DESIGN CRITERIA

Guidelines for Preparing Erosion Control Drawings for Land Development.

for

the Unified Government of Wyandotte County/Kansas City, Kansas

Revised June 1, 2009

Adopted ______________________ 7-8-09
Director of Water Pollution Control Date

DESIGN CRITERIA

EROSION AND SEDIMENT CONTROL

SECTION 1 ADMINISTRATIVE

1.1 Scope: This chapter is directed toward the project designer to guide the preparation of construction phase erosion control drawings.

1.2 Relationship of Erosion and Sediment Control Plans to the SWPPP: A Storm Water Pollution Prevention Plan, or SWPPP, is required for State permits. The drawings and written sequences described in this guideline should be part of the SWPPP. The SWPPP includes additional documentation created before and during the execution of the project. Refer to the general permit for the State in which the project is located for additional requirements.

1.3 Reference Documents: This chapter provides mandatory requirements on the application of certain BMPs. Additional considerations on those and additional BMPs, as well as background information on erosion and sedimentation, are available in numerous other sources. The following references are recommended as sources of supplemental guidance and information.

A. Information on the regulatory background, scientific state of the art, and minimum control measures for erosion control may be found in the Environmental Protection Agency document <u>*National Management Measures to Control Nonpoint Source Pollution from Urban Areas. Management Measure 8: Construction Site Erosion, Sediment, and Chemical Control*</u>. (November 2005, EPA-841-B-05-004).

B. Information about SWPPP including site analysis, BMP selection, notification, placement, and maintenance, record keeping and permit termination may be found in the Environmental Protection Agency document <u>*Developing Your Stormwater Pollution Prevention Plan, A Guide for Construction Sites*</u>. (April 2007, EPA 833-R-060-04).

C. Fact sheets describing the applicability, limitations, maintenance, effectiveness and cost of individual BMPs may be found on the EPA website: *National Menu of Best Management Practices; Construction Site Stormwater Runoff Control*, <u>http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/</u> or current URL.

D. Information on the mechanics of erosion and sedimentation, fact sheets describing the applicability, limitations, maintenance and cost of individual BMPs, and information on water quality management, all within the particular context of Missouri and Kansas water quality concerns, may be found in <u>*Protecting Water Quality a Construction Site Water Quality Field Guide*</u>, a joint document issued by the St. Charles County Soil and Water Conservation District, Missouri Department of Natural Resources, Mid America Association of Conservation Districts, et al.

1.4 Designer Qualifications: The design and plan preparation for erosion control drawings and written sequence shall be completed by, or under the direct supervision of, a professional engineer who also meets one of the following the minimum continuing education requirements:

A. 7 hours within the last 24 months of classroom instruction in sediment and erosion control taught by a qualified instructor.

B. 21 hours lifetime of classroom instruction in sediment and erosion control taught by a qualified instructor.

C. 14 hours lifetime of web-based or classroom instruction, which includes specific instruction on the general permit requirements and SWPPP preparation, when retention of the material is measured by an exam.

1.5 Innovative Products and Methods: Erosion control is an evolving field and new products and methods are emerging. Obtain approval from the municipal authority prior to using a new product or method in the design. The protocol for proposing innovative products and methods includes:

A. Submit research based evaluation: A proposal for an innovative product or method shall include quantitative research of the performance of the product or method evaluated against a control. Research may be sponsored by the manufacturer. Submit the research paper.

B. Research paper shall include a summary indicating the value range under which the product or method was evaluated and found to be effective. Information shall contain sufficient detail to determine whether the proposed application is indicated.

C. Information shall include the removal efficiency of the product or method.

SECTION 2 EROSION CONTROL GENERALLY & DESIGN APPROACHES

2.1 Mechanics of Soil Loss: The first step in design of erosion control is a basic understanding of soil loss. There are three separate ways in which soil loss occurs.

A. Sheet and Rill Erosion. Sheet erosion is relatively uniform erosion of the soil surface. Rill erosion occurs when runoff concentrates in small channels (rills). The Revised Universal Soil Loss Equation (RUSLE) predicts loss from sheet and rill erosion. It lists a number of factors that influence soil loss. The factors that the designer and contractor have the most control over are the type of cover, the duration of exposure, and the steepness and length of slope.

B. Gulley and Channel Erosion: Erosion of a gully or channel occurs when the applied shear stress from flowing water exceeds the shear resistance of the channel bed. Once bed erosion is deep enough, slope instability may cause mass wasting of the bank into the flow path. Water readily washes out this loose material. In addition to shear resistance, the frequency, duration and volume of flow affect how much material is lost. The problem can be addressed directly by reducing applied shear or increasing shear resistance or indirectly by reducing the volume and frequency of flow by up-slope diversion.

C. Wind Erosion. In the Kansas City metro area, cohesive soils, moderate annual rainfall, and considerable tree cover all reduce potential wind erosion. Good erosion control for sheet and rill erosion will also control for wind erosion. Wind erosion is generally not a separate design concern.

2.2 The A.R.T. of Erosion Control: At the highest conceptual level there are three strategies for reducing erosion on a construction site. Kansas City area soils tend to be clay based and slow to settle out of suspension. As a result, common sediment recapture BMPs have low removal efficiencies and emphasis should be on avoidance and reinforcement techniques.

A. Avoid. Remove or reduce one of the factors that contribute to erosion. Techniques include avoiding silty soils, restricting access to undisturbed or restored areas, timing short term stream crossing to reduce the probability of rainfall impacting the construction, reducing the duration of exposure through management of the construction sequence, reducing flow velocities with check dams or flatter flowline slopes, diverting clean water, and reducing slope lengths with redistributive slope interrupts. Surface roughening can reduce the volume and velocity of sheet flow.

B. Reinforce. Increase the resistance of the soil surface or channel bed against erosion. Techniques include channel lining and ground covers such as temporary vegetation, mulches, erosion control blankets, or pavement.

C. Treat. Remove sediment from stormwater exiting the construction site by filtering or settling. Settling is often used in combination with a diversion system to collect and transport silt laden water to a central treatment pool. Common treatment techniques can recapture only the courser soil particles, so emphasis should be on avoidance and reinforcement.

2.3 Multiple Design Approaches Provided: There is no single optimal approach for design of erosion control plans. This guideline presents several different approaches. The approaches overlap. As a result there is a certain amount of repeated information among the different sections of the guideline.

2.4 Design by Performance Goals: This approach consists of a list of short statements of general principles to achieve in an erosion control plan. These are a more pragmatic restatement of the A.R.T. strategies; but they are still general in nature. They are educational and informative. They help illuminate the function each BMP might serve. Design principles can be used to evaluate the adequacy of a design; but they may lack the specificity necessary for regulatory purposes. Lists and exact statements of design principles vary. *Section 3 Performance Goals* provides one such list.

2.5 Sequence Based Drawings: Limiting duration of bare soil is one of the most powerful avoidance tools – and historically one of the least appreciated by the local construction industry. This design process produces a series of "snapshots" of site conditions to illustrate how BMPs change during the project. Each "snapshot" is tied to a construction milestone, reinforcing the requirement to manage the construction schedule. This approach tends to be rote and directive, it does not offer insight into why BMPs are selected. *Section 4 Plan Presentation* is an example of this design process.

2.6 Checklist: This method consists of an evaluation form for the quality assurance officer or municipal reviewer to determine that appropriate BMPs have been applied in sufficient measure to meet permit requirements. It is narrowly focused and very directive in nature. It offers no insight into why BMPs are selected and only limited criteria to select among BMPs with similar functions. *Section 5 Design Checklist* is a sample of this design method.

2.7 Sample Applications: This approach examines BMPs applied to a similar project in an attempt to stimulate ideas for the current project. It applies the A.R.T. strategies to the particular opportunities and constraints intrinsic in a specific type of construction. It is suggestive and informative rather than directive. *Section 6 Sample Applications by Project Type* provides discussions of typical construction projects.

2.8 BMP Fact Sheets: This approach lists all erosion control BMPs available along with a summary of their applicability, performance parameters and limitations. The designer selects those that are applicable to the project and the site. This addresses the sizing and spacing concerns but does not address the larger conceptual concerns. This method provides limited means to evaluate the adequacy of the overall plan. Sources for BMP information follow.

A. *Sections 7 through 11* identify the most common and effective BMPs. They include definitions and give abbreviated applicability and site placement information. They do not include installation information, removal efficiencies and cost data typical of other fact sheets.

B. The <u>*National Menu of Best Management Practices;*</u> <u>*Construction Site Stormwater Runoff Control*</u> and <u>*Protecting Water Quality a Construction Site Water Quality Field Guide*</u>, all cited in *Section 1 Administrative,* include detailed discussions of applicability and limitations, removal efficiencies, and cost data of common BMPs. These contain more complete information than do the BMP descriptions in *Sections 7* through *11*.

SECTION 3 PERFORMANCE GOALS

3.1 General: This section provides a high-level overview of basic sediment and erosion control principles. It also serves as an introduction to erosion control techniques.

3.2 Protect Undisturbed Areas: Areas planned to remain undisturbed throughout construction may include stream corridors, wetlands, and native areas to be used as amenities or post-construction BMPs. Other areas to avoid include zones where grading is complete and the ground has been reseeded. These areas should be fenced to avoid damage by construction traffic.

3.3 Divert Flow Away from Exposed Ground: There are two distinct applications of diversion. First, clean water from off-site or restored areas can be diverted away from disturbed areas. Second, steep slopes should have water diverted away from the top of slope until the vegetation is established.

3.4 Treat Runoff to Remove Sediment: There are two general locations for sediment treatment. First, flow should be treated at the down-slope limit of construction prior to release from the site. Some combination of linear sediment control or a settlement pool with an associated conveyance system should be used. Second, runoff from steep slopes should be treated at the toe of the slope; generally some linear sediment control device is used. Steep slopes that have more than 10 foot change in elevation from toe to top should have intermediate linear sediment control that will interrupt and redistribute the flow.

3.5 Provide Effective Cover: Timely placement of erosion resistant cover reduces erosion on areas where grading has ceased. Approved non-living cover is effective immediately. Seeded areas need protection during the establishment period. Mulches provide immediate erosion protection and a hospitable micro-environment for seed germination. If the slopes are long, then seeded areas need devices that will interrupt and redistribute the flow across the slope.

