CHAPTER 6

EROSION AND SEDIMENT CONTROL PLAN (ESCP) DESIGN

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6.1 Background

The purpose of erosion and sediment control planning is to clearly establish which control measures are intended to prevent erosion and offsite sedimentation during construction. The Erosion and Sediment Control Plan (ESCP) should serve as a guide for the location, installation, and maintenance of practices to control erosion and prevent sediment from leaving the site during construction. An example ESCP is included in Appendix C.

Erosion and sediment control planning determines the measures which should be provided to prevent or minimize erosion and intercept and treat sediment-laden runoff which occurs during construction and site stabilization. The ESCP specifies the measures identified during planning to prevent sediment deposition onto adjacent properties and into receiving waters. The ESCP also identifies measures to control volume, velocity and peak flow rates of concentrated storm water runoff onsite and to meet the Oregon Drainage Law relating to quantity and velocity of runoff leaving the site during construction. Permanent storm water management facilities such as curbs, inlets, gutters, etc., are incorporated in the project design to control runoff after construction is complete, and may be incorporated as elements of the ESCP for use during construction.

> In order to prevent pollution related to its construction projects and meet local, State and Federal requirements, ODOT requires a Pollution Control Plan (PCP) and an Erosion and Sediment Control Plan (ESCP) for each project. For projects with minimal soil disturbance ODOT may specify that the contractor develop both the PCP and the ESCP. Otherwise, ODOT develops the ESCP and the contractor modifies it to fit the construction scenario. The contractor develops the PCP.

An approved ESCP is the primary document specifying the necessary requirements for minimizing impacts related to erosion and sedimentation. The ESCP is reviewed and approved by ODOT and/or the permitting jurisdiction. ODOT has 1200CA permits for each Region, so permits from local jurisdictions are only required if regulations for a local agency are more stringent than that of the DEQ. The ESCP consists of plans, details, and Specifications 00280, 00290, and 01030 in the contract documents. The ESCP must be available on the construction site for review.

Typically review submittals for the ESCP occur at the preliminary, advanced and final stages of the project along with other sections of the contract plans. The ESCP should be developed and included in the distribution of the preliminary plans. A more complete ESCP, including details, should be developed for inclusion in the advanced plans. Once the plan is developed and before the plan goes to final approval, the designer should request review of the plan, special provisions and details by an erosion control designer in the Geo-Environmental Section.

6.1.1 Designer Responsibilities

A designer puts the ESCP together in the office based upon information provided from the roadway plans and a field site visit. A determination is made about what best management practices are appropriate. A variety of BMP's should be included on the plan order to provide adequate tools in the field.

Construction and erosion and sediment control contractors have a defined responsibility to prevent pollution from leaving a site. They must follow a plan, or obtain approval to a revised plan, and insure that the site is stable. Between the ESCP that is created in the office, the reality of construction, contractor responsibility and Mother Nature, site adjustment is inevitable, and mandatory.

Whether the ESCP is adequate or not, it is the responsibility of the project inspector to follow up with the contractor to insure that erosion is controlled on the site and compliance with the NPDES Permit is achieved. If the plan is inadequate, it is difficult for the inspector to obtain compliance and to have the best management practices available to obtain adequate control. Change orders are needed which are often costly and burdensome. An adversarial relationship can result between the inspector and the contractor when more work is required for erosion control and the contractor has not anticipated the need to commit resources to address erosion. Therefore, the best scenario includes a good plan, open lines of communication, and defined responsibilities.

6.2 Plan Preparation

Chapter 5 discusses the ODOT ESCP planning process. Chapter 6 will be of interest primarily to designers; however, much of the information included is useful to persons involved in ESCP implementation.

6.2.1 Assessing the Project Site

To develop the ESCP, a designer must, (1) identify potential erosion and sediment problems, (2) develop design objectives, (3) formulate and evaluate alternatives, (4) select best erosion control measures to combat potential concerns and (5) develop a plan.

The following site and project information are required to be evaluated for project design:

- Surface soil types and erodibility.
- Extent and location of soil disturbance (total area).

- What kind of runoff and how much is coming onto the construction site? Clean rainwater from a stabilized site, bare ground runoff, sheet flows, channel flows, etc.?
- Where is the total runoff volume going to exit and how?
- In a major rain event, what are the worst case scenarios upstream and downstream?
- What is the overall construction environment? Urban, rural, open fields, industrial, pristine forestland?
- When will construction take place in relation to when major rainfall events are likely? What is the construction schedule? Will construction be phased?

The designer should note the following conditions that exist:

- Requirements of permitting and local agencies.
- Special requirements by Oregon Department of Fish and Wildlife, Department of Forestry, NOAA-Fisheries, or the Department of Environmental Quality. This information is gathered at project team meetings or with the assistance of the Region Environmental Coordinators or the ODOT Environmental Section.
- Type and condition of existing vegetation. Note whether the existing vegetation has root mass that is capable of holding the soil in place and a leaf canopy that can break the velocity of overland flow. If sediment is entrained in the runoff, can it settle out before it reaches surface water? Does the topography of the site trap sediment that has been entrained? These questions will help the designer to determine whether clearing limits are required.

The designer can get additional information about topography and drainage patterns from the cross sections, profiles and staging plans that may help during design.

6.2.1.1 Soil Types

Knowing the type of soil found on the project site will help the designer decide upon the degree of erosion protection required. This will ensure that the ESCP is adequate to control soil movement without being overly conservative. Soil information is found in the Natural Resource Conservation Service Soil Survey, a mapped inventory by county with physical properties and characteristics described for each soil type.

One can roughly determine soil type by feeling the soil. Visit the project site and pick up a handful of soil. Rub it between your fingers. Does it feel gritty like sand or is it smooth like powder? Gritty soils may indicate a high content of sand. Soils that contain mostly sand will drain freely. Clays and silts feel powdery when dry. Clay is sticky when wet. Silts and clays absorb water before becoming saturated and causing runoff of rainwater on the surface. In addition, clays and silts have smaller particles that are easily detached and carried in runoff.

The soils found on a construction site are often highly disturbed and do not resemble the native soil. Consider the depth of cut on the project and what soils are there. Consider the fill material. Will these soils be erodible? Will they sustain vegetation or be covered with rock? Will they become highly compacted? Soil particle properties, such as size, shape, and density have a direct effect on soil detachment, dispersion, transport, and eventual deposition. For example, a fine textured soil having large amounts of silt and fine sand or highly expansive clay minerals is quite susceptible to erosion from rainsplash and runoff. The smaller, lighter particles (fine sand and clays) are transported by water more easily than the coarser particles: as soil particle size increases the soil's erodibility decreases.

TABLE 6.1 USDA Particle size classes

USDA Particle Size Classes

Particle name	Size, inches	
Gravel	Greater than 0.0787	*Larger = Less Erodible*
Sand	0.0787-0.00394	
Very fine sand	0.00394-0.00197	
Silt	0.00197-0.0000787	
Clay	Less than 0.0000787	Smaller = More Erodible

6.2.1.2 Topography

From the site visit, determine the drainage patterns from the topography. Does runoff flow from offsite through the construction site? If so, measures should be taken to re-route this water around areas that will have ground disturbance.

