
Chapter 10 - Erosion and Sediment Control

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Chapter 10 - Erosion and Sediment Control

10.1 Introduction

Erosion and sedimentation are natural or geologic processes whereby soil materials are detached and transported from one location and deposited in another, primarily due to rainfall and runoff. Accelerated erosion and sedimentation can occur at times in conjunction with highway and transportation facility construction. This accelerated process can result in significant impacts such as safety hazards, expensive maintenance problems, unsightly conditions, instability of slopes, and disruption of ecosystems. For this reason, the total design process must be done with consideration given to minimization of erosion and sedimentation.

10.1.1 Objective

The purpose of erosion reassessing* and sediment control is to provide an effective plan to control soil erosion and prevent sediment from leaving the construction site. The Department's annually approved erosion and sediment control and stormwater management standards and specifications. Additional information can be found in the Virginia Erosion and Sediment Control Handbook and the Virginia Erosion and Sediment Control Regulations. This Handbook can be ordered from the Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation at (804) 786-2064 or from the website, http://www.dcr.virginia.gov/soil_&_water/e&s.shtml.

The Virginia Erosion and Sediment Control Regulations (VESCR) (4VAC50-30-40) can be accessed from the website, www.dcr.virginia.gov/soil_&_water/e&s.shtm#pubs.

10.1.2 Principal Factors Influencing Erosion

10.1.2.1 Soil Characteristics

The properties of soil which influence erosion by rainfall and runoff are ones which affect the infiltration capacity of a soil and those which affect the resistance of soil particles be detached and carried away by falling or flowing water. Soils containing high percentages of fine sands and silt are normally the most erodible. As the clay and organic matter content of these soils increases, the potential for erosion decreases. Clays act as a binder to soil particles, thus reducing the potential for erosion. However, while clays have a tendency to resist erosion, once eroded they are easily transported by water. Soils high in organic matter have a more stable structure which improves their permeability. Such soils resist raindrop detachment and infiltrate more rainwater. Clear, well-drained, and well-graded gravels and gravel-sand mixtures are usually the least erodible soils. Soils with high infiltration rates and permeabilities reduce the amount of runoff.

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10.1.2.2 Vegetative Cover

Vegetative cover plays an important role in controlling erosion in the following ways:

- Shields the soil surface from the impact of falling rain
- Holds soil particles in place
- Maintains the soil's capacity to absorb water
- Slows the velocity of runoff
- Removes subsurface water between rainfalls through the process of evapotranspiration

By limiting and staging the removal of existing vegetation, and by decreasing the area and duration of exposure, soil erosion, and sedimentation can be significantly reduced. Special consideration should be given to the maintenance of existing vegetative cover on areas of high erosion potential such as erodible soils, steep slopes, drainage ways, and the banks of streams.

10.1.2.3 Topography

The size, shape, and slope characteristics of a watershed influence the amount and rate of runoff. As both slope length and gradient increase, the rate of runoff increases and the potential for erosion is increased. Slope orientation can also be a factor in determining erosion potential.

10.1.2.4 Climate

The frequency, intensity, and duration of rainfall are fundamental factors in determining the amounts of runoff produced in a given area. As both the volume and velocity of runoff increase, the capacity of runoff to detach and transport soil particles also increases. Where storms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in temperature, as well as variations in rainfall, help to define the high erosion risk period of the year. When precipitation falls as snow, no erosion will take place. However, in the spring the melting snow adds to the runoff and erosion hazards are high. Because the ground is still partially frozen, its ability to absorb runoff is reduced. Frozen soils are relatively erosion-resistant. However, soils with high moisture content are subject to uplift by freezing action, and are usually very easily eroded upon thawing.

10.2 Design Policy

A policy for erosion and sediment control is stated in the American Association of State Highway Transportation Officials' publication, "A Policy on Geometric Design of Rural Highways," as follows:

"Erosion prevention is one of the major factors in the design, construction, and maintenance of highways. Erosion can be controlled to a considerable degree by geometric design particularly relating to the cross section. In some respects the control is directly associated with proper provision for drainage and fitting landscape development. Effect on erosion should be considered in the location and design stages."

"Erosion and maintenance are minimized largely by the use of flat side slopes, rounded and blended with natural terrain; drainage channels designed with due regard to width, depth, slopes, alignment and protective treatment; located and spaced facilities for ground water interception; dikes, berms and other protective devices; and protective ground covers and planting."

10.2.1 Federal Policy

As a result of the National Environmental Policy Act of 1969 and the Chesapeake Bay Protection Act, much attention has been directed to the control of erosion and sedimentation. As a result of this concern, numerous state and federal regulations and controls governing land disturbing activities have been developed and published. Federal control requirements are enforced* by numerous agencies such as the Corps of Engineers (COE), Department of Conservation and Recreation (DCR), Environmental Protection Agency (EPA), Fish and Wildlife Service (FWS), etcetera, through their administration of various permitting requirements (Section 404, Section 402 of the Federal Water Pollution Control Act (FWPCA), and Section 9 and 10 of the River and Harbor Act).

10.2.2 State Policy

The Department of Conservation and Recreation annually reviews and approves VDOT's Erosion and Sediment Control Program. This Annual review includes all of VDOT's erosion and sediment control standards, specifications, policies, and design guidelines as outlined in the Road and Bridge Standards, Road and Bridge Specifications, Drainage Manual, Road Design Manual, Instructional and Informational Memoranda, and other associated directives.

Any maintenance or construction activity that disturbs more than 10,000 square feet (929 m²), or 2,500 square feet (232 m²) in areas defined as Tidewater Virginia in the Virginia Chesapeake Bay Preservation Act, must have a specific erosion and sediment control plan developed and implemented in accordance with VDOT's Erosion and

* Rev 9/09

10.2 – Design Policy

Sediment Control Approved Program^{*}. The requirements of the Virginia Erosion and Sediment Control Regulations (VESCR), <http://www.dcr.virginia.gov/soil_&_water/documents/eslawrqs.pdf>, and the VDOT Erosion and Sediment Control Annual Plan will be incorporated into every design and will be enforced on all VDOT operations.

Refer to the latest Location and Design Instructional and Informational Memorandum I&IM LD (D) 11 for additional policy and design guidelines.

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10.3 Documentation

10.3.1 Design Documentation

Drainage designers should use the guidelines and checklists such as those provided in the Virginia Erosion and Sediment Control Handbook (VESCH) to verify that critical design issues have been accounted for with each design phase of the project.

