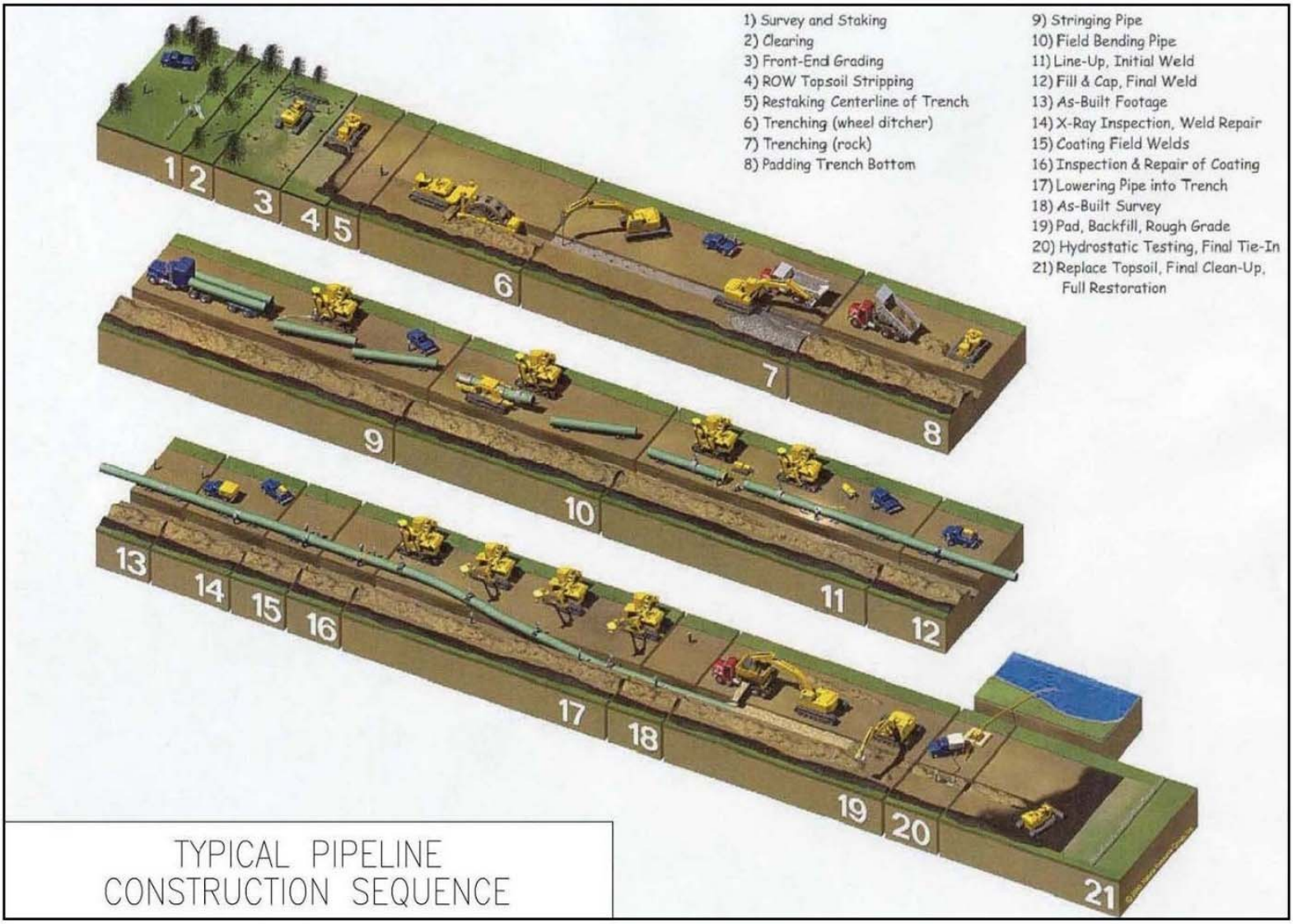
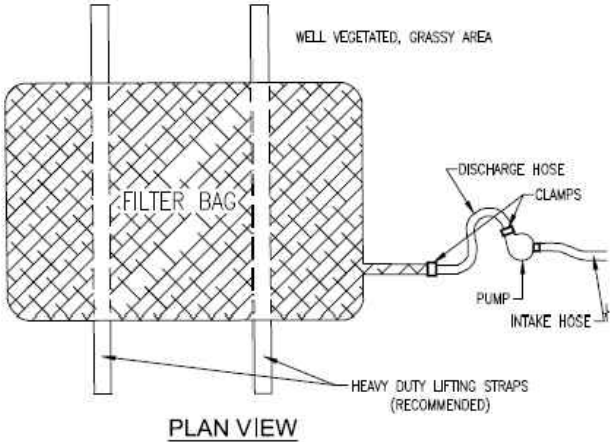
APPENDIX B - FIGURES



TYPICAL PIPELINE CONSTRUCTION SEQUENCE



PLAN VIEW

ELEVATION VIEW

LOW VOLUME FILTER BAGS SHALL BE MADE FROM NON-WOVEN GEOTEXTILE MATERIAL SEWN WITH HIGH STRENGTH, DOUBLE STITCHED "J" TYPE SEAMS. THEY SHALL BE CAPABLE OF TRAPPING PARTICLES LARGER THAN 150 MICRONS. HIGH VOLUME FILTER BAGS SHALL BE MADE FROM WOVEN GEOTEXTILES THAT MEET THE FOLLOWING STANDARDS:

Property	Test Method	Minimum Standard
Avg. Wide Width Strength	ASTM D-4884	60 lb/in
Grab Tensile	ASTM D-4632	205 lb
Puncture	ASTM D-4833	110 lb
Mullen Burst	ASTM D-3786	350 psi
UV Resistance	ASTM D-4355	70%
AOS % Retained	ASTM D-4751	80 Sieve

A SUITABLE MEANS OF ACCESSING THE BAG WITH MACHINERY REQUIRED FOR DISPOSAL PURPOSES SHALL BE PROVIDED. FILTER BAGS SHALL BE REPLACED WHEN THEY BECOME ½ FULL OF SEDIMENT. SPARE BAGS SHALL BE KEPT AVAILABLE FOR REPLACEMENT OF THOSE THAT HAVE FAILED OR ARE FILLED. BAGS SHALL BE PLACED ON STRAPS TO FACILITATE REMOVAL UNLESS BAGS COME WITH LIFTING STRAPS ALREADY ATTACHED.

BAGS SHALL BE LOCATED IN WELL-VEGETATED (GRASSY) AREA, AND DISCHARGE ONTO STABLE, EROSION RESISTANT AREAS. WHERE THIS IS NOT POSSIBLE, A GEOTEXTILE UNDERLAYMENT AND FLOW PATH SHALL BE PROVIDED. BAGS MAY BE PLACED ON FILTER STONE TO INCREASE DISCHARGE CAPACITY. BAGS SHALL NOT BE PLACED ON SLOPES GREATER THAN 5%. FOR SLOPES EXCEEDING 5%, CLEAN ROCK OR OTHER NON-ERODIBLE AND NON-POLLUTING MATERIAL MAY BE PLACED UNDER THE BAG TO REDUCE SLOPE STEEPNESS.

NO DOWNSLOPE SEDIMENT BARRIER IS REQUIRED FOR MOST INSTALLATIONS. COMPOST BERM OR COMPOST FILTER SOCK SHALL BE INSTALLED BELOW BAGS LOCATED IN HQ OR EV WATERSHEDS, WITHIN 50 FEET OF ANY RECEIVING SURFACE WATER OR WHERE GRASSY AREA IS NOT AVAILABLE.

THE PUMP DISCHARGE HOSE SHALL BE INSERTED INTO THE BAGS IN THE MANNER SPECIFIED BY THE MANUFACTURER AND SECURELY CLAMPED. A PIECE OF PVC PIPE IS RECOMMENDED FOR THIS PURPOSE.

THE PUMPING RATE SHALL BE NO GREATER THAN 750 GPM OR ½ THE MAXIMUM SPECIFIED BY THE MANUFACTURER, WHICHEVER IS LESS. PUMP INTAKES SHALL BE FLOATING AND SCREENED.

FILTER BAGS SHALL BE INSPECTED DAILY. IF ANY PROBLEM IS DETECTED, PUMPING SHALL CEASE IMMEDIATELY AND NOT RESUME UNTIL THE PROBLEM IS CORRECTED.

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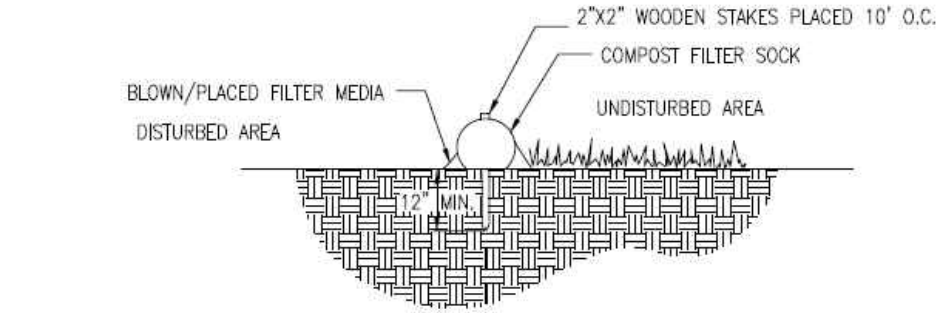
Mountain Valley PIPELINE

DESIGN ENGINEERING

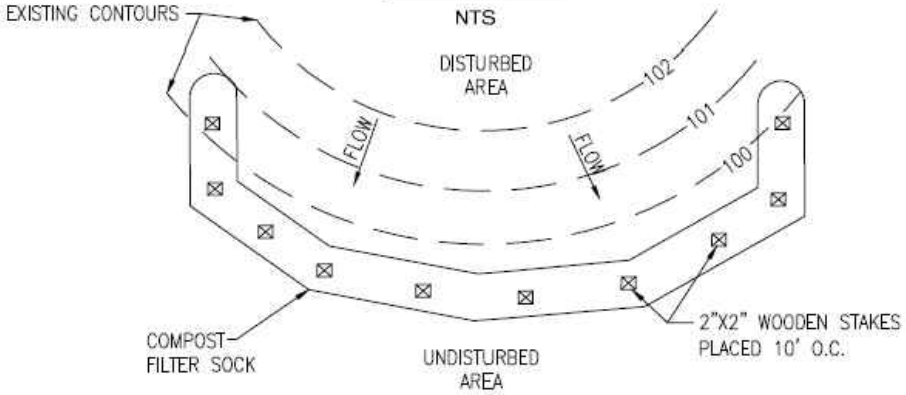
ENVIRONMENTAL DETAIL

PUMPED WATER FILTER BAG

DRAWING NO.	REV.
MVP-ES2	0



SECTION VIEW
NTS



PLAN VIEW
NTS

SOCK FABRIC SHALL MEET STANDARDS OF TABLE 4.1. COMPOST SHALL MEET THE STANDARDS OF TABLE 4.2.

COMPOST FILTER SOCK SHALL BE PLACED AT EXISTING LEVEL GRADE. BOTH ENDS OF THE SOCK SHALL BE EXTENDED AT LEAST 8 FEET UP SLOPE AT 45 DEGREES TO THE MAIN SOCK ALIGNMENT. MAXIMUM SLOPE LENGTH ABOVE ANY SOCK SHALL NOT EXCEED MAXIMUM PERMISSIBLE SLOPE LENGTH ABOVE COMPOST FILTER SOCKS. STAKES MAY BE INSTALLED IMMEDIATELY DOWNSLOPE OF THE SOCK IF SO SPECIFIED BY THE MANUFACTURER.

TRAFFIC SHALL NOT BE PERMITTED TO CROSS FILTER SOCKS.

ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN IT REACHES HALF THE ABOVEGROUND HEIGHT OF THE SOCK AND DISPOSED IN THE MANNER DESCRIBED ELSEWHERE IN THE PLAN.

SOCKS SHALL BE INSPECTED WEEKLY AND AFTER EACH RUNOFF EVENT. DAMAGED SOCKS SHALL BE REPAIRED ACCORDING TO MANUFACTURER'S SPECIFICATIONS OR REPLACED WITHIN 24 HOURS OF INSPECTION.

BIODEGRADABLE FILTER SOCKS SHALL BE REPLACED AFTER 6 MONTHS; PHOTODEGRADABLE SOCKS AFTER 1 YEAR. POLYPROPYLENE SOCKS SHALL BE REPLACED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

UPON STABILIZATION OF THE AREA TRIBUTARY TO THE SOCK, STAKES SHALL BE REMOVED. THE SOCK MAY BE LEFT IN PLACE AND VEGETATED OR REMOVED. IN THE LATTER CASE, THE MESH SHALL BE CUT OPEN AND THE MULCH SPREAD AS A SOIL SUPPLEMENT.

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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

COMPOST FILTER SOCK

DRAWING NO.	REV.
MVP–ES3	0

TABLE 4.1

Compost Sock Fabric Minimum Specifications

Material Type	3 mil HDPE	5 mil HDPE	5 mil HDPE	Multi-Filament Polypropylene (MFPP)	Heavy Duty Multi-Filament Polypropylene (HDMFPP)
Material Characteristics	Photo-degradable	Photo-degradable	Bio-degradable	Photo-degradable	Photo-degradable
Sock Diameters		12"	12"	12"	12"
	12"	18"	18"	18"	18"
	18"	24"	24"	24"	24"
		32"	32"	32"	32"
Mesh Opening	3/8"	3/8"	3/8"	3/8"	1/8"
Tensile Strength		26 psi	26 psi	44 psi	202 psi
Ultraviolet Stability % Original Strength (ASTM G-155)	23% at 1000 hr.	23% at 1000 hr.		100% at 1000 hr.	100% at 1000 hr.
Minimum Functional Longevity	6 months	9 months	6 months	1 year	2 years

Two-ply systems	
Inner Containment Netting	HDPE biaxial net
	Continuously wound
	Fusion-welded junctures
	3/4" X 3/4" Max. aperture size
Outer Filtration Mesh	Composite Polypropylene Fabric (Woven layer and non-woven fleece mechanically fused via needle punch)
	3/16" Max. aperture size

Sock fabrics composed of burlap may be used on projects lasting 6 months or less.

TABLE 4.2

Compost Standards

Organic Matter Content	80% - 100% (dry weight basis)
Organic Portion	Fibrous and elongated
pH	5.5 - 8.0
Moisture Content	35% - 55%
Particle Size	98% pass through 1" screen
Soluble Salt Concentration	5.0 dS/m (mmhos/cm) Maximum

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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

COMPOST FILTER SOCK TABLES

DRAWING NO.	REV.
MVP–ES3.1	0

Slope Percent	Maximum Slope Length for Compost Filter Sock in Feet Note: Table developed from Filtrexx Sediment Control product cut sheet by Filtrexx International, LLC. As a general reference. Refer to manufacturers specifications for brand of compost filter sock used.				
	8 in	12 in	18 in	24 in	32 in
2 (or less)	600	750	1000	1300	1650
5	400	500	550	650	750
10	200	250	300	400	500
15	140	170	200	325	450
20	100	125	140	260	400
25	80	100	110	200	275
30	60	75	90	130	200
35	60	75	80	115	150
40	60	75	80	100	125
45	40	50	60	80	100
50	40	50	55	65	75

MAXIMUM SLOPE LENGTH ABOVE COMPOST FILTER SOCK AND RECOMMENDED DIAMETER

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Mountain Valley PIPELINE

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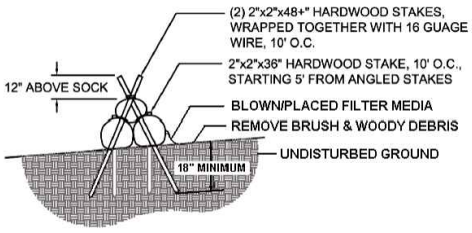
ENVIRONMENTAL DETAIL

COMPOST FILTER SOCK TABLES

DRAWING NO.	REV.
MVP–ES3.2	0



STACKED COMPOST FILTER SOCK DETAIL

NOTES:

1. TEMPORARY RIGHT OF WAY DIVERSION AND OUTLET INTENDED FOR USE IN LIEU OF SILT FENCING OR COMPOST FILTER SOCK ALONG STRAIGHT SECTIONS OF RIGHT OF WAY LOCATED NEAR RIDGE LINES OR OTHER UPLAND AREAS WHICH ARE 200 FT OR MORE UPSLOPE OF IDENTIFIED STREAMS OR WETLANDS.
2. ROLLED EROSION CONTROL PRODUCT AND/OR MULCHING SHALL BE USED TO STABILIZE THE TEMPORARY COMPACTED SOIL BERM, DIVERSION DITCH, AND TEMPORARY FILL SLOPE.
3. THE DIVERSION DITCH SHALL BE SIZED BASED ON THE DRAINAGE AREA AND STD & SPEC 3.12 (DIVERSION) DETAILED IN THE VESCH.
4. SPOIL FROM THE PIPELINE TRENCH TO BE USED TO CONSTRUCT THE TEMPORARY SOIL BERM.
5. OUTLET TRENCH TO BE CUT FROM THE PIPELINE TRENCH TO THE DIVERSION DITCH AT TRENCH PLUGS/BREAKERS AND AT LOW POINTS IN THE PIPELINE TRENCH.
6. TEMPORARY FILL SLOPE TO BE CONSTRUCTED NO STEEPER THAN 2H:1V.
7. SIDE SLOPES OF TEMPORARY SOIL BERM AND DIVERSION DITCH SHALL BE NO STEEPER THAN 2H:1V.
8. ENDS OF COMPOST FILTER SOCK AT SUMP OUTLET TO BE TURNED UPSLOPE AND BUTTED UP AGAINST THE BERM TO PREVENT FLOW FROM PASSING AROUND COMPOST FILTER SOCK.

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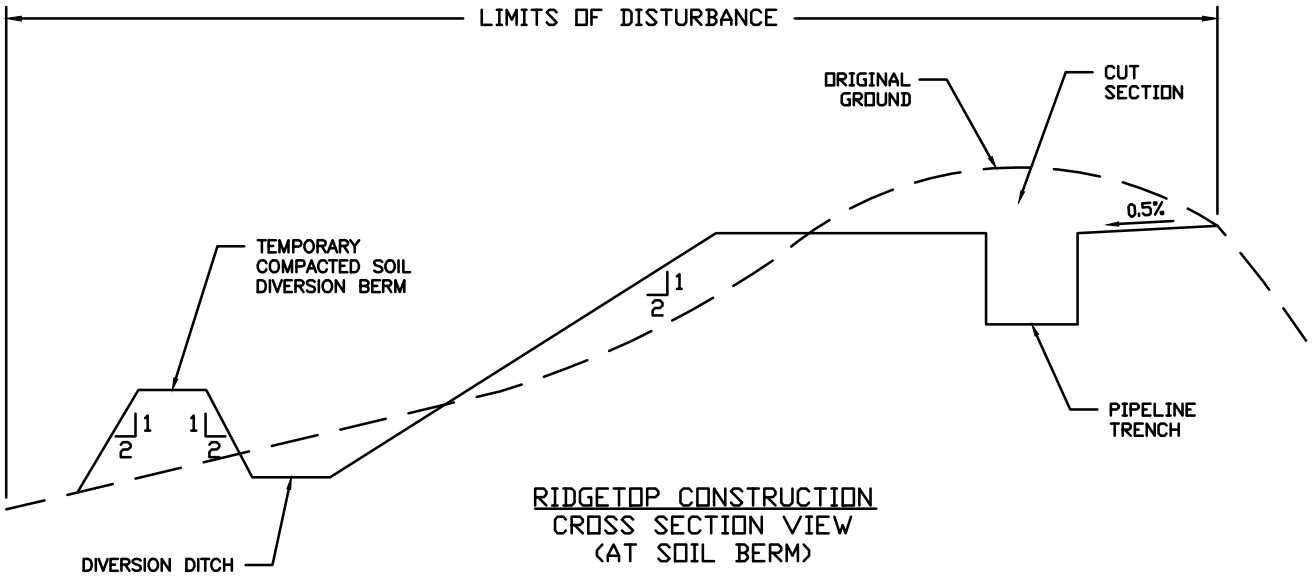
Mountain Valley PIPELINE

DESIGN ENGINEERING

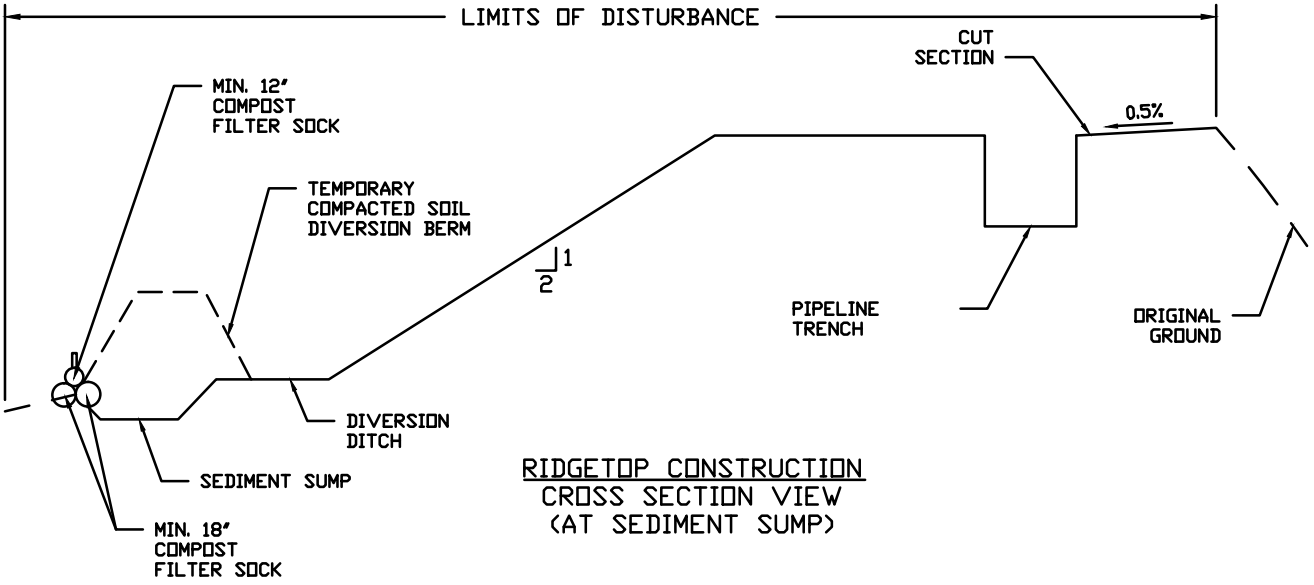
ENVIRONMENTAL DETAIL

TEMPORARY RIGHT OF WAY DIVERSION AND OUTLET DETAIL

DRAWING NO.	REV.
MVP-ES4	0



RIDGETOP CONSTRUCTION
CROSS SECTION VIEW
(AT SOIL BERM)



RIDGETOP CONSTRUCTION
CROSS SECTION VIEW
(AT SEDIMENT SUMP)

DRAWN	DATE
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APP'D	DATE
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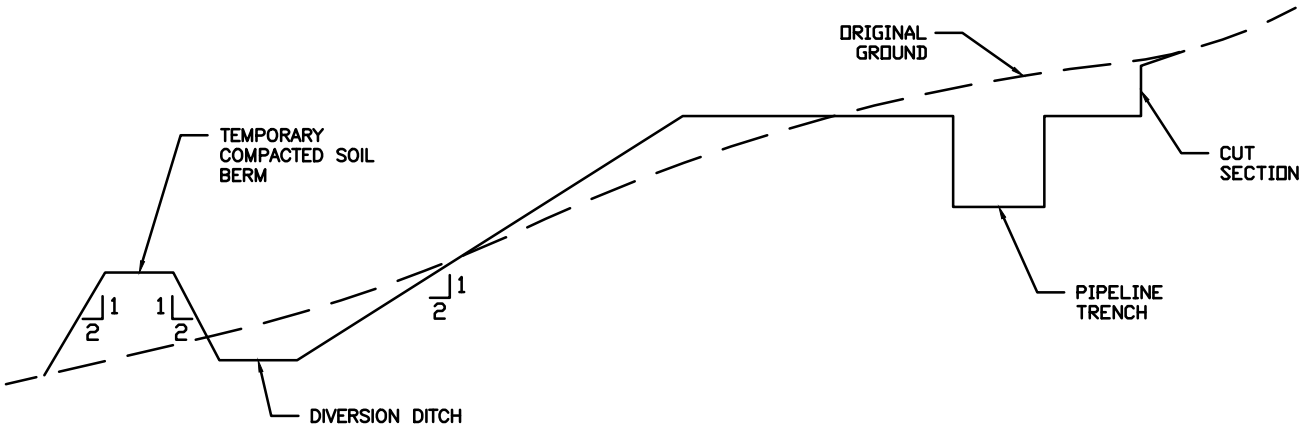
Mountain Valley PIPELINE

DESIGN ENGINEERING

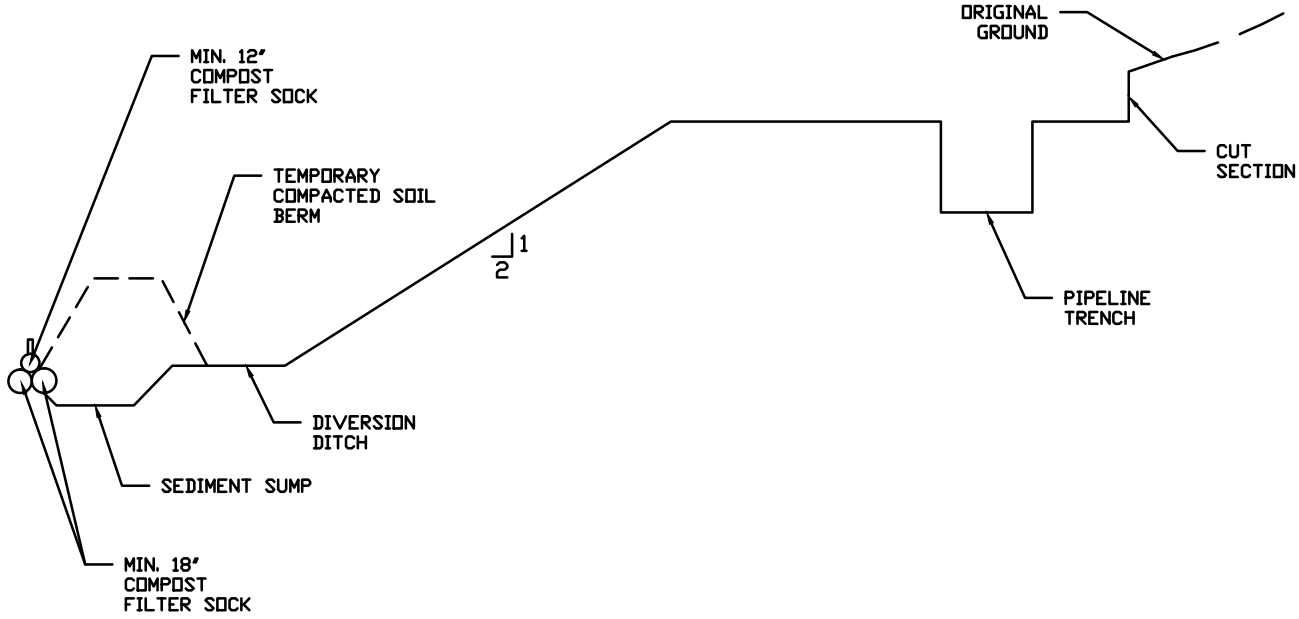
ENVIRONMENTAL DETAIL

TEMPORARY RIGHT OF WAY
DIVERSION AND OUTLET DETAIL

DRAWING NO.	REV.
MVP-ES4.1	0



SIDE SLOPE CONSTRUCTION
CROSS SECTION VIEW
(AT SOIL BERM)