3.6 Limit Duration of Exposure: A low cost and effective way of reducing erosion is to control the sequence in which clearing, grading and restoration activities are scheduled. Examples:

A. If portions of the work can be completed before mass grading, delay clearing the rest of the site until grading is actually needed.

B. Progressive clearing – on sites over 10 acres clear only a portion of the site at a time. Grade and stabilize a portion of that before clearing more land. Maintain the active work area at less than 10 acres whenever possible. If progressive clearing is infeasible for the project, negotiate with the reviewing municipality for how to provide substantial limitation of duration, such as a defined maximum exposure time.

C. Whenever there is a pause or change in the location of grading or excavation, stabilize the parts of the site just vacated.

D. Some crossings of a stream or swale can be completed in a few days. Coordinate that work with the weather forecast so it can be finished before the next predicted rainfall.

E. Some post-construction BMPs are sensitive to sediment accumulation. Do not install these until the remainder of the site is stabilized.

3.7 Provide Erosion Resistant Conveyances: Bare earth should be protected from concentrated flows. Check dams can be used to reduce velocity and lower shear stress. Erosion resistant linings provide a high level of shear resistance. Use of pipes eliminates soil exposure to running water – either permanent storm sewer or temporary pipes may be used.

3.8 Protect Steep Slopes: Steep slopes are especially prone to erosion. Steep, seeded slopes benefit from the use of highly effective mulch, slope interrupts, diversion of water at the top of slope, and sediment treatment adjacent to the toe of the slope.

SECTION 4 PLAN PRESENTATION

4.1 General: This section describes the types of drawings that are generally necessary to convey the time sensitive nature of erosion control design.

4.2 Written Sequence Required: Management of the construction schedule is a separate, non-structural BMP recognized by the EPA. Erosion control plans must have a written sequence. See *Section 6 Sample Applications by Project Type* for typical sequences.

4.3 Drawing Conventions:

A. Provide only the background information necessary to orient the BMP installation on the site,

B. Identify each type of BMP on a graphic legend on each drawing,

C. All items should be shown to scale and in their proper location.

D. Controls that are linear should be show by a unique line type.

E. Cover type or status of an area (such as undisturbed or active work zone) should be shown as a unique pattern with or without a boundary line. Areas should not be shown with only a boundary line only.

F. Each erosion control device that is to be removed should be specifically designated.

4.4 Site Assessment: A site assessment is required for the SWPPP. A site analysis shall consist of both text and drawings.

A. Written information typically includes the location, nature and size of the development; the location and nature of the receiving waters; changes to the discharge from the site; the soil type and identification of highly-erodibility soil.

B. Drawings typically show the property limits; the proposed limits of the disturbed area; identification of concentrated flow paths; identification of where runoff enters and exits the site; and a slope analysis. The slope analysis should classify the slope uphill from the limit of disturbance as short or long. Short slopes have catchment lengths less than 75' for slopes flatter than 5%, or lengths less than 50' for slopes greater than 5%.

C. The reference document, *Developing Your Stormwater Pollution Prevention Plan, A Guide for Construction Sites*, as well as the Kansas and Missouri general permits provide additional guidance for the content of the site assessment.

4.5 Phased Erosion Control Drawings: Erosion control at significant construction milestones should be shown on separate drawings. Milestone is defined in *5 Design Checklist*. Erosion control milestones common to most construction projects are work to be done prior to general clearing of the site, BMPs applied to inactive areas once mass grading or some other project milestone is reached, and final restoration/end of construction sequence. Supplemental plans of sediment basins, early work areas, and post-construction water quality facilities may also be needed. See *Section 6 Sample Applications by Project Type* for phasing considerations.

4.6 Pre-clearing Drawing: This drawing shows the controls to be installed prior to general clearing of the site. The background drawing should show the existing contours, adjacent streets, right of way, easements and property lines. Do not show final contours on this drawing. Commercial developments may also show the footprint of the primary building for reference. Show the BMPs selected for the following:

A. Access barriers for areas to remain undisturbed.

B. Down-slope perimeter sediment control.

C. Runoff controls.

D. Cover to be placed on contractor areas.

E. Limits of work for each early work opportunity. Include a separate pre-clearing plan for each early work opportunity.

4.7 Sediment Basin Embankment and Spillway Detail: Whenever a sediment basin is used the erosion control drawings should include a detail for each basin showing:

A. Existing contours at the site of the basin.

B. Proposed contours for the embankment, basin excavation if any, and emergency spillway.

C. The cover to be placed on the embankment, both interior and exterior side slopes.

D. Pond limits and the actual pond volume calculated to the elevation of the top of riser; drainage area and required pond volume.

E. Maximum pond limits at 4% design storm are shown at their approach to roads, structures and utilities.

F. Spot elevations on top of riser, flowline of control section of overflow spillway, water elevation in pond at 50% and 4% design storm release rates, and top of embankment "as constructed" and "as settled". Location and spot elevation of sediment removal marker.

G. The size and number of dewatering holes per row on the riser, the row spacing and the elevation of the lowest row of dewatering holes.

H. Cross sections of open channel overflow conveyance control section and exit channel. Lining requirements of exit channel.

4.8 Sediment Trap Detail: Whenever a sediment trap is used the erosion control drawings should include a detail for each trap showing:

A. Existing contours at the site of the trap.

B. Proposed contours for the embankment and trap excavation if any, and overflow route.

C. The as constructed and as settled elevation of the embankment. The volume of the trap, measured to the lowest overflow elevation on the as settled crest. The extend of ponding at the overflow elevation.

D. The cover to be placed on the embankment, both interior and exterior side slopes.

E. Location of rock section of the embankment to serve as an outlet.

F. Location and spot elevation of sediment removal marker.

4.9 Inactive Area Stabilization Drawings: These drawings identify the inactive areas and show the site condition at significant milestones in the excavation and grading work. The background drawing should show property lines and easements, storm sewer system and contours as they will exist at the construction milestone portrayed. Commercial lot development may also show the footprint of the primary building for reference. Do not show other improvements to be constructed subsequent to stabilization of inactive areas. Other content:

A. Disposition of the contractor areas, perimeter controls and construction phase runoff conveyance systems shown on the pre-clearing drawing or previous inactive area stabilization drawing.

B. Show steep slope protection. Show the separate elements of steep slope protection including extent and type of mulch, top of slope diversion, sediment control near toe of slope, slope interrupts, and slope drains if included.

C. Show stabilization for stormwater channels that could not be built prior to general grading.

D. Show type and extent of stabilization of areas that will be inactive during subsequent construction. An effective design will have each location on the site identified as one of the following:

1. An active work zone,
2. A non-disturbed area,
3. Identified mud free surface in contractor areas,
4. Identified cover on a restored inactive area, or
5. Sediment trap, sediment basin, or stable open channel conveyance.

E. Show barriers separating active work zone and inactive areas stabilized by planting, blankets or mulch.

F. Show slope interrupts and inlet protection.

4.10 Final restoration Drawing: This drawing shows the site condition immediately after placement of final stabilization but before seeded cover is established. The background drawing should show final contours, property lines and easements, permanent storm sewer system and outlet protection, and permanent at grade and above ground construction. Do not show underground utilities other than storm sewer. Other content:

A. Retain BMPs for down-slope perimeter sediment control of seeded areas,

B. Show removal of contractor areas and construction access. Show removal of all temporary access barriers,

C. Show extent of topsoil placement if any. This may require a separate view,

D. Show type and extent of cover in all areas,

E. Show limits of post construction BMP installation. Include a requirement in the written sequence that installation shall only occur after all vegetative cover is established. Note – only infiltration and retention type BMPs require delayed installation

F. Provide text that requires removal of sediment trap or basin and perimeter diversion ditch and also requires stabilization of those areas once vegetative cover is established. Identify the cover to be applied to stabilize area disturbed by removal of temporary BMPs.

SECTION 5 DESIGN CHECKLIST

5.1 General: This section provides checklists and tables that may be used for quality assurance reviews. Although generally redundant with the rest of the design guidelines some requirements are contained only in this section.

A. Interpretation: This checklist is intended to be a tool to evaluate whether the erosion and sediment control plans meet these design guidelines. To that end a literal interpretation is encouraged. However, complete compliance may not be possible to achieve on all sites. In such a case the rule of evaluation should be that the maximum practicable compliance has been achieved for the performance goals in *Section 3 Performance Goals.*

B. Definitions: Where found in the checklist the following terms have specific meanings indicated:

1. Catchment length: The distance that a drop of water travels between the uphill ridgeline and a linear control.

2. Contractor area: defined in *Section 3 Access Limits and Contractor Areas*

3. Early work opportunity: Work that may be conducted prior to mass grading without affecting the overall duration of the project.

4. Inactive area: Any part of the project site that may be reasonably managed by the contractor to not require further construction for a 14 days or longer. The need for subsequent construction at a location does not affect the inactive status so long as the delay is reasonably expected to be 14 days. Inactive areas usually occur whenever there is a change in the contractor's use of the site.

5. Milestone: An identifiable point in the project schedule when the contractor's use of any portion of the site pauses, changes or may pause or change. Typical milestones that may affect erosion control needs are the beginning or completion of mass grading, building "top out" on small or medium site construction, or traffic routing phases on roadway projects. (Linear pipeline projects have nearly daily changes of the work zone; for linear projects a single drawing with a specialized construction sequence will convey multiple milestones.)

Table 1
Erosion and Sediment Control Checklist

General	
1	A series of erosion control drawings is provided. Each drawing is related to a milestone in the contractor's use of the site. Exceptions include linear projects, such as a utility extension, or sites under one acre; these may have a single drawing. Single family home site may use a standard template rather than a custom drawing.
2	Designer is a P.E. with relevant continuing education in erosion and sediment control.
3	A written construction sequence is included on the erosion control plans.