The design of sediment traps, sediment basins and other major erosion and sediment control measures is to be supported by engineering calculations which are to* be included as a part of the project's drainage report. Instruction for designing erosion and sediment control measures can be found in Appendix 10B-1 and* the VESCH.

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10.4 References

AASHTO, Highway Drainage Guidelines fourth edition 2007, Chapter* III, Guidelines for Erosion and Sediment Control in Highway Construction.

Division of Soil and Water Conservation, Virginia Department of Conservation and Recreation, 1992. Virginia Erosion & Sediment Control Handbook, Third Edition.

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Appendix 10A-1 Definitions and Abbreviations

Abbreviations:

DCR	Department of Conservation and Recreation
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FWPCA	Federal Water Pollution Control Act
FWS	Fish and Wildlife Service
USCOE/USACE	United States Corps of Engineers
VESCH	Virginia Erosion and Sediment Control Handbook
VESCR	Virginia Erosion and Sediment Control Regulations
VDOT	Virginia Department of Transportation

Appendix 10B-1 Erosion and Sediment Control Plan Details

10.1 DESIGN GUIDELINES

10.1.1 References

- In addition to the information contained herein, the following references contain design and/or construction guidelines and details:
 - VDOT Road and Bridge Standards.
 - VDOT Road and Bridge Specifications.
 - DCR Virginia Erosion and Sediment Control Handbook.
 - VDOT Drainage Manual
 - Hydraulic Design Advisories
 - L&D Instructional and Informational Memorandum

10.1.2 Diversion of Off-Site Stormwater Run-Off

- Stormwater run-off from areas outside the project limits shall, where practical, be diverted around the disturbed areas of the project.
- Erosion and sediment control measures such as diversion ditches, diversion dikes (VDOT Road and Bridge Standard EC-9) (Reference DCR Standard 3.09), stabilized channels, etc. shall be used to limit the stormwater run-off flowing across the disturbed areas of the project.
- Where diversion of runoff from offsite areas is impractical, the flow can be conveyed through the disturbed area in a culvert or a stabilized channel or ditch. Erosion and sediment control measures, such as temporary filter barrier or silt fence, shall be provided along the sides of the ditch or channel to prevent sediment from adjacent disturbed areas from entering the ditch or channel.

10.1.3 Stabilized Construction Entrances - VDOT Road and Bridge Standard. EC-11* (Reference DCR Standard 3.02)

Wherever construction traffic will enter or cross a public road, a stabilized construction entrance is required to minimize the transporting of sediment onto the adjoining surface. This entrance is to be constructed in accordance with the details shown on Standard Drawing EC-11 of the VDOT Road and Bridge Standards.

In areas where clay or other soils that can be easily tracked onto a public roadway are encountered, a wash rack shall be provided to facilitate removal of sediment from vehicles using the entrance. Sediment laden runoff shall be directed to an approved sediment trapping device.

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- Surface water shall be piped under the construction entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.
- Maintenance must be provided to assure continuous performance of the stabilized construction entrance.
- The need and potential locations for stabilized construction entrances should be discussed at the Field Inspection meeting or discussed with the appropriate District Environmental Manager or Construction Engineer.

**10.1.4 Temporary Silt Fence - VDOT Road and Bridge Standard EC-5
(Reference DCR Standard 3.05 & 3.08)**

- Temporary Silt Fence is to be used to control sediment in non-concentrated (sheet) flow areas.
- Temporary Silt Fence is to be used at the toe of embankments where the fill height is equal to or greater than 5' (1.5 m).
- Additional erosion and sediment control measures must be provided to supplement Temporary Silt Fences located along the toe of embankments where the area draining to Temporary Silt Fence exceeds 11,000 square feet (1020 m²) per 100 linear feet (30 m) of Silt Fence.

**10.1.5 Temporary Filter Barrier - VDOT Road and Bridge Standard EC-5
(Reference DCR Standard 3.05 & 3.08)**

- Temporary Filter Barrier is to be used to control sediment in non-concentrated (sheet) flow areas.
- Temporary Filter Barrier is to be used at the toe of embankments where the height of fill is less than 5' (1.5 m).
- Additional erosion and sediment control measures must be provided to supplement Temporary Filter Barriers located along the toe of embankments where the area draining to Temporary Filter Barrier exceeds 11,000 square feet (1020 m²) per 100 linear feet (30 m) of Filter Barrier.
- Baled Straw Silt Barrier (Reference DCR Standard 3.04) may be substituted for Temporary Filter Barrier, with the approval of the Project Engineer and/or District Environmental Staff*, in non-critical areas, such as pavement locations, where geotextile type filter barrier cannot be installed in accordance with the Standard Drawings and Specifications.

10.1.6 Brush Barriers - VDOT Road and Bridge Standard EC-5*

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(Reference DCR Standard 3.06)

- Brush Barriers may to be used to control sediment in non-concentrated (sheet) flow areas.
- Additional erosion and sediment control measures must be provided to supplement Brush Barriers located parallel along the toe of embankments if the area draining to the Brush Barrier exceeds 11,000 square feet (1020 m²) per 100 linear feet (30 m) of Brush Barrier.
- It is desirable, where feasible, that Brush Barriers remain in place after completion of the project in order to provide an area for wildlife habit. Any Brush Barriers left in place must have any geotextile fabric removed.

10.1.7 Inlet Protection - VDOT Road and Bridge Standard EC-6 (Reference DCR Standard 3.07)

- Provide Inlet Protection Type A at:
 - Grate inlets in graded median and roadside ditches.
 - Grate inlets in sump areas.
 - Grate inlets in other ditch locations or areas of concentrated flow.
- Provide Inlet Protection Type B at:
 - Curb opening inlets as needed.
- Sediment forebays shall be utilized at drop inlet locations where increased efficiency of sediment removal is desired or where drainage area/storage volume requirements dictate. The need for sediment forebays may be determined by the designer during the design phase of the project or by the Project Engineer or District Environmental Staff during the construction phase of the project.

10.1.8 Sediment Traps – VDOT Road and Bridge Standard EC-7 (Reference DCR Standard 3.13)

- Temporary Sediment Traps should be used to detain sediment-laden runoff from small disturbed areas. Use of Temporary Sediment Traps should be limited to those locations where the total contributing drainage area is less than 3 acres (1.2 hectares).
- Temporary Sediment Traps are normally located in areas of concentrated flow. The outflow from Temporary Sediment Traps is normally controlled by the use of a rock checkdam.

