE
D-NSD-21		BOULDER CLUSTERS
D-NSD-22		BOULDER CROSS VANE
D-NSD-23		BOULDER CROSS VANE WITH STEP

D-NSD-24	BOULDER W-WEIR
D-NSD-25	BOULDER VANES AND J-HOOK
D-NSD-26	LOG VANES, ROOT WADS, AND BOULDER J-HOOK
D-NSD-27	LOG AND BOULDER STEP POOLS
D-NSD-28	LOG AND BOULDER RIFFLES
D-NSD-28A	LOG AND BOULDER RIFFLES
D-NSD-29	CONSTRUCTED ALLUVIAL RIFFLE
D-NSD-30	SUBSTRATE RESTORATION
D-NSD-31	CLAY CHANNEL PLUG
D-NSD-32	WOOD AND BOULDER TOE WITH GEO-LIFTS
D-NSD-32A	WOOD AND BOULDER TOE WITH GEO-LIFTS
D-NSD-33	COIR FIBER EROSION CONTROL BLANKET AND COIR FIBER ROLLS
D-NSD-34	LIVE STAKES AND LIVE SILTATION
D-NSD-35	LIVE FASCINES
D-NSD-36	BRUSH MATTRESS
D-NSD-37	SPECIAL NOTES FOR NATURAL STREAM DESIGN

5-140.00 ROADWAY AND PAVEMENT APPURTENANCES

5-140.01 CONCRETE PAVEMENT

DRAWING	REVISION DATE	DESCRIPTION
RP-CS-1	09-29-10	CONCRETE SHOULDER RUMBLE STRIP DETAIL (FOR 4-LANE DIVIDED HIGHWAY)
RP-CS-2	09-29-10	CONCRETE SHOULDER RUMBLE STRIP DETAIL (FOR 6-LANE OR WIDER DIVIDED HIGHWAY)

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Revised: 02/03/2017

RP-J-1	10-26-00	PORTLAND CEMENT CONCRETE PAVEMENT JOINT TYPES AND SPACING
RP-J-3	10-26-00	PORTLAND CEMENT CONCRETE PAVEMENT JOINT TYPES AND SPACING
RP-J-5	07-01-01	TYPICAL ACCELERATION AND DECELERATION LANE JOINT TYPES AND SPACING FOR CONCRETE RAMPS
RP-J-7	07-14-14	CONCRETE RAMP JOINT TYPES AND SPACING
RP-J-9	02-02-12	CONTRACTION AND CONSTRUCTION JOINTS FOR CONCRETE PAVEMENT
RP-J-11	07-29-96	3/4" AND 1 3/4" EXPANSION AND EDGE PAVEMENT JOINTS
RP-J-13	03-20-91	3/4" AND 1 3/4" ELASTOMERIC COMPRESSION JOINT SEALS
RP-J-15	01-19-02	LONGITUDINAL CONTRACTION AND CONSTRUCTION JOINTS
RP-J-17	02-02-12	DOWEL ASSEMBLY DEVICES
RP-J-18	02-02-12	DOWEL ASSEMBLY DEVICES
RP-J-19	02-02-12	DOWEL ASSEMBLY DEVICES
RP-J-23	07-25-12	CONCRETE PAVEMENT REPAIR DETAILS
RP-J-24	05-27-01	CONCRETE PAVEMENT SPALL AND RANDOM CRACK REPAIR DETAILS
RP-J-25	05-27-01	CONCRETE PAVEMENT JOINT REPAIR DETAILS

5-140.02 INTERSECTIONS

DRAWING	REVISION DATE	DESCRIPTION
RP-D-15	04-08-16	DETAILS OF STANDARD CONCRETE DRIVEWAYS
RP-D-16	04-08-16	DETAILS OF LOWERED STANDARD CONCRETE DRIVEWAYS
RP-DHO-1	10-26-93	MEDIAN OPENINGS ON 4-LANE DIVIDED HIGHWAY
RP-I-5	12-18-96	EXAMPLES OF STREET & ALLEY INTERSECTIONS

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RP-R-1	05-27-01	STANDARD RAMPS TO SIDE ROADS
RP-PMR-1	05-27-01	STANDARD DETAILS FOR PROPOSED PERMANENT MAINTENANCE RAMP

5-140.03 CURBS

DRAWING	REVISION DATE	DESCRIPTION
RP-MC-1	02-28-02	STANDARD 4" SLOPING (MOUNTABLE) CONCRETE CURBS AND CONCRETE CURBS AND GUTTERS
RP-MC-2	02-28-02	STANDARD 6" SLOPING (MOUNTABLE) CONCRETE CURBS AND CONCRETE CURBS AND GUTTERS
RP-NMC-10	07-29-03	STANDARD VERTICAL (NONMOUNTABLE) CONCRETE CURBS AND CONCRETE CURBS AND GUTTERS
RP-NMC-11	02-28-02	STANDARD VERTICAL (NONMOUNTABLE) CONCRETE CURBS AND CONCRETE CURBS AND GUTTERS
RP-R-2		STANDARD CONSTRUCTION DETAILS FOR ROUNDABOUTS

5-140.04 SIDEWALKS

DRAWING	REVISION DATE	DESCRIPTION
RP-H-3	10-10-16	CURB RAMP AND TRUNCATED DOME SURFACE DETAIL
RP-H-4	10-10-16	PERPENDICULAR CURB RAMP
RP-H-5	10-10-16	PARALLEL CURB RAMP
RP-H-6	10-10-16	PEDESTRIAN REFUGE
RP-H-7	10-10-16	PERPENDICULAR CURB RAMP IN CURVE
RP-H-8	10-10-16	PERPENDICULAR CURB RAMP PLACED OUTSIDE CURVE
RP-H-9	10-10-16	PARALLEL CURB RAMP IN CURVE
RP-S-7	02-05-16	DETAILS FOR CONCRETE SIDEWALKS

RP-S-8	02-05-16	DETAILS FOR STANDARD CONCRETE STEPS AND PIPE HANDRAILS
RP-S-9		ALTERNATE DETAILS FOR PEDESTRIAN FACILITIES

5-140.05 WALLS

DRAWING	REVISION DATE	DESCRIPTION
W-CIP-1		ROADWAY FEATURES AT CAST IN PLACE RETAINING WALL
W-MSE-1		ROADWAY FEATURES FOR MSE SEGMENTAL PRECAST FACING RETAINING WALL
W-MSE-2		ROADWAY FEATURES FOR MSE MODULAR BLOCK FACING RETAINING WALL
W-SG-1		STANDARD GRAVITY-TYPE RETAINING WALLS
W-SP-1		ROADWAY FEATURES AT SOLDIER PILE AND SOIL ANCHORED RETAINING WALLS
W-TW-1		DETAILS OF TREE WALLS

5-150.00 SAFETY DESIGN AND FENCES

5-150.01 CLEAR ZONE AND SAFETY PLANS

DRAWING	REVISION DATE	DESCRIPTION
S-CZ-1		CLEAR ZONE CRITERIA
S-PL-1		SAFETY PLAN AT ROADSIDE HAZARDS
S-PL-2	10-10-16	SAFETY PLAN AT SIDEROADS OR PRIVATE DRIVES
S-PL-3	10-10-16	SAFETY PLAN: MINIMUM INSTALLATION AT BRIDGE ENDS
S-PL-4	10-10-16	SAFETY PLAN FOR BRIDGE PIERS IN CLEAR ZONE
S-PL-5	10-10-16	SAFETY PLAN FOR BRIDGE ENDS IN MEDIANS
S-PL-6	10-10-16	SAFETY PLAN SAFETY HARDWARE PLACEMENT ON OUTSIDE EDGE