Will areas of soil disturbance occur on long slopes that are greater than a 2% grade? If so, the lengths of these uninterrupted flows should be broken up so that the rainfall runoff will only flow short distances thereby decreasing flow velocity and the erosive force. In flat areas, runoff is slow and soil particles are not moved far from the point of raindrop impact. If the slopes are steep and short, surface cover may be needed to decrease runoff and promote rainfall infiltration into the soil. On steep slopes, soil movement increases dramatically. For example, on a 100 ft. long slope, doubling the gradient from 1:3 to 1:1.5 triples the soil loss. Thus, constructing very long slopes and especially, long, steep slopes, should be avoided. Those that already exist should not be disturbed.

6.2.2.1 ESCP – Determine Applicable Design Elements

Once the project site has been assessed, the catch points for cuts and fills, drainage areas and drainage patterns, sensitive areas, size and location of drainage structures, and of disturbance should be located on the base map. Approximate final slope (grades) and any known problems such as highly erodible soils or unstable slopes should also be noted.

The following eight elements should be evaluated for every project. Erosion control measures should be chosen based on the elements which apply to the project and on the Best Management Practices design criteria in Chapter 4, Erosion and Sediment Control Measures and Best Management Practices.

6.2.2.2 Clearing Limit

Limiting site disturbance is the single most effective method for reducing erosion. Clearing limits prevent disturbance of areas not designated for clearing or grading, protect the natural environment, provide a buffer between disturbed areas and sensitive areas and reduces the need for other erosion control measures. Clearing limits shown on the plan should be clearly marked in the field. This is not necessary outside of the project right of way.

Since clearing limits should be marked before ground disturbance occurs, the designer should show the sensitive areas as “no work” areas on the ESCP, even when the “no work” areas are shown elsewhere in the plans. Sensitive areas and their buffers may require more substantial protection such as plastic or metal safety fences or stake and wire fences. Sediment fence, in combination with survey flagging, is also an acceptable method of marking sensitive areas and their buffers. However, sediment fences should only be used for this purpose if it is also needed for sediment control.

6.2.2.3 Sensitive Area Restrictions

Any project, regardless of size, that disturbs areas near or within a stream or associated buffer, a wetland or its associated buffer, or within 100 ft. of a lake has the potential to seriously damage water resources. Projects along or near waterways may have special requirements that should be incorporated into the ESCP. Contact ODOT Environmental Section for specific requirements.

When dealing with sensitive areas, the following recommendations should be incorporated into the plan where appropriate:

- Before the rainy season, a sediment barrier should be constructed between the disturbed areas and the surface water in order to isolate the construction area from the water resource.

- Additional perimeter protection should be installed to reduce the likelihood of sediment entering the surface waters. This might include multiple sediment fences; sediment fences in combination with sediment barriers, a berm, or application of a thick layer of mulch upslope of a sediment fence.
- Runoff generated by decanting should be directed through a sediment trap and/or the water released uniformly over a well-vegetated, relatively flat area. A well-vegetated area with dense grass or similar vegetation is a filter for the runoff to pass through. Since pumps are used for decanting, it may be possible to pump the sediment-laden water away from the surface water so that vegetation can be more effectively utilized for filtration.

6.2.2.4 Surface Water Control

Surface water controls collect and convey surface water to minimize erosion and may:

- Intercept runoff on and above disturbed slopes.
- Divert offsite runoff around project.
- Convey the runoff to a sediment trap, basin or stabilized outlet.
- Release the runoff downslope of any disturbed areas.

Surface water control measures include dikes, swales, ditches, pipe slope drains and level spreaders. Interceptor dikes/swales intercept runoff and take it away from disturbed ground. Ditches and pipe slope drains convey runoff through a site. Riprap or level spreaders dissipate the velocity of runoff and release it in a non-erosive manner. Vegetation-lined channels are often preferable to pipe slope drains whenever the channel gradient does not exceed 5%, vegetation can be adequately established, and the channel is accessible for maintenance.

Surface water controls should be constructed during the initial grading of an area so they are in place before there is any opportunity for storm runoff to cause erosion. If the soils and topography are such that no offsite discharge of surface water is anticipated based on the 10-year design storm, surface water controls may not be needed. When using vegetation-lined channels, they should be established early in the project. Irrigation may be required to establish a thick, dense stand of vegetation. Grass may require mowing and removal of the dead plant material to optimize its effectiveness. If vegetation cannot be adequately established, the channel should be protected with matting or rock.

6.2.2.5 Perimeter Protection

Perimeter protection measures are so named because they are installed at the perimeter of disturbed areas. These measures either reduce runoff velocity or retain sediment while allowing water to pass, or collect runoff and direct it to a sediment trap or basin for treatment.

Perimeter protection can be used as the primary means of sediment removal when the catchment area is very small. It may be a secondary means of sediment removal, for instance, following a sediment trap or basin. Perimeter protection measures include sediment fence, sediment barriers, interceptor dikes and swales and sediment traps and sediment basins. Perimeter protection may be used as the primary treatment when the flow path meets the criteria listed below. Otherwise perimeter protection should be used in combination with other measures.

Table 6.2 Criteria for perimeter protection as primary treatment

Average Slope	Flow Path Length
1:1.5 or flatter	100 ft. or shorter
1:2 or flatter	115 ft. or shorter
1:4 or flatter	150 ft. or shorter
1:6 or flatter	200 ft. or shorter

Conveyance of runoff from a construction site can more safely be achieved by:

- Utilizing and supplementing existing stable watercourses.
- Installing storm drains with stable outlets.
- Designing and constructing stable open channels.

The plan should indicate locations for these design facilities. Outlets for channels, diversions, slope drains, or other structures should be completed and stabilized before installing perimeter protection measures. Impacts to existing facilities, if they are to be used for erosion control during construction, should be evaluated.

6.2.2.6 Revised Universal Soil Loss Equation (RUSLE)

In order to properly design retention and conveyance structures, a designer must be able to calculate the quantities of water and sediment that will be managed by the structure. For smaller structures such as sediment traps, lined swales or check dams, design details can be developed using simple guidelines based on general assumptions about soil type and tributary area. This is generally acceptable because the failure of one of these BMP's would not generally be a catastrophic or life-threatening event. Moreover, maintenance of these BMP's is relatively simple and if sediment loads are higher than expected, they can be easily modified and maintained more frequently without loss of effectiveness. The design and construction of a sediment basin or large conveyance is more rigorous, however, because failure of these types of structures could seriously endanger natural resources or human life. In addition, they cannot be easily maintained when in use during the rainy season. For this reason, the designer needs to be able to calculate the quantity of sediment that will be transported or retained in a structure. The design method for calculating soil loss from disturbed land presented in this manual is the Revised Universal Soil Loss Equation (RUSLE). RUSLE estimates soil loss from a slope caused by raindrop impact and overland flow (collectively referred to as "interrill" erosion), plus rill erosion. It does not estimate gully or stream-channel erosion. RUSLE is a tool to estimate the rate of soil loss based on site-specific environmental conditions and a guide for the selection and design of sediment and erosion-control systems for the site. RUSLE does not determine when soil loss is excessive at a site, or when erosion-control systems have failed. The RUSLE user makes such decisions based upon numerous criteria, of which soil-loss and sediment-yield estimates are one important component.

Portions of the following paragraphs describing RUSLE were excerpted from Chapter 1 of the Guidelines for the use of RUSLE – Version 1.06, with permission of Publishing Editor Joe Galetovic of the Office of Surface Mining in Denver, Colorado. For a copy of the complete guidelines and RUSLE software, please contact:

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The Revised Universal Soil Loss Equation (RUSLE, Renard et al., 1997) is a technology for estimating soil loss from most undisturbed lands experiencing overland flow, from lands undergoing disturbance, and from newly or established reclaimed lands. RUSLE also may be used as a part of the procedures to prepare permit applications and to assess reclamation success in support of bond release.