SIDE SLOPE CONSTRUCTION
CROSS SECTION VIEW
(AT SEDIMENT SUMP)

DRAWN	DATE
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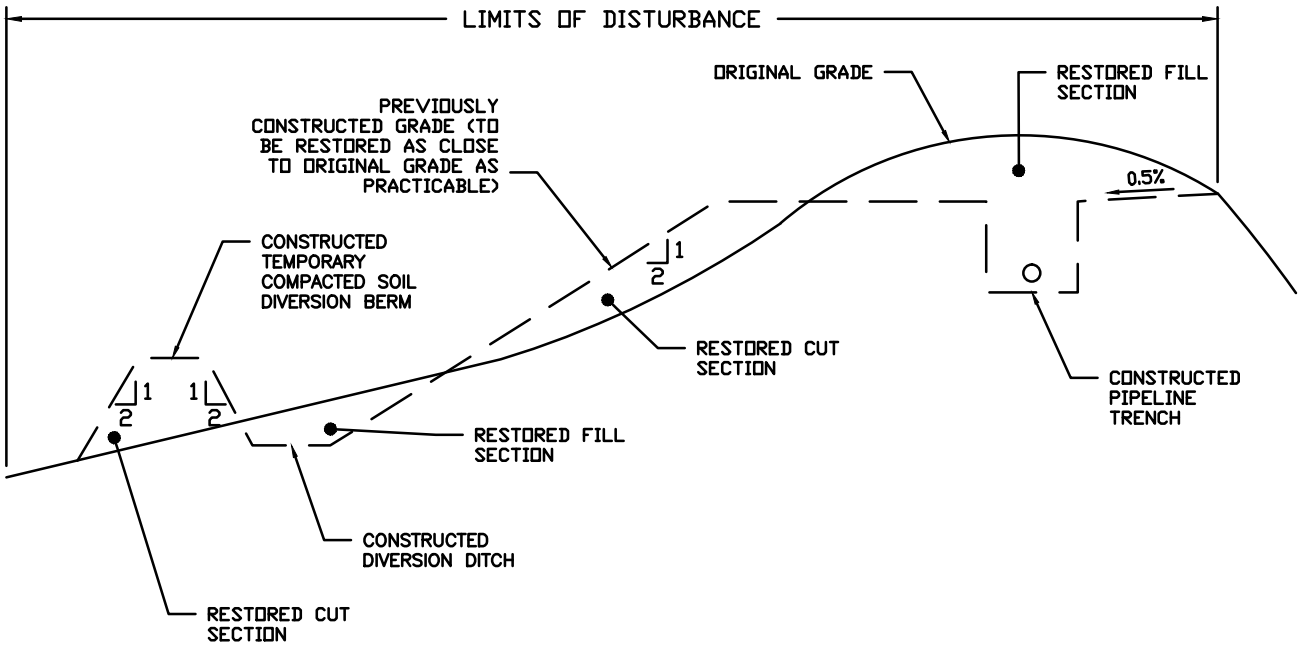
Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

TEMPORARY RIGHT OF WAY
DIVERSION AND OUTLET DETAIL

DRAWING NO.	REV.
MVP–ES4.2	0



DRAWN	DATE
CHECKED	DATE
APP'D	DATE
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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

POST CONSTRUCTION RIDGETOP RECLAMATION DETAIL

DRAWING NO.	REV.
MVP–ES4.3	0

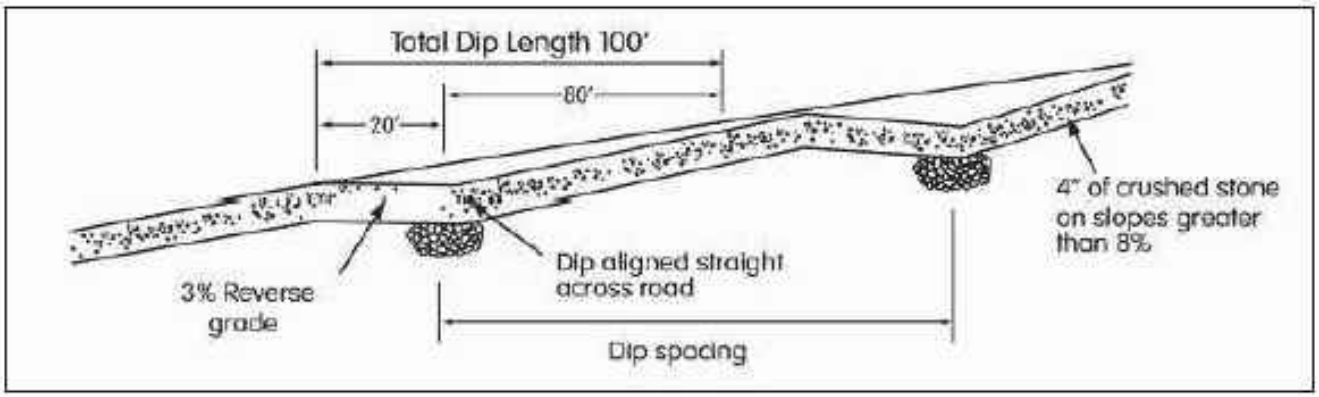

Table II-4 Spacing of Broad-Based Dips

Road Grade (%)	Distance Between Drains (Ft)
2	300
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140

DESIGN CRITERIA:
1. MAXIMUM ROAD GRADE ON WHICH DIPS CAN BE CONSTRUCTED IS 10%
2. A 3% REVERSE GRADE SHOULD BE CONSTRUCTED IN THE EXISTING ROADBED, BY CUTTING UPGRADE OF THE DIP LOCATION.
3. BROADBASED DIP SHOULD BE ARMORED WITH STONE TO WITHSTAND EXPECTED TRAFFIC.
4. DRAINAGE OUTLET PROTECTION SHALL BE PROVIDED WITH APPROPRIATE SEDIMENT BARRIER STRUCTURES.
5. SPACING: REFER TO TABLE II-4.

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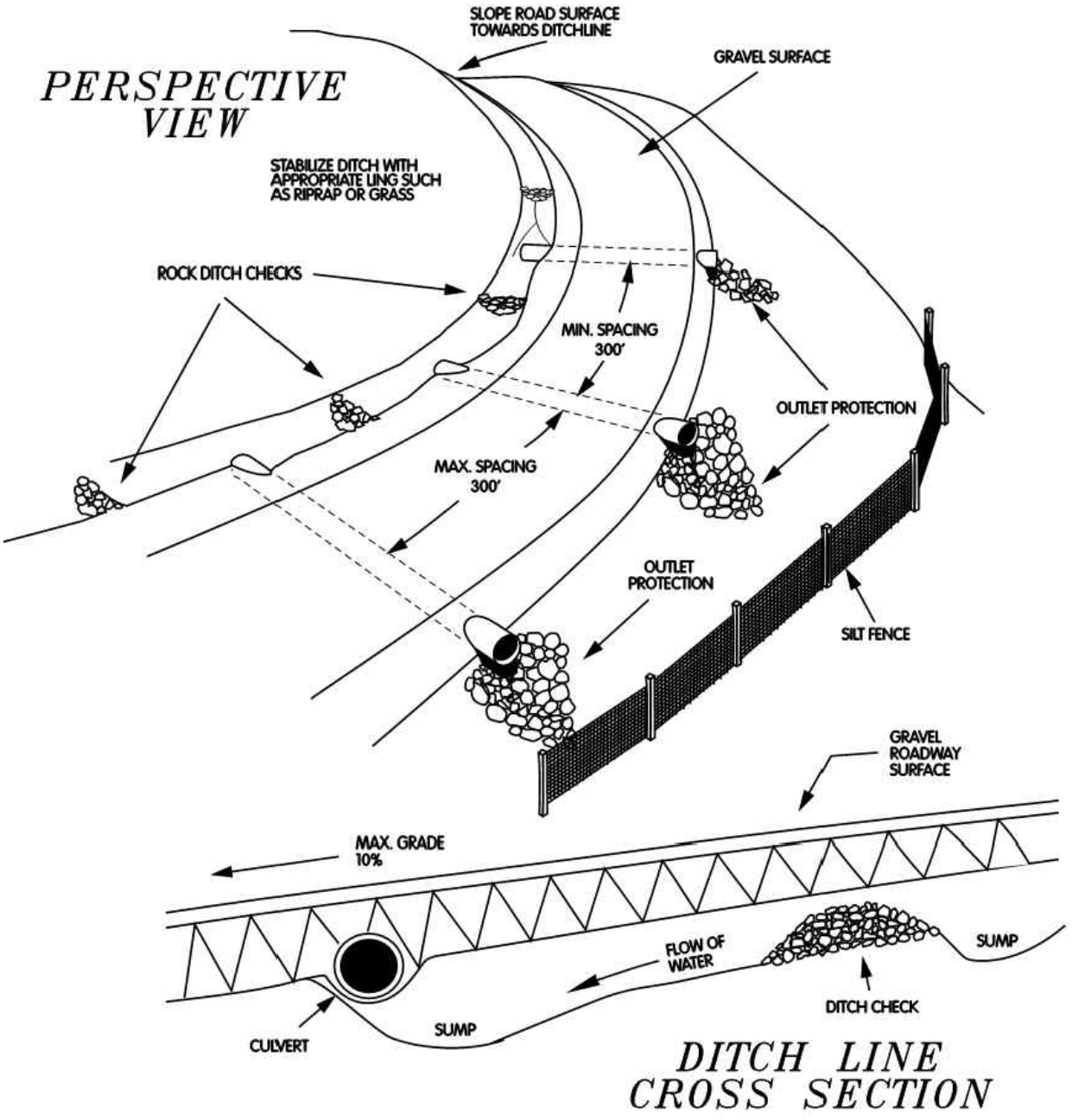
Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

BROAD BASED DIP

DRAWING NO.	REV.
MVP-ES5	0



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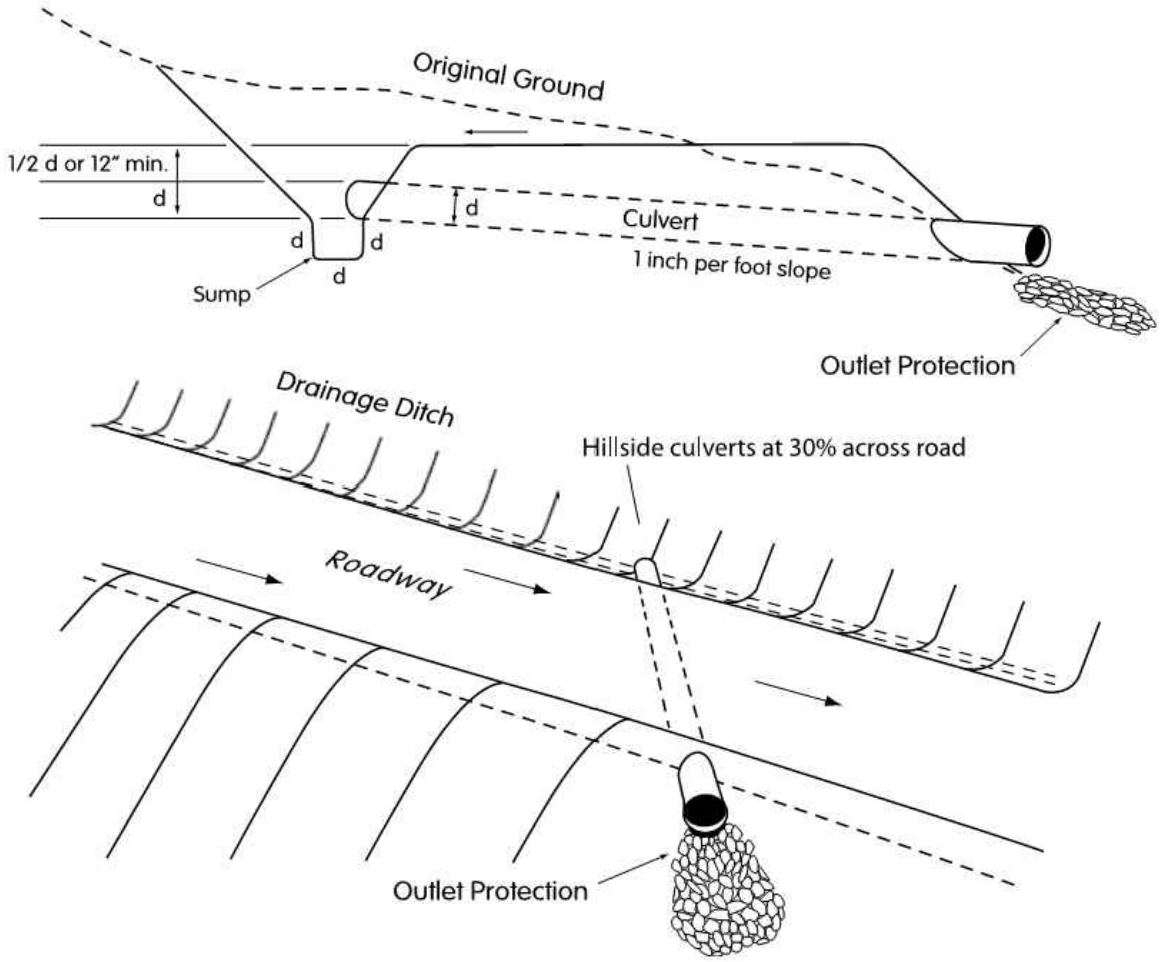
Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

ACCESS ROADS

DRAWING NO.	REV.
MVP–ES6	0



DRAWN	DATE
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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

DITCH RELIEF CULVERT

DRAWING NO.	REV.
MVP–ES7	0

TABLE 3.3- Sizing and Spacing of Ditch Relief Culverts for Temporart Access Roads

Road Grade (%)	Culvert Spaceing* (ft)	Length of Upslope Drainage (ft)				
		<300	300-400	400-500	500-600	>600
		Minimum Culvert Size (in)				
2	300	12	15	15	15	18
3	235	12	15	15	15	18
4	200	12	15	15	15	18
5	180	12	12	15	15	15
6	165	12	12	12	15	15
7	155	12	12	12	12	15
8	150	12	12	12	12	15
9	145	12	12	12	12	15
10	140	12	12	12	12	15
12	135	12	12	12	12	15

*Culvert spacing may be adjusted slightly to take advantage of natural drainage courses

TABLE 3.4 - Recommended Maximum Spacing of Ditch Relief Culverts (18" dia. CMP) For Permanent Access Roads

Road Grade Percent	Soil Type in Ditch				
	Gravel, Sandy Gravels, Aggregate Surfacing	Silty Gravels, Clayey Gravels	Plastic and Nonplastic Inorganic Clays	Inorganic Silts, Silty or Clayey Sands	Sands, Silty Sands, and Gravelly Sands
	Culvert Spacing Feet*				
2	390	315	245	170	95
4	335	275	210	145	85
6	285	230	180	125	75
8	240	195	150	105	65
10	200	160	125	90	55
12	160	130	105	75	45
14	135	110	85	60	35

*Culvert spacing may be adjusted slightly to take advantage of natural drainage courses

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Mountain Valley PIPELINE

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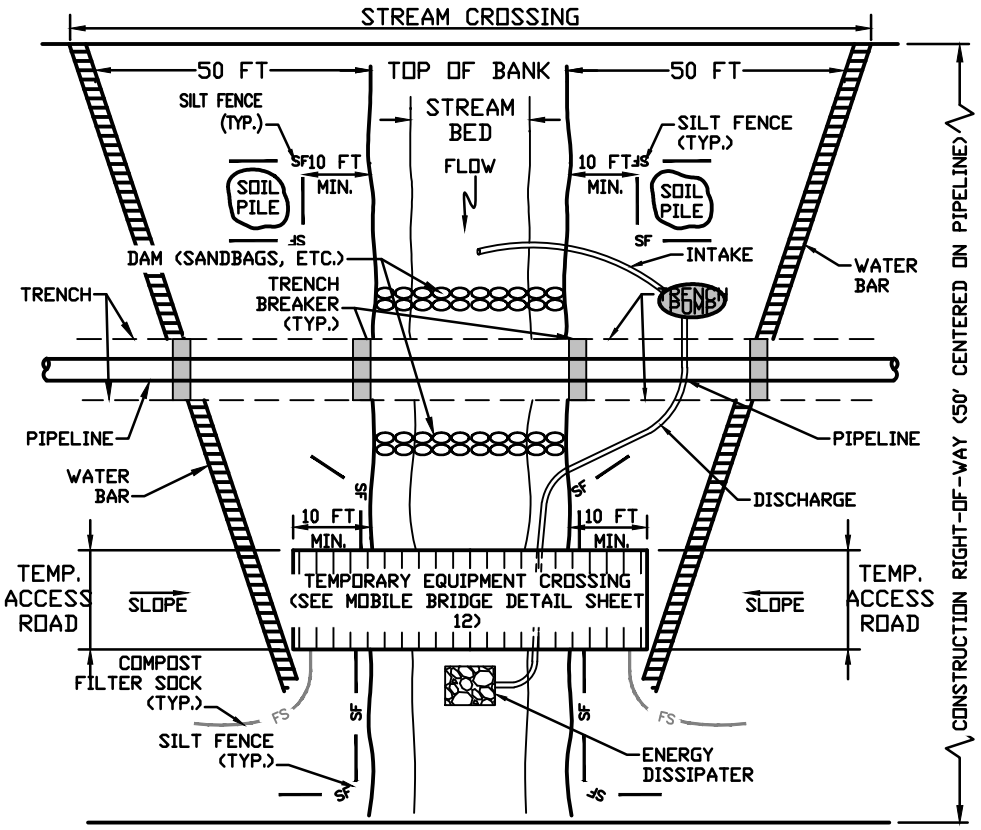
ENVIRONMENTAL DETAIL

DITCH RELIEF CULVERT SPACING

DRAWING NO.	REV.
MVP–ES7.1	0



PLAN VIEW

NOTES:

1. INSTALL COMPOST FILTER SOCKS, TRENCH BREAKERS, PUMP, ENERGY DISSIPATER, AND DAMS BEFORE TRENCHING STREAM.
2. PUMP MUST BE OF SUFFICIENT CAPACITY TO CONVEY NORMAL AND/OR EXISTING STREAM FLOW OVER TRENCH. A BACK-UP PUMP OF EQUAL CAPACITY MUST BE AVAILABLE ON-SITE DURING CONSTRUCTION OF THE PIPELINE CROSSING.
3. PLACE SOIL PILES A MINIMUM OF 10 FEET FROM TOP OF BANK.
4. INSTALL WATER BARS AT APPROACHES TO STREAM CROSSING AND COMPOST FILTER SOCKS, SILT FENCE, OR SUPER SILT FENCE (AS INDICATED ON PLAN SHEETS).
5. MAINTAIN SURFACE OF TEMPORARY EQUIPMENT CROSSING TO PREVENT SOIL DISCHARGES TO STREAM.
6. APPROACHES TO CROSSINGS ARE NOT TO EXCEED A DEPTH OF 6 INCHES ABOVE ORIGINAL GRADE.
7. RESTORE AREA TO APPOXIMATE ORIGINAL CONTOURS.

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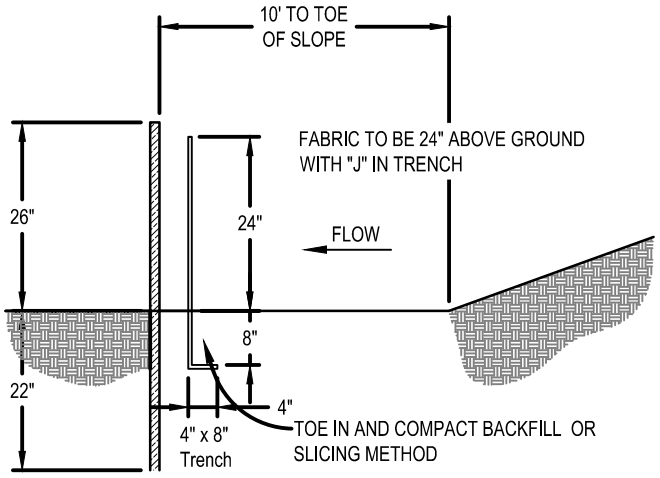
Mountain Valley PIPELINE

DESIGN ENGINEERING

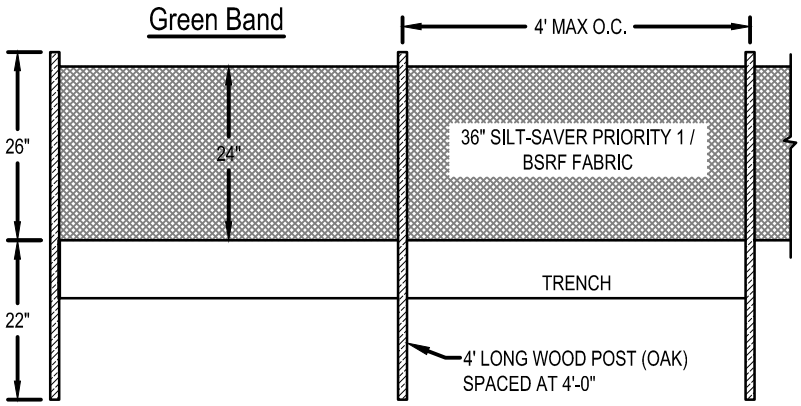
ENVIRONMENTAL DETAIL

STREAM CROSSING
PUMP STATION

DRAWING NO.	REV.
MVP–ES8	0



SIDE VIEW



FRONT ELEVATION

PRIORITY 1

TAKEN FROM SILT-SAVER, INC OR EQUAL

NOTES:

THE TYPE OF REINFORCED FILTRATION DEVICE (PRIORITY 1 OR PRIORITY 2) WILL BE SELECTED BASED ON FIELD CONDITIONS DURING CONSTRUCTION

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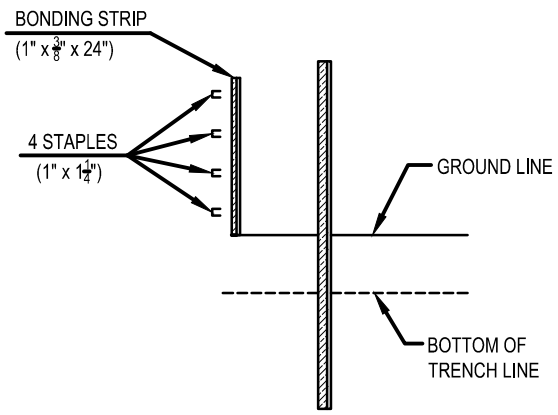
Mountain Valley PIPELINE

DESIGN ENGINEERING

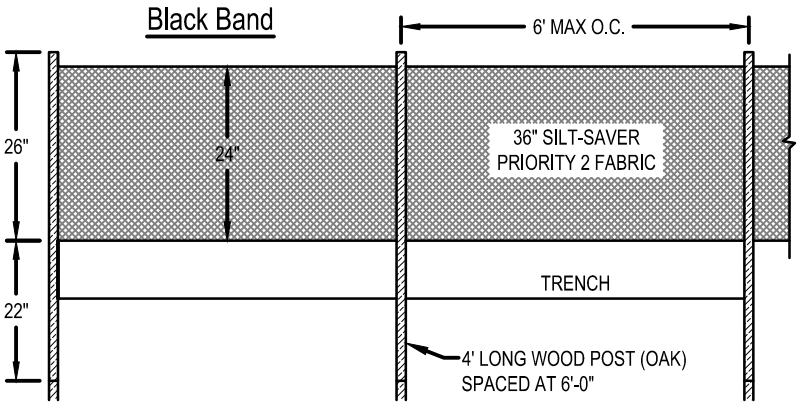
ENVIRONMENTAL DETAIL

BELTED SILT RETENTION FENCE (BSRF)

DRAWING NO.	REV.
MVP-ES9	0



POST (OAK)
(1-3/4" X 1-1/4" X 48")



FRONT ELEVATION

PRIORITY 2
TAKEN FROM SILT-SAVER, INC OR EQUAL

NOTES:

THE TYPE OF REINFORCED FILTRATION DEVICE (PRIORITY 1 OR PRIORITY 2) WILL BE SELECTED BASED ON FIELD CONDITIONS DURING CONSTRUCTION

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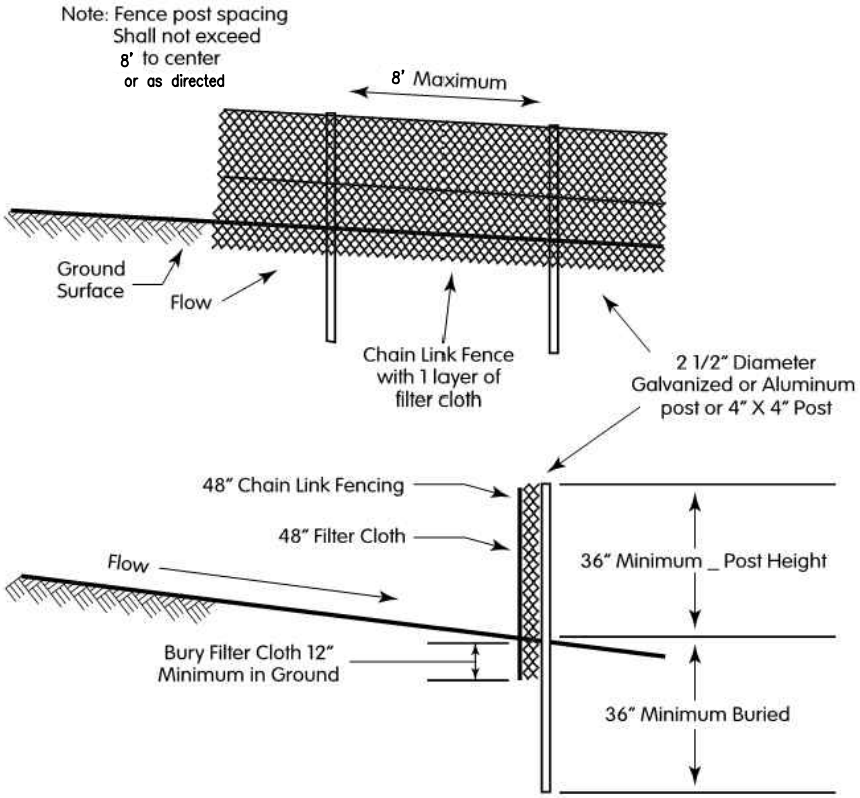
Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

BELTED SILT RETENTION FENCE (BSRF)

DRAWING NO.	REV.
MVP-ES9.1	0



SUPER SILT FENCE

TAKEN FROM WVDEP 2006 MANUAL

NOTES:

THE TYPE OF REINFORCED FILTRATION DEVICE (PRIORITY 1 OR PRIORITY 2) WILL BE SELECTED BASED ON FIELD CONDITIONS DURING CONSTRUCTION

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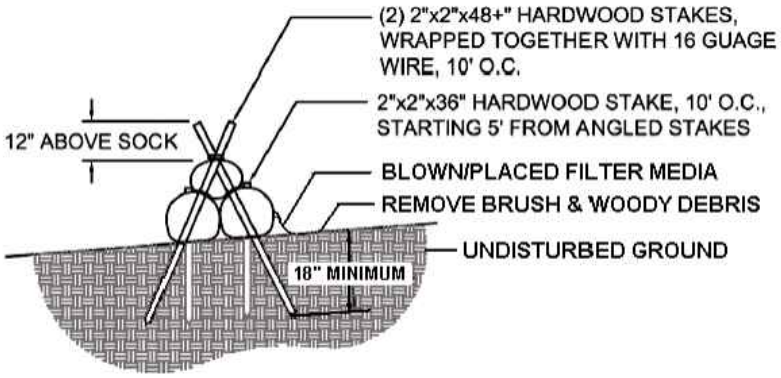
Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

SUPER SILT FENCE

DRAWING NO.	REV.
MVP-ES9.2	0



NOTES:

THE TYPE OF REINFORCED FILTRATION DEVICE (PRIORITY 1 OR PRIORITY 2) WILL BE SELECTED BASED ON FIELD CONDITIONS DURING CONSTRUCTION

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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

STACKED COMPOST FILTER SOCK
DETAIL CROSS SECTION VIEW

DRAWING NO.	REV.
MVP–ES9.3	0

Forest Regeneration Woody Seed Mix and Application Rates.