- Temporary Sediment Traps shall not be constructed in live streams.
- The storage volume for Temporary Sediment Traps shall be 134 cubic yards per acre (254 m³ per hectare) of the total contributing drainage area and shall consist of 50% in the form of wet storage (excavated area) and 50% in the form of dry storage.
- The need and location for Temporary Sediment Traps is to be determined by the Hydraulics Engineer based on the anticipated sequence of construction.
- The general design for Temporary Sediment Traps is to be in accordance with the details shown on Standard Drawing EC-7 of the VDOT Road and Bridge Standards. Specific dimensions for each Temporary Sediment Trap are to be determined by the **designer*** and summarized on the Temporary Sediment Trap Detail Sheet.
- The Project Engineer, in conjunction with the District Environmental Staff, shall determine the time schedule for the removal of the Temporary Sediment Traps.

10.1.9 Temporary Sediment Basins (Reference DCR Standard 3.14)

- Temporary Sediment Basins should be used to detain sediment laden runoff from disturbed areas where the total contributing drainage area is 3 acres (1.2 hectares) or greater. The maximum drainage area controlled by a Temporary Sediment Basin should not exceed 100 acres (40 hectares).
- The sediment storage volume for Temporary Sediment Basins shall be 134 cubic yards per acre (254 m³ per hectare) of the total contributing drainage area. The storage volume shall consist of 50% in the form of wet storage (permanent pool) and 50% in the form of dry storage. The hydraulic performance of the Temporary Sediment Basin shall be predicated on the runoff from the entire watershed.
- The need and location for Temporary Sediment Basins is to be determined by the **designer** based on the anticipated sequence of construction.
- Specific details and dimensions for each Temporary Sediment Basin are to be determined by the **designer** and the design details (including wet and dry storage volumes) are to be included in the construction plans.
- Concentrated stormwater discharge from Temporary Sediment Basins shall be discharged directly into an adequate natural or man-made receiving channel as defined by Minimum Standard 19 (MS-19) of the Virginia Erosion and Sediment Control Regulations.

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- The **designer*** is referred to the Virginia Erosion and Sediment Control Handbook for further design parameters and construction details.
- The Project Engineer, in conjunction with the District Environmental **Staff**, shall determine the time schedule for removal of Temporary Sediment Basins.
- Permanent Stormwater Management (SWM) basins may be used as temporary sediment basins during the construction phase of the project by modifying the outflow control structure in order to provide the required wet and dry storage volumes. Typical details for modifying a standard riser structure are shown on Standard Drawing SWM-DR .

10.1.10 Slope Drains - VDOT Standard **EC-10 (Reference DCR Standard 3.15)**

- Slope Drains are to be used in high (8' or greater) (2.4 m or greater), long fill situations to control slope erosion. Exceptions would be where the length of fill is less than 100' (30 meters) or at bridge locations where run-off is being handled by other means.
- The need for Slope Drains is to be determined by the **designer**.
- During the construction phase of the project, the Project Engineer and/or the District Environmental **Staff** may require additional slope drains as dictated by field conditions.

10.1.11 Culvert Outlet Protection - VDOT Road and Bridge Standard **EC-1 & **EC-3** (Reference DCR Standard 3.18)**

- Erosion control protection shall be provided at the outlet of each culvert where required in accordance with the guidelines set forth in **Chapter 8 of this Manual**.
- The placement of the outlet protection shall be in accordance with Standard Drawing EC-1 or **EC-3**.
- The Project Engineer and/or the District Environmental **Staff** shall inspect the outlet ends of all culverts during the construction phase of the project. Where not specified on the plans, but warranted by field conditions, additional outlet protection shall be added in order to ensure the stability of the area adjacent to the culvert outlet.

10.1.12 Rock Check Dams - VDOT Road and Bridge Standard **EC-4 (Reference DCR Standard 3.20)**

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- Type I Rock Check Dams are to be used in trapezoidal ditches where the bottom width is greater than 2' (0.6 m).
- Type II Rock Check Dams are to be used in triangular (vee) ditches and trapezoidal ditches where the bottom width is 2' (0.6 m) or less.
- Rock Check Dams may be designated as permanent SWM structures that are to be left in place after completion of the project in order to function as a part of the overall SWM Plan for the project. Rock Check Dams designated as permanent structures, and located within the clear zone adjacent to a travelway, shall be designed so as not to present a hazard to traffic (see Standard Drawing EC-4).
- During the construction phase of the project, the Project Engineer and/or the District Environmental Monitor may approve the use of geosynthetic check dams in lieu of Rock Check Dams Type II provided that the check dams are not designated as permanent stormwater management structures and provided that there is no additional cost to the Department. The Materials Division's Approved Products List includes the names of approved geosynthetic check dam manufacturers.

**10.1.13 Temporary Diversion Channel - VDOT Road and Bridge Standard EC-12*
(Reference DCR Standard 3.24 & 3.25)**

- A Temporary Diversion Channel should be used where culvert installation is proposed in a live stream environment (perennial or intermittent) and where it will be necessary to divert the stream in order for the culvert to be installed in the dry.
- The designer, using USGS Topographical Maps and/or field observations, shall determine the need for a Temporary Diversion Channel and identify the most feasible location for the channel.
- When it is determined that a Temporary Diversion Channel is required, the designer shall determine the following:
 - The length of the Temporary Diversion Channel.
 - The bottom width of Temporary Diversion Channel necessary to essentially match that of the existing low water stream channel.
 - The depth of the Temporary Diversion Channel (average ground surface elevation minus average natural streambed elevation).
 - The class of lining required based on the following:

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Specify Class A Lining where the Temporary Diversion Channel slope is less than 2 percent.

Specify Class B Lining where the Temporary Diversion Channel slope is equal to or greater than 2 percent.

- The location of the Temporary Diversion Channel should be shown on the appropriate ESC plan sheet, when using the Multiple Phase ESC Plan concept, or the Construction plan sheet, when using the Single Phase ESC Plan concept.
- Temporary Silt Fence shall be provided along both sides of the Temporary Diversion Channel.

10.1.14 Dewatering Basins - VDOT Road and Bridge Standard EC-8 (Reference DCR Standard 3.26)

- Dewatering Basins are provided to receive sediment-laden water pumped from a construction site in order to allow for filtration before the water reenters a natural watercourse.
- Accumulated sediment in the Dewatering Basin shall be removed and disposed of in an approved disposal area outside of the 100-year flood plain, unless otherwise noted on the plans.
- Surface water flow shall be diverted around the Dewatering Basin.
- A stabilized conveyance shall be provided from the outlet of the Dewatering Basin to the receiving channel.
- The need for Dewatering Basins is to be determined by the Hydraulics Engineer during the design phase of the project.
- The field location of Dewatering Basins is to be determined by the Contractor during the construction phase of the project.
- During the construction phase of the project, the Project Engineer and/or the District Environmental Staff* may approve the use of a synthetic dewatering basin in lieu of the dewatering basin shown on Standard Drawing EC-8 of the VDOT Road and Bridge Standards provided that there is no additional cost to the Department regardless of the number of synthetic dewatering basins required for each site.