Erosion Terminology

Several terms are used in association with the removal of soil from the land surface. Although there is not complete agreement in the connotations attributed to these terms, the following definitions are employed in this report.

- Erosion includes a group of processes by which earth materials are entrained and transported across a given surface.
- Soil loss is that material actually removed from the particular hillslope or hillslope segment. The soil loss may be less than erosion due to onsite deposition in micro-topographic depressions on the hillslope.
- Sediment yield from a surface is the sum of the soil losses minus deposition in macro-topographic depressions, at the toe of the hillslope, along field boundaries, or in terraces and channels sculpted into the hillslope.

RUSLE estimates soil loss from a hillslope caused by raindrop impact and overland flow (collectively referred to as "interrill" erosion), plus rill erosion. It does not estimate gully or stream-channel erosion.

The RUSLE Model

RUSLE is a set of mathematical equations that estimate average annual soil loss and sediment yield resulting from interrill and rill erosion. It is derived from the theory of erosion processes, more than 10,000 plot-years of data from natural rainfall plots, and numerous rainfall-simulation plots. RUSLE is an exceptionally well-validated and documented equation. A strength of RUSLE is that it was developed by a group of nationally-recognized scientists and soil conservationists who had considerable experience with erosional processes (Soil and Water Conservation Society, 1993).

RUSLE retains the structure of its predecessor, the Universal Soil Loss Equation (USLE, Wischmeier and Smith, 1978), namely:

$$A = R\ K\ L\ S\ C\ P \qquad (1)$$

Where: A = Average annual soil loss in tons per acre per year
R = Rainfall/runoff erosivity
K = Soil erodibility
LS = Hillslope length and steepness
C = Cover-management
P = Support practice

The R factor is an expression of the erosivity of rainfall and runoff at a particular location. The value of "R" increases as the amount and intensity of rainfall increase. For user convenience, these data are contained in the CITY database file provided within the computer program. The basic program includes the files for numerous cities throughout the United States, but many more site-specific files are available within each state from the offices of the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS); formerly the Soil Conservation Service, (SCS).

The K factor is an expression of the inherent erodibility of the soil or surface material at a particular site under standard experimental conditions. The value of "K" is a function of the particle-size distribution, organic-matter content, structure, and permeability of the soil or surface material. For undisturbed soils, the nomograph equations embedded within the RUSLE program are used to compute appropriate erodibility values.

The LS factor is an expression of the effect of topography, specifically hillslope length and steepness, on rates of soil loss at a particular site. The value of "LS" increases as hillslope length and steepness increase, under the assumption that runoff accumulates and accelerates in the downslope direction. This assumption is usually valid for lands experiencing overland flow but may not be valid for forest and other densely-vegetated areas.

The C factor is an expression of the effects of surface covers and roughness, soil biomass, and soil-disturbing activities on rates of soil loss at a particular site. The value of "C" decreases as surface cover and soil biomass increase, thus protecting the soil from rainsplash and runoff. The "biological" inputs to RUSLE may not be familiar to all RUSLE users; however, the necessary values usually can be obtained through consultation of the literature and professional staff at local NRCS offices. The RUSLE program uses a sub-factor method to compute the value of "C". The sub-factors that influence "C" change through time, resulting in concomitant changes in soil protection. For user convenience, a VEGETATION database file is contained within the computer program that characterizes numerous plant types. In some cases, the plants used in reclamation may be included in these files. In other cases, files may be customized to include the desired plants and plant combinations. Likewise, the files include other types of surface treatments used as temporary covers for erosion control.

RUSLE also contains an OPERATIONS database file that characterizes the effects of various soil-disturbing activities on soil-loss rates. These operations alter the roughness, infiltration, distribution of biomass, and runoff properties of the surface. The operations usually are common tillage activities that may be used in the development of a seedbed at reclaimed sites. The files include activities specific to erosion control and disturbed-land reclamation. The effectiveness of cover-management sub-factors varies with local conditions.

Therefore, the user is strongly encouraged to calculate C values through the

RUSLE equations rather than selecting values from generalized tables.

The P factor is an expression of the effects of supporting conservation practices, such as contouring, buffer strips of close-growing vegetation, and terracing, on soil loss at a particular site. The value of "P" decreases with the installation of these practices because they reduce runoff volume and velocity and encourage the deposition of sediment on the hillslope surface. The effectiveness of certain erosion-control practices varies substantially due to local conditions. For example, contouring is far more effective in low-rainfall areas than in high-rainfall areas.

Therefore, the user is strongly encouraged to calculate P values through the RUSLE equations rather than selecting values from generalized tables.

Care must be exercised to insure that all data inputs are accurate because they may affect several components of soil-loss estimation. It is often prudent to consult with qualified earth and environmental scientists to affirm the accuracy of the data inputs. Further, the soil-loss estimates produced by RUSLE rest upon the assumption that factor inputs accurately reflect field conditions. Factor adjustments are required whenever actual conditions depart from specification.

The recommendations provided herein for the use of RUSLE on mining, construction, and reclaimed land applications represent the best judgment of the Working Group. It is the user's responsibility to determine whether or not RUSLE is applicable to a particular field situation.

These guidelines provide direction for maximizing the accuracy of RUSLE soil-loss estimates on mined lands, construction sites, and reclaimed lands.

RUSLE is a tool to estimate the rate of soil loss based on site-specific environmental conditions and a guide for the selection and design of sediment and erosion-control systems for the site.

RUSLE does not determine when soil loss is excessive at a site, or when erosion-control systems have failed. The RUSLE user makes such decisions based upon numerous criteria, of which soil-loss and sediment-yield estimates are one important component.

6.2.2.7 Sediment Retention

Sediment retention measures remove sediment from runoff by holding a volume of water for a length of time, allowing particles 0.00787 inches and larger to settle out. Sediment retention should be used as a last line of defense when included in an ESCP. Other design elements must also be included in the plan to assure sediment from erosion is under control.

When sediment retention is used by itself, the potential for catastrophic failures is high. Sediment traps are a common facility used for sediment retention. When a sediment trap is required, it should be shown on the ESCP with the dimensions of each trap described on the sediment trap detail or plan sheets.

6.2.2.7.1 Sediment Trap Sizing

Sediment traps must be sized to handle the area contributing sediment-laden runoff. The following design criteria are based on a variation of the Rational Formula, allowing a relatively simple set of calculations to be used to size the traps, while accounting for rainfall patterns that occur in different hydrologic zones across the state. Facilities designed to collect contributing areas up to 5 acres can use these design criteria. Facilities designed to collect contributing areas larger than 5 acres must use more thorough design criteria and would then be considered a Sediment Basin. Refer to the Volume 1 of the ODOT Hydraulics Manual for more detailed designed guidance.

STEP 1: Calculate the Storage Volume (V), using a variation of the Rational Formula. Determine the volume of rainfall generated by the 10-year, 6-hour rainfall event over the contributing area to the trap.

$$\mathbf{V = (C) \times (I) \times (A) \times (Duration)}$$

Constants (assumed)

C = 0.5 = runoff Coefficient assumed to represent smooth graded area with no vegetation.