Species	Common Name	Seeding Rate (lbs/acre)
Oak-Hickory Forest a		
Fagus grandifolia	American Beech	0.3
Liriodendron tulipifera	Tulip Poplar	0.3
Pinus strobus	White Pine	0.3
Pinus virginiana	Virginia Pine	0.3
Prunus serotina	Black Cherry	0.3
Amelanchier canadensis	Canadian Serviceberry	0.3
Cercis canadensis	Eastern Redbud	0.3
Cornus florida	Flowering Dogwood	0.3
Diospyros virginiana	Persimmon	0.3
Ilex opaca	American Holly	0.3
Nyssa sylvatica	Black Gum	0.3
Sassafras albidum	Sassafras	0.3
Hamamelis virginiana	Witch Hazel	0.3
Lindera benzoin	Spicebush	0.3
Vaccinium angustifolium	Lowbush Blueberry	0.3
Viburnum acerifolium	Mapleleaf Viburnum	0.3
Vitis aestivalis	Grape	0.3

a\ Oak and hickory species to be planted as bare root seedlings in addition to this mix. Refer to Section 5.9 Bare Roost Seedling Planting for more information. At minimum, 3 of the 5 overstory, 4 of the 7 understory, and 2 of the 4 shrub species will comprise the woody seed mix for Oak-Hickory Forests.

NOTE:

WOODY SEED MIX TO BE USED IN COMBINATION WITH MVP-ES11.2 UPLAND MEADOW SEED MIX.

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FOREST REGENERATION WOODY SEED MIX AND APPLICATION RATES

DRAWING NO.	REV.
MVP–ES11.1	0

Upland Meadow Seed Mix and Application Rates in Virginia.

Species	Common Name	Seeding Rate (lbs/acre)	pH	Bloom Period (if applicable)
Elymus virginicus	Virginia Wildrye	4.00	5.0 - 7.4	June to October
Schizachyrium scoparium	Little Bluestem	11.68	5.0 - 8.4	July to October
Sorghastrum nutans	Indiangrass	1.00	5.0 - 7.8	August to October
Asclepias syriaca	Common Milkweed	0.10		June to August
Asclepias tuberosa	Butterfly Milkweed	0.10	4.8 - 6.8	June to August
Chamaecrista fasciculata	Partridge Pea	0.60	5.5 - 7.5	July to September
Chamaecrista nictitans	Sensitive Partridge Pea	0.06		June to October
Coreopsis lanceolata	Lanceleaf Coreopsis	0.44	6.0 - 7.0	April to July
Eupatorium coelestinum	Mistflower	0.04	5.5 - 7.5	July to October
Heliopsis helianthoides	Oxeye Sunflower	0.40		July to August
Lespedeza virginica	Slender Bushclover	0.10		July to September
Liatris graminifolia	Grassleaf Blazing Star	0.10	5.8 - 6.8	August to October
Monarda fistulosa	Wild Bergamot	0.10	6.0 - 8.0	June to September
Penstemon laevigatus	Appalachian Beardtongue	0.10		late May to late August
Pycnanthemum incanum	Hoary Mountainmint,	0.20		May to June
Rudbeckia fulgida var. fulgida	Orange Coneflower	0.02	< 6.8	summer
Rudbeckia hirta	Blackeyed Susan	0.04		July to October

Species	Common Name	Seeding Rate (lbs/acre)	pH	Bloom Period (if applicable)
Senna hebecarpa	Wild Senna	0.60	6.0 - 7.0	May to July
Solidago juncea	Early Goldenrod	0.10		July to August
Solidago nemoralis	Gray Goldenrod	0.04		June to July
Tradescantia ohiensis	Ohio Spiderwort	0.04	6.5 - 7.5	August to September
Tradescantia virginiana	Virginia Spiderwort	0.10		late April to mid-July
		20.00		

DRAWN	DATE	Mountain Valley PIPELINE	ENVIRONMENTAL DETAIL
CHECKED	DATE		UPLAND MEADOW SEED MIX AND APPLICATION RATES
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Upland Steep Slope Seed Mix and Application Rates in Virginia.

Species	Common Name	Seeding Rate (lbs/acre)	pH	Bloom Period (if applicable)
Agrostis perennans	Autumn Bentgrass	3.15	5.5 - 7.5	Midsummer
Elymus virginicus	Virginia Wildrye	9.05	5.0 - 7.4	June to October
Panicum clandestinum	Deertongue	4.50	4.0 - 7.5	May to September
Schizachyrium scoparium	Little Bluestem	11.25	5.0 - 7.4	July to October
Sorghastrum nutans	Indiangrass	14.40	5.0 - 7.8	August to October
Asclepias syriaca	Common Milkweed	0.09		June to August
Aster pilosus	Heath Aster	0.05	5.4 - 7.0	After fall frost
Chamaecrista fasciculata	Partridge Pea	0.45	5.5 - 7.5	July to September
Coreopsis lanceolata	Lanceleaf Coreopsis	0.45	6.0 - 7.0	April to July
Eupatorium coelestinum	Mistflower	0.05	5.5 - 7.5	July to October
Heliopsis helianthoides	Oxeye Sunflower	0.45		July to August
Liatris graminifolia	Grassleaf Blazing Star	0.09	5.8 - 6.8	August to October
Monarda fistulosa	Wild Bergamot	0.23	6.0 - 8.0	June to September
Pycnanthemum incanum	Hoary Mountainmint	0.05	< 6.8	summer
Rudbeckia hirta	Blackeyed Susan	0.45	6.0 - 7.0	May to July
Senna hebecarpa	Wild Senna	0.23		July to August
Solidago nemoralis	Gray Goldenrod	0.05	6.5 - 7.5	August to September
Tradescantia ohiensis	Ohio Spiderwort	0.05		late April to mid-July
		45.00		

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CHECKED	DATE		UPLAND STEEP SLOPE SEED MIX AND APPLICATION RATES
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PROJECT ID: PXXXX		DESIGN ENGINEERING	DRAWING NO. MVP–ES11.3 / REV. 0

Wetlands Seed Mix and Application Rates in Virginia.

Species	Common Name	Seeding Rate (lbs/acre)	pH	Bloom Period (if applicable)
Alisma subcordatum	Mud Plantain	0.04		
Carex gynandra	Fringed Sedge	0.10	5.0 - 7.0	Midsummer
Carex lupulina	Hop Sedge	1.00		May to June
Carex lurida	Shallow Sedge	3.00	6.2 - 7.0	June to October
Carex scoparia	Blunt Broom Sedge	1.00	4.9 - 6.8	June to July
Carex vulpinoidea	Fox Sedge	6.90	4.6 - 6.9	July to August
Cinna arundinacea	Wood Reedgrass	0.40	6.8 - 8.9	June to August
Elymus virginicus	Virginia Wildrye	4.00	4.0 - 8.5	August to September
Juncus effusus	Soft Rush	0.60	5.0 - 7.4	June to October
Onoclea sensibilis	Sensitive Fern	0.20	5.5 - 7.0	May to June
Scirpus cyperinus	Woolgrass	0.20		June to October

Species	Common Name	Seeding Rate (lbs/acre)	pH	Bloom Period (if applicable)
Scirpus polyphyllus	Many Leaved Bulrush	0.20	4.8 - 7.2	July to September
Asclepias incarnata	Swamp Milkweed	0.40		July to August
Eupatorium coelestinum	Mistflower	0.10	5.0 - 8.0	June to July
Eupatorium fistulosum	Joe Pye Weed	0.14	5.5 - 7.5	July to October
Eupatorium perfoliatum	Boneset	0.20	4.5 - 7.0	July to September
Helenium autumnale	Common Sneezeweed	0.10		July to October
Heliopsis helianthoides	Oxeye Sunflower	0.40	4.0 - 7.5	August to September
Ludwigia alternifolia	Seedbox	0.10		July to August
Mimulus ringens	Square Stemmed Monkeyflower	0.10		August to September
Verbena hastata	Blue Vervain	0.72		June to September
Vernonia noveboracensis	New York Ironweed	0.10		June to October
		20.00		

NOTE:

ANNUAL RYEGRASS WILL BE USED AT A RATE OF 40 LBS/AC FOR STABILIZATION OF WETLANDS DISTURBED BY THE PROJECT.

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WETLAND SEED MIX AND APPLICATION RATES

DRAWING NO.	REV.
MVP–ES11.4	0

Riparian Seed Mix and Application Rates in Virginia.

Species	Common Name	Seeding Rate (lbs/acre)	pH	Bloom Period (if applicable)
Alisma subcordatum	Autumn Bentgrass	0.04	5.0 - 7.0	Midsummer
Carex gynandra	Big Bluestem	0.10		May to June
Carex lupulina	Virginia Wildrye	1.00	6.2 - 7.0	June to October
Carex lurida	Soft Rush	3.00	4.9 - 6.8	June to July
Carex scoparia	Path Rush	1.00	4.6 - 6.9	July to August
Carex vulpinoidea	Deertongue	6.90	6.8 - 8.9	June to August
Cinna arundinacea	Indiangrass	0.40	4.0 - 8.5	August to September
Elymus virginicus	Swamp Milkweed	4.00	5.0 - 7.4	June to October
Juncus effusus	Partridge Pea	0.60	5.5 - 7.0	May to June
Onoclea sensibilis	Mistflower	0.20		June to October
Scirpus cyperinus	Joe Pye Weed	0.20	4.8 - 7.2	July to September
Scirpus polyphyllus	Boneset	0.20		July to August
Asclepias incarnata	White Avens	0.40	5.0 - 8.0	June to July
Eupatorium coelestinum	Common Sneezeweed	0.10	5.5 - 7.5	July to October
Eupatorium fistulosum	Oxeye Sunflower	0.14	4.5 - 7.0	July to September
Eupatorium perfoliatum	Wild Bergamot	0.20		July to October
Helenium autumnale	Slender Mountainmint	0.10	4.0 - 7.5	August to September
Heliopsis helianthoides	Blackeyed Susan	0.40		July to August
Ludwigia alternifolia	Wild Senna	0.10		August to September
Mimulus ringens	Blue Vervain	0.10		June to September
Verbena hastata	New York Ironweed	0.72		June to October
		20.00		

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RIPARIAN SEED MIX AND APPLICATION RATES

DRAWING NO.	REV.
MVP-ES11.5	0

Native tree and shrub species for bare root plantings within riparian areas and forested wetlands.

Species	Common Name	Indicator Status	Riparian Planting[1]	Forested Wetland Planting[2]
Native Trees				
Acer rubrum	Red Maple	FAC	X	X
Acer saccharinum	Silver Maple	FACW	X	X
Betula nigra	River Birch	FACW	X	X
Carpinus caroliniana	American Hornbeam	FAC	X	X
Carya glabra	Pignut Hickory	FACU	X	
Carya ovata	Shagbark Hickory	FACU	X	
Chionanthus virginicus	White Fringe Tree	FAC+	X	
Diospyros virginiana	Common Persimmon	FAC-	X	

Species	Common Name	Indicator Status	Riparian Planting[1]	Forested Wetland Planting[2]
Fraxinus pennsylvanica	Green Ash	FACW	X	X
Juniperus virginiana	Eastern Red Cedar	FACU	X	X
Liquidambar styraciflua	Sweet Gum	FAC	X	X
Liriodendron tulipifera	Tuliptree	FACU	X	X
Nyssa sylvatica	Black Gum	FAC	X	
Platanus occidentalis	American Sycamore	FACW-	X	X
Populus deltoids	Eastern Cottonwood	FAC	X	
Quercus bicolor	Swamp White Oak	FACW+	X	X
Quercus falcata	Cherrybark Red Oak	FACW	X	X
Quercus phellos	Willow Oak	FAC+	X	X
Quercus nigra	Water Oak	FAC	X	
Quercus palustris	Pin Oak	FACW	X	X
Salix nigra	Black Willow	FACW	X	X
Ulmus americana	American Elm	FACW-	X	X

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Mountain Valley PIPELINE

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ENVIRONMENTAL DETAIL

NATIVE TREE AND SHRUB SPECIES FOR BARE ROOT PLANTINGS WITHIN RIPARIAN AREAS AND FORESTED WETLANDS

DRAWING NO.	REV.
MVP–ES11.6	0

Native Shrubs				
Alnus serrulata	Brook-side Alder	OBL		X
Amelanchier canadensis	Canada Serviceberry	FAC	X	
Aronia arbutifolia	Red Chokecherry	FACW	X	X
Baccharis halimifolia	Groundsel Bush	FACW-	X	X
Cephalanthus occidentalis	Buttonbush	OBL		X
Cornus amomum	Silky Dogwood	FACW	X	X
Cornus stolonifera	Red-osier Dogwood	FAC	X	X
Hamamelis virginiana	American Witchhazel	FAC-	X	
Ilex verticillata	Common Winterberry	FACW+	X	X
Itea virginica	Virginia Willow	OBL		X
Iva frutescens	Marsh Elder	FACW+	X	X
Leucothoe racemosa	Fetter-bush	FACW	X	X
Lindera benzoin	Spicebush	FACW-	X	X
Lyonia ligustrina	Maleberry	FACW	X	X
Magnolia virginiana	Sweetbay Magnolia	FACW+	X	X
Physocarpus opulifolius	Eastern Ninebark	FACW-	X	X
Sambucus canadensis	American Elder	FACW-	X	X
Vaccinium corymbosum	Highbush Blueberry	FACW-	X	X
Virburnum dentatum	Arrow-wood	FAC	X	
Viburnum prunifolium	Black-haw	FACU	X	

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NATIVE TREE AND SHRUB SPECIES FOR BARE ROOT PLANTINGS WITHIN RIPARIAN AREAS AND FORESTED WETLANDS

DRAWING NO.	REV.
MVP–ES11.7	0

Stream crossings proposed for bare-root seedling plantings.

Waterbody Name	MP	County	State	Valuable Resource
Kimballton Branch	199.1, 199.4	Giles	VA	headwaters of wild trout stream, coldwater stream

Waterbody Name	MP	County	State	Valuable Resource
Stony Creek	200.4	Giles	VA	candy darter, green floater, coldwater stream, wild trout stream
Little Stony Creek	204.4	Giles	VA	coldwater stream, wild trout stream
Sinking Creek	211.2	Giles	VA	candy darter, green floater, coldwater stream, wild trout stream, non-listed mussels
UNT Craig Creek	219.2	Montgomery	VA	Headwaters of James spinymussel occurrences, USFS lands area
UNT Craig Creek	219.3	Montgomery	VA	Headwaters of James spinymussel occurrences, USFS lands area
Craig Creek	219.7	Montgomery	VA	Headwaters of James spinymussel occurrences, USFS lands area
Craig Creek	219.7	Montgomery	VA	Headwaters of James spinymussel occurrences, USFS lands area
UNT Craig Creek	219.8	Montgomery	VA	Headwaters of James spinymussel occurrences, USFS lands area
UNT Craig Creek	220.0	Montgomery	VA	Headwaters of James spinymussel occurrences, USFS lands area
Mill Creek	222.2	Montgomery	VA	upstream of Roanoke logperch suitable habitat, orangefin madtom, coldwater stream, wild trout
North Fork Roanoke River	227.2	Montgomery	VA	Roanoke logperch present, non-listed mussels present, orangefin madtom, coldwater stream, wild trout
North Fork Roanoke River	227.4	Montgomery	VA	Roanoke logperch present, non-listed mussels present, orangefin madtom, coldwater stream, wild trout
Bradshaw Creek	230.7	Montgomery	VA	Roanoke logperch suitable habitat, orangefin madtom, coldwater stream, wild trout
Bradshaw Creek	231.5	Montgomery	VA	Roanoke logperch suitable habitat, orangefin madtom, coldwater stream, wild trout
Roanoke River	235.4	Montgomery	VA	Roanoke logperch present, orangefin madtom, non-listed mussels present
Bottom Creek	241.1	Roanoke	VA	upstream of Bottom Creek Gorge, orangefin madtom, coldwater stream, wild trout
Bottom Creek	242.5	Roanoke	VA	upstream of Bottom Creek Gorge, orangefin madtom, coldwater stream, wild trout

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STREAM CROSSINGS PROPOSED FOR BARE ROOT SEEDING PLANTINGS

DRAWING NO.	REV.
MVP–ES11.8	0

Mill Creek	245.1	Roanoke	VA	upstream of Bottom Creek Gorge, orangefin madtom, coldwater stream, wild trout
Green Creek	247.1	Franklin	VA	upstream of Bottom Creek Gorge, orangefin madtom, coldwater stream, wild trout
Green Creek	247.4	Franklin	VA	upstream of Bottom Creek Gorge, orangefin madtom, coldwater stream, wild trout
North Fork Blackwater River	249.7	Franklin	VA	Roanoke logperch suitable habitat, coldwater stream wild trout stream

Waterbody Name	MP	County	State	Valuable Resource
Teels Creek	258.2	Franklin	VA	upstream of Roanoke logperch suitable habitat, one of numerous project crossings of Teels Creek
Teels Creek	260.3	Franklin	VA	upstream of Roanoke logperch suitable habitat, one of numerous project crossings of Teels Creek
Teels Creek	261.0	Franklin	VA	upstream of Roanoke logperch suitable habitat, one of numerous project crossings of Teels Creek
Teels Creek	261.8	Franklin	VA	upstream of Roanoke logperch suitable habitat, one of numerous project crossings of Teels Creek
Teels Creek	262.3	Franklin	VA	Roanoke logperch suitable habitat, one of numerous project crossings of Teels Creek contributing sediment impacts
Little Creek	262.6	Franklin	VA	Roanoke logperch suitable habitat, numerous crossings upstream contributing sediment impacts
Little Creek	263.3	Franklin	VA	Roanoke logperch suitable habitat, non-listed mussels present, numerous crossings upstream contributing sediment impacts
Maggodee Creek	269.4	Franklin	VA	Roanoke logperch suitable habitat
Blackwater River	269.7	Franklin	VA	Roanoke logperch present, non-listed mussels present
UNT to Jacks Creek	278.8	Franklin	VA	orangefin madtom
Turkey Creek	280.5	Franklin	VA	orangefin madtom
Strawfield Creek	282.3	Franklin	VA	orangefin madtom
Parrot Branch	282.9	Franklin	VA	orangefin madtom
Jonnikin Creek	284.4	Pittsylvania	VA	orangefin madtom
UNT to Rocky Creek	287.1	Pittsylvania	VA	orangefin madtom
Pigg River	289.1	Pittsylvania	VA	Roanoke logperch present, orangefin madtom, mussels present including yellow lampmussel (VA threatened)
Harpen Creek	289.9	Pittsylvania	VA	Roanoke logperch suitable habitat, orangefin madtom
Harpen Creek	292.0	Pittsylvania	VA	orangefin madtom

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STREAM CROSSINGS PROPOSED FOR BARE ROOT SEEDING PLANTINGS

DRAWING NO.	REV.
MVP–ES11.9	0

Name	Ph preference	Wetland Indicator Status
Annual Ryegrass (Lolium Multiflorum (L. perenne var. italicum))	5.0–7.9	NI/moderate
German/Foxtail Millet (Setaria italica)	5.3–6.9	FACU
Cereal Rye (Secale cereale)	5.2–8.0	NI/damp
Browntop Millet (Panicum ramosum)	5.5–6.9	FACU

NOTES:

1): MINIMUM SEED RATE WILL BE 50 LBS/ACRE

2): UTILIZE APPROPRIATE SEED FOR TIME OF YEAR

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Mountain Valley PIPELINE

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ENVIRONMENTAL DETAIL

VIRGINIA TEMPORARY EROSION CONTROL SEED MIX

DRAWING NO.	REV.
MVP–ES11.10	0

Upland Area Seed Mixes within the Jefferson National Forest

Scientific Name	Common Name	Growth Habit	pH Preference
Upland Areas - Non-native Species for Erosion Control			
Lolium perenne subsp. *multiflorum*	Italian ryegrass; Annual ryegrass	Graminoid	5.0 – 7.9
Urochloa ramosa (*Panicum ramosum*)	Browntop millett	Graminoid	5.5 – 6.9
Secale cereale	Cereal rye	Graminoid	5.2 – 8.0
Setaria italica	Foxtail millet	Graminoid	5.3 – 6.9
Upland Areas - Native Species			
Chasmanthium laxum[a]	Slender woodoats	Graminoid	4.5 – 7.0
Eragrostis spectabilis[a]	Purple lovegrass	Graminoid	4.0 – 7.5
Panicum virgatum	Switchgrass	Graminoid	4.5 – 8.0
Sorghastrum nutans	Indiangrass	Graminoid	5.0 – 7.8
Tridens flavus[a]	Purpletop	Graminoid	4.5 – 6.5
Apocynum cannabinum[a]	Indian hemp	Forb	4.5 – 7.0
Chamaecrista fasciculata	Partridge pea	Forb	5.5 – 7.5
Desmodium canadense	Showy ticktrefoil	Forb	wide tolerance
Desmodium paniculatum	Panicledleaf ticktrefoil	Forb	6.0 – 7.0
Elymus virginicus[b]	Virginia wildrye	Graminoid	5.0 – 7.4
Geum canadense[a]	White avens	Forb	4.5 – 7.5
Heliopsis helianthoides	Oxeye sunflower; Smooth oxeye	Forb	unknown
Monarda fistulosa[b]	Wild bergamot	Forb	6.0 – 8.0
Pycnanthemum spp.[b]	Mountain mint	Forb	unknown
Rubus allegheniensis[a]	Common blackberry; Allegheny blackberry	Forb/ Subshrub	4.6 – 7.5
Rudbeckia hirta	Blackeyed Susan	Forb	6.0 – 7.0
Solidago canadensis[a]	Canada goldenrod	Forb	4.8 – 7.5
Tradescantia virginiana[a]	Virginia spiderwort	Forb	4.0 – 8.0

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Mountain Valley PIPELINE

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ENVIRONMENTAL DETAIL

US FOREST SERVICE
(NATIONAL FOREST) LANDS
UPLAND AREA SEED MIX

DRAWING NO.	REV.
MVP–ES12.1	0

Riparian Seed Mixes within Jefferson National Forest

Scientific Name	Common Name	Habit	pH Preference
Non-native Species for Erosion Control			
Lolium perenne subsp. multiflorum	Italian ryegrass; Annual ryegrass	Graminoid	5.0 – 7.9
Urochloa ramosa (Panicum ramosum)	Browntop millett	Graminoid	5.5 – 6.9
Secale cereale	Cereal rye	Graminoid	5.2 – 8.0
Setaria italica	Foxtail millet	Graminoid	5.3 – 6.9
Native Species			
Agrostis perennans	Autumn bentgrass; upland bentgrass	Graminoid	5.5 – 7.5
Elymus virginicus	Virginia Wildrye	Graminoid	5.0 - 7.4
Sorghastrum nutans	Indiangrass	Graminoid	5.0 – 7.8
Asclepias incarnata	Swamp milkweed	Forb	5.0 – 8.0
Chamaecrista fasciculata	Partridge pea	Forb	5.5 – 7.5
Eutrochium fistulosum (Eupatorium fistulosum)	Joe pye weed	Forb	4.5 – 7.0
Eupatorium maculatum	Spotted joe pye weed	Forb	5.5 – 7.0
Eupatorium perfoliatum	Boneset	Forb	unknown
Helenium autumnale	Common sneezeweed	Forb	4.0 – 7.5
Senna hebecarpa	Wild senna; American senna	Forb	unknown
Senna marilandica	Maryland senna	Forb / Subshrub	4.0 – 7.0
Vernonia noveboracensis	New York ironweed	Forb	4.5 -8.0

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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

US FOREST SERVICE
(NATIONAL FOREST) LANDS
RIPARIAN SEED MIX

DRAWING NO.	REV.
MVP–ES12.2	0

Species for hydroseed mixes within the Jefferson National Forest.

