

Section 1

Introduction

1.1 Background and Purpose

This manual of Best Management Practices (BMPs) has been compiled for the City of Franklin to assist contractors, developers, and various businesses and industries to comply with the guidelines set forth by the National Pollution Discharge Elimination System (NPDES) Phase II Rule. This manual will assist the City of Franklin by requiring use of practices that benefit water quality, an overall goal of the Phase II program. Specifically, this manual will assist in BMP selection, design, and implementation.

The City of Franklin is experiencing rapid development which requires special emphasis on Erosion Prevention and Sedimentation Control (EP&SC) during construction, as well as permanent structures to manage the increased stormwater runoff created by an increase in impervious areas. In addition, there are BMPs to assist commercial and industrial facilities whose businesses may potentially affect stormwater quality or quantity.

The fact sheets in this manual are designed for easy reference. They are Categorized, focused, and concise to allow easy access and expedient use. Each fact sheet can be used as a stand-alone document that may be distributed to facilitate focused discussion about design and/or implementation of each management practice. There are BMPs that require structural practices while many are non-structural practices where everyday activities may be performed in a manner that limits the impact of stormwater runoff to surface water quality.

1.2 Stormwater Quality and Quantity

Currently the City of Franklin has a Stormwater Management Ordinance, which serves as the City's primary stormwater management guideline. This manual is designed to support and enforce the Ordinance by way of elaborating on various practices, as well as offering specific guidance for selection of BMPs, minimum specifications and requirements, and more complete information about various practices. The Ordinance gives authority to the BMP manual in section 7.3.

Stormwater quantity management involves slowing, detaining, and/or controlling the amount and flow rate of runoff from "major" storm events ranging from a 10 to 500-year statistical storm frequency. Considering the increase in impervious areas due to increased development, an increase in volume places a new emphasis on stormwater quality.

The City of Franklin is now requiring stormwater quality management techniques be applied to new development and redevelopment in the form of structural and non-structural Best Management Practices (BMPs). Stormwater quality management involves pollutant control, capture, and /or treatment. Some of the pollutants are referred to as "point sources" and appear in the

form of regulated discharges, spills, dumping, illicit connections, etc. This manual briefly discusses minimizing the chance of unregulated point sources, but primarily focuses on nonpoint source pollution.

1.3 Sources of Pollution and their Impacts

1.3.1 Erosion Overview

Short-term stormwater quality management predominately focuses on erosion prevention and sedimentation control (EP&SC) for construction sites. However, for some fully developed sites, EP&SC can also be a concern. Soil erosion is the process by which soil particles are removed from land surfaces by wind, water or gravity. Natural erosion generally occurs at slow rates. However, the rate of erosion increases when land is cleared or altered and left disturbed. Erosion rates will increase when flow rates and velocities discharged from a site exceed the erosive range.

Clearing and grubbing activities during construction remove vegetation and disrupt the structure of the soil surface, leaving the soil susceptible to rainfall erosion, stream and channel erosion, and wind erosion if left untreated. Ultimately, the material suspended by erosion settles during sedimentation in downstream reaches.

There are negative influences on streams and rivers when sediment enters the waterways. As sediment volumes increase in waterways the overall capacity decreases. This causes increases in flooding as well as creating excessive maintenance needs.

1.3.1.1 Water Erosion

Rainfall events begin the water erosion process by dislodging minute soil particles. These soil particles then become suspended in the water droplet. The sediment laden water droplets accumulate on the soil until a sufficient quantity has developed to begin flowing under the forces of gravity.

The initial flow of sediment laden water generally consists of a thin, slow-moving sheet, known as sheet flow. In most cases sheet flow does not prove to be highly erosive, however it does begin the transport of the sediment that was previously suspended. Irregularities in soil surface and uneven topography will usually cause sheet flow to become concentrated into rivulets where flow causes an increase in velocity and erosive energy. This increase in erosive energy of water flowing in rivulets creates small grooves, or rills, in the soil surface.

Rill erosion of the soil surface concentrates flows, which increases flow velocity and erosive energy due to gravitational forces. This results in deeper and wider rills that

may join together with adjacent rills. Typically, rills run parallel to the slope and each other. In addition, rills are small enough to be stepped across, and are usually enlarged by direct erosion of the rill's sides and bottom by the action of flowing water.