S-PL-6A SAFETY PLAN SAFETY HARDWARE PLACEMENT IN MEDIAN

5-150.02 CABLE BARRIER

DRAWING	REVISION DATE	DESCRIPTION
S-CB-1		CABLE BARRIER PLACEMENT

5-150.03 CRASH CUSHIONS

DRAWING	REVISION DATE	DESCRIPTION
S-CC-1	08-26-15	CRASH CUSHION
S-CC-2		CRASH CUSHION (GATING) BARREL ARRAY

5-150.04 GUARDRAIL DETAILS

DRAWING	REVISION DATE	DESCRIPTION
S-GR31-1	10-20-16	W-BEAM GUARDRAIL
S-GR31-1A		W-BEAM BARRIER FASTENING HARDWARE
S-GRS-1	01-29-16	SPECIAL CASE LONG SPAN GUARDRAIL ONE POST OMITTED
S-GRS-2	05-25-16	SPECIAL CASE: GUARDRAIL ATTACHMENT TO CONCRETE DECKS
S-GRS-3		SPECIAL CASE: GUARDRAIL FOOTING
S-GRS-4	04-12-16	SPECIAL CASE GUARDRAIL HEIGHT TRANSITION DETAIL
S-GRC-1	10-10-16	GUARDRAIL CONNECTION TO BRIDGE ENDS OR BARRIER WALL
S-GRC-2	10-10-16	GUARDRAIL CONNECTION TO BRIDGE END FOR LOCAL ROADS (ADT < 2000)

S-GRC-3	10-10-16	MEDIAN DIVIDER GUARDRAIL TRANSITION TO CONCRETE MEDIAN BARRIER
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5-150.05 GUARDRAIL TERMINALS

DRAWING	REVISION DATE	DESCRIPTION
S-GRT-1		TYPE 12 GUARDRAIL TERMINAL BURIED-IN-BACKSLOPE
S-GRT-2	04-04-16	TYPE 38 GUARDRAIL END TERMINAL
S-GRT-2P	10-10-16	EARTH PAD FOR TYPE 38 AND TYPE 21 TERMINAL
S-GRT-2R	10-10-16	EARTH PAD FOR TYPE 38 AND TYPE 21 TERMINAL (RETROFIT)
S-GRT-3	10-10-16	TYPE 21 GUARDRAIL END TERMINAL
S-GRT-4	10-10-16	TYPE 13 GUARDRAIL END TERMINAL (TRAILING END)

5-150.06 GUARDRAIL ANCHORS

DRAWING	REVISION DATE	DESCRIPTION
S-GRA-1	10-10-16	TYPE 12 GUARDRAIL ANCHOR
S-GRA-1A		GUARDRAIL ANCHOR FOR TYPE 12 TERMINAL (ALTERNATIVE)
S-GRA-3	10-10-16	TYPE 13 GUARDRAIL ANCHOR
S-GRA-4	10-10-16	IN-LINE GUARDRAIL ANCHOR
S-GRA-5		FLARED GUARDRAIL ANCHOR

5-150.07 CONCRETE MEDIAN BARRIERS

DRAWING	REVISION DATE	DESCRIPTION
S-SSMB-1	08-19-13	32" SINGLE SLOPE CONCRETE BARRIER WALL

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S-SSMB-2	08-19-13	51" SINGLE SLOPE CONCRETE BARRIER WALL
S-SSMB-3	07-16-13	51" HALF SIZE SINGLE SLOPE CONCRETE BARRIER WALL
S-SSMB-4	04-12-16	FLARED SINGLE SLOPE CONCRETE MEDIAN BARRIER WALL (VERTICAL BACK)
S-SSMB-5		SINGLE SLOPE MEDIAN BARRIER WALL CATCH BASIN DETAIL
S-SSMB-6	10-10-16	GUARDRAIL ATTACHMENT TO SINGLE SLOPE CONCRETE BARRIER WALL
S-SSMB-7	05-10-14	FOOTING DETAILS FOR OVERHEAD SIGN STRUCTURE 32" MEDIAN BARRIER WALL
S-SSMB-8	05-20-14	FOOTING DETAILS FOR OVERHEAD SIGN STRUCTURE 51" MEDIAN BARRIER WALL
S-SSMB-9	07-16-13	SINGLE SLOPE BARRIER WALL FOR GRADE SEPARATED MEDIAN

5-150.08 BICYCLE/PEDESTRIAN RAIL

DRAWING	REVISION DATE	DESCRIPTION
S-BPR-1	02-05-16	BIKE/PEDESTRIAN SAFETY RAIL

5-150.09 FENCE AND RIGHT-OF-WAY MARKERS

DRAWING	REVISION DATE	DESCRIPTION
S-F-1	05-24-12	HIGH VISIBILITY FENCE
S-F-10	06-01-09	STANDARD RIGHT-OF-WAY STOCK FENCE
S-F-10A	06-01-09	STANDARD RIGHT-OF-WAY STOCK FENCE WITH TIMBER POSTS
S-F-10B	05-14-10	STANDARD RIGHT-OF-WAY CHAIN LINK FENCE
S-F-10C	05-14-10	RIGHT-OF-WAY FENCE AT BRIDGES AND BOX CULVERTS
S-F-10D		RIGHT-OF-WAY FENCE LOCATIONS AT INTERCHANGES

S-FG-11	05-14-10	STANDARD STOCK FENCE GATE
S-FG-2	01-24-08	EXAMPLES OF WATER GATES AND WATER CROSSINGS
S-RP-2	02-08-16	STANDARD CONCRETE RIGHT-OF-WAY MARKERS

5-160.00 DESIGN - TRAFFIC CONTROL

5-160.01 PAVEMENT MARKINGS

DRAWING	REVISION DATE	DESCRIPTION
T-M-1	07-24-14	DETAILS OF PAVEMENT MARKINGS FOR CONVENTIONAL ROADS AND MARKING ABBREVIATIONS
T-M-2	10-10-16	DETAILS OF PAVEMENT MARKINGS FOR CONVENTIONAL ROADS
T-M-3	07-24-14	MARKING STANDARDS FOR TRAFFIC ISLANDS, MEDIANS & PAVED SHOULDERS ON CONVENTIONAL ROADS
T-M-4	10-10-16	STANDARD INTERSECTION PAVEMENT MARKINGS
T-M-5	04-23-13	MARKING DETAILS FOR EXPRESSWAYS & FREEWAYS
T-M-6	06-22-12	MARKING DETAIL FOR EXPRESSWAY & FREEWAY INTERCHANGES
T-M-7	01-12-12	GORE MARKING DETAILS FOR EXPRESSWAY & FREEWAY INTERCHANGES
T-M-8	01-12-12	MARKING DETAILS FOR EXPRESSWAYS & FREEWAYS
T-M-9	11-01-11	PAVEMENT MARKING AND SIGNING DETAILS FOR RAMP INTERSECTIONS
T-M-10	06-15-12	SIGNING AND PAVEMENT MARKINGS FOR SHARED- USE PATHS
T-M-11	10-10-16	SIGNING AND PAVEMENT MARKINGS FOR BICYCLE LANE OR ROUTES
T-M-12	01-30-15	SIGNING AND PAVEMENT MARKINGS FOR BICYCLE LANES ON URBAN ROADWAYS
T-M-13		SIGNING AND PAVEMENT MARKINGS FOR BICYCLE LANES

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T-M-14	11-01-11	SIGNING AND PAVEMENT MARKINGS FOR BICYCLE LANES AT INTERSECTIONS
T-M-15		ASPHALT SHOULDER RUMBLE STRIP INSTALLATION DETAILS FOR INTERSTATE AND ACCESS CONTROLLED ROUTES
T-M-15A	01-30-15	ASPHALT SHOULDER RUMBLE STRIP INSTALLATION DETAILS FOR NON-ACCESS CONTROLLED ROUTES
T-M-16	01-30-15	ASPHALT SHOULDER RUMBLE STRIPE INSTALLATION DETAILS FOR NON-ACCESS CONTROLLED ROUTES
T-M-16A	07-24-14	ASPHALT CENTER LINE RUMBLE STRIPE
T-M-17	02-20-14	PAVEMENT MARKING DETAILS FOR ROUNDABOUTS