Scientific Name	Common Name	Growth Habit	pH Preference
Non-native Species for Temporary Erosion Control			
Lolium perenne subsp. *multiflorum*	Italian ryegrass; Annual ryegrass	Graminoid	5.0 – 7.9
Urochloa ramosa (*Panicum ramosum*)	Browntop millett	Graminoid	5.5 – 6.9
Secale cereale	Cereal rye	Graminoid	5.2 – 8.0
Setaria italica	Foxtail millet	Graminoid	5.3 – 6.9
Native – Highly Preferred			
Sorghastrum nutans	Indiangrass	Graminoid	5.0 – 7.8
Tridens flavus	Purpletop	Graminoid	4.5 – 6.5
Native – Preferred			
Agrostis perennans	Autumn bentgrass; Upland bentgrass	Graminoid	5.5 – 7.5
Dichanthelium clandestinum	Deertongue	Graminoid	4.0 – 7.5
Elymus canadensis	Canada wildrye	Graminoid	5.0 – 7.9
Desmodium canadense	Showy ticktrefoil	Forb	wide tolerance
Heliopsis helianthoides	Oxeye sunflower; Smooth oxeye	Forb	unknown
Lespedeza virginica	Slender bushclover; Slender lespedeza	Forb	acid tolerant
Liatris spicata	Dense blazing star; Spiked gayfeather	Forb	5.6 - 7.5
Senna hebecarpa	Wild senna; American senna	Forb	unknown
Native – Moderately Preferred			
Panicum virgatum	Switchgrass	Graminoid	4.5 – 8.0
Chamaecrista fasciculata	Partridge pea	Forb	5.5 – 7.5
Rudbeckia hirta	Blackeyed Susan	Forb	6.0 – 7.0

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US FOREST SERVICE
(NATIONAL FOREST) LANDS
HYDROSEED MIX

DRAWING NO.	REV.
MVP–ES12.3	0

Name	Ph preference	Wetland Indicator Status
Annual Ryegrass (Lolium Multiflorum (L. perenne var. italicum))	5.0–7.9	NI/moderate
German/Foxtail Millet (Setaria italica)	5.3–6.9	FACU
Cereal Rye (Secale cereale)	5.2–8.0	NI/damp
Browntop Millet (Panicum ramosum) (introduced in VA & south; possibly ok for WV?)	5.5–6.9	FACU

NOTES:

1): A MINIMUM OF (2) OF THE ABOVE LISTED SPECIES SHALL BE UTILIZED

2): APPLY WHENEVER EROSION CONTROL IS NEEDED OUTSIDE OF NORMAL (PERMANENT) SEEDING SEASONS

3): APPLY CONCURRENT WITH PERMANENT EROSION CONTROL

4): APPLY PRIOR TO PERMANENT SEEDING WITH WILDLIFE MIXES

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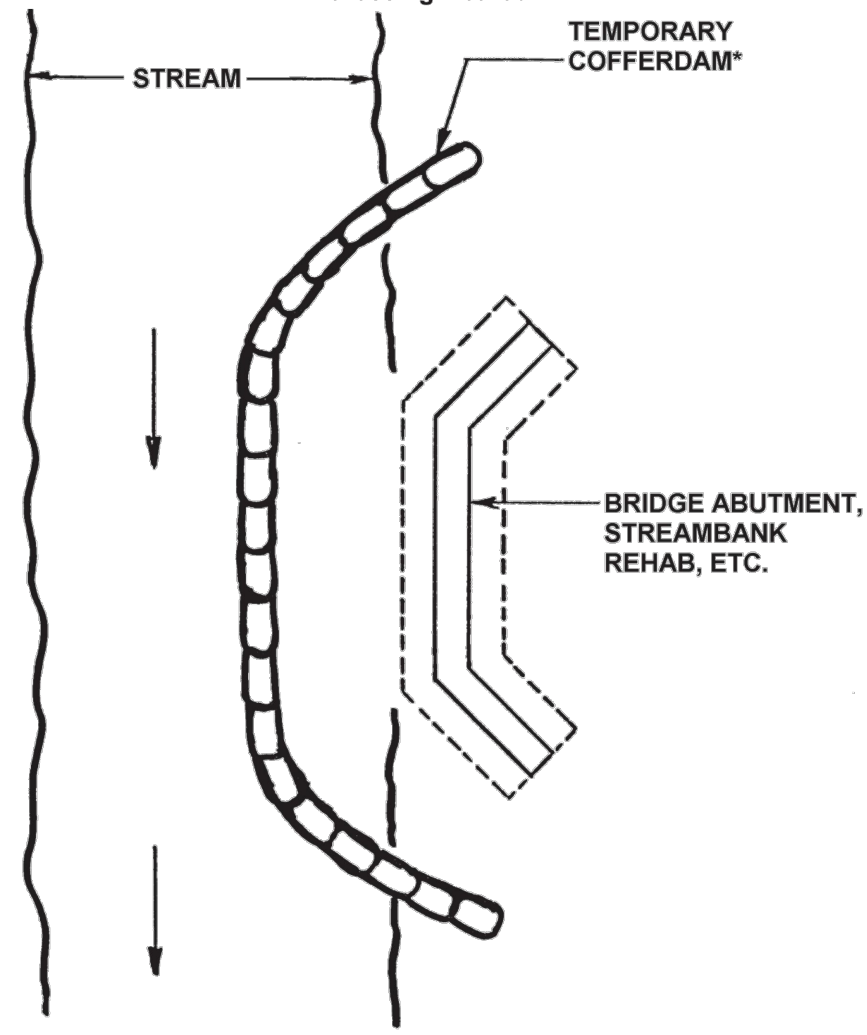
US FOREST SERVICE
(NATIONAL FOREST) LANDS
TEMPORARY EROSION CONTROL SPECIES

DRAWING NO.	REV.
MVP–ES12.4	0

MVP-ES13 Cofferdam Stream Crossing Methodn



PA DEP

* **Sandbags (Standard Construction Detail #3-15), Jersey barriers (Figure 3.13) or other non-erosive material, no earth fill.**

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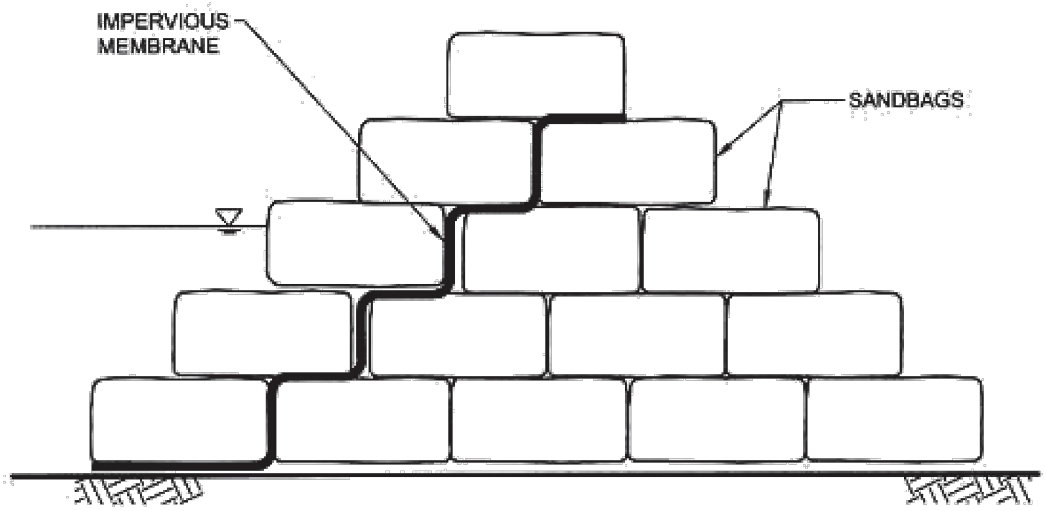
Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

COFFERDAM STREAM CROSSING METHOD

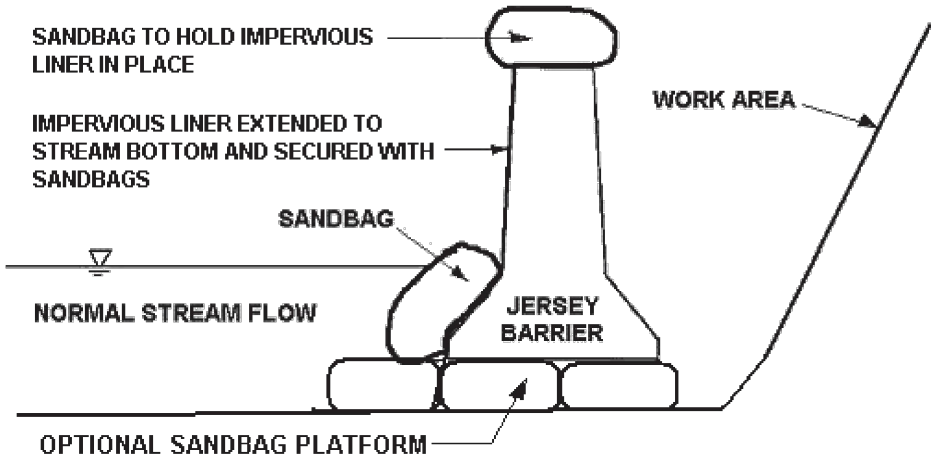
DRAWING NO.	REV.
MVP–ES13.1	P



PA DEP

2 BAG MINIMUM HEIGHT ABOVE NORMAL BASE FLOW

FIGURE 3.13
Jersey Barrier Cofferdam – End View



PA DEP

NOTES: AT NO TIME, SHOULD MORE THE 60% OF THE STREAM CHANNEL WIDTH BE DIVERTED DURING PIPELINE INSTALLATION.

GRUBBING SHALL NOT TAKE PLACE WITHIN 50 FEET OF TOP-OF-BANK UNTIL ALL MATERIALS REQUIRED TO COMPLETE CROSSING ARE ON SITE AND PIPE IS READY FOR INSTALLATION. TRENCH BREAKERS SHALL BE INSTALLED WITHIN THE TRENCH ON BOTH SIDES OF THE STREAM CHANNEL (MVP TYPICAL DETAIL MVP-20). WATER ACCUMULATING WITHIN THE WORK AREA SHALL BE PUMPED TO A PUMPED WATER FILTER BAG OR SEDIMENT TRAP PRIOR TO DISCHARGING INTO ANY RECEIVING SURFACE WATER.
HAZARDOUS OR POLLUTANT MATERIAL STORAGE AREAS SHALL BE LOCATED AT LEAST 100 FEET BACK FROM THE TOP OF STREAMBANK. ALL EXCESS EXCAVATED MATERIAL SHALL BE IMMEDIATELY REMOVED FROM THE STREAM CROSSING AREA.
ALL DISTURBED AREAS WITHIN 50 FEET OF TOP-OF-BANK SHALL BE BLANKETED OR MATTED WITHIN 24 HOURS OF INITIAL DISTURBANCE FOR MINOR STREAMS OR 48 HOURS OF INITIAL DISTURBANCE FOR MAJOR STREAMS UNLESS OTHERWISE AUTHORIZED.

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Mountain Valley PIPELINE
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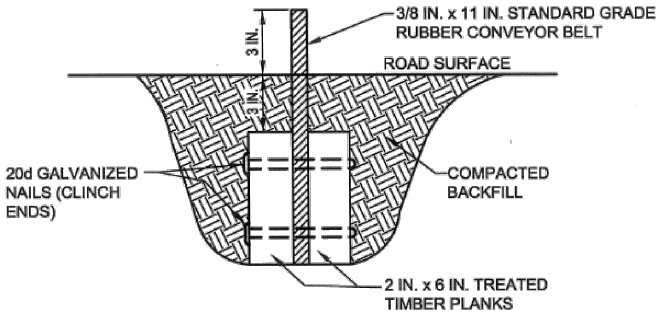
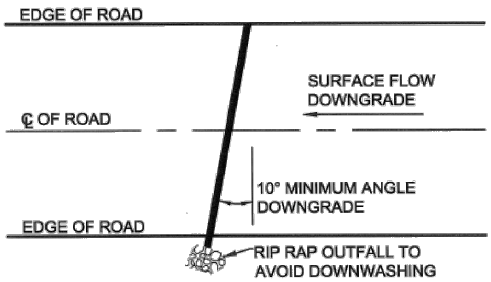
COFFERDAM STREAM CROSSING METHOD

DRAWING NO.	REV.
MVP–ES13.2	P

STANDARD CONSTRUCTION DETAIL
Water Deflector



TYPICAL CROSS-SECTION



TYPICAL PLAN VIEW

USDA Forest Service

Deflector shall be inspected weekly and after each runoff event.

Accumulated sediment shall be removed from deflector within 24 hours of inspection.

Belt shall be replaced when worn and no longer effective.

Deflectors may be used to direct runoff from an access road to a well-vegetated area or sediment removal facility.

A deflector is typically constructed from rubber belting ranging from 5/16" to 1/2" thick held between two 2" x 6" wooden planks.

This method of directing runoff from an access road works best on low traffic roads. deflectors can be used on roads with grades exceeding 10%.

Table II-4 Spacing of Broad-Based Dips

Road Grade (%)	Distance Between Drains (Ft)
2	300
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140

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Mountain Valley PIPELINE

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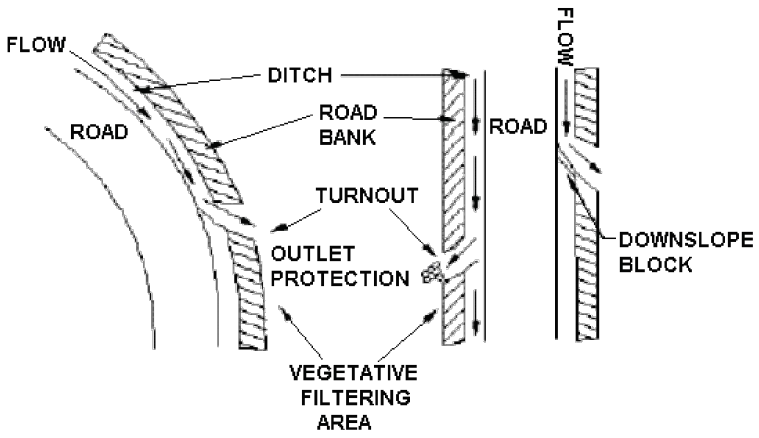
ENVIRONMENTAL DETAIL

WATER DEFLECTOR

DRAWING NO.	REV.
MVP–ES14	P

Typical Turnout



Indiana CCD

TURNOUT - **SEDIMENT REMOVAL EFFICIENCY: VERY LOW. THIS DEVICE IS NOT AN ABACT FOR SPECIAL PROTECTION WATERSHEDS, BUT MAY BE USED TO MAKE OTHER BMPS WHICH ARE ABACT WORK MORE EFFECTIVELY.** CHANNELS THAT DRAIN WATER AWAY FROM ROADS OR ROADSIDE DITCHES INTO WELL-VEGETATED AREAS ARE KNOWN AS TURNOUTS. TURNOUTS ARE TYPICALLY LOCATED ALONG CROWNED ROADWAYS WHERE RUNOFF CANNOT SHEET FLOW OFF THE ROADWAY. LIKE DITCH RELIEF CULVERTS, THE PURPOSE OF TURNOUTS IS TO MINIMIZE THE VOLUME OF WATER IN A ROADSIDE DITCH. TURNOUTS SHOULD BE LOCATED SO AS TO TAKE ADVANTAGE OF NATURAL DRAINAGE COURSES OR BUFFER AREAS WHEREVER POSSIBLE. AN EXCAVATED SUMP AT THE END OF THE TURNOUT CAN BE EFFECTIVELY USED TO POND AND SETTLE OUT SEDIMENT PRIOR TO DISCHARGING TO A VEGETATED BUFFER. WHERE A SUITABLE VEGETATIVE FILTER STRIP IS NOT AVAILABLE, A COMPOST FILTER SOCK, ROCK FILTER OR OTHER SEDIMENT REMOVAL BMP SHOULD BE INSTALLED AT THE OUTLET OF THE TURNOUT.

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Mountain Valley PIPELINE

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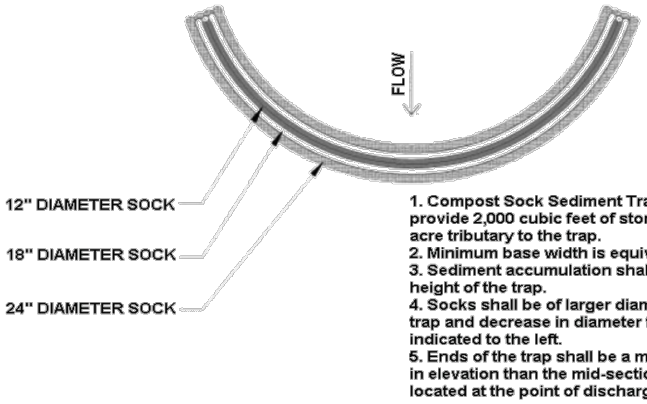
ENVIRONMENTAL DETAIL

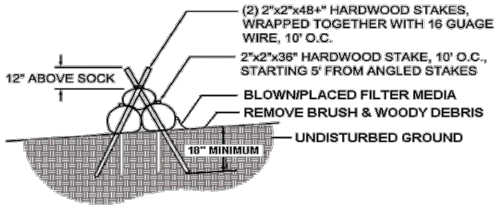
ROAD TURNOUT DETAIL

DRAWING NO.	REV.
MVP–ES15	P



1. Compost Sock Sediment Trap shall be sized to provide 2,000 cubic feet of storage capacity for each acre tributary to the trap.
2. Minimum base width is equivalent to the height.
3. Sediment accumulation shall not exceed 1/3 the total height of the trap.
4. Socks shall be of larger diameter at the base of the trap and decrease in diameter for successive layers as indicated to the left.
5. Ends of the trap shall be a minimum of 1 foot higher in elevation than the mid-section, which shall be located at the point of discharge.

PLAN VIEW



Adapted from Filtrexx

STAKING DETAIL

Compost sock sediment traps shall not exceed three socks in height and shall be stacked in pyramidal form as shown above. Minimum trap height is one 24" diameter sock. Additional storage may be provided by means of an excavated sump 12" deep extending 1 to 3 feet upslope of the socks along the lower side of the trap.

Compost sock sediment traps shall provide 2,000 cubic feet storage capacity with 12" freeboard for each tributary drainage acre. (See manufacturer for anticipated settlement.)

The maximum tributary drainage area is 5.0 acres. Since compost socks are "flow-through," no spillway is required.

Compost sock sediment traps shall be inspected weekly and after each runoff event. Sediment shall be removed when it reaches 1/3 the height of the socks.

Photodegradable and biodegradable socks shall not be used for more than 1 year.

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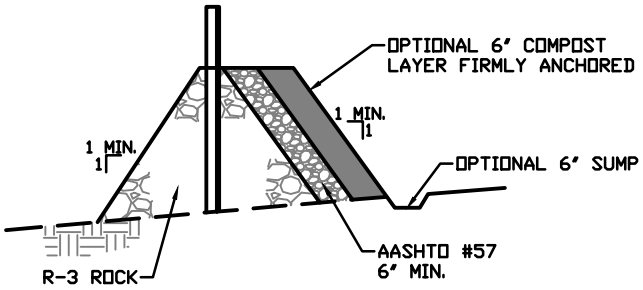
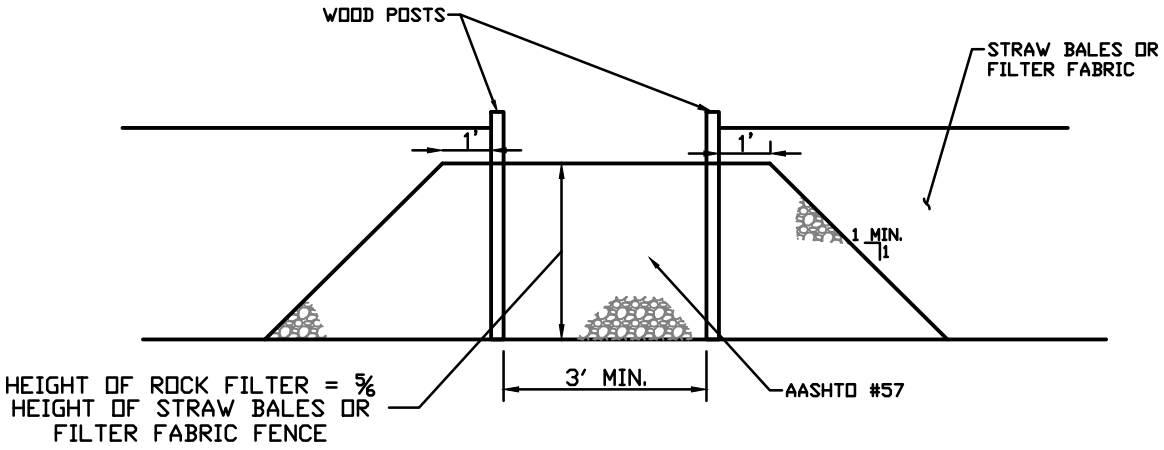
ENVIRONMENTAL DETAIL

COMPOST SOCK
SEDIMENT TRAP

DRAWING NO.	REV.
MVP–ES16	P



OUTLET CROSS SECTION



UP-SLOPE FACE

A ROCK FILTER OUTLET SHALL BE INSTALLED WHERE FAILURE OF A SILT FENCE OR STRAW BALE BARRIER HAS OCCURRED DUE TO CONCENTRATED FLOW. ANCHORED COMPOST LAYER SHALL BE USED ON UPSLOPE FACE IN HQ AND EV WATERSHEDS.

SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH 1/3 THE HEIGHT OF THE OUTLET.

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Mountain Valley PIPELINE

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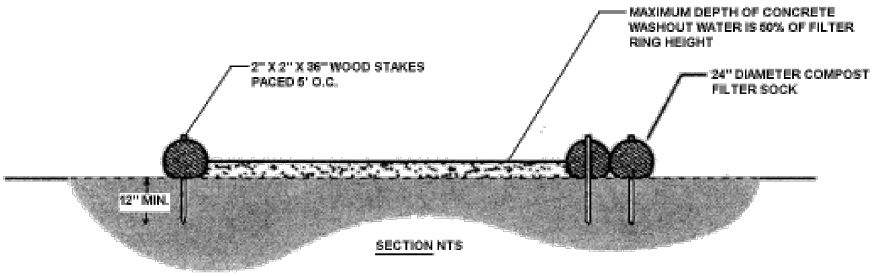
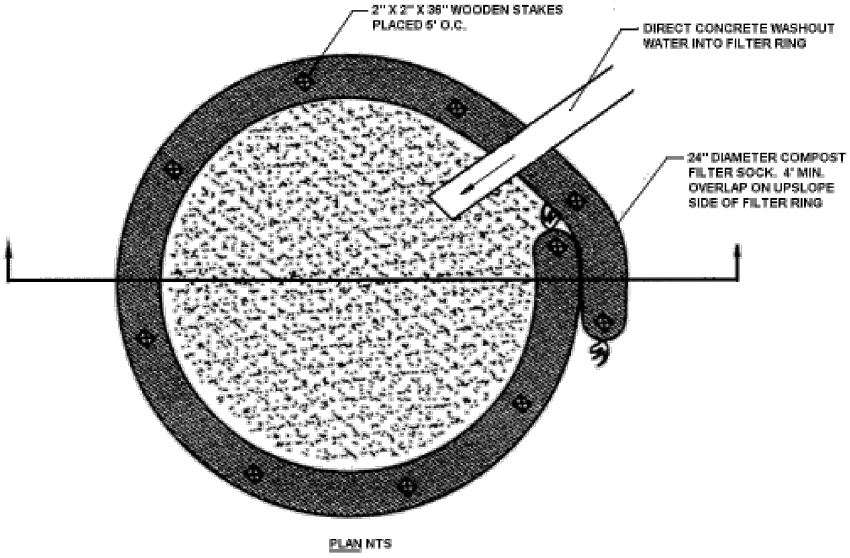
ENVIRONMENTAL DETAIL

ROCK FILTER OUTLET

DRAWING NO.	REV.
MVP-ES17	P



NOTES:
1. INSTALL ON FLAT GRADE FOR OPTIMUM PERFORMANCE
2. 18" DIAMETER FILTER SOCK MAY BE STACKED ONTO DOUBLE 24" DIAMETER SOCKS IN PYRAMIDAL CONFIGURATION FOR ADDED HEIGHT.



A suitable impervious geomembrane shall be placed at the location of the washout prior to installing the socks.
Adapted from Filtrexx

Wherever compost sock washouts are used, a suitable impervious geomembrane should be placed at the location of the washout. Compost socks should be staked in the manner recommended by the manufacturer around perimeter of the geomembrane so as to form a ring with the ends of the sock located at the upslope corner. Care should be taken to ensure continuous contact of the sock with the geomembrane at all locations. where necessary, socks may be stacked and staked so as to form a triangular cross-section.

For any project on which concrete will be poured or otherwise formed on site, a suitable washout facility must be provided for the cleaning of chutes, mixers, and hoppers of the delivery vehicles unless such a facility will be used at the source of the concrete. Under no circumstances may wash water from these vehicles be allowed to enter any surface waters. Make sure that proper signage is provided to drivers so that they are aware of the presence of washout facilities. Washout facilities should not be placed within 50 feet of storm drains, open ditches or surface waters. They should be in a convenient location for the trucks, preferably near the place where the concrete is being poured, but far enough from other vehicular traffic to minimize the potential for accidental damage or spills. Wherever possible, they should be located on slopes not exceeding a 2% grade.

Maintenance

All concrete washout facilities should be inspected daily. Damaged or leaking washouts should be deactivated and repaired or replaced immediately. Accumulated materials should be removed when they reach 75% capacity. Plastic liners should be replaced with each cleaning of the washout facility.

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Mountain Valley PIPELINE
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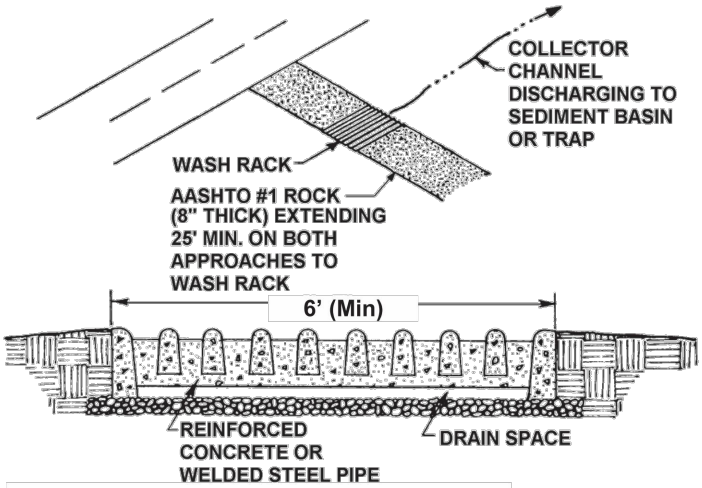
ENVIRONMENTAL DETAIL

COMPOST SOCK
WASHOUT PIT TYPICAL

DRAWING NO.	REV.
MVP–ES18	P

Rock Construction Entrance with Wash Rack



Modified from Smith Cattleguard Company

IF EXCESSIVE AMOUNTS OF SEDIMENT ARE BEING DEPOSITED ON ROADWAY, EXTEND LENGTH OF ROCK CONSTRUCTION ENTRANCE BY 70 FOOT INCREMENTS UNTIL CONDITION IS ALLEVIATED OR INSTALL WASH RACK.

Wash rack shall be 20 feet (min.) wide or total width of access.

Wash rack shall be designed and constructed to accommodate anticipated construction vehicular traffic.

A water supply shall be made available to wash the wheels of all vehicles exiting the site.

MAINTENANCE: Rock construction entrance thickness shall be constantly maintained to the specified dimensions by adding rock. A stockpile of rock material shall be maintained on site for this purpose. Drain space under wash rack shall be kept open at all times. Damage to the wash rack shall be repaired prior to further use of the rack. All sediment deposited on roadways shall be removed and returned to the construction site immediately. Washing the roadway or sweeping the deposits into roadway ditches, sewers, culverts, or other drainage courses is not acceptable.

At a minimum, rock construction entrances with wash racks should be constructed to the length, width, and thickness dimensions shown on standard construction detail #3-2. A metal wash rack or livestock grate is an acceptable alternative to the reinforced concrete one shown in the standard detail. Approaches to the wash rack should be lined with aashto #1 at a minimum of 25' on both sides. The wash rack should discharge to a sediment removal facility, such as a vegetated filter strip or into a channel leading to a sediment removal device (e.g. a sediment trap or sediment basin). Rock construction entrances with wash racks should be maintained to the specified dimensions by adding rock when necessary at the end of each workday. A stockpile of rock material should be maintained on site for this purpose.

Sediment deposited on paved roadways should be removed and returned to the construction site.

NOTE: Washing the roadway or sweeping the deposits into roadway ditches, sewers, culverts, or other drainage courses is not acceptable.

Damaged wash racks should be repaired as necessary to maintain their effectiveness.

