9. Construction Site Stormwater Management

9.1 General

Construction activities produce many kinds of pollutants which can cause water quality problems. In addition to erosion and sedimentation, construction activities often require the use of toxic or hazardous materials such as petroleum products and fuels, pesticides, herbicides, fertilizers, asphalt, concrete and sealants. These types of materials often contain small amounts of toxic substances which may harm human, plant and animal life along receiving streams and within lakes and ponds.

Management practices which control erosion and sedimentation fall into three main types; those which divert runoff from construction areas, those which prevent erosion on the construction site, and those which trap sediment before it can leave the construction site.

This section of the Stormwater Management and Drainage Manual provides information on many management practices and controls which can be used to comply with the conditions of a grading and land alteration permit. While specific practices are identified, careful consideration must be given to selecting the most appropriate management practices based upon site-specific conditions and installing controls in a timely and proper manner. New, novel, innovative, and proven BMP's for stabilization, erosion control, sediment control, and outlet protection measures not explicitly mentioned below are allowed and encouraged. New and novel measures require a submittal of a proposed alternative for staff's review and approval. It also must be noted that proper maintenance is required on all controls for them to remain effective.

9.1.1 Grading and Drainage Plans

City code and state regulations provide that any person proposing to engage in grading, clearing, filling, cutting, quarrying, construction or similar activities regulated by this article shall apply to the Director of Planning and Development for approval of plans and issuance of a grading and land alteration permit.

There are several exceptions to grading and land alteration permit requirements, and these exceptions are considered by the City Design Review Engineer during Grading and Drainage Plan review. There are no exceptions to the need to prepare and submit a Grading and Drainage Plan. Proposed development which does not meet the criteria for a Grading and Drainage Plan, as set forth in the following paragraphs, must include certification from the Architect and/or Engineer that the criteria are not applicable to the proposed development. Failure to provide certification will result in the plan being rejected by the City Design Review Engineer.

A Grading and Drainage Plan is required for **any** of the following activities:

A. Cut or fill activity greater than fifteen (15) vertical feet in height.
B. Cut or fill volume equal to or greater than one thousand (1,000) cubic yards.
C. Clearing that exceeds one (1) acre in size.
D. Clearing that is less than one (1) acre in size but is a part of a larger development.
E. Any land alteration on properties that are located within the 100-year floodplain boundary.

The Grading and Drainage Plan is submitted to and reviewed by the City Design Review Engineer to determine if a Grading Permit is required. Where vertical cut or fill activity greater than thirty (30) feet is indicated, Planning Commission approval is required. It should be noted that all construction work must include appropriate drainage and erosion control measures, regardless of whether a grading and land alteration permit is required.

The Universal Soil Loss Equation has been adopted by the City of Little Rock to enable planners and developers to predict the average rate of soil erosion from construction sites. The City has established an allowable rate of soil loss at five tons per acres per year (5 t/a/yr). Grading plan development requires the application of the Universal Soil Loss Equation to determine the potential soil erosion from a site, which establishes the need for erosion controls. Once erosion controls are identified, the Universal Soil Loss Equation can be used to estimate the effectiveness and adequacy of erosion controls.

The application of erosion and sedimentation controls falls within the sequence of design; stabilization practices; erosion controls; sedimentation controls; and other controls, as applicable. It is possible to control site runoff with stabilization practices alone, where stabilization can reduce the potential soil loss from the site to at or below five (5) tons per acre per year. Where stabilization cannot reduce the potential soil loss to at or below the allowable limit, then erosion controls are also required. Where a combination of stabilization practices and erosion controls are not effective in reducing potential soil loss, sedimentation controls are also required.

9.1.2 Sketch Grading and Drainage Plan Requirements

A Sketch Grading and Drainage Plan may be submitted for agricultural land uses or forestry activities on land owned by forest-related industry. A Sketch Plan is required as a part of the Planning Commission Application for any of the activities identified in Section 9.1.1 above, and for planned unit developments, conditional use permits, site plan reviews, subdivision approvals, or multiple building site approvals.