Duration = T_c = Time of Concentration = 6 hrs **= 21,600 sec**

STEP 1-A: Determine area contributing sediment laden runoff to the sediment trap. Areas with existing vegetation or paved surfaces need not be included when determining this area.

A = Contributing Area (acre)

STEP 1-B: Determine hydrologic zone within which the project site is located. Refer to I-D-R Curve Zone Map in Appendix D.

Zone = Hydrologic Zone

STEP 1-C: Determine rainfall intensity generated by the 10-year, 6-hour rainfall event. Use the following table to select the appropriate intensity.

I_{10} = Intensity (in/hr)

Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
I_{10} (in/hr)	0.45	0.42	0.37	0.37	0.37	0.3	0.27	0.28	0.25	0.19	0.18	0.19	0.15

STEP 1-D: Determine the volume of required storage.

By using the formula described in STEP 1 and applying the assumed constants, the formula can be simplified to:

$$\mathbf{V\ (ft^3) = I\ A\ (10{,}800)}$$

Divide the storage volume evenly between dry and wet storage. The wet storage normally occupies the bottom two-thirds of the trap depth.

Example

Required: Determine required volume for a temporary sediment trap.

Given: A = 1.2 acre; Site Location = Alsea, Oregon

Solution: Alsea is located in Zone 4; I_{10} for 6-hr storm in Zone 4 = 0.37 in/hr.

V = (0.37 in/hr) x (1.2 acre) x (10,800) = **<u>4,795 ft^3</u>**

STEP 2: Calculate the dimensions of the sediment trap by satisfying the volume requirements.

The trap dimensions must be assumed and then the volume of the trap based on the initial assumptions can be calculated using the following:

$$V = [LWD] + [(L+W)ZD^2] + [4/3Z^2D^3]$$

Where:

V	=	Storage Volume
W	=	Width of Trap on Bottom
L	=	Length of Trap on Bottom
D	=	Depth of Trap
Z	=	Side slope (1:Z; vertical to horizontal)

Example

Required: Determine volume of proposed temporary sediment trap.

Given: W = 10 ft, L = 30 ft, D = 4.5 ft, Z = 3

Solution: $V = [30 \times 10 \times 4.5] + [(30+10) \times 3 \times 4.5^2] + [(4/3) \times 3^2 \times 4.5^3] = \underline{\mathbf{4{,}874\ ft^3}}$

STEP 3: Outlet Structure Design: The outlet structure for a temporary sediment trap should be sized to handle expected flows. For most sediment traps a rock weir (spillway) will be sufficient. For larger flows or areas with heavy sediment loading a perforated riser pipe may need to be used as outlet to the trap.

ROCK WIER The crest of the weir should be 1 ft. below the top of the embankment. The weir should be constructed of two layers of different size rock. The top 12 in. must be 3-6 in. riprap. The bottom layer should be of a smaller size. If large flows are expected, the size of the rock should be designed for stability in accordance with Volume 1 of the ODOT Hydraulics Manual.

- Rock Weir Sizing: The weir length (X) can be estimated using the broad crested weir equation and assuming a 1 in. flow depth over the weir (H). The amount of flow going over the weir can be estimated using the information developed for sizing the trap. Assume a weir coefficient (C_w) of 0.4.

$Q = CI_{10}A$ (Rational Formula)

$X = \{(3/16)\ Q/C - [0.8(\text{Tan}\ \Theta)\ H^{2.5}]\} / H^{1.5}$ (Broad Crested Weir Formula)

$X\ (ft) = 6\ I_{10}\ A$

Example

Required: Determine length of rock weir.

Given: A = 1.2 acre; Site Location = Alsea, Oregon

Solution: Alsea is located in Zone 4; I_{10} for 6-hr storm in Zone 4 = 0.37 in/hr.

X = (6) x (0.37 in/hr) x (1.2 acre) = 2.7 ft **use 3 ft min**

RISER PIPE An alternate to the rock weir outlet is a riser pipe. Detail DET 417 (located at the end of Chapter 4 shows a typical riser pipe outlet detail). A typical detail for the riser pipe should show the following:

- Pipe slit perforations, which are .6 in. wide by 6 in. long, or 1 in. diameter holes spaced 6 in. vertically and horizontally from the outside edges above the wet storage elevation.
- The riser pipe should be wrapped with .3 to .6 in. wire hardware cloth and covered with geotextile overlapped, folded and fastened at the seam. The geotextile should extend 6 in. above and below the highest and lowest slits and should be secured top and bottom with straps or connecting bands.
- Anchor the riser using a concrete or steel base. The concrete base should be 20 in. deep with the riser embedded 10 in. The steel base should be .3 in. thick, welded watertight to the riser and covered with 2 ft. of stone or gravel.
- Table 6-3 gives riser pipe diameters for different size drainage areas.

Table 6-3 Outlet riser pipe diameters.

Maximum Drainage Area	**Minimum Barrel Diameter**	**Minimum Riser Diameter**
1 acre	24 in.	15 in.
2 acres	15 in.	18 in.
3 acres	18 in.	21 in.
4 acres	21 in.	24 in.
5 acres	21 in.	27 in.

Recommended Limits

Table 6.4 List of recommended outlet riser pipe diameters

A list of recommended size limits must be checked prior to completing the trap sizing calculations. These limits include:

Recommended Limits		
Variable	**Min**	**Max**
V	890	17,658
D	1.1	1.5
L	3	N/A
W	1	N/A
L/W	2	N/A
Z	2	N/A
X	1	N/A

V Acceptable volumes using this design criteria are 890 ft^3 to 17,658 ft^3. Sediment traps smaller than 33 yd^3 are equivalent to a check dam. Sediment traps larger than 654 yd^3 are considered a sediment basin and designed using more thorough methods.

D Sediment traps shallower than 3 ft. will not provide adequate settling depth or wet vs. dry storage volume separation. Sediment traps deeper than 5 ft. are considered a sediment basin and designed using more thorough methods.

L	Any sediment trap shorter than 10 ft. is equivalent to a check dam.
L/W	Calculate the trap length (L) using: L = 3W If site conditions disallow a 1:3 L/W ratio, a 1:2 may be used if the traps are small in size.
W	Any sediment trap narrower than 3 ft. is equivalent to a check dam.
Z	Optimum side slopes are 1:3. Side slopes as steep as 1:2 can be used if site conditions can not sustain flatter slopes. Slopes may be steeper than 1:2 is ground consists of stable rock.
X	Rock weirs (spillway) narrower than 3 ft. provide less effective flow spreading and may contribute to erosion downstream.

Design Options

Site conditions often dictate sediment trap sizes and locations. When required sediment trap volumes exceed feasible site location conditions the following options can be considered:

- Design smaller sediment traps and place them in series instead of providing one large sediment trap.
- Limiting areas of disturbance (which reduces the area the sediment trap must serve).

Spreadsheet Analysis

A spreadsheet has been developed to assist designing temporary sediment traps. The spreadsheet calculates STEP 1, STEP 2, STEP 3 (rock weir only) and checks the recommended limits. The location of the spreadsheet is discussed in section 6.3.

6.2.2.8 Cover Measures

Temporary and permanent cover measures protect disturbed areas. Covering exposed soils prevents erosion, thus reducing reliance on less effective sediment removal and is the only practical method of reducing turbidity. Ideally, all disturbed ground not being worked should be covered to prevent wind and water erosion.