10.1.15 Turbidity Curtains (Reference DCR Standard 3.27)

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- A Turbidity Curtain is used to provide sedimentation protection for a watercourse from up-grade land disturbance or from dredging or filling operations within the watercourse.
- A Turbidity Curtain may be used in both non-tidal and tidal watercourses where intrusion into the watercourse by construction activities or sediment movement is unavoidable.
- Turbidity Curtains should not be placed across the main flow of a significant body of moving water but instead should be located parallel to the direction of flow.
- The Turbidity Curtain should extend for the entire depth of the water to the bed (bottom) of the channel except in locations subject to tidal action and/or significant wind or wave forces.
- At locations subject to tidal action and/or significant wind and wave forces, the bottom of the Turbidity Curtain should extend no closer than 1.0' (0.3 m) above the bed (bottom) of the channel at mean low water.
- An impervious material should be used for the Turbidity Curtain for general applications.
- A pervious material should be used for the Turbidity Curtain for special applications in areas of tidal or moving water where there is a need to extend the curtain all the way to the bed (bottom) of the channel.
- The maximum depth (height) of the curtain shall be no greater than 10 feet (3.0 m) for all stages of water level anticipated during the duration of the curtain's installation.
- The **designer**^{*} is referred to the Virginia Erosion and Sediment Control Handbook for further design parameters and construction details.

10.1.2 DESIGN CONSIDERATIONS

10.1.2.1 Right of Way/Easement:

- Prior to the Public Hearing Stage of the project, the need for fee right-of-way, permanent easement or temporary easement to accommodate the construction and maintenance of temporary diversion channels, sediment traps, sediment basins or other perimeter erosion and sediment control devices should be addressed.

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- All right of way or easements needed to accommodate the construction and maintenance of temporary diversion channels and erosion and sediment control measures shall be shown on the plans prior to their submission for right-of-way acquisition.

10.1.2.2 Safety

- Guardrail or fencing around sediment traps or sediment basins should be specified where it is determined to be needed for the safety of pedestrians or vehicles.
- The need for guardrail or fencing should be determined by the District Construction Engineer or other person so designated.

10.1.2.3 Maintenance Access

- The need to maintain erosion and sediment control, control measures during construction shall be considered in the development of the ESC plan.
- The plan design shall incorporate a means of access (e.g., sufficient right-of-way, easements, flattened slopes, etc.) for the maintenance of sediment traps, sediment basins and other erosion and sediment control measures.

10.1.3 PLAN DETAILS

10.1.3.1 Symbols

- Standard symbols are to be used to depict erosion and sediment control items on the plans in accordance with General Note E-3* shown in the latest Location and Design Instructional and Informational Memorandum (D) 110 and in accordance with instructions in the VDOT CADD Manual.

10.1.3.2 Check Dams

- Rock Check Dams that are to function as a part of the permanent SWM Plan for the project should be designated on the plans as follows:

“Rock Check Dam Type (specify) - Permanent SWM Structure (to remain in place after project completion).”

10.1.3.3 Dewatering Basins

- Do not show specific locations on the plans.

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- The description of the applicable drainage structure (or a separate description note when utilizing individual sheets to depict a phased ESC Plan) should note the need for a Dewatering Basin(s) and specify the number required.

10.1.3.4 Stabilized Construction Entrances

- The specific locations of Stabilized Construction Entrances will not be shown on the plans. A note should be included on the appropriate plan sheet(s) specifying the general location (station, lane, roadway, etc.) where it is anticipated that Stabilized Construction Entrances will be required.

10.1.3.5 Filter Cloth

- Where existing fence is available for the attachment of the Filter Cloth, the plans are to specify the following: “Filter Cloth Req’d. (Attach to Exist. Fence).”

10.1.3.6 Slope Drains

- The specific locations of Slope Drains will not be shown on the plans. A note should be included on the appropriate plan sheet(s) specifying the general location (station to station, lane, roadway, etc.) and estimated quantity of Slope Drains and Culvert Outlet Protection Class **1***, St’d. EC-1 required.

10.1.3.7 Temporary Diversion Channel

- When the location is shown on an individual phased ESC Plan Sheet, the description for the Temporary Diversion Channel should specify the width of the channel required and the class of lining required (A or B). Temporary Silt Fence along both sides of the Temporary Diversion Channel should be specified.
- When the location is shown on the Construction plan sheet, the description for the Temporary Diversion Channel should be included in the description for the applicable drainage structure. The following information should be included in the drainage description:

Temporary Diversion Channel Req’d. Width = (specify)
(specify) cu. yds. (m³) Temporary Diversion Channel Excavation
(specify) sq. yds. (m²) Temporary Diversion Channel Lining, Class (specify)
(specify) ft. (m) Temporary Silt Fence Req’d.

- The plan description calls attention to the need for a Temporary Diversion Channel and defines the width of the channel and the class of lining required.

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- The designer* should be liberal when estimating the length of Temporary Diversion Channel required in order to avoid significant cost overruns during construction.
- The Contractor, with approval of the Project Engineer and/or the District Environmental Staff, will have the latitude to field locate the Temporary Diversion Channel where needed to best fit his planned construction sequencing. The Contractor is paid for the actual quantity of excavation and quantity of lining installed.
- Sufficient right of way and/or temporary/permanent easement should be provided in order to allow the contractor the latitude to locate the Temporary Diversion Channel on either side of the proposed structure. Location of wingwalls or other appurtenances that protrude beyond the neat lines of the culvert's barrel shall be considered when locating the Temporary Diversion Channel and establishing the required R/W or Easement.

10.1.3.8 General Notes

- See the latest Location and Design Instructional and Informational Memorandum (D) 110 for the applicable Erosion and Sediment Control Notes that are to be included on the General Notes Sheet of the plans.

10.1.4 MAINTENANCE

- Accumulated sediment shall, at a minimum, be removed from erosion and sediment control facilities as follows:
 - Sediment Traps & Basins - When the wet storage volume has been reduced by approximately 50%.
 - Temporary Silt Fence or Filter Barrier – When it retains sediment up to ½ of its height.
 - Rock Check Dams – When the storage capacity behind the dam has been reduced by approximately 50%.
 - Dewatering Basins – When the excavated volume has been reduced by approximately 50%.
 - All other erosion and sediment control facilities – When the capacity, height or depth has been reduced by approximately 50%.