Table 1 Erosion and Sediment Control Checklist	
Specifications	
4	The project specification addresses the inspection and maintenance of the BMPs used. Use of APWA 2150 satisfies this requirement.
5	The project specification addresses pollution prevention through good housekeeping, including spill response. Use of APWA 2150 satisfies this requirement.
Site analysis	
6	A separate site analysis is provided. The site analysis includes both a written project description and a drawing analyzing flow patterns and slope lengths based on existing contours.
7	The written description identifies the location, nature and size of the project and the size of the area to be disturbed.
8	The written description identifies sensitive or impaired downstream waters, as defined by a government entity.
9	The written description identifies the soil type on the project site and highlights highly erodible soil types.
10	The drawings indicate the limit of the proposed disturbance. The entire length of the downslope limit of disturbance is identified.
11	The drawings identify catchment lengths at the down-slope perimeter of disturbance as either long or short slope lengths. Short slopes have catchment lengths less than 75' for slope less than 5%, or lengths less than 50' for slope greater than 5%.
12	The drawings locate all concentrated flow paths entering, crossing or exiting the site. A concentrated flow path is any flowline, swale, or line marked by a reversal of side slopes that has a drainage area greater than 0.5 acres.
13	The drawings show drainage area for upstream sheet flow entering the site.
Form of drawings	
14	Background drawing shows contours in place at the milestone depicted. In general, no other contours are shown.
15	Background drawing shows only the permanent construction that is in place at the milestone depicted. Background drawing shows sufficient property line, R.O.W., baseline, building footprint or other alignment information to establish locations of BMPs.
16	Lines and patterns used to indicate BMPs are identified in a graphic legend.
17	Erosion controls to be removed at the depicted milestone are identified individually by leader note.
18	All items are shown to scale and in their scale accurate position.
19	All BMPs are located within the property limits or construction easements of the project.
Protection of undisturbed areas	
20	Pre-clearing plans and subsequent plans show access barrier between active work areas and areas to remain undisturbed.
21	Inactive area stabilization plans show access barrier between work zones and seeded areas stabilized by blankets, mulch, or spray applied mulch.

Table 1
Erosion and Sediment Control Checklist

22	Construction fence is used for the access barrier where the undisturbed area is in response to regulation, i.e. stream buffer or native area used as post construction water quality BMP. Otherwise rope line or permanent curb may be used.
Perimeter sediment control	
23	Perimeter sediment control devices are shown on pre-clearing plan and inactive area stabilization plans.
24	The entire down-slope perimeter has a sediment control BMP identified; and the BMPs selected meet the loading limits of *Table 4, Load Rates for Sediment Control.*
25	There is a detail plan for each sediment basin or sediment trap, and the plan passes the appropriate checklist.
26	There is a grading detail for the pit accompanying each inlet used as perimeter sediment control. The cut slopes do not exceed 2:1; and storage volume of pit is not less than 950 cf/acre.
27	The elevation of the silt fence does not vary by more than 1.0 feet throughout its treatment length, and the ends are returned uphill a minimum of 1.5 feet higher than the treatment length.
28	Other linear sediment control devices are located generally along a contour and the ends are returned uphill.
29	Vegetative buffers have a minimum width of 10 feet. Vegetative buffers may be located in any orientation to the contour. Vegetative buffers are protected by an access barrier – except for linear projects where the width of vegetative buffer is at least as wide as the work zone the access barrier is optional.
Runoff control	
30	To the extent practicable, flows from undisturbed upstream areas are collected and transported around or through the site unmingled with silt laden water. Diverted flow is transported in a continuous erosion resistant conveyance system.
31	To the extent practicable, runoff control devices are shown on pre-clearing plan. Pre-clearing installation may not be practicable in the following conditions: 1. Top slope diversion on embankment fill slopes, 2. Where deep fills will significantly alter the drainage pattern.
32	Where runoff control could not be placed prior to clearing, the first applicable inactive area stabilization plan shows said runoff control devices.
33	To the extent practicable, concentrated flows within the limits of disturbance with drainage area greater than 0.5 acre are collected and transported in a continuous conveyance system.
34	Conveyances for the continuous conveyance system are approved in *Table 5, Stable Conveyance Types*, and any limiting requirement is met.
35	Outlet protection at the discharge point for the conveyance system is approved in *Table 5, Stable Conveyance Types*, and any limiting requirement is met.
36	Where check dams are used they are spaced so the elevation of the bottom of the upper check dam is at the same elevation as or lower than the top of the lower check dam. In lieu of requiring profiles for evaluation of spacing, the alternate review standard is that the plan view shall show the change in the channel flowline between adjacent check dams to be 2 feet or less.

Table 1 Erosion and Sediment Control Checklist	
37	Water bars are used on linear projects wherever the fall line of the ground is within 45° of the centerline of the trench. Water bar is constructed from earth, compost berm, gravel berm, compost sock or silt fence. Water bars terminate in vegetative buffer and runoff does not re-enter trench zone. Water bars are spaced less than 50 feet apart.
Stabilization of steep slopes. A steep slope is any slope that is both steeper than 15% and has a difference in elevation between toe and top greater than 3 feet.	
38	Steep slope protection is shown on the inactive area stabilization plan.
39	Water is diverted from the top of slope by a diversion dike or by use of adverse grade at the top of slope. Diverted water is transported in a continuous conveyance system and discharged onto a stable area.
40	Cover type is approved for "all slopes" in *Table 6, Approved Cover Types*.
41	Where the difference in elevation between the toe and top is greater than 10 feet, a slope interrupt is used at intervals not to exceed 10 feet vertical. The slope interrupt for steep slopes may be compost berm, compost sock, or gradient terrace. Silt fence is not used for steep slope interrupt.
42	Sediment control is located near the toe of the slope. Sediment control meets the loading limits of *Table 4, Load Rates For Sediment Controls*. Where the toe of the slope is not level and linear sediment control devices are used frequent breaks are shown with the downhill end returned up-slope.
Inactive area stabilization	
43	A separate inactive area stabilization drawing is provided for each milestone in the land disturbance activities and for each change in the contractor areas.
44	Each inactive area stabilization drawing shows the sediment control and runoff control from previous phases to either continue in place, or be relocated, or be removed.
45	Each area to receive topsoil is indicated.
46	Each subarea within the project site is shown as having one of the following cover types: an active work area, an undisturbed area, an identified cover on a restored inactive area, an identified mud free surface in contractor areas, or an erosion control device such as a sediment trap, sediment basin or stable open channel conveyance. Each cover type is shown graphically as a unique pattern and not as outline only.
47	The cover identified for a restored inactive area is approved in *Table 6, Approved Cover Types*, for the ground slope in that area. If a bonded fiber matrix is used as a cover either the reviewing municipality has adopted a BFM specification or an adequate project specification is provided.
48	Long, mild and moderate slopes (longer than 75 feet and flatter than 15%) are interrupted at intervals not to exceed 75 feet. Slope interrupts for long, mild and moderate slopes are compost berm, gravel berm, compost sock, or silt fence. Slope interrupts shall approximately follow a contour
49	Silt fence or other linear sediment control is shown within the interior of the construction area where the downslope perimeter of seeded areas is adjacent to pavement or open channels.
50	Inlet protection is used within the interior of the construction area where it will not cause hazard to traffic or cause erosion along the downstream bypass route.

Table 1 Erosion and Sediment Control Checklist	
51	Inactive area stabilization drawings show access barrier between active work areas and inactive areas restored by seeding. Paving, sod and similar immediately effective covers do not need an access barrier.
Written Construction Sequence	
52	The written construction sequence requires perimeter controls and access controls shown on the pre-clearing plan to be installed prior to other construction activity.
53	Where early work opportunities are identified, the written construction sequence requires they be persecuted in advance of general clearing to the maximum extent allowed by critical path analysis and the special conditions of the project.
54	The written construction sequence requires runoff control devices to be, to the maximum extent practicable, installed prior to general clearing. Pre-clearing installation may not be practicable in the following conditions: 1. top slope diversion on steep embankment slopes created during the grading phase, 2. Where deep fills will alter the drainage pattern.
55	Where early installation of runoff control devices is not practicable, the written construction sequence requires check dams to be constructed across the drainageway at the end of any shift when the local weather forecast predicts greater than 10% chance of rain prior to the completion of the next planned shift.
56	The written construction sequence requires all diversion channels, grass lined channels, sediment traps and sediment basins to be stabilized within 5 days of installation.
57	The written construction sequence requires steep slope protection to be placed as soon as practicable during the grading operation.
58	Where water bars are used, the written construction sequence requires water bars to be installed concurrent with the trench backfill operation.
59	The written construction sequence identifies the construction milestone applicable to each inactive area stabilization drawing that triggers the placement or adjustment of the ground cover, access barriers, and other erosion and sediment controls shown on the drawing.
60	The written construction sequence requires that infiltration and retention based post construction water quality BMPs will not be installed until the drainage area is stabilized with an allowable cover and all vegetative cover in the catchment area are established.
61	The written sequence requires that all downslope sediment control stay in place until after the drainage area is stabilized and all vegetative cover in the drainage area are established. Or in the case of sediment basins and traps that are converted to permanent stormwater management facilities that the conversion take place after the drainage area is stabilized and all vegetative cover in the drainage area is established. The written sequence requires stabilization of the areas disturbed by the removal or conversion of the downslope sediment controls.
62	The written sequence requires a plan modification if the plan fails to substantially control erosion and offsite sedimentation.
63	Sites over 10 acres shall have limits in the area of ground to be exposed at any one time or shall have a defined maximum time of exposure for each subarea of the site. Maximum exposure limits have been negotiated with the municipality issuing the permit. Maximum exposure limits are included in the written construction sequence.

Table 1 Erosion and Sediment Control Checklist	
Final restoration	
64	Topsoil and planting soil placement is shown on the final restoration plan.
65	Limits of disturbance for installation of post construction water quality BMPs are shown on the final restoration plan.
66	Final restoration plans show the removal of contractor areas and temporary access controls and sediment controls to areas where seed has established or that are protected by immediately effective cover such as pavement or landscape beds. Construction sequence for the final restoration plan calls for the retention of access controls and sediment controls for areas where seed has not established 70% cover.
67	Cover for area affected by the end of construction removal of temporary BMPs is shown on the final restoration drawing.
Good housekeeping and other measures	
68	A rock construction access is shown on all phases prior to placement of base pavement on all paved surfaces on the site.
69	A concrete washout facility is shown on all phases with concrete deliveries to site.
70	Soil stockpiles are located within 50' of a hillcrest or has an up-slope diversion dike. Stockpiles are located at least 50' away from a drainage way. Stockpiles have sediment control located within 25' of their down-slope toe. Cover for stockpile is approved for steep slopes, and notes require cover to be installed within 14 days of completion of stockpile.
71	A topsoil stockpile is located on the pre-clearing plan, or final restoration plan calls for adequate depths of imported planting soil in all planting areas.