Temporary cover protects disturbed areas not at finished grade or areas that will be redisturbed at a later date. Temporary cover methods include mulch, erosion control matting, plastic sheeting, seeding, sodding, and others. Mulch and plastic sheeting protect disturbed areas from days to a few months. Plastic sheeting is most applicable to short term stockpile protection and on certain slopes steeper than 1:1.5. Seeding and sodding can protect uncorked areas for months. Soil stockpiles should always be protected with plastic sheeting, tarpaulins, silt fence, diversion dikes, or combinations thereof.

Permanent cover methods include seeding and mulching, erosion control matting with seed on steep slopes, riprap, gravel, bark mulch with tree and shrub planting. and sodding.

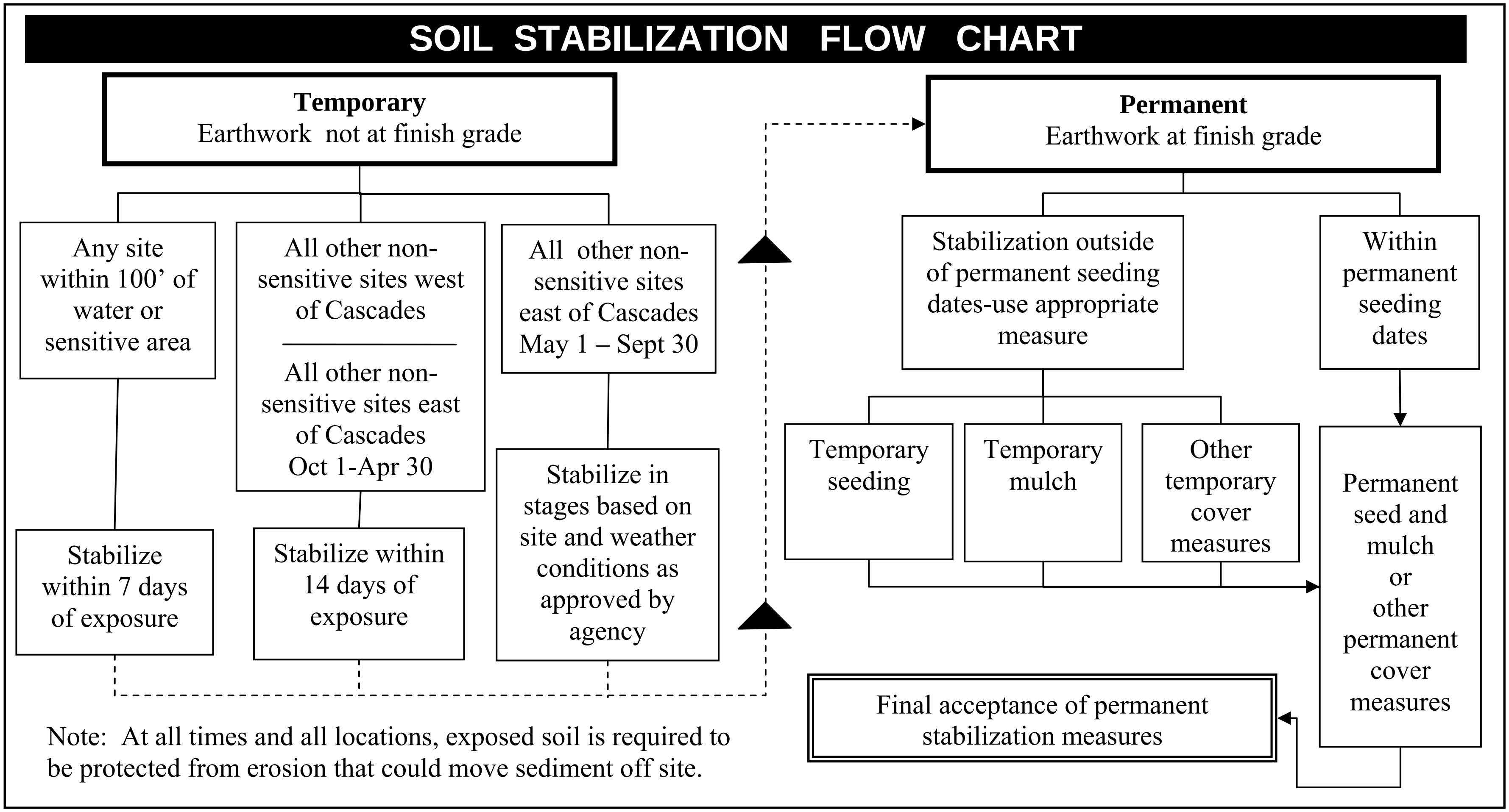


Figure 6-1 Flow diagram of the stabilization requirements found in specifications

Cover measures are described in Section 00280 of the Standard Specifications and seeding dates are described in Section 01030. Permanent and temporary cover measures may be called out by the square yard, acre, or lump sum but need not be shown on the ESCP.

6.2.2.9 Matting

Matting that is appropriate for use on ODOT construction projects must be tested and approved by the Texas Department of Transportation (TXDOT). For roll-type and spray-on erosion control products used to stabilize and revegetate slopes or drainage channels, TXDOT test for two critical performance standards:

1. How well the product protects the surface of the slope or the geometry of the channel from loss of sediment.
2. How well the product promoted the establishment of warm-season perennial vegetation over time.

TXDOT engineers believe that in order for a product to be placed on its Approved Product List (APL), it must meet or exceed the adopted standards for both the sediment loss and the vegetation density factors. A failure within either one prevents a product from being included on the APL.

By analyzing how products actually performed, TXDOT has established both a maximum allowable sediment loss standard and a minimum vegetation density standard for each of four possible slope/soil combinations on an embankment.

To determine the type of matting that will be appropriate for slope protection, the designer must know the soil type and the slope steepness, i.e. 1:2 or 1:3 (V:H). To determine the type of matting appropriate for channel lining, the designer must know the shear stress on the channel bottom. The procedure for determining shear stress is described in Volume 1 of the ODOT Hydraulics Manual.

The latest performance information and the APL are available on the Web. Go to the TexDOT home page, which may be accessed at http://www.dot.state.tx.us. Click on Divisions and Special Offices button, then click the Construction and Maintenance Division button.

Areas of the ESCP that require erosion control matting should be shown using a patterning that is reflected in the legend.

6.2.2.10 Traffic Area Stabilization

Traffic area stabilization is necessary when access is planned for more than 25 trips per day from construction equipment. Construction road and parking area stabilization reduces safety hazards caused by sediment on public right-of-way. It also reduces the amount of sediment that can end up in the drainage system by minimizing the amount of sediment transported offsite. Stabilization is also an excellent form of dust control in the summer months. Traffic area stabilization methods covered in this manual include construction entrance stabilization and construction road/parking area stabilization. Construction entrances are needed to protect sediment from being tracked offsite or onto paved surfaces. They should be included on the plans, legend, and in the cost estimate. Equipment servicing areas and other areas that require stabilization are included in the Pollution Control Plan and need not be shown in the ESCP or paid for separately.

6.2.2.11 Dust Control

Dust control measures minimize the transport of soil by wind, thereby reducing traffic hazards and sediment deposition in water resources. Watering is the most common dust control (palliative) used. Other methods include mulching, seeding, gravel, or spraying exposed areas with an approved dust palliative – see Qualified Products List. Oil is seldom appropriate for dust control. Using covered haul equipment reduces dust from materials transported offsite. Measures strictly for dust control are included in the Pollution Control Plan and need not be shown on the plans or estimate.