The joining together of several adjacent rills, or sufficient enlargement of a single rill, begins gully erosion. In most cases gullies run parallel to the slope and may have one or more lateral branches. Gullies are enlarged by the following four key actions:

1. Gullies often have a "head cut" at the upstream end, which progresses its way upstream as water flowing into the gully erodes away the lip of the head. A waterfall working its way upstream can exemplify this. This can be seen in the picture below.



Severe gully erosion.

2. The flow in a gully tends to under cut the banks. Once the banks are sufficiently under cut, the banks will collapse into the gully where the collapsed soil is then washed away.
3. The collapse of banks into the gully causes flowing water to be diverted around the temporary blockage of soil. This temporary blockage of soil increases the velocity along one or both banks, which results in increased bank erosion.
4. The concentration of flows in the gully may result in scour of the gully floor until a stable slope is obtained.

1.3.1.2 Stream and Channel Erosion

- Construction activities often require the disturbance of streams and channels. Once vegetation or other bank protection measures are disturbed, flows may begin to erode the unprotected soil.
- Construction activities often require the disturbance of flow. However, this should only happen when traversing banks such as temporary stream crossing, culvert installation, bridge construction, etc. By diverting flows within the channel, velocities are generally increased in some areas to

compensate for decrease in other areas. The increase in velocity may exceed those normally experienced by the channel, resulting in bank erosion and bottom scour.

- Increasing the quantity and flow rate to streams and channels often results from construction activities and construction of facilities that increase the quantity and rate of runoff as well as how runoff is conveyed to the discharge point. The increased quantity and rate of flow can cause bank erosion and bottom scour.

1.3.1.3 Wind Erosion

Dust is defined as solid particles or particulate matter small enough to remain suspended in the air for a period of time and large enough to eventually settle out of the air. Dust from a construction site originates as inorganic particulate matter from rock and soil surfaces and material storage piles. The majority of dust generated and emitted into the air at a construction site is related to earth moving, demolition, construction traffic on unpaved surfaces, and wind over disturbed soil surfaces.

1.3.1.4 Factors Influencing Erosion

There are five primary factors that influence erosion: soil characteristics, vegetative cover, topography, climate, and rainfall.

Soil Characteristics – Particle size, particle gradation, organic content, soil structure, and soil permeability are all characteristics that contribute to the determination of erodibility. These characteristics affect the stability and infiltration capacity of the soil. Less permeable soil has increase risk of runoff and erosion. Typically soils that contain high percentages of silts and clays are the most erodible.

Channel flow is also affected by soil characteristics in that tractive-force or shear stress developed by flowing water over the channel banks and bottom may cause soil particles to move and become suspended into the runoff. The “permissible shear” stress indicates the stress that the channel banks and bottom can sustain without jeopardizing stability. It is possible to increase the allowable shear stress in the channel by utilizing “soft/green” or “hard” armoring on the channel bottoms and banks.

Vegetative Cover – Vegetative cover creates an erosion shield by stabilizing the soil. In addition, vegetative cover protects soil from direct rain, and also decreases the velocity of runoff. This allows greater infiltration as well as maintaining the soil’s capacity to absorb water. Vegetative root structures create a favorable soil structure, improving its stability and permeability.



Topography - The slope, length and steepness are key elements needed to determine the volume and velocity of runoff. Increases in slope length, and/or steepness causes an increase in the runoff rate, and consequently, increase the potential of erosion.

Climate - High precipitation areas as well as areas with freeze/thaw cycles have significant effects on soil stability and structure.

Rainfall - Frequency, intensity, and duration are fundamental factors in determining the amounts of erosion produced. In Tennessee, the erosion risk period is typically highest in the wet season (typically December through May), which coincides with the period of minimal vegetative cover.

1.3.2 Sedimentation Overview

Once eroded, soil particles may travel anywhere from a few inches to many miles away before gravity causes them to settle. This process of soil particles settling is known as sedimentation. Excessive levels of sedimentation can create problems such as clogging storm drains, blocking streams and channels, damage to habitat, and in some cases result in formation of habitats in undesirable locations. The objectives set forth by the ordinance require 90% total suspended solids removal of the first flush. Section 6.2.9 of the ordinance elaborates on this requirement. Slowing of the flow of water or air causes soil particles to settle, while creating conditions of rapid and/or turbulent flow prevents particles from settling. Detention basins create an environment for sediment to settle out before exiting the site.