Table 2 Checklist for Sediment Basin Detail	
1	A separate custom detail is provided for each sediment basin.
2	The sediment basin is not located in a stream buffer.
3	Existing and construction phase contours are shown. Total volume to the top of riser is not less than 3600 cf/acre of drainage area. Total volume includes sediment storage and transient storage.
4	The extent of ponding at the elevation of the top of riser is shown. The minimum surface area, with water surface at the top of the riser, is 1000 sf/acre, or the flow length is twice the average width.
5	The embankment height does not exceed 15.0 feet, unless designed by a qualified geotechnical professional. The embankment slopes do not exceed 2.5:1. Top width is at least 8 feet. The cover on the embankment is approved for steep slopes. See *Table 5, Approved Cover Types.*
6	Riser information includes the riser and drain pipe location and diameters, elevation of lowest row of holes, number and size of holes per row, row spacing and top of riser elevation.
7	Dewatering provisions meet one of the following: A. With a permanent pool of 30 to 50% of the design volume, the area of dewatering holes is 0.15 to 0.20 sq-in/row/acre of drainage area. Rows of dewatering holes are separated by 6 inches, vertical. B. With a permanent pool less than 30% of the deign volume, the area of dewatering holes is 0.10 to 0.15 sq-in/row/acre of drainage area. Rows of dewatering holes are separated by 6 inch, vertical. (because the smaller permanent pool will have more dewatering rows the area per row will be smaller) A manufactured skimmer is used and a dewatering rate is identified that will drain the basin in 24 to 48 hours.
8	The extent of ponding at the elevation of 4% design storm routed through the overflow spillway is shown at roads, structures and utilities. Ponding does not encroach upon any roadway, structure or utility.
9	The route of the overflow channel and the dimensions of the control section of the overflow channel are shown. Control section and exit channel are located outside of the embankment, and are shown to be seeded and mulched or lined.
10	The overflow channel has a control section that is level in the direction of flow for a distance of 20 feet. The control section width meets the requirements of *Section 9 Sediment Basin.*
10	Spot elevations shown include: the flowline of the control section, the water surface elevations of the 50% and 4% design storms, the minimum embankment crest elevation "as constructed" and after settlement, and the elevation of the downstream toe of embankment. The settlement allowance for the "as constructed" elevation is 5% of the fill depth.
11	Water surface elevations comply with the limits of *Section 9, Figure 1: Relationships between sediment basin design elevations.*
12	Outlet protection is provided where the drain pipe and the overflow channel rejoin the watercourse.
13	Location and elevation of the sediment cleanout marker is shown. In Kansas the cleanout level can be no more than 20% of the total storage volume. In Missouri the cleanout level can be no more than 50% of the total storage volume. The permanent pool, if used, does not exceed the cleanout level.

Table 3 Checklist for Sediment Trap Detail	
1	A separate, custom detail is provided for each sediment trap.
2	Existing and proposed contours are shown. The storage volume and extent of ponding at overflow elevation are shown. Ponding depth is less than 7 feet, and the storage volume is greater than 1800 cf/acre of drainage area.
3	The embankment slopes do not exceed 2.5:1, and the embankment height is less than 15 feet. Stabilization of embankment is appropriate for steep slopes.
4	The minimum embankment crest elevations "as constructed" and after settlement are shown. The settlement allowance for the "as constructed" elevation is 5% of the fill depth.
5	Cover for the downstream face of the embankment approved for steep slopes, see *Table 6, Approved Cover Types*.
6	The location of the rock outlet section of the embankment is shown. An overflow channel is not required for sediment traps with drainage area less than 5 acres.
7	Location and elevation of the sediment cleanout marker is shown. In Kansas the cleanout level can be no more than 20% of the total storage volume. In Missouri the cleanout level can be no more than 50% of the total storage volume.

Table 4
Load Rates for Sediment Controls

BMP	**Load limits for perimeter sediment control**	**Interior placement for inactive area stabilization**
Sediment Basin*	5 to 50 acre drainage area	N.A.
Sediment Trap*	0 to 5 acre drainage area	N.A.
Silt Fence	<0.25 acre drainage area/100' of treatment length.	At the down-slope edge of seeded inactive areas, and slope interrupt at 75 foot spacing on mild and moderate slopes.
Compost Sock, Compost Berm, Vegetative Buffer and other Linear sediment control devices	Sheet flow only: < 75' catchment length for slopes < 5% < 50' catchment length for slopes > 5%	At the down-slope edge of seeded inactive areas, and slope interrupt at 75 foot spacing on mild and moderate slopes, and slope interrupt at 10-foot vertical spacing on steep slopes.
Inlet Protection, Sump Type with Excavated Pit*	0 to 3 acres drainage area, only where Sediment Trap is infeasible	N.A.
Inlet Protection, Sump Type without Pit	N.A.	Only where ponding will not create traffic hazard
On-Grade Type	N.A.	Only when both continuous stable conveyance and additional treatment are provided downstream.

* A stabilized diversion dike or other runoff conveyance is usually necessary to complete the treatment system.

Table 5 Stable Conveyance Types	
Conveyance	**Limit**
Undisturbed stream corridor, with access control	None
Diversion dike, bare ground	Drainage area < 5 Acres, Exposure < 21 Days, Slope < 5%
Diversion dike, seeded & erosion control blanket	Drainage area < 5 Acres
Open channel with check dams	Drainage area < 10 Acres
Open channel with sod lining	Slope less than 5% or the velocity less than 5 fps for the 50% design storm
Open channel with rock or TRM lining	None
Temporary and permanent piped system	None
Water bars	Limited to linear work sites with stable vegetation adjacent to down-slope edge. Spacing less than 50 feet
Slope drain	Drainage area < 2 acres
Outlet protection	
Riprap pad	None
Rock rimmed plunge pool	None
Permanent energy dissipating structure	None
Lateral discharge to a stream	Discharge elevation is at the base flow elevation
Discharge to a sediment basin or sediment trap	Discharge elevation 0 - 1' above maximum sediment accumulation elevation
Discharge point	
Natural stream, vegetated swale or public storm sewer.	Clean water bypass only, outlet protection provided
Sediment basin or sediment trap	Bypass offsite clean water to the extent practicable.

Table 6 Approved Cover Types		
Cover	**Mud Free Surface**	**Allowed for**
Seed with erosion control blanket		All slopes
Erosion control blanket without seed		All slopes, winter only
Seed with compost mulch		All slopes
Compost mulch without seed		All slopes, winter only
Sod		All slopes
Final landscape planting and mulch		All slopes
Temporary shoring or permanent retaining wall		All slopes
Seed with bonded fiber matrix		All slopes, with municipal approval
Seed with straw mulch		Mild or moderate slope only
Seed with spray applied mulch		Mild or moderate slope only
Compost mulch without seed		Mild or moderate slope only
Erosion control blanket without seed		Mild or moderate slope only
Crushed stone, gravel or millings	√	Mild slope only
Pavement or pavement base course	√	Mild slope only
Building floor slab	√	Mild slope only
Steep slopes are steeper than 15% and have a change in elevation between top and toe of more than 3 feet. Moderate slopes are flatter than 15% or with less than 3 feet elevation change between toe and top. Mild slopes are flatter than 5%		

SECTION 6 SAMPLE APPLICATIONS BY PROJECT TYPE

6.1 General: This section explores opportunities to apply erosion control principles in ways that are specific to the type of construction. These are typical starting points; however, site conditions may override any of these recommendations.

6.2 Large Land Development: These are projects that disturb a large area. Typical projects are: infrastructure for single family subdivisions, regional commercial center, or large "garden level" apartment complexes. Characteristics include: large land areas, significant new drainage improvements, considerable latitude in drainage system design, significant land area devoted to detention or post-construction BMPs, grading operations of several weeks duration, and a considerable inactive area once grading is complete. These projects often include on site detention, stream crossings or other stream interventions.

A. Opportunities:

1. The standard pre-clearing, <u>inactive area</u> stabilization, and final stabilization plan presentation is well suited for this type of construction.

2. Storm sewer, permanent erosion control, and detention may be used for construction phase runoff control and sediment treatment with minor adjustments.

3. Construction items that may precede general clearing are sanitary and storm sewer, demolition if any, and stream interventions such as crossings, stabilization or relocation.

4. Very large sites should have some sort of phased or sequential grading plan.

5. Steep slopes can be protected while mass grading is ongoing. Individual elements of steep slope protection, such as sediment control at toe or diversion at top, may often be placed prior to any grading occurring.

6. Once mass grading is complete the inactive area of a subdivision will include all lot area except the front utility easement. This represents the majority of a single family residential subdivision and all of the steep slopes. Tie inactive area stabilization to initiation of pavement preparation or installation of shallow utilities.

7. For a commercial complex, consider a separate grading limits and a separate erosion control plan for outlying parking (any area not needed as contractor areas). This can fit into the construction schedule in a number of places.

8. Consider topsoiling. For commercial or multifamily sites where building construction runs concurrent with site development topsoil may be placed during the construction period. For residential subdivisions a common stockpile may be placed for re-use by individual builders.

B. Typical Written Sequence: This is written for a typical single family subdivision; edit as necessary.

1. Implement Pre-Clearing Plan: All structural BMPs‡ shown on the pre-clearing plan must be in place before general clearing operations. Clearing necessary to place structural BMPs shall be the minimum required for installation. Coordinate clearing necessary to place structural BMPs with local weather forecast so that clearing and placement may be completed within a forecast dry period. Stabilize all diversions dikes, sediment basins, and sediment traps within 5 days after installation.

2. Early Work: Clear minimum work zone and construct any early work items of permanent construction that are shown on the pre-clearing plan.

3. Grading: Clear site and complete mass grading.

4. Implement Steep Slope Protection. During grading operations, place steep slope protection shown on the inactive area stabilization drawing as soon as practicable.

5. Stabilize Inactive Areas: The ground cover and other structural BMPs shown on the inactive area stabilization drawing must be placed within 14 days of cessation of mass grading at each location. In determining the inactive status of the ground, evaluate each portion of the site separately. The need for subsequent placement of trenched utilities, future building or other construction in an otherwise inactive area is not justification for delay of stabilization.

6. Install Site Improvements: Construct the remainder of the utilities, roads, buildings and other site improvements depicted on the construction plans.