10.1.5 BASIS OF PAYMENT

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10.1.5.1 Siltation Control Excavation

- All silt removal and sediment cleanout from erosion and sediment control items will be measured and paid for as “cubic yards (m³) of Siltation Control Excavation.”

10.1.5.2 Rock Check Dams

- To be measured and paid for per each for the type specified.

10.1.5.3 Temporary Filter Barrier and Silt Fence

- To be measured and paid for in linear feet (m).

10.1.5.4 Temporary Sediment Basins and Sediment Traps

- Excavation for Temporary Sediment Basins or Sediment Traps will be measured and paid for as “cubic yards (m³) Temporary Sediment Basin Excavation.” If additional fill material is needed for dams or berms, it will be measured and paid for as “cubic yards (m³) of Regular Excavation, Borrow Excavation or Embankment.”

10.1.5.5 Dewatering Basins

- To be measured and paid for per each.

10.1.5.6 Inlet Protection

- To be measured and paid for per each for the type specified.

10.1.5.7 Temporary Diversion Dike

- Will not be measured for payment, but the cost shall be included in the price bid for other appropriate items.

10.1.5.8 Stabilized Construction Entrance

- Will not be measured for payment but the cost shall be included in the price bid for other appropriate items.

10.1.5.9 Slope Drains

- To be measured and paid for per each regardless of size or length.
- EC-1 Class 1 to be measured and paid for per square yard or ton

10.1.5.10 Brush Silt Barriers

- Will not be measured for payment but the cost shall be included in the price bid for other appropriate items.

10.1.5.11 Geotextile Fabric

- When attached to brush barriers or an existing fence, payment will be made for square yards (m^2) of Geotextile Fabric.

10.1.5.12 Culvert Outlet Protection

- (Std. EC-1, Class A1 & Class I & Class II - to be measured and paid for in square yds or tons.
- (Std. EC-3, soil stabilization mat – to be measured and paid for in square yds.

10.1.5.13 Turbidity Curtains

- To be measured and paid for in linear feet (m) of the type specified, measured from edge of curtain to edge of curtain along the support cable.

10.1.5.14 Temporary Diversion Channel

- To be measured and paid for in cubic yards (m^3) Temporary Diversion Channel Excavation and square yards (m^2) Temporary Diversion Channel Lining for the Class specified.

10.1.6 QUANTITY ESTIMATES

10.1.6.1 Summary Sheet

- All estimated quantities for erosion and sediment control items are to be summarized on the Erosion Control Summary Sheet.
- Estimated quantities are to be shown for each phase of the ESC Plan.

10.1.6.2 Rock Check Dams

- Summarize a quantity of 4.74 cubic yards ($3.6 m^3$) of Siltation Control Excavation for each Rock Check Dam Type I specified. This should allow for two cleanouts.
- Summarize a quantity for 0.32 cubic yards ($0.2 m^3$) of Siltation Control Excavation for each Rock Check Dam Type II specified. This should allow for two cleanouts.

10.1.6.3 Temporary Filter Barrier

- The estimated quantity depicted on the plans is to be increased by a percentage factor of 100% and the adjusted quantity shown on the Erosion Control Summary Sheet.
- Summarize a quantity for cubic yards (m³) of Siltation Control Excavation as follows:

Metric - 0.25 m³ of Siltation Control Excavation for each meter of Temporary Filter Barrier summarized on the Erosion Control Summary Sheet.

Imperial - 0.17 Cubic yards of Siltation Control Excavation for each linear foot of Temporary Filter Barrier summarized on the Erosion Control Summary Sheet.

10.1.6.4 Temporary Silt Fence

- The estimated quantity depicted on the plans is to be increased by a percentage factor of 100% and the adjusted quantity shown on the Erosion Control Summary Sheet.*
- Summarize a quantity for cubic yards (m³) of Siltation Control Excavation as follows:

Metric - 0.25 m³ of Siltation Control Excavation for each meter of Temporary Silt Fence specified.

Imperial - 0.17 Cubic yards of Siltation Control Excavation for each linear foot of Temporary Silt Fence specified.

10.1.6.5 Brush Silt Barrier

- The estimated linear feet (m) is to be shown on the Erosion Control Summary Sheet.

10.1.6.6 Temporary Sediment Basins and Traps

- Summarize the cubic yards (m³) of Temporary Sediment Basin Excavation on the Erosion Control Summary Sheet. If Borrow or Embankment is needed, it is to be included in roadway totals on the Grading Diagram and Summary Sheet.
- The Grading Diagram is to reflect how the cubic yards (m³) of Temporary Sediment Basin Excavation and cubic yards (m³) of Embankment is to be distributed.

* Rev 7/12

- Temporary Sediment Basin control structure (riser pipe) – Summarize pay item as linear feet (meters) of Temporary Sediment Riser Pipe (size) on the Erosion Control Summary Sheet.
- Any culvert pipe necessary for a temporary sediment basin shall be included with other applicable pipe on the Drainage Summary Sheet.
- Summarize a quantity for cubic yards (m^3) of Siltation Control Excavation that is equal to 50% of the total volume (wet storage volume plus dry storage volume) of the basin or trap. This will allow for two cleanouts.

10.1.6.7 Dewatering Basin

- The number of Dewatering Basins specified for each applicable site shall consider any potential phased construction of the proposed drainage structure. At a minimum, the following number of dewatering Basins shall be specified:
 - One Dewatering Basin for each pipe(s) or major structure that has a combined hydraulic opening of 12.6 square feet ($1.17 m^2$) (48" (1200 mm) diameter pipe or equivalent) or greater including bridges 20' (6 m) or less in length.
 - Two Dewatering Basins for each bridge over 20' (6 m) in length.
- Summarize a quantity of 4 cubic yards ($3.1 m^3$) of Siltation Control Excavation for each Dewatering Basin specified, based on a minimum Dewatering Basin size of 6' x 6' x 3' (2 m x 2 m x 1 m). This will allow for two cleanouts.

10.1.6.8 Inlet Protection*

- Type A
 - Summarize a quantity of 15 cubic yards ($11.5 m^3$) of Siltation Control Excavation for each Drop Inlet Silt Trap Type A specified at St'd DI-5, DI-7A,7B and DI-12,12A,12B,12C Drop Inlet locations. This should allow for two cleanouts.
 - Summarize a quantity of 5 cubic yards ($3.8 m^3$) of Siltation Control Excavation for each Drop Inlet Silt Trap Type A specified at Standard DI-1 and DI-7 Drop Inlet locations. This should allow for two cleanouts.