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Mountain Valley PIPELINE

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ENVIRONMENTAL DETAIL

ROCK CONSTRUCTION ENTRANCE WITH WASH RACK

DRAWING NO.	REV.
MVP–ES20	P

ROCK FILTER - **Sediment Removal Efficiency: LOW. This device is not an ABACT for special protection watersheds. However, the efficiency may be raised to moderate (ABACT for HQ watersheds) by anchoring a 6" layer of compost on the upgradient side.** Rock filters may be used to control runoff within constructed channels — at the downstream end of the channel, during construction — until the protective lining is installed or during a temporary disturbance within the channel. They may also be used below construction work within an existing channel while flow is being diverted past the work area . In such cases, the filter should be located between the work area and the discharge from the bypass system. In no case are rock filters to be placed within a channel meeting the definition of a waterbody.

Rock filters may not be used instead of appropriate channel linings. This practice often results in overtopping of the channel during storm events, scouring of the channel bottom below the filter, or erosion of the channel side slopes as sediment deposits build up behind the filter. Rock filters may not be used in roadside ditches instead of a suitable temporary protective liner until vegetation is established except at the inflows to ditch relief culverts on dirt or gravel roads or on temporary or permanent access roads.

Rock filters may not be used instead of an adequate protective lining in sediment basin emergency spillways. This can reduce the effective discharge capacity of the spillway and, in so doing, increase the possibility of embankment failure.

Rock filters should be constructed according to the specifications shown in Standard Construction Detail # 4-14.

Rock filters should be constructed with riprap sized as follows:

For channels with total depth > 3 feet, use R-4.
For channels with total depth between 2 and 3 feet, use R-3.

Rock filters should not be used in channels of less than 2 feet total depth.

The filter should be equal in height to **half** the total channel depth with a 6" depression in the center.

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ROCK FILTER

DRAWING NO.	REV.
MVP–ES21.1	P

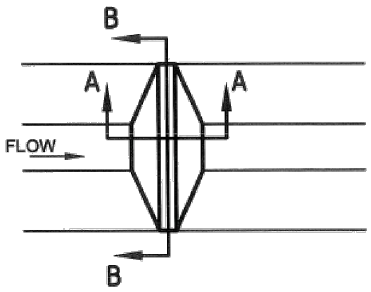
A one foot thick layer of AASHTO #57 (or smaller) stone should be placed on the upstream side of the filter. In special protection watersheds, a 6" layer of compost should be placed and anchored on top of the filter stone. NOTE: Filter fabric and straw bales should not be used in rock filters!

Rock filters should be inspected weekly and after each runoff event.

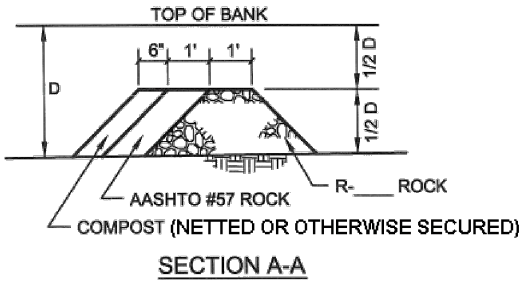
Clogged filter stone (AASHTO # 57) should be replaced.

Needed repairs should be initiated immediately after the inspection.

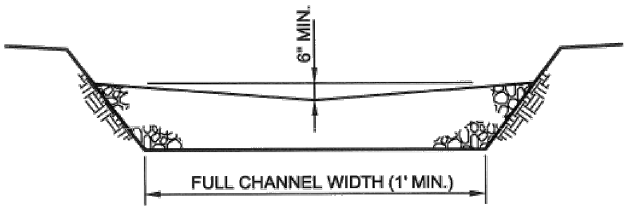
STANDARD CONSTRUCTION DETAIL # 4-14
Rock Filter



PLAN VIEW



SECTION A-A



SECTION B-B

PA DEP

FOR 3' ≤ D USE R-4
FOR 2' ≤ D < 3' USE R-3
NOT APPLICABLE FOR D < 2'

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

ROCK FILTER NO.	LOCATION	D (FT.)	RIPRAP SIZE

Sediment shall be removed when accumulations reach 1/2 the height of the filter.

Immediately upon stabilization of each channel, installer shall remove accumulated sediment, remove rock filter, and stabilize disturbed areas.

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ROCK FILTER

DRAWING NO.	REV.
MVP–ES21.2	P

VEGETATIVE FILTER STRIP - **Sediment Removal Efficiency: MODERATE when used in series with another sediment removal BMP that does not result in a concentrated discharge onto the vegetative filter strip. This device, when used in this way, is an ABACT for HQ but not for EV watersheds.** A vegetative filter strip consists of a well-vegetated, grassy area below a disturbed area that can be used to remove sediment from runoff prior to its reaching surface waters.

To be effective, runoff should be in the form of sheet flow, and the vegetative cover should be established prior to the disturbance. Due to the time required to establish vegetation and the need to control runoff from the areas disturbed while constructing filter strips, constructed vegetative filter strips are not recommended. The suitability of natural vegetative filter strips should be either field verified by the Department or conservation district or documented by photo(s) submitted by the applicant prior to approval. Vegetative filter strips on neighboring properties should not be proposed unless permission to use that area as a vegetative filter strip has been obtained from the owner of the property along with an agreement to leave the filter strip area undisturbed for as long as it is needed. Where control of the filter strip cannot be assured throughout its intended use, a substitute BMP that will be installed should the filter strip no longer be available should be specified in the E&S Plan.

Vegetative filter strips may be used to remove sediment from project runoff that is directed to the strip as sheet flow. The minimum filter strip width should be determined from Table 4.6.

Vegetation should be an existing, well-established, perennial grass. Wooded and brushy areas are not acceptable for purposes of sediment removal.

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ENVIRONMENTAL DETAIL

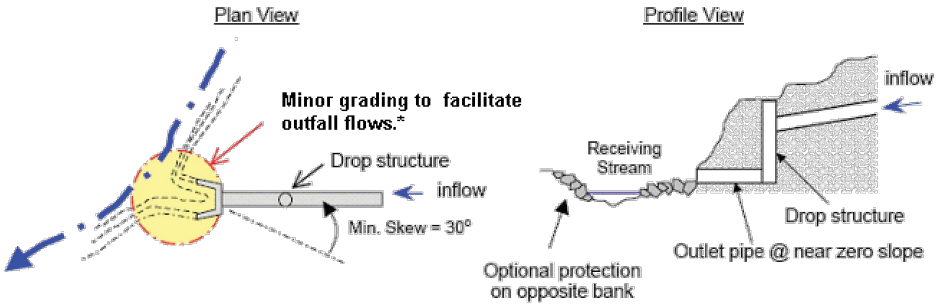
VEGETATIVE FILTER STRIP

DRAWING NO.	REV.
MVP–ES22	P

RIPRAP APRON - Riprap aprons may be used to prevent scour at pipe or channel outfalls where anticipated discharge velocities do not exceed 17.0 feet per second, there is sufficient room to construct the apron, and where the aprons can be installed on a level grade. In cases where discharge velocities exceed 17.0 fps, a suitable means of velocity reduction (e.g. drop structure) should be used prior to discharging significant flows onto a riprap apron.

Aprons should be oriented so that the discharge enters the receiving channel at less than 90 degrees to the channel flow direction, as shown in Figure 9.2. In no case should the discharge enter the channel at an angle greater than 90 degrees to the channel flow direction.

FIGURE 9.2
PROPER OUTFALL ORIENTATION TO RECEIVING STREAM



***Chapter 105 permit(s) required. Provide sediment barrier to protect stream and outfall channels.**

Riprap aprons should be constructed according to the dimensions shown in Standard Construction Detail # 9-1 for outfalls having an endwall, or Standard Construction Detail #9-2 for outfalls with no endwall.

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CHECKED	DATE		RIPRAP APRON
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JOB NO.			
PROJECT ID: PXXXX			

They should be constructed at or near zero grade from back to front and side to side. Where aprons are constructed with a gradient back to front, the rock size and/or apron length should be adjusted upwards to compensate**. In no case should riprap aprons be constructed with a back to front gradient exceeding 0.05 ft/ft.**

Determine whether the maximum or minimum tailwater conditions exist at the outfall for the design discharge.

Minimum tailwater exists when the depth of the flow in the receiving watercourse, as calculated by Manning's equation, is less than ½ the diameter of the discharge pipe, or where no channel or swale exists at the point of discharge. Where this condition exists, use Figure 9.3. If the resulting apron width is wider than the existing channel width and discharge is directly into a downslope channel, as shown in Standard Construction Detail # 9-3, use the channel width as the width of the apron.

Maximum tailwater exists when the depth of flow in the receiving watercourse, as calculated by Manning's equation, is greater than ½ the diameter of the discharge pipe. Where this condition exists, use figure 9.4. If the resulting apron width is wider than the existing channel width and discharge is directly into a downslope channel, as in Standard Construction Detail # 9-3, use the channel width as the width of the apron.

Note: Figure 9.3 and 9.4 should not be used for designing outlet protection below box culverts.

If the anticipated discharge velocity exceeds the maximum allowable in Table 6.6 for the riprap size taken from Figure 9.3 or 9.4, the size of the riprap should be increased to a size whose permissible velocity is not exceeded. If the velocity exceeds the maximum permissible for riprap, a suitable method of reducing the velocity prior to discharge onto the rock (e.g. drop structure or dissipater) should be incorporated into the design. Should a design discharge not intersect the curve corresponding to the pipe diameter, use the lowest point on that curve to determine apron dimensions.

Grouting of riprap is not recommended for most installations. Where riprap is grouted, the following applies:

1. Precautions must be taken to prevent uncured concrete from coming in contact with any surface waters.

2. Grout should be placed in a layer with thickness equivalent to the d50 stone size over the entire extent of the apron prior to rock placement.

3. After stone placement, void spaces should be filled with grout.

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Mountain Valley PIPELINE

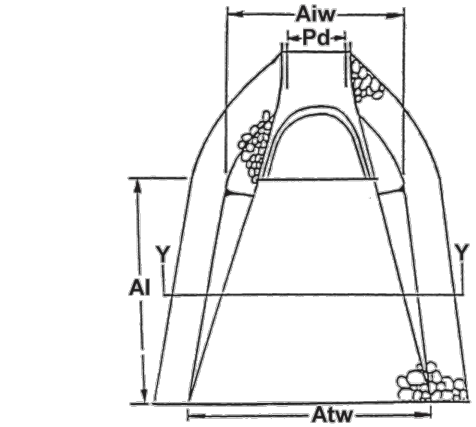
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

RIPRAP APRON

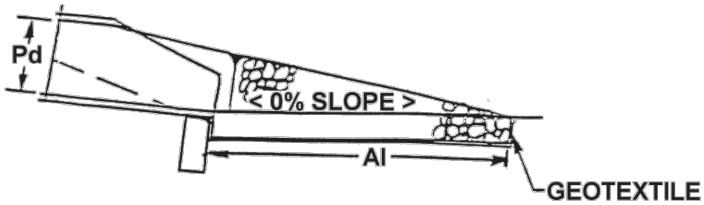
DRAWING NO.	REV.
MVP–ES23.2	P

STANDARD CONSTRUCTION DETAIL # 9-1
Riprap Apron at Pipe Outlet with Flared End Section or Endwall



PLAN VIEW

SECTION Y-Y



ELEVATION VIEW

PA DEP

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

OUTLET NO.	PIPE DIA Pd (IN)	RIPRAP		APRON		
		SIZE (R-__)	THICK. Rt (IN)	LENGTH Al (FT)	INITIAL WIDTH Aiw (FT)	TERMINAL WIDTH Atw (FT)

All aprons shall be constructed to the dimensions shown. Terminal widths shall be adjusted as necessary to match receiving channels.

All aprons shall be inspected at least weekly and after each runoff event. Displaced riprap within the apron shall be replaced immediately.

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Mountain Valley PIPELINE

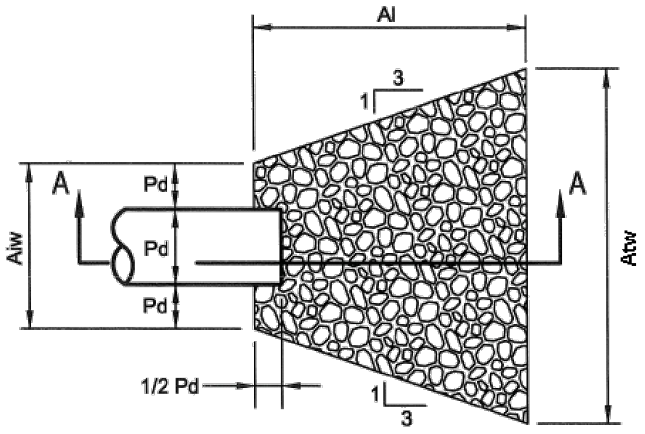
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

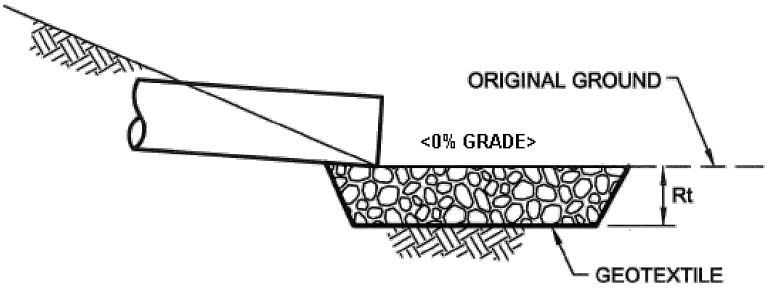
RIPRAP APRON

DRAWING NO.	REV.
MVP–ES23.3	P

STANDARD CONSTRUCTION DETAIL # 9-2
Riprap Apron at Pipe Outlet without Flared Endwall



PLAN VIEW



SECTION A - A

Adapted from USDOT, FHA HEC-14

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

OUTLET NO.	PIPE DIA Pd (IN)	RIPRAP		APRON		
		SIZE (R-__)	THICK. Rt (IN)	LENGTH Al (FT)	INITIAL WIDTH Aiw (FT)	TERMINAL WIDTH Atw (FT)

All aprons shall be constructed to the dimensions shown. Terminal widths shall be adjusted as necessary to match receiving channels.

All aprons shall be inspected at least weekly and after each runoff event. Displaced riprap within the apron shall be replaced immediately.

Extend riprap on back side of apron to at least ½ depth of pipe on both sides to prevent scour around the pipe.

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Mountain Valley PIPELINE

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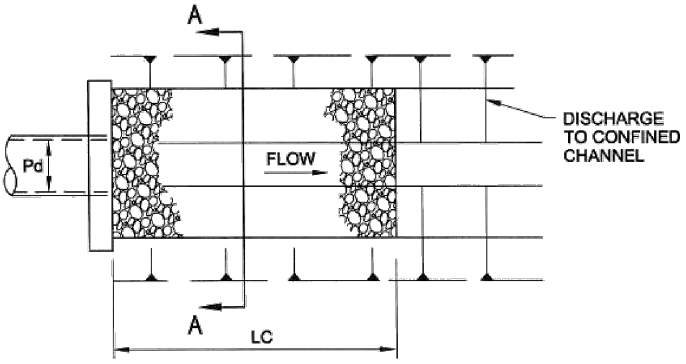
ENVIRONMENTAL DETAIL

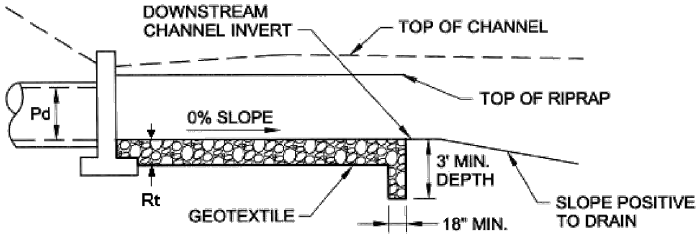
RIPRAP APRON

DRAWING NO.	REV.
MVP–ES23.4	P

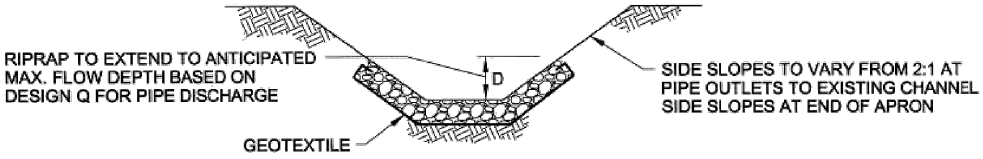
STANDARD CONSTRUCTION DETAIL # 9-3
Riprap Apron at Pipe Outlet to an Existing Channel



PLAN VIEW



ELEVATION



SECTION A -A

Adapted from USDA NRCS

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

OUTLET NO.	PIPE DIA Pd (IN)	RIPRAP		APRON					
		SIZE (R-__)	THICK. Rt (IN)	LENGTH LC (FT)	INITIAL BOTTOM WIDTH (at Endwall)(FT)	END WIDTH (FT)	INITIAL TOP WIDTH (at Endwall) (FT)	END TOP WIDTH (FT)	SIDE SLOPES H:V

All aprons shall be constructed to the dimensions shown. Terminal widths shall be adjusted as necessary to match receiving channels.

All aprons shall be inspected at least weekly and after each runoff event. Displaced riprap within the apron shall be replaced immediately.

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Mountain Valley PIPELINE

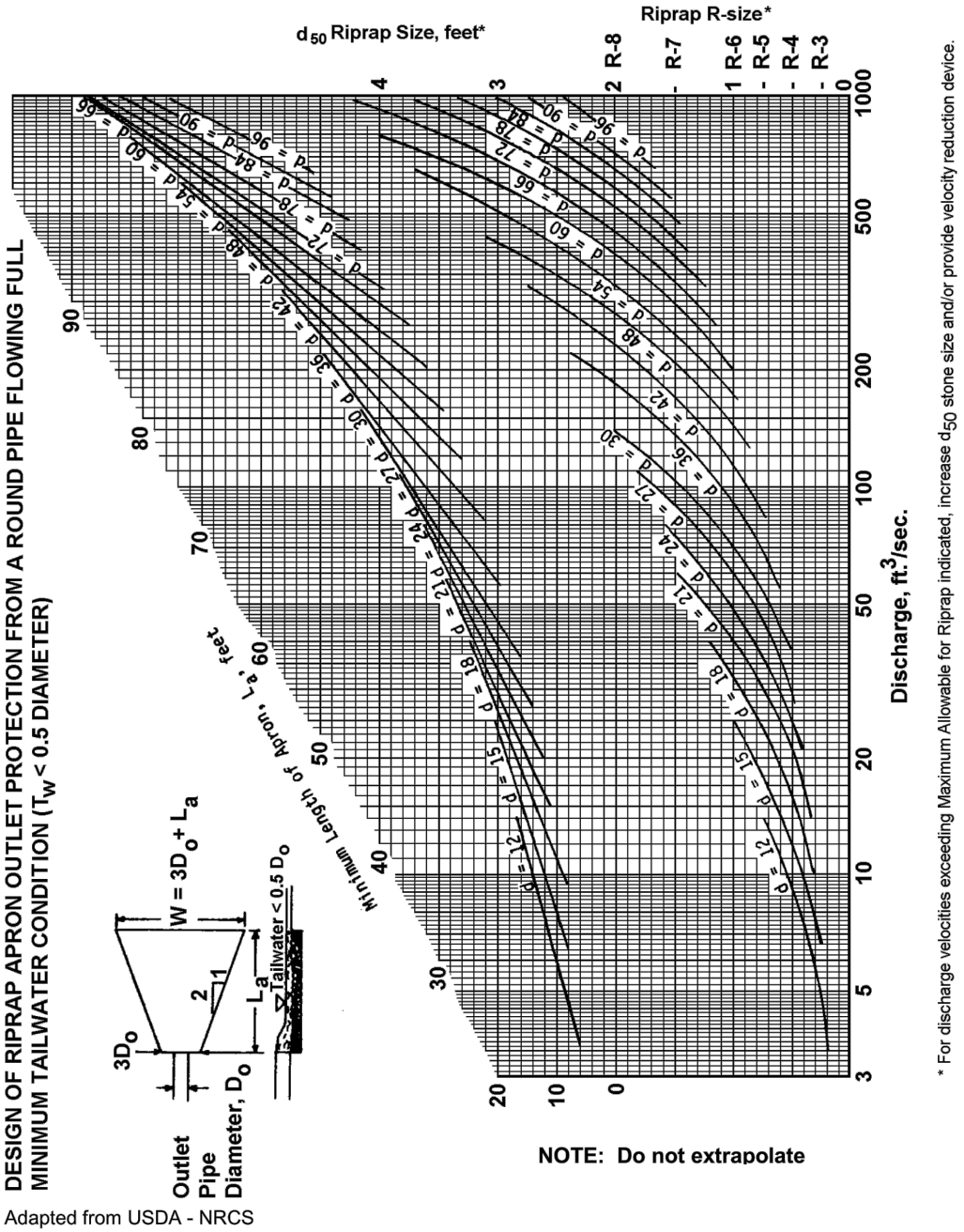
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

RIPRAP APRON

DRAWING NO.	REV.
MVP–ES23.5	P

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition



Adapted from USDA - NRCS

Not to be used for Box Culverts

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CHECKED	DATE		RIPRAP APRON
APP'D	DATE		
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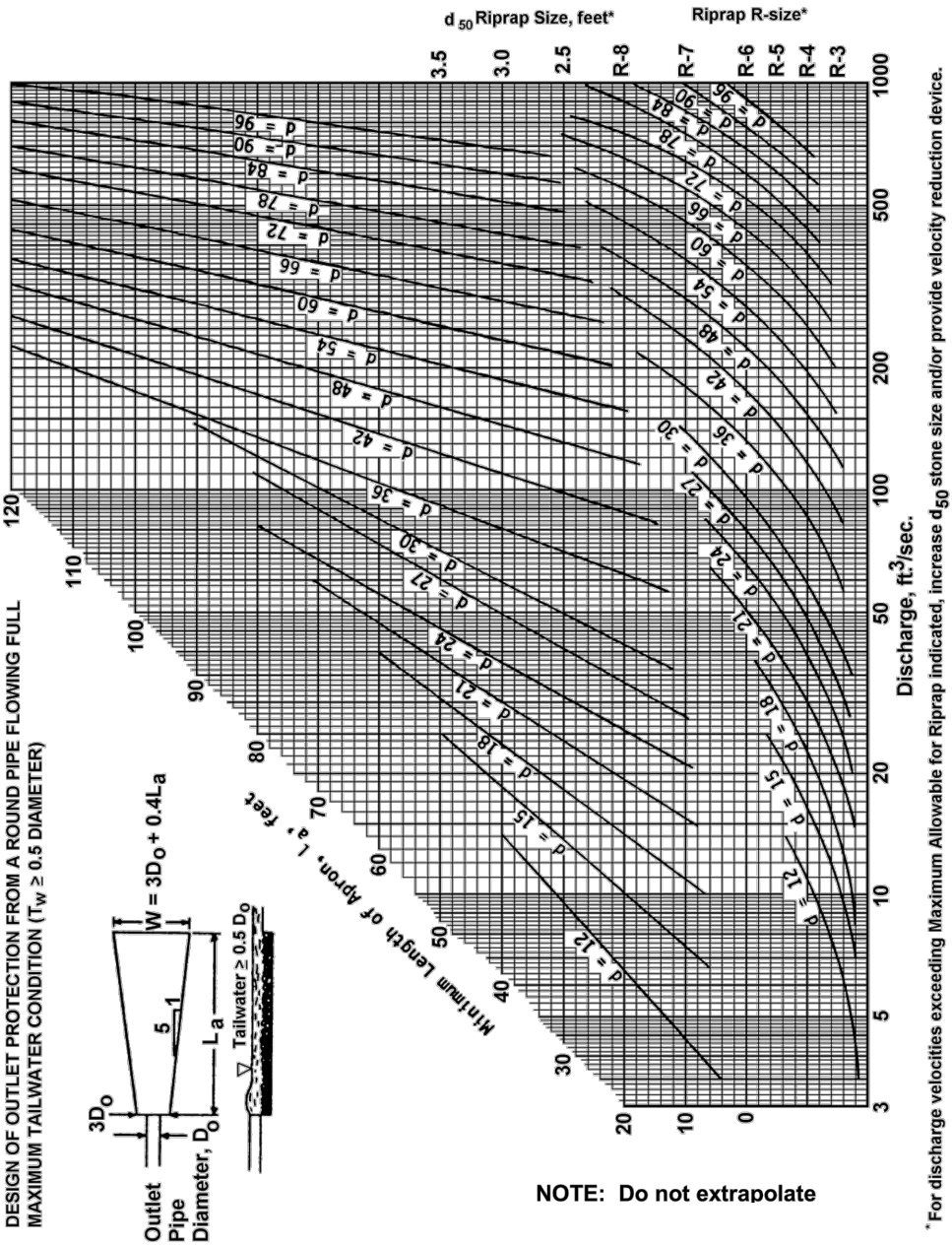
PROJECT ID: PXXXX			

FIGURE 9.4
Riprap Apron Design, Maximum Tailwater Condition



Adapted from USDA - NRCS

Not to be used for Box Culverts

DRAWN	DATE	Mountain Valley PIPELINE	ENVIRONMENTAL DETAIL
CHECKED	DATE		
APP'D	DATE		RIPRAP APRON
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Determine whether maximum or minimum tailwater conditions exist at the outfall for the design discharge.

Minimum tailwater exists when the depth of flow in the receiving watercourse, as calculated by Manning's equation, is less than ½ the diameter of the discharge pipe, or where no channel or swale exists at the point of discharge. Where this condition exists, use Figure 9.3. If the resulting apron width is wider than the existing channel width and discharge is directly into a downslope channel, as in Standard Construction Detail #9-3, use the channel width as the width of the apron.

Maximum tailwater exists when the depth of flow in the receiving watercourse, as calculated by Manning's equation, is greater than ½ the diameter of the discharge pipe. Where this condition exists, use Figure 9.4. If the resulting apron width is wider than the existing channel width and discharge is directly into a downslope channel, as in Standard Construction Detail #9-3, use the channel width as the width of the apron.

For less than full-pipe flow conditions, calculate anticipated velocity as described at the beginning of this chapter and adjust riprap size where necessary to comply with Table 6.6. Locate the design discharge along the bottom of Figure 9.3 or 9.4. Follow a vertical line to the point where it intersects the first curve corresponding to the diameter of the discharge pipe. From that point follow a horizontal line to the right to determine the minimum R-size of the riprap. **Do not extrapolate the curve lines**. Where flows fall below the curve for a specific size of pipe, use the minimum rock size and apron dimensions indicated at the lower ends of the curves for the proposed pipe size.

Check Table 6.6 to make sure that the anticipated discharge velocity does not exceed the maximum permissible velocity for the size of riprap obtained in this step. If the anticipated discharge velocity exceeds the maximum permissible velocity, increase the size of the riprap to a size whose permissible velocity is not exceeded.

Follow the same vertical line mentioned above to the point where it intersects the second curve corresponding to the diameter of the discharge pipe. From that point, follow a horizontal line to the left and read the minimum length of the apron (L_a) in feet.

For minimum tailwater conditions, the apron width (W) may be calculated by the formula:

$$\mathbf{W = 3D_o + L_a}$$

where D_o = Outlet pipe diameter
L_a = Length of the apron

For maximum tailwater conditions, the apron width (W) may be calculated by the formula:

$$\mathbf{W = 3D_o + 0.4\,L_a}$$

Where the apron design width (W) exceeds the downstream watercourse bottom width and the apron is directly in line with the channel, the maximum width of the apron should be the channel width.

