APPENDIX J -- STORMWATER MANAGEMENT

When rain hits land covered with natural vegetation about 90% of the rainfall evaporates, seeps into the ground until the soil is saturated or is taken up by vegetation and exhaled (transpired) as water vapor. The remaining 10% runs off the surface into natural storage areas such as ponds and wetlands or into the natural routes to the sea such as creeks and rivers. When