7. Implement Final Stabilization: Coordinate removal of construction phase BMPs necessary to place final stabilization with local weather forecast so that removal and placement may be completed within a forecast dry period. Down-slope perimeter controls shall not be removed until final stabilization is placed and vegetative cover is established over the remainder of the site.

8. Establishment and Final Construction: Once the remainder of the site is stabilized including establishment of seeded cover types, construct permanent water quality BMPs and remove the sediment controls and the remaining access controls. Restore area disturbed by removal of sediment controls.

9. Plan Modification: The contractor must modify the plan if the plan fails to substantially control erosion and offsite sedimentation. Plan modifications due to ineffectiveness may be taken without prior approval of the review agency, but must be fully documented and approval secured from the permitting authority as soon as practicable. The contractor may modify the plan or construction sequence if implementation is infeasible for site conditions or contractor methods. Any such modification shall control erosion and offsite sedimentation to the maximum extent practicable. Any such modification shall require the prior approval of the permitting authority.

‡ Structural BMP refers to any BMP that requires installation of physical placement on the site as opposed to management BMPs such as management of the construction sequence, inspection, maintenance and good housekeeping activities.

6.3 Small and Medium Site Construction: These are construction of building, parking and landscape on a single lot where utilities and street access are already in place to the lot edge. Typical work includes single family house and infill commercial lots up to a few acres. Characteristics include: small overall size, demolition and grading phase of very short duration, a high potential for mud tracking, few if any new drainage improvements, little latitude in drainage design, and detention when required is likely to be underground. These projects have extensive contractor areas relative to their size, particularly during framing, roofing, and siding of the primary structure.

A. Opportunities:

1. There is seldom opportunity for early construction that would significantly delay general clearing.

2. Where the work includes an on-site storm inlet, consider incorporating inlet protection with excavated pit.

3. Diversion of upstream water is often the only practical runoff control.

4. Consider enhanced construction entrance with grating and wheel wash facilities.

5. Inactive area: Small sites are intensively used for storage, assembly and erection of the building structural elements. Typically there are few inactive areas until the framing, siding and roofing are done. This should be the milestone for inactive area restoration.

6. On commercial sites the proposed paving represents nearly all of contractor areas as well as a large portion inactive area. Consider modifying the permanent pavement section to include a soil separator fabric and aggregate base that may be used for construction phase erosion control and mud control.

7. Consider early placement of landscape or other permanent cover for protection of inactive areas during the interior finish stage.

8. Topsoiling: Consider topsoiling for single family residential. The intense use of a small commercial site for building, parking, and landscaped areas with amended soil may leave little opportunity for topsoiling.

B. Typical Written Sequence: edit as necessary for specific site conditions:

1. Implement Pre-Clearing Plan: All structural BMPs‡ shown on the pre-clearing plan must be in place before general clearing operations. Clearing necessary to place structural BMPs is the minimum required for the installation. Coordinate clearing necessary to place structural BMPs with local weather forecast so that clearing and placement may be

completed within a forecast dry period. Stabilize all diversions dikes, sediment basins, and sediment traps within 5 days after installation.

2. Clear and Stabilize Work Areas: Grade building pad and contractor areas and place all-weather surface on contractor areas.

3. Implement Steep Slope Protection. During grading operations, place steep slope protection shown on the inactive area stabilization drawing as soon as practicable.

4. Building Top-out: Complete building foundation, framing, siding and roof installation including utility services.

5. Stabilize Inactive Areas: The ground cover and other structural BMPs shown on the inactive area stabilization must be placed within 14 days of cessation of ground disturbing activity at the location of the BMP, but in no case later than 14 days from building top out. In determining the inactive status of the ground, evaluate each portion of the site separately. The need for subsequent placement of trenched utilities, pavement or other construction in an otherwise inactive area is not justification for delay of stabilization.

6. Finish Interior: Construct the interior of the structure and minor structures depicted on the construction plans.

7. Implement Final Stabilization: Place permanent site cover. Coordinate removal of construction phase BMPs necessary to place final stabilization with local weather forecast so that removal and placement may be completed within a forecast dry period. Down-slope perimeter controls shall not be removed until final stabilization is placed and vegetative cover is established over the remainder of the site.

8. Establishment and Final Construction: Once the remainder of the site is stabilized including establishment of seeded cover types, construct permanent water quality BMPs and remove the sediment controls and the remaining access controls. Restore area disturbed by removal of sediment controls.

9. Plan Modification: The contractor must modify the plan if the plan fails to substantially control erosion and offsite sedimentation. Plan modifications due to ineffectiveness may be taken without prior approval of the review agency, but must be fully documented and approval secured from the permitting authority as soon as practicable. The contractor may modify the plan or construction sequence if implementation is infeasible for site conditions or contractor methods. Any such modification shall control erosion and offsite sedimentation to the maximum extent practicable. Any such modification shall require the prior approval of the permitting authority.

‡ Structural BMP refers to any BMP that requires installation of physical placement on the site as opposed to management BMPs such as management of the construction sequence, inspection, maintenance and good housekeeping activities.

6.4 Roadway: These are public capital works projects for arterial and collector roadway construction and reconstruction with vertical grade changes. Road projects are characterized by long narrow work zones typically crossing several drainageways. They have relatively large land areas and significant off-site flow contribution. Project requirements usually include land acquisition needs, complex phasing driven by maintenance of traffic and relocation of utilities. Grading operations that are of several weeks duration but a relatively minor fraction of the entire construction schedule. The pavement and shoulder areas are subject to multiple construction operations with necessary lag time in between, therefore inactive areas are often limited to cut and fill slopes. These projects often include stream crossings or stream relocation. Pavement reconstruction without change in the vertical grade is a special subset of this article.

A. Opportunities:

1. Drainage areas are large enough that sediment traps will usually be needed. Typical location of the traps is at the two downstream or all four quadrants of a stream crossing. Identify requirements early in design and secure necessary easements as part of project land acquisition. The contractor will typically be unable to procure the necessary easements in a timely manner; they must be part of the pre-bid acquisition.

2. Consider the extent to which permanent conveyances may be used for construction phase runoff control. Consider permanent top of cut slope diversion channel and slope drains. Consider permanent gradient terraces.

3. Inactive areas are practically limited to cut and fill slopes. These may typically be restored quite early in the construction. Apply all steep slope protections as early as possible.

4. Consider adding project phases for stream crossings to be completed in advance of general clearing.

5. Project phasing will be driven by utility relocation needs and the need to maintain public access. Inactive area stabilization drawings should match the project phasing. Assess and show what erosion control stage (undisturbed, active work zone, inactive, finished) each location can reach at the milestones represented by the project phasing. Provide a separate erosion control plan to be implemented at the start of each construction phase.

6. Pavement reconstruction without change in vertical grade: No erosion control is needed for mill and overlay so long as milling depth is less than asphalt depth. Consider limiting exposure of the subgrade to a maximum time or maximum length of roadway exposed at any one time. Other than that avoidance technique, gravel bag check dams at flowline may be of some benefit. See the discussion in *Section 8 Sediment Control* about the efficacy of inlet protection.

B. Typical Written Sequence: edit as necessary for specific site conditions:

1. Implement Pre-Clearing Plan: All structural BMPs‡ shown on the pre-clearing plan must be in place before general clearing operations. Clearing necessary to place structural BMPs shall be the minimum

required for installation. Coordinate clearing necessary to place structural BMPs with local weather forecast so that clearing and placement may be completed within a forecast dry period. Stabilize all diversions dikes, sediment basins, and sediment traps within 5 days after installation.

2. Early Work: Clear minimum work zone and construct any early work items of permanent construction that are shown on the pre-clearing plan.

3. Construct permanent roadway improvements following designated phases.

4. Implement Steep Slope Protection. During grading operations, place steep slope protection shown on the inactive area stabilization drawing as soon as practicable.

5. Implement Erosion and Sediment Control Modifications at Project Phases: Prior to conducting other construction activities on each phase, install all BMPs shown and remove all BMPs shown to be removed on the applicable erosion control plan.

6. Implement Final Stabilization: Coordinate removal of construction phase BMPs necessary to place final stabilization with local weather forecast so that removal and placement may be completed within a forecast dry period. Down-slope perimeter controls shall not be removed until final stabilization is placed and vegetative cover is established over the remainder of the site.

7. Establishment and Final Construction: Once the remainder of the site is stabilized including establishment of seeded cover types, construct permanent water quality BMPs and remove the sediment controls and the remaining access controls. Restore area disturbed by removal of sediment controls.

8. Plan Modification: The contractor must modify the plan if the plan fails to substantially control erosion and offsite sedimentation. Plan modifications due to ineffectiveness may be taken without prior approval of the review agency, but must be fully documented and approval secured from the permitting authority as soon as practicable. The contractor may modify the plan or construction sequence if implementation is infeasible for site conditions or contractor methods. Any such modification shall control erosion and offsite sedimentation to the maximum extent practicable. Any such modification shall require the prior approval of the permitting authority.

‡ Structural BMP refers to any BMP that requires installation of physical placement on the site as opposed to management BMPs such as management of the construction sequence, inspection, maintenance and good housekeeping activities.

6.5 Utility Main Extension: These are new lines and major maintenance of existing lines of utilities installed by open cut trench. Typical projects include water, gas, and electrical mains. Characteristics include: a long narrow project area, an active work zone that is concentrated in a small area at any given time and correspondingly long inactive periods for any particular location, a large number of concentrated flow crossings, very minor drainage improvements, and areas adjacent to the project area are undisturbed.

A. Opportunities:

1. Minimize duration of exposure by limiting clearing in advance of excavation and require restoration at short intervals. EPA has established a 14 day maximum for restoration after an area becomes inactive.

2. Require crossings of waterways to be completed in forecast periods of no rain. Treat every low point in the existing ground profile as a crossing.

   a. For minor crossings, less than 10 acres, use a erosion control blanket

   b. Larger crossings should have stream intervention designed according to APWA 5600.

3. Consider using a vegetated buffer (with access barriers if too narrow) or other linear sediment control device. See catchment length requirements in *Table 4 Load Rates for Sediment Controls*. Consider using an up-slope diversion dike to shorten slope length. Break diversion dike frequently and cross trench with a water-bar and erosion control blanket.

4. Cross country routes will need rock construction entries at defined access points. However, routes are often near streets with multiple low/volume access points along the way. Access may be at existing driveways. If there is no haul in/haul out, a rocked construction entry may not be necessary.