A Sketch Plan must identify all the following:

A. Acreage of the proposed project.
B. Land areas to be disturbed, (hatching or shading).
C. Stages of grading which identify the limits of sections to be disturbed and the approximate order of development.
D. Extent of cut and fill, shown by placing a dashed line at the top and toe of cut or fill slopes, and indicating on the plan the height and slope of the cut or fill.
E. Provisions for collecting and discharging surface water.
F. Erosion and sediment control measures, including structural and vegetative measures.

The Sketch Plan requires the seal and signature of a registered engineer, architect or landscape architect certifying that the Sketch Plan complies with Municipal Code. Plans for areas of less than five (5) acres where vertical cut or fill height does not exceed ten (10) feet, or where only tree clearing activities will take place may be prepared by a contractor or the property owner.

A Grading and Drainage Plan Checklist has been prepared and is included in Appendix A. Refer to Section 9.1.4 for information on other local, state, and federal permitting requirements.

9.1.3 Complete Grading and Drainage Plan Requirements

A Complete Grading and Drainage Plan includes the requirements for a Sketch Plan and the following additional information:

A. A vicinity drawing identifying property lines, existing or platted streets and public ways within or immediately adjacent to the site.
B. Location of all known existing sewers, water mains, culverts, underground utilities, and existing permanent buildings within and adjacent to the tract.

C. Citation of any existing legal rights-of-way or easements affecting the property.
D. Soil loss calculations as estimated by the Universal Soil Loss Equation (Section 9.6).
E. A plan of the site at a minimum scale of 1'' = 100', showing:
    1. Address and telephone number of the owner, developer, and permittee.
    2. Approximate location and width of proposed streets.
    3. Approximate location and dimension of all proposed or existing lots.
    4. Approximate location and dimension of all parcels of land which will be dedicated to open space, public use, or will remain undisturbed.
    5. Existing and proposed topography at a maximum contour interval of five (5) feet.
    6. An approximate timing schedule indicating the starting and completion dates of the development.
    7. A timing schedule for the sequence of grading and the application of erosion and sediment control measures.
    8. Acreage of the proposed project.
    9. Identification of unusual material or soils in land areas to be disturbed and engineering recommendations for correcting any problems.
    10. Identification of suitable fill materials, including the type and source of outside fill materials.
    11. Specification of measures to control runoff, erosion, and sedimentation during construction, noting the areas where controls are required, and the type of controls employed.
    12. Measures to protect neighboring built-up areas and city property during construction.
    13. Provisions to stabilize soils and slopes after construction is complete, including when and where stabilization measures will be employed.

The Complete Plan must include the seal and signature of a registered engineer. If all boundary street and drainage improvements are in place, the seal and signature of a registered architect or landscape architect is acceptable.

The stormwater pollution prevention plan (SWPPP) shall be included with the grading & land alteration permit submittal to verify compliance with state's MS4 permit agreement with the City. A Grading and Drainage Plan Checklist has been prepared and is included in Appendix A.

9.1.4 Other permit Requirements

Application to Develop in a Flood Hazard Area

Proposed development within Special Flood Hazard Areas of the City requires the developer or their agent to obtain and complete an Application and Permit Form to Develop in a Flood Hazard Area. Work within the 100-year floodplain requires the applicant to complete FEMA Form TOD-1: Certification/Application Forms for Letters of Map Amendment/Revision Based on Fill. Work within the regulatory floodway, including changes in base flood elevations, fill, channelization, and bridge/culvert replacement projects require the applicant to prepare and submit applicable portions of FEMA Form RSD-1: Revisions to National Flood Insurance Maps. Additional information is available from the City's Floodplain Administrator.

Section 10 of the Rivers and Harbors Act of 1899

This Act prohibits the obstruction or alteration of navigable waters of the Unites States without a permit. Section 10 Permits are issued by the United States Army Corps of Engineers Permits Branch, who should be contacted at (501) 324-5295 for additional information.

Clean Water Act Section 404 Permits

Section 301 of this Act prohibits the discharge of dredged or fill material into waters of the United States without a permit. Section 404 Permits are issued by the United States Army Corps of Engineers. Contact the United States Army Corps of Engineers Permits Branch at (501) 324-5295 for more information.