6.2.2.12 Additional Design Features

The ESCP should address any of the previous nine concerns, which may apply to the project. In addition, the ESCP should do the following:

- Show clearing limits, drainage courses, easements, setbacks, and sensitive areas and their buffers and areas of preserved vegetation.
- Provide controls such as check dams at features such as cuts and fills; cut and fill transitions and use storm drain inlet protection.
- Provide energy dissipation at culvert outlets when needed such as scour basins.
- Provide velocity control structures such as check dams along steep slopes and grades.

Once the applicable design elements are determined, plan sheets can be developed using the base map. The plan sheets should include enough information at a scale large enough to clearly communicate the ESCP to contractors, inspectors and permitting jurisdictions.

6.2.3 Develop Base Map

The base map should be plotted at the same scale as that of the rest of the roadway plans. Topographic features such as contours and water bodies are important because the length of slope and steepness of slope is used to determine the level of erosion protection. Grading limits and their proximity to water features will tell the designer when to use perimeter protection or another method that will trap sediments before they reach the water. Cut and fill lines are necessary to determine whether perimeter erosion protection is required such as silt fence or if check dams are needed when determining how the project grading will change the existing topography at the site.

The existing and proposed storm drainage features are required so the designer can evaluate where inlet or outlet protection measures will be needed. Drainage ditches may need check dams to slow the runoff from the project site in order to settle out sediments.

The base map should be plotted at a scale large enough to easily distinguish important features such as drainage swales and topography. The base map should include the following information:

- Alignment and stations.
- Names of roads and waterways.
- Right of Way and easements.
- Storm water drainage (culverts, pipes, etc.).
- Natural drainage features (lakes, swales, rivers, streams, wetlands, etc.).
- Cut and fill lines and expected slopes.
- Topography outside cuts and fills.
- Roadway grades.
- Extent of surrounding development.
- Detours and detour structures.

6.2.4 Develop Plan Sheets

Refer to the *ODOT Contract Plans Development Guide*, Chapter 7 for the correct procedure for developing the ESCP Plan Sheets. The following is a list of items that should be included in the ESCP:

Plan Sheet Checklist

- ❑ Sheet title, sheet number and "V" number
- ❑ Plan sheet (DEK.DGN and PLANS.DGN)
- ❑ ODOT flying tee logo
- ❑ Notes in the lower right corner (if necessary)
- ❑ Reference to standard drawings (if necessary)
- ❑ Signature block (first Erosion Control sheet only)
- ❑ Engineer or landscape architect's stamp (all ESCP sheets)
- ❑ Location of Best Management Practices (BMP) using standard symbols
- ❑ Erosion control construction notes and reference bubbles
- ❑ Existing ground contour lines in 1 or 2 foot increments (screening optional) with major elevations labeled
- ❑ Proposed grading contours (optional)
- ❑ Cut and fill lines and topography outside cuts and fills
- ❑ Erosion control BMP's, relative to construction staging (optional)
- ❑ Alignment showing line labels and stationing ahead on line
- ❑ Place names including roads and all waterways
- ❑ Right of Way and easements
- ❑ Storm water drainage system (culverts, pipes, inlets)
- ❑ Natural drainage features (lakes, swales, rivers, streams, etc.)
- ❑ Arrows indicating drainage patterns and flow directions
- ❑ Show boundaries of environmentally sensitive areas such as wetlands, burial grounds, etc.
- ❑ Location and names of Best Management Practices (BMP) including aggregate construction entrances
- ❑ Delineation of clearing limits
- ❑ Construction notes for each plan sheet giving construction directions
- ❑ North Arrow on each plan sheet
- ❑ Legend of ODOT standard symbols actually used per plan sheet
- ❑ Existing structures

6.2.4.1 Erosion Control Construction Notes

The boilerplate language for the construction notes is found in the Contract Plans Development Guide, Volume 2. The Construction Notes should appear on the first ESCP plan sheet. A number of different formats are available that can be inserted onto the plan sheet. Use only the paragraphs that are pertinent to the plan. For example, when aggregate construction entrances are not used in the plan, the final paragraph must be deleted from the construction notes. Also, if sediment fences are not used on the project, delete the paragraph that pertains to sediment fence. The designer may add language in the construction notes to direct the contractor or to further explain the ESCP.

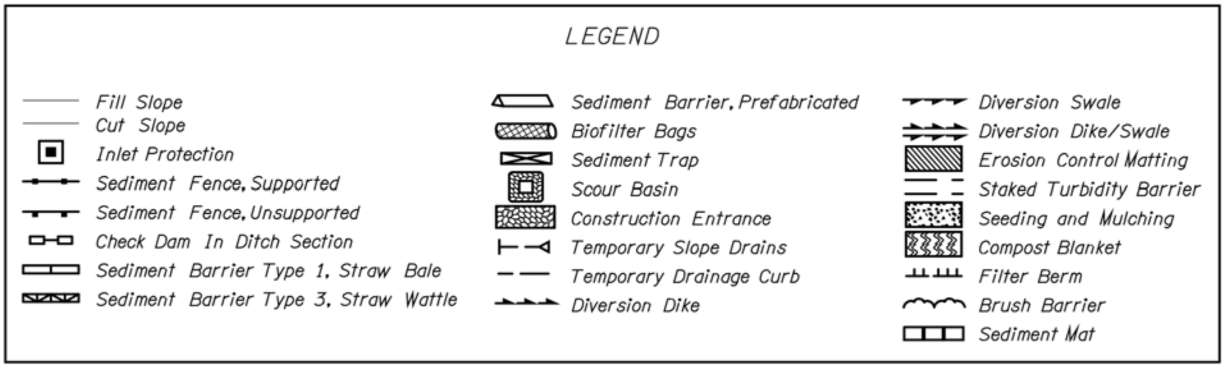
GENERAL NOTES:

> *The Implementation Of These Erosion Control Plans And The Construction, Maintenance, Replacement And Upgrading Of These Facilities Are The Responsibility Of The Contractor Until All Construction Is Completed And Approved.*
>
> *Develop A Revised Plan Of The Erosion Control Facilities Shown In Accordance With The Requirements Of Sec. 00280, Supplemental Standard Specifications. This Plan Must Be Constructed In Conjunction With All Clearing And Grading Activities. Construct In Such A Manner As To Insure That Sediment And Sediment-Laden Water Does Not Enter The Drainage System, Roadway, Or Violate Applicable Water Standards. Construct Controls In Segments Applicable To Each Staging Phase.*
>
> *The Erosion Control Facilities Shown On This Plan Are The Minimum Requirements For Anticipated Site Conditions. During The Construction Period, These Facilities Shall Be Upgraded For Unexpected Storm Events And To Insure That Sediment And Sediment-Laden Water Do Not Leave The Site.*
>
> *Stabilized Construction Entrances Shall Be Installed At The Beginning Of Construction And Maintained For The Duration Of the Project. Additional Measures May Be Required To Insure That All Paved Areas Are Kept Clean For The Duration Of The Project.*
>
> *Construct Sediment Fence 6 ft. At The Toe Of Fill Slopes In Areas Where Sediment-Laden Water Has A Potential Of Entering Waterways Or Leaving The R/W.*

6.2.4.2 Erosion Control Legend

The ESCP and construction legend should meet the same standards as given for the roadway portion of the plans. Use only the items that are included in the ESCP design.

Figure 6-2 Erosion Control Legend



6.2.5 Plan Sheet Format

The ESCP plan can either be a separate section, be included in the roadway construction plans, or be shown as a table of locations. In all cases, the erosion control Detail sheet must be included.