Wet detention basins prove to be very effective in removals. Removal efficiencies for various parameters in a wet detention pond are illustrated in the table below.

REMOVAL EFFICIENCIES FROM WET DETENTION PONDS	
Parameter	Percent Removal
<i>Total Suspended Solid</i>	50-90
<i>Total Phosphorus</i>	30-90
<i>Soluble Nutrients</i>	40-80
<i>Lead</i>	70-80



Zinc	40-50
Biochemical Oxygen Demand or Chemical Oxygen Demand	20-40

1.3.3 Nutrients

Fertilizers, pesticides, construction chemicals, and solid waste contain phosphorus and nitrogen, which can result in excessive or accelerated growth of vegetation or algae. This increase in vegetation results in the impairment of lakes and other water sources and the growth of algae causes the depletion of dissolved oxygen potentially resulting in fish kills.

1.3.4 Oxygen Demanding Substances

The biological decomposition of organic matter in stormwater depletes the amount of dissolved oxygen (DO), which causes biochemical oxygen demand (BOD). BOD measures the degree of dissolved oxygen depletion by expressing the amount of easily oxidized organic matter present in water. In addition, certain non-organics materials in the water can intensify DO depletion.

1.3.5 Metals

Artificial surfaces such as galvanized metal, paint, or preserved wood contain metals that can enter stormwater as their surfaces corrode, flake, dissolve, decay, or leach. These metals that are found in urban stormwater are often from cars and trucks. Over half the trace metal load carried in stormwater is associated with sediments to which these eroded metals attach. Heavy metals are of concern because they are toxic to aquatic organisms, can be bioaccumulative, and have the potential to contaminate drinking water supplies.

1.3.6 Pesticides

Pesticides are herbicides, insecticides, and rodenticides that are commonly used on construction sites, lawns, parks, golf courses, etc. Excessive or improper application of these pesticides may result in direct water contamination, indirect water pollution by aerosol drift, or erosion of treated soil and subsequent transport into surface waters.

1.3.7 Oil, Grease, and Fuels

These products are widely used and may spill, leak, or be dumped on the ground where they can wash into waterways. Sources include leakage during normal vehicle use, hydraulic line failure, spills during fueling, and inappropriate disposal of drained fluids. These products can cause harm to plant and animal life.

1.3.8 Other Toxic Chemicals

Synthetic organic compounds such as adhesives, cleaners, sealants, and solvents are often applied, and may be improperly stored and disposed. Accidental spills or deliberate dumping of these chemicals onto the ground or into storm drains causes environmental harm to receiving waters.

1.3.9 Miscellaneous Wastes

Miscellaneous wastes include wash water from concrete mixers, paints and painting equipment cleaning activities, solid organic wastes resulting from trees and shrubs removed during land clearing, wood and paper materials derived from packaging of building products, food and containers, such as paper, aluminum, and metal cans, industrial or heavy commercial process wash/cooling water, vehicle washing, other commercial or industrial wastes and sanitary wastes. Periodic spills or storage of these materials outside can result in these materials being transported to surface waters during storm events. The discharge of these waters can lead to unsightly and polluted receiving waters.

1.4 BMP Selections

1.4.1 Define BMP Objectives

BMP objectives must address development and construction as well as existing industry, businesses, and private parties whose activities may contribute to overall water quality. These activities are all unique and require specific knowledge of pollution risks associated with each specific activity. This knowledge is essential in selecting BMPs effectively. Each unique project has specific risks that be addressed through the BMPs selected for use. In order to reach this goal specific project risks are identified, BMP objectives are developed, and BMPs are selected. The following BMP objectives supplement the standards set forth by the City's Stormwater Management Ordinance:

1. **Practice Good Housekeeping:** Proper management of pollutant sources and modification of construction activities can prevent pollutants from draining or being transported off-site.