Arkansas Solid Waste Management Code of 1984

The Arkansas Department of Pollution Control and Ecology authorizes all legitimate fill operations. An Application for Request for Fill Area is required to be completed and approved for development consisting of fill for the purpose of surface leveling. Contact the Solid Waste Division of the Arkansas Department of Pollution Control and Ecology at (501) 570-2858 for more information.

Arkansas State Water and Air Pollution Control Act

The Arkansas Department of Pollution Control and Ecology authorizes the discharge of storm water associated with industrial activity from construction sites - those areas or common plans of development or sale that will result in the disturbance of five or more acres total land area. The Department has issued General Permit ARR10A000 for construction activities. A Notice of Intent is required at least 48 hours prior to commencing land disturbance activities. Contact the NPDES Branch of the Arkansas Department of Pollution Control and Ecology at (501) 562-7444 for more information.

Burning Permit

Site clearing often generates timber debris which may be mulched or burned on site. Burning requires approval from the City Fire Marshall on a permit form furnished by the Fire Department. Contact the Fire Department at (501) 371-4796 for more information, and to obtain permit forms.

Burning of demolition and construction debris is regulated by the Arkansas Department of Pollution Control and Ecology Air Division. Contact the Air Division at (501) 570-2161 for more information.

9.2 Sediment Control Criteria and Requirements

Stabilization

A record of the dates when grading activities occur, when construction activities temporarily or permanently cease on a portion of the site except as provided within bulleted text below, and when stabilization measures are initiated shall be included in the erosion and sediment control plan. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.

- Where the initiation of stabilization measures by the 14th day after construction activity temporarily or permanently ceases is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.
- Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g., the total time that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of the site by the 14th day after construction activity temporarily ceased.

Stabilization practices may include temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, and preservation of mature vegetation and other appropriate measures. See Section 15-52 of the Little Rock City Code for tree protection requirements.

9.3 Stabilization Practices

EPA NPDES Fact Sheets for the following Erosion and Sediment Control BMPs can be found on their website under the National Menu of Best Management Practices (BMPs) for Stormwater-Construction | US EPA.

Examples of construction site stabilization practices:

- **Chemical Stabilization**
- **Filter Strips**
- **Preservation of natural vegetation**
- **Seeding**
- **Sod stabilization**
- **Stream bank stabilization**
- **Subsurface drains**

Chemical Stabilization. Chemical stabilization practices involve spraying soil surfaces with various man-made materials to hold the soil in place temporarily. This control is an alternative where temporary seeding is not practical because of the season or climate. Chemical stabilization can provide immediate and effective erosion control anywhere on a construction site.

Existing and Natural vegetation. Every means shall be taken to conserve and protect existing vegetation. The potential for soil loss shall be minimized by retaining natural vegetation wherever possible. Development in the Hillside/Hilltop Overlay District should comply with the recommendations of the Hillside/Hilltop Best Management Practices Manual about the retention of natural vegetation on Hillside/Hilltops.

Establishing New Vegetation. Vegetation practices may be either temporary or permanent and, at a minimum, should comply with Little Rock City Code Section 29-197, Advanced Grading Plan Requirements. They may be applied singularly or in combination with other practices. Cutting, filling, and grading soils with heavy equipment results in areas of exposed subsoils or mixtures of soil horizons. Conditions such as acidity, low fertility, compaction, and dryness or wetness often prevail and are unfavorable to plant growth and should be accounted for in the selection of plantings is required as specified for each BMP.

Long slopes and steep grades shall not be created. Stormwater drainage structures where such conditions already exist are normally subjected to hydraulic forces requiring both special establishment techniques and grasses that have high resistance to scouring. Vegetation practices and structural techniques are available to provide both temporary and permanent protective cover on these difficult sites, where encountered.

Filter Strips. These are areas of the site left undisturbed by clearing and construction activities. They are like buffer zones, slowing runoff velocity to allow sediment to settle out. However, filter strips serve the additional purpose of allowing runoff to infiltrate into the ground. Filter strips are an effective control applicable to sites where adequate space exists to leave undisturbed areas. Filter strips should be aligned perpendicular to the line of flow and can be used along with diversion ditches or berms to direct flow onto the vegetated surface area.

