

**CITY OF PLANO
EROSION AND SEDIMENT CONTROL MANUAL
1997**



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Chapter 1

INTRODUCTION AND SCOPE

Hundreds of acres of land are disturbed every year in the City of Plano for the construction of subdivisions, homes, shopping centers, office complexes, highways and other developments. Without erosion control measures this exposed land is vulnerable to accelerated erosion and sedimentation that can cause damage to adjacent properties, storm drain facilities, streams and other water resources of the City and State.

The City of Plano Erosion and Sediment Control Manual has been prepared by the City of Plano Engineering Division to provide technical assistance to design consultants, property owners, developers and contractors conducting land disturbing activity and involved with the development of property within the City of Plano. The information contained in this manual is intended as an aid in the preparation and implementation of erosion control plans and practices specifically for land disturbing activities within the City of Plano, Texas.

The manual focuses primarily on the design, construction and maintenance of methods that have proven to be effective in the control and prevention of soil erosion caused by rainfall and stormwater runoff. The soil erosion and sedimentation process will be briefly discussed in an overview, but a detailed discussion of these topics is beyond the scope of this manual. The list of references in the Appendix of this manual contain several recommended readings on the subjects of erosion and sedimentation.

In January 1989 the City Council of the City of Plano, Texas adopted the first local erosion control ordinance for implementation within the City's jurisdiction. The National Pollution Discharge Elimination System (NPDES), regulated by the Environmental Protection Agency (EPA), also requires all activities that meet the definition of an "industrial activity" to obtain storm water permits. Currently any construction activity that disturbs 5 acres or more of land meets the EPA definition of an "industrial activity" and must comply with NPDES permit requirements.

The City of Plano's erosion control ordinance and procedures are not meant to duplicate existing State or Federal regulations, but to compliment and precede these rules to help protect property and our water resources. Erosion control plans prepared to meet City requirements will meet or exceed State and Federal requirements, thus eliminating duplicate efforts. The design and submittal procedures at the local level will be identical to those required when a project must comply with State and Federal requirements, thus preparing consultants, owners and contractors for compliance procedures. However, additional forms and documentation may be necessary to comply with State and Federal regulations.

Chapter 2

REGULATIONS

- 2.1 **PLANO EROSION CONTROL ORDINANCE** - This section contains excerpts from the City of Plano Erosion Control Ordinance, but may be incomplete and should be used for information purposes only. This chapter should not be used for legal interpretations or proceedings.

CITY OF PLANO EROSION CONTROL ORDINANCE

ARTICLE VI. EROSION CONTROL

Sec. 14-92. Definitions

The following words, terms, and phrases, when used in this Article, shall have the meanings ascribed to them in this Section, except where the context clearly indicates a different meaning:

Below ground installations means activity that causes excess sediment laden water, concrete sawing wash water, wash water or drilling mud pumped from an excavation or structure and shall be treated as sediment laden runoff for erosion control purposes.

Building Official means the Building Official for the City of Plano or his designee.

Construction Activities means construction activities that require a building permit.

Director of Development Services means the Director of Development Services for the City of Plano or his designee.

Erosion control plan means a site plan with necessary details, showing the property where land disturbing activity will take place and showing the locations and types of devices, procedures and practices to be used to control erosion and sedimentation.

Final approval means completion of a project, site or building in accordance with City of Plano requirements and ordinances. In the case of a building, a Certificate of Occupancy is issued.

Land disturbing activity means any activity, including but not limited to excavation, planting, tilling, and grading, which disturbs 5,000 or more square feet of the natural or improved vegetative ground cover so as to expose soil to the erosive forces of rain, storm water runoff or wind. All installations and maintenance of franchise utilities such as telephone, gas, electric, etc., shall be considered land disturbing activities.

Manual means the City of Plano Erosion and Sediment Control Manual, as amended from time to time. A current copy of the Manual shall be kept on file in the Office of Development Services.

Off-site borrow area means a source of earth fill material used in the construction of embankments or other earth fill structures, that is located on another parcel of property other than where the principal construction is occurring.

Off-site sedimentation means deposit of soil material beyond the limits of the property undergoing land disturbing activity or in City streets, alleys or drainage facilities in an amount sufficient to constitute a threat to public safety and comfort.

Off-site spoil area means an area on another parcel of property, other than where the principal construction is occurring, where excess earth, rock or construction material is disposed of.

Permanent erosion control devices means devices or practices installed prior to final approval and maintained after final approval to prevent or minimize the erosion and deposit of soil materials. Such devices may include, but shall not be limited to, permanent seeding, sod, storm drain channels, channel linings, storm drain pipes, outlet velocity control structures and storm water detention structures.

Permanent ground cover means permanent vegetative cover on all bare soil areas of a property not covered by a permanent structure or landscaping improvements, including but not limited to, live sod, perennial grasses or other materials which lessen runoff and soil erosion on the property.

Phased occupancy means use or inhabitation of a single structure or other portion of a project as such structure or portion thereof is completed, but before the project as a whole is fully completed and finally approved by City.

Related land area includes the property where the principal land disturbing activity is taking place, all adjacent property, off-site borrow areas, off-site spoil areas, off-site properties necessary for required utility extensions, and off-site areas for required street improvements.

Responsible party means a business entity, franchised utility company, developer, property owner, contractor or holder of a building permit who is required to comply with the terms of this Article.

Staging area means an on-site or off-site location used by a Contractor to store materials for a project, to assemble portions of equipment or structures, to store equipment or machinery, to park vehicles, or for other construction related uses.

Stop work order means the suspension of all City permits with no approvals or inspections of work for the site or project being performed.

Temporary erosion control devices means devices installed or practices implemented and maintained during land disturbing activities to prevent, minimize or control the erosion and deposit of soil materials.

Sec. 14-93. Erosion Control Required.

(a) Application of Article. A Responsible Party engaging in any land disturbing activity or any construction activities shall prepare an Erosion Control Plan and submit that Plan to the City for approval. This Article shall apply regardless of whether a Responsible Party is required to obtain a permit from the City in order to conduct such land disturbing or construction activity. The Responsible Party shall also be held liable for violations of this Article committed by third parties engaging in activities related to the Responsible Party's project.

(b) Erosion Control Plan Implementation and Compliance. Each Responsible Party shall implement and maintain the erosion control measures shown on its approved Erosion Control Plan in order to minimize the erosion and the transport of silt, earth, topsoil, etc., by water runoff or construction activities, beyond the limits of the Responsible Party's site onto City streets, drainage easements, drainage facilities, storm drains or other City property prior to beginning any land disturbing activity.

(c) Off-Site Borrow, Spoil and Staging Areas. Where applicable, off-site borrow areas, spoil areas and construction staging areas shall be considered as part of the project site and shall be governed by this Article.

(d) Related Land Areas. The erosion control requirements of this Article shall apply to all related land areas. Additionally, when land disturbing activity occurs on a project, all disturbed land areas related to the project shall have permanent erosion control established before final occupancy of structures located thereon or final acceptance of the subdivision may be obtained. This section applies whether or not a building permit is required.

(e) Below Ground Installations. All discharges resulting from below ground installations shall be passed through City approved erosion control device(s) or removed from the site and properly disposed of.

Sec. 14-94. Erosion Control Plans.

(a) Plan Requirements Generally. Each Erosion Control Plan required by this Article shall clearly identify all erosion and sediment control measures to be installed and maintained throughout the duration of the project for which that Plan is submitted. The Responsible Party shall install and maintain erosion control devices in accordance with his City approved Erosion Control Plan as required by this Article.

Sec. 14-95. Non-Residential and Multi-Family Construction.

When construction or land disturbing activities are conducted as part of a Non-Residential or Multi-Family construction project, permanent erosion control shall be established prior to the occupancy of any non-residential or multi-family structure. Phased occupancy will be allowed only when there are no outstanding erosion control violations for the project for which the request is made.

Sec. 14-96. Residential Subdivisions - Compliance.

In addition to the other requirements of this Article, when construction or land disturbing activities are conducted as part of a Residential Subdivision project, the following shall apply:

(a) Erosion Control Deposit Account. Prior to approval of the final plat by the Planning and Zoning Commission, the Developer shall submit an Erosion Control Plan for approval by City and shall pay an erosion control deposit to the City in the amount of \$100.00 per lot. The deposit shall be posted to ensure implementation and continued maintenance of the City approved Erosion Control Plan for the development as required by this Ordinance. No inspection of any type may be performed on a project or portion thereof until a City approved Erosion Control Plan is implemented by the Responsible Party.

(b) Final Acceptance. Permanent erosion control devices and when applicable, temporary erosion control devices, as specified in the approved Erosion Control Plan shall be installed and maintained prior to final acceptance of a subdivision. The Developer for such subdivision shall continue to maintain all temporary erosion control devices until permanent erosion control has been established on all those lots within the subdivision for which a building permit has not been issued.

(c) Transfer of Property by Developer. If the Developer sells all of the lots in a subdivision to one purchaser, that purchaser becomes the Responsible Party for the subdivision, is liable for violation of this Article and shall post an erosion control deposit as required by this Article. The balance remaining in the original Developer's account shall be released as provided herein upon the submission of written proof of transfer of lots or a new erosion control deposit by the purchaser. As required by this Article, the such purchaser shall post an erosion control deposit with City.

(d) Deductions from Erosion Control Deposit Account/Stop Work Orders/Citation. City shall inspect the erosion control devices located at a site for compliance with the approved Erosion Control Plan submitted by a Developer. If a Developer fails to implement or maintain erosion control devices as specified in his approved Erosion Control Plan, City shall provide such party with written notice of noncompliance identifying the nature of the noncompliance. Such notice shall also inform the Developer of the circumstances under which a deduction from his deposit account will be made and the time frame for the filing of an appeal of such action by City. The Developer shall have twenty-four (24) hours to bring his erosion control devices into compliance with the approved Erosion Control Plan for the site to which notice of noncompliance was issued. Correction shall include sediment clean-up, erosion control device repair, erosion control device maintenance and/or installation of additional erosion control devices to prevent re-occurrence of the violation. The 24-hour cure period may be extended for inclement weather or other factors at the discretion of the Director of Development Services.

At the end of the twenty-four (24) hour cure period, City shall re-inspect the site and shall deduct a re-inspection fee of \$150.00 from the Developer's erosion control deposit account. If at the time of such re-inspection, the erosion control devices at the site have not been brought into compliance with the approved Erosion Control Plan, City may issue a stop work order and issue a

citation for each violation of this Article. All deductions from a Developer's erosion control deposit account may be appealed as provided in Section 14-101 of this Ordinance.

(e) Erosion Control Deposit Account Balance - Deposit Refund. After building permits have been issued for seventy-five percent (75%) of the lots within the development, the Developer may request the return of the remainder of his deposit by submitting a written request to the Development Services Department. However, the Developer shall continue to maintain temporary erosion control devices on those remaining lots for which building permits have not been issued and for any other areas upon which permanent erosion control has not been established. The balance of the deposit remaining in an account after deductions for all violations have been made shall be refunded within thirty (30) days of receipt of the written request for refund along with a list of all deductions made from his deposit account. The Responsible Party shall have the right of appeal as set forth in Section 14-101 of this Chapter.

(f) Erosion Control Deposits. Erosion control deposits posted pursuant to the requirements of this Article shall not accrue interest.

Sec. 14-97. Franchised Utility Companies.

Subject to the terms of its franchise agreement with City, including but not limited to terms regarding permits, a franchised utility company engaging in land disturbing activities within the City of Plano shall comply with the following:

(a) Erosion Control Plan. Prior to beginning any land disturbing activity or upon the effective date of this ordinance, an Erosion Control Plan shall be submitted for approval by the City.

(b) Stop Work Order/Citation. City shall inspect the erosion control devices located at a site for compliance with the approved Erosion Control Plan submitted for such site. If a Responsible Party fails to implement or maintain erosion control devices as specified in his approved Erosion Control Plan, City shall provide such party with written notice of noncompliance identifying the nature of such noncompliance. The Responsible Party shall have twenty-four (24) hours to bring his erosion control devices into compliance with the approved Erosion Control Plan for the site where the violation occurred. Correction shall include sediment clean-up, erosion control device repair, and erosion control device maintenance. The 24-hour cure period may be extended for inclement weather or other factors at the discretion of the Director of Development Services.

At the end of the 24-hour cure period, City shall re-inspect the site. If at the time of such re-inspection, the erosion control devices at the site have not been brought into compliance with the approved Erosion Control Plan, City may issue a stop work order and issue a citation for each violation of the City's erosion control requirements. To obtain a re-inspection for removal of the stop work order, a request for re-inspection must be submitted.

Sec. 14-98. Farming and Ranching Activities.

Prior to beginning any land disturbing activity or upon the effective date of this ordinance, a Responsible Party engaging in land disturbing activities for farming and ranching purposes shall submit an Erosion Control Plan for approval by the City. The approved Erosion Control Plan shall be implemented and erosion control devices shall be maintained as specified in the Plan. A Responsible Party engaging in farming or ranching activities shall comply with all other general requirements of this Ordinance.

Sec. 14-99. Residential Lots with a Building Permit.

When land disturbing activities are conducted on a residential lot for which a building permit must be issued, the Responsible Party shall comply with the following:

(a) Erosion Control Plan. Prior to approval of a building permit for a residential lot by the City, the Contractor or other Responsible Party obtaining the building permit shall submit an Erosion Control Plan for approval by the City. No inspection may be performed on a project until a City-approved Erosion Control Plan is implemented.

(b) Stop Work Order/Citation. City shall inspect the erosion control devices located at a site for compliance with the approved Erosion Control Plan submitted for such site. If a Responsible Party fails to implement or maintain erosion control devices as specified in his approved Erosion Control Plan, City shall provide such party with written notice of noncompliance identifying the nature of such noncompliance. The Responsible Party shall have twenty-four (24) hours to bring his erosion control devices into compliance with the approved Erosion Control Plan for the site where the violation occurred. Correction shall include sediment clean-up, erosion control device repair, erosion control device maintenance, and/or installation of additional erosion control devices to prevent re-occurrence of the violation. The 24-hour cure period may be extended for inclement weather or other factors at the discretion of the Building Official.

At the end of the 24-hour cure period, City shall re-inspect the site and may assess a re-inspection fee. If at the time of such re-inspection, the erosion control devices at the site have not been brought into compliance with the approved Erosion Control Plan, City may issue a stop work order and issue a citation for each violation of the City's erosion control requirements. When a stop work order has been issued, a re-inspection fee shall be assessed. To obtain a re-inspection for removal of the stop work order, a request must be submitted therefor and a re-inspection fee, as set by the Building Inspection Department of the City of Plano, shall be paid.

(c) Removal of Erosion Control Devices. Upon final occupancy or upon establishing permanent ground cover on a lot, all temporary erosion control devices shall be removed.

Sec. 14-100. Enforcement.

(a) Violations. It shall be an offense for a Responsible Party or a third party performing work on a project to violate any of the requirements of this Article, including, but not limited to, the following:

- (1) Conducting any land disturbing or construction activity without an approved Erosion Control Plan for the location where the violation occurred.
- (2) Failing to install erosion control devices or to maintain erosion control devices throughout the duration of land disturbing activities, in compliance with the approved Erosion Control Plan for the location where the violation occurred.
- (3) Failing to remove off-site sedimentation that is a direct result of land disturbing activities where such off-site sedimentation results from the failure to implement or maintain erosion control devices as specified in an approved Erosion Control Plan for the location where the violation occurred.
- (4) Allowing sediment laden water resulting from below ground installations to flow from a site without being treated through an erosion control device.
- (5) Failing to repair damage to existing erosion control devices, including replacement of existing grass or sod.

(b) Notice of Violation. Written notice of violation shall be given to the Responsible Party or his job site representative as identified in the Erosion Control Plan for a site. Such notice shall identify the nature of the alleged violation and the action required to obtain compliance with the approved Erosion Control Plan.

(c) Class C Misdemeanor. Any person, firm, or corporation violating any of the provisions or terms of this Article shall be deemed guilty of a Class C misdemeanor and, upon conviction thereof, be subject to a fine not exceeding \$500 for each offense, and each and every day such violation shall continue shall be deemed to constitute a separate offense.

Sec. 14-101. Appeals.

(a) Appeal to Director of Development Services. Upon notice of noncompliance, a Responsible Party may appeal the City's decision to take deductions from his erosion control deposit pursuant to Section 14-96 of this Article, by filing a written appeal to the Director of Development Services within seven (7) days of City's written notice of its intent to make such deduction for costs as allowed herein. An appeal filed pursuant to this section shall specifically state the basis for the aggrieved party's challenge to the City's authority to take deductions under this Article.

(b) Standard for Appeals. When reviewing an appeal filed pursuant to this Section, the Director of Development Services shall evaluate all evidence submitted. The burden of proving that a violation of this Article occurred shall be on the City. The City shall provide evidence

sufficient to reasonably support a determination that the Responsible Party failed to comply with the requirements of this Article as alleged by the City.

(c) Issuance of Opinion by Director. Decisions of the Director of Development Services shall be issued within twenty (20) days of City's receipt of the written appeal. Decisions of the Director of Development Services shall be final.

2.2 USEPA - NPDES PERMIT PROGRAM - Under current Federal law and EPA/State Regulations, all owners/operators of storm water discharges from industrial activities must have applied for and be operating pursuant to a NPDES permit, or risk Federal penalties. The regulations define "storm water discharges associated with industrial activity" to include storm water discharges from construction activities (including clearing, grading and excavation activities) that result in the disturbance of five or more acres of total land area, including areas that are part of a larger common plan of development or sale.

The EPA administers the NPDES program under the Clean Water Act (CWA), but a provision in the CWA allows states to request authorization to administer the NPDES program instead of the EPA. States that develop an EPA approved plan can become responsible for issuing permits and administering the NPDES program locally. To date the State of Texas has not developed an EPA approved plan and is not delegated to issue NPDES permits. Dischargers in Texas must comply with EPA's regulations which mandate that baseline requirements be met.

Two kinds of permits are issued under the NPDES program. One is an individual permit tailored to fit the specific requirements of a particular facility, while the second, a general permit, provides umbrella-like coverage to a large number of facilities. General permits have been established by the EPA with generic requirements for sediment and erosion control, storm water management, and other controls. Coverage under the general permit will normally be available for all construction activities. The general permit is also the quickest and easiest to obtain.

The operator of a construction site must submit a Notice of Intent (NOI) for coverage under the general permit, prior to the start of construction. For the purposes of this permit, "operator" is the party or parties that either individually or taken together meet the following two criteria:

- They have operational control over the site specifications; and
- They have day to day operational control of those activities at the site necessary to ensure compliance with plan requirements and permit conditions.
-

In many instances, more than one party will have to submit an NOI for the same project in order to satisfy both criteria.

Currently all NOI's prepared for activities within the State of Texas shall be sent to:

Storm Water Notices of Intent
P.O. Box 1215
Newington, VA 22122

Due to ongoing changes in Federal regulations always check the NOI form for the up-to-date mailing address.

Sites operating under approved state or local sediment or erosion control plans, are required to submit signed copies of the NOI to the approving state or local agencies, as well. Once the NOI is submitted for a general permit, the construction activities are automatically covered and construction may begin within 2 days, unless contacted by EPA. An actual permit will not be issued, although a specific permit number will be assigned to each application.

When the General permit is used a Storm Water Pollution Prevention Plan (SWPPP) is required. The SWPPP consists of an erosion and sediment control plan along with an accompanying report that outlines the methods that will be employed to reduce pollution at the site. The SWPPP shall be prepared in accordance with design guidelines acceptable to the EPA by a Registered Professional Engineer, licensed in the State of Texas. The purpose of the SWPPP is to identify potential sources of erosion and pollution to storm water discharge, and to provide mechanisms to reduce those pollutants. Although the plan is not to be submitted with the NOI, an applicant is required to prepare such a plan prior to NOI submission. Also the erosion and sediment control plan is required by the City of Plano's erosion control ordinance for land disturbing activities.

Persons required to comply with NPDES requirements under the storm water application rule could be subject to enforcement by the EPA. When required to comply, the permittee is subject to enforcement for breaching any condition of the General Construction Permit. In Texas, the EPA regional office is the primary regulating agency and will undertake enforcement actions where warranted. There are four methods of enforcement that are typically used. They are administrative orders, civil actions, criminal actions, and citizen suits.

Chapter 3

PRINCIPLES OF EROSION AND SEDIMENTATION

3.1 GENERAL

The most effective means of reducing the soil lost from property is to prevent the erosion of the soil. Structural barriers can provide 70% to 90% sediment removal efficiencies from runoff, but natural groundcover and mulching can provide 90% to 98% reduction in erosion and soil loss.

3.2 EROSION PROCESS

Erosion is a natural process by which soil and rock is loosened and removed by the action of water or wind. The primary focus of this manual is the control of erosion and sedimentation caused by surface water runoff. Construction-site erosion has been shown to be in most cases, the most excessive form of erosion known causing serious and costly problems, both on-site and off-site.

Runoff, water moving over the soil surface, is caused by rain water falling at a faster rate than it can be absorbed by the soil. The runoff water detaches and transports soil particles from one location to another. The erosiveness of flowing water depends upon its velocity, turbulence, plus the amount and type of abrasive material it transports. The higher the velocity of runoff, the higher the number of soil particles that can be transported.

The potential for an area to erode is related to four factors: soil type, surface cover, topography and climate.

The soil type has a direct impact on the erodibility of the soil. Key factors that affect the erodibility of a type of soil are the soil texture, the organic matter content, the type of soil structure, and the permeability of the soil.

Surface cover primarily in the form of vegetation, shields the soil surface from the impact of falling rain, reduces runoff velocity and spreads out the flow of water.

Topographic features such as the size of drainage basins and the steepness of slopes directly affect runoff rates and volumes.

Climate, particularly the frequency, intensity, and duration of rainfall are primary factors that determine the amount of runoff produced.

3.3 EROSION CONTROL

Effective erosion control addresses the prevention of soil erosion by protecting the soil surface from the erosive forces of rain and runoff. Prevention of erosion is always better than remedial measures and should receive priority in any erosion and sedimentation control plan. Soil erosion cannot be completely prevented, as some natural erosion occurs on the landscape even under ideal conditions.

The idea is to prevent accelerated erosion to the extent practicable. The following practices can be used to prevent erosion:

- Plan the development to fit the site topography (Avoid highly erosive areas).
- Minimize the duration and size of area exposed without ground cover.
- Protect exposed ground areas from off-site runoff.
- Stabilize exposed ground areas as soon as possible.
- Reduce runoff velocities whenever possible.
- Protect steep slopes from excessive runoff.

Project phasing, particularly on large projects, can be critical to successful erosion control. The minimizing of disturbed land area, re-establishment of ground cover and the installation of BMPs should be carefully coordinated with the phases of a project.

3.4 SEDIMENTATION PROCESS

Sedimentation is the deposition of soil particles that have been transported by runoff. The amount and size of the material that can be transported increases with the velocity of the runoff. Sedimentation occurs when the runoff slows down enough and for a long enough period of time to allow the suspended soil particles to settle from the runoff. Gravel and sand particles are usually not transported very far by running water and are deposited when the water first slows down. Conversely, some very small clay particles, may not settle out even when the water stops moving. This is because the particles are held in suspension.

3.5 SEDIMENTATION CONTROL

Sedimentation control is a remedial measure that involves trapping sediment as runoff leaves the land during storm events. Most sedimentation control is achieved through the use of structural controls, sometimes referred to as Best Management Practices (BMPs).

Effective sedimentation control requires that the majority of the eroded soil be captured on-site. Chapter 5 of this manual provides the user with an inventory of BMPs, that when properly used, installed and maintained will effectively control sedimentation from a construction site. BMPs are generally applicable to a specific site situation and the erosion control plan for a site shows the correct BMP to control off-site sedimentation.

Chapter 4

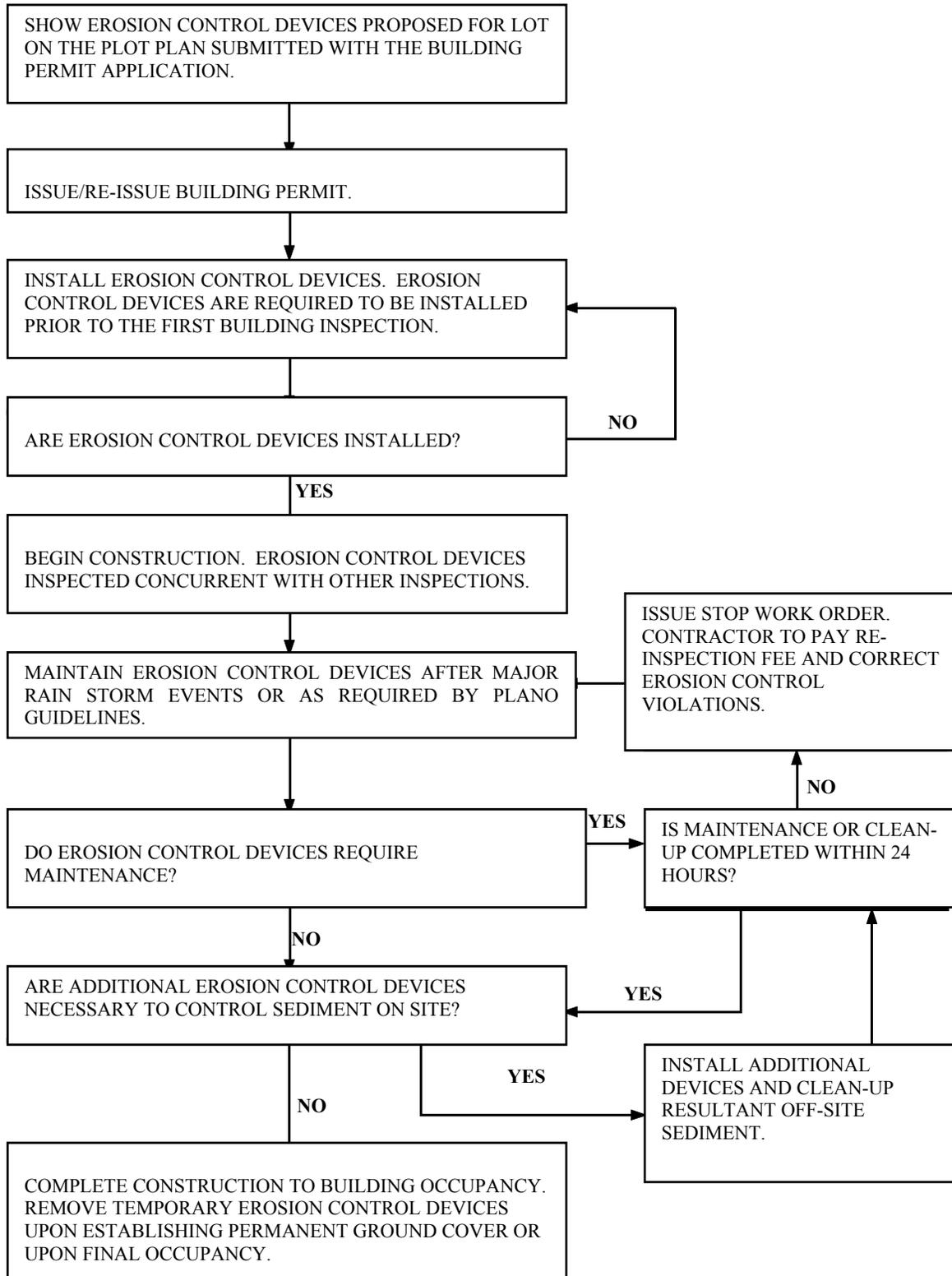
PLAN PREPARATION

4.1 PLAN REVIEW & APPROVAL PROCESS

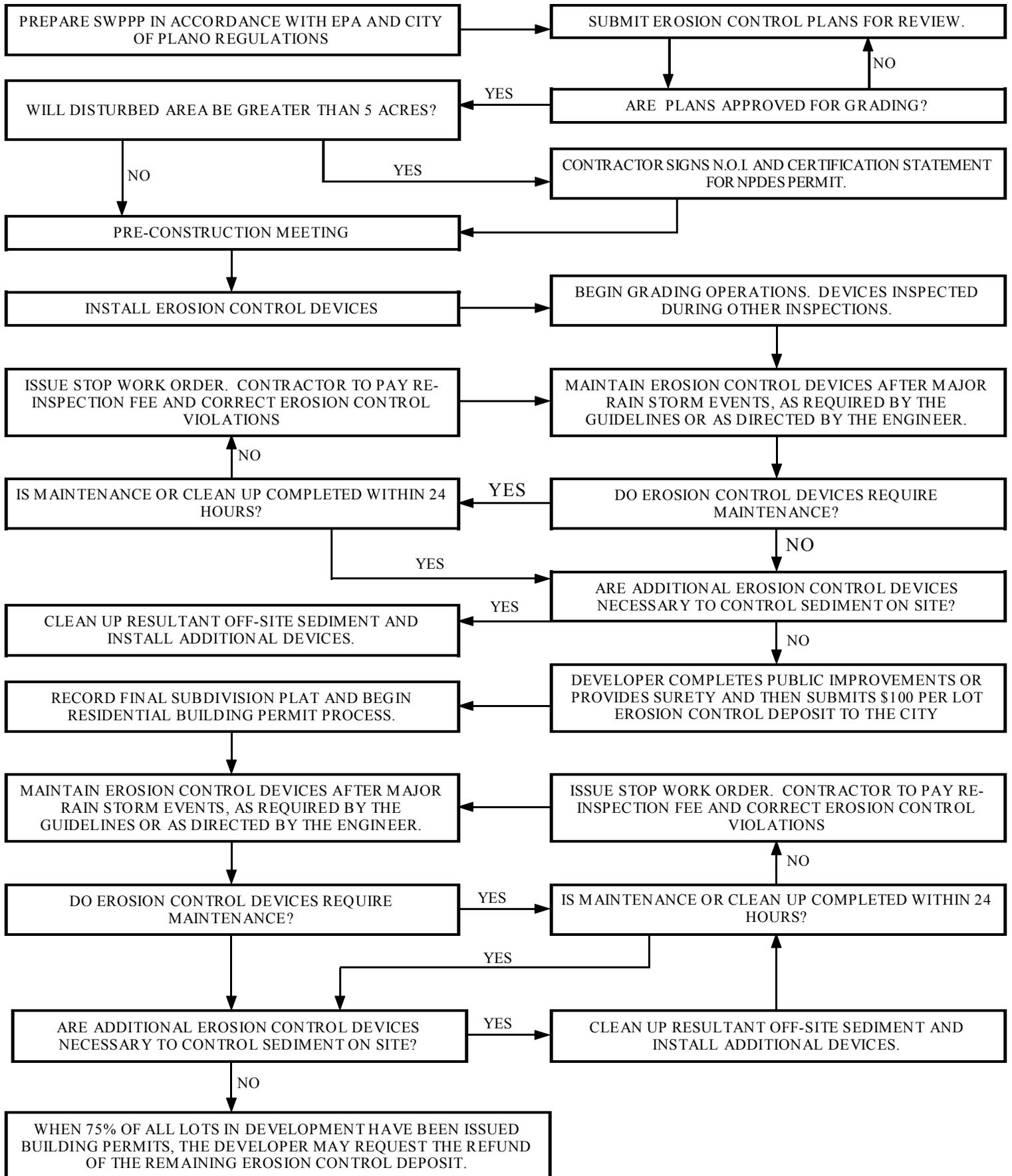
The following Figures 4.1.A, B and C are attached to show a more detailed flowchart of the erosion control process for each type of development that is usually seen in the City of Plano.

The remaining sections in this Chapter provide guidance and examples on how to prepare an Erosion Control Plan. Section 4.2 is for use in preparing erosion control plans for single family residential home construction. The plan requirements are somewhat less stringent than what is required for other major types of land disturbing activity. Section 4.3 is for use in preparing erosion control plans for all other types of land disturbing activity within the City of Plano. Plans prepared in accordance with these requirements will be very close to meeting EPA requirements for a Soil and Water Pollution Prevention Plan (SWPPP).

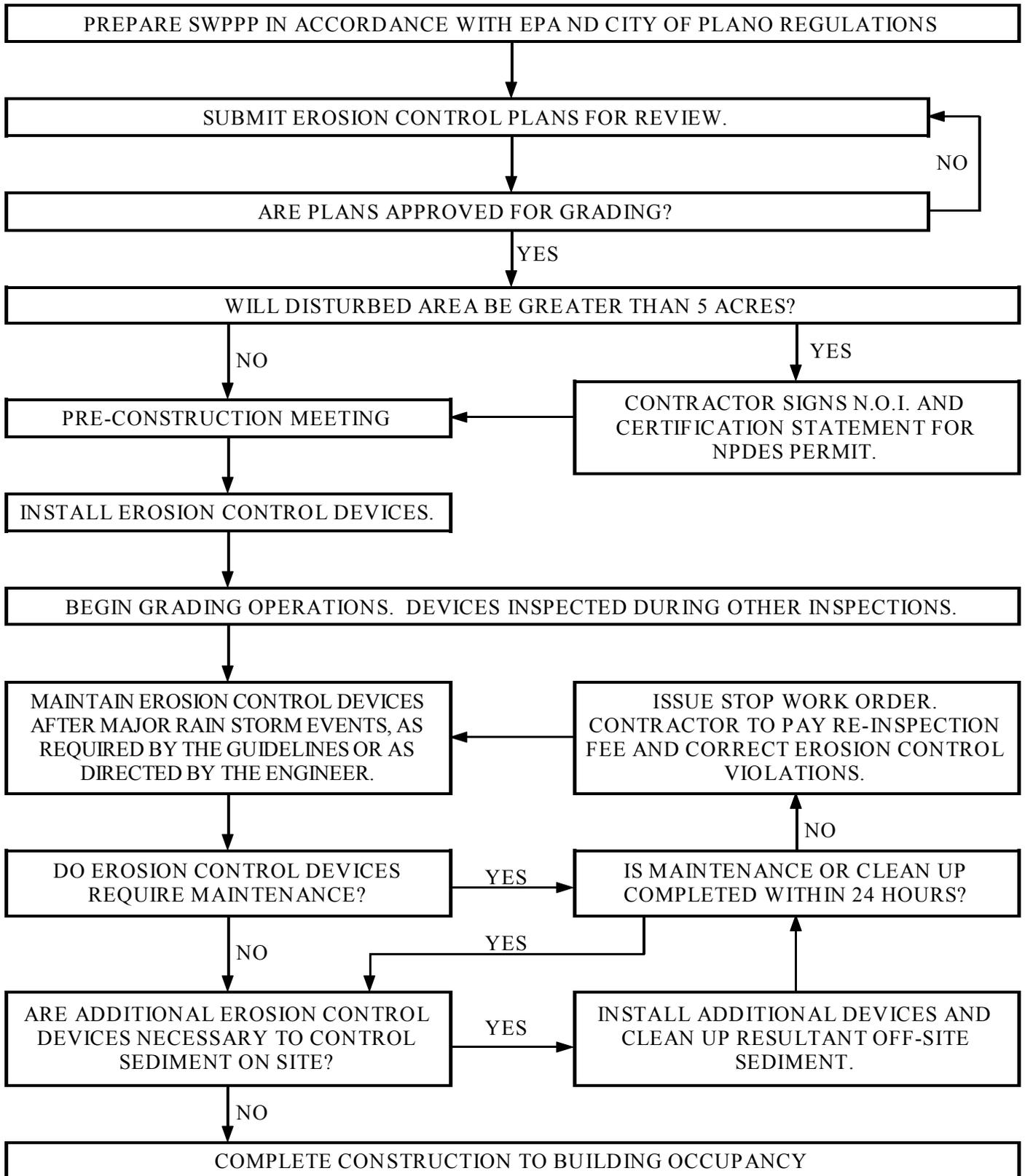
**FIGURE 4.1.A
RESIDENTIAL BUILDING EROSION CONTROL**



**FIGURE 4.1.B
RESIDENTIAL SUBDIVISION EROSION CONTROL**



**FIGURE 4.1.C
CAPITAL IMPROVEMENTS PROJECTS, NON-RESIDENTIAL
AND MULTI-FAMILY EROSION CONTROL**



4.2 SINGLE FAMILY RESIDENTIAL EROSION CONTROL PLANS

For single family residential buildings the erosion control devices for the control of sediment shall be shown on the plot plan which is submitted to obtain the individual building permit for a lot.

On most residential building lots in the City of Plano the erosion control devices required will be minimal. A standard lot will require a 20' temporary stone construction entrance/exits; erosion control matting, silt fence or diversion ditches to control off-site sediment; and possibly a small stone overflow or outlet structure where concentrated flow leaves the property. The largest erosion control problem that is foreseen for these lots, is the maintenance and upkeep of these devices during the construction period. Upkeep includes making sure that the home builder's employees and sub-contractors do not destroy or disturb the devices, thus rendering them useless.

The implementation of these erosion control requirements will mean some minor changes in the way that a contractor conducts his/her operations on a building lot, but the proper use of the BMPs in this manual also will provide benefits. Some benefits of controlling sediment runoff from a lot include:

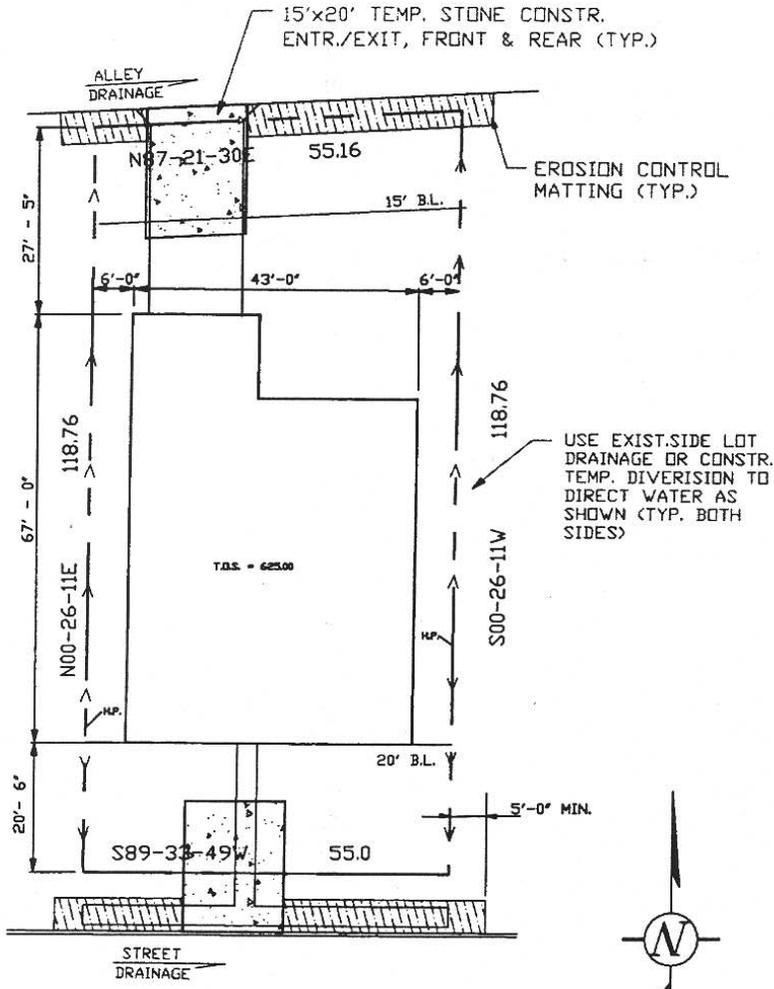
- Preventing the loss of valuable fill material and/or topsoil.
- Preventing additional man-hours spent cleaning up off-site sediment damage.
- Minimizing damage claims from downstream neighbors.
- Emphasizing "good neighbor relations" with your client and the neighborhood.
- Not delaying your project with stop work orders and re-permit fees.
- Keeps your company legal, since erosion control is the law!

The City of Plano Erosion Control Ordinance also makes the Contractor responsible for erosion control and stabilization of off-site areas disturbed as a result of the home building operation. This includes adjacent lots used for material storage and/or staging during the construction.

To complete a single family residential erosion control plan for a typical lot in the City of Plano, the following information should be added to an already completed plot plan:

- Show location of the high point for side lot drainage.
- Show the direction of drainage flow in the street(s) and alley(s).
- Show locations of 20' temporary gravel construction exits/entrances.
- Show locations of other erosion control devices or methods necessary to control off-site sedimentation (See details in Chapter 5).

The following two pages show example single family residential erosion control plans. It should be noted that different BMPs can be used depending upon the site orientation and topography.



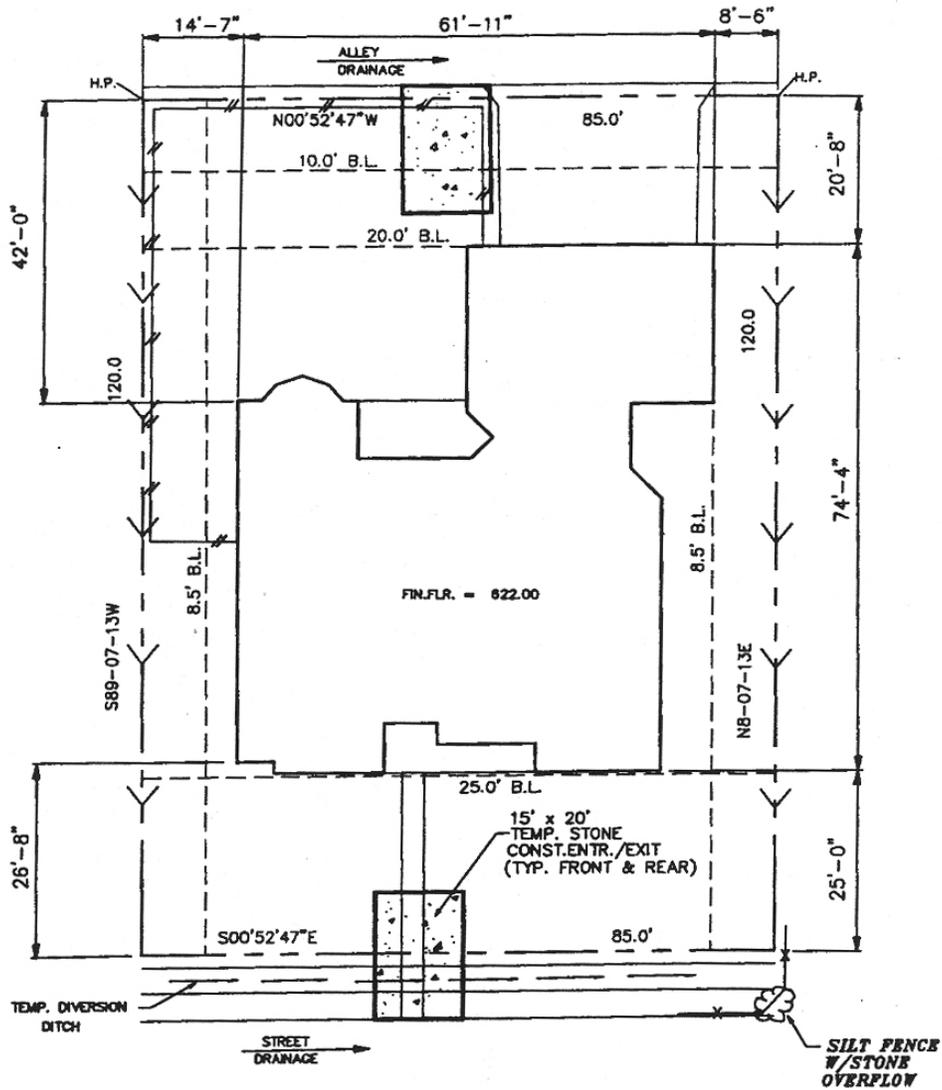
4412 SUBDIVISION LANE

SCALE: 1"=20'

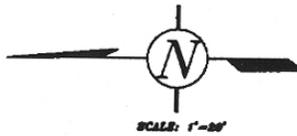
EXAMPLE
EROSION CONTROL
PLAN

Lot Area = 6413 SqFt.
Top of Curb = 623.00
Typ. 'A' Drainage

SUBDIVISION DEVELOPMENT WOODS	
ADDRESS 4412 SUBDIVISION DR.	
CITY PLANO, TX.	DATE 9/9/99



8004 SUBDIVISION DRIVE



EXAMPLE
EROSION CONTROL
PLAN

Lot Area = 10200 Sq.Ft.
Top of Curb = 620.20
Typ. 'A' Drainage

SUBDIVISION: DEVELOPMENT WOODS	
ADDRESS: 8004 SUBDIVISION DR.	
CITY: PLANO, TX.	DATE: 9/9/99

4.3. EROSION CONTROL PLANS

This Section covers requirements for erosion control plans for all land disturbing activities except single family residential construction. An erosion control plan in accordance with this Section shall be required for all other activities that require a building permit or disturb more than 5,000 square feet of existing ground cover. Plans and specifications prepared for construction of improvements shall address specific erosion and sediment control measures or techniques to implement a suitable program to control erosion from disturbed areas on site and to protect downstream properties from the deposition of sediment.

The requirements for erosion control plans within the City of Plano are very similar to the requirements established for the EPA-NPDES permit program, but with much more emphasis on the actual performance of BMPs installed.

Figure 4.3.A is an erosion control plan design checklist that is provided to assist the design professional in the preparation of an erosion control plan for a site and to ensure that all minimum required items have been addressed. All of the items listed should be included somewhere in the construction plan set, but do not necessarily have to be on one separate erosion control plan sheet. The use of this checklist does not relieve the design professional of his or her responsibilities in preparing construction plans and documents. Sound engineering design and judgment should be used by design professionals preparing construction documents for erosion and sediment control. Most of the information listed is already required for the preparation of construction plans or site plans for property development. On small sites some information may not be available or pertinent to the work involved. On a case-by-case basis City review staff may allow the omission of non-pertinent information. The following paragraphs briefly describe each item listed on the checklist :

GENERAL INFORMATION:

1. Owner's Name, Address & Phone – Is the property owner's name, current mailing address and phone number noted on the plans?
2. Developer's Name, Address & Phone - Is the developer's name, the job site representative for the project, current mailing address and phone number noted on the plans?
3. Engineer's Name, Address & Phone - Is the design engineer's name, the engineering company's name, current mailing address and phone number noted on the plans?
4. PE Seal, Sign & Date - Final construction documents shall be sealed, signed and dated by a professional engineer licensed to practice engineering in the State of Texas.
5. Site Acreage Noted - Note the total acreage of the property being developed.
6. Vicinity Map - Provide a vicinity map on the plans showing the general location of the project.
7. N. Arrow & Graphic Scale - Provide a properly orientated north arrow and a properly sized graphic scale bar on each plan view sheet. This item is very important due to the use of electronic drafting procedures where drawing sizes and scales can be literally changed with the flip of a button.

8. Title Block Complete - Is all information in the title block complete and correct on all plan sheets?
9. Revision Block Complete - Is there a revision block provided on the plan sheets? This item is particularly important on erosion control plans since it is very likely that there will be changes to the plan during the construction process. The use of a revision block on the plans makes keeping track of any revisions much easier.
10. Symbol Legend - Is there a complete and legible symbol legend provided on the plan sheets?
11. General Notes - Provide standard general notes as needed from Figure 4.3.B.

TOPOGRAPHIC INFORMATION:

1. Site Boundaries - Show the property lines, easement lines and right-of-way lines for the property being developed.
2. Existing Ground Contours - Show existing ground contours for the entire property and to the extent necessary around the perimeter of the site to show the relationship of the surrounding properties to the site. Use a 2-foot contour interval (or less) and make sure that at least two contours on the plan are labeled.
3. Existing Structures - Show any existing structures on the site and list them as either "to remain" or "to be removed" as appropriate.
4. Existing Utilities - Show any above ground and below ground utility locations for the site. Coordination with local utility companies and the use of utility locating services can solve many problems before they become major issues.
5. Existing Drainage Features - Show any existing on-site drainage features such as streams, rivers, lakes, ditches, wetlands, springs, etc.
6. 100-yr. Flood Plain with Elevations - Show any mapped 100-year flood plain located on or adjacent to the site. Flood Insurance Rate Maps are available for inspection in the City of Plano Engineering Division which show the general locations of mapped flood plains within the City and the 100-year flood elevations. Erosion control devices should be located outside the 100-year flood plain.
7. On-site Drainage Area Map - Show the drainage area boundaries for drainage sub-basins on site in accordance with the City of Plano's, Design Manual for Storm Drainage Facilities.
8. Benchmark or TBM - Note the location and vertical information for the benchmark(s) or temporary benchmark(s) used for vertical control on the project.
9. Off-site Drainage Area Map - Show the drainage area boundaries for off-site drainage areas that impact the site in accordance with the City of Plano's, Design Manual for Storm Drainage Facilities. If off-site drainage areas do not impact the site, then this item is not required.
10. Limits of Trees/Shrubs to Remain - Show and label the locations of individual trees and shrubs plus areas of dense trees and shrubs that are slated to remain on the property after development is complete.

11. Limits of Undisturbed Areas - Show and label the limits of existing ground cover on the site that are to remain undisturbed during the construction process.

DESIGN INFORMATION:

1. Construction Limits Shown - Clearly show the limits of construction on the plans.
2. Disturbed Area Noted (Acres) - Note the number of acres of disturbed land area for the project. This includes all areas disturbed on site as well as any off site borrow, spoil or utility construction areas. Areas in excess of 5 acres are required to obtain an NPDES permit in accordance with EPA regulations.
3. Proposed Grading Plan - Show proposed ground contours for the entire property and to the extent necessary around the perimeter of the site to show how proposed grades are to match existing grades. Use a 2-foot contour interval (or less) and make sure that at least two contours on the plan are labeled. Very flat sites may require the use of spot elevations and/or cross section views.
4. Proposed Structures & Pavement - Show layout of proposed improvements for the site as per the site plan or preliminary subdivision plat for the property.
5. Proposed Storm Drainage Plan & Calculations - Submit storm drainage plans and calculations in accordance with the City of Plano's, Design Manual for Storm Drainage Facilities.
6. Proposed Site Utilities - Submit site utility layout plans.
7. Construction Schedule & Phasing Plan - A written construction schedule of major site construction items must be on the plan. If the project is being done in phases the erosion control plan must be also phased to take into account the sequence of construction. Very complicated projects may require that several different phases of erosion control plans be implemented over the life of the project. Specific dates are not required and the schedule can be in a generic, outline type format.
8. Borrow & Spoil Areas Identified - Off site borrow and spoil areas are considered as part of the project site and must also comply with the erosion control requirements for the project. This includes the installation of BMPs to control off site sedimentation and the establishment of permanent ground cover on disturbed areas prior to final approval of the project.
9. BMP Locations - Are erosion control devices located properly to control sediment from leaving the site? Also, are the correct types of BMPs being used?
10. BMP Calculations - Submit calculations for the sizing and design of each BMP used for the project. BMPs should be properly labeled for easy identification (i.e. 1, 2, 3, etc. or A, B, C, etc.).
11. BMP Details - BMPs require adequate details for proper construction. This includes proper dimensioning and material specifications. The details included in this manual are accepted by the City of Plano for the control of erosion and sediment on construction sites. Some of these devices do require additional dimensions to be provided by the designer.
12. BMP Maintenance Schedule - Submit a BMP maintenance schedule for the BMPs proposed for use on the project. Chapter 5 in this manual gives recommended inspection and maintenance intervals for the different types of BMPs. The schedule should also identify the responsible party for the maintenance of the different BMPs used throughout the life of the project.

FIGURE 4.3.A
EROSION CONTROL PLAN DESIGN CHECKLIST

GENERAL INFORMATION

- | | |
|--------------------------------------------------------|------------------------------------------------------------|
| <input type="checkbox"/> OWNER'S NAME, ADDRESS & PHONE | <input type="checkbox"/> DEVELOPER'S NAME, ADDRESS & PHONE |
| <input type="checkbox"/> ENGNR'S NAME, ADDRESS & PHONE | <input type="checkbox"/> PE SEAL, SIGN & DATE |
| <input type="checkbox"/> SITE ACREAGE NOTED | <input type="checkbox"/> VICINITY MAP |
| <input type="checkbox"/> N. ARROW & GRAPHIC SCALE | <input type="checkbox"/> TITLE BLOCK COMPLETE |
| <input type="checkbox"/> REVISION BLOCK COMPLETE | <input type="checkbox"/> SYMBOL LEGEND |
| <input type="checkbox"/> GENERAL NOTES | <input type="checkbox"/> OTHER _____ |

TOPOGRAPHIC INFORMATION

- | | |
|------------------------------------------------------|-----------------------------------------------------------|
| <input type="checkbox"/> SITE BOUNDARIES | <input type="checkbox"/> EXISTING GROUND CONTOURS |
| <input type="checkbox"/> EXISTING STRUCTURES | <input type="checkbox"/> EXISTING UTILITIES |
| <input type="checkbox"/> EXISTING DRAINAGE FEATURES | <input type="checkbox"/> 100-YR. FLOOD PLAIN WITH ELEVS. |
| <input type="checkbox"/> ON-SITE DRAINAGE AREA MAP | <input type="checkbox"/> BENCHMARK OR TBM |
| <input type="checkbox"/> OFF-SITE DRAINAGE AREA MAP | <input type="checkbox"/> LIMITS OF TREES/SHRUBS TO REMAIN |
| <input type="checkbox"/> LIMITS OF UNDISTURBED AREAS | <input type="checkbox"/> OTHER _____ |

DESIGN INFORMATION

- | | |
|-----------------------------------------------------------|----------------------------------------------------------|
| <input type="checkbox"/> CONSTRUCTION LIMITS SHOWN | <input type="checkbox"/> DISTURBED AREA NOTED (ACRES) |
| <input type="checkbox"/> PROP. GRADING PLAN | <input type="checkbox"/> PROP. STRUCTURES & PAVEMENT |
| <input type="checkbox"/> PROP. STORM DRAIN. PLAN & CALCS. | <input type="checkbox"/> PROP. SITE UTILITIES |
| <input type="checkbox"/> CONSTR. SCHEDULE & PHASING PLAN | <input type="checkbox"/> BORROW & SPOIL AREAS IDENTIFIED |
| <input type="checkbox"/> BMP LOCATIONS | <input type="checkbox"/> BMP CALCULATIONS |
| <input type="checkbox"/> BMP DETAILS | <input type="checkbox"/> BMP MAINTENANCE SCHEDULE |
| <input type="checkbox"/> | |
| OTHER _____ | |

FIGURE 4.3.B
EROSION CONTROL PLAN
STANDARD GENERAL NOTES

1. EROSION CONTROL DEVICES AS SHOWN ON THE EROSION CONTROL PLAN FOR THE PROJECT SHALL BE INSTALLED PRIOR TO THE START OF LAND DISTURBING ACITIVITIES ON THE PROJECT.

1. ALL EROSION CONTROL DEVICES ARE TO BE INSTALLED IN ACCORDANCE WITH THE APPROVED PLANS AND SPECIFICATIONS FOR THE PROJECT. CHANGES ARE TO BE APPROVED BEFORE CONSTRUCTION BY THE DESIGN ENGINEER AND THE CITY OF PLANO ENGINEERING DIVISION.

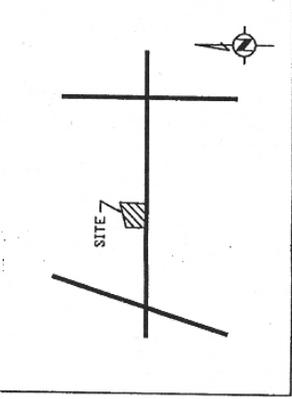
2. IF THE EROSION CONTROL PLAN AS APPROVED CANNOT CONTROL EROSION AND OFF-SITE SEDIMENTATION FROM THE PROJECT THE EROSION CONTROL PLAN WILL BE REQUIRED TO BE REVISED AND/OR ADDITIONAL EROSION CONTROL DEVICES WILL BE REQUIRED ON SITE.

3. IF OFF-SITE SOIL BORROW OR SPOIL SITES ARE USED IN CONJUNCTION WITH THIS PROJECT, THIS INFORMATION SHALL BE DISCLOSED AND SHOWN ON THE EROSION CONTROL PLAN. OFF-SITE BORROW AND SPOIL AREAS ARE CONSIDERED A PART OF THE PROJECT SITE AND THEREFORE SHALL COMPLY WITH THE CITY OF PLANO EROSION CONTROL REQUIREMENTS. THESE AREAS SHALL BE STABILIZED WITH PERMANENT GROUND COVER PRIOR TO FINAL APPROVAL OF THE PROJECT.

EXAMPLE
 EROSION CONTROL/
 GRADING PLAN
 SHEET 1 of 1

ABC SALES BLDG.
 OWNED and DEVELOPED
 by
 JOE DEVELOPER
 200 MAIN ST. PLANO, TX
 PHONE: (232)-987-6540

JOES ENGINEERING, INC.
 123 PUBLIC STREET
 ANYTOWN, TX, 12345
 PHONE (123)-456-7890



- GENERAL NOTES:
1. ADD NOTES FROM FIG. 4.3.B IN MANUAL
 2. DISTURBED AREA = 4.25 AC.
 3. UNDISTURBED AREA = 0.25 AC.
 4. TOTAL SITE AREA = 4.50 AC.
 5. SEE SHT. -- FOR PROP. UTILITIES
 6. SEE SHT. -- FOR DRAIN CALCS. AND IMPROVEMENTS
 7. SEE SHT. -- FOR BMP DETAILS

DATE
 SIGNATURE
 P.E.

REV.	BY	REVISION

CONSTRUCTION SCHEDULE AND PHASING

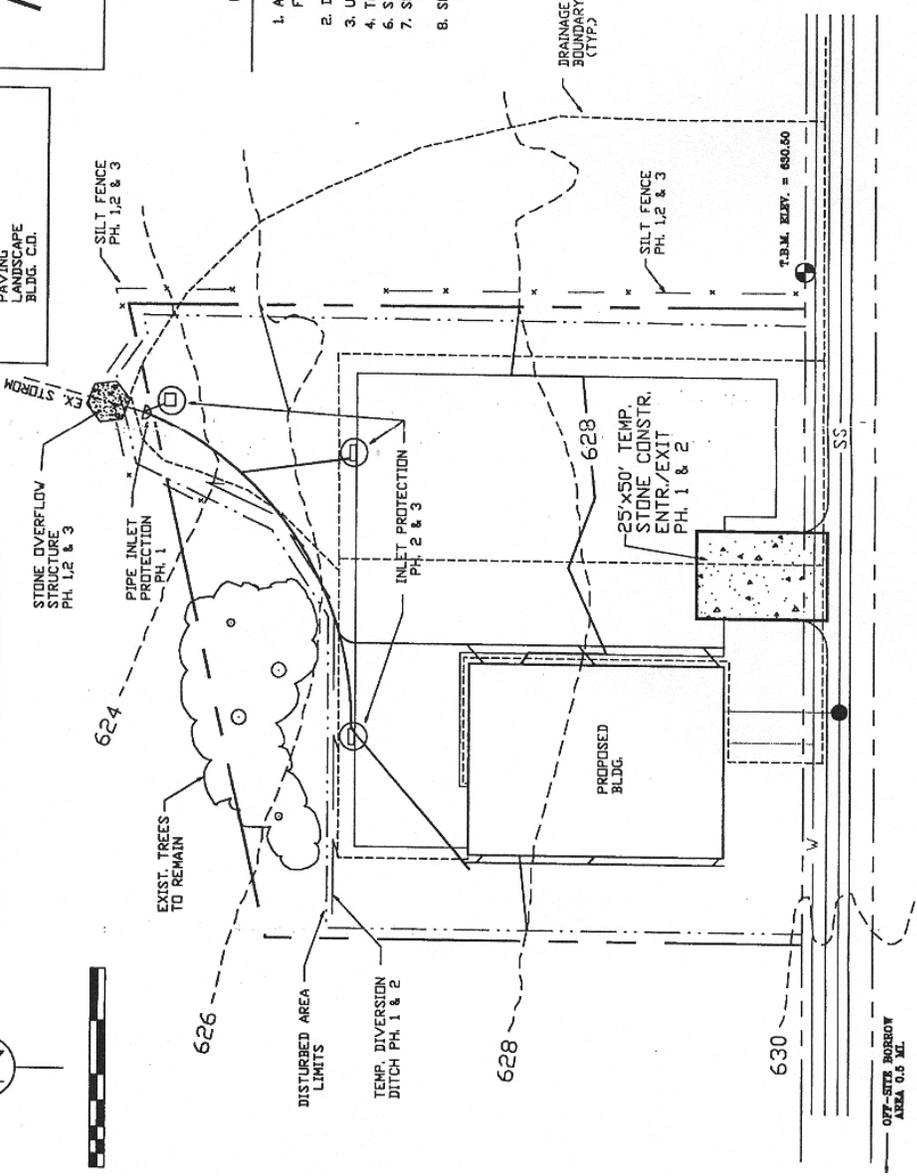
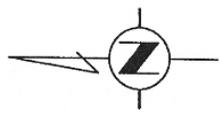
PH. 1	INSTALL PH. 1 BMP'S ROUGH GRADING INSTALL STORM DRAIN
PH. 2	INSTALL PH. 2 BMP'S BLDG. CONSTR. FINISH GRADING
PH. 3	INSTALL PH. 3 BMP'S PAVING LANDSCAPE BLDG. C.D.

B.M.P. MAINT. SCHED.

BMP	MAINT. FREQ.	BY

SYMBOL LEGEND

--	--



4.4 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

Environmental Protection Agency (EPA) regulations require a National Pollutant Discharge Elimination System (NPDES) permit for all construction activities that result in the disturbance of 5 acres or more of total land area.

When the General permit is used a Storm Water Pollution Prevention Plan (SWPPP) is required. The SWPPP consists of an erosion and sediment control plan along with an accompanying report that outlines the methods that will be employed to reduce pollution at the site. The SWPPP shall be prepared in accordance with design guidelines acceptable to the EPA by a Registered Professional Engineer, licensed in the State of Texas. The purpose of the SWPPP is to identify potential sources of erosion and pollution to storm water discharge, and to provide mechanisms to reduce those pollutants. Although the plan is not to be submitted with the Notice of Intent (NOI), an applicant is required to prepare such a plan prior to NOI submission.

The following is a summary of SWPPP requirements. The items indicated with an asterisk, would normally be included in an Erosion Control Plan prepared in accordance with City of Plano requirements as specified in this Manual:

SUMMARY OF SWPPP COMPONENTS

A. Site Description

1. Describe nature of construction activity
2. List proposed disturbed area*
3. Runoff coefficient*
4. Site plan, including: Drainage patterns* Approximate slopes
Limit of disturbed area* Surface waters (Type)*
Location of structural and non-struct. BMPs*
Location of stabilization practices*
5. Receiving waters (Name)

B. Description of Controls

1. Sequence of major activities*
2. Timing for each control measure, installation thru removal*
3. Description of erosion and sediment controls
4. Stormwater management
5. Other controls
6. Approved State or local plans*
7. Description of maintenance*
8. Inspector's responsibility: Changes to the plan Inspection reports

C. Description of Non-Storm Water Discharges

D. Industrial Activities On Site

E. Contractors Certification

Chapter 5

DEVICE STANDARDS AND SPECIFICATIONS

5.1 GENERAL –

This chapter provides standards and specifications for the design, construction, and maintenance of BMPs for the control of sediment from land disturbing activities. These devices are primarily for the control of sediment caused by storm water induced erosion and will generally be accepted by City of Plano design review staff if they are properly designed and used.

The design and use of BMPs is a very new idea that is still going through many significant changes. Consultants should make sure that they understand how and where a sediment or erosion control device is supposed to be used before specifying it on their plans. The use of new devices and ideas for sediment or erosion control will be accepted for review, if accompanied by adequate supporting information. Also, always check with the reviewing authority to make sure that this Manual is up-to-date prior to proceeding with specific plan preparation.

All persons involved in erosion and sediment control must also realize that there are a variety of different names commonly used for the same or similar type structures. Different jurisdictions also may have different design standards. This Manual will give the user assistance in both areas when dealing with the City of Plano. Consultants will be required to be specific on their erosion control plans and contractors will be required to construct to the City of Plano details.

Each sediment control device in this chapter is placed in a section by itself with the following information provided: Description, Purpose, Application, Limitations, Design Criteria, Material Specifications, Maintenance Requirements, and a Detail. This format will place all of the information relative to a specific device all in one location for use by the designer, contractor, inspector, and plan reviewer.

Material specifications listed in this Chapter use the latest versions of the North Central Texas Council of Governments, Standard Specifications for Public Works Construction, the City of Plano, Special Provisions to Standard Specifications for Public Works Construction and the Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges to the maximum extent possible. With the relative newness of this type of work in the North Texas region, there will certainly be many changes in the future. Users must be sure that they are using an up-to-date version of the manual to avoid delays in project approval.

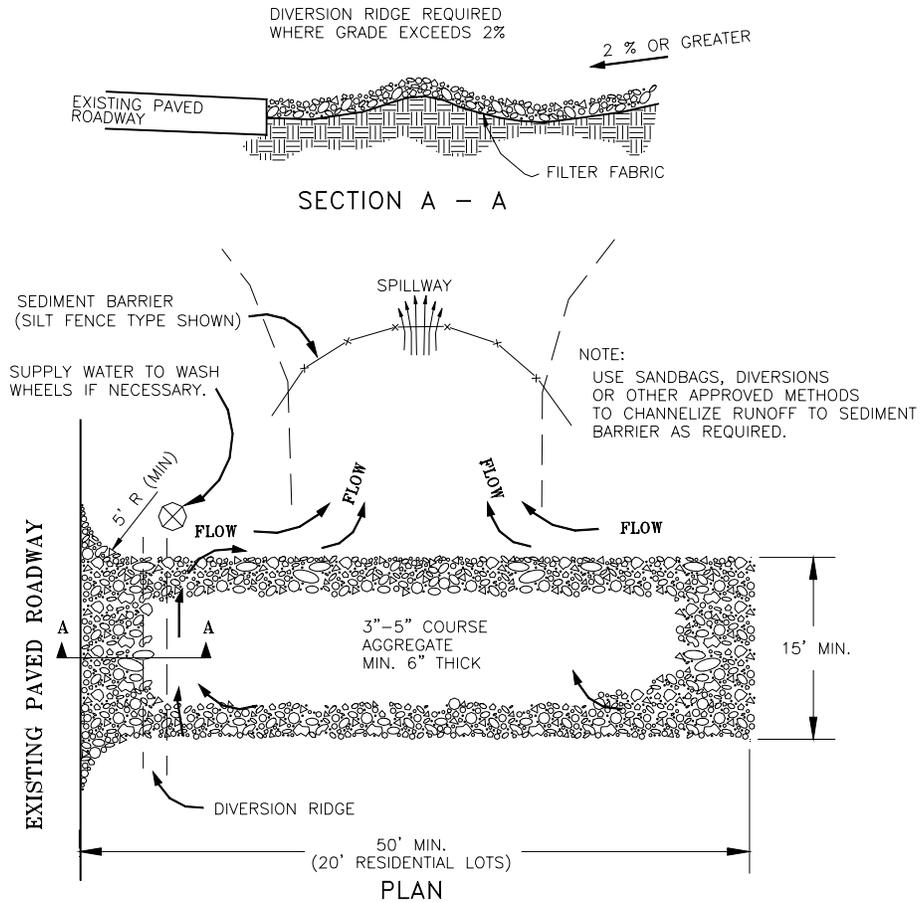
Most all devices listed in this Manual will require maintenance, including sediment cleanout and removal, at some time during the construction process. Unless special provisions have been made, this sediment should be disposed of on site, with proper BMP protection, and stabilized with permanent ground cover prior to final approval of a site. Material can be disposed of off-site, but the area used for disposal becomes a part of the construction site by definition and will require erosion control devices and stabilization prior to finalizing the project.

Maintenance inspections are the responsibility of the Contractor performing the work on site. City inspection staff will make periodic inspections to enforce compliance and are available to assist the Contractor on a case-by-case basis for particularly difficult situations.

5.2 TEMPORARY STONE CONSTRUCTION ENTRANCE/EXIT

1. **DESCRIPTION** - An aggregate area or pad located where vehicles enter and leave a construction site.
2. **PURPOSE** - To provide an area where vehicles can remove mud and sediment from their tires prior to driving on public streets. If used properly, it reduces the requirement to remove sediment from public streets, directs the majority of traffic to a single location, and provides protection for other BMPs on site through traffic control.
3. **APPLICATIONS** - Use wherever traffic will be leaving a construction site and moving directly onto a public road or an off-site paved surface. Primary installations include exits from storage areas, staging areas, truck haul routes, and borrow/spoil areas.
4. **LIMITATIONS** - Selection of the stone construction exit/entrance location is critical, since to be effective all traffic must use the area(s) to exit a site. The device is not suitable for use on long, linear projects unless there are designated points for controlled access. Contractors shall clean-up excessive stone from existing paved streets during the construction process.
5. **DESIGN CRITERIA** -
 - A. Minimum pad dimensions: Width = 15 feet or total width of vehicle access, whichever is greater.
Length = 50 feet (Residential lots use 20')
Depth = 6 inches
 - B. Grade: Avoid grades steeper than 5% and grade to drain back on to the site or to another BMP to control off-site sedimentation.
 - C. Location: Locate the construction entrance/exit to limit the amount of sediment that leaves the construction site and to provide for maximum use by vehicles leaving the site. Do not place along curves in the public roadway.
 - D. Filter Fabric: Shall be used for installations with a construction period of more than 6 months, where heavy truck traffic is anticipated daily, or very weak sub-grade soils are present.
6. **MATERIAL SPECIFICATIONS** -
 - A. Aggregate - Natural stone or re-cycled concrete meeting the gradation requirements of NCTCOG Specification Item 2.1.8.(d). [3" -4" Diameter]
 - B. Filter fabric - NCTCOG Specification Item 2.23.3.
7. **MAINTENANCE REQUIREMENTS** - Inspections should be made weekly and after rain storm events to ensure that the device is functioning properly. When sediment or mud has clogged the void spaces between the stones or mud is being tracked onto the public roadway the aggregate pad must be washed down or replaced. Runoff from the washdown operation shall not be allowed to drain directly off site without first flowing

through another BMP to control off-site sedimentation. Periodic re-grading or the addition of new stone may be required to maintain the efficiency of the installation.

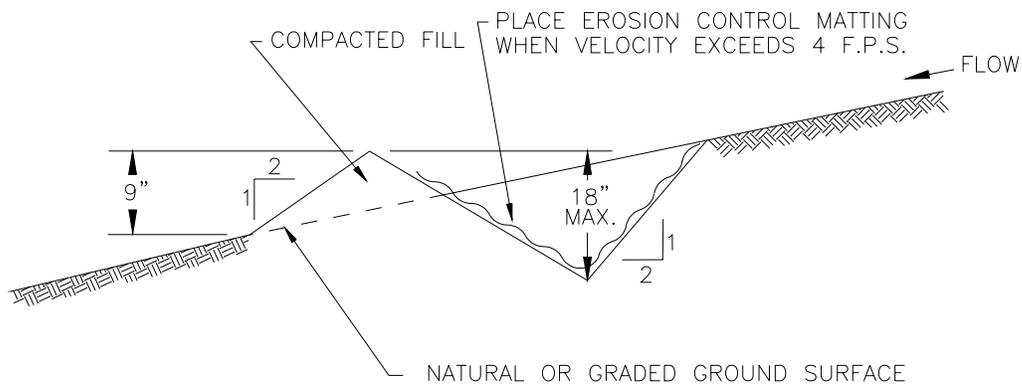
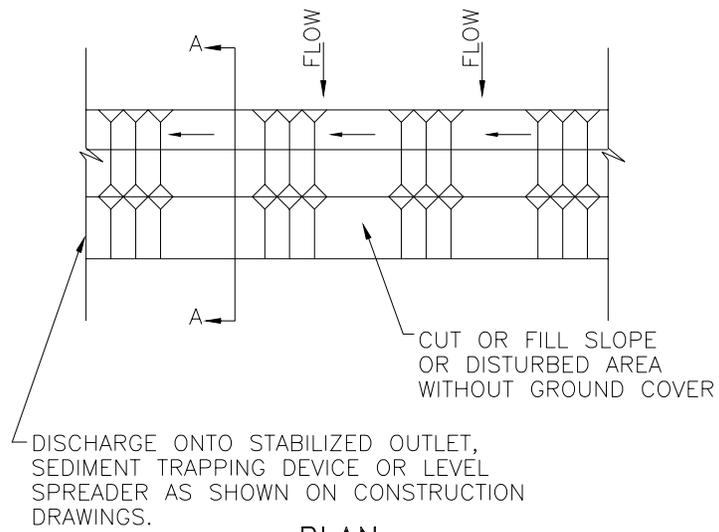


TEMPORARY STONE CONSTRUCTION ENTRANCE / EXIT

N.T.S.

5.3 TEMPORARY DIVERSIONS

1. **DESCRIPTION** - A ridge, excavated channel, or combination ridge and channel which redirects on-site or off-site runoff to a desired location, during the construction or land disturbing activity.
2. **PURPOSE** - To protect disturbed ground areas from up-slope runoff and to divert sediment laden on-site runoff to installed BMPs for sediment removal.
3. **APPLICATIONS** - Typical applications include:
 - A. Installation above cut or fill slopes to intercept runoff before it flows down a steep slope.
 - B. Installations to intercept runoff from undisturbed areas to divert the flow around the construction site.
 - C. Across unprotected slopes, as a slope break, to reduce the slope length.
 - D. Around the perimeter of the site to prevent sediment laden runoff from leaving the site and to direct the runoff to an appropriate BMP.
 - E. Within the construction site to divert runoff to the appropriate BMP or to isolate an area from sedimentation damage.
4. **LIMITATIONS** - Diversions must not be constructed at a steep grade. They must be sized to be able to convey the flow from the drainage area entering the diversion. The locations of diversions should be carefully planned since they may limit the movement of construction vehicles across the site.
5. **DESIGN CRITERIA** -
 - A. Drainage Area - 5 acres or less.
 - B. Design Capacity - Peak runoff from a 10 year storm.
 - C. Design Velocity - 6 feet per second or less at design capacity.
 - D. Side Slopes - 2H:1V or flatter.
 - E. Freeboard - 0.5 feet between top of ridge and water surface at design flow.
6. **MATERIAL SPECIFICATIONS** -
 - A. Erosion Control Matting - TxDOT approved Specification Item 169, Class 2.
7. **MAINTENANCE REQUIREMENTS** - Inspect diversions weekly or immediately after rainfall events. Particular attention must be paid to areas where sediment builds up in the channel, areas where vehicles have crossed or caused damage, areas where the ridge begins to erode, and any areas where flow overtops the ridge. Sediment in the channel shall be promptly removed and damaged areas of the ridge shall be stabilized by appropriate methods. Methods of stabilization may include the following or any combination of the following; netting, mulching, temporary seeding, or the flattening of the side slopes. Diversions to be left in place for more than 30 days should be stabilized by establishing temporary ground cover.



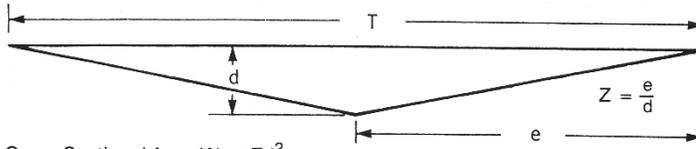
TEMPORARY DIVERSION

N.T.S.

5.4 GRASS LINED CHANNELS

1. **DESCRIPTION** - A channel with vegetation and possibly temporary or permanent erosion control matting that is constructed to a design cross section and grade for the conveyance of stormwater runoff during long-term or different phases of construction.
2. **PURPOSE** -To convey concentrated stormwater runoff without erosion, sediment deposition, or flooding.
3. **APPLICATIONS** - This practice can be applied where:
 - Concentrated stormwater runoff must be conveyed on a site.
 - A vegetative lining can provide sufficient stability for the channel and flow conditions.
 - Channel grades are generally less than 5%.
 - Space is available for a relatively large cross section.
4. **LIMITATIONS** - The use of this practice is normally limited to:
 - Areas where a channel slope of from 1% to 5% can be attained.
 - Areas where the natural drainage patterns can be maintained by use of the open channels.
 - Design flow velocities that will be less than 6 feet per second.
 - Areas graded through existing ground conditions (i.e. not in fill material).
5. **DESIGN CRITERIA** -
 - A. Capacity - shall convey the runoff from a 100-year storm.
 - B. Shape - Trapezoidal, parabolic or V bottom at the discretion of the designer.
 - C. Velocity - Less than 6 feet per second at design flow. Erosion control matting may be required to stabilize when design velocity \geq 6 fps.
 - D. Side Slopes - 3H:1V or flatter.
 - E. Freeboard - One foot between design flow depth and top of bank.
6. **MATERIAL SPECIFICATIONS** -
 - A. Seeding:- Temporary: TxDOT Specification Item 164
Permanent: NCTCOG Specification 3.10 as modified by the City of Plano Special Provisions
 - B. Sodding - NCTCOG Specification 3.9.
 - C. Erosion Control Matting - TxDOT approved Specification Item 169, Class 2.
7. **MAINTENANCE REQUIREMENTS** - During the vegetation establishment period inspect channels after every rain event. Check for erosion and sediment buildup and repair as needed. After establishment of vegetation periodically check channel for damage. Particular attention must be given to side slopes, embankments at pipe inlets and outlets, and condition of the vegetative stabilization. Vegetated channels require maintenance for weed control, possible mowing, sediment removal and rill development.

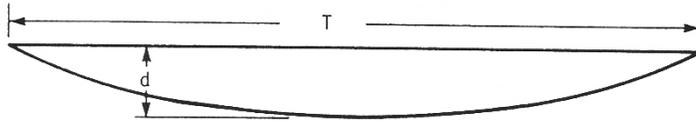
V-Shape



Cross-Sectional Area (A) = Zd^2
 Top Width (T) = $2dZ$

Hydraulic Radius (R) = $\frac{Zd}{2\sqrt{Z^2 + 1}}$

Parabolic Shape

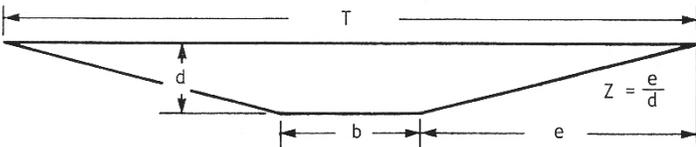


Cross-Sectional Area (A) = $\frac{2}{3} Td$

Top Width (T) = $\frac{1.5A}{d}$

Hydraulic Radius = $\frac{T^2 d}{1.5T^2 + 4d^2}$

Trapezoidal Shape

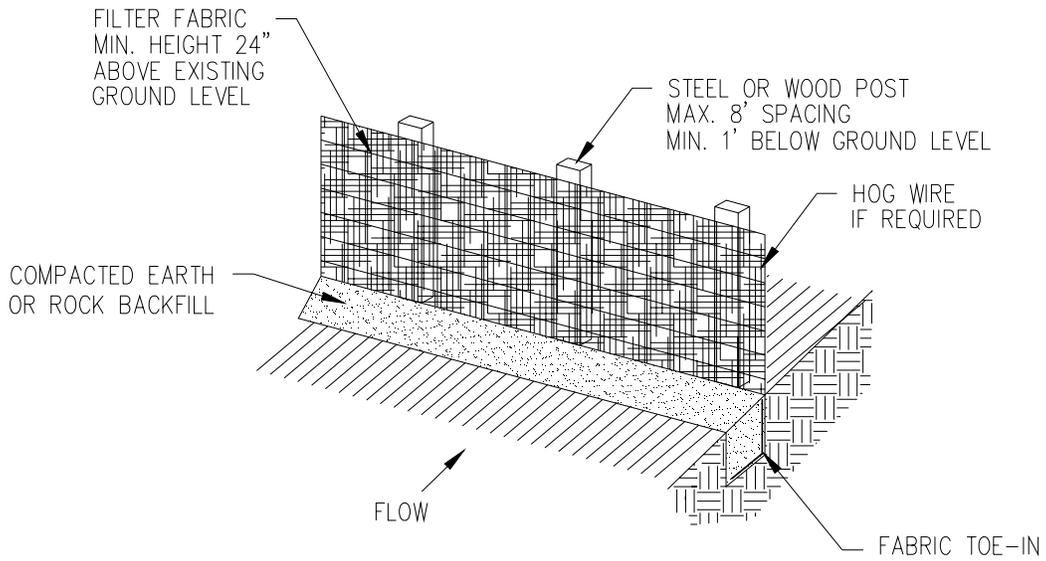


Cross-Sectional Area (A) = $bd + Zd^2$
 Top Width (T) = $b + 2dZ$

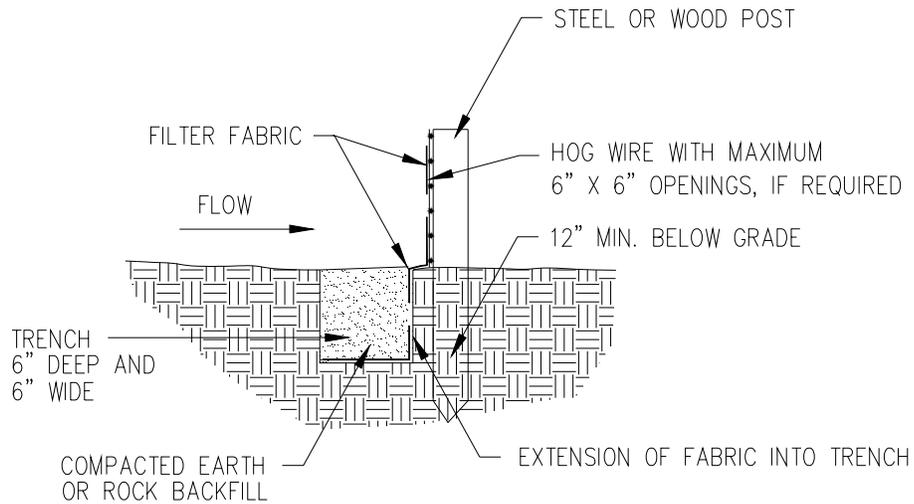
Hydraulic Radius = $\frac{bd + Zd^2}{b + 2d\sqrt{Z^2 + 1}}$

5.5 SILT FENCE

1. **DESCRIPTION** - A temporary sediment barrier consisting of filter fabric stretched between and attached to metal or wooden posts, with the bottom of the fabric firmly embedded in the soil. At installations draining larger areas the filter fabric will be attached to a hog wire support that is attached to the fence posts.
2. **PURPOSE** - To slow the flow of sediment laden water from small disturbed areas to allow sedimentation to occur and to filter out larger sediment particles as the water flows through the filter fabric.
3. **APPLICATIONS** - Silt fence is normally used as a perimeter control immediately downstream of small disturbed areas. It can also be used as a flow diversion for very small drainage areas, but does not function as well as a normal diversion channel and is usually much more expensive.
4. **LIMITATIONS** - Do not install silt fences across channels, ditches, streams, pipe outlets, or areas of concentrated water flow. Silt fence locations can limit construction vehicle access so the locations should be well planned to prevent obstructions. Water will pond behind the silt fence, resulting in localized flooding during major rain events.
5. **DESIGN CRITERIA** - Place silt fence along perimeter of site where disturbed area sheet runoff must be controlled. Limit the drainage area to 0.25 acres per 100 lineal feet of fence. Provide hog wire support backing whenever the drainage area exceeds 0.10 acres per 100 lineal feet of fence. Maximum post spacing shall not exceed 8 feet. Stone overflow structures or other outlet device shall be installed at all low points along the fence or every 300 feet if there is no apparent low point.
6. **MATERIAL SPECIFICATIONS** -
 - A. Filter Fabric - NCTCOG Specification 2.23.4.
 - B. Washed Stone - NCTCOG Specification 2.1.8.(e).
 - C. Hog Wire - NCTCOG Specification 2.8.2.(b)(1).
 - D. Fence Posts - NCTCOG Specification 2.8.2.(b) for wood or steel.
7. **MAINTENANCE REQUIREMENTS** - Silt fence should be inspected weekly and after major rain events to ensure that the device is functioning properly. Remove sediment from behind fence when the depth of sediment has built up to one-third the height of the fence above grade. Inspect the base of the fence to ensure that no gaps have developed and re-trench as necessary. Inspect fence posts to ensure that they are properly supporting the fence. Straighten, reset and add posts if necessary. If filter fabric is ripped, damaged or deteriorated, replace it in accordance with the original specifications and details.



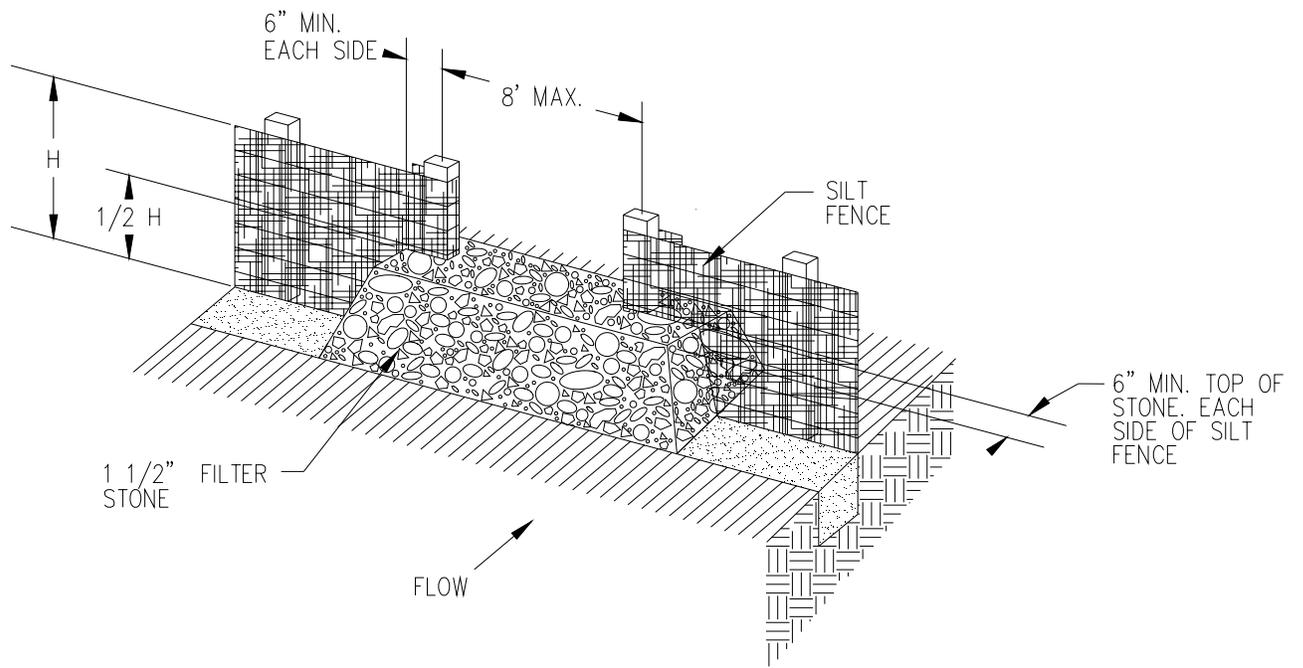
ISOMETRIC VIEW



SECTION VIEW

SILT FENCE

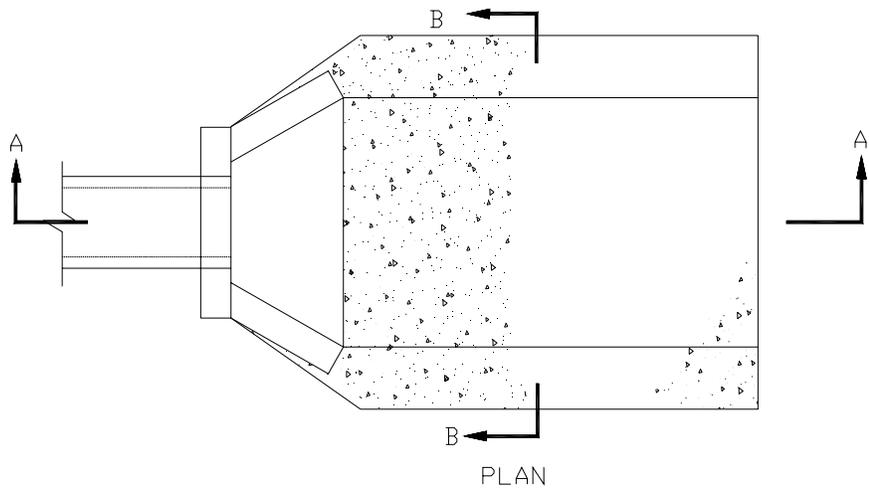
N.T.S.



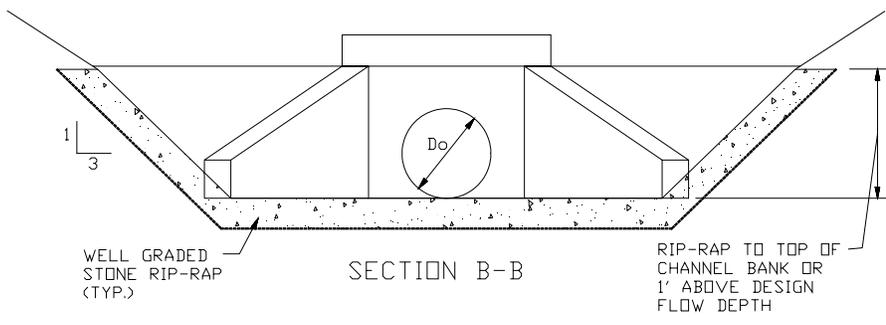
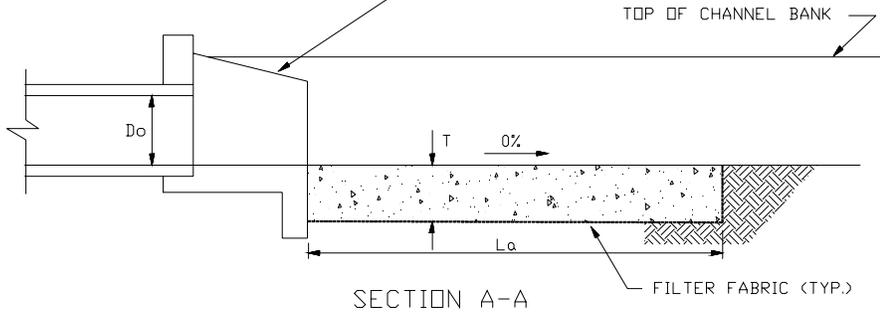
STONE OVERFLOW STRUCTURE
N.T.S.

5.6 OUTLET VELOCITY CONTROL STRUCTURE

1. **DESCRIPTION** - A stone rip-rap structure placed at a pipe outlet, headwall outlet or the outlet end of an armored channel section.
2. **PURPOSE** - Used to reduce the outlet flow velocity and dissipate the outlet flow energy to reduce the potential for downstream channel erosion.
3. **APPLICATIONS** - Applies to all pipe, headwall or armored channel outlets into vegetated channels where the outlet flow velocity exceeds 4 feet per second.
4. **LIMITATIONS** - Do not use where the downstream channel has a very steep longitudinal slope or where a vertical drop will result at the pipe end or end of the rip-rap pad. Method does not apply well to narrow downstream channels.
5. **DESIGN CRITERIA** -
 - A. Design Flow - Runoff from a 100-year storm.
 - B. Pad Dimensions - See Figure 5.6.A. for L_a and W .
Thickness (T) = $(1.5) \times (d_{max})$
 - C. Rip-Rap Size - See Figure 5.6.A. for d_{50} size.
 $d_{max} = (1.5) \times (d_{50})$
 - D. Grade - Zero percent (0%) for the length of the pad.
6. **MATERIAL SPECIFICATIONS** -
 - A. Stone Rip-Rap - Natural stone or re-cycled concrete meeting the gradation requirements for NCTCOG Specification 2.1.6.(b)(2) and 2.1.8.(d) mixed in a 1:1 ratio.
 - B. Filter Fabric - NCTCOG Specification 2.23.3.
7. **MAINTENANCE REQUIREMENTS** - Inspect periodically and after major rain storm events to ensure that the facility is functioning properly. Repair dislodged or missing stone rip-rap and repair any downstream erosion as soon as possible.



TYPE 'B' HEADWALL SHOWN,
SIMILAR FOR OTHER HEADWALLS
OR END OF CONC. CHANNEL LINING.



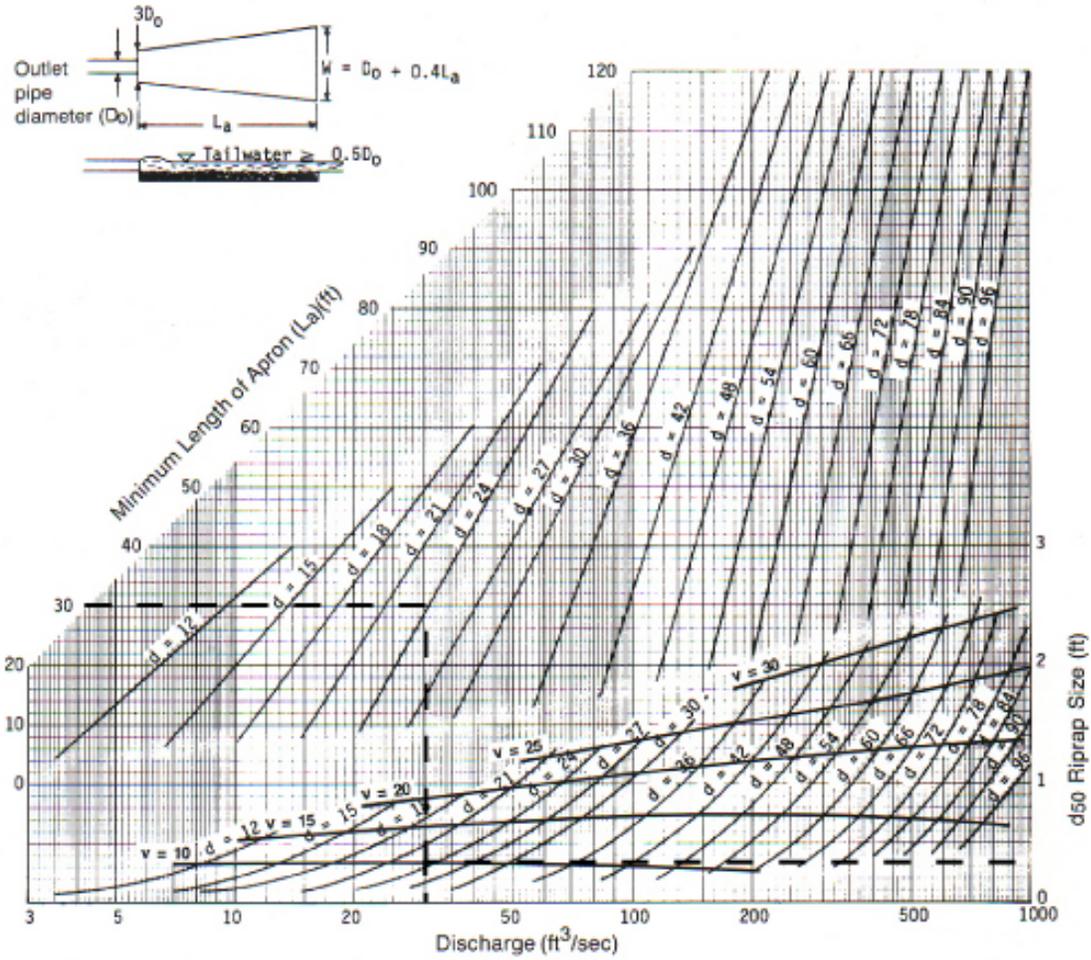
OUTLET VELOCITY CONTROL STRUCTURE

N.T.S.

FIGURE 5.6.A

Example: Pipe Diameter = 24"
Design Flow = 30 cfs

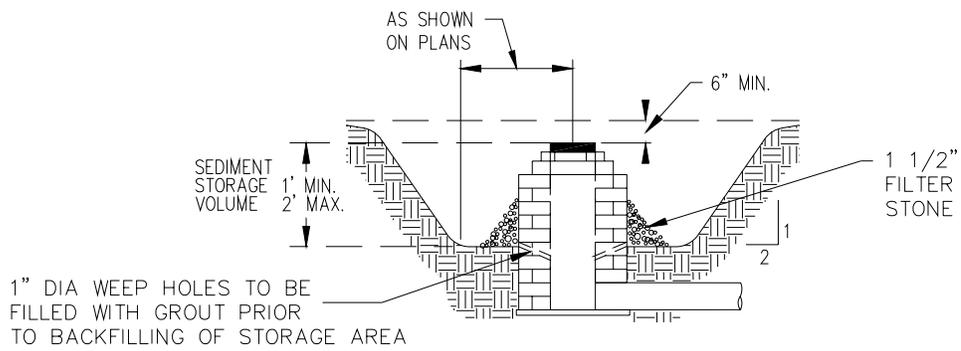
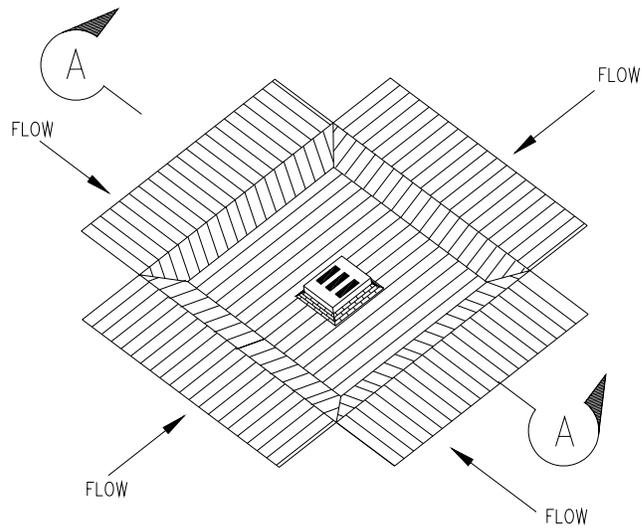
From Chart: $d_{50} = 0.3 \text{ ft.} = 4 \text{ in.}$
 $d_{\text{max.}} = (1.5) \times (d_{50}) = 6 \text{ in.}$
 Apron Thickness = $(1.5) \times (d_{\text{max.}}) = 9 \text{ in.}$
 From Chart: $L_a = 30 \text{ ft.}$



Curves may not be extrapolated.

5.7 EXCAVATED DROP INLET PROTECTION

1. **DESCRIPTION** - An excavated area surrounding a storm drain drop inlet.
2. **PURPOSE** - To remove sediment from storm runoff before it enters into the storm drain system.
3. **APPLICATIONS** - Where storm drain drop inlets are to be used prior to final stabilization of the area draining to the structure. This method is used where the inlet will collect relatively heavy flows and overflow capability is needed. Weep holes or other methods of de-watering the storage area must be provided. This method can also be used in conjunction with other drop inlet protection methods (block and gravel or silt fence barriers) to provide more efficient sediment removal.
4. **LIMITATIONS** - Ponding will occur around the inlet with possible localized flooding as the result. Final stabilization and cleanout may be difficult if the finished area around the drop inlet is to be paved. This method is not applicable to use around existing inlets in a paved area.
5. **DESIGN CRITERIA** -
 - A. Drainage Area - 5.0 acres or less.
 - B. Depth - 1 foot minimum, 2 feet maximum, measured from crest of inlet.
 - C. Volume - 1800 cubic feet per acre of drainage area.
 - D. Side Slopes - 2H:1V or flatter.
 - E. De-watering Time - 48 hours or less. Size and number of holes as needed.
6. **MATERIAL SPECIFICATIONS** -
 - A. Filter Stone - NCTCOG Specification 2.1.8.(e)
7. **MAINTENANCE REQUIREMENTS** - Excavated drop inlet protection should be inspected weekly and after major rain events to ensure that the device is functioning properly. Remove sediment from the excavation when the depth of sediment has built up to one-half of the design depth. If de-watering of storage volume is not occurring, clean or replace filter stone surrounding weep holes. Clean the stone surface the first few times by raking. Repeated sediment build-up will require filter stone replacement.



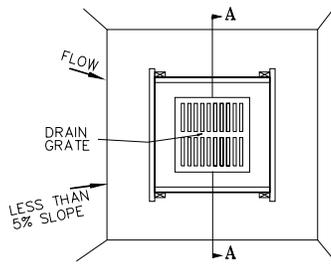
SECTION A-A

EXCAVATED DROP INLET PROTECTION

N.T.S.

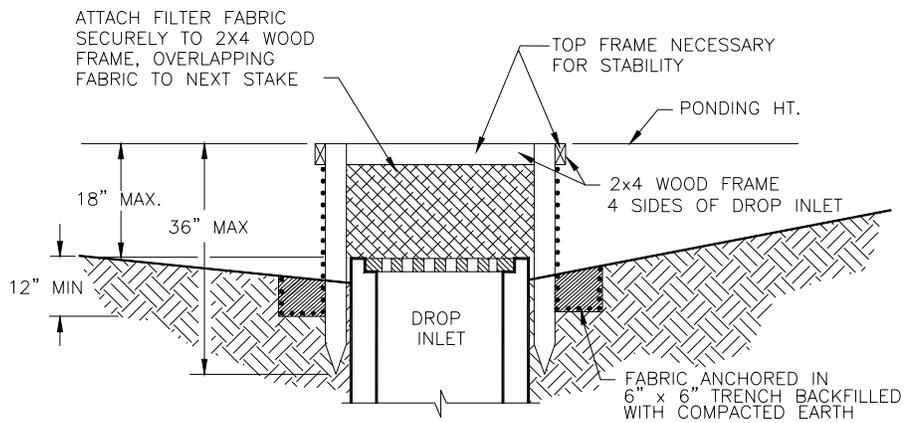
5.8 FILTER FABRIC DROP INLET PROTECTION

1. **DESCRIPTION** - A temporary filter fabric barrier surrounding a storm drain drop inlet.
2. **PURPOSE** - To filter sediment from storm runoff before it enters into the storm drain system.
3. **APPLICATIONS** - Where storm drain drop inlets are to be used prior to final stabilization of the area draining to the structure. This method of inlet protection is effective for small drainage areas with flat slopes and sheet flow type runoff. This method can be used in conjunction with the excavated drop inlet protection or block and gravel inlet protection to provide more effective sediment control.
4. **LIMITATIONS** - This method should not be used alone at inlets that receive concentrated channel or gutter flow. This method is not applicable for use around existing inlets in a paved area.
5. **DESIGN CRITERIA** -
 - A. Drainage Area - 1.0 acre or less.
 - B. Maximum Post Spacing - 4 feet.
 - C. Maximum Fence Height - 1.5 feet.
6. **MATERIAL SPECIFICATIONS** -
 - A. Filter Fabric - NCTCOG Specification 2.23.4.
 - B. Hog Wire - NCTCOG Specification 2.8.2.(b)(1), (If used).
 - C. Fence Posts - NCTCOG Specification 2.8.2.(b) for wood or steel.
7. **MAINTENANCE REQUIREMENTS** - Filter fabric drop inlet protection should be inspected weekly and after major rain events to ensure that the device is functioning properly. Remove sediment from around filter fabric when the depth of sediment has built up to one-third the height of the fence above grade. Inspect the trenched in base of fence to ensure that no gaps have developed and re-trench as necessary. Inspect fence posts to ensure that they are properly supporting the filter fabric. Straighten and reset posts if necessary. If filter fabric is ripped, damaged or deteriorated, replace it in accordance with the original specifications and details.



PLAN VIEW

NOTE: CONCENTRATED DITCH FLOW COMING FROM ONE OR MORE SIDES TOWARD THE DROP INLET MAY REQUIRE A STONE OVERFLOW STRUCTURE TO BE CONSTRUCTED ON ONE SIDE OF THE DROP INLET. HOG WIRE SHOULD BE USED TO SUPPORT THE FILTER FABRIC FOR INSTALLATIONS USED MORE THAN 90 DAYS



SECTION A-A

FILTER FABRIC DROP INLET PROTECTION

N.T.S.

5.9 BLOCK & GRAVEL DROP INLET PROTECTION

1. DESCRIPTION - A temporary sediment control barrier made of standard concrete block and filter stone (gravel) surrounding a storm drain drop inlet.

2. PURPOSE - To remove sediment from storm runoff before it enters into the storm drain system.

3. APPLICATIONS - Where storm drain drop inlets are to be used prior to final stabilization of the area draining to the structure. This method is used where the inlet will collect relatively heavy stormwater flows and overflow capability is needed. This method can also be used to protect drop inlets located in paved areas.

4. LIMITATIONS - Ponding will occur around the inlet with possible localized flooding as the result.

5. DESIGN CRITERIA -

A. Drainage Area - 2.0 acres or less.

B. Height - Two rows of concrete blocks (Maximum).

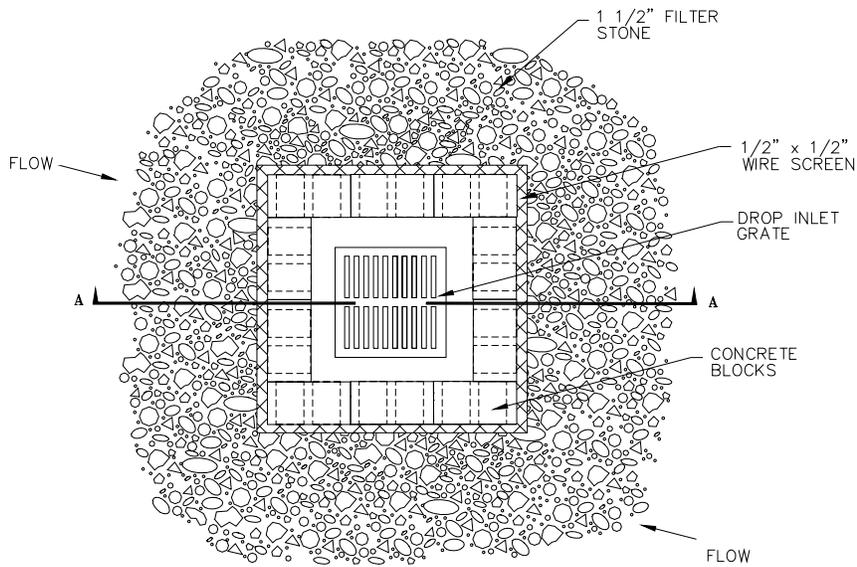
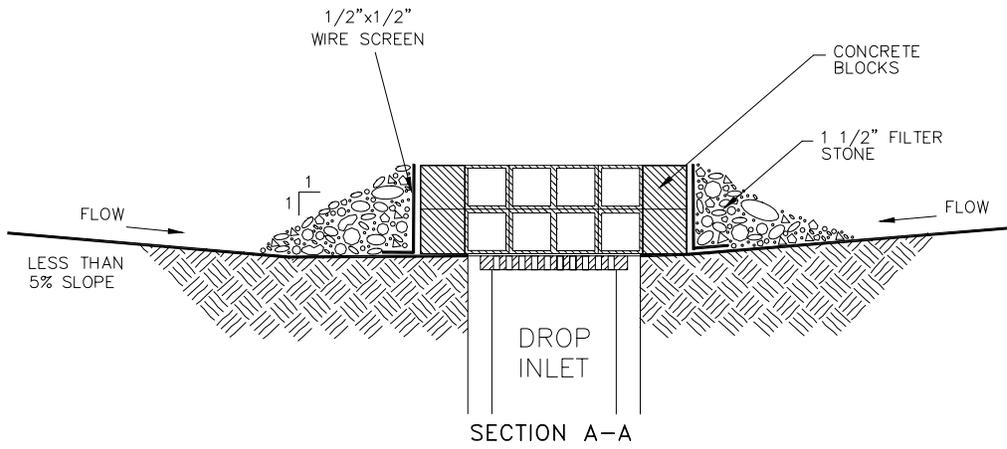
6. MATERIAL SPECIFICATIONS -

A. Concrete Block - ASTM C 139, Concrete Masonry Unit for Construction.

B. Wire Fabric - Standard galvanized hardware fabric with ½" by ½" openings.

C. Filter Stone - NCTCOG Specification 2.1.8.(e).

7. MAINTENANCE REQUIREMENTS - Block and gravel drop inlet protection should be inspected weekly and after major rain events to ensure that the device is functioning properly. Remove sediment from the storage area when the depth of sediment has built up to one-half of the storage depth. If de-watering of the storage volume is not occurring, clean or replace the filter stone (gravel). Clean the filter stone surface the first few times by raking. Repeated sediment build-up will require filter stone replacement.



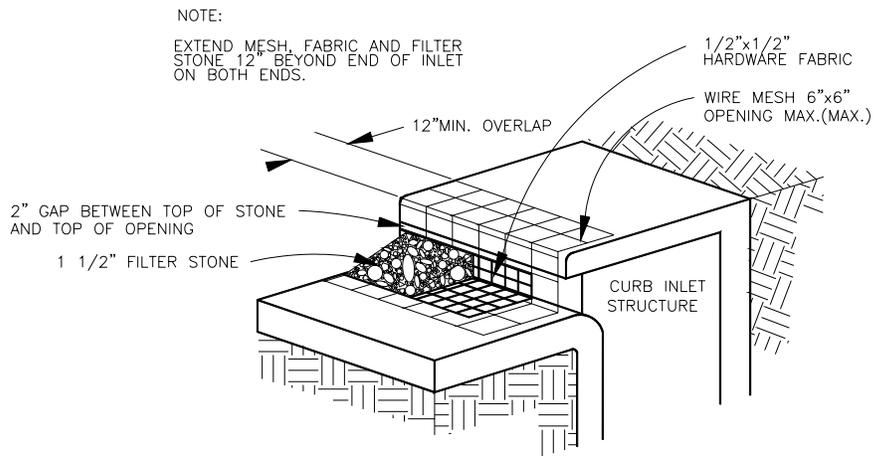
PLAN VIEW

BLOCK/GRAVEL DROP INLET PROTECTION

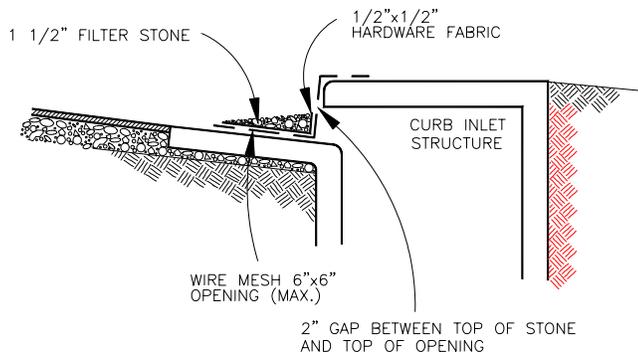
N.T.S.

5.10 CURB INLET PROTECTION

1. **DESCRIPTION** - A temporary sediment control barrier made of filter stone and standard concrete block, welded wire fabric, hardware fabric or 2x4 studs surrounding a storm drain curb inlet.
2. **PURPOSE** - To remove sediment from storm runoff before it enters into the storm drain system.
3. **APPLICATIONS** - Where storm drain curb inlets are to be used prior to final stabilization of the area draining to the structure. This method is used where the inlet will collect relatively heavy flows and overflow capability is needed. This method is also to be used to protect existing curb inlets located in paved areas.
4. **LIMITATIONS** - Ponding will occur around the inlet with possible localized flooding as the result. When used at locations that are open to vehicle traffic, this device will encroach into the traveled way. If the curb inlet is not a recessed type inlet a traffic barricade shall be placed at each end of the inlet protection device.
5. **DESIGN CRITERIA** -
 - A. Drainage Area - 2.0 acres or less.
 - B. Height - 6" (Maximum).
6. **MATERIAL SPECIFICATIONS** -
 - A. Concrete Block - ASTM C 139, Concrete Masonry Unit for Construction.
 - B. Wire Fabric - Standard galvanized hardware fabric with ½" by ½" openings.
 - C. Filter Stone - NCTCOG Specification 2.1.8.(e).
 - D. Wire Mesh - Welded wire fabric conforming to NCTCOG Specification 2.2.7 maximum opening 6"x6".
7. **MAINTENANCE REQUIREMENTS** - Curb inlet protection should be inspected weekly and after major rain events to ensure that the device is functioning properly. Remove sediment from the storage area when the depth of sediment has built up to one-half of the storage depth. If de-watering of the storage volume is not occurring, clean or replace the filter stone. Clean the filter stone surface the first few times by raking. Repeated sediment build-up will require filter stone replacement.



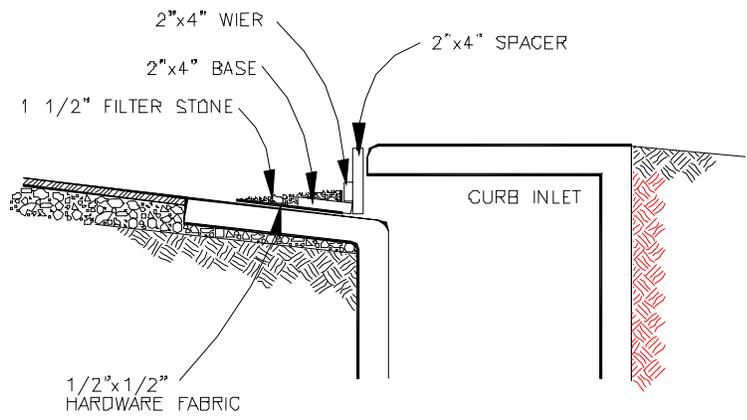
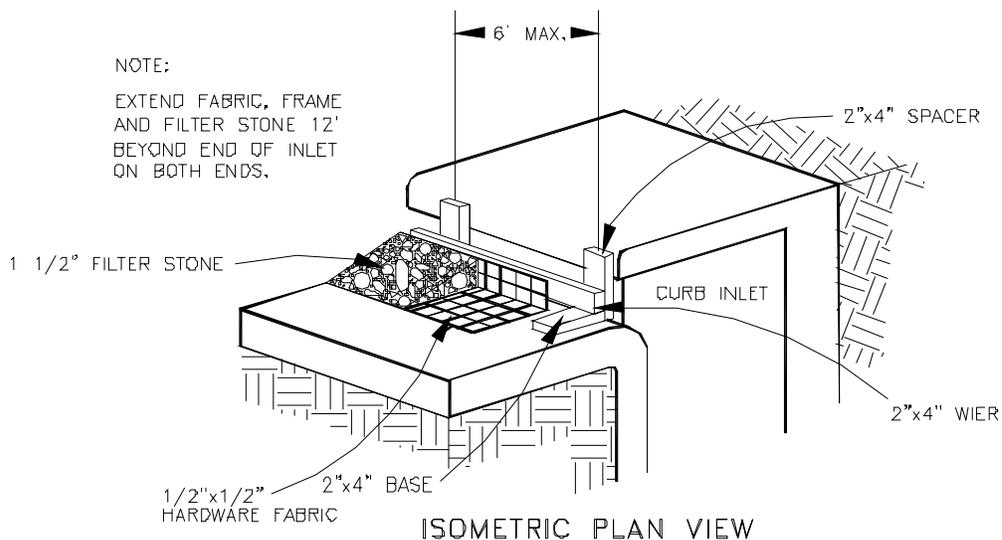
ISOMETRIC PLAN VIEW



INLET SECTION

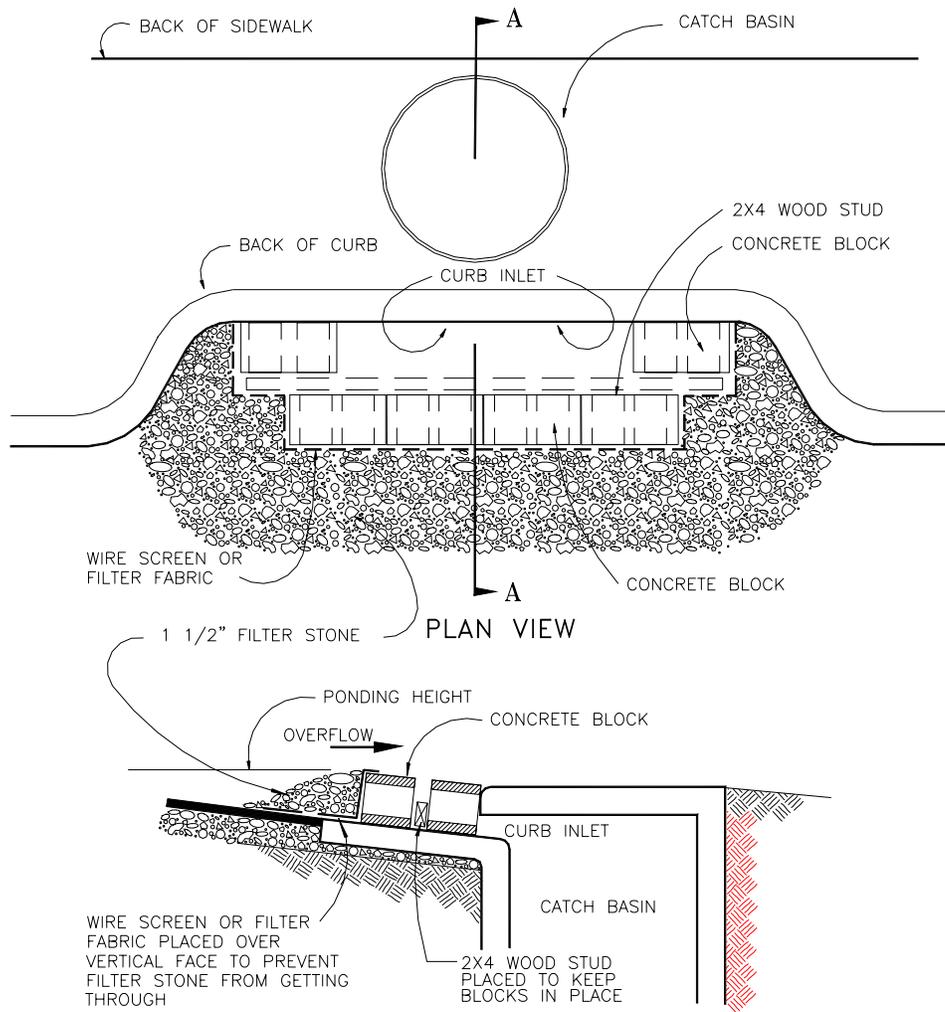
TYPE A CURB
 INLET PROTECTION

N.T.S.



TYPE B CURB
 INLET PROTECTION

N.T.S.



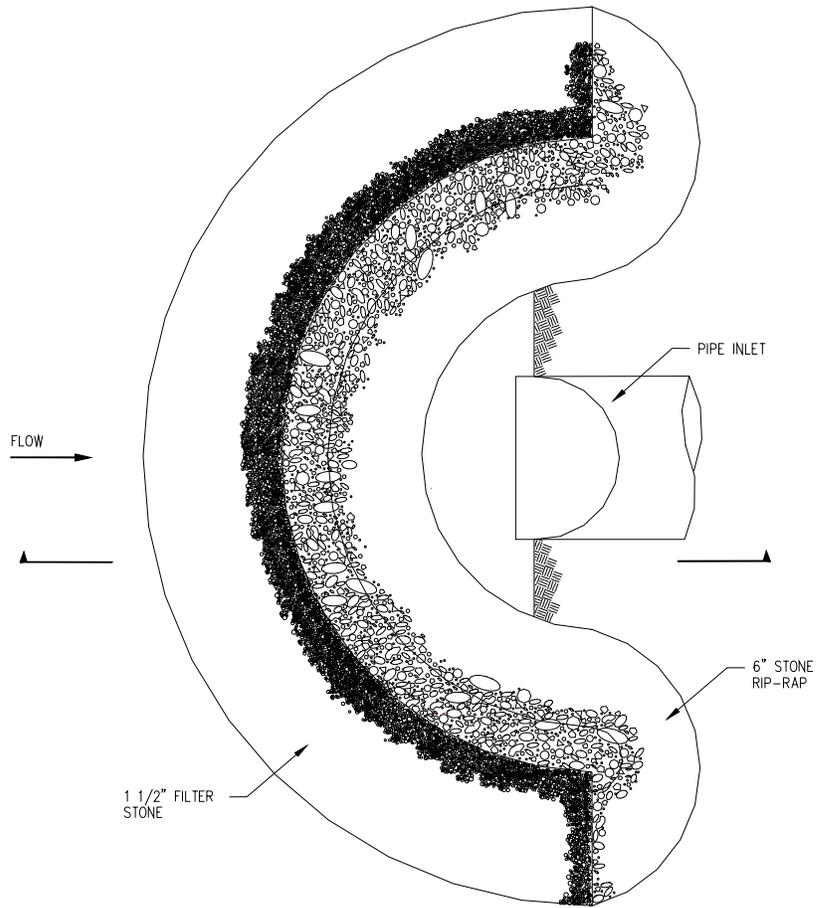
SECTION A - A

BLOCK AND GRAVEL RECESSED CURB INLET PROTECTION

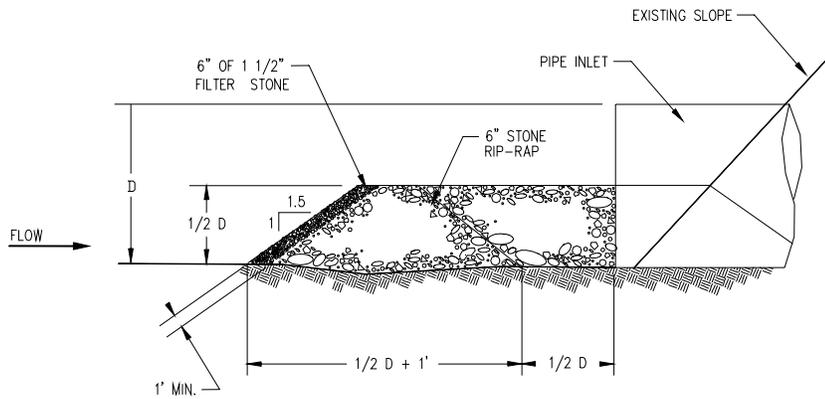
N.T.S.

5.11 PIPE INLET PROTECTION

1. **DESCRIPTION** - A temporary sediment control barrier made of standard concrete block and filter stone or stone rip-rap and filter stone surrounding the inlet end of a storm drain pipe or inlet pipe headwall.
2. **PURPOSE** - To remove sediment from storm runoff before it enters into the storm drain system.
3. **APPLICATIONS** - Where existing or proposed storm drain pipes or culverts are to be used prior to final stabilization of the area draining to the pipe inlet. This method is used where the pipe inlet will collect relatively heavy stormwater flows and overflow capability is needed.
4. **LIMITATIONS** - Ponding will occur around the pipe inlet with possible localized flooding as the result. Excavation of a sediment storage area can make final channel stabilization difficult and may create a separate erosion problem if not properly constructed. Do not use Cinder Block Pipe Inlet Protection for pipes larger than 36" in diameter.
5. **DESIGN CRITERIA** -
Volume - 1800 cubic feet per acre of drainage area.
Side Slopes - 1.5H:1V or flatter.
Top of Stone and Sediment Storage - $\frac{1}{2}$ of inlet pipe diameter.
6. **MATERIAL SPECIFICATIONS** -
Concrete Block - ASTM C 139, Concrete Masonry Unit for Construction.
Wire Fabric - Standard galvanized hardware fabric with $\frac{1}{2}$ " by $\frac{1}{2}$ " openings.
Filter Stone - NCTCOG Specification 2.1.8.(e).
Stone Rip-Rap - NCTCOG Specification 2.1.6.(b)(2), Type A.
7. **MAINTENANCE REQUIREMENTS** - Pipe inlet protection should be inspected weekly and after major rain events to ensure that the device is functioning properly. Remove sediment from the sediment storage area when the depth of sediment has built up to one-half of the design depth. If de-watering of the storage volume is not occurring, clean or replace the filter stone surrounding the pipe inlet. Clean the stone surface the first few times by raking. Repeated sediment build-up will require filter stone replacement.



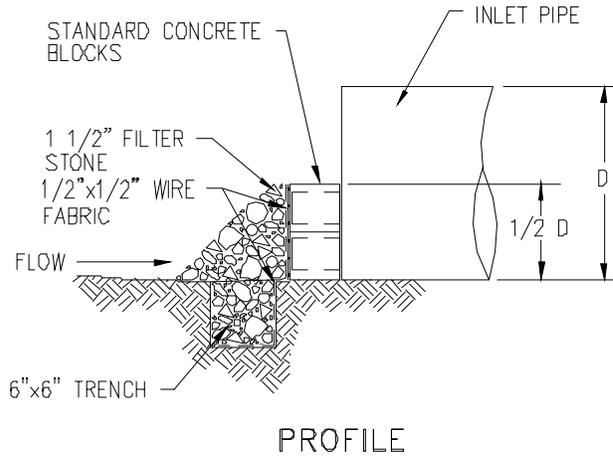
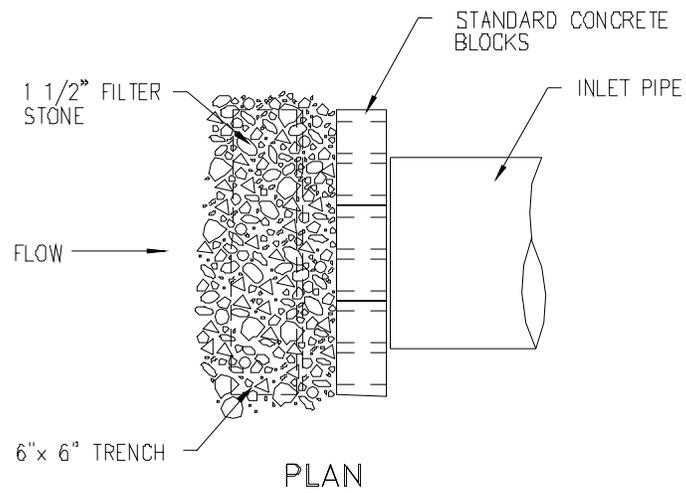
PLAN



SECTION

RIP-RAP PIPE INLET PROTECTION

N.T.S.

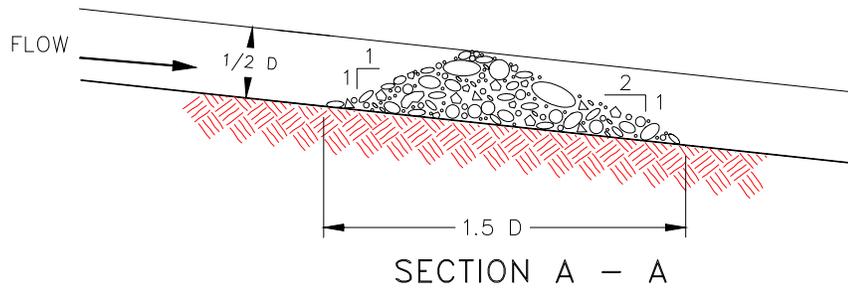
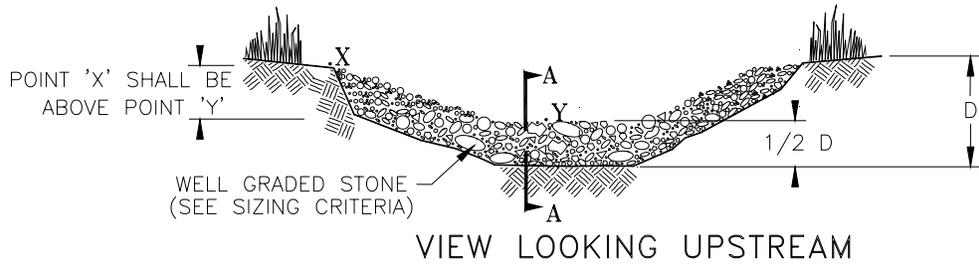


CINDER BLOCK PIPE INLET PROTECTION

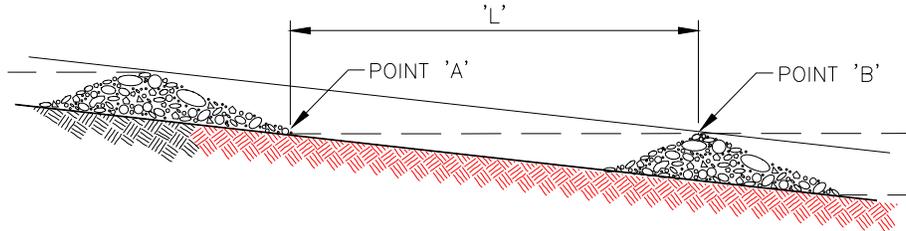
N.T.S.

5.12 ROCK CHECK DAMS

1. **DESCRIPTION** - A small temporary dam made of stone or re-cycled concrete constructed across a swale, ditch, or channel.
2. **PURPOSE** - Reduces the velocity of flow and thus the erosion potential of the flowing water. Also provides minimal sediment storage behind the dam.
3. **APPLICATIONS** - Rock check dams are used primarily in small to moderately sized open channels that have erosive velocities for design flow conditions. They are typically used in long linear roadway type projects or on short steep sections of drainage channel. These devices are a smaller version of stone outlet sediment traps which are used for larger drainage areas.
4. **LIMITATIONS** - Rock check dams shall not be used in a live stream. The installation of check dams reduces the hydraulic capacity of the channel and localized flooding may result. If not properly installed as detailed or not properly maintained the use of this method can lead to more serious channel erosion problems and channel instability. Method should not be used as a primary erosion control device, but in conjunction with other devices.
5. **DESIGN CRITERIA** -
 - A. Drainage Area - 2.0 acres or less.
 - B. Linear Spacing - Top of the downstream dam is at the same elevation as the bottom of the upstream dam.
 - C. Maximum Height - 2 feet at the center of the dam.
 - D. Stone Size - Well graded from 1-1/2" diameter through the maximum stone diameter. Max. Stone Diameter (inches) = (3 inches/ft.) x (Base Width in feet)
 - E. Stone Slope - 1.5H:1V or flatter.
6. **MATERIAL SPECIFICATIONS** -
 - A. Aggregate - Natural stone or re-cycled concrete meeting the gradation requirements for NCTCOG Specification 2.1.6.(b)(2) and 2.1.8.(d) mixed in a 1:1 ratio.
7. **MAINTENANCE REQUIREMENTS** - Rock check dams should be inspected weekly and after all rain events to ensure that the device is functioning properly. Remove sediment from the storage area upstream of the dam when the depth of sediment has built up to one-half of the dam height. Repair damage to the channel in the vicinity of the check dams immediately to prevent additional damage. Replace missing or dislodged rock as needed to maintain the design height and cross section of the check dam.



'L' = THE DISTANCE SUCH THAT POINTS 'A' AND 'B' ARE OF EQUAL ELEVATION.

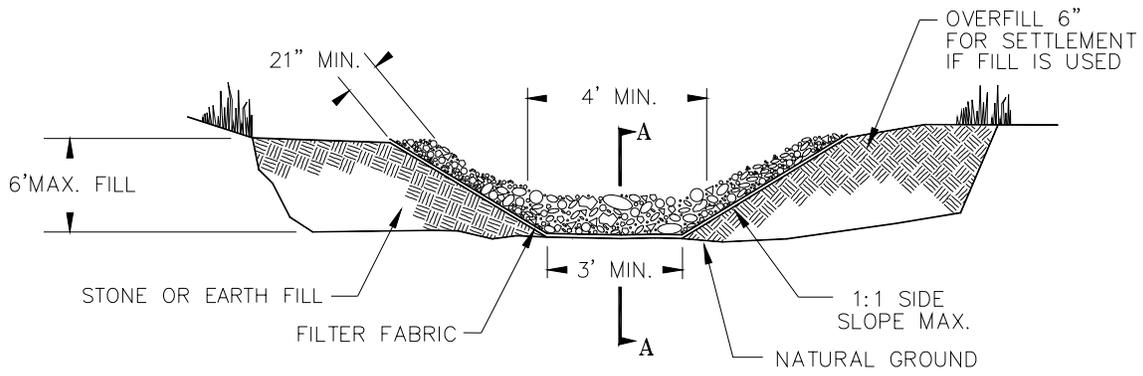


ROCK CHECK DAM

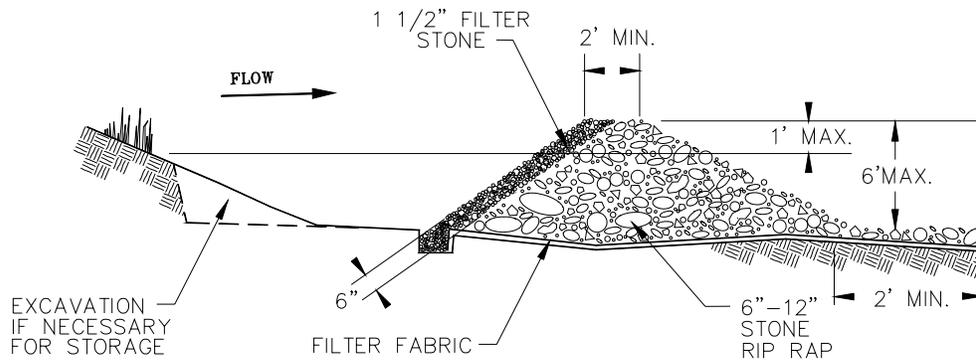
N.T.S.

5.13 STONE OUTLET SEDIMENT TRAP

1. **DESCRIPTION** - A ponding area formed by placing an earth and/or stone embankment across a drainageway or swale. The ponding area may be natural or improved to provide the required storage volume.
2. **PURPOSE** - To detain sediment laden runoff long enough to allow the majority of the sediment to settle from the water and to allow diffused runoff from the outlet.
3. **APPLICATIONS** - Normally used where the natural topography allows for the construction of the embankment to form the ponding area. Diversions, drainage improvements, and localized grading will allow placement in almost any location that has adequate space for the storage area and will accept the runoff from the disturbed site. The stone outlet sediment trap can be used instead of the standard sediment basin.
4. **LIMITATIONS** - Do not place device in a live stream. Avoid placing in areas planned for future improvements such as pavement or buildings. Inlet channels or pipe should be located as far away from the stone outlet as is practicable to allow for maximum sediment settling time in the basin.
5. **DESIGN CRITERIA** -
 - A. Drainage Area - 30 acres, maximum.
 - B. Storage Volume - 1800 cubic feet per acre of disturbed land draining to the device.
 - C. Surface Area of Storage Area - 1% (0.01) of the area draining to the device.
 - D. Embankment Height - 6 feet (maximum) to top.
 - E. Embankment Slopes - 1.5H:1V or flatter.
 - F. Embankment Top Width - 2 feet (minimum)
 - G. Stone Outlet Width - 4 feet (minimum)
 - H. Outlet Capacity - 10-year design storm, $C = 0.50$, Max. $T_c = 15$ minutes.
 - I. Freeboard @ Design Flow - 6 inches.
6. **MATERIAL SPECIFICATIONS** -
 - A. Stone Rip-Rap - NCTCOG Specification 2.1.6.(b)(2), Type A or re-cycled concrete meeting the same gradation.
 - B. Filter Stone - NCTCOG Specification 2.1.8.(e).
 - C. Filter Fabric - NCTCOG Specification 2.23.4.
7. **MAINTENANCE REQUIREMENTS** - Stone outlet sediment traps should be inspected weekly and after major rain events to ensure that the device is functioning properly. Remove sediment from the storage area when the depth of sediment has built up to one-half the height of the stone outlet. Inspect the downstream base of the stone outlet and the downstream flow channel to ensure that no excessive erosion or gullies have developed and repair as necessary. The sediment storage area should drain within 48 to 72 hours after a rain event. The filter stone on the upstream face of the stone outlet may require cleaning or replacement if standing water remains for longer periods.



VIEW LOOKING UPSTREAM



SECTION

STONE OUTLET SEDIMENT TRAP

N.T.S.

5.14 SEDIMENT BASIN

1. DESCRIPTION - A basin created by building an earth dam across a waterway or low drainage area and/or by excavation. The basin temporarily detains sediment laden runoff and releases it at a reduced rate normally through a perforated corrugated metal riser and barrel assembly.

2. PURPOSE - To detain the sediment laden runoff long enough to allow the sediment to settle from the stormwater and become trapped in the basin. Prevents sedimentation in off-site streams, lakes and drainageways.

3. APPLICATIONS - The device is one of the most effective BMPs available for sedimentation control, but due to the area required for storage and the cost of construction it is usually used on larger projects with drainage areas greater than 5 acres. This application works particularly well where larger disturbed areas naturally drain toward one outlet point.

4. LIMITATIONS - Limitations on the use of this device include:

- The drainage area to any one basin shall not exceed 100 acres.
- Do not locate basin storage area in areas planned for future construction (i.e. buildings, pavements, structures, etc.)
- If excessive erosion occurs in area draining to the basin, the cleanup, disposal and stabilization of sediment from the basin can become a very costly operation.
- Access must be provided for heavy equipment to perform cleanout and removal operations.
- Do not locate in live streams or within 100-year floodplains.

5. DESIGN CRITERIA -

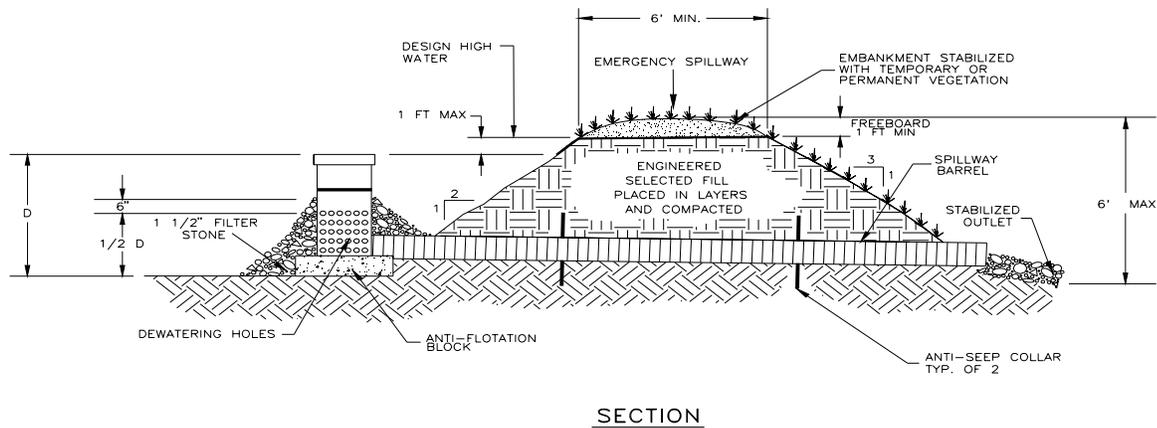
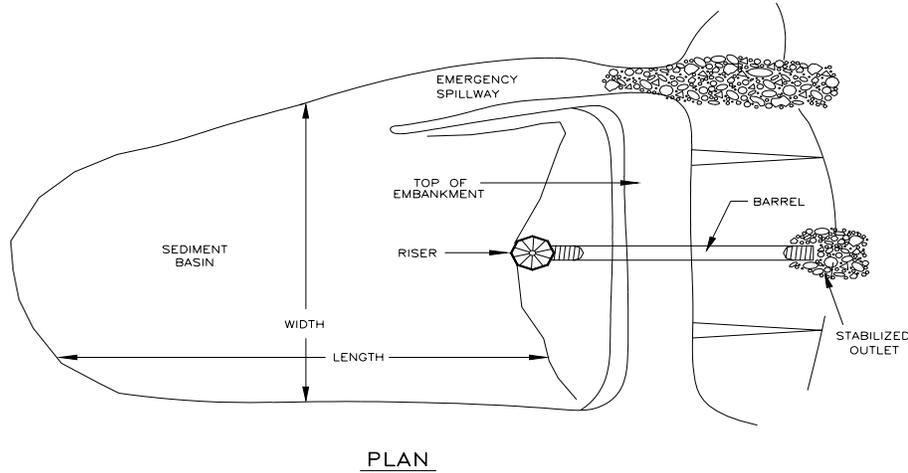
- A. Drainage Area - Less than 100 acres.
- B. Storage Volume - 1800 cubic feet per disturbed acre draining to basin.
- C. Length/Width Ratio - 2:1
- D. Surface Area - 1% of drainage area to basin.
- E. Dam Height - 6 feet (Max.)
- F. Embankment Slopes - 3H:1V or flatter on downstream face.
2H:1V or flatter on upstream face.
- G. Top of Dam Width - 6 feet (Min.)
- H. Riser/Barrel Capacity - Peak runoff from 10-year storm event.
- I. Side Channel Overflow Capacity - Peak runoff from 100-year storm event.
- J. Basin Dewatering - ½" diameter holes spaced 10"-12" horizontally and 8" vertically from bottom of riser up to ½ of riser height. Place 1-1/2" filter stone around the outside of the riser to a height 6" above top row of ½" holes.

6. MATERIAL SPECIFICATIONS -

- A. Riser/Barrel - NCTCOG Specification 2.12.16.
- B. Filter Stone - NCTCOG Specification 2.1.8.(e).
- C. Concrete - NCTCOG Specification 2.2., Class B.

D. Stone Rip-Rap - Natural stone or re-cycled concrete meeting the gradation requirements of NCTCOG Specification Item 2.1.8.(d).

7. **MAINTENANCE REQUIREMENTS** - Periodically inspect sediment basin to ensure that facility is functioning properly. Clean out sediment and dispose of properly when the sediment storage volume is 1/2 full. Clean or replace filter stone when stone becomes clogged with sediment or facility will no longer drain properly. Check outlet of spillway barrel and downstream toe of dam to ensure that water is not flowing under the dam or along the outside edge of the spillway pipe. Check downstream channel and overflow channel for erosion and gullies and repair as needed



SEDIMENT BASIN/POND

N.T.S.

5.15 SLOPE DRAIN

1. DESCRIPTION - A temporary pipe or conduit (flexible or rigid) extending from the top to the bottom of an unstabilized cut or fill slope.

2. PURPOSE - To convey concentrated stormwater runoff down an unstabilized cut or fill slope without causing erosion.

3. APPLICATIONS - The practice applies to construction areas where stormwater runoff flowing to the top of a cut or fill slope will cause erosion if allowed to flow over the slope. Generally used with diversions to convey stormwater down a slope until the permanent stormwater conveyance system is put into operation. The installation protects the slope from excessive erosion, but does not reduce the sediment load already being conveyed in the runoff. Therefore, the practice must be used in conjunction with other sediment control devices downstream of the installation.

4. LIMITATIONS - Improper sizing of the inlet or the pipe itself can lead to serious erosion of the slope that the device is protecting. Drains and diversions can be easily damaged by construction equipment. Securing the pipe to the slope can be difficult and require significant maintenance during the life of a project.

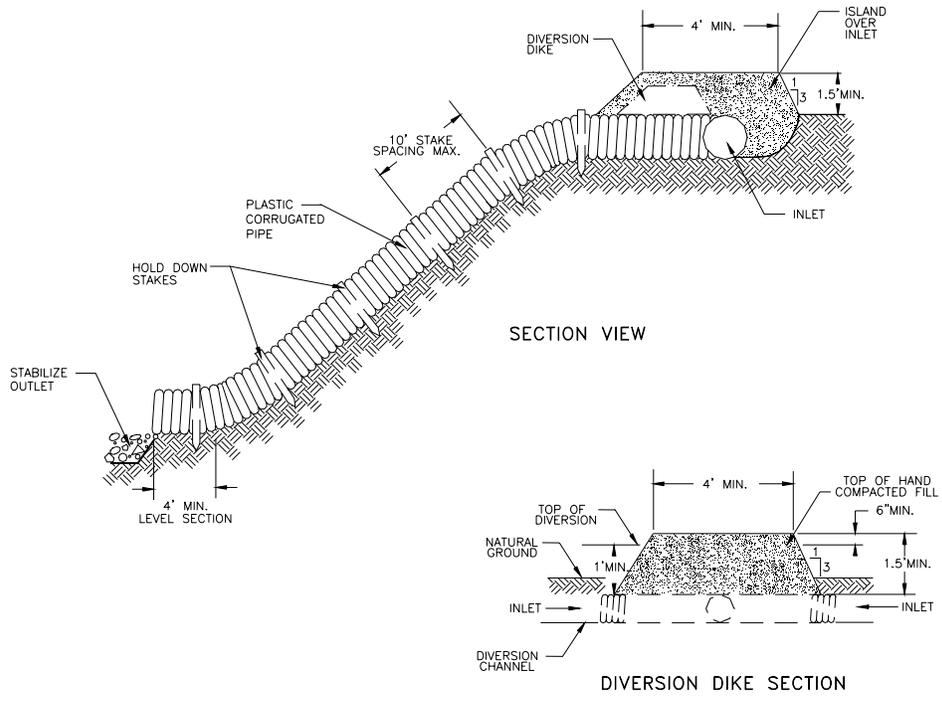
5. DESIGN CRITERIA -

- A.** Capacity - Peak runoff from a 10-year storm event.
- B.** Pipe Anchor Spacing - 10 feet (Max.)
- C.** Outlet Stabilization - Outlet Velocity Control Structure (See Section 5.7)
- D.** Drainage Area - 1.0 acre (Max.)

6. MATERIAL SPECIFICATIONS -

- A.** Pipe - Flexible or rigid with watertight joints.
- B.** Rip-Rap - See Outlet Velocity Control Structure, Section 5.7.

7. MAINTENANCE REQUIREMENTS - Inspect the slope drain installations after all rainfall events to ensure that the facilities are functioning properly. Particular attention must be paid to the diversion inlet channels, the berm at the pipe inlet, the pipe anchoring system, and the pipe outlet.



SLOPE DRAIN
N.T.S.

5.16 EROSION CONTROL MATTING

1. DESCRIPTION - A geomembrane or biodegradable fabric placed over disturbed ground areas or immediately downstream of disturbed ground areas.

2. PURPOSE - To limit the effects of erosive runoff, rainfall impact, and to control minor amounts of sediment runoff.

3. APPLICATIONS - Matting can be used on any construction-related disturbed land areas, but are particularly effective for erosion control on short steep slopes and channel bottoms or sides. They are also well suited for sheet flow sedimentation control from small drainage areas on flat grades.

4. LIMITATIONS - Although matting can be highly effective for erosion control, it may be less cost effective than other BMPs in certain situations. When used for sedimentation control the drainage area must be kept small enough to ensure sheet flow on to the matting at relatively flat grades (i.e. low velocities).

5. DESIGN CRITERIA -

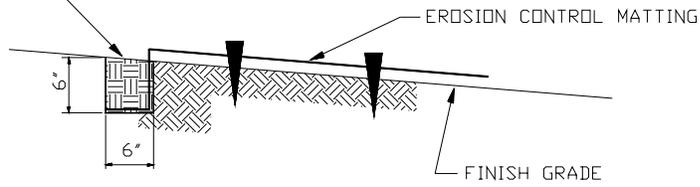
A. Matting for Erosion Control and Flexible Channel Liners - Follow the manufacturer's recommendations.

B. Sedimentation Control - Limit drainage area to 30 feet per linear foot of mat.
Max. Slope \leq three percent (3%).

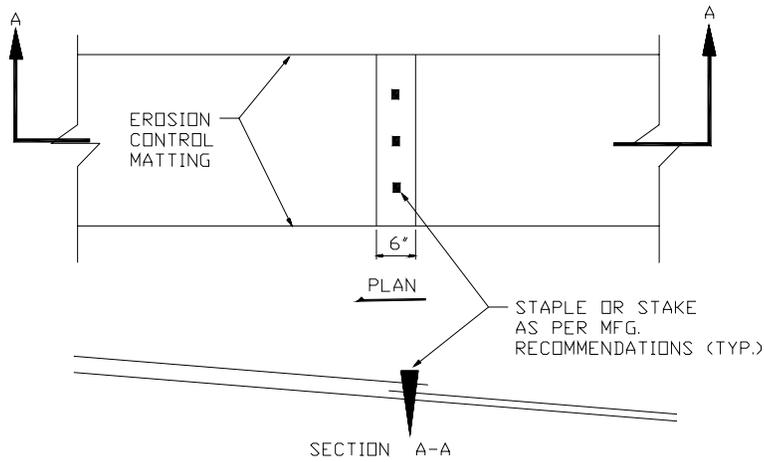
6. MATERIAL SPECIFICATIONS - Products listed in the most recent TxDOT Approved Product List for slope protection and flexible channel liners. Mats are usually installed according to the manufacturer's recommended guidelines. Manufacturer's information will verify acceptable applications for a particular product.

7. MAINTENANCE REQUIREMENTS - Inspect the erosion control matting installations after all rainfall events to ensure that the facilities are functioning properly and have not been displaced by runoff. Particular attention must be paid to the upstream ends of channel linings and slope protection, as well as the joints between adjacent mats. Repair any damaged areas promptly and replace any displaced matting. Additional staking may be required on steeper slopes and in channel bottoms.

TRENCH EROSION CONTROL
MATTING AT UP-STREAM
END. BACKFILL W/ SOIL
& COMPACT.



UPSTREAM ANCHORING



TYPICAL JOINT OVERLAP

EROSION CONTROL MATTING

N.T.S.

Chapter 6

VEGETATIVE STABILIZATION

6.1 GENERAL - This chapter provides standards and specifications for the use of vegetative BMPs for controlling erosion due to land disturbing activities. These methods are primarily for preventing erosion caused by rainfall impact and storm water runoff. The timely use of temporary and permanent ground covers can have a dramatic effect on the amount of erosion that will leave the site of land disturbing activity.

Material specifications listed in this Chapter use the latest versions of the North Central Texas Council of Governments, Standard Specifications for Public Works Construction, the City of Plano, Special Provisions to Standard Specifications for Public Works Construction and the Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges to the maximum extent possible.

6.2 TEMPORARY SEEDING

1. DESCRIPTION - The planting of fast growing annual grasses or small grains to provide initial, temporary ground cover for disturbed areas.

2. PURPOSE - To temporarily stabilize disturbed land areas and earthen BMPs that will not be brought to final grade or have permanent stabilization applied within a period of 30 days.

3. APPLICATIONS - This practice applies to graded areas, soil areas with sparse vegetation, and soil areas with no vegetation. Specific construction site applications include diversions, earth dams, temporary sediment basins, roadway embankments, rough graded areas and soil stockpiles.

4. LIMITATIONS - The application of temporary seeded ground cover has the following limitations:

- Areas must be re-seeded or permanently stabilized within 1-year.
- High cost for short term uses.
- Improper attention to materials and application techniques can lead to higher maintenance costs and severe erosion damage.
- Not applicable to areas used by foot and vehicle traffic.
- Not applicable to areas with excessive stormwater runoff or high velocity runoff.

5. DESIGN CRITERIA - Comply with requirements of TxDOT Standard Construction Specification Item No. 164, Seeding for Erosion Control.

6. MATERIAL SPECIFICATIONS - Comply with requirements of TxDOT Standard Construction Specification Item No. 164, Seeding for Erosion Control.

7. MAINTENANCE REQUIREMENTS - Inspect areas with temporary ground cover weekly and immediately after heavy rainfall events. Repair rills, bare areas, and washouts immediately and re-seed to establish temporary ground cover. Watering may be required to initiate the germination process. The use of annual grasses requires that the areas be re-seeded yearly or be stabilized with permanent ground cover. Protect seeded areas from foot and vehicle traffic.

6.3 PERMANENT SEEDING

1. DESCRIPTION - Stabilizing disturbed ground areas by establishing perennial vegetative ground cover by seeding.

2. PURPOSE - To permanently stabilize disturbed areas by establishing a relatively low cost, maintainable ground cover.

3. APPLICATIONS - Permanent vegetative techniques can and should be applied to almost all construction sites at the completion of the project. Permanent seeding is used on fine-graded areas on which long-lived vegetative ground cover is the most practical and effective method for stabilizing the soil. The method can also be used on rough-graded areas that will not be brought to final grade for more than a year.

4. LIMITATIONS - The application of permanent seeded ground cover has the following limitations:

- Seasonal limits on suitable seeding dates for specific varieties of seed.
- Improper attention to materials and application techniques can lead to higher maintenance costs and severe erosion damage.
- Not applicable to areas used by foot and vehicle traffic.
- Not applicable to areas with excessive stormwater runoff or high velocity runoff.
- Not applicable to steep slopes. Slopes steeper than 3H:1V restrict the use of equipment for seedbed preparation and mowing.
- May require permanent irrigation.

5. DESIGN CRITERIA - Comply with requirements of the North Central Texas Council of Governments (NCTCOG), Standard Specifications for Public Works Construction, Item 3.10. Seeding, and as modified by the City of Plano Special Provisions, latest edition.

6. MATERIAL SPECIFICATIONS - Comply with requirements of the North Central Texas Council of Governments (NCTCOG), Standard Specifications for Public Works Construction, Item 3.10. Seeding and Item 2.15. Materials for Seeding and Sodding, and as modified by the City of Plano Special Provisions, latest edition.

7. MAINTENANCE REQUIREMENTS - Repair rills, bare areas, and washouts immediately and re-seed to establish permanent ground cover. Watering, fertilization and soil supplements may be required to initiate the germination process and to maintain permanent ground cover. Protect seeded areas from excessive water runoff and traffic prior to establishing vegetation. May require periodic mowing and weed control.

6.4 SODDING

1. **DESCRIPTION** - Stabilizing bare ground areas by laying a continuous cover of grass sod.
2. **PURPOSE** - To provide immediate vegetative stabilization to disturbed land areas and earthen BMPs.
3. **APPLICATIONS** - Practice applies to disturbed land areas that require immediate and permanent ground cover or where sodding is the preferred method of establishing grass. Locations that are particularly well suited to stabilization with sod include:
 - Swales, channels and ditches carrying storm water at acceptable velocities.
 - Steeper slopes than can be stabilized by normal seeding.
 - Residential or commercial lawns and golf courses where prompt use and aesthetics are important.
 - Areas around drop inlets after the drainage basin has been stabilized.
4. **LIMITATIONS** - The application of sod ground cover has the following limitations:
 - More costly to install than seeding.
 - More difficult to obtain, transport and store.
 - May require permanent irrigation.
5. **DESIGN CRITERIA** - Comply with requirements of the North Central Texas Council of Governments (NCTCOG) Standard Specifications for Public Works Construction, Item 3.9 Sodding, and as modified by the City of Plano Special Provisions, latest edition.
6. **MATERIAL SPECIFICATIONS** - Comply with requirements of the North Central Council of Governments (NCTCOG), Standard Specifications for Public Works Construction, Item 3.9 Sodding and Item 2.15 Materials for Seeding and Sodding, and as modified by the City of Plano Special Provisions, latest edition.
7. **MAINTENANCE REQUIREMENTS** - Repair rills and washouts immediately and re-sod to establish permanent ground cover. Watering, fertilization and soil supplements may be required to establish and maintain permanent ground cover. Remove dead sod and replace promptly. May require periodic mowing and weed control. Slopes steeper than 3H:1V will require staking of the sod to hold it in place.

Chapter 7

INSPECTIONS AND ENFORCEMENT

7.1 GENERAL - The primary responsibility for inspecting and maintaining the erosion control BMPs found at any given site within the City of Plano rests with the Responsible Party as defined by the Erosion Control Ordinance. This will usually be the Contractor that actually constructed the BMPs. The erosion control plan for any site shall list a BMP Maintenance Schedule for the devices used. Each device specified in Chapter 5 listed the maintenance requirements for that device and City of Plano staff will do follow-up inspections on all permitted sites and as requested on sites without permits.

7.2 INSPECTION PROCEDURE - The following procedure can be used on most construction sites to ensure that the erosion control plan and devices are effectively controlling sediment runoff from the site:

1. Does the site topography match what is shown on the construction plans?
2. Does the site work comply with the erosion control plan?
3. Does the erosion control plan appear reasonable for the site?
4. Has the construction phasing of the project been taken into account on the erosion control plan and is the Contractor following the plan?
5. Check all erosion control BMPs -
 - Are they properly installed (dimensions & materials)?
 - Are they properly located to control sediment?
 - Do the BMPs require repair?
 - Do the BMPs require cleanout?
5. Check the perimeter of the site for evidence of off-site sedimentation, particularly at gutters, streams, inlets, and swales.
6. Are additional erosion control devices required to control sediment runoff?

7.3 ENFORCEMENT PROCEDURE - The intent of the enforcement procedure is to correct insufficient erosion and sedimentation controls as early as possible. It also is meant to place emphasis on the repair and maintenance of inadequate BMPs by not allowing inspections and approvals of other on-site work items until corrections to BMPs have been accomplished. The following summarizes the enforcement process that will normally be followed by the City of Plano:

1. Follow-up of a citizen's complaint or a regularly scheduled City inspection of the site.
2. An inspection report is completed by the City's authorized representative and delivered to the Responsible Party for the site.

3. If violations of the Ordinance are discovered a Notice of Violation is issued.
4. Corrections completed by the Responsible Party (Contractor, Owner, Developer, Etc.).
5. If corrections are not completed within the time allocated, a stop work order is issued.
6. Corrections completed by the responsible party (Contractor, Owner, Developer, Etc.) and all fees are paid prior to release of the stop work order.
7. If corrections are not completed, the City initiates court action against the Responsible Party (Contractor, Owner, Developer, Etc.).

Figures 4.1.A, B, and C show a more detailed flowchart of the approval and enforcement process for each type of development that is usually seen in the City of Plano.

Chapter 8

APPENDICES

8.1 EROSION CONTROL DEVICE PHOTOGRAPHS

TEMPORARY STONE CONSTRUCTION ENTRANCE/EXIT



PROPER INSTALLATION



NO INSTALLATION

TEMPORARY DIVERSION & STONE OVERFLOW



STONE OVERFLOW STRUCTURE



NOTE: TOP OF STRUCTURE IS TOO HIGH.

GRASSED CHANNELS



WITH EROSION CONTROL MATTING



**WITHOUT EROSION CONTROL MATTING
CHANNEL FAILURE**

SILT FENCE



PROPER INSTALLATION AT SUBDIVISION FINAL ACCEPTANCE



DAMAGE DUE TO CONSTRUCTION TRAFFIC & DUMPING

SILT FENCE



**PROPERLY INSTALLED SILT FENCE WITH HEAVY SEDIMENT LOAD.
STONE OVERFLOW SHOULD HAVE BEEN INSTALLED.**



**IMPROPERLY INSTALLED SILT FENCE.
NOTE GAP BETWEEN FENCE AND GROUND**

EXCAVATED INLET PROTECTION

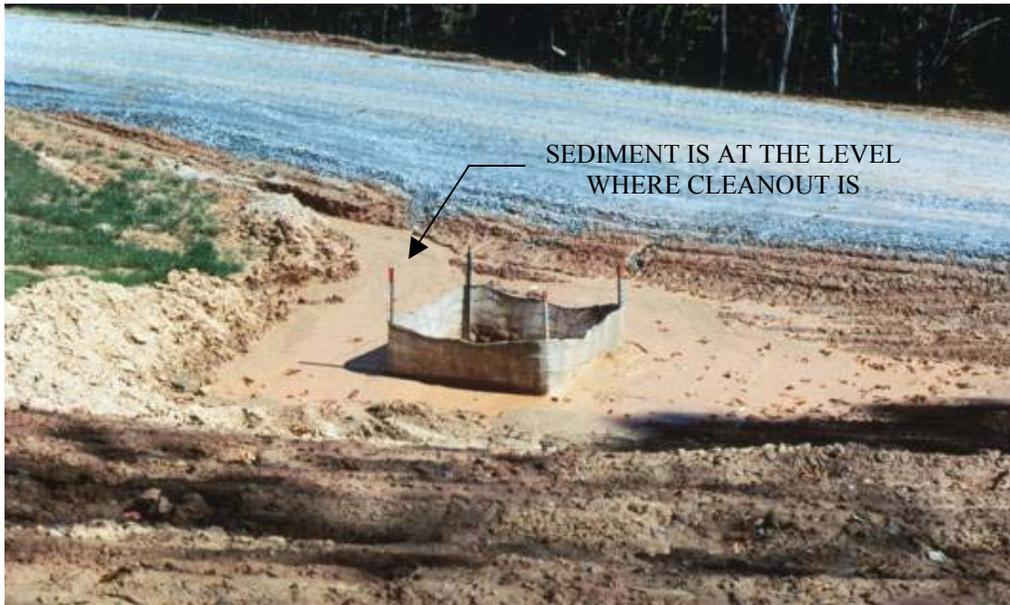


NOTE: STONE PROTECTING WEEP HOLES THAT DRAIN THE AREA BELOW THE OVERFLOW ELEVATION.



IMPROPER USE OF STRAW BALES

FILTER FABRIC DROP INLET PROTECTION



PROPERLY INSTALLED FILTER FABRIC INSTALLATION



PROPERLY INSTALLED FILTER FABRIC ON UNFINISHED CURB INLET

CURB INLET PROTECTION



CLOGGED INLET PROTECTION IN NEED OF MAINTENANCE



IMPROPER USE OF HAY BALES FOR INLET PROTECTION

ROCK CHECK DAMS



IMPROPER CONSTRUCTION LEADING TO BANK EROSION



FAILED CHECK DAM DUE TO IMPROPERLY SIZED RIP-RAP

STONE OUTLET SEDIMENT TRAP



SEDIMENT BASIN



IMPROPER USE OF HAY BALES FOR INLET PROTECTION

EROSION CONTROL MATTING FOR SINGLE LOT CONSTRUCTION



IMPROPER USE OF SILT FENCE AS DIVERSION

VIOLATION EXAMPLES

FAILURE TO REPAIR DAMAGE TO EROSION CONTROL DEVICES



VIOLATION EXAMPLES

FAILURE TO MAINTAIN EROSION CONTROL DEVICES



VIOLATION EXAMPLES

FAILURE TO INSTALL EROSION CONTROL DEVICES



VIOLATION EXAMPLES
FAILURE TO REPAIR DAMAGE TO EXISTING
EROSION CONTROL DEVICES



VIOLATION EXAMPLES
FAILURE TO INSTALL EROSION CONTROL DEVICES
SUFFICIENT TO CONTROL SEDIMENTATION



VIOLATION EXAMPLES
FAILURE TO REMOVE OFF-SITE SEDIMENTATION



8.2 GLOSSARY

- **BARREL** - A pipe placed through a dam, levee or dike to control the release of water.
- **BMP** - Best Management Practices. Consist of practices, procedures, and devices used to prevent or reduce pollutants, including sediment, from polluting the waters of the United States.
- **BORROW AREA** - A source of earth fill material used in the construction of embankments or other earth fill structures.
- **CHANNEL** - A natural stream or excavated ditch that conveys water.
- **CHANNELIZATION** - Alteration of a stream channel by widening, deepening, straightening, or paving certain areas to improve flow characteristics.
- **CHECK DAM** - A small, temporary dam constructed across a drainage ditch, swale or channel to lower the speed of concentrated flows and promote sediment deposition.
- **CONTOUR** - An imaginary line on the surface of the earth connecting points of the same elevation.
- **CUT** - Portion of land surface or area from which earth has been removed or will be removed by excavating; the depth below the original ground surface to the excavated ground surface.
- **DAM** - A barrier to confine or impound water or for the retention of soil, sediment or debris.
- **DESIGN STORM** - A selected rainfall pattern of specified amount, intensity, duration, and frequency that is used as a basis for design.
- **DISCHARGE** - Usually the rate of water flow commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, or millions of gallons per day.
- **DIVERSION** - A channel with a supporting ridge on the lower side constructed at the top, across, or at the bottom of a slope for the purpose of controlling surface runoff.
- **DIVERSION DIKE** - A barrier built to divert surface runoff.
- **DIVIDE, DRAINAGE** - The boundary between watersheds.
- **DRAINAGEWAY** - A natural or artificial depression that carries surface water to a larger watercourse or outlet such as a river or lake.
- **DROP INLET** - Overall structure in which the water drops through a vertical riser connected to a discharge conduit or storm sewer.
- **EARTH DAM** - Dam constructed of compacted suitable soil materials.
- **ENERGY DISSIPATOR** - A device used to reduce the energy of flowing water to prevent erosion.
- **EPA** - The Environmental Protection Agency. The federal agency responsible for administering the NPDES permit program.
- **ERODIBILITY** - Susceptibility to erosion.
- **EROSION** - The wearing away of the land surface by water, wind, ice, gravity, or other geological agents.
- **EROSION CONTROL PLAN** - A site plan with necessary details, showing the property where land disturbing activity will take place and showing the locations and types of BMPs to be used to control erosion and sedimentation.
- **FILTER FABRIC** - A woven or non-woven, water-permeable material generally made of synthetic products such as polypropylene and used in erosion and sediment control applications to trap sediment or prevent the movement of fine soil particles.

- **FLOOD PLAIN** - The lowland that borders a stream and is subject to flooding when the stream overflows its banks.
- **GABION** - A wire mesh cage, usually rectangular, filled with rock and used to protect channel banks and other sloping areas from erosion.
- **GEOTEXTILES** - See filter fabric.
- **GRADE STABILIZATION STRUCTURE** - A structure for the purpose of stabilizing the grade of a gully or other watercourse, thereby preventing further erosion or lowering of the channel bottom.
- **GRADING** - The cutting and/or filling of the land surface to a desired slope or elevation.
- **GRASSED WATERWAY** - A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses and used to safely conduct surface water from an area.
- **GROUND COVER** - Low-growing, spreading plants (grasses or legumes) useful for low-maintenance landscape areas.
- **INVERT** - The inside bottom of a culvert or other conduit.
- **LEGUME** - Any member of the pea or pulse family which includes peas, beans, peanuts, clovers, alfalfa, sweet clovers, lespedezas, vetches, black locust, and kudzu.
- **NPDES** - National Pollutant Discharge Elimination System. A federal program that requires a permit for storm water discharges to the waters of the U.S.
- **OUTLET PROTECTION** - Stone, rip-rap, concrete or asphalt aprons installed to reduce the speed of concentrated storm water flows, thereby reducing erosion and scouring at storm water outlets.
- **RAINFALL INTENSITY** - The rate at which rain is falling at any given instant, usually expressed in inches per hour.
- **RATIONAL METHOD** - A means of computing storm drainage flow rates by use of the formula $Q = CiA$, where C is a coefficient describing the physical drainage area, i is the rainfall intensity, and A is the drainage area.
- **RECEIVING STREAM** - The body of water into which runoff or effluent is discharged.
- **RILL** - A small intermittent watercourse with steep sides, usually only a few inches deep, normally caused by erosion.
- **RISER** - A vertical pipe or structure extending from the barrel, storm sewer or bottom of a pond BMP that is used to convey the discharge from the pond or drainage area.
- **RUNOFF** - That portion of precipitation that flows from a drainage area on the land surface, in open channels or in storm water conveyance systems.
- **SCOUR** - The clearing and digging action of flowing water, especially the downward erosion caused by stream water in sweeping away mud and silt from the stream bed.
- **SEDIMENT** - Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice.
- **SEDIMENT BASIN** - A settling pond with a controlled storm water release structure used to collect and store sediment produced by land disturbing activities. The basin detains sediment-laden runoff from larger drainage areas long enough to allow most of the sediment to settle out.
- **SEDIMENT POOL** - The reservoir space allocated for the accumulation of sediment in a sedimentation control device.
- **SEDIMENT TRAP** - A settling basin with a filter outlet designed to retain runoff long enough to allow most of the silt to settle out.

- **SEDIMENTATION** - The deposition of suspended soil particles that have settled out from storm water runoff.
- **SHEETFLOW** - Runoff which flows over the ground surface as a thin, even layer, not concentrated in a channel or a rill.
- **SILT** - Parts of the soil structure consisting of particles between 0.002 and 0.05 mm in diameter.
- **SLOPE** - Degree of deviation of a surface from the horizontal. Slope is measured and is shown as a numerical ratio or percent.
- **SOIL** - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.
- **STABILIZATION** - The proper placing, grading and/or covering of soil, rock or earth to ensure its resistance to erosion, sliding, or other movement. Also see Vegetative Stabilization.
- **STORM FREQUENCY** - The time interval between major storms of predetermined intensity and volumes of runoff (e.g. 10-year or 100-year storm).
- **STORM SEWER (DRAIN)** - A sewer that carries storm water, surface drainage, street wash and other wash waters, but excludes sewage and industrial wastes. Also called a storm drain.
- **STORM WATER** - Runoff from a rain event or snow melt runoff. Also called surface runoff.
- **SWALE** - An elongated, gentle depression in the land surface that conveys storm water into primary drainage channels. Swales are normally without flowing or standing water.
- **SWPPP** - Storm Water Pollution Prevention Plan. A document that is a part of the NPDES permit application and consists of the site erosion control plan, waste management plan, and site narrative as required by the EPA.
- **TEMPORARY SEEDING** - The growing of short-term (less than 1-year) vegetation on disturbed areas to prevent erosion.
- **TOE OF SLOPE** - The base or bottom of a slope at the point where the ground surface abruptly changes to a significantly flatter grade.
- **TOPOGRAPHY** - A general term that includes the physical features of a surface area including relative elevations and the position of natural and man-made features.
- **VEGETATIVE STABILIZATION** - Protection of erodible areas with temporary seeding, permanent seeding, or sodding.
- **WATERSHED** - The region drained by or contributing water to a stream , lake, or other body of water.

8.3 SOURCES OF ASSISTANCE

1. City of Plano, Development Services Department, Engineering Division
1520 K Avenue, Room 250, P.O. Box 860358, Plano, TX 75086-0358
(972) 941-7152 Fax (972) 941-7397
2. City of Plano, Building Inspections Department
1520 K Avenue, Room 250, P.O. Box 860358, Plano, TX 75086-0358
(972) 941-7140 Fax (972) 941-7177
3. U.S. Environmental Protection Agency
Region 6, 1445 Ross Avenue, Mailcode: 6W-PM, Dallas, TX 75202-2733
Permits - (214) 665-7521 Enforcement - (214) 665-7112
4. North Central Texas Council of Governments
616 Six Flags Drive, P.O. Box 5888, Arlington, TX 76005-5888
(817) 640-3300

8.4 REFERENCES

1. Guilford County Planning and Development Department, Guidelines for Soil Erosion and Sedimentation Control, Greensboro, NC, October 1990.
2. Institute for Water Resources, Civil Works Environmental Desk Reference, IWR Report 96-PS-3, Alexandria, VA, July 1996.
3. National Association of Home Builders, NAHB Storm Water and Urban Runoff Guide for Builders and Developers, 1996.
4. North Carolina, State of - Department of Environment, Health and Natural Resources, Division of Land Resources, Erosion and Sediment Control Planning and Design Manual, September 1, 1988.
5. North Central Texas Council of Governments, Standard Specifications for Public Works Construction, Second Edition as amended by 1988, 1989, 1990, 1991, and 1992/1993 Amendment Packets, Arlington, TX, 1987.
6. North Central Texas Council of Governments, Storm Water Quality Best Management Practices for Construction Activities, First Edition, February 1993.
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8. Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges, March 1993.
9. United States Department of Agriculture, Soil Conservation Service, Soil Survey of Collin County, Texas, June 1969.
10. United States Department of Agriculture, Soil Conservation Service, Soil Survey of Dallas County, Texas, February 1980.
11. United States Department of Agriculture, Soil Conservation Service, Soil Survey of Denton County, Texas, January 1980.
12. United States Environmental Protection Agency, Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA Office of Wastewater Enforcement and Compliance, Washington, DC, September 1992.