* Rev 9/09

- Type B
 - Summarize a quantity of 5 cubic yards (3.8 m³) of Siltation Control Excavation for each Drop Inlet Silt Trap Type B specified at curb drop inlet locations. This should allow for two cleanouts.

10.1.6.9 Stabilized Construction Entrance

- The estimated number of Stabilized Construction Entrances is to be shown on the Erosion Control Summary Sheet.

10.1.6.10 Slope Drains

- Summarize the estimated number of Slope Drains and the quantity of Culvert Outlet Protection Class 1*, St'd. EC-1 on the Erosion Control Summary Sheet.
- The number of Slope Drains required is to be estimated as follows:
 - One Slope Drain for each 250 linear feet (75 m), or portion thereof, for fills 8 feet (2.4 m) in height or greater, for each roadway baseline; e.g., 200' (60 m) of fill = 1 Slope Drain; 580' (175 m) of fill = 3 Slope Drains.

10.1.6.11 Erosion Control Mulch

- Summarize a quantity on the Erosion Control Summary Sheet when recommended by the Environmental Division.
- This material is estimated at the rate of 50 square yards per 100 feet (135 m² per 100 meters) of roadway alignment.

10.1.6.12 Turbidity Curtain

- Summarize as linear feet (meters) of Turbidity Curtain for the type specified (Pervious or Impervious) on the Erosion Control Summary Sheet.

10.1.6.13 Temporary Diversion Channel

- An estimated quantity of Temporary Diversion Channel Excavation and Temporary Diversion Channel Lining for the Class specified (A or B) is to be shown on the Erosion Control Summary Sheet.
- Silt fence along both sides of channel is to be measured and paid for separately and summarized on the Erosion Control Summary Sheet.

* Rev 9/09

- The designer* shall estimate the cubic yards (m^3) of temporary Diversion Channel Excavation and the square yards (m^2) of Temporary Diversion Channel Lining based on the estimated width and depth of the channel using Table 1.