Temporary Vegetation. Earth moving activities such as heavy cutting, filling, and grading are generally performed in several stages and are often interrupted by lengthy periods, during which the land lies idle and is subject to accelerated erosion especially during rainfall events. In addition, final land grading may be completed during a season not favorable for immediate establishment of permanent vegetation. In such conditions, rapid growing annual grasses shall be used to rapidly

establish protective cover. This can later be worked into the soil for use as mulch when the site is prepared for establishment of permanent vegetation.

Permanent Vegetation. Final selection should be based on adaptation of the plants to the soils and climate, suitability for their specific use, ease of establishment, longevity, or ability to reseed, maintenance requirements, aesthetics, and other special qualities. Maintenance must be the most important consideration in selecting plants for permanent stabilization.

Plants that provide long-lived stabilization with the minimum amount of required maintenance should be selected. Where management potential is limited because of specialized circumstances, the best plants to choose are those that are well adapted to the site and to the specific purpose for which they are to be used. For example, grasses used for waterway stabilization must be able to withstand submergence and provide a dense cover to prevent scouring of the channel boundary.

In playgrounds, grasses must lend themselves to close grooming and be able to withstand heavy trampling. In some places, such as southern-exposed cut-and-fill slopes, the plants must be adapted to full sunlight and drought conditions. In other places, plants must be able to tolerate shade or high moisture conditions. Some plants can be used for beautification as well as for soil stabilization.

9.4 Erosion Control Methods

Control of erosion during construction requires an examination of the entire site to identify potential problem areas such as steep slopes, highly erodible soils, soil areas that could be unprotected for long periods or during peak rainy seasons, and natural drainageways. Assure erosion control in these critical areas. After a rain, the effectiveness of erosion control measures must be re-evaluated. Maintenance and cleaning of these facilities is also important.

Examples of Erosion Control Methods:

- **Buffer zone**
- **Compost Blankets**
- **Drainage Swale**
- **Diversion Dike**
- **Geotextiles**
- **Gradient Terraces**
- **Interceptor Dikes and Swales**
- **Mulching**
- **Outlet Protection**
- **Riprap**
- **Seeding**
- **Sodding**
- **Soil Retention**
- **Surface Roughening**
- **Temporary Slope Drain**

Additional items with respect to City erosion control requirements are provided herein:

Buffer zones. These are vegetated strips of land which control erosion by reducing the speed of runoff. Buffer zones can be areas left undisturbed during clearing and construction (filter strips), or they can be newly planted in areas that were previously disturbed by clearing and site activity.

Diversion Dike. This is a compacted earthen ridge constructed immediately above a cut or fill slope. Its purpose is to intercept storm runoff from upstream soil drainage areas and divert the water away from the exposed stabilized **outlet.**

Interceptor Dike. This is a temporary ridge of compacted soil or, preferably, gravel constructed across disturbed rights-of-way. An interceptor dike reduces erosion by intercepting stormwater and diverting it to stabilized outlets.

Perimeter Dike. This is a compacted earthen dike constructed along the perimeter of a disturbed area to divert sediment-laden stormwater to onsite trapping facilities. It is maintained until the disturbed area is permanently stabilized.

Flexible Down Drain. This is a temporary structure used to convey stormwater from one elevation to another without causing erosion. It is made of heavy-duty fabric or other material that can be removed when the permanent water disposal system is installed.

Mulching. When final grading has not been completed, straw, wood chips, jute matting, or similar materials can be applied to provide temporary protection. Areas brought to final grade during midsummer or winter can be mulched immediately and overseeded at the proper season with several permanent grasses or legume species. Application of mulch to disturbed areas allows for more infiltration of water into the soil, reduces runoff, holds seed, fertilizer, and lime in place, retains soil moisture; helps maintain temperatures conducive to germination, and greatly retards erosion. Mulch is essential in establishing good stands of grasses and legumes in disturbed areas. It is important to stabilize or anchor mulch using such practices as an anchoring tool, biodegradable tackifier (hydromulch), netting, peg and twine, or slitting to prevent it from blowing or washing off the site. Use of mulch in combination with Green Stormwater Practices shall comply with the requirements established in Chapter 8 and Appendix C.