Grouting of riprap is not recommended for most installations. Where riprap is grouted, the following applies:

1. Precautions must be taken to prevent uncured concrete from coming into contact with any surface waters.
2. Grout should be placed in a layer with thickness equivalent to the d50 stone size over the entire extent of the apron prior to rock placement.
3. After stone placement, void spaces should be filled with grout.

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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

RIPRAP APRON

DRAWING NO.	REV.
MVP–ES23.8	P

EARTHEN LEVEL SPREADER

LOCATION - Earthen level spreaders are normally used where diversion ditches or dikes outlet onto areas of established vegetation — grass, typically not brush or forested. They are **not** to be used below sediment traps, sediment basins, or stormwater pipes.

Earthen level spreaders may be used for drainage areas less than or equal to 1 acre where sediment-free stormwater runoff can be released in sheet flow down a stabilized slope without causing erosion. Where the downstream slope is stabilized with grass, a minimum uniform cover of 90% is required. Wooded areas, with little or no grass cover, are not considered stabilized areas for this purpose. Earthen level spreaders should only be used where there will be no construction traffic over the level spreader.

To avoid reconcentrating flow downstream of the spreader, the maximum distance from the earthen level spreader to an existing or constructed defined drainage course is 100 feet with a 6% maximum slope and where very uniform and very stable site conditions exist. Greater distances may be considered on a case-by-case basis for very mild slopes and heavily vegetated areas but should not normally exceed 150 feet.

Earthen level spreaders should be constructed on soil, not on fill.

MAXIMUM DRAINAGE AREA - Maximum drainage area to an earthen level spreader should not exceed 1 acre.

MAXIMUM DISCHARGE and MINIMUM LENGTH - The maximum discharge for earthen level spreaders should be 1 cfs per foot of length based on the peak rate of flow from a ten-year frequency rainfall event. An acceptable simplified method to determine the length (L_{min}) is that L_{min} is equal to five feet per acre of drainage area.

DESIGN - The grade of the last 20 feet of the diversion channel that feeds the earthen level spreader should create a smooth transition from the channel grade to the earthen level spreader and, where possible, should be less than or equal to 1 percent. Construct earthen level spreaders on zero percent grades to insure uniform spreading of sediment-free runoff. Minimum width of earthen level spreaders should be 6 feet. A transition section should be constructed between the diversion channel and the earthen level spreader if the widths are different.

Protect the lip of an earthen level spreader with an erosion-resistant material, such as a reinforced erosion control blanket or TRM, to prevent erosion and enable vegetation to become established. For a permanent installation, a rigid lip of non-erodible material, such as pressure-treated timbers or concrete curbing, should be used. A smooth transition should be provided between the level spreader and the native ground downslope.

For a vegetated lip, the erosion-control matting should be a minimum of 4 feet wide and extend 6 inches over the level lip. The upstream edge should be buried at least six inches deep in a vertical trench. The downstream edge should be securely held in place with closely spaced, heavy-duty staples, at least 12 inches long. A rigid level lip should be entrenched at least 2 inches below the ground surface and securely anchored to prevent displacement. Immediately after the earthen level spreader is constructed, the entire area of the spreader should be appropriately seeded and mulched.

Typical details of earthen level spreaders are shown on Standard Construction Detail # 9-5.

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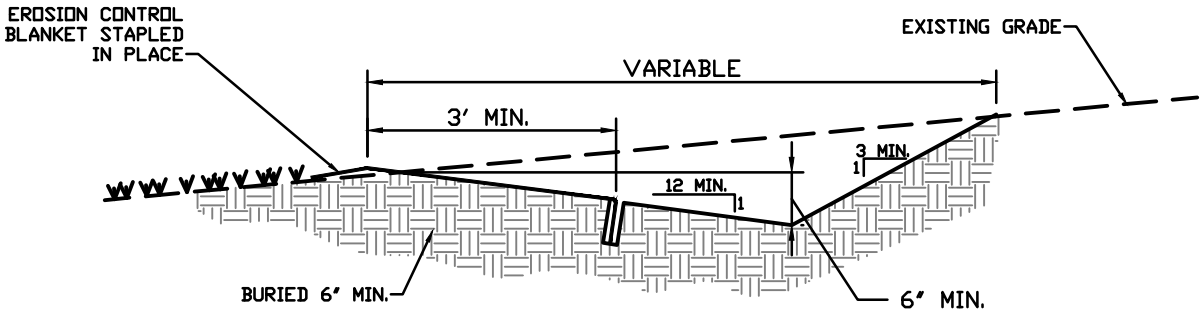
Mountain Valley PIPELINE

DESIGN ENGINEERING

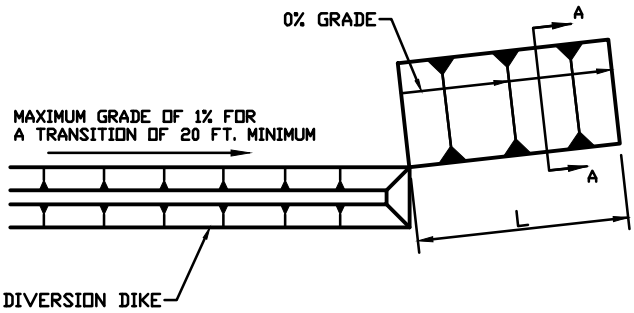
ENVIRONMENTAL DETAIL

EARTHEN LEVEL SPREADER

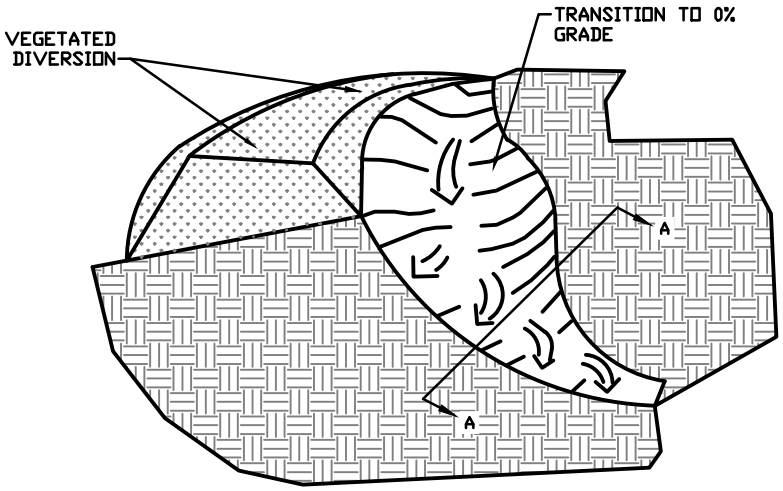
DRAWING NO.	REV.
MVP–ES24.1	P



SECTION A-A



PLAN VIEW



ISOMETRIC VIEW

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Mountain Valley PIPELINE

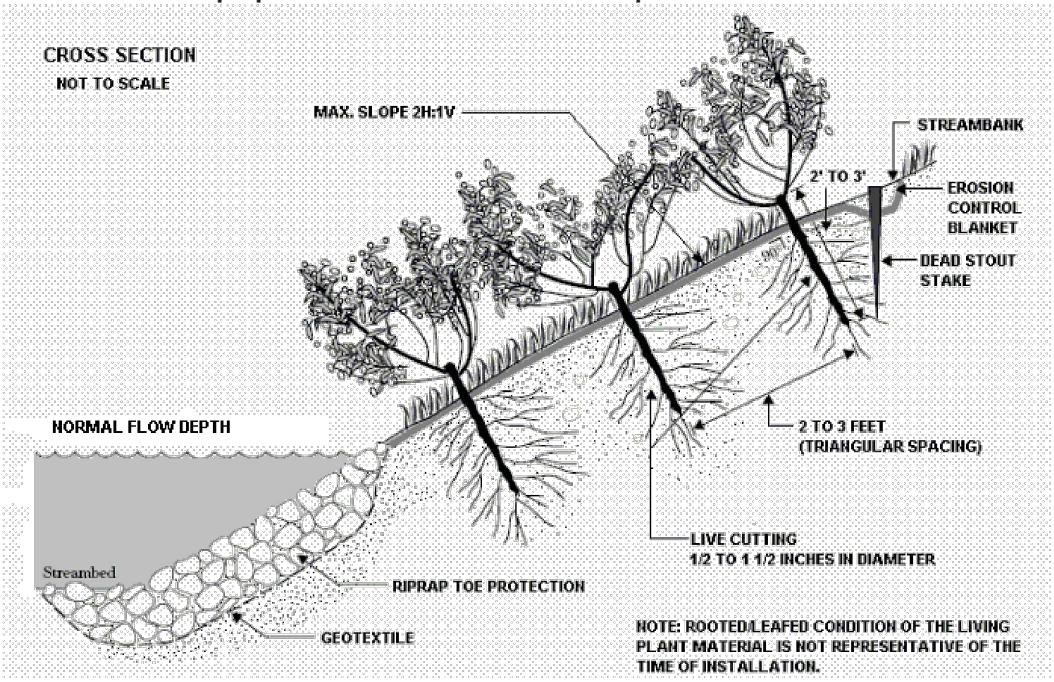
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

EARTHEN LEVEL SPREADER

DRAWING NO.	REV.
MVP-ES24.2	P

Figure 15.1
Riprap Streambank Protection with Optional Live Stakes



Adapted from USDA NRCS, *Engineering Field Handbook,* Chapter 16

Filter stone, as specified in Table 6.6, may be substituted for the geotextile where site and soil conditions warrant.

NOTE: Extend riprap into streambed only as far as required to provide proper toe support.

DRAWN	DATE	Mountain Valley PIPELINE	ENVIRONMENTAL DETAIL
CHECKED	DATE		RIPRAP STREAMBANK PROTECTION WITH OPTIONAL LIVE STAKES
APP'D	DATE		
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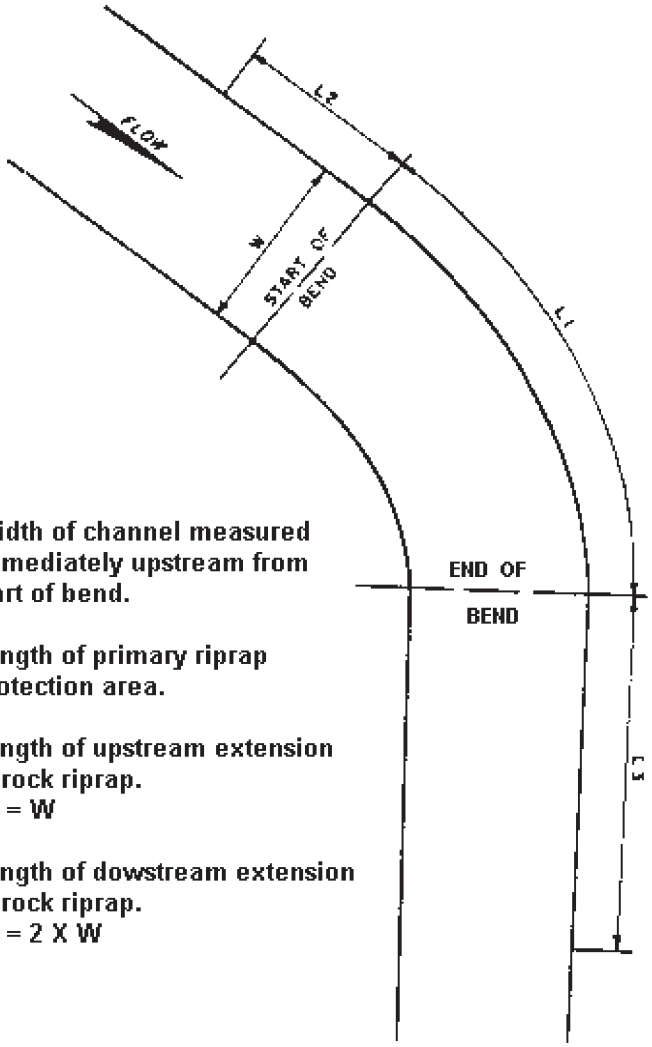
JOB NO.			
PROJECT ID: PXXXX		DESIGN ENGINEERING	DRAWING NO. MVP–ES25 / REV. P

Extension of Primary Rock Riprap Protection Area



W = Width of channel measured immediately upstream from start of bend.

L1 = Length of primary riprap protection area.

L2 = Length of upstream extension of rock riprap.
L2 = W

L3 = Length of dowstream extension of rock riprap.
L3 = 2 X W

PA DEP

NOTE:

UPSTREAM AND DOWNSTREAM ENDS MUST BE KEYED INTO THE BANK AS PER PERMIT REQUIREMENTS

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Mountain Valley PIPELINE

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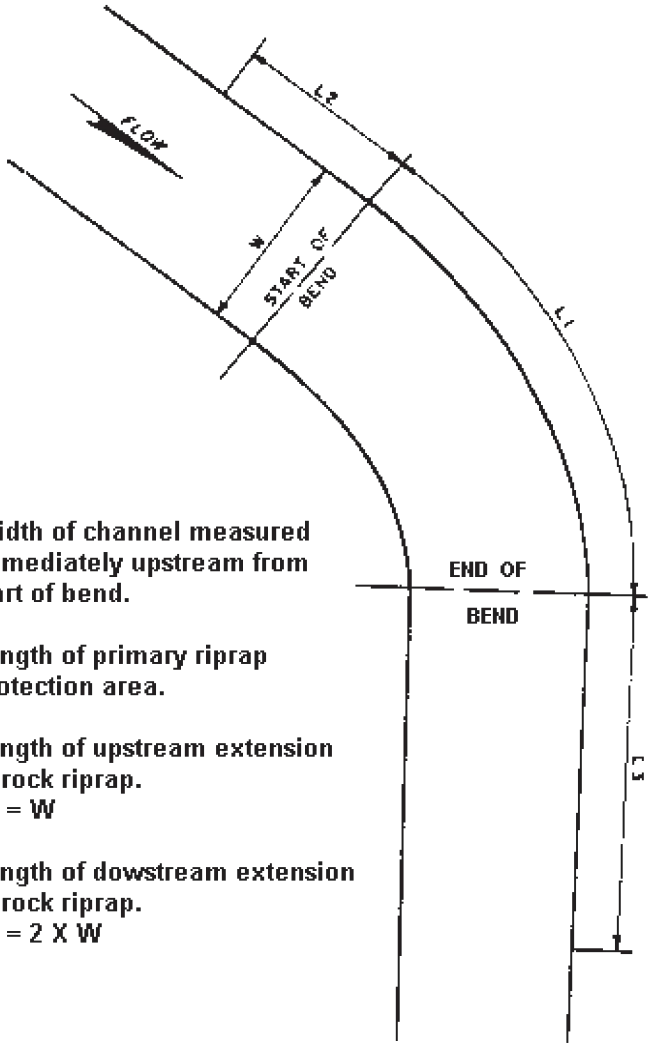
ENVIRONMENTAL DETAIL

ROCK RIPRAP
PROTECTION AREA

DRAWING NO.	REV.
MVP–ES26	P

FIGURE 15.2
Extension of Primary Rock Riprap Protection Area



W = Width of channel measured immediately upstream from start of bend.

L1 = Length of primary riprap protection area.

L2 = Length of upstream extension of rock riprap.
L2 = W

L3 = Length of dowstream extension of rock riprap.
L3 = 2 X W

PA DEP

NOTE: Upstream and downstream ends must be keyed into the bank as per GP-3 requirements.

DRAWN	DATE	Mountain Valley PIPELINE	ENVIRONMENTAL DETAIL
CHECKED	DATE		ROCK RIPRAP PROTECTION AREA
APP'D	DATE		
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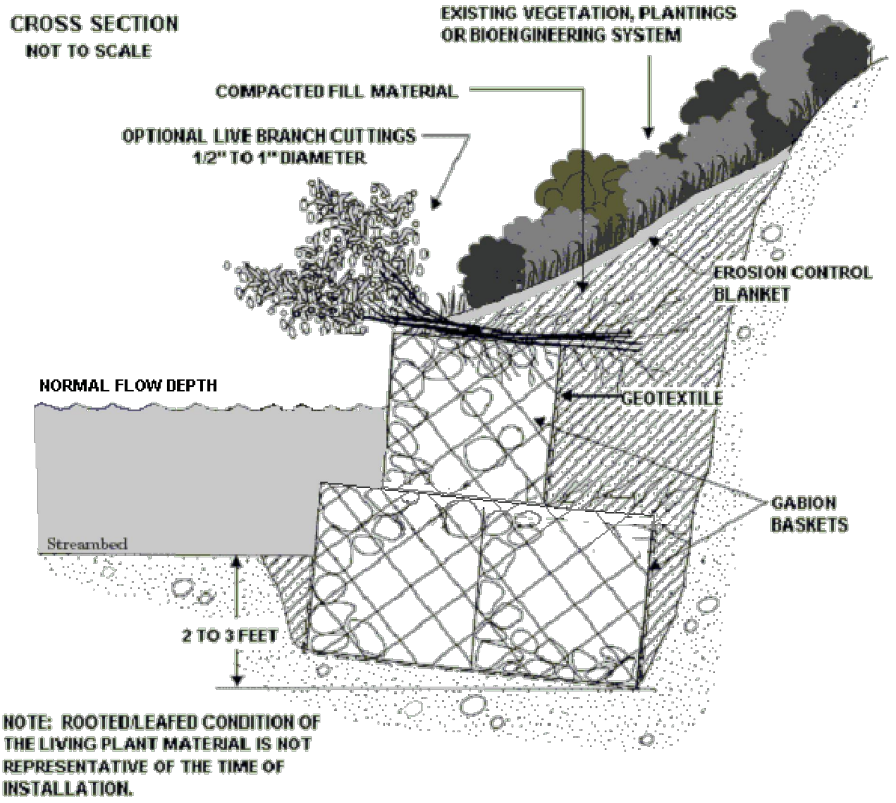
GABIONS and Reno mattress have been used to stabilize stream banks for many years. Results have been mixed. While successful in many locations, gabions have failed where undermined or where the wire baskets have been damaged by abrasion or corrosion. Therefore, before specifying gabions for streambank stabilization, consideration should be given to the available substrate, pH, and anticipated sediment transport of the water. If these are not suitable, another form of stabilization should be considered.

Where gabions or Reno mattresses are proposed, they are typically installed as shown in Figure 15.3 or 15.4. As with other types of stabilization, sufficient details should be provided on the detail sheets to ensure their proper installation, and supporting calculations should be included in the narrative to show they are properly sized. Gabion and Reno mattress installations should be designed according to manufacturers' specifications.

Special attention should be given to preventing scour at the upstream and downstream ends of the baskets. Appropriate means to prevent undermining should also be taken.

FIGURE 15.3
Gabion Streambank Protection



Adapted from USDA, NRCS, *Engineering Field Handbook,* Chapter 16

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Mountain Valley PIPELINE
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

GABION STREAMBANK PROTECTION

DRAWING NO.	REV.
MVP–ES27	P

BIOENGINEERING

A number of bioengineering techniques have been developed in recent years that effectively stabilize streambanks while providing a more natural appearance than is afforded by hard armor. The following are a few examples:

Live stakes are woody vegetative cuttings, typically willow, dogwood or other species tolerant of occasional flooding, that are capable of rooting when inserted into the ground. When properly prepared, handled, and placed, the stakes will root, grow, and form a stabilizing root mat. This mat reinforces the soil by binding soil particles, extracting excess moisture, and providing a protective cover.

Stakes should be freshly cut, healthy, straight, and at least 1 year old with side branches removed and bark intact. Cuttings should be ½" to 1 ½" diameter and 2 to 3 feet long. Bases should be cut cleanly at an angle to facilitate insertion into the soil. Tops should be square to aid in tamping.

APPLICATIONS

- Live Stakes should be installed during the dormant period.
- They are an effective streambank protection where site conditions are uncomplicated, construction time is limited, and an inexpensive method is desired.
- Live Stakes can be used to repair small earth slips and slumps in frequently wet areas.
- They can be used to peg down some erosion control blankets.

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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

BIOENGINEERING

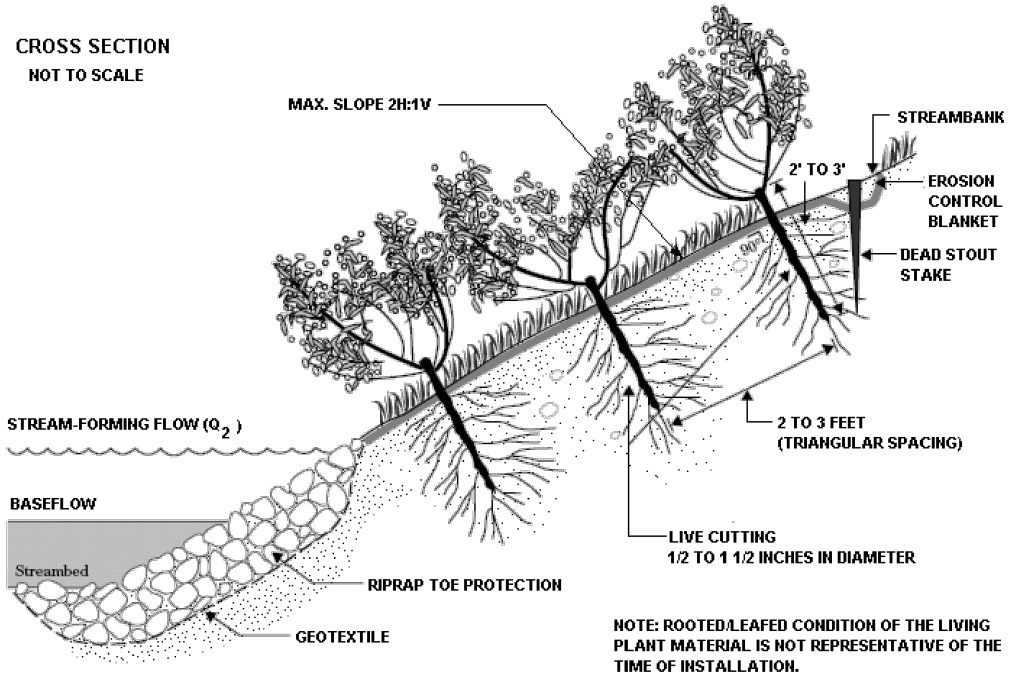
DRAWING NO.	REV.
MVP–ES28.1	P

- Natural colonization by surrounding plant communities can be enhanced by the installation of live stakes.
- Intervening areas between other bioengineering techniques can be stabilized with live stakes.
- Live stakes enhance natural habitat.

INSTALLATION GUIDELINES

- Grade slopes to 2H:1V, or flatter for less cohesive soils or presence of sand lenses. Install suitable toe protection, such as properly sized riprap, below the stream-forming flow elevation (2-year storm = Q_2, often marked by a lack of vegetation).
- Erodible slopes should be blanketed prior to inserting cuttings.
- Keep cuttings fresh and moist after they have been cut into appropriate lengths. Cuttings should be installed the same day that they are prepared. If this is not possible, it is recommended that they be soaked 24 hours prior to installation.
- Tamp cuttings into the ground at 90 degrees to the slope and angled downstream. Approximately 4/5 of the cutting should be inserted into the ground. 2 to 5 bud scars should remain above ground. Buds should be oriented up, and soil should be firmly packed around the stake.
- Care should be taken to avoid splitting the stakes during installation. Split stakes should be replaced. If there is difficulty in tamping the stakes, an iron bar can be used to make a pilot hole.
- Stakes should be placed 2 to 3 feet apart using triangular spacing.

FIGURE 15.6
Live Stakes



Adapted from USDA, NRCS, *Engineering Field Handbook,* Chapter 16

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Live fascines are long bundles of branch cuttings bound together. They are typically placed in shallow trenches on slopes and streambanks to reduce erosion and shallow sliding.

Cuttings should be ¼" to 1" in diameter cut from species that root easily and have long, straight branches, such as willow or dogwood. They should be tied together with untreated twine to form a live fascine ranging from 5 to 10 feet long depending upon site conditions and handling limitations. Diameters of the bundles should be 6 to 8 inches. All buds should be oriented in the same direction. Cuttings should be staggered so that tops are evenly distributed length wise along the bundle.

APPLICATIONS

- Live fascines are an effective streambank stabilization technique. When properly installed, there is a minimum of site disturbance.
- Live fascines can be used to protect slopes from shallow — 1 to 2 foot depth — slides.
- Typically, live fascines are placed above the bankfull elevation, although for small watersheds (< 2,000 acres) they may be placed below the bankfull elevation.
- Live fascines offer immediate protection from surface erosion.
- Conditions for native plant colonization are enhanced.

INSTALLATION GUIDELINES

- Prepare the live fascine bundle and live stakes immediately prior to installation.
- Dig a 10" X 10" trench along contour at the base of the slope just above stream-forming flow, 2-year-24-hour peak flow elevation = Q_2. Note: A suitable toe protection such as, properly sized riprap, should be installed below the trench. See Figure 15.7.
- Additional trenches should be spaced on the slope at intervals shown in Table 15.1.
- Intervals between trenches should be seeded, mulched, and covered with a suitable erosion control blanket.
- Place live fascine into the trench as shown in Figure 15.7.
- Drive dead stakes directly through the live fascine until flush with the top of the bundle. Use extra stakes at bundle overlaps.
- Tamp in live stakes immediately downslope (adjacent to) the bundle leaving the top 3" of the live stake exposed.
- Place moist soil along the sides of the bundles leaving the top of the live fascine slightly exposed.