5-160.02 WORK ZONES

DRAWING	REVISION DATE	DESCRIPTION
T-FAB-1	05-27-97	FLASHING YELLOW ARROW BOARD
T-PBR-1	06-30-09	INTERCONNECTED PORTABLE BARRIER RAIL
T-PBR-2	11-01-11	DETAIL FOR VERTICAL PANELS AND FLEXIBLE DELINEATORS
T-WZ-10	04-02-12	ADVANCE ROAD WORK SIGNING ON HIGHWAYS AND FREEWAYS
T-WZ-11	03-13-09	ONE LANE CLOSURE DETAIL ON DIVIDED HIGHWAYS
T-WZ-12	03-13-09	ONE LANE CLOSURE DETAIL FOR BRIDGES ON DIVIDED HIGHWAYS
T-WZ-13	03-13-09	TWO-OUTSIDE LANE CLOSURE ON FREEWAY OR EXPRESSWAY
T-WZ-14	03-13-09	TWO-OUTSIDE LANE CLOSURE ON INTERSTATES AND EXPRESSWAYS (PORTABLE BARRIER RAIL)
T-WZ-15	04-02-12	INTERIOR LANE CLOSURE ON FREEWAYS OR EXPRESSWAYS
T-WZ-16	03-13-09	LANE SHIFT ON DIVIDED HIGHWAYS AND FREEWAYS

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T-WZ-18	03-13-09	SHOULDER CLOSURE DETAIL FOR FREEWAYS AND DIVIDED HIGHWAYS
T-WZ-19	04-02-12	MEDIAN CROSS-OVER DETAIL ON DIVIDED HIGHWAYS
T-WZ-20	12-18-99	GEOMETRIC MEDIAN CROSS-OVER DETAIL ON DIVIDED HIGHWAYS
T-WZ-21	03-15-11	LANE CLOSURE WITH LEFT HAND MERGE AND LANE SHIFT
T-WZ-30	09-01-05	TRAFFIC CONTROL 2-LANE, 2-WAY DIVERSION (40 MPH OR LESS)
T-WZ-31	09-01-05	TRAFFIC CONTROL 2-LANE, 2-WAY DIVERSION (GREATER THAN 40 MPH)
T-WZ-32	10-29-13	TRAFFIC CONTROL PLAN SIGNAL LAYOUT FOR TRAFFIC SIGNAL AT TWO LANE BRIDGE RECONSTRUCTION SITE
T-WZ-33	05-27-98	TRAFFIC CONTROL PLAN FOR CLOSE INTERSECTION CONDITIONS USING TRAFFIC SIGNAL AT TWO LANE BRIDGE RECONSTRUCTION SITE
T-WZ-34	09-01-05	TRAFFIC CONTROL PLAN GENERAL NOTES FOR TRAFFIC SIGNAL AT TWO LANE BRIDGE RECONSTRUCTION SITE
T-WZ-35	04-02-12	TRAFFIC CONTROL PLAN PAY ITEM AND SIGN DETAILS FOR TRAFFIC SIGNAL AT TWO LANE BRIDGE RECONSTRUCTION SITE
T-WZ-36	04-02-12	LANE CLOSURE ON LOW-VOLUME 2-LANE HIGHWAY
T-WZ-40	04-02-12	RIGHT LANE CLOSURES AT NEAR SIDE OF INTERSECTIONS
T-WZ-41	04-02-12	LEFT LANE CLOSURES AT NEAR SIDE OF INTERSECTIONS
T-WZ-42	04-02-12	CENTER LANE CLOSURES AT NEAR SIDE OF INTERSECTIONS
T-WZ-50	04-02-12	TRAFFIC CONTROL FOR SIGNALS ONLY PROJECTS ON 2 OR 3 LANE MAJOR ROUTES
T-WZ-51	04-02-12	TRAFFIC CONTROL FOR SIGNALS ONLY PROJECTS ON 4 OR 5 LANE MAJOR ROUTES
T-WZ-52	04-02-12	TRAFFIC CONTROL FOR SIGNALS ONLY PROJECTS ON 4 OR 5 LANE MAJOR AND MINOR ROUTES
T-WZ-53	04-02-12	TRAFFIC CONTROL FOR SIGNALS ONLY PROJECTS ON 4 OR MORE LANE DIVIDED MAJOR ROUTES

T-WZ-54	04-02-12	TRAFFIC CONTROL FOR SIGNALS ONLY PROJECTS ON 4 OR MORE LANE DIVIDED MAJOR ROUTES AND 4 OR MORE LANE MINOR ROUTES
T-WZ-55	10-10-16	SIDEWALK TRAFFIC CONTROL

5-170.00 EROSION PREVENTION AND SEDIMENT CONTROL

5-170.01 DEWATERING DEVICES

DRAWING	REVISION DATE	DESCRIPTION
EC-STR-1	08-01-12	DEWATERING STRUCTURE
EC-STR-2	08-01-12	SEDIMENT FILTER BAG

5-170.02 SLOPE DEVICES

DRAWING	REVISION DATE	DESCRIPTION
EC-STR-3B	08-01-12	SILT FENCE
EC-STR-3C	08-01-12	SILT FENCE WITH WIRE BACKING
EC-STR-3D	04-01-08	ENHANCED SILT FENCE
EC-STR-3E	04-01-08	SILT FENCE FABRIC JOINING DETAILS
EC-STR-8	06-10-14	FILTER SOCK
EC-STR-27	08-01-12	TEMPORARY SLOPE DRAIN AND BERM
EC-STR-29	08-01-12	PERMANENT SLOPE DRAIN PIPE
EC-STR-34	08-01-12	EROSION CONTROL BLANKET FOR SLOPE INSTALLATION
EC-STR-35	08-01-12	FILTER BERMS
EC-STR-37	06-10-14	SEDIMENT TUBE

5-170.03 DITCH DEVICES

DRAWING	REVISION DATE	DESCRIPTION
EC-STR-4	08-01-12	ENHANCED SILT FENCE CHECK (TRAPEZOIDAL DITCH)
EC-STR-4A	08-01-12	ENHANCED SILT FENCE CHECK (V-DITCH)
EC-STR-4B	08-01-12	ENHANCED SILT FENCE CHECK DETAILS
EC-STR-6	05-06-16	ROCK CHECK DAM
EC-STR-6A	05-06-16	ENHANCED ROCK CHECK DAM
EC-STR-7	08-01-12	SEDIMENT TRAP WITH CHECK DAM
EC-STR-55	08-01-12	GABION CHECK DAM
EC-STR-56	04-01-08	GABION CHECK DAM DESIGN TABLES
EC-STR-57	04-01-08	GABION ASSEMBLY DETAILS
EC-STR-58	04-01-08	GABION ASSEMBLY DETAILS
EC-STR-59	08-01-12	GABION CHECK DAM GENERAL NOTES AND COMPONENT PROPERTIES
EC-STR-61	08-01-12	LEVEL SPREADERS

5-170.04 INLET PROTECTION

DRAWING	REVISION DATE	DESCRIPTION
EC-STR-11	08-01-12	CULVERT PROTECTION TYPE 1
EC-STR-19	04-01-08	CATCH BASIN PROTECTION
EC-STR-39	08-01-12	CURB INLET PROTECTION TYPE 1 & 2
EC-STR-39A	08-01-12	CURB INLET PROTECTION TYPE 3 & 4
EC-STE-40		CATCH BASIN FILTER ASSEMBLY FOR CIRCULAR STRUCTURES
EC-STR-41		CATCH BASIN FILTER ASSEMBLY (TYPE 1)

EC-STR-41A	CATCH BASIN FILTER ASSEMBLY (TYPE 1) SLIPCOVER DETAILS
EC-STR-42	CATCH BASIN FILTER ASSEMBLY (TYPE 2)
EC-STR-42A	CATCH BASIN FILTER ASSEMBLY (TYPE 2) SLIPCOVER DETAILS
EC-STR-43	CATCH BASIN FILTER ASSEMBLY (TYPE 3)
EC-STR-43A	CATCH BASIN FILTER ASSEMBLY (TYPE 3) SLIPCOVER DETAILS
EC-STR-44	CATCH BASIN FILTER ASSEMBLY (TYPE 4)
EC-STR-44A	CATCH BASIN FILTER ASSEMBLY (TYPE 4) SLIPCOVER DETAILS
EC-STR-45	CATCH BASIN FILTER ASSEMBLY (TYPE 5)
EC-STR-45A	CATCH BASIN FILTER ASSEMBLY (TYPE 5) SLIPCOVER DETAILS
EC-STR-46	CATCH BASIN FILTER ASSEMBLY (TYPE 6)
EC-STR-46A	CATCH BASIN FILTER ASSEMBLY (TYPE 6) SLIPCOVER DETAILS
EC-STR-47	CATCH BASIN FILTER ASSEMBLY (TYPE 7)
EC-STR-47A	CATCH BASIN FILTER ASSEMBLY (TYPE 7) SLIPCOVER DETAILS
EC-STR-48	CATCH BASIN FILTER ASSEMBLY (TYPE 8)
EC-STR-48A	CATCH BASIN FILTER ASSEMBLY (TYPE 8) SLIPCOVER DETAILS
EC-STR-49	CATCH BASIN FILTER ASSEMBLY (TYPE 9)
EC-STR-49A	CATCH BASIN FILTER ASSEMBLY (TYPE 9) SLIPCOVER DETAILS
EC-STR-50	CATCH BASIN FILTER ASSEMBLY (TYPE 10)
EC-STR-50A	CATCH BASIN FILTER ASSEMBLY (TYPE 10) SLIPCOVER DETAILS
EC-STR-51	CATCH BASIN FILTER ASSEMBLY (TYPE 11)