5. Water-bars should be applied where the fall line of the slope is closer than 45° to the trench centerline.

6. Direct bury, trenchless and overhead utilities need consider only the access and concentrated flow recommendations.

   a. Direct bury or trenchless plans should show concentrated flow areas on the plans to show that bore pits and similar areas of disturbance avoid the flow areas.

B. Typical Written Sequence: this sample is written for trenched utilities; edit as necessary:

1. Up-slope diversion and down-slope treatment devices – including access barriers for vegetative buffers – shall be installed prior to clearing of the reach protected.

2. Stabilize all diversions dikes, sediment basins, and sediment traps within 5 days after installation.

3. Clearing of any reach shall be no more than 3 days in advance of the excavation work within that reach.

4. Topsoil shall be segregated and reapplied to trench prior to placement of final cover.

5. Stream crossings shall be coordinated with a 5 calendar day forecast of no rain. The crossing shall be completed, from clearing to permanent cover in the flow area within 5 calendar days.

6. Crossings of minor swales shall be completed and restored with erosion control blanket all in the same day.

7. Water-bars shall be installed the same day the trench is backfilled.

8. Completed trench and other inactive areas shall be stabilized on an interval not to exceed 14 days.

9. To avoid damage to restoration plantings, weekly inspection of inactive areas shall be made by foot. Areas within ¼ mile of paved access points may be taken as representative of establishment of more inaccessible areas.

10. Establishment and Final Construction: Once the remainder of the site is stabilized including establishment of seeded cover types, remove temporary BMPs.

11. Plan Modification: The contractor must modify the plan if the plan fails to substantially control erosion and offsite sedimentation. Plan modifications due to ineffectiveness may be taken without prior approval of the review agency, but must be fully documented and approval secured from the permitting authority as soon as practicable. The contractor may modify the plan or construction sequence if implementation is infeasible for site conditions or contractor methods. Any such modification shall control erosion and offsite sedimentation to the maximum extent practicable. Any such modification shall require the prior approval of the permitting authority.

6.6 Commercial Borrow or Fill Site: These are borrow or fill sites established to serve the needs of more than one project. Characteristics include: major changes in grade, intermittent periods of use over a time span of months or years, multiple operators using the site, reliance on surface drainage with minor piped drainage improvements. Fill sites often will segregate types of materials, particularly clean earth from rubble, rubble areas have highly variable runoff coefficient.

A. Borrow site opportunities: Because of the long times involved, use spatial phasing to limit the area of disturbance at any one time. Use discrete cells to limit disturbance area. A separate drawing for each cell is needed. Necessary elements for the drawing depicting the opening of a new cell would include:

1. Depiction of restoration of previous cell: cover type, restoration of previous sediment pool, all steep slope elements for protection of the face of excavation (unless previous face is active face of new cell), inactive face likely to be steep so set both top diversion and toe of slope linear sediment control device well away from face, and stable runoff conveyance from slope drains to permanent improvement.

2. Access controls including:

   a. A fence and gate controlling access to the site

   b. A rocked construction entry.

   c. Haul road and loading maneuvering area at the initial face of excavation in the newly opened cell.

   d. A barrier along the haul road and maneuvering area to prevent traffic from entering restored areas.

   e. A barrier at the top limits of the new cell.

3. Runoff control includes:

   a. A diversion dike at the top limits of the new cell, along with appropriate slope drains and stable receiving conveyances. Up-slope diversion will be minimized if cell boundaries are coordinated with existing ridge lines.

   b. Diversion dike to direct flow from maneuver area toward the treatment pool.

4. Treatment facility: Either a sediment trap of a sediment basin depending on area. Maximum area, including treatment area, maneuvering area and area to be excavated, is 10 acres with a sediment basin. But limiting the cell area to 5 acres will allow use of the simpler and smaller sediment trap for treatment.

B. Construction rubble fill site opportunities: Construction rubble has a large particle size. The surface roughness and pore space of rubble piles are large. The rubble piles themselves are unlikely to erode or generate much runoff. More immediate goals are to protect clean earth stockpiles, prevent mud tracking, and accomplish quick restoration whenever rubble piles are leveled and capped.

1. The fill area should avoid or relocate permanent utilities.

2. The site should be fenced, gated and signed with contact information. A rocked construction entry is usually necessary.

3. The site perimeter and any stream corridor should be identified by a construction fence.

4. Provide down-slope sediment control at the site perimeter and any stream corridor.

5. Clean earth stockpiles for capping should be separated from rubble piles. See *Section 7 Access Limits and Contractor Areas* for stockpile requirements.

6. Level, cap, seed and mulch fill areas whenever the area of the rubble mounds plus the maneuvering area reaches two acres. See *Section 11*

Inactive Area Restoration for cover types and slope interruption requirements. To extent practical level, cap and seed during spring or fall germination periods.

7. Typically the working face of the fill area is not capped until the closing of the site. Place steep slope protection on fill face when site is closed.

8. Due to a long duration of exposure a separate dust control plan should be prepared for sites without natural windbreaks and for sites near habitable buildings or arterial roads.

SECTION 7 ACCESS LIMITS AND CONTRACTOR AREASGeneral: This section covers BMPs that are related to contractor's management of access on and over the project site.

7.2 Contractor Areas: Contractor areas are those centralized facilities and spaces used by the contractor that are not part of the permanent improvements. These include: field office, construction entry, concrete washout tank, employee and equipment parking, equipment maintenance area, storage yard, assembly and erection areas. Only areas intended to remain in place for a significant portion of the project are included in this definition. Short term sites may be excluded; these include: excavation sites, haul roads of short duration, and materials that are delivered to the point of installation rather than a centralized yard. The following erosion control shall apply:

A. Access to the site shall be a stable rocked construction entry. Exceptions are low volume entries commensurate with exploratory work or spot repairs with no haul in or haul out.

B. The contractor areas are to have a surface that will not track mud. Mud free surfaces include pavement, asphalt or granular base course, and millings.

C. The requirement for and timing of removal of temporary contractor facilities must be clearly identified in the erosion control drawings and construction sequence.

7.3 Isolation of Areas to Remain Undisturbed: All areas to remain undisturbed throughout construction are to be identified and protected by a physical access barrier. Allowable barriers are as follows:

A. Undisturbed area is required by regulation: Examples are stream buffer, wetland, or native area used as post construction stormwater treatment BMP. When required by regulation, access barrier will be a construction fence.

B. Voluntary limits of disturbance: This includes any area to be preserved where such preservation is the choice of the owner and is not required by regulation. Where non-disturbance is voluntary the access barrier may be either a construction fence, a rope line or a permanent barrier such as a curb, retaining wall or lined channel.

7.4 Isolation of Inactive Area: Use a permanent barrier, rope line or construction fence to isolate the inactive areas. See *Section 11 Inactive Area Restoration* for definition of inactive area.

7.5 Stockpiles: Locate stockpiles away from concentrated flow. Protect from sheet flow by locating within 50 feet of a crest, or else provide an up-slope diversion dike. Provide sediment control within 25 feet of the downstream toe of the stockpile; provide cover approved for steep slopes. Avoid locations that would cause haul routes to cross streets or pavements.

SECTION 8 SEDIMENT CONTROL

8.1 General: This section provides allowable hydraulic loading rates, descriptions, and sizing and application requirements for sediment control BMPs

8.2 Hydraulic Loading Limits: Sediment control BMPs shall be used consistent with the loading rates in *Section 5 Design Checklist: Table 4 – Load Rates for Sediment Controls.*

8.3 Sediment Basin: A sediment basin is a large pool created by some combination of excavation and embankment. It includes outlet works that will drain or partially drain the basin in one to two days. It includes spillways to pass larger flows. Sediment treatment relies on settlement of soil particles. Typically used in conjunction with diversion dikes or other runoff conveyance as a downstream perimeter control. See *Section 9 Sediment Basin* for additional design requirements.

8.4 Sediment Trap: A sediment trap is a large pool created by some combination of excavation and embankment. Dewatering works are a section of rock embankment lined with gravel on its upstream face. A sediment trap does not include an overflow channel and serves a smaller drainage area than a sediment basin. Sediment removal relies on settlement of soil particles. Typically used in conjunction with diversion dikes or other runoff conveyance as a downstream perimeter control. The required volume is 1,800 cubic feet/acre of drainage area. The maximum effective depth is 7 feet.

8.5 Silt Fence: Silt fence consists of a permeable fabric mounted on posts. Removal relies on settlement in a shallow pool behind the fence. Positioning details vary with use as follows:

A. As perimeter control: Only the portion placed within 1.0 feet of the lowest point of an uninterrupted reach of fence may be included in the hydraulic loading calculation. Ends of the fence must be returned uphill to a height of 1.5 feet above the lowest point. The fence along the slope functions as part filter and part conveyance to the ponded reach; but it will not pond water for settlement. For the purpose of calculating the hydraulic loading a sloping section of silt fence shall be considered to be a diversion conveying water to the treatment section.

B. As toe protection for steep banks: The fence should be as level as practical without running too far from the toe of slope. The fence must be set a short distance from the toe of the slope to allow for a ponding area. The ends must be returned uphill as above.

C. As interruption on long slopes: Fence must be set level with the contour. The ends must be returned uphill as above.

D. As an internal sediment control for inactive area stabilization: The fence must run along the back of curb or back of sidewalk and will not therefore be level. Consider alternate linear sediment control devices for improved performance.

8.6 Other Linear Sediment Control Devices: Any of several filter mediums that have been recognized by the US EPA to significantly remove sediment by trapping sediment as water passes through the medium. Non-biodegradable filers must have sufficient strength to resist displacement during use and resist tearing or disintegration during removal.

A. Types: Other linear sediment control includes compost berms, compost sock, vegetative buffers, gravel berms, fiber rolls, brush rolls, foam dikes, and similar low, semi-permeable barriers.

B. Placement: Linear sediment control devices do not need to be as precisely level as silt fence. However, they should generally follow a contour to maximize the interception of flow. Typical uses include both perimeter control and interruption/redistribution of flow on both steep slopes and long slopes.

C. Advantages of Compost Berms and Compost Socks: Compost berms and compost socks have additional environmental advantages over silt fence and other types of linear sediment control devices. Compost berms and socks conform to the soil and therefore require little or no ground preparation to prevent underflow. Seed may be mixed directly with the compost prior to placement, saving a construction step and improving sediment control. Compost BMPs are made from a renewable resource that currently contributes to the solid waste disposal stream. They are biodegradable so disposal is simpler and when appropriate with the final use they may be left to decompose in place.