TABLE 15.1
Live Fascine Spacing (ft)

Slope Steepness	Predominant Soils		
	Erosive	Non-erosive	Fill
3H:1V or flatter	3 to 5	5 to 7	3 to 5 *
Up to 1H:1V	3*	3 to 5	Not recommended

* Not recommended alone

Adapted from USDA, NRCS, *Engineering Field Handbook,* Chapter 16

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CHECKED	DATE		LIVE FASCINES
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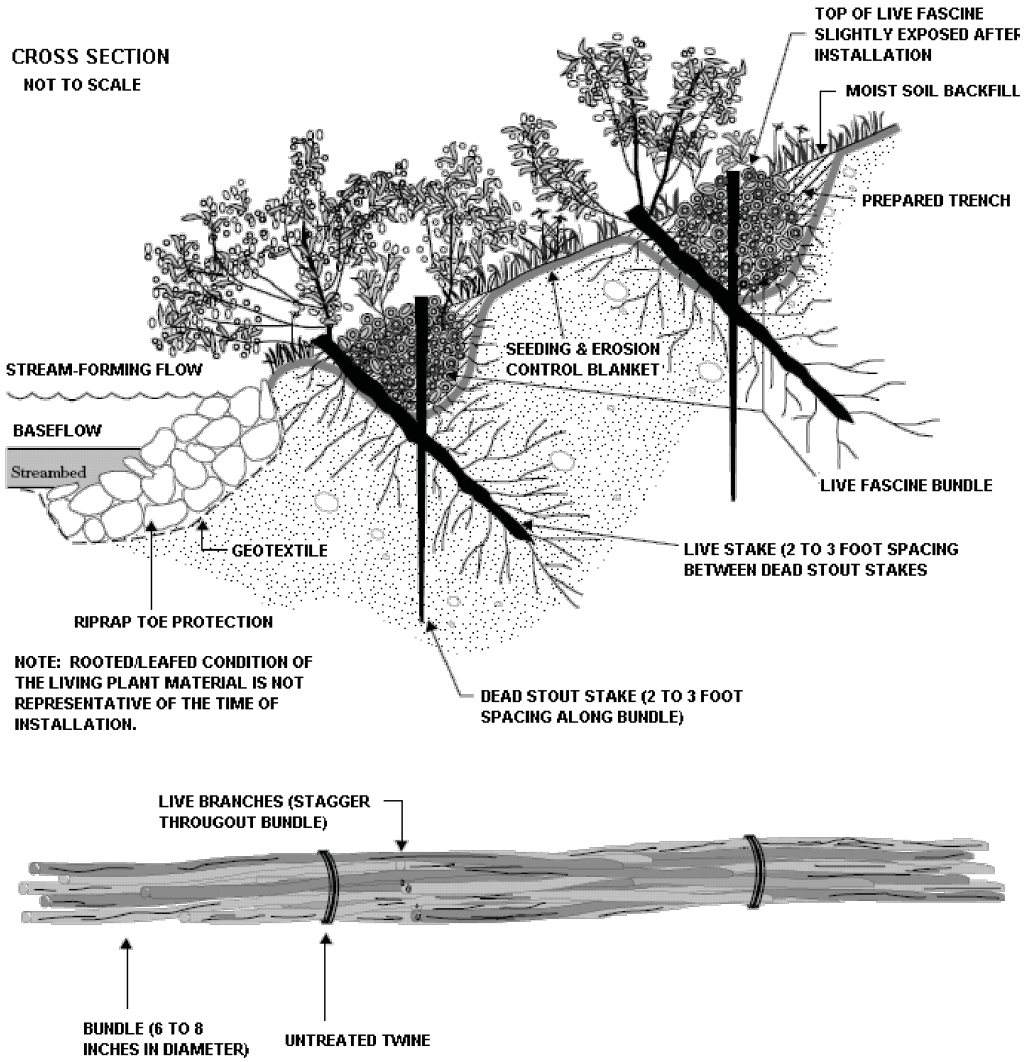
FIGURE 15.7
Live Fascines



Adapted from USDA, NRCS, *Engineering Field Handbook,* Chapter 16

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Mountain Valley PIPELINE

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LIVE FASCINES

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MVP–ES29.2	P

Branchpacking is the alternating of layers of live branches and compacted backfill to repair small scour holes and slips in streambanks. It provides a filter barrier that prevents erosion from bankfull and overbank flows. Branchpacking rapidly establishes a vegetated streambank and enhances colonization by native vegetation.

Soil is immediately reinforced. The live branches serve as tensile reinforcement. Once the plant tops begin to grow, the branchpacking system becomes increasingly effective in retarding runoff and minimizing erosion. Sediment trapped by the vegetation refills the hole, while the roots spread throughout the surrounding soil to form a unified mass.

The live branches should range from ½" to 2" in diameter and be long enough to reach from the undisturbed soil at the back of the trench and extend slightly from the rebuilt streambank.

APPLICATIONS

- Branchpacking is an effective means of repairing holes in streambanks ranging from 2 to 4 feet in height and depth.
- It is typically not effective in repairing slump areas greater than 4 feet high or 4 feet deep.

INSTALLATION GUIDELINES

- Divert any concentrated upslope runoff away from the repair area.
- Prepare the cuttings immediately prior to installation.
- Install suitable toe protection, such as. properly sized riprap or fiber log, below the stream-forming flow elevation (2-year storm elevation = Q_2).

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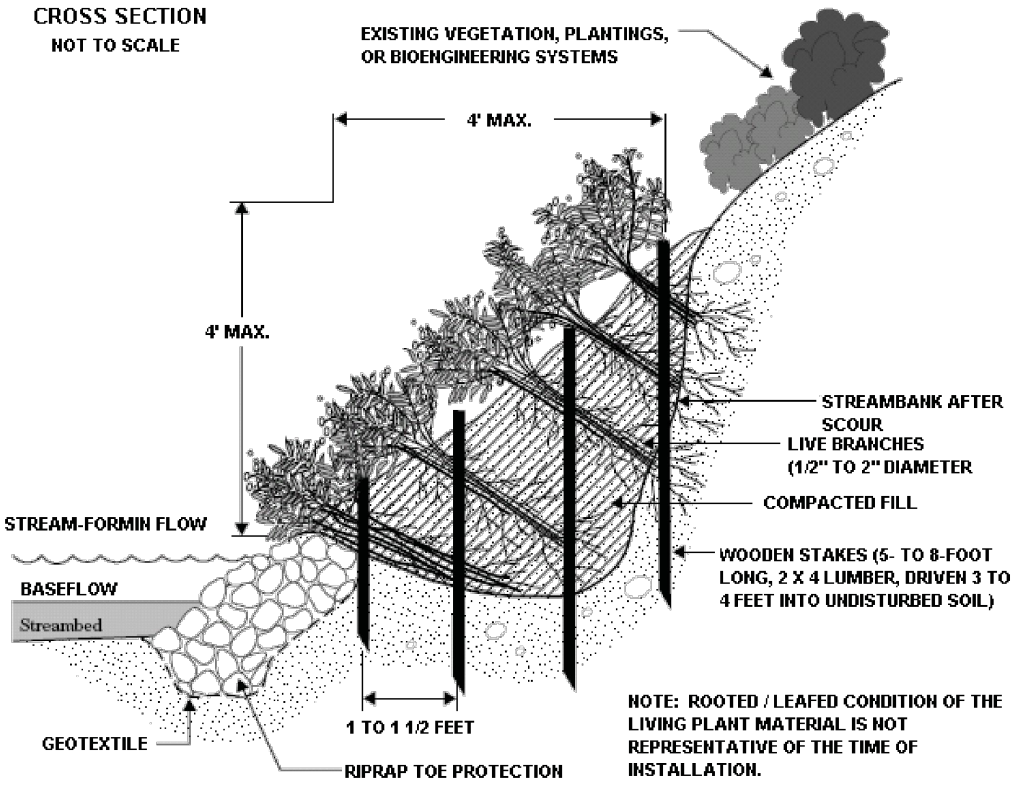
ENVIRONMENTAL DETAIL

BRANCHPACKING

DRAWING NO.	REV.
MVP–ES30.1	P

- Beginning at the lowest point just above the Q_2 elevation, drive wooden stakes vertically 3 to 4 feet into the ground. Stakes should be spaced 1 to 1 ½ feet apart as shown in Figure 15.8.
- Place initial layer of branches 4" to 6" thick in the bottom of the hole, between the vertical stakes and perpendicular to the slope face. Branches should be placed in a crisscross pattern with buds generally pointing toward the slope face. Basal ends of the branches should touch the undisturbed soil at the back of the hole.
- Cover each layer of branches with a layer of compacted soil to ensure soil contact with the branches.
- Subsequent layers of branches should be installed with the basal ends lower than the growing tips.
- The final layer should conform to the existing slope.

FIGURE 15.8
Branchpacking



Adapted from USDA, NRCS, *Engineering Field Handbook,* Chapter 16

DRAWN	DATE	Mountain Valley PIPELINE	ENVIRONMENTAL DETAIL
CHECKED	DATE		BRANCHPACKING
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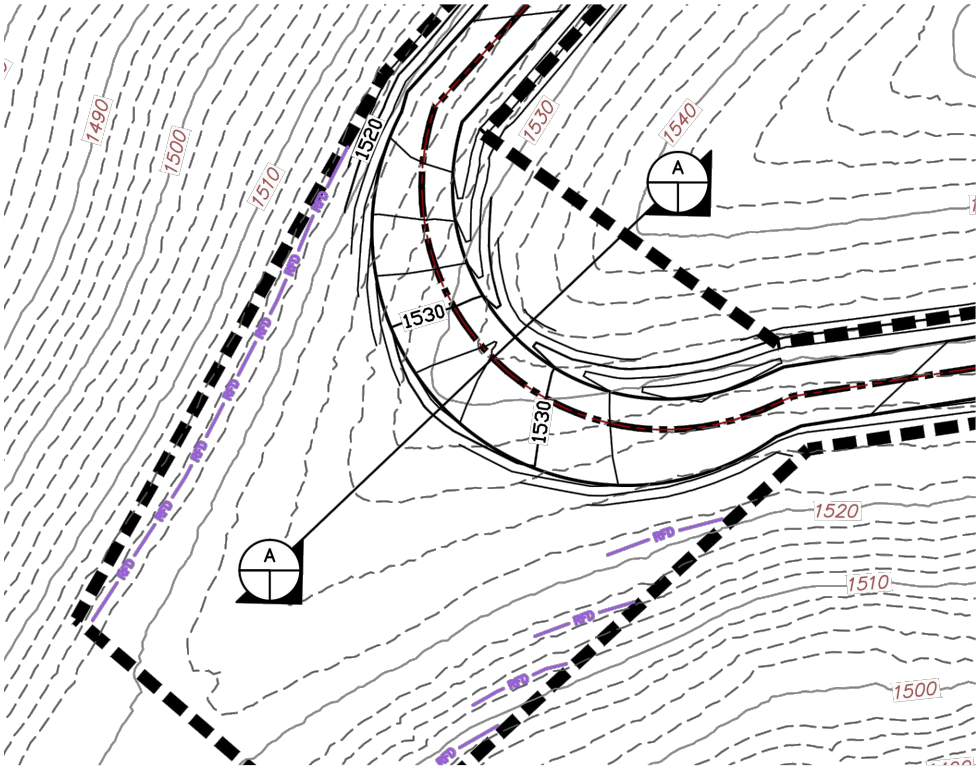
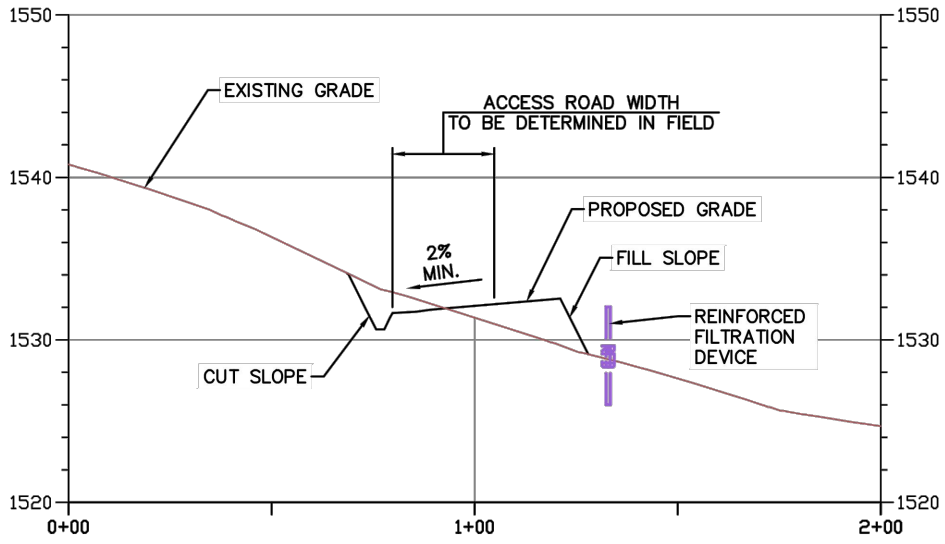


PLAN VIEW



SECTION VIEW A-A

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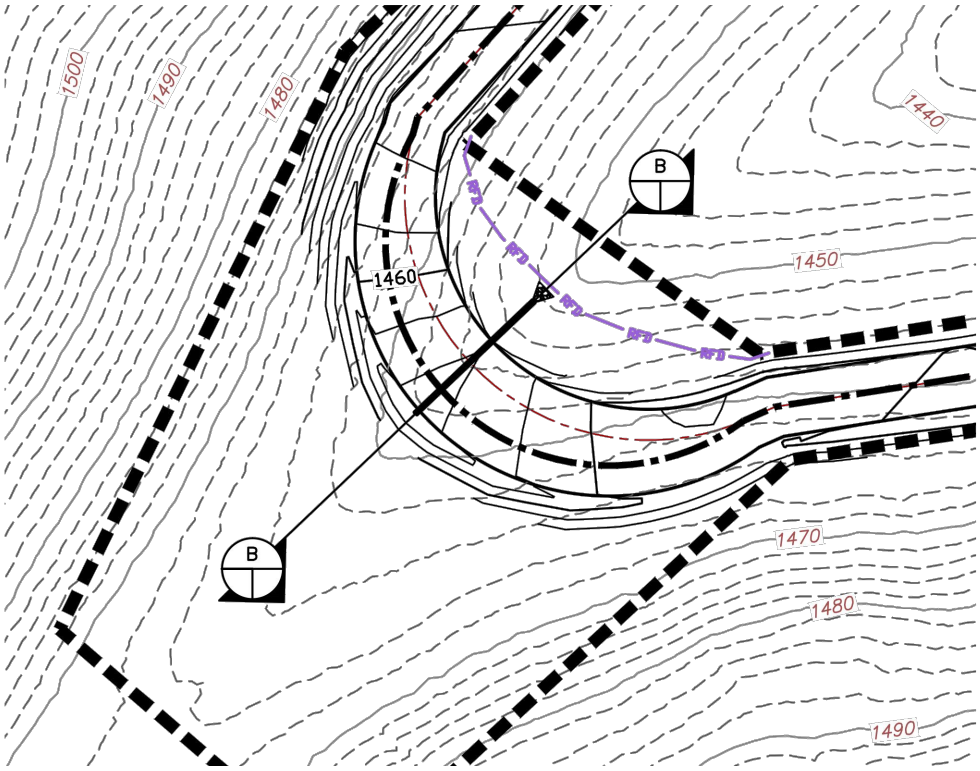
Mountain Valley PIPELINE

DESIGN ENGINEERING

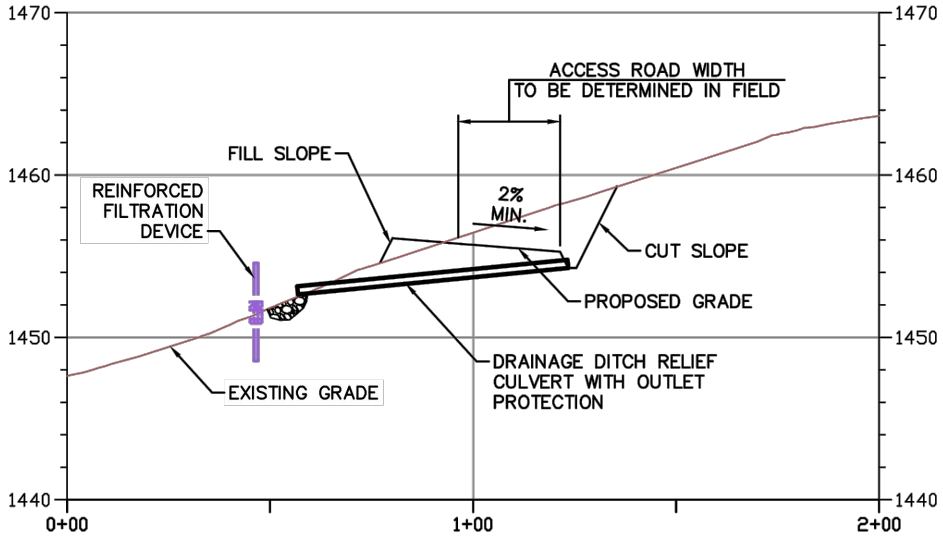
ENVIRONMENTAL DETAIL

ATWS VEHICLE TURNING RADIUS NOSE DETAIL

DRAWING NO.	REV.
MVP–ES31	P



PLAN VIEW



SECTION VIEW B-B

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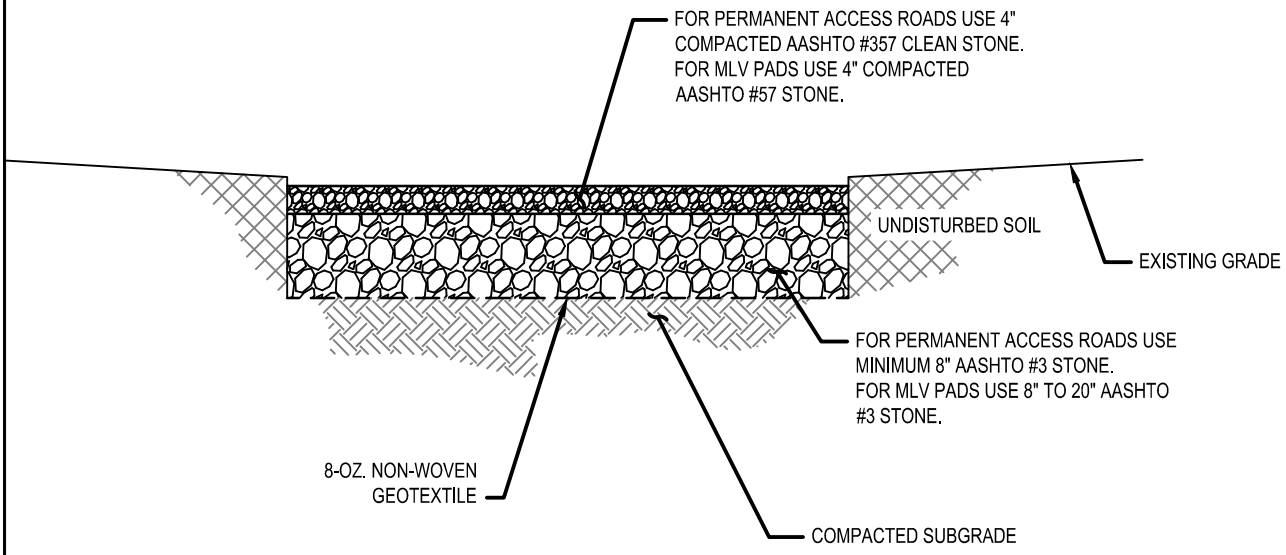
Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

ATWS VEHICLE TURNING RADIUS VALLEY DETAIL

DRAWING NO.	REV.
MVP–ES32	P



NOTES:

1. THICKNESS OF AASHTO #3 STONE/AGGREGATE LAYER FOR MLV PADS TO BE BETWEEN 8" AND 20" DEPENDING ON THE STORAGE VOLUME NEEDED TO MEET STORMWATER QUANTITY REQUIREMENTS.
2. THICKNESS OF ASSHTO #3 STONE/AGGREGATE LAYER FOR ACCESS ROADS TO BE A MINUMUM OF 8" OR MORE AS DIRECTED.
3. COMPACT SUBGRADE PRIOR TO BACKFILL PLACEMENT. FOR BACKFILL, A MIN. 95% COMPACTION (ASTM D 698) IS REQUIRED.
4. UNSUITABLE MATERIAL SHALL BE REMOVED PRIOR TO SUBGRADE COMPACTION AND BACKFILL PLACEMENT. ADDITIONAL SUBGRADE COMPACTION NOT REQUIRED FOR MLV PADS.

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Mountain Valley PIPELINE

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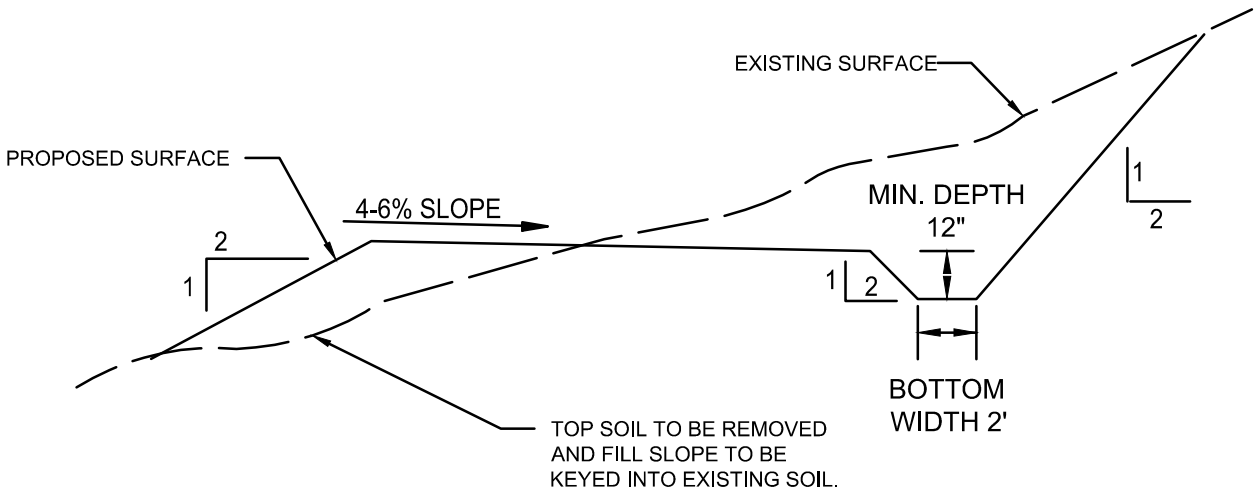
ENVIRONMENTAL DETAIL

GAP GRADED GRAVEL DETAIL FOR MAINLINE VALVE PADS & PERMANENT ACCESS ROADS

DRAWING NO.	REV.
MVP-ES33	P



NOTE:

1. INSLOPE WITH DITCH SECTION FOR USE ON STEEP SLOPE AND AREAS WITH POOR SOILS.
2. EROSION CONTROL MATTING TO BE INSTALLED ON CUT AND FILL SLOPES STEEPER THAN 3H:1V.

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Mountain Valley PIPELINE

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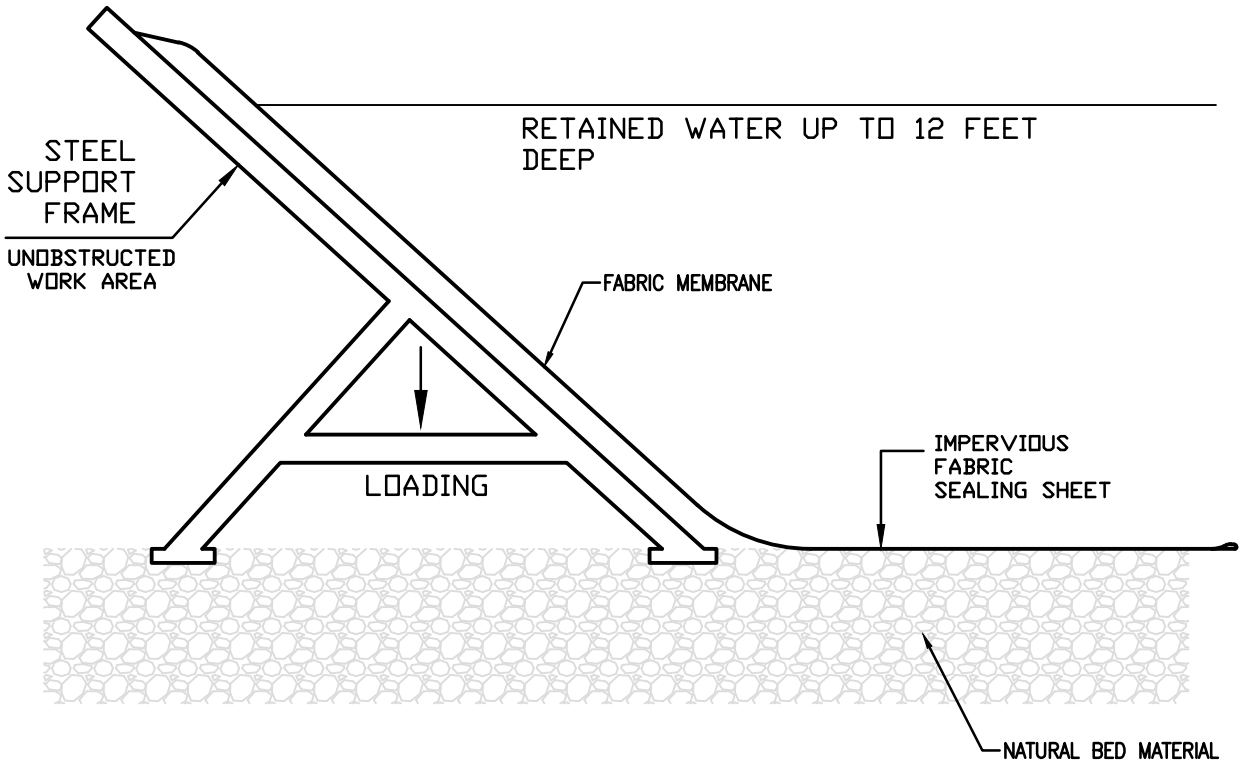
ACCESS ROAD TYPICAL SECTION

DRAWING NO.	REV.
MVP–ES34	P



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Mountain Valley PIPELINE

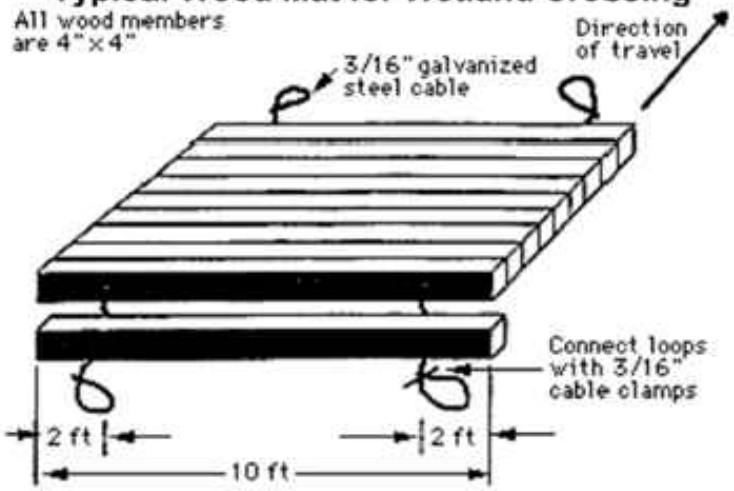
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

PORTADAM DETAIL

DRAWING NO.	REV.
MVP–ES36	P

Typical Wood Mat for Wetland Crossing



University of Minnesota FS 07009

A geotextile underlayment shall be used under the wood mat.

Source: PaDEP, E&S Pollution Control Manual, March 2012

NOTE:
CULVERTS MAY BE SUBSTITUTED WHEN
REQUIRED BY FIELD VERIFIED CONDITIONS.

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Mountain Valley PIPELINE

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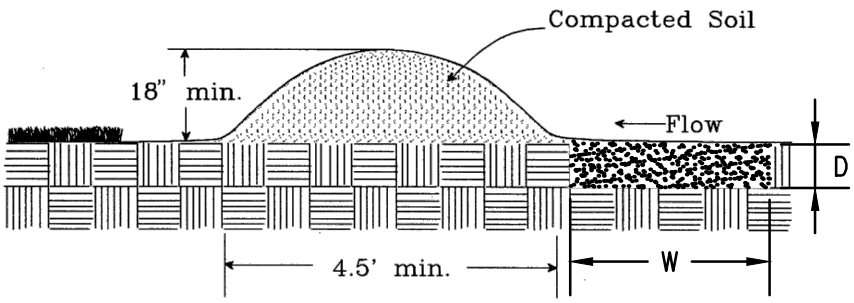
ENVIRONMENTAL DETAIL

TIMBER MAT/WETLAND CROSSING

DRAWING NO.	REV.
MVP-ES37	P



NOTES

1. WIDTH "W" OF SOIL AMENDMENT PER PERMANENT DIVERSION DIKE/WATERBAR WITH SOIL AMENDMENT SCHEDULE.
2. THE INCORPORATION DEPTH "D" IS ASSUMED TO BE 1 FT PER TABLE 4.3 IN VA DEQ STORMWATER DESIGN SPEC #4.
3. DEVELOPED FROM VA. DSWC PLATE 3.09-1.
4. SEE SHEET 0.7, TEMPORARY RIGHT OF WAY DIVERSION/WATERBAR ADDITIONAL DETAILS FOR PLAN VIEW.