EC-STR-51A CATCH BASIN FILTER ASSEMBLY (TYPE 11) SLIPCOVER
DETAILS

5-170.05 DETAINING DEVICES

DRAWING	REVISION DATE	DESCRIPTION
EC-STR-12	08-01-12	ROCK SEDIMENT DAM
EC-STR-13	08-01-12	ROCK AND EARTH SEDIMENT EMBANKMENT
EC-STR-15	08-01-12	SEDIMENT BASIN
EC-STR-16	08-01-12	SEDIMENT BASINS RISER AND COLLAR APPURTENANCES
EC-STR-17	08-01-12	SEDIMENT BASIN EMBANKMENT DETAILS
EC-STR-18		SEDIMENT BASIN FLOATING OUTLET STRUCTURE
EC-STR-21	08-01-12	PERMANENT RIPRAP BASIN ENERGY DISSIPATORS

5-170.06 IN-STREAM DEVICES

DRAWING	REVISION DATE	DESCRIPTION
EC-STR-11A	08-01-12	CULVERT PROTECTION TYPE 2
EC-STR-25	08-01-12	TEMPORARY CULVERT CROSSING, CONSTRUCTION EXIT, CONSTRUCTION FORD
EC-STR-30		INSTREAM DIVERSION (WITHOUT TRAFFIC)
EC-STR-30A		INSTREAM DIVERSION (WITH TRAFFIC)
EC-STR-31	08-01-12	TEMPORARY DIVERSION CHANNEL
EC-STR-31A	04-01-08	TEMPORARY DIVERSION CHANNEL DESIGN
EC-STR-32	08-01-12	TEMPORARY DIVERSION CULVERTS
EC-STR-33	08-01-12	SUSPENDED PIPE DIVERSION (DOWNSTREAM)
EC-STR-33A	08-01-12	SUSPENDED PIPE DIVERSION (UPSTREAM)

EC-STR-36	08-01-12	TURF REINFORCEMENT MAT FOR CHANNEL INSTALLATION
EC-STR-38	08-01-12	FLOATING TURBIDITY CURTAIN

SECTION 2 – STANDARD TRAFFIC OPERATIONS DRAWINGS

5-200.00 SIGNS

DRAWING	REVISION DATE	DESCRIPTION
T-S-6	02-12-91	STANDARD MOUNTING DETAILS - BOLTED EXTRUDED PANELS
T-S-7	02-12-91	HIGHWAY SHIELDS USED ON INTERSTATE AND U.S. NUMBERED ROUTES
T-S-8	07-15-91	HIGHWAY SHIELDS USED ON STATE NUMBERED ROUTES AND ARROWS
T-S-9	06-10-14	STANDARD LAYOUT - GROUND MOUNTED SIGNS
T-S-10	04-04-12	STANDARD MOUNTING DETAILS - FLAT SHEET SIGNS, ALUMINUM-STEEL DESIGN
T-S-11	06-06-11	DELINEATOR AND MILEPOST DETAILS
T-S-12	07-02-15	STANDARD STEEL GROUND MOUNTED SIGNS, BREAK-AWAY TYPE POST FOOTING DETAILS, SQUARE TUBES
T-S-13	07-20-12	STANDARD STEEL GROUND MOUNTED SIGNS, BREAK-AWAY TYPE POST FOOTING DETAILS, I-BEAMS
T-S-14	08-17-12	STANDARD STEEL GROUND MOUNTED SIGNS, BREAK-AWAY TYPE POST FOOTING DETAILS, WF-BEAMS
T-S-15	12-07-90	STANDARD CONDUIT & GROUND DETAILS FOR OVERHEAD & CANTILEVER SIGN STRUCTURES
T-S-16	07-02-15	GROUND MOUNTED ROADSIDE SIGN PLACEMENT DETAILS
T-S-16A	07-02-15	GROUND MOUNTED ROADSIDE SIGN PLACEMENT DETAILS
T-S-17	07-02-15	STANDARD GROUND MOUNTED SIGN USING PERFORATED/KNOCKOUT SQUARE TUBE
T-S-18	02-14-14	END OF ROADWAY, DEAD END SIGNS, AND METAL BARRICADES (TYPE III)
T-S-19	07-19-15	STANDARD STEEL SIGN SUPPORTS
T-S-20	11-01-11	SIGN DETAILS

T-S-21	07-02-15	DETAILS FOR SIGNS MOUNTS ON CONCRETE MEDIAN BARRIERS
T-S-22	09-12-13	SIGN LAYOUT FOR HOV LANES
T-S-23A	07-02-15	MULTI-DIRECTIONAL SLIP BASE BREAKAWAY P-POST SIGN SUPPORT
T-S-23B	07-19-13	MULTI-DIRECTIONAL SLIP BASE BREAKAWAY STRUCTURAL PIPE SIGN SUPPORT
T-S-23C	07-02-15	BREAKAWAY POST SIGN SUPPORTS
T-S-24	08-02-13	DETAILS OF SIGN WITH SOLAR FLASHING ASSEMBLY

5-210.00 SIGNALS

DRAWING	REVISION DATE	DESCRIPTION
T-SG-1	06-27-16	WOOD POLE DETAILS FOR SPAN MOUNTED SIGNALS
T-SG-2	06-27-16	LOOP LEAD-INS, CONDUIT, AND PULL BOXES
T-SG-3	06-27-16	STANDARD NOTES AND DETAILS OF INDUCTIVE LOOPS
T-SG-3A	06-27-16	ALTERNATE DETECTION DETAILS
T-SG-4	06-27-16	SPAN WIRE AND MESSENGER CABLE DETAILS
T-SG-5	06-27-16	CONTROLLER CABINET DETAILS
T-SG-6		PEDESTRIAN SIGNAL DETAILS
T-SG-7	06-27-16	SIGNAL HEAD ASSEMBLIES
T-SG-7A		TYPICAL SIGNAL HEAD PLACEMENT APPROACHES WITH NO THROUGH MOVEMENTS
T-SG-7B		TYPICAL SIGNAL HEAD PLACEMENT APPROACHES WITH NO THROUGH MOVEMENTS
T-SG-7C		TYPICAL SIGNAL HEAD PLACEMENT ONE-LANE AND TWO-LANE APPROACHES
T-SG-7D		TYPICAL SIGNAL HEAD PLACEMENT TWO-LANE APPROACHES