D. Vegetative Buffers: Minimum effective width of vegetative buffer is 10 feet. Buffers must have access barrier to ensure minimum width is preserved. When buffers used on linear projects are at least as wide as the work zone they do not require an access barrier. Areas to remain undisturbed may be used as vegetative buffers.

8.7 Inlet Protection: There are two general types of inlet protection, sump and on-grade.

A. Sump type with or without excavated pit: This type consists of a barrier set a short distance away from the inlet opening. The barrier consists of a structural support and a filter such as a gravel layer or filter fabric. Removal is through settlement of soil particles. High flows overtop the barrier and dewatering is through the filter layer. An excavated pit adjacent to the inlet increases the storage volume and removal efficiency.

1. Applicability: Overflow type, sump inlet protection may be used for both side opening and grated inlets. Where used as perimeter sediment control the minimum pit capacity is 950 cubic feet per acre of drainage area.

2. Limitation: Because water and sediment accumulate in a wide area around the inlet, overflow types are not appropriate on roads that are open to the public. They are not applicable for on-grade inlets.

B. On-grade type: This type is a semi-permeable throat insert is placed in the inlet opening. Often, a block is used to create a gap between the insert and the throat to allow overtopping at higher flow.

1. Applicability: On-grade types are not adequate by themselves to satisfy the downslope perimeter treatment requirement. Because of reduced inlet capacity on-grade inlets should be used only where the bypass route is erosion resistant and an effective sediment control BMP is provided along the bypass route. Can be used adjacent to traffic.

2. Limitation: Do not use without providing downstream treatment and an erosion resistant, conveyance along the bypass route.

C. The Missouri General Permit states, "Where sediment is present on roadways all storm water curb inlets shall have inlet protection."

SECTION 9 SEDIMENT BASIN

9.1 General: This section provides supplemental design criteria for sediment basins. These criteria are for a temporary facility meant to be removed within 3 years, and having a drainage area of less than 50 acres. For larger or permanent structures, a qualified geotechnical engineer experienced in dam design should complete the embankment and spillway designs. Where sediment basins are required they shall be installed as soon as practicable, generally before any other clearing occurs on the site.

9.2 Placement Restrictions: Do not locate a sediment basin in an area of continuously running water. Do not locate a sediment basin where failure of the embankment will result in loss of life or damage to structures, roads or utilities. Do not locate a sediment basin where ponding will prevent the use of public roads or utilities. Do not locate a sediment basin within a designated regulated stream buffer or a designated stream preservation area; consult the municipal authority for the site for stream designations. To the extent practical, divert runoff from non-disturbed areas around the sediment basin.

9.3 Embankment: Maximum embankment height from downstream toe to crest is 15 feet. Minimum top width is 8 feet; maximum slope of embankment face is 2.5:1. The "as constructed" elevation of the embankment crest shall include 5% of the embankment height as an allowance for settling. Design shall show both "as constructed" and "as settled" elevations of the crest. Embankment shall have cover approved for steep slopes.

9.4 Volume: Total required volume is 3600 cubic feet per acre of drainage area. Drainage area includes any offsite areas tributary to the basin, unless the offsite area is diverted around the entire disturbed area and sediment basin. Storage volume is calculated to the rim elevation of overflow riser.

A. A portion of the total volume is allotted for sediment storage. (The Kansas General Permit restricts the sediment storage volume to 20% of the total. The Missouri General Permit allows sediment storage volume to be 50% of the total).

B. Each sediment basin must have a marker indicating the elevation of the maximum allowed volume of silt accumulation. The marker must be clearly visible from an easily accessible point on the sediment basin perimeter.

C. A permanent pool increases removal efficiency and is generally recommended. However, at some sites the nuisance associated with a permanent pool may outweigh the water quality benefits. Consult the municipal authority prior to final design. If used, the volume of the permanent pool should be limited to the allowable sediment storage volume.

9.5 Surface Area/ Shape Factor: For effective removal the surface area of the pool at the elevation of the primary spillway shall meet at least one of the following requirements:

A. Minimum surface area shall be 1000 square feet per acre of drainage area, or

B. Flow length from the major inlet to primary spillway shall be twice the average top width of the pond, or

$$L \geq (2*A)^{0.5}$$

Where A is the surface area at the top of the riser and L is the distance from entry of the largest flow volume to the riser. Flow length may be increased by use of wire backed silt fence or other baffle. If baffles are required they shall be arranged so as to not interfere with silt removal.

9.6 Dewatering: A dewatering device shall be included in the design to provide for a draw down time between 24 and 48 hours. Dewatering device may be either a skimmer or dewatering holes in a vertical riser. A skimmer provides superior sediment removal since the dewatering occurs from the relatively cleaner surface layer of the sediment basin and the dewatering is at a constant rate whereas dewatering holes release at a faster initial rate when less settlement has occurred.

A. Manufactured skimmer: Dewatering by skimmer occurs at a constant rate. To assist contractor's selection of skimmer the basin detail must establish dewatering rate in cf/hour that meets the drawdown time criteria.

B. Dewatering holes in a vertical riser: Design must show the size of holes, number of holes per row, and row spacing required to meet the drawdown time criteria. Drawdown holes must be protected by a gravel filter; filter fabric will clog and is not allowed. Absent a detailed analysis, dewatering holes, spaced at 6 inches vertically, may be estimated as follows:

1. Small permanent pool (0 to 30% of required volume): To draw down 2500 to 3600 CF/acre of storage over the allotted time use a total dewatering area per row 0.10 to 0.15 square-inches/acre of drainage area.

2. Large permanent pool (30 to 50% of required volume): To draw down 1800 to 2499 CF/acre of storage over the allotted time use a total dewatering area per row 0.15 to 0.25 square-inches/acre of drainage area. Note: For similarly shaped basins a larger permanent pool will result in many fewer rows of dewatering holes and a smaller initial pressure head for the bottom row. These effects more than offset the effect of a smaller total volume to be discharged. Although the result is counterintuitive, the dewatering area per row is greater for large permanent pools.

9.7 Freeboard and Spillways: The primary overflow conveyance shall be an open top riser. The riser shall convey a 50% design storm prior to discharge from an auxiliary open channel overflow. An open channel overflow shall protect the embankment from overtopping during a 4% design storm. The settled crest of the embankment shall have a minimum of 0.5 foot of freeboard above the 4% design storm. The following shortcuts for riser and overflow channel represent the upper envelope from routing the design storms through a wide range of sample basins. Shortcuts were developed using a runoff coefficient for construction sites of 0.7, the Huff third quartile distribution for rainfall at a point, and rainfall intensities from *Precipitation Frequency Estimates for the Kansas City Metropolitan Area; McEnroe and Young, June 2002.* The shortcut methods are applicable for drainage areas between 5 and 50 acres and water surface areas at top of riser between 550 and 2000 SF/acre.

A. Open top riser: The riser shall include anti-vortex crown and a trash rack. As a shortcut to storm routing the vertical separation, in feet, between the top of riser and the flowline of the open channel control section may be calculated as:

$$H_1 \geq 2900*A/(WS + 3000*D^2)\text{, but not less than 1.0 feet.}$$

Where: A = Drainage area of sediment basin, in acres.
WS = Water surface area of the sediment basin at the top of riser elevation, in square feet.
D = Diameter of riser, in feet. Diameter shall not be less than 2.0 feet.

B. Open channel overflow: Open channel overflow shall consist of an entry channel, a control section and an exit channel.

1. Entry channel shall have an adverse slope and be at least as wide as the control section.

2. Control section shall be level along the direction of flow, trapezoidal in shape, and shall have a minimum length in the direction of flow of 20 feet. Control section shall be located outside the embankment and shall be seeded. As a shortcut to storm routing the control section may be sized as below:

$$Q_{actual} = 3.8*A - 0.001*WS*\Delta_1, \text{ but not less than } 1.0*A$$

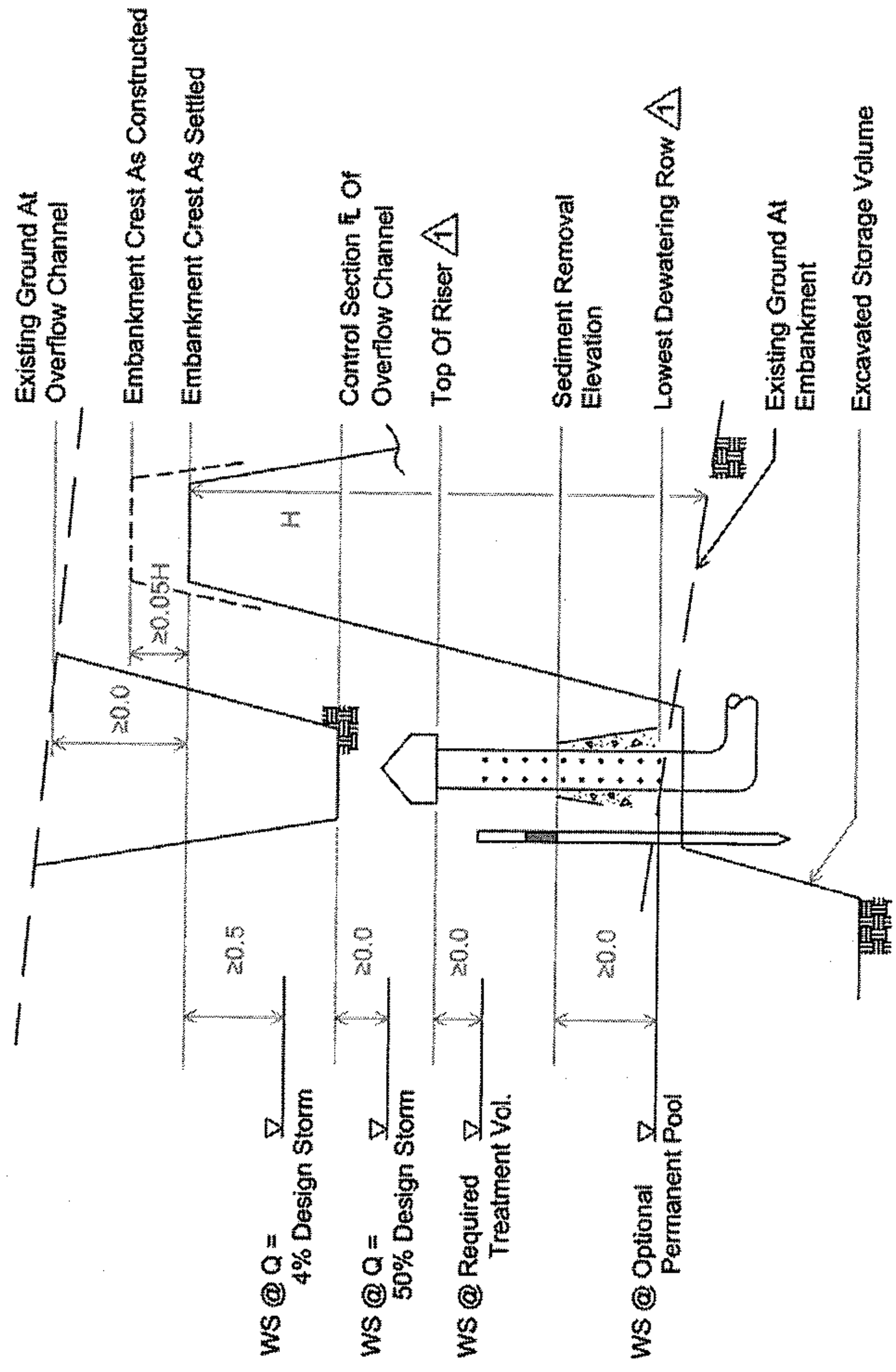
$$Q_{allowable} = 3.0*B*(\Delta_2-0.5)^{3/2}$$