Permanent Diversion Dike/Waterbar with Soil Amendment Schedule

Drainage Area	Diversion Dike Identification #	Soil Amendment Depth (D) (ft)	Soil Amendment Width (W) (ft)	Minimum Length of Soil Amendment
DA-GI-002	WB-1	1	2	10
DA-GI-006	WB-2	1	2	5

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Mountain Valley PIPELINE

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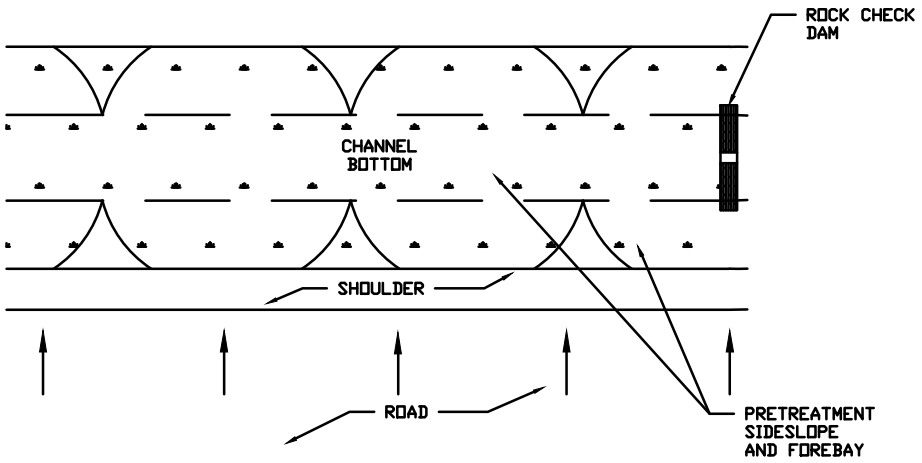
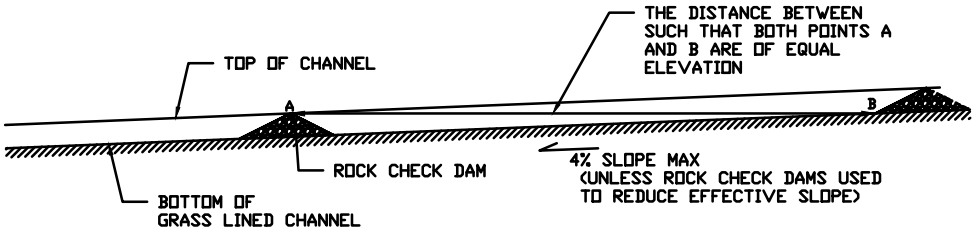
ENVIRONMENTAL DETAIL

DIVERSION DIKE/WATERBARS WITH COMPOST

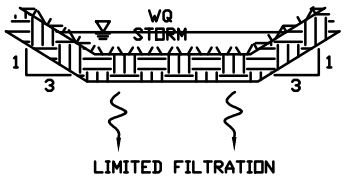
DRAWING NO.	REV.
MVP-ES38	P



PLAN



LONGITUDINAL PROFILE



TYPICAL SECTION

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Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

GRASS–LINED CHANNEL

DRAWING NO.	REV.
MVP–ES39	P

NOTES:

A BONDED FIBER MATRIX (BMF) IS AN EFFECTIVE METHOD OF STABILIZING STEEP SLOPES WHEN USED PROPERLY. BMFs MAKE USE OF A CROSS-LINKED HYDROCOLLOID TACKIFIER TO BOND THERMALLY PROCESSED WOOD FIBERS. APPLICATION RATES VARY ACCORDING TO SITE CONDITIONS. FOR SLOPES UP TO 3H:1V THE BFM SHOULD BE APPLIED AT A RATE OF 3,000 LB/ACRE. STEEPER SLOPES MAT NEED AS MUCH AS 4,000 LB/ACRE.

BFMs SHOULD ONLY BE USED WHEN NO RAIN IS FORECASTED FOR AT LEAST 48 HOURS FOLLOWING HE APPLICATION. THIS IS TO ALLOW THE TACKIFIER SUFFICIENT TIME TO CURE PROPERTY. ONCE PROPERLY APPLIED, A BFM IS TYPICALLY 90% EFFECTIVE IN PREVENTING ACCELERATED EROSION. BFMs SHOULD NOT BE APPLIED BETWEEN SEPTEMBER 30 AND APRIL 1.

A POLYMER STABILIZED FIBER MATRIX (PSFM) CAN ALSO BE AN EFFECTIVE METHOD OF STABILIZING STEEP SLOPES WHEN USED PROPERTY. PSFMs MAKE USE OF A LINEAR SOIL STABILIZING TACKIFIER THAT WORKS DIRECTLY ON SOIL TO MAINTAIN SOIL STRUCTURE, MAINTAIN PORE SPACE CAPACITY AND FLOCCULATE DISLODGED SEDIMENT THAT WILL SIGNIFICANTLY REDUCE RUNOFF TURBIDITY. PROPERLY APPLIED, A PSFM MAY BE AS MUCH AS 99% EFFECTIVE.

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Mountain Valley PIPELINE

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ENVIRONMENTAL DETAIL

BONDED FIBER MATRIX

DRAWING NO.	REV.
MVP–ES40	P

Typical Polymer Stabilized Fiber Matrix Application Rates

Maximum Rainfall of ≤ 20"							
SLOPE	6:1	5:1	4:1	3:1	2:1	1.5:1	1:1
Soil Stabilizer (gals/acre)	4	5	6	7	8	9	10
Fiber (lb/acre)	1,500	1,500	1,500	1,800	2,000	2,500	3,000

Maximum Rainfall of > 20" and for Site Winterization			
SLOPE	≤5:1	4:1	≥3:1
Soil Stabilizer (gals/acre)	6	8	10
Fiber (lb/acre)	2,000	2,500	3,000

NOTES:

UNLIKE ROLLED BLANKETS, THERE IS NO NEED TO SMOOTH THE SLOPE PRIOR TO APPLICATION OF HYDRAULICALLY APPLIED BLANKETS. IN FACT SOME ROUGHENING OF THE SURFACE, EITHER NATURAL OR MECHANICALLY INDUCED, IS PREFERABLE. HOWEVER, LARGE ROCKS, THOSE > 9 INCHES, AND EXISTING RILLS SHOULD BE REMOVED PRIOR TO APPLICATION. TRACKING OR GROOVING OF SLOPES SHOULD BE CONSIDERED TO SLOW WATER FLOWS DURING A STORM EVENT. SLOPE INTERRUPTION DEVICES SUCH AS STAIR STEP GRADING OR BENCHING SHOULD BE APPLIED PRIOR TO THE APPLICATION. MIXING AND APPLICATION RATES SHOULD FOLLOW MANUFACTURER'S RECOMMENDATIONS.

HYDRAULICALLY APPLIED BLANKETS ARE TYPICALLY APPLIED IN TWO STAGES. UNLESS SPECIFICALLY RECOMMENDED TO BE APPLIED IN ONE APPLICATION BY THE MANUFACTURER, THE SEED MIXTURE AND SOIL AMENDMENTS SHOULD BE APPLIED FIRST. IF THE SEED IS APPLIED AT THE SAME TIME AS THE HYDRAULICALLY APPLIED BLANKET, THE BONDED FIBERS MAY KEEP THE SEED FROM MAKING SUFFICIENT CONTACT WITH THE SOIL TO GERMINATE. AFTER THE SEED MIXTURE IS APPLIED, THE BFM, FGM, OR PSFM SHOULD BE SPRAYED OVER THE AREA AT THE REQUIRED APPLICATION RATE. (SEE ABOVE TABLES)

HYDRAULIC EROSION CONTROL PRODUCTS (HEPC USED ON JNF LANDS MUST BE SUITABLE FOR WILDLIFE

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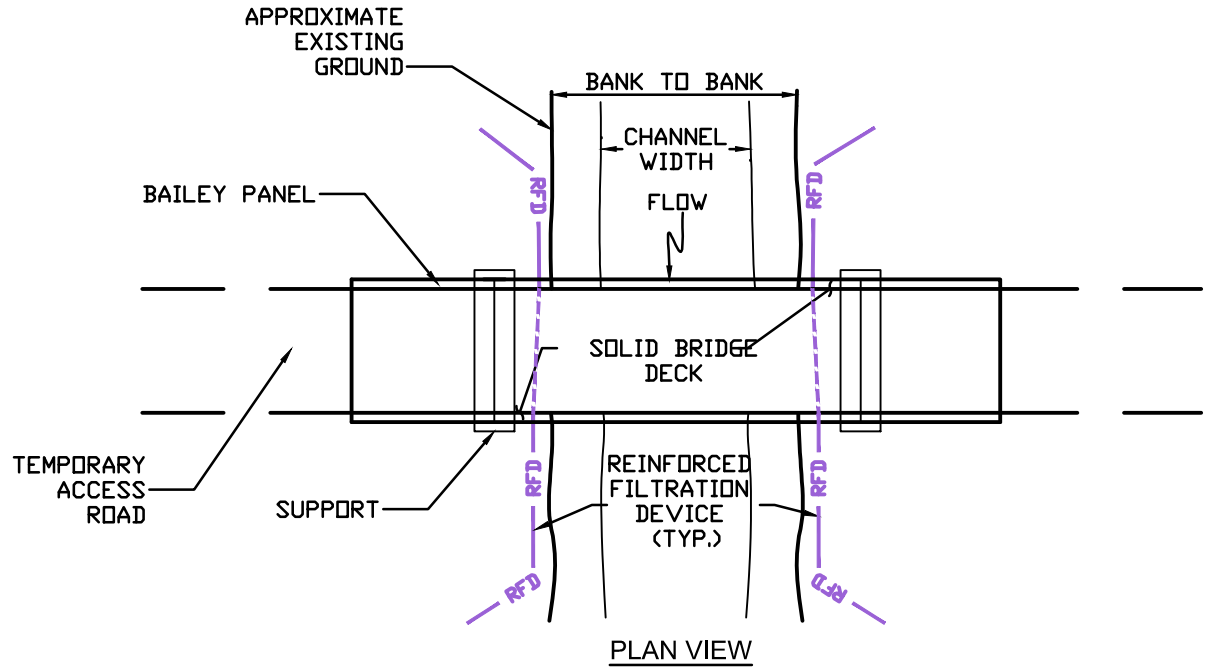
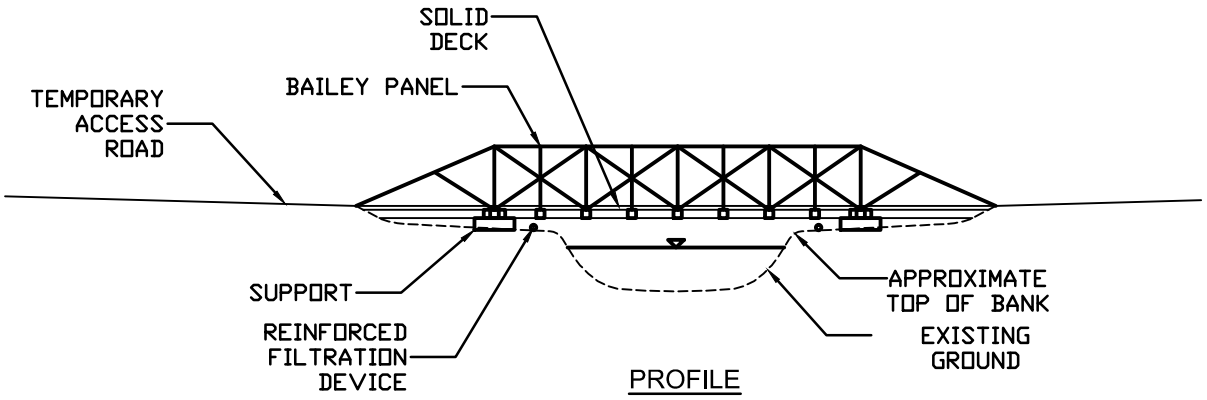
BONDED FIBER MATRIX

DRAWING NO.	REV.
MVP–ES40.1	P



PLAN VIEW



PROFILE

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Mountain Valley PIPELINE

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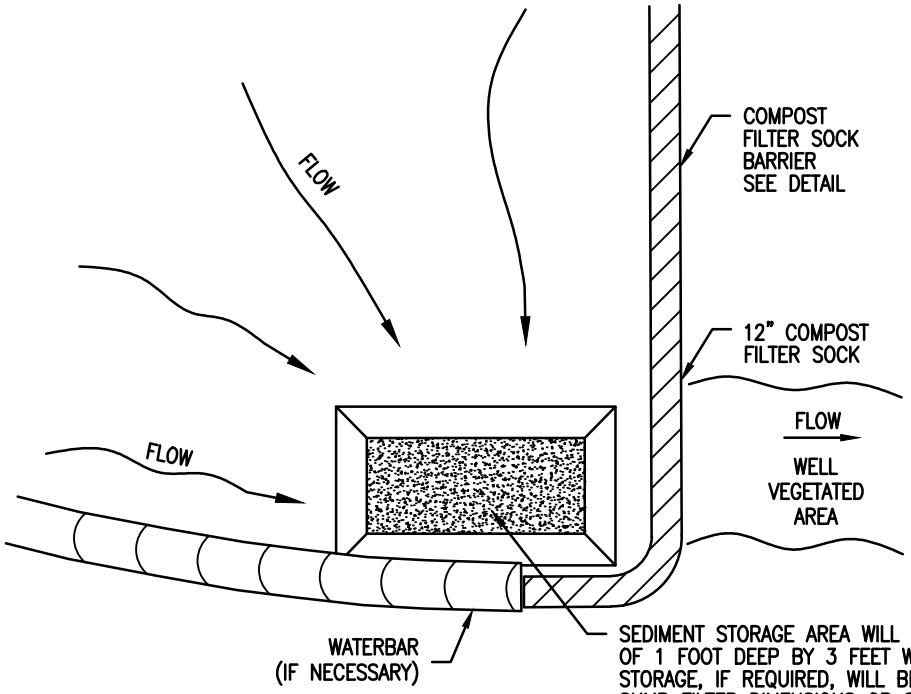
MODULAR TEMPORARY BAILEY BRIDGE

DRAWING NO.	REV.
MVP–ES41	P



NOTES:

1. SUMP FILTER MAY BE USED IN CONJUNCTION WITH WATERBAR (AS DIRECTED BY OWNER REPRESENTATIVE).
2. SUMP FILTER SHALL BE LOCATED ENTIRELY WITHIN PROPOSED RIGHT OF WAY.
3. BMP SHOULD BE CHECKED WEEKLY AND AFTER EACH STORMWATER EVENT FOR SEDIMENT ACCUMULATION, PROPER OPERATION, AND COMPOST FILTER SOCK INTEGRITY.
4. ADDITIONAL COMPOST FILTER SOCKS MAY BE NECESSARY BEYOND WHAT IS SHOWN ON DETAIL TO MEET INTENDED BMP REQUIREMENTS.

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Mountain Valley PIPELINE

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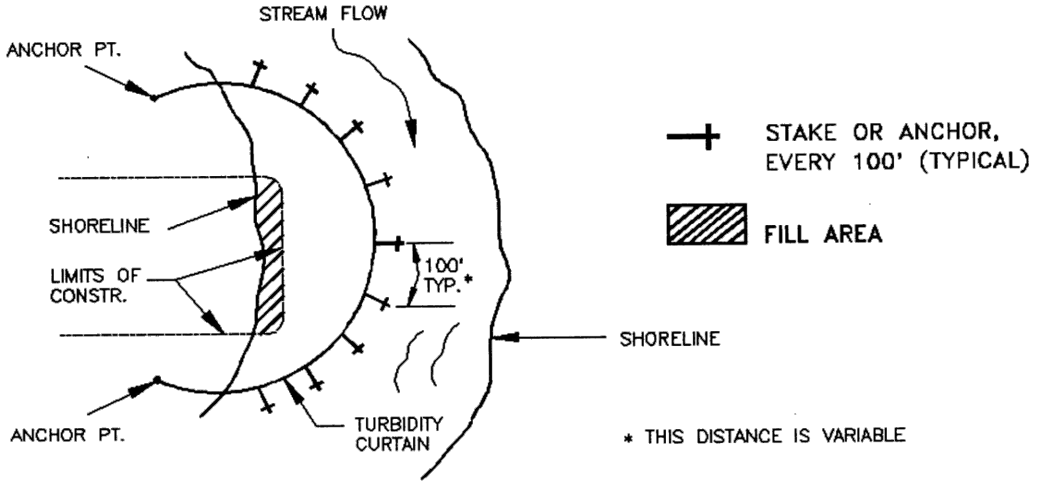
ENVIRONMENTAL DETAIL

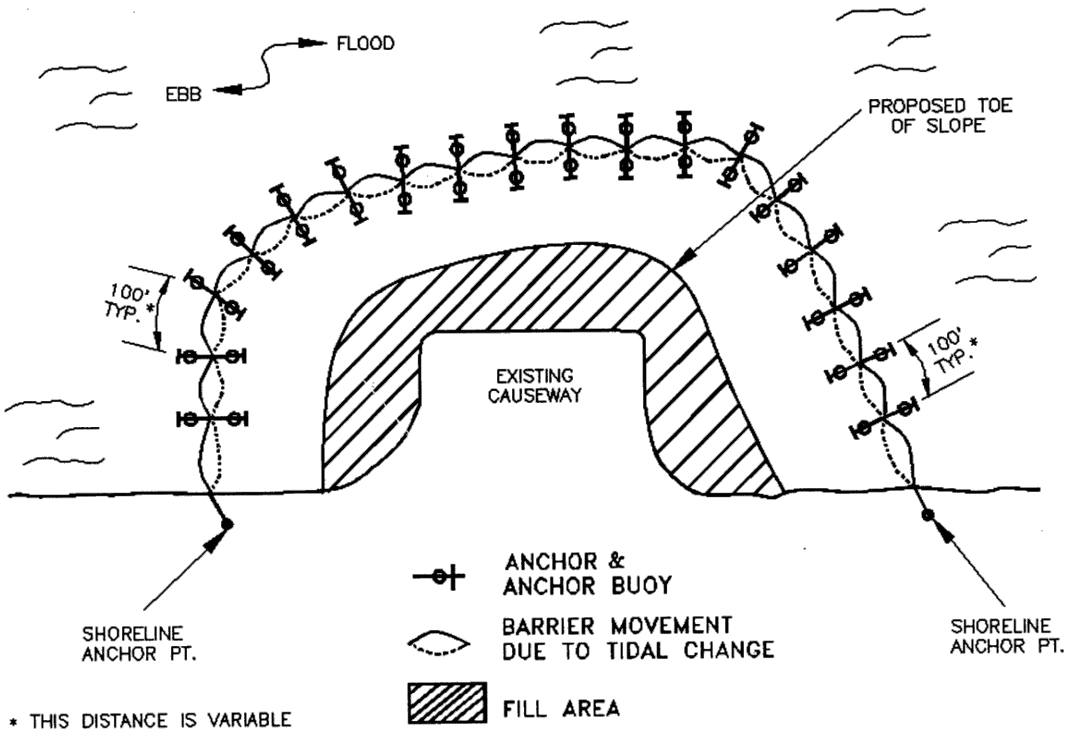
TYPICAL SUMP FILTER

DRAWING NO.	REV.
MVP-ES42	P

TYPICAL LAYOUTS:
STREAMS, PONDS & LAKES (PROTECTED & NON-TIDAL)



TIDAL WATERS AND/OR HEAVY WIND & WAVE ACTION



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Mountain Valley PIPELINE

DESIGN ENGINEERING

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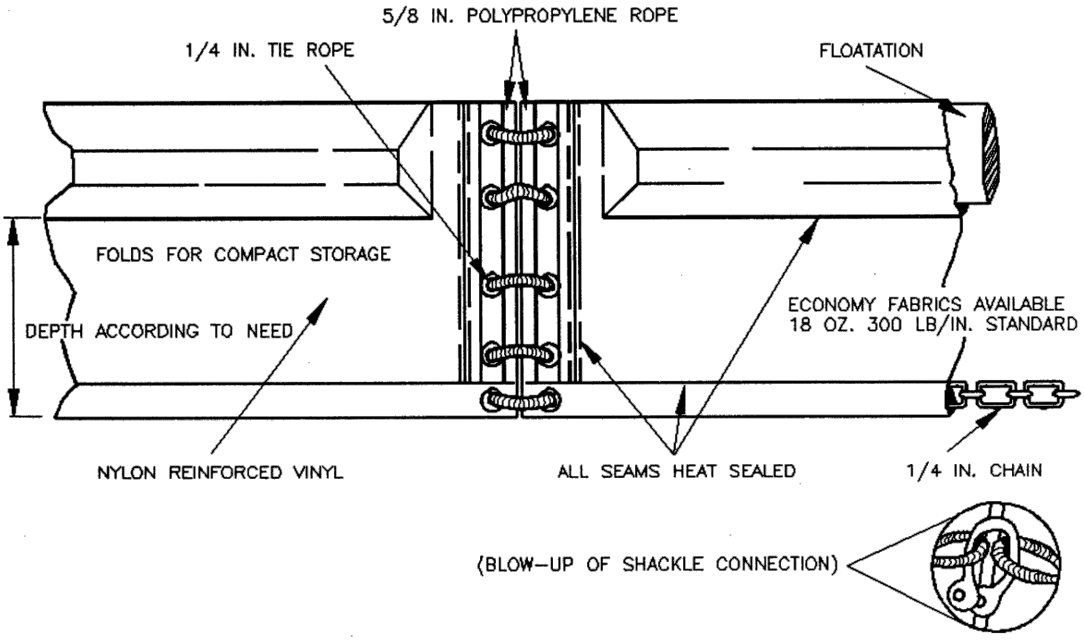
TURBIDITY CURTAIN DETAIL

DRAWING NO.	REV.
MVP-ES43	P

TYPE I



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Mountain Valley PIPELINE

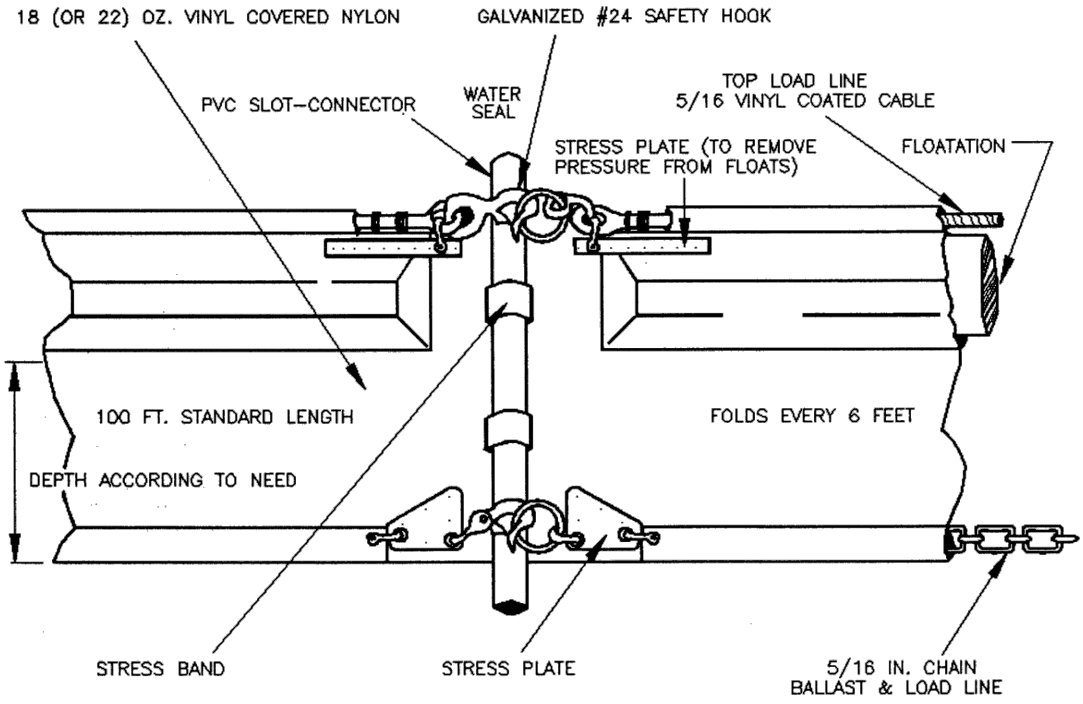
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

TURBIDITY CURTAIN DETAIL

DRAWING NO.	REV.
MVP-ES43.1	P

TYPE II



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Mountain Valley PIPELINE

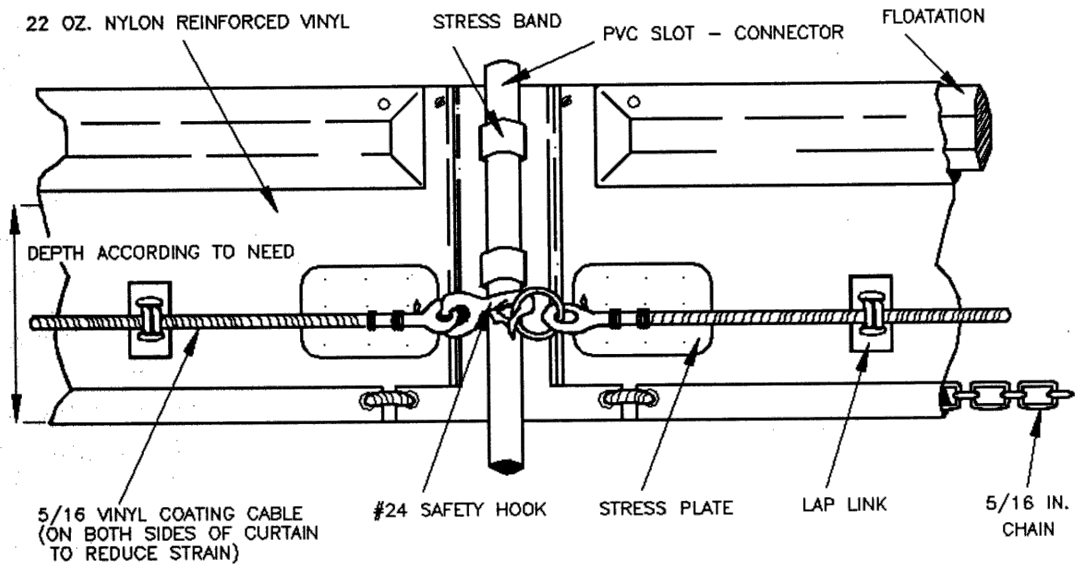
DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

TURBIDITY CURTAIN DETAIL

DRAWING NO.	REV.
MVP-ES43.2	P

TYPE III



DRAWN	DATE
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APP'D	DATE
SCALE N.T.S.	SHEET 1 OF 1
JOB NO.	
PROJECT ID: PXXXX	

Mountain Valley PIPELINE

DESIGN ENGINEERING

ENVIRONMENTAL DETAIL

TURBIDITY CURTAIN DETAIL

DRAWING NO.	REV.
MVP–ES43.3	P