T-SG-7E		TYPICAL SIGNAL HEAD PLACEMENT THREE-LANE APPROACHES
T-SG-7F		TYPICAL SIGNAL HEAD PLACEMENT THREE-LANE APPROACHES
T-SG-7G		TYPICAL SIGNAL HEAD PLACEMENT THREE-LANE APPROACHES
T-SG-7H		TYPICAL SIGNAL HEAD PLACEMENT THREE-LANE AND FOUR-LANE APPROACHES
T-SG-7I		TYPICAL SIGNAL HEAD PLACEMENT FOUR-LANE APPROACHES
T-SG-7J		TYPICAL SIGNAL HEAD PLACEMENT FOUR-LANE APPROACHES
T-SG-7K		TYPICAL SIGNAL HEAD PLACEMENT FOUR-LANE APPROACHES
T-SG-7L		TYPICAL SIGNAL HEAD PLACEMENT FOUR-LANE APPROACHES
T-SG-7M		TYPICAL SIGNAL HEAD PLACEMENT FIVE-LANE APPROACHES
T-SG-7N		TYPICAL SIGNAL HEAD PLACEMENT FIVE-LANE APPROACHES
T-SG-7O		TYPICAL SIGNAL HEAD PLACEMENT FIVE-LANE APPROACHES
T-SG-7P		TYPICAL SIGNAL HEAD PLACEMENT FIVE-LANE APPROACHES
T-SG-7Q		TYPICAL SIGNAL HEAD PLACEMENT FIVE-LANE APPROACHES
T-SG-7R		TYPICAL SIGNAL HEAD PLACEMENT SIX-LANE APPROACHES
T-SG-7S		TYPICAL SIGNAL HEAD PLACEMENT SIX-LANE AND SEVEN-LANE APPROACHES
T-SG-8	06-27-16	STRAIN POLE DETAILS FOR SPAN MOUNTED SIGNALS
T-SG-9	06-27-16	DETAILS OF CANTILEVER SIGNAL SUPPORT
T-SG-9A	06-27-16	MISCELLANEOUS SIGNAL DETAILS

T-SG-10	06-27-16	MAST ARM POLE AND STRAIN POLES FOUNDATION DETAILS
T-SG-11	06-27-16	MAINTENANCE OF EXISTING SIGNALS DURING HIGHWAY CONSTRUCTION
T-SG-12	06-27-16	TYPICAL WIRING FOR SIGNAL HEADS AND DETECTION LOOPS
T-SG-13	06-27-16	FLASHING BEACON DETAIL

5-220.00 LIGHTING AND UTILITY POLES

DRAWING	REVISION DATE	DESCRIPTION
T-FO-1		FIBER OPTIC AERIAL ENTRANCE DETAILS
T-FO-2		FIBER OPTIC UNDERGROUND ENTRANCE DETAILS
T-FO-3		FIBER OPTIC AERIAL CONNECTION DETAILS
T-FO-4		FIBER OPTIC PULL BOX, CABINET & POLE DETAILS
T-L-1	12-04-13	STANDARD LIGHTING FOUNDATION DETAILS
T-L-1SA	09-11-13	STANDARD LIGHTING DETAILS FOR SINGLE ARM SUPPORTS
T-L-1TM		STANDARD LIGHTING DETAILS TENON MOUNTED OFFSET LIGHTING SUPPORTS
T-L-2	12-04-13	FOUNDATION DETAIL FOR LUMINAIRE MOUNTED ON CONCRETE MEDIAN BARRIER
T-L-3	04-15-96	STANDARD LIGHTING DETAILS PULL BOXES
T-L-4	05-25-11	STANDARD LIGHTING DETAILS CONDUIT, CABLE INSTALLATION

5-230.00 RAILROAD CROSSING

DRAWING	REVISION DATE	DESCRIPTION
T-RR-1	11-01-11	TYPICAL PAVEMENT MARKING AT RAILROAD ACTIVE HIGHWAY GRADE CROSSINGS AND RAILROAD ADVANCE WARNING SIGN
T-RR-2	11-01-11	STANDARD DRAWING FOR RAILROAD AND HIGHWAY CROSSING SIGNAL WITH GATE
T-RR-3	11-01-11	STANDARD DRAWING FOR RAILROAD-HIGHWAY CROSSING SIGNAL
T-RR-4	11-01-11	STANDARD DRAWING FOR TYPICAL CURB & GUTTER PLAN FOR RAILROAD-HIGHWAY CROSSING WITH OR WITHOUT GATES
T-RR-5	11-01-11	RAILROAD-HIGHWAY CROSSING SIGNAL WITH CANTILEVER SPAN
T-RR-6	10-25-13	TYPICAL SIGNING AND MARKING AT PASSIVE RAILROAD HIGHWAY GRADE CROSSINGS

SECTION 3 – STANDARD STRUCTURE DRAWINGS

5-300.00 NEW STRUCTURES

DRAWING	REVISION DATE	DESCRIPTION
STD-1-1	05-01-14	BRIDGE RAILING CONCRETE PARAPET
STD-1-1SS	05-01-14	BRIDGE RAILING SINGLE SLOPE CONCRETE PARAPET
STD-1-2	03-28-08	SLIDER PLATE AND DECK DRAIN
STD-1-2SS		SLIDER PLATES FOR SINGLE SLOPE PARAPETS AND DECK DRAINS
STD-1- 3	07-31-00	STD. CONCRETE MEDIAN BARRIER
STD-1-3SS	11-01-10	STD. SINGLE SLOPE CONCRETE MEDIAN BARRIER
STD-1-4	01-05-01	SLIDER PLATES FOR MEDIAN BARRIER
STD-1-4SS		SLIDER PLATE ASSEMBLIES FOR SINGLE SLOPE MEDIAN BARRIER
STD-1-5	03-26-14	PAVEMENT AT BRIDGE ENDS
STD-1-6	04-28-97	BRIDGE END DRAIN W/ PAVEMENT AT BRIDGE ENDS
STD-1-7	08-24-11	BRIDGE END DRAIN W/ PAVEMENT AT BRIDGE ENDS
STD-1-8	05-01-95	BRIDGE END DRAIN 2' X 8' 7" W/PAVEMENT AT BRIDGE ENDS
STD-1-9	05-01-95	BRIDGE END DRAIN 4' X 7" W/PAVEMENT AT BRIDGE ENDS
STD-1-10	03-28-94	BRIDGE END DRAIN W/O PAVEMENT AT BRIDGE ENDS
STD-1-11	08-24-11	BRIDGE END DRAIN W/O PAVEMENT AT BRIDGE ENDS
STD-1-12	03-28-94	BRIDGE END DRAIN 2'x8'7" W/O PAVEMENT AT BRIDGE ENDS
STD-1-13	03-28-94	BRIDGE END DRAIN 4'x8'7" W/O PAVEMENT AT BRIDGE ENDS
STD-2-1	11-01-10	BRIDGE MOUNTED INTERCONNECTED PORTABLE BARRIER RAIL

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English

Revised: 02/03/2017

STD-2-2		VERTICAL PANEL DETAILS
STD-3-1	11-01-10	STRIPSEAL EXPANSION JOINT
STD-3-2	11-01-10	STRIPSEAL EXPANSION JOINT
STD-4-1	04-08-05	STD. PRECAST PRESTRESSED BRIDGE DECK PANELS GENERAL DETAILS
STD-4-2	04-08-05	STD. PRECAST PRESTRESSED BRIDGE DECK PANELS DESIGN CRITERIA
STD-4-3	03-02-02	STD.PRECAST PRESTRESSED BRIDGE DECK PANELS GENERAL DETAILS
STD-4-4	06-10-96	STD. PRECAST PRESTRESSED BRIDGE DECK PANELS CONSTRUCTION DETAILS
STD-5-1	10-25-93	STD. PILE DETAILS
STD-5-2	05-01-14	STD. PILE DETAILS
STD-6-1	11-01-10	STANDARD SEISMIC DETAILS
STD-6-2	11-07-94	STANDARD SEISMIC DETAILS
STD-7-1	06-02-14	STD. CONCRETE RAIL
STD-8-2	11-01-10	LIGHT STANDARD SUPPORT DETAILS
STD-8-2SS		SINGLE SLOPE PARAPET STANDARD LIGHT SUPPORT DETAILS
STD-8-3	09-01-91	MEDIAN BARRIER LIGHT STANDARD SUPPORT DETAILS
STD-8-3SS		SINGLE SLOPE MEDIAN BARRIER STANDARD LIGHT SUPPORT DETAILS
STD-8-4		SIGN, LUMINAIRE, AND TRAFFIC SIGNAL SUPPORTS
STD-9-1	10-07-08	REINFORCING BAR SUPPORT DETAILS FOR CONCRETE SLABS
STD-10-1	04-08-05	MISCELLANEOUS ABUTMENT AND DRAINAGE DETAILS
STD-11-1	05-01-14	BRIDGE RAILING W/ STRUCTURAL TUBING
STD-11-2	05-01-14	STANDARD CONCRETE CLASSIC RAIL
STD-14-1	05-01-14	STD. DETAILS AND INT. DIAPH.DETAILS FOR BULB - TEE BEAMS