2. **Contain Waste:** Dispose of all construction waste in designated areas, and keep stormwater from flowing on to or off of these areas.
3. **Minimize Disturbed Areas:** Land clearing should take place only in areas that will be under active construction within a few months of the time of clearing. Phasing clearing of a large development is recommended. Land clearing during the rainy season should be avoided if at all possible. Sensitive areas such as steep slopes, buffers, and natural watercourse should never be disturbed if at all possible.
4. **Stabilize Disturbed Areas:** Temporary stabilization techniques should be utilized in areas where there are disturbed soils that are not undergoing active construction. Upon final completion of a construction activity, permanent landscaping and stabilization should be applied.
5. **Protect Slopes and Channels:** Steep and unstable slopes should not be disturbed if they are outside of the approved grading plan area. Runoff should be conveyed from the top of the slope in a safe manner ensuring that the slope is stabilized as soon as possible. Natural Channels should not be disturbed if at all possible. Temporary and permanent channel crossings require stabilizing as quickly as possible to ensure that increases in runoff velocity caused by the project do not erode the channel.
6. **Control Site Perimeter:** Upstream runoff should be diverted either around or through the construction project in a safe manner. These diversions should be designed to ensure that downstream property would not be damaged. In addition, all runoff exiting the construction site should be free of excessive sediment, and other pollutants.
7. **Control Internal Erosion:** Sediment laden water should be detained or otherwise treated within the site to avoid potential pollution to external waterways.

Site characteristics and specific contractor activities affect the potential for erosion and pollution by other constituents used on the construction site. While determining BMP objectives site conditions and climatic factors should be considered.

1. Site conditions include the following:
 - Soil type, including underlying soil strata that are likely to be exposed to stormwater.
 - Natural terrain and slope.



- Final slopes and grades
 - Location of concentrated flows, storm drains, and streams.
 - Existing vegetation and ground cover.
2. Climatic factors include the following:
 - Seasonal rainfall patterns.
 - Appropriate design storm, which takes into account quantity, intensity, and duration of rainfall.
 3. Type of Construction activity.
 4. Construction schedules, construction sequencing and phasing of construction.
 5. Size of construction project and areas to be graded.
 6. Location of the construction activity relative to adjacent uses and public improvements.
 7. Cost-effectiveness considerations.
 8. Types of construction materials and potential pollutants present or that will be brought on-site.
 9. Floodplain, Floodway, and buffer requirements.

1.4.2 Determine BMP Categories

Once the BMP objectives are defined, BMP categories must be determined. In order to determine the BMP categories, a plan for the project will be needed. This plan should contain enough detail that draining patterns, topography, existing and permanent stormwater control structures can be located with ease. The plan will be required in order to obtain a Stormwater Management Permit, which is required for all development and redevelopment as identified in Sections 2, and 6 of the Ordinance. The plan should identify all of the following information in addition to any requirements set forth by the ordinance regarding this matter:

1. Stormwater entrance and exiting locations. Sheet and Channel flow for the existing and final grading contours should be included. This should

be in accordance with the master stormwater management plan for the specific watershed. (See section 6.2.3, and 6.2.4 of the Ordinance)

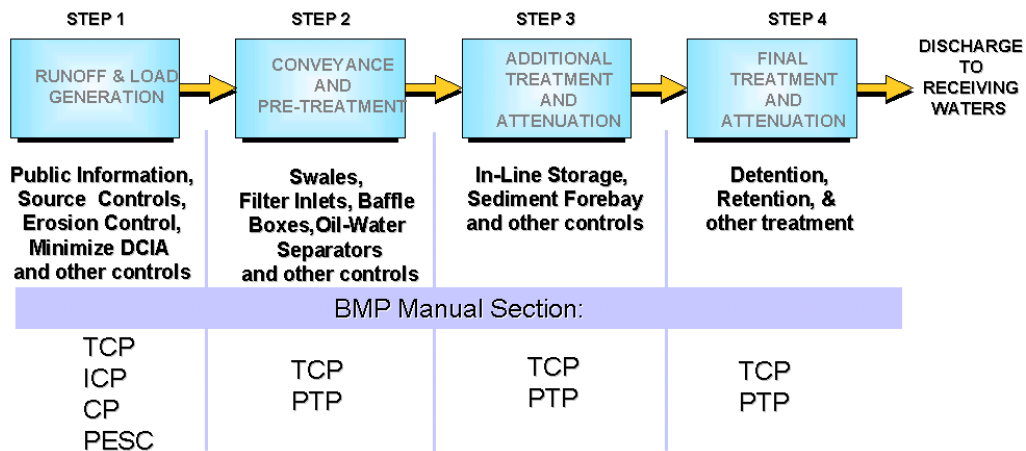
2. Identify locations of steep slopes and unlined channels that are subject to high rates of erosion. Long, steel slopes over 100 feet in length are considered as areas of moderate to high erosion potential. Soil bioengineering is preferred for stabilization over rip rap, and other hard armoring techniques. (See section 6 of Ordinance)
3. Categorize slopes as:
 - Low Erosion Potential (0 to 5 percent slope)
 - Moderate Erosion Potential (5 to 10 percent slope)
 - High Erosion Potential (slope greater than 10 percent)(Section 1 of the Ordinance discusses variables that may change the rate and volume of runoff.)
4. Identification of sensitive areas that should not be disturbed such as wetlands, springs, sinkholes, floodplains, floodways, sensitive areas or buffers, including other areas where site improvements will not be constructed. Clearing limits should be identified to prevent and disturbance during construction activities. (see section 6 of Ordinance)
5. Identification of tributary areas for each outfall location should be included. The approximate area of each tributary should be calculated.
6. Identification of locations where contractor activities may have a risk of causing a runoff or polluted discharge. (See section 6 for specific regulation regarding this matter)