Riprap. This is a layer of loose rock placed over the soil surface to prevent erosion by surface flow or wave action. Riprap may be used, as appropriate, at storm drain outlets, channel bank and bottom protection, roadside ditch protection, drop structures, etc.

Storm Drain Outlet Protection. This practice involves putting paving or riprap on channel sections immediately below storm drain outlets. A storm drain outlet is designed to reduce the velocity of flow and prevent downstream channel erosion. It is also known as an energy dissipater.

Temporary Storage, Shop and Staging Areas. Locate storage and shop yards where erosion and sediment hazards are slight. If this is not feasible, apply necessary paving and erosion control practices.

9.5 Siltation and Sediment Control

Examples of Siltation and Sediment Control Methods:

- **Compost Filter Berms**
- **Construction Entrance/Exits**
- **Compost Filter Socks**
- **Dust Control**
- **Fiber Rolls**
- **Filter Berms**
- **Sediment Basins and Rock Dams**
- **Sediment Filters and Chambers**
- **Sediment Traps**
- **Silt Fences**
- **Storm Drain Inlet Protection**
- **Temporary Storm Drain Diversion**
- **Temporary Stream Crossing**
- **Vegetated Buffers**

Additional items with respect to City sediment control requirements are provided herein:

Control and prevention of soil erosion during and after construction is the most important element of siltation and sediment control. However, it is physically and economically impractical to eliminate all soil erosion. Therefore, provisions must be made to trap eroded material at specified points. Some measures to implement are as follows:

- As inlet protection and on long slopes or runs, silt fence or rock check dams shall be used to create temporary ponds that store runoff and allow suspended solids to settle. These temporary ponds may be retained as part of the permanent storage system after construction; however, they must be inspected / surveyed to ensure that the design capacity of the system was not compromised by siltation.
- Inlet protection shall be maintained throughout construction and shall not be removed until vegetation is established. Such measures shall be periodically inspected in accordance with the requirement of the SWPPP and repaired / replaced when no longer functioning in accordance with design. Silted-in areas shall be mucked out after significant rainfall to restore capacity.
- Egress points from construction sites should be controlled so that the sediment is not carried offsite by construction traffic. A temporary construction entrance shall be constructed at points where traffic will be entering from or leaving a construction site to public right-of-way, street, alley, sidewalk, or parking area. Its purpose is to reduce or eliminate the transport of mud from the construction area onto the public right-of-way by motor vehicles or by runoff. An additional track-out area should be established where appropriate if traffic from heavy equipment is limited to areas not typically disturbed by passenger vehicles entering / leaving the construction site.

Construction Entrance/Exits. A stabilized rock exit is required on construction sites. Rock exits must be at least 20 feet wide by 20 feet long (1 & 2 family residential) or 50 feet long (all other construction sites) by 6-inch-thick stabilized rock having a minimum average diameter of 3 inches. If there is an existing curb, loose material such as fill dirt or gravel shall not be used to ramp up to it from the street. Temporary wooden ramps in front of curbs are acceptable.

Dust Control. Saturate ground or apply dust suppressors. Keeping dust down to tolerable limits on the construction site and haul roads is very important.

Outlet Protection. Outlet protection reduces the speed of concentrated storm water flows. Stone, riprap, concrete aprons, paved sections and settling ponds below outlets prevent scouring and erosion around the outlet. Outlet protection should be applied at locations of all pipes, dike, swale, and channel outlets. Outlet protection should be installed early in the development process and can be added later as necessary to prevent erosion.

Sediment Basins and Rock Check Dams. A rock check dam is an auxiliary structure installed in combination with and as a part of a diversion, interceptor, or perimeter dike, or other structures designed to temporarily detain sediment-laden stormwater. The rock check dam provides a means of draining off and filtering the stormwater while retaining the sediment behind the structure.

Sediment basins can be used to trap runoff waters and sediment from disturbed areas. The water is temporarily detained to allow sediment to drop out and be retained in the basin while the water is automatically released. Sediment basins usually consist of a dam or embankment, a pipe outlet, and an emergency spillway. They are usually situated in natural drainageways or at the low corner of the site. In situations where embankments may not be feasible, a basin excavated below the earth's

surface may serve the same purpose. A special provision, however, must be made for draining such an impoundment.