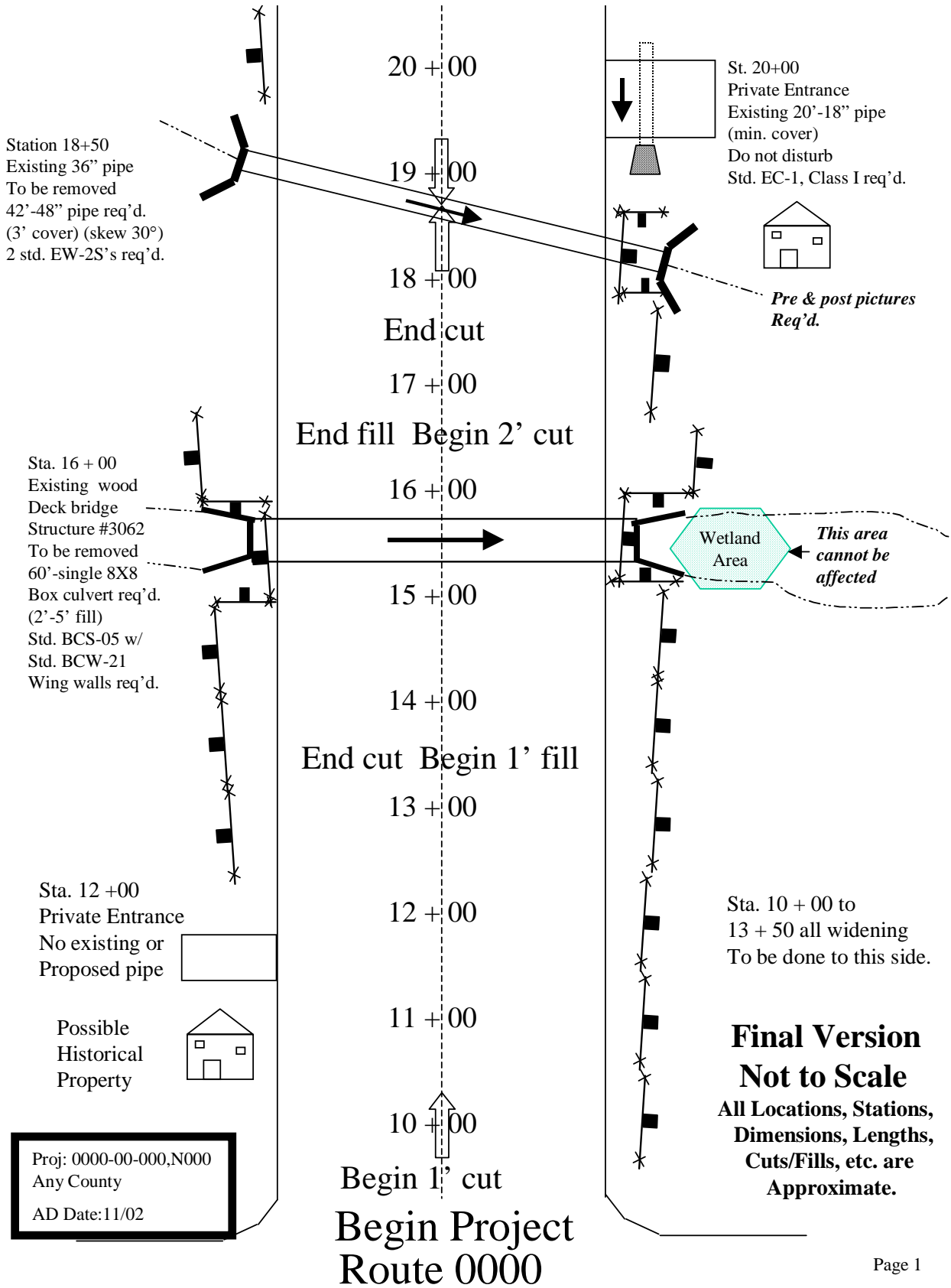
* Rev 9/09

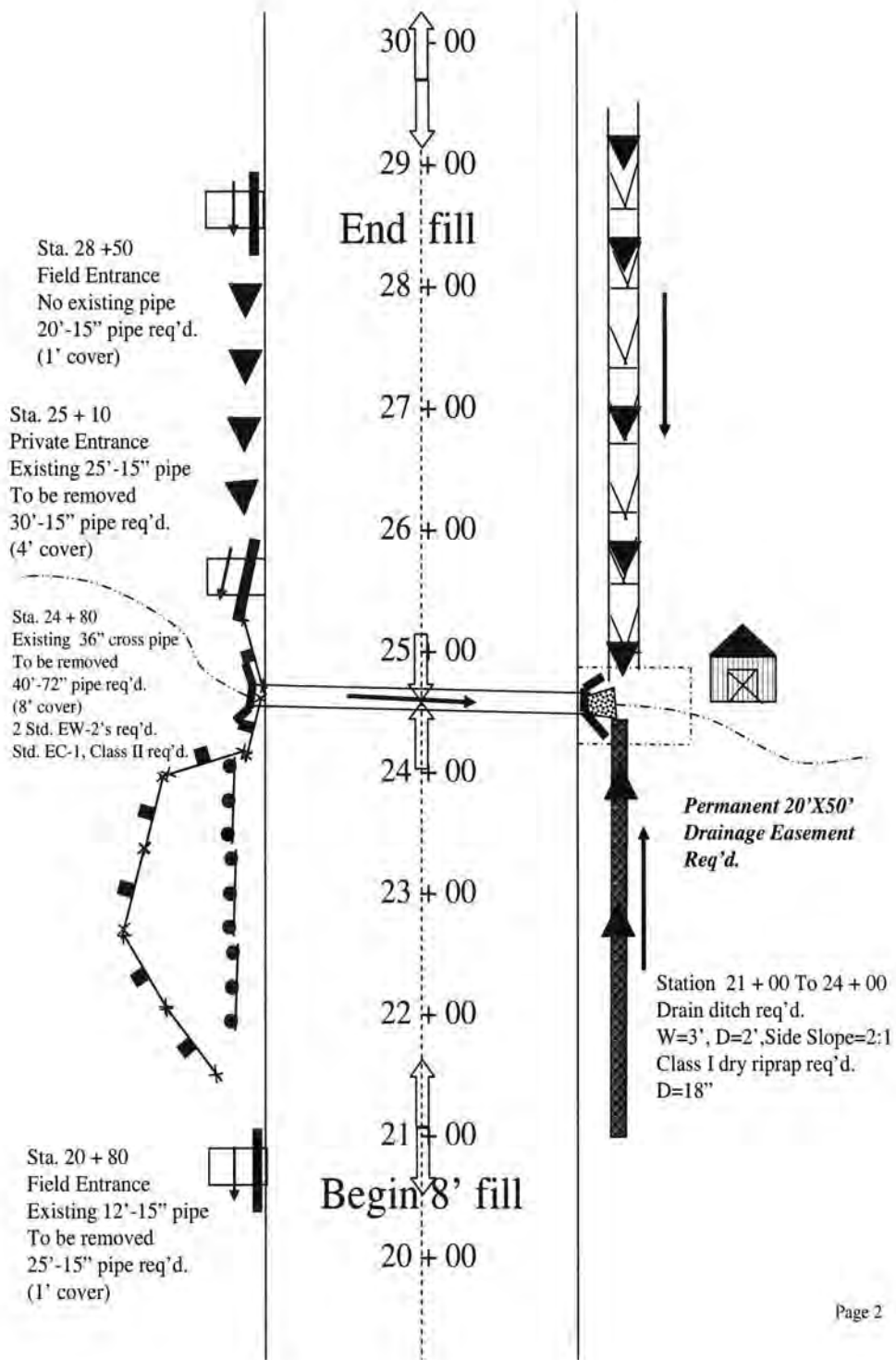
TABLE 1 - TEMPORARY DIVERSION CHANNELS (IMPERIAL)									
S.Y. LINING / C.Y. EXCAVATION (PER LIN. FT.)									
		3' WIDTH	4' WIDTH	5' WIDTH	6' WIDTH	7' WIDTH	8' WIDTH	9' WIDTH	10' WIDTH
1' DEPTH	S.Y.	0.83	0.94	1.10	1.20	1.30	1.40	1.50	1.60
1' DEPTH	C.Y.	0.19	0.22	0.26	0.30	0.33	0.37	0.41	0.44
2' DEPTH	S.Y.	1.32	1.44	1.54	1.66	1.77	1.88	1.98	2.10
2' DEPTH	C.Y.	0.52	0.59	0.67	0.74	0.81	0.89	0.96	1.04
3' DEPTH	S.Y.	1.82	1.94	2.05	2.16	2.27	2.38	2.49	2.60
3' DEPTH	C.Y.	1.00	1.11	1.22	1.33	1.44	1.56	1.67	1.78
4' DEPTH	S.Y.	2.32	2.43	2.54	2.66	2.77	2.88	2.99	3.10
4' DEPTH	C.Y.	1.63	1.78	1.93	2.07	2.22	2.37	2.52	2.67
5' DEPTH	S.Y.	2.82	2.93	3.04	3.16	3.27	3.38	3.48	3.60
5' DEPTH	C.Y.	2.41	2.59	2.78	2.96	3.15	3.33	3.52	3.70
6' DEPTH	S.Y.	3.31	3.43	3.53	3.64	3.76	3.87	3.98	4.09
6' DEPTH	C.Y.	3.33	3.56	3.78	4.00	4.22	4.44	4.67	4.89
7' DEPTH	S.Y.	3.81	3.92	4.03	4.14	4.26	4.39	4.48	4.59
7' DEPTH	C.Y.	4.41	4.67	4.93	5.19	5.44	5.70	5.96	6.22
8' DEPTH	S.Y.	4.31	4.42	4.53	4.64	4.76	4.87	4.98	5.09
8' DEPTH	C.Y.	5.63	5.93	6.22	6.52	6.81	7.11	7.41	7.70
9' DEPTH	S.Y.	4.81	4.92	5.03	5.14	5.25	5.36	5.47	5.58
9' DEPTH	C.Y.	7.00	7.33	7.67	8.00	8.33	8.67	9.00	9.33
10' DEPTH	S.Y.	5.30	5.41	5.52	5.64	5.75	5.86	5.97	6.08
10' DEPTH	C.Y.	8.52	8.89	9.26	9.63	10.00	10.37	10.74	11.11