This plan will allow easy identification of BMP categories that need to be considered on a particular construction project. Planning before construction, and phasing construction activities always proves to be more cost effective than treatment of stormwater after the fact. Preventative maintenance is simpler, and less costly, than correcting a problem that has occurred.

Once BMP objectives have been determined, the BMP treatment train illustrated in Figure 1-1 can be utilized. The BMP treatment train is used to determine BMP objectives that will be met by various BMPs. Many BMPs can achieve more than one objective, which should be taken into account when selecting BMPs. This allows for selecting the most cost-effective BMP. For example, it is not always necessary to install extensive sediment trapping

controls during construction. In fact, sediment trapping should be used only as a short-term measure for active construction areas, and replaced by permanent stabilization measures as soon as possible. However, it should be noted that perimeter/outfall control in the form of permanent detention ponds should be built first and used as temporary sediment control during construction. After construction is complete and tributary area is stabilized, the permanent outlet configuration can be reestablished.

Figure 1-1



BMP treatment Train

1.4.3 Temporary and Permanent BMPs

Temporary BMPs are designed to address construction activities, while permanent BMPs address long-term stormwater management objectives. Planning for both short and long term goals allows for favorable results with respect to cost and performance.

Temporary BMPs include many different “good housekeeping” methods as well as short term EP&SC activities. The steps involved in utilizing temporary BMPs includes design, review by the City of Franklin, and implementation. The construction site operator and/or licensed professional engineer should be responsible for the design of these BMPs. In some sensitive and more difficult cases, design will require a licensed professional engineer. The contractor bears the responsibility of constructing, maintaining, implementing, and seeking help when it is apparent that the BMPs are not meeting their objectives.

Permanent BMPs are the final improvements to the configuration of the project. They are designed for long-term management of stormwater pollution. Permanent BMPs are typically selected during the planning phase, in

conjunction with the approval of the tentative plan designed during the design phase of a project. On occasion, revision or addition to permanent BMPs during construction may be necessary due to unforeseen natural or manmade factors.

Permanent BMPs may include swales, sediment or detention ponds, and a variety of other features. Licensed professional engineers are responsible for selection of these management practices. These practices should be included in the plans and specifications for the project. In addition, the long-term maintenance responsibilities should be identified in the plans and specifications to prevent future disputes. Typically, this responsibility is left to either the public or private owner of the property. The contractor is responsible for properly constructing the permanent control.

1.4.4 BMP Selection for Construction Activities

Construction activities can result in stormwater runoff pollution if not managed properly. BMPs are used to minimize the potential for stormwater pollution. It is recognized that all BMPs are not effective on every construction site. It is important that all BMPs are considered, and that those which are effective for the project at hand should be selected. Considerations for selecting BMPs for contractor activities include the following:

1. Is it expected to rain? BMPs may be different on rainy days vs. dry days, winter vs. summer, etc. For instance, a material storage area may be covered with a tarp during the rainy season, but not in the summer. However, it should be noted that plans should be made for some amount of rain even if it is not expected to generate a flooding event.
2. How much material is used? Less intensive BMP implementation may be necessary if a "small" amount of pollutant containing material is used (however, remember that different materials pollute in different amounts).
3. How much water is used? The more water used and wastewater generated, the more likely that pollutants transported by this water will reach the stormwater system or be transported off-site. Washing out one concrete truck on a flat area of the site may be sufficient (as long as the concrete is safely removed later), but a pit should be constructed if a number of trucks will be washed out at the same site.

4. What are the site conditions? BMPs selected will differ depending on whether the activity is conducted on a slope or flat ground, near a stormwater structure or watercourse, etc. Anticipating problems and conducting activities away from certain sensitive areas will reduce the cost and inconvenience of performing BMPs.

5. What about accidents? Pre-establishing a BMP for each conceivable pollutant discharge may be very costly and significantly disrupt construction. As a rule of thumb, establish controls for common (daily or weekly) activities and be prepared to respond quickly to accidents. Define the difference, not everything can be called an accident and maybe classified as negligent disregard of proper practices.

Therefore, keep in mind that the BMPs for contractor activities are suggested practices that may or may not apply in every case. Construction personnel should be instructed to develop additional or alternative BMPs that are more cost-effective for a particular project. The best BMP is a construction work force aware of the pollution potential of their activities and committed to a clean worksite.

1.4.5 BMP Selection for EP & SC Activities

BMPs for erosion and sediment control are selected to meet the BMP objectives based on specific site conditions, construction activities, and cost-effectiveness. Different BMPs may be needed at different times during construction since construction activities are constantly changing site conditions.

EP& SC must begin with the initial prevention of erosion. This can be accomplished through soil protection techniques that will prevent the runoff of soil particles. Erosion and sedimentation will most probably occur to some degree due to active construction areas, and BMP s must be selected to take care of these issues once they have occurred. SC BMPs allow sedimentation to be removed from flows before these flows exit the construction site.

Consequently, the best protection on active construction sites is generally obtained through simultaneous application of both EP BMPs and SC BMPs. This combination is effective because it prevents most erosion before it begins and has the ability to capture sediments that become suspended before the transporting flows leave the construction site.

The following general items are provided to aid in preparing the project plans and choosing appropriate erosion and sediment control BMPs:

Minimize Disturbed Areas - Project layout and schedule should be compared with on-site management measures that where appropriate, can limit the exposure of the project site to erosion and sedimentation. Section 6 of the ordinance sets standards that require responsible construction practices. The following BMPs should be considered in order to reach desired goals:

1. Do not disturb any portion of the site unless an improvement is to be constructed there immediately.
2. Staging and timing of construction, grading, clearing, etc. can minimize the size of exposed areas and the length of time the areas are exposed and subject to erosion. For example, only areas that are actively involved in cut and fill operations or are otherwise being graded should be exposed.
3. Retain existing vegetation and ground cover where feasible, especially along watercourses and along the downstream perimeter of the site.
4. The first task when construction begins is to construct outfall detention or perimeter sedimentation controls with weirs/berms, and temporary sedimentation control barriers. Construction of permanent stormwater control facilities such as detention basins should occur towards the beginning of the project and used for sediment trapping, slope stabilization, velocity reduction, etc. during the construction period.
5. Construction should be completed as quickly as possible.
6. Landscaping or other stabilization techniques should be installed immediately after the land has been graded to its final contour.
7. Denuded areas should be at a minimum during the wet months of December through May.

Stabilize Disturbed Areas - Stabilization is very important because it protects the soil from being eroded away. Stabilization techniques may include vegetative, chemical, or physical soil coverings. It is important to keep in mind that any soil which is exposed is subject to erosion due to a rainfall event, runoff flowing over the soil, wind blowing across that soil, and vehicles driving on the soil. Consequently, it is important that all soil is covered, other than that which is undergoing active construction. Locations on a construction site that are more susceptible to erosion are:

1. Slopes
2. Highly erosive soils

3. Construction entrances
4. Stream channels
5. Soil stockpiles

Site Perimeter – BMPs for regulating flow in and out of the site perimeter should be a priority. The following ideas should be considered:

1. Disturbed areas or slopes that drain toward adjacent properties, storm drain inlets or receiving waters, should be protected with temporary linear barriers (continuous berms, silt fences, sand bags, etc.) to reduce or prevent sediment discharge while construction in the area is active. In addition, the contractor should be prepared to stabilize those soils with EP measures prior to the onset of rain.
2. When grading has been completed, the areas should be protected with EP controls such as mulching, seeding, planting, or emulsifiers. The combination of EP measures and SC measures should remain in place until the area is permanently stabilized.
3. Significant offsite flows (especially concentrated flows) that drain onto disturbed areas or slopes should be controlled through use of continuous berms, earth dikes, drainage swales, and lined ditches that will allow for controlled passage or containment of flows.
4. Concentrated flows that are discharged off of the site should be controlled through outlet protection and velocity dissipation devices in order to prevent erosion of downstream areas.
5. Perimeter controls should be placed everywhere runoff enters or leaves the site. They are usually installed just before clearing, grubbing, and rough grading begin. Perimeter controls for all but the smallest projects will become overloaded by both runoff and sediment. Additional controls within the interior of the construction site should supplement perimeter controls once rough grading is complete.

Internal Swales and Ditches – Until permanent facilities have been constructed flows are directed toward internal swales, curbs, and ditches. Design and implementation criteria should include the following:

1. Temporary stormwater facilities are susceptible to erosion from concentrated flows, and should be stabilized through temporary check dams, geotextile mats, and under extreme erosive conditions by lining with concrete.



2. Long or steep slopes should be terraced at regular intervals (per local requirements) in order to slow down the runoff, and to allow for small amounts of sediment to settle out.
3. Slope benches may be constructed with either ditches along them or back-sloped at a gentle angle toward the hill. These benches and ditches intercept runoff before it can reach an erosive velocity and divert it to a stable outlet.
4. A rough surface such as tall grass can be installed to reduce overland flow velocities.

Internal Erosion - After all erosion and sediment control BMPs have been utilized, excessive sediment should be removed from stormwater both within and along the perimeter of the project site. To prevent erosion temporary barriers or traps should slow the velocity of sediment-laden water. This flow should then enter a pond where soil particles may settle. Appropriate strategies for implementing sedimentation controls include:

1. Sediment-laden water should be directed to temporary sediment traps.
2. Locate sediment basins and traps at low points below disturbed areas.
3. Existing and proposed storm drainage structures should be protected from sediment clogging by implementation of inlet protection for area drains and curb inlets.
4. Temporary sediment traps or ponds should be constructed at stormwater outfalls for the site.
5. Stormwater detention ponds should be excavated early in the project so that they can serve as sedimentation ponds during construction, remove accumulated sediment, and landscape the ponds when the upstream drainage area is stabilized.
6. Temporary sediment barriers such as:
 - Continuous Berms
 - Silt Fences
 - Straw Bale Barriers
 - Sand Bag Barriers

- Brush or Rock Filter

Stormwater Inlets and Outfalls – All stormwater inlets, including drop inlets, and pipe inlets, should be protected from sediment intrusion if the area draining to the inlet has been disturbed. This protection may include sand bags, sediment traps, or other similar devices. In addition internal outfalls must be protected to reduce scour from high velocity flows leaving pipes or other drainage facilities.

1.4.6 BMP Selection for Structural Treatment Controls

The developer proposes most permanent BMPs during the early planning process of a project. Typically, there is not a single BMP that addresses all long-term stormwater quality problems. Instead, a multi level strategy will be worked out with the City of Franklin, which incorporates source controls, a series of on-site treatment controls, and community-wide treatment controls. This concept is presented in section 1.4.2, which discusses the BMP treatment train.

In most cases permanent BMPs are implemented most effectively when they are tied in with the actual project design. When stormwater controls are considered as part of the design they are conceptually planned out and consequently, more effective. The following should be considered in the design process.

1. Is a detention/retention facility required for flood control? Often, facilities are required to maintain peak runoff at predevelopment levels to reduce downstream conveyance system damage and other costs associated with flooding. Most permanent BMPs can be incorporated into flood control detention/retention facilities with modest design refinements and limited increase in land area and cost. Please refer to section 6.2.6 for the stormwater detention policy set by the City's Ordinance.
2. Planned open spaces that have slopes less than 5% may be merged with stormwater quality/quantity facilities. Such integrated, multi -use areas may achieve several objectives at a modest cost.
3. Infiltration BMPs may serve as groundwater recharge facilities although soil conditions are critical to their succeed. Detention/retention areas may be created in landscaped areas of the project, and vegetated swales/filters may be used as roadside/median or parking lot median vegetated areas.



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