The ESCP is normally a separate section of the contract plans and is 11" X 17" sheet size as is most common for contract plans developed in the ODOT Roadway Section. The detail sheets precede the plan sheet. Each plan and detail sheet will all have an engineer's stamp. The first page of the ESCP set will also include the name of the drafter and the designer.

The ESCP can have the following formats*:*

- 11 X 17 sheets with a separate ESCP section in the plans.
- 11 X 17 sheets with the ESCP incorporated into the Roadway plans
- Table of Locations

In the event that the ESCP is not too complicated and the roadway plans can accommodate additional items without appearing confusing, the erosion control items can be placed on the roadway construction plans. It is important to include a legend that reflects the erosion control items. In this case, the construction notes should be on the first erosion control page of the first standard detail sheet.

6.2.5.1 Table of Location Plan Sheet Format

This ESCP format is typically used when the project is long and the need for erosion control best management practices is limited to sporadic locations. At a minimum, the ESCP must include the table of location, the erosion control construction notes, and the details for each best management practice called for on the table of locations.

The table of locations must include the location where the erosion control method is needed. The locations should be noted using English stationing. The erosion control item is listed by station as well as which side of the road that it should be installed. An ***L*** is used for left or ***R*** for right by increasing station. The page number reference for the corresponding plan sheet displaying the detail should also be included. Below is an example of an ESCP table of locations.

Station	**(L/R)**	**Erosion Control BMP**	**Quantity**	**Plan Sheet**
"L" 1+61	Lt.	Supported Silt Fence		2D
"NB" 1+65	Lt.	Inlet Protection (Type 3)		2D-2
"L" 1+79	Rt.	Inlet Protection (Type 3)		2D-2
"L" 0+98 to "L" 1+99	Lt.	Unsupported Sediment Fence		2D
"L" 1+14 to "L" 1+18	Lt.	Unsupported Sediment Fence		2D
"NB" 1+32	Rt.	Inlet Protection (Type 3)		2D-2
"L" 1+94 to "L" 1+96	Rt.	Unsupported Sediment Fence		2D

6.3 Designer Tools

6.3.1 Soil Survey Information

Each county has a published survey of soils. The county soil survey contains much information useful for any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock.

These and many other soil properties that affect land use are described in the soil survey. Broad areas of soils are shown on a general soil map. The location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Natural Resource Conservation Service. The Natural Resource Conservation Service (NRCS) has an office in each county where a copy of the soil survey can be obtained free of charge. A directory of NRCS county offices can be found on the Internet at *http://www.or.nrcs.usda.gov/people/cnty/officedir.html*.

6.3.2 Contract Plans Development Guide

The method for putting together the ESCP is found in the most current version of the Contract Plans Development Guide, Chapter 7. Volume 1 of Chapter 7 contains information about how to set up the ESCP using Microstation$_{tm.}$ Volume 2 shows examples of the boiler plate formats of the erosion control notes, legend, and plan sheet formats as well as examples of standard details as they would appear within an ESCP.

6.3.3 Hydraulics Manual

The ODOT Hydraulics Manual is available from the Geo-Environmental Unit's Practices & Standards Unit. Volume 1 contains detailed technical information useful in assessing a project site for erosion control measures, such as, how to calculate peak flow rate using the Rational Method, the NRCS Unit Hydrograph Method, and the USGS Urban Equation.

6.3.4 Precipitation Data

The occurrence and amounts of rainfall is important for the designer when deciding to what extent the erosion control measures must be used. During construction, the contractor must monitor the rainfall onsite using a rain gauge. Precipitation data may be found by contacting the National Weather Service.

West Coast Weather Observation at www.ocs.orst.edu/obs_west.shtml gives information on temperatures, wind direction, relative humidity, and precipitation all over Oregon.

Oregon Coast and Pacific Northwest Weather Forecasts provides weather predications, as well as current weather data and can be reached at http://IWIN.nws.noaa.gov/iwin/or/or.html

6.3.5 Internet Sites

Oregon Seed Certification Service	www.oscs.orst.edu
Natural Resource Conservation Service	www.or.nrcs.usda.gov
International Erosion Control Association	www.ieca.org
Qualified Products List:	http//www.odot.state.or.us

Click on contractors, then Qualified Products

Matting materials approved products list

TXDOT Testing Laboratory www.dot.state.tx.us

Click on Divisions and Special Offices, then Construction and Maintenance

West Coast Weather Observations www.ocs.orst.edu/obs_west.shtml

Oregon Coast and Pacific NW Weather http://IWIN.nws.noaa.gov/iwin/or/or.html

ODOT FTP Site ftp://ftp.odot.state.or.us

Technical Services/Roadway/Standards: EC Details 400 Series

Technical Services/Hydraulics/Econtrol: Statewide seeding recommendations, cost estimate spreadsheet, and the sediment trap design spreadsheet

6.4 Cost Estimate

The ESCP designer prepares a quantity and cost estimate for specific erosion control best management practices included in the ESCP. The designer must compile a list of all erosion control bid items and estimate a cost for each of the bid items.

A project cost estimate normally includes a lump sum bid item called “Erosion Control”. This item is for developing and updating the Erosion and Sediment Control Plan (ESCP) required in section 00280 and also covers any additional work required but not included in the Bid Schedule, including monitoring BMP’s and providing an Erosion and Sediment Control Manager (ESCM). A sample spreadsheet listing each item can be used to prepare cost estimates and an example cost estimate form is shown on the following page.

PROJECT :		**DATE:**	
HIGHWAY:		**MP:**	
COUNTY :			
KEY NO.:		**ESTIMATOR:**	

CODE	**ITEM**	**UNITS**	**QUAN**	**UNIT COST**	**TOTAL COST($)**
SECTION 00280					
	Biofilter Bags	Each			
	Check Dams	Each			
	Construction Entrance	Each			
	Diversion Dike/Swale	ft			
	Temporary Drainage Curbs	ft			
	Erosion Control	LS			
	Flow Spreader	ft			
	Inlet Protection	Each			
	Matting	ft^2			
	Temporary Mulching	AC			
	Plastic Sheeting	ft^2			
	Sand Bags	Each			
	Temporary Scour Holes	Each			
	Sediment Barrier	ft			
	Sediment Fence, Supported	ft			
	Sediment Fence, Unsupported	ft			
	Temporary Sediment Trap	Each			
	Temporary Slope Drains	ft			
	Temporary Stabilization	LS			
	Tire Wash Facility	Each			
SECTION 01030					
	Fertilizing	AC			
	Mobilization, Seeding	Each			
	Permanent Mulching	AC			
	Seeding, Permanent	AC			
	Seeding, Temporary	AC			
	Soil Testing	AC			
				Sub Total	**$0**
	Anticipated Items-				
	Additional erosion control measures	LS			
				Total	**$0**

6.5 Specifications

The designer develops and is responsible for the specifications for the ESCP. The specifications must reflect each best management practice found in the ESCP and may contain additional information about materials, application, maintenance, and payment. The Standard Specifications cover most of the information needed for the commonly used best management practices. The Special Provisions are used to make modifications to the standard specifications and templates are available. Special provisions are used to make changes to the standard specifications on a job-by-job basis.

The designer and the construction staff should be familiar with each portion of sections 00290, 00280, and 01030 of the specifications (Standard, Supplemental, and Special Provisions).