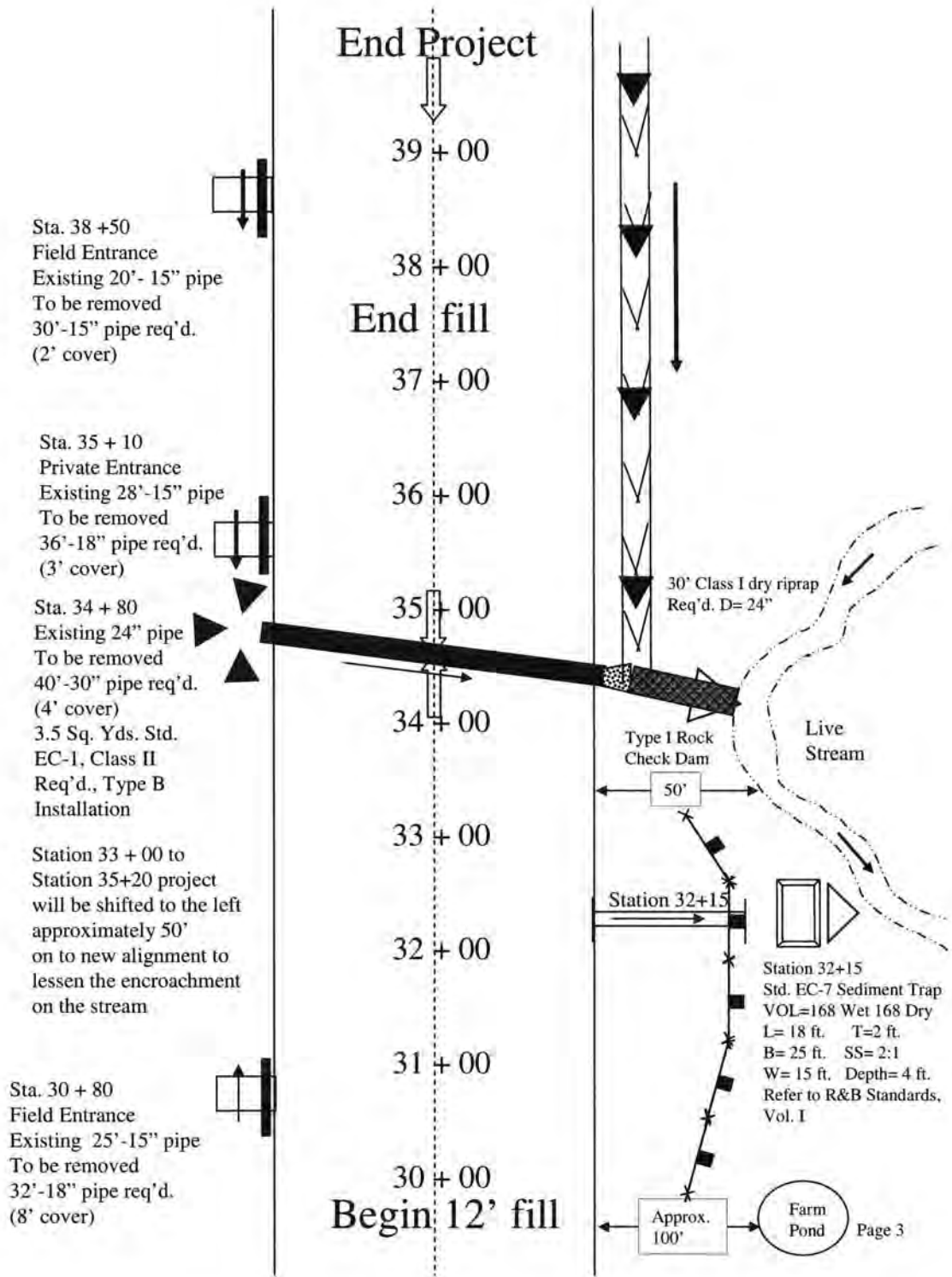
TABLE 1 - TEMPORARY DIVERSION CHANNELS (METRIC)						
M ² LINING / M ³ EXCAVATION (PER METER)						
		1.00 m WIDTH	1.50 m WIDTH	2.00 m WIDTH	2.50 m WIDTH	3.00 m WIDTH
0.30mDepth	m ²	2.34	2.84	3.34	3.84	4.34
0.30mDepth	m ³	0.48	0.63	0.78	0.93	1.08
0.60mDepth	m ²	3.68	4.18	4.68	5.18	5.68
0.60mDepth	m ³	1.32	1.62	1.92	2.22	2.52
0.90mDepth	m ²	5.02	5.52	6.02	6.52	7.02
0.90mDepth	m ³	2.52	2.97	3.42	3.87	4.32
1.20mDepth	m ²	6.37	6.87	7.37	7.87	8.37
1.20mDepth	m ³	4.08	4.68	5.28	5.88	6.48
1.50mDepth	m ²	7.71	8.21	8.71	9.21	9.71
1.50mDepth	m ³	6.00	6.75	7.50	8.25	9.00
1.80mDepth	m ²	9.05	9.55	10.05	10.55	11.05
1.80mDepth	m ³	8.28	9.18	10.08	10.98	11.88
2.10mDepth	m ²	10.39	10.89	11.39	11.89	12.39
2.10mDepth	m ³	10.92	11.97	13.02	14.07	15.12
2.40mDepth	m ²	11.73	12.23	12.73	13.23	13.73
2.40mDepth	m ³	13.92	15.12	16.32	17.52	18.72
2.70mDepth	m ²	13.07	13.57	14.07	14.57	15.07
2.70mDepth	m ³	17.28	18.63	19.98	21.33	22.68
3.00mDepth	m ²	14.42	14.92	15.42	15.92	16.42
3.00mDepth	m ³	21.00	22.50	24.00	25.50	27.00

EROSION AND SEDIMENT CONTROL PLAN







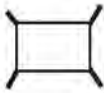










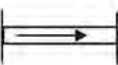

EXAMPLE NO PLAN PROJECT







KEY
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	Pipe – Existing		Type II rock check dam
	Pipe – 42" or smaller		Type I rock check dam
	Pipe – 48" or larger		Silt Fence
	Box Culvert		EC-2
	Stream or edge of water		EC-3, Type B
	Guardrail		EC-1 Outlet protection
	Pond		Dry riprap
	Potential wetland area		Sediment trap
	House/dwelling		Temporary slope drain
	Barn		

NOTE:

- A temporary diversion channel St'd EC-12 may be required for work in live streams. Must be reviewed and approved by Environmental. (R&B Standard)
- All E&S controls need to be removed within 30 days after project is stabilized. (MS 18)
- All referenced standards and E&S controls should conform to the latest edition of the VDOT Road & Bridge Standards.
- Refer to contract documents for all quantities. (e.g.: minor structure excavation, bedding, backfill, etc.)
- Dewatering devices may be required at live stream pipe installations.
- All disturbed areas will be stabilized with seed and mulch in accordance with the Roadside Development Sheet.