$$Q_{allowable} \geq Q_{actual}$$

Where:
Q_{actual} = Shortcut estimate of storm runoff from a 4% event after routing through sediment basin, in cfs.
A = Drainage area of sediment basin, in acres.
WS = Water surface area of the sediment basin at the top of riser elevation, in square feet.
Δ_1 = Elevation difference between the flowline of control section and the top of riser, in feet.
$Q_{allowable}$ = Maximum release rate through the control section calculated at conditions of minimum required freeboard, in cfs.
B = Bottom width of the control section, in feet. Width should be as small as practical to keep the excavated control section level without special construction techniques, but not less than 10 feet.
Δ_2 = Elevation difference between the settled elevation of the top of the embankment and the flowline of the control section, in feet.

3. Exit channel: Exit channel may be trapezoidal or triangular. The bank full capacity shall exceed Q_{actual} as calculated above. Centerline radius of the exit channel shall be 4 times the top width. Exit channel shall be located outside of the embankment and shall be seeded or lined. Manning's formula may be used for exit channel design calculation.

C. Outlet protection: An outlet protection is required where the riser discharge and where the open channel overflow discharge rejoin the natural flow path.



1 If A Skimmer Is Used For Dewatering, A Riser Is Still Required As A Primary Spillway.

FIGURE 1
RELATIONSHIPS BETWEEN SEDIMENT BASIN DESIGN ELEVATIONS

SECTION 10 RUNOFF CONTROL

10.1 General: This section provides descriptions sizing and application requirements for runoff control BMPs

10.2 Stream Stabilization Measures: Where streambed grade control or stream bank erosion protection is part of the permanent construction, then show permanent stream protection BMPs on the pre-clearing plan and require they be install prior to general clearing. Refer to APWA 5600 or local municipalities design guidelines.

10.3 Diversion Dikes, Gradient Terrace, and Slope Drains: Diversion dikes are low earth berms that capture sheet flow and divert it to an erosion resistant conveyance or a sediment trap or basin. Design details vary with use as follows:

A. Up-slope perimeter diversion: Only drainage areas greater than 0.5 acres are required to be diverted around the construction area. Diversion must terminate at an erosion resistant conveyance.

B. Down-slope perimeter control: Used to convey runoff to a sediment trap or a sediment basin.

C. Top of slope diversion: Placed to divert flow away from the face of a steep slope. Often used in conjunction with a slope drain to convey water to the toe of the slope. The diversion system must terminate in an erosion resistant conveyance or a sediment trap, or a sediment basin.

D. Limitations on diversion dikes: Where practical select diversion routes that are flatter than 5% slope. Flowline slopes over 5% and all diversions that are likely to remain in place longer than 21 days shall be seeded and protected with erosion control blankets. Diversion dikes with greater than 5 acre drainage area are to be designed as an erosion resistant construction phase conveyance.

E. Gradient terrace: A permanent diversion that interrupts a steep slope and conveys water at a low velocity to a stabilized outlet. Where used gradient terraces shall interrupt the slope at vertical separations not less than 20 feet of elevation change.

F. Slope Drain: A temporary pipe, laid across the surface of a slope to convey water from an up-slope diversion to another stable conveyance. A slope drain installation includes anchors to hold it in place, outlet protection, and an uphill head wall typically built from gravel bags.

10.4 Erosion Resistant Construction Zone Conveyance: These conveyances collect and carry water through the site. Design flow for temporary system is the 50% storm (for small construction sites in the Kansas City metropolitan region, 2.9 cfs/acre is recommended). Refer to APWA 5600 for design parameters that are omitted here. Cost effective design may be realized by planning for parts of the permanent storm sewer system to fulfill this requirement. Allowable types are as follows:

A. Pipes. Either permanent storm sewer or temporary piping. Temporary pipe may be buried or anchored along the surface of the ground. Permanent pipes should have at a minimum velocity of 3 ft/sec at design flow to avoid clogging.

B. Check dams. Effective for drainage areas up to 10 acres. A series of check dams is usually required; space so that the base of the upstream dam is at the same elevation as the top of the next downstream dam.

1. Where grading modifies the existing topography to such an extent that erosion resistant conveyance cannot be established prior to general clearing of the site, require material for check dams to be stored on the site. Require coordination with the daily weather forecast so that: at the end of any day, if greater than a 10% chance of rain is predicted prior to or on the day at which work is scheduled to resume, then check dams shall be placed before leaving the site.

C. Sod lined channel: Sod lined channels are applicable where slope is less than 5%, the velocity is less than 5fps, and the channel conveys relatively clean stormwater runoff, such as a channel sited on the up-slope perimeter of a construction site.

D. Continuous lining with TRM or rock. These are not covered by the EPA menu of BMPs but are allowed. Design reference is APWA 5600.

10.5 **Water Bar:** A barrier to sheet flow applied on an angle to the contour so as to divert runoff to stable cover on the low side of a utility trench or other narrow construction zone. Diversion dike, compost berm, silt fence or other linear sediment control device identified in *Section 8 Sediment Control* may be used. Except vegetated filter strip cannot be used as a water bar.

10.6 **Outlet protection:** Generally means riprap or lined plunge pool at outlet of any conveyance but may include impact structures and other velocity reduction devices. Permanent protection measures may be installed as construction phase management measures. Refer to APWA 5600 or local municipal authority's design guidelines.

SECTION 11 INACTIVE AREA RESTORATION

11.1 General: This section lists approved cover for various conditions, protective measures required for steep slopes, and placement of additional sediment control devices to protect mild and moderate slopes on inactive areas.

11.2 Inactive Area Defined: An inactive area is any part of the project site that may be reasonably managed by the contractor to not require further construction for a 14 days or longer. The need for subsequent construction at a location does not affect the inactive status so long as the delay is reasonably expected to be 14 days. Inactive areas usually occur whenever there is a change in the contractor's use of the site.

11.3 Inactive Area Approved Cover Types: Permanent or temporary soil cover shall be placed over all inactive areas. Allowable cover types for specific slopes and conditions are listed in *Table 6 – Approved Cover Types*.

A. Cover types to use only with project specific municipal approval. These are proprietary products for which the industry has not yet developed voluntary standards. They may be effective but will have to be specified as individually approved products. Prior consultation with the municipal authority is necessary to select these methods.

1. Chemical stabilization,

2. Bonded fiber matrix

B. Cover types not recommended for inactive areas. Although these cover types may have effectiveness for short term site management such as protection from an individual event, or response to seasonal germination constraints; they have marginal overall effectiveness or require frequent reapplication. They should not be included in the original erosion control drawings.

1. Surface roughening,

2. Spray applied mulch without seed,

3. Straw mulch without seed, except in winter

11.4 Steep Slope BMPs: On slopes steeper than 15% apply all the following:

A. Divert water at top of slope by either a diversion dike to a protected slope drain or by design of an adverse slope away from the top of embankment. See *Section 10 Runoff Control* for information about stabilized diversion dikes and slope drains.

B. Place cover approved for steep slopes on the face of the slope. See *Inactive Area Approved Cover Types* this section for approved cover types.

C. On slopes with an elevation change greater than 10 feet, place a compost berm or other linear sediment control device at vertical separations not to exceed 10 feet change in elevation. Alternately place permanent gradient terrace with stabilized outlets at same vertical spacing. See *Section 10 Runoff Control* for information about gradient terraces.

D. Compost sock, silt fence or other linear sediment control device at toe placed sufficiently away from the actual toe to create a ponding area. Where the toe of the slope is not level use frequent breaks and return end uphill. See *Section 8 Sediment Control* for placing compost sock, silt fence and other linear sediment control device.

11.5 Interruption of Interior Slopes: Sheet flow on mild and moderate slopes in inactive areas shall be interrupted by a compost sock, silt fence or other linear sediment control device at the following locations:

A. On long slopes interrupt the slope at horizontal intervals not to exceed 75 feet.

B. For steep slopes, refer to *Steep Slope BMPs* this section.

11.6 Interior Sediment Control: Sediment recapture devices should be placed as close to the source as possible.

A. Silt fence of other linear sediment control device should be placed to protect interior pavements from sediment laden runoff. The linear sediment control should be placed as close to the curb as practicable as soon after construction of the curb as practicable.

B. Although they do not have the storage capacity to be sufficient as a perimeter sediment control inlet protection devices should be place in all inlets, as early as practicable, except where doing so would create a ponding hazard to traffic or an erosion hazard to an unprotected downstream conveyance due to bypassed flow.

11.7 Topsoiling: Topsoiling is the stockpiling and reapplication of topsoil. Topsoiling will reduce the runoff rate and to enhance establishment of vegetative cover. Topsoiling is in important permanent water quality BMP, but not strictly an erosion control measure. However, it is necessary to include stockpile information in the erosion control plans to adequately protect the topsoil resource.