6.5.1 Pollution Control – Section 00290

Water Pollution Prevention Measures are a part of work required on all construction projects. Section 00290 of the specifications describes the contractor's responsibilities related to the prevention of water pollution and the requirements for the pollution control plan.

6.5.2 Erosion Control – Section 00280

Erosion control measures are a part of work required on all construction projects which disturb soil. Section 00280 of the specifications describes the contractor's responsibilities related to the erosion control for the project. The work for the materials, installation, maintenance, inspection, and removal of each BMP is included in payment for the pay item for the specific BMP. Some BMP's are included in the lump sum pay item "Erosion Control." Unit measure pay items are preferred over lump sum because it reduces the risk to the contractor, generally yields more reasonable costs, and makes quantity adjustments in the field easier to negotiate.

6.5.2.1 Specific BMP's

The pay items that are available for specific BMP's and include materials, installation, maintenance, inspection, and removal include:

Pay Item	Unit of Measurement
Bio-filter Bag	ft or each
Check Dam	each
Construction Entrance	each
Diversion Dike/Swale	ft
Drainage Curb	ft
Flow Spreader	ft
Inlet Protection	each
Matting	ft^2 or ac
Temporary Mulch	ft^2 or ac
Plastic Sheeting, Temporary	ft^2
Sand Bags	ft or each
Temporary Scour Hole	each
Sediment Barrier	ft or each
Sediment Fence (Supported)	ft
Sediment Fence (Unsupported)	ft
Temporary Sediment Trap	each
Temporary Slope Drain	ft
Tire Wash Facility	each

6.5.2.2 Temporary Stabilization

Stabilization, Temporary is a lump sum pay item that is intended to clarify the need for temporary stabilization measures during a project which are a direct result of contractor staging and mode of operation decisions. It should be included on all jobs with a significant amount of anticipated earthwork. No separate payment should be made for BMP's when they are used to satisfy the temporary stabilization requirements for the job, even when the specific BMP pay item may be included in the contract. (For example: A stockpile of waste material is temporarily left onsite instead of immediately being hauled to the disposal site. The stockpile is then stabilized using placing plastic sheeting over the material. This work should be paid for by "Stabilization, Temporary," not "Plastic Sheeting, Temporary."). If this pay item is not included in the contract, the temporary stabilization work is included in the pay item "Erosion Control."

6.5.2.3 Erosion Control

Erosion Control is a lump sum pay item that is required on all jobs. Many important tasks are paid for by this pay item and it should not be ignored or minimized when preparing an engineer's estimate or bid for a construction contract. If this pay item is not included in the contract, all work described below is considered incidental and no separate payment is made. The major tasks include:

- Providing a qualified individual as an Erosion and Sediment Control Manager.
- Pollution Control Plan.
- Dust Control.
- Developing an Erosion Control Plan if none is provided.
- Revising the Erosion Control Plan to meet site conditions.
- Documenting installation, performance, maintenance, and removal of BMP's.
- Keeping Erosion Control Plan up-to-date.
- Temporary Stabilization (if not included as a separate pay item).
- Rainfall Monitoring.

6.5.3 Seeding – Section 01030

Seeding is a part of work required on all construction projects with disturbed soil anticipated at the end of the project. Section 01030 of the specifications describes the contractor's responsibilities related to seeding, fertilizing, mulching, and any specified soil testing operations that are necessary for vegetation establishment. An important part of seeding is the selection of the appropriate seed mixtures and rate of application. Each job may have unique soil, climatic, or other environmental conditions, so it is recommended to contact a qualified Landscape Architect, agronomist, horticulturist, or erosion control specialist for recommendations. There are two ways in which seeding can be specified, material specifications and performance specifications. Material specifications require the designer to specify seed mixtures and rates of application. Performance specifications require the designer to specify seed mixtures and final performance criteria. Seed application rates need not to be specified for performance specifications unless the designer wishes to include a minimum application rate.

The pay items, which are available for specific seeding applications, include:

Pay Item	Unit of Measurement
Fertilizing	ac
Mobilization (Seeding)	each
Mulching (Seeding)	ac
Seeding (Lawns)	ft^2
Seeding (Permanent)	ac
Seeding (Temporary)	ac
Seeding (Water Quality)	ac
Seeding (Wetland)	ac
Seeding (Wildflower)	ac
Seeding (Woody Plant)	ac
Soil Testing	ac

Seeding, fertilizing, and mulching are often combined into one operation. In these cases a single "Seeding" pay item may be used that is explained in the special provisions as including other materials as part of the operation.

The "Seeding (Temporary)" pay item is seldom used because this work is normally paid for by "Stabilization, Temporary." It is included here to allow the designer other options for paying for this type of work.

6.6 Narrative

For more complex projects, a narrative may be included in the project file and may also become part of the plan when necessary to explain the ESCP in greater detail. The narrative should be brief, clear and concise while stating pertinent information. The narrative should include design dates, expected rainfall, expected runoff velocities, expected peak flows, soil types, total project area and total disturbed area. It should discuss any particular concerns related to the project ESCP including special environmental and jurisdictional requirements, steep slopes, highly erodible soils, etc. and how the concerns were addressed.

Narrative Checklist

- ❑ Estimated total project area (acre)
- ❑ Estimated total disturbed (acre)
- ❑ Surficial soil types and erodibility (Soil Conservation Service K value)
- ❑ Runoff coefficients for disturbed areas
- ❑ Estimated peak flows for the design storm runoff
- ❑ Receiving waters
- ❑ Jurisdictions within the project limits
- ❑ State and local requirements incorporated into the plan
- ❑ Special environmental considerations related to storm water runoff
- ❑ Anticipated concerns, or possible problems
- ❑ Information sources and/or contacts
- ❑ Discuss special design features used for drainage with average grades exceeding 3%

6.7 Project Design Phases

In ODOT, Regions have responsibility for the development of projects. The following are the major project development phases used by ODOT and a brief summary of typical erosion control-related tasks for each phase (for projects with significant ground disturbance):

6.7.1 Project Planning and scoping

- Estimate erosion control needs based on the type of project, type and amount of disturbance impacts anticipated, and project environmental setting.
- From above, estimate level of effort required for erosion control preliminary engineering (design and associated).
- Using budgeting guidelines, estimate a dollar figure for cost of constructed items.
- Plan for the time, labor, and budget resources needed to perform the work.
- Incorporate scoping results into general project planning.

6.7.2 Preliminary Plans

- Confirm that a designer has been assigned for erosion control.
- Monitor general project design decisions with any potential for affecting erosion-related impacts. The goal is to eliminate or minimize impacts where feasible.

- Begin preparation or adaptation of base sheets for erosion control plans.
- Review Preliminary Plan set for any erosion-related impacts of structures, staging, or other areas of work.

6.7.3 Advance Plans

- Begin erosion control design (if not begun in previous phase).
- Ensure that all relevant information has been collected for design including relevant environmental documents such as the Biological Assessment.
- Analyze project for erosion-related impacts from all areas of design.
- Prepare base sheets that show all critical information such as topography.
- Visit site to confirm data and review site conditions.
- Select initial BMPs to mitigate for disturbance impacts.
- Finalize BMPs and complete plans, specifications, and estimate.

6.7.4 Final Plans

- Respond to comments made during Advance Plans distribution.
- Update base sheets and revise design and plans as required.
- Prepare final set of contract documents, submit for final review.
- Stamp Contract Documents in compliance with state requirements.
- Ensure that designer is available to respond to questions throughout bidding period.