STD-14-2	11-01-10	STD. DETAILS AND INT. DIAPH.DETAILS FOR I-BEAMS
STD-14-3	10-15-08	STD. DETAILS FOR PRESTRESSED BOX BEAMS

5-310.00 LRFD BOX CULVERTS

(See Section 4-604.00)

DRAWING	REVISION DATE	DESCRIPTION
STD-17-1		INDEX OF DRAWINGS
STD-17-2		TERMINOLOGY
STD-17-3		GENERAL NOTES
STD-17-4		DESIGN SECTION LIMITS
STD-17-5		TYPICAL SECTION AND DETAILS
STD-17-6		TYPICAL ELEVATIONS
STD-17-7		CURB, RAIL & EDGE BEAM DETAILS - SKEW NOT LESS THAN 45 DEG.
STD-17-8		EDGE BEAM DETAILS FOR FILLS GREATER THAN 3' - 6"
STD-17-9		INTERIOR WALL END TREATMENTS
STD-17-10		TYPICAL WINGWALL DETAILS AND NOTES
STD-17-11		WINGWALL DIMENSIONS AND QUANTITIES
STD-17-12		WINGWALL DIMENSIONS AND QUANTITIES
STD-17-13		WINGWALL DIMENSIONS AND QUANTITIES
STD-17-14		WINGWALL DIMENSIONS AND QUANTITIES
STD-17-15		WINGWALL & SPECIAL RETAINING WALL DESIGN SECTION
STD-17-16		WINGWALL DESIGN SECTION
STD-17-17	06-01-11	BACKFILL AND DRAINAGE DETAILS
STD-17-18		BACKFILL DETAILS
STD-17-19		PAVED OUTLET DETAIL

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English

Revised: 02/03/2017

STD-17-20		LOW FLOW CHANNEL CONSTRUCTION DETAILS FOR CULVERT INLET AND OUTLET
STD-17-21		DEBRIS DEFLECTION WALL FOR BOX BRIDGE
STD-17-22		DEBRIS DEFLECTION WALL FOR SLAB BRIDGE
STD-17-23		SIDEWALK AND MISCELLANEOUS DETAILS
STD-17-24		WARPED SLOPE DETAIL
STD-17-25		STAGE CONSTRUCTION JOINT DETAIL (FILL ABOVE TOP OF SLAB NOT GREATER THAN 3'-6")
STD-17-26		EXTENSION DETAILS
STD-17-27		EXTENSION DETAILS FOR SCoured OUTLET
STD-17-28		END SECTION DETAILS
STD-17-29		PRECAST BOX CULVERT DETAILS
STD-17-34		INTERNAL ENERGY DISSIPATOR FOR BOX AND PIPE CULVERTS
STD-17-51	05-01-14	BOX BRIDGE, 1 BARREL AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-17-52		BOX BRIDGE, 1 BARREL AT 8', CLEAR HTS. 3' - 5', 0 - 60' FILL
STD-17-53		BOX BRIDGE, 1 BARREL AT 8', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-54		BOX BRIDGE, 1 BARREL AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-55		BOX BRIDGE, 1 BARREL AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-17-56		BOX BRIDGE, 1 BARREL AT 12', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-57		BOX BRIDGE, 1 BARREL AT 12', CLEAR HTS. 7' - 9', 0 - 60' FILL
STD-17-58		BOX BRIDGE, 1 BARREL AT 12', CLEAR HTS. 10' - 12', 0 - 60' FILL
STD-17-59		BOX BRIDGE, 1 BARREL AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL

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English

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STD-17-60		BOX BRIDGE, 1 BARREL AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-17-61		BOX BRIDGE, 1 BARREL AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-62		BOX BRIDGE, 1 BARREL AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-63		BOX BRIDGE, 1 BARREL AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-17-64		BOX BRIDGE, 1 BARREL AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-17-65		BOX BRIDGE, 1 BARREL AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-66		BOX BRIDGE, 1 BARREL AT 18', CLEAR HTS. 9' - 11', 0 - 60' FILL
STD-17-67		BOX BRIDGE, 1 BARREL AT 18', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-68		BOX BRIDGE, 1 BARREL AT 18', CLEAR HTS. 15' - 18', 0 - 60' FILL
STD-17-71	05-01-14	BOX BRIDGE, 2 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-17-72		BOX BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 3' - 5', 0 - 60' FILL
STD-17-73		BOX BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-74		BOX BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-75		BOX BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-17-76		BOX BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-77		BOX BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 7' - 9', 0 - 60' FILL
STD-17-78		BOX BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 10' - 12', 0 - 60' FILL

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English

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STD-17-79	BOX BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-17-80	BOX BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-17-81	BOX BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-82	BOX BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-83	BOX BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-17-84	BOX BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-17-85	BOX BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-86	BOX BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 9' - 11', 0 - 60' FILL
STD-17-87	BOX BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-88	BOX BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 15' - 18', 0 - 60' FILL
STD-17-91	BOX BRIDGE, 3 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-17-92	BOX BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 3' - 5', 0 - 60' FILL
STD-17-93	BOX BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-94	BOX BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-95	BOX BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-17-96	BOX BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-97	BOX BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 7' - 9', 0 - 60' FILL

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English

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STD-17-98	BOX BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 10' - 12', 0 - 60' FILL
STD-17-99	BOX BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-17-100	BOX BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-17-101	BOX BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-102	BOX BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-103	BOX BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-17-104	BOX BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-17-105	BOX BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-106	BOX BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 9' - 11', 0 - 60' FILL
STD-17-107	BOX BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-108	BOX BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 15' - 18', 0 - 60' FILL
STD-17-111	SLAB BRIDGE, 1 BARREL AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-17-112	SLAB BRIDGE, 1 BARREL AT 8', CLEAR HTS. 3' - 5', 0 - 60' FILL
STD-17-113	SLAB BRIDGE, 1 BARREL AT 8', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-114	SLAB BRIDGE, 1 BARREL AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-115	SLAB BRIDGE, 1 BARREL AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-17-116	SLAB BRIDGE, 1 BARREL AT 12', CLEAR HTS. 4' - 6', 0 - 60' FILL

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English

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STD-17-117	SLAB BRIDGE, 1 BARREL AT 12', CLEAR HTS. 7' - 9', 0 - 60' FILL
STD-17-118	SLAB BRIDGE, 1 BARREL AT 12', CLEAR HTS. 10' - 12', 0 - 60' FILL
STD-17-119	SLAB BRIDGE, 1 BARREL AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-17-120	SLAB BRIDGE, 1 BARREL AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-17-121	SLAB BRIDGE, 1 BARREL AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-122	SLAB BRIDGE, 1 BARREL AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-123	SLAB BRIDGE, 1 BARREL AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-17-124	SLAB BRIDGE, 1 BARREL AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-17-125	SLAB BRIDGE, 1 BARREL AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-126	SLAB BRIDGE, 1 BARREL AT 18', CLEAR HTS. 9' - 11', 0 - 60' FILL
STD-17-127	SLAB BRIDGE, 1 BARREL AT 18', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-128	SLAB BRIDGE, 1 BARREL AT 18', CLEAR HTS. 15' - 18', 0 - 60' FILL
STD-17-131	SLAB BRIDGE, 2 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-17-132	SLAB BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 3' - 5', 0 - 60' FILL
STD-17-133	SLAB BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-134	SLAB BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-135	SLAB BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL

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English

Revised: 02/03/2017

STD-17-136	SLAB BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-137	SLAB BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 7' - 9', 0 - 60' FILL
STD-17-138	SLAB BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 10' - 12', 0 - 60' FILL
STD-17-139	SLAB BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-17-140	SLAB BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-17-141	SLAB BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-142	SLAB BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-143	SLAB BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-17-144	SLAB BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-17-145	SLAB BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-146	SLAB BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 9' - 11', 0 - 60' FILL
STD-17-147	SLAB BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-148	SLAB BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 15' - 18', 0 - 60' FILL
STD-17-151	SLAB BRIDGE, 3 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-17-152	SLAB BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 3' - 5', 0 - 60' FILL
STD-17-153	SLAB BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-154	SLAB BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL

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English

Revised: 02/03/2017

STD-17-155	SLAB BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-17-156	SLAB BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-17-157	SLAB BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 7' - 9', 0 - 60' FILL
STD-17-158	SLAB BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 10' - 12', 0 - 60' FILL
STD-17-159	SLAB BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-17-160	SLAB BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-17-161	SLAB BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-162	SLAB BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-163	SLAB BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-17-164	SLAB BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-17-165	SLAB BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-17-166	SLAB BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 9' - 11', 0 - 60' FILL
STD-17-167	SLAB BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-17-168	SLAB BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 15' - 18', 0 - 60' FILL

5-320.00 BRIDGE REPAIRS

DRAWING	REVISION DATE	DESCRIPTION
SBR-2-115	06-15-16	GENERAL NOTES AND DETAILS FOR EXPANSION JOINT REPLACEMENT CONSTRUCTION TYPES "A" THRU "J" – 1991
SBR-2-116	01-04-96	GENERAL DETAILS FOR STRIPSEAL EXPANSION JOINT REPLACEMENT CONSTRUCTION DETAILS TYPES "A" THRU "J" – 1991
SBR-2-117	05-30-96	STRIPSEAL EXPANSION JOINTS - REPLACEMENT CONSTRUCTION DETAILS TYPE "A" AND TYPE "B" – 1991
SBR-2-118	05-30-96	STRIPSEAL EXPANSION JOINT REPLACEMENT CONSTRUCTION DETAILS TYPE "C" AND TYPE "D" – 1991
SBR-2-119	05-30-96	STRIPSEAL EXPANSION JOINT REPLACEMENT CONSTRUCTION DETAILS TYPE "E" AND TYPE "F" – 1991
SBR-2-120	05-30-96	STRIPSEAL EXPANSION JOINT REPLACEMENT CONSTRUCTION DETAILS TYPE "G" AND "H" – 1991
SBR-2-121	01-04-96	STRIPSEAL EXPANSION JOINT REPLACEMENT CONSTRUCTION DETAILS TYPE "J" – 1991
SBR-2-122	01-04-96	DETAILS FOR PRECAST SLAB BRIDGE CHANNELS, SPANS 16' - 0" THRU 34' - 0", DEGREE OF SKEW 90 - 75 - 60 - 45 – 1992
SBR-2-123	01-04-96	DETAILS FOR PRECAST SLAB BRIDGE CHANNELS, SPANS 16' - 0" THRU 34' - 0", DEGREE OF SKEW 90 - 75 - 60 - 45 – 1992
SBR-2-124	01-04-96	DETAILS SHOWING REPLACEMENT OF EXISTING BRIDGERAIL SYSTEM WITH NEW JERSEY SHAPE CONCRETE PARAPET AND NEW 10' -2" ENDPOST – 1988
SBR-2-125	11-05-01	DETAILS SHOWING REPLACEMENT OF EXISTING BRIDGERAIL SYSTEM WITH NEW JERSEY SHAPE CONCRETE PARAPET AND NEW 10' -2" ENDPOST – 1988
SBR-2-126	01-04-96	DETAILS SHOWING REPLACEMENT OF EXISTING BRIDGERAIL SYSTEM WITH NEW JERSEY SHAPE CONCRETE PARAPET AND NEW 10' -2" ENDPOST – 1988
SBR-2-127	11-05-01	DETAILS SHOWING PIER PROTECTION WITH NEW CONCRETE BARRIER WALL – 1988

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English

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SBR-2-128	01-04-96	DETAILS SHOWING PIER PROTECTION WITH NEW CONCRETE BARRIER WALL – 1988
SBR-2-129	11-05-01	DETAILS SHOWING PIER PROTECTION WITH NEW VERTICAL CONCRETE BARRIER – 1988
SBR-2-130	01-04-96	DETAILS SHOWING PIER PROTECTION WITH NEW VERTICAL CONCRETE BARRIER – 1988
SBR-2-131	01-22-02	DETAILS SHOWING GUARDRAIL ATTACHMENT AT BRIDGE ENDS TO EXISTING CONCRETE SLOPE FACE ENDPOST – 1989
SBR-2-132	01-04-96	DETAILS SHOWING GUARDRAIL ATTACHMENT AT BRIDGE ENDS EXISTING CONCRETE SLOPE FACE ENDPOST – 1989
SBR-2-133	01-22-02	DETAILS SHOWING GUARDRAIL ATTACHMENT AT BRIDGE ENDS TO EXISTING CONCRETE VERTICAL FACE ENDPOST – 1989
SBR-2-134	01-04-96	DETAILS SHOWING GUARDRAIL ATTACHMENT AT BRIDGE ENDS TO EXISTING CONCRETE VERTICAL FACE ENDPOST – 1989
SBR-2-135	01-22-02	GUARDRAIL ATACHMENT TO EXISTING PIER PROTECTION – 1991
SBR-2-136	11-05-01	STANDARD DRAWING FOR REPLACING EXISTING CONCRETE ENDPOST AND GUARDRAIL AT EXISTING BRIDGE ENDS – 1992
SBR-2-137	11-05-01	STANDARD SHOWING DETAILS FOR ATTACHING NEW GUARDRAIL TO EXISTING END OF BRIDGE – 1992
SBR-2-138	11-05-01	STANDARD SHOWING DETAILS FOR ATTACHING NEW GUARDRAIL AT EXISTING BRIDGE END AND ALONG EXISTING BRIDGE RAIL – 1992
SBR-2-140	11-05-01	STANDARD SHOWING DETAILS FOR ATTACHING NEW GUARDRAIL ALONG EXISTING BRIDGE RAILS – 1992
SBR-2-144	01-22-02	STANDARD SHOWING DETAILS OF ATTACHING GUARDRAIL BRIDGERAIL TO TOP OF EXISTING CURBS – 1992

5-330.00 BOX CULVERTS (Previous)

(See Section 4-604.00)

DRAWING	REVISION DATE	DESCRIPTION
STD-15-1	11-06-08	INDEX OF DRAWINGS AND TERMINOLOGY
STD-15-2	03-28-08	GENERAL NOTES
STD-15-3	02-28-03	DESIGN SECTION LIMITS
STD-15-4	12-07-01	TYPICAL SECTION AND DETAILS
STD-15-5	02-28-03	TYPICAL ELEVATION
STD-15-6	03-28-08	CURB AND RAIL DETAILS SKEW NOT LESS THAN 45 DEG.
STD-15-7	03-02-02	STANDARD EDGE BEAM DETAILS FOR FILLS GREATER THAN 3' - 8"
STD-15-8	12-07-01	INTERIOR WALL END TREATMENTS
STD-15-9	02-28-03	TYPICAL WINGWALL DETAILS AND NOTES
STD-15-10	11-06-08	WINGWALL DIMENSIONS AND QUANTITIES
STD-15-11		WINGWALL DIMENSIONS AND QUANTITIES
STD-15-12	03-28-08	WINGWALL & SPECIAL RETAINING WALL DESIGN SECTION
STD-15-13		WINGWALL DESIGN SECTION
STD-15-14	06-01-11	BACKFILL AND DRAINAGE DETAILS
STD-15-15		BACKFILL AND DRAINAGE DETAILS
STD-15-16	12-07-01	PAVED OUTLET DETAIL
STD-15-16A		LOW FLOW CHANNEL CONSTRUCTION DETAILS FOR CULVERT INLET AND OUTLET
STD-15-17		DEBRIS DEFLECTION WALL
STD-15-18		DEBRIS DEFLECTION WALL
STD-15-19		SIDEWALK AND MISCELLANEOUS DETAILS
STD-15-20		WARPED SLOPE DETAIL

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English

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STD-15-21	03-02-02	STAGE CONSTRUCTION JOINT DETAIL (FILL ABOVE TOP OF SLAB NOT GREATER THAN 3'-8")
STD-15-22	02-28-03	EXTENSION DETAILS
STD-15-23	12-07-01	EXTENSION DETAILS FOR SCOURED OUTLET
STD-15-24	12-07-01	END SECTION DETAILS
STD-15-25	11-01-10	PRECAST BOX CULVERT DETAILS
STD-15-26		PRECAST BOX CULVERT DETAILS
STD-15-27		PRECAST BOX CULVERT DETAILS
STD-15-28		PRECAST BOX CULVERT DETAILS
STD-15-29		PRECAST BOX CULVERT DETAILS
STD-15-30		STANDARD INTERNAL ENERGY DISSIPATOR FOR BOX AND PIPE CULVERTS
STD-15-35		BOX BRIDGE, 1 BARREL AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-15-36		BOX BRIDGE, 1 BARREL AT 8', CLEAR HTS. 3' - 4', 0 - 60' FILL
STD-15-37	05-01-14	BOX BRIDGE, 1 BARREL AT 8', CLEAR HTS. 5' - 8', 0 - 60' FILL
STD-15-38	09-19-06	BOX BRIDGE, 1 BARREL AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-15-39		BOX BRIDGE, 1 BARREL AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-15-40		BOX BRIDGE, 1 BARREL AT 12', CLEAR HTS. 4' - 7', 0 - 60' FILL
STD-15-41		BOX BRIDGE, 1 BARREL AT 12', CLEAR HTS. 8' - 12', 0 - 60' FILL
STD-15-42		BOX BRIDGE, 1 BARREL AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-15-43		BOX BRIDGE, 1 BARREL AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-15-44		BOX BRIDGE, 1 BARREL AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL

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English

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STD-15-45		BOX BRIDGE, 1 BARREL AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-46		BOX BRIDGE, 1 BARREL AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-15-47		BOX BRIDGE, 1 BARREL AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-15-48		BOX BRIDGE, 1 BARREL AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-49		BOX BRIDGE, 1 BARREL AT 18', CLEAR HTS. 9' - 13', 0 - 60' FILL
STD-15-50		BOX BRIDGE, 1 BARREL AT 18', CLEAR HTS. 14' - 18', 0 - 60' FILL
STD-15-55		BOX BRIDGE, 2 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-15-56		BOX BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 3' - 4', 0 - 60' FILL
STD-15-57		BOX BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 5' - 8', 0 - 60' FILL
STD-15-58	06-01-11	BOX BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-15-59		BOX BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-15-60		BOX BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 4' - 7', 0 - 60' FILL
STD-15-61		BOX BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 8' - 12', 0 - 60' FILL
STD-15-62		BOX BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-15-63		BOX BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-15-64		BOX BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-15-65		BOX BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL

TDOT ROADWAY DESIGN GUIDELINES

English

Revised: 02/03/2017

STD-15-66		BOX BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-15-67		BOX BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-15-68		BOX BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-69		BOX BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 9' - 13', 0 - 60' FILL
STD-15-70		BOX BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 14' - 18', 0 - 60' FILL
STD-15-75		BOX BRIDGE, 3 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-15-76		BOX BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 3' - 4', 0 - 60' FILL
STD-15-77	12-07-01	BOX BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 5' - 8', 0 - 60' FILL
STD-15-78	12-07-01	BOX BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-15-79	12-07-01	BOX BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-15-80		BOX BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 4' - 7', 0 - 60' FILL
STD-15-81		BOX BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 8' - 12', 0 - 60' FILL
STD-15-82		BOX BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-15-83		BOX BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-15-84		BOX BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-15-85		BOX BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-86		BOX BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL

TDOT ROADWAY DESIGN GUIDELINES

English

Revised: 02/03/2017

STD-15-87		BOX BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-15-88		BOX BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-89		BOX BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 9' - 13', 0 - 60' FILL
STD-15-90		BOX BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 14' - 18', 0 - 60' FILL
STD-15-95		SLAB BRIDGE, 1 BARREL AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-15-96		SLAB BRIDGE, 1 BARREL AT 8', CLEAR HTS. 3' - 4', 0 - 60' FILL
STD-15-97		SLAB BRIDGE, 1 BARREL AT 8', CLEAR HTS. 5' - 8', 0 - 60' FILL
STD-15-98		SLAB BRIDGE, 1 BARREL AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-15-99	02-28-03	SLAB BRIDGE, 1 BARREL AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-15-100	02-28-03	SLAB BRIDGE, 1 BARREL AT 12', CLEAR HTS. 4' - 7', 0 - 60' FILL
STD-15-101	02-28-03	SLAB BRIDGE, 1 BARREL AT 12', CLEAR HTS. 8' - 12', 0 - 60' FILL
STD-15-102		SLAB BRIDGE, 1 BARREL AT 14', CLEAR HTS. 5' - 9', 0 - 60' FILL
STD-15-103		SLAB BRIDGE, 1 BARREL AT 14', CLEAR HTS. 10' - 14', 0 - 60' FILL
STD-15-104		SLAB BRIDGE, 1 BARREL AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-105		SLAB BRIDGE, 1 BARREL AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-15-106		SLAB BRIDGE, 1 BARREL AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-15-107		SLAB BRIDGE, 1 BARREL AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL

TDOT ROADWAY DESIGN GUIDELINES

English

Revised: 02/03/2017

STD-15-108		SLAB BRIDGE, 1 BARREL AT 18', CLEAR HTS. 9' - 13', 0 - 60' FILL
STD-15-109		SLAB BRIDGE, 1 BARREL AT 18', CLEAR HTS. 14' - 18', 0 - 60' FILL
STD-15-115	02-28-03	SLAB BRIDGE, 2 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-15-116	02-28-03	SLAB BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 3' - 4', 0 - 60' FILL
STD-15-117	06-01-11	SLAB BRIDGE, 2 BARRELS AT 8', CLEAR HTS. 5' - 8', 0 - 60' FILL
STD-15-118	02-28-03	SLAB BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-15-119	02-28-03	SLAB BRIDGE, 2 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-15-120	02-28-03	SLAB BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 4' - 7', 0 - 60' FILL
STD-15-121	02-28-03	SLAB BRIDGE, 2 BARRELS AT 12', CLEAR HTS. 8' - 12', 0 - 60' FILL
STD-15-122	02-28-03	SLAB BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-15-123	02-28-03	SLAB BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-15-124	02-28-03	SLAB BRIDGE, 2 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-15-125	02-28-03	SLAB BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-126	02-28-03	SLAB BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-15-127	02-28-03	SLAB BRIDGE, 2 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-15-128	02-28-03	SLAB BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-129	02-28-03	SLAB BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 9' - 13', 0 - 60' FILL

TDOT ROADWAY DESIGN GUIDELINES

English

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STD-15-130	02-28-03	SLAB BRIDGE, 2 BARRELS AT 18', CLEAR HTS. 14' - 18', 0 - 60' FILL
STD-15-135		SLAB BRIDGE, 3 BARRELS AT 6', CLEAR HTS. 3' - 6', 0 - 60' FILL
STD-15-136		SLAB BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 3' - 4', 0 - 60' FILL
STD-15-137		SLAB BRIDGE, 3 BARRELS AT 8', CLEAR HTS. 5' - 8', 0 - 60' FILL
STD-15-138		SLAB BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 4' - 6', 0 - 60' FILL
STD-15-139		SLAB BRIDGE, 3 BARRELS AT 10', CLEAR HTS. 7' - 10', 0 - 60' FILL
STD-15-140		SLAB BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 4' - 7', 0 - 60' FILL
STD-15-141		SLAB BRIDGE, 3 BARRELS AT 12', CLEAR HTS. 8' - 12', 0 - 60' FILL
STD-15-142		SLAB BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 5' - 7', 0 - 60' FILL
STD-15-143		SLAB BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 8' - 11', 0 - 60' FILL
STD-15-144		SLAB BRIDGE, 3 BARRELS AT 14', CLEAR HTS. 12' - 14', 0 - 60' FILL
STD-15-145		SLAB BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-146		SLAB BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 9' - 12', 0 - 60' FILL
STD-15-147		SLAB BRIDGE, 3 BARRELS AT 16', CLEAR HTS. 13' - 16', 0 - 60' FILL
STD-15-148	12-07-01	SLAB BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 6' - 8', 0 - 60' FILL
STD-15-149	12-07-01	SLAB BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 9' - 13', 0 - 60' FILL
STD-15-150	12-07-01	SLAB BRIDGE, 3 BARRELS AT 18', CLEAR HTS. 14' - 18', 0 - 60' FILL