Sediment basins may be temporary or permanent. Temporary basins serve only during the construction stage and are eliminated when vegetation is established, and the area is stabilized. Permanent structures are designed to fit into the plan for the permanent installation. Design shall conform to the requirements within this manual. State and local safety regulations must be observed regarding design, warning signs, and fencing of these structures.

Sediment Traps. A sediment trap is a structure of limited capacity designed to create a temporary pond around storm drain inlets or at points where silt-laden stormwater is discharged. It is used to trap sediment on construction sites, prevent storm drains from being blocked, and prevent sediment pollution of watercourses. Sediment traps should also be located where permanent Stormwater Control Measures (SCM) will be constructed.

Silt Fences. This is a temporary barrier constructed across or at the toe of the slope. Its purpose is to intercept and detain sediment from areas one-half acre or smaller where only sheet erosion may be a problem.

Dewatering. All rainwater pumped out of sumps and depressions on construction sites should be clear and free of sediment, and must discharge to a sedimentation pond, sediment bag, or settling tank in such a manner as to not cause additional erosion problems.

Water Control. Subsurface drains used to remove excess groundwater are sometimes required at the base of fill slopes or around building foundations. When heavy grading is done and natural water channels are filled, the subsurface drains may be used to prevent accumulation of groundwater. Subsurface drains may be needed in vegetated channels to lower a high-water table and to improve drainage conditions so vegetation can be established and maintained.

9.6 Design of Erosion and Sediment Controls

Universal Soil Loss Equation

The Universal Soil Loss Equation adopted by the City of Little Rock is:

$$\boldsymbol{A = R(K)(L)(S)(C)(P)} \qquad \textbf{Eq. 9.1}$$

Where: A= soil loss in tons per acre per year

R = rainfall and runoff factor

K = soil erodibility factor

L = slope length factor

S = slope-steepness factor

c = cover and management factor

P = practice factor

The rainfall and runoff factor (R) is 300 for Pulaski County, Arkansas. Therefore, the Universal Soil Loss Equation takes the following form:

$$\boldsymbol{A = 300(K)(L)(S)(C)(P)} \qquad \textbf{Eq. 9.2}$$

Soil erodibility factors K are presented in Table D-1 (Appendix D) for all soils identified by soil classification within Pulaski County, Arkansas. Soil association maps are found in the Soll survey of Pulaski County, Arkansas, published by the USDA Soil Conservation Service (See References, Appendix E.)

The slope length factor (L) and the slope-steepness factor (S) can be combined and identified as the topographic factor (LS). Values for LS are found in Table D-2 (Appendix D), which identifies the topographic factor for specific combinations of slope length and steepness.

The cover and management factor (C) represents the ratio of soil loss from land managed through mulching, vegetation, and revegetation to soil loss from disturbed and unprotected lands. Where site preparation removes all vegetation and the root zone of plants, the soil is left completely unprotected and the value of C = 1. Cover and management factors for mulching are presented in Table D-3 (Appendix D). Cover and management factors for vegetation practices are presented in Table D-4 (Appendix D).

The practice factor (P) represents the ratio of soil loss with a specific management practice to the corresponding loss from unprotected slopes. Where no management practice for erosion control is provided, the value of P = 1. Practice factors for gradient terraces, earth dikes, and interceptor dikes and swales are presented in Table D-5 (Appendix D). Practice factors for buffer zones, filter strips and natural vegetation are presented in Table D-6 (Appendix D).

The above information, when incorporated into the Universal Soil Loss Equation, produces the following:

$$\boldsymbol{A = 300(K)(LS)(C)(P)} \qquad \textbf{Eq. 9.3}$$

Where: A = soil loss in tons/acre/year

R = 300, a constant

K = soil erodibility factor (Table D-1)

LS = slope length factor (Table D-2)

C = cover & management factor (Tables D-3,4)

P = practice factor (Tables D-5, 6)

9.7 Reference

Drainage Criteria Manual | Fayetteville, AR - Official Website (fayetteville-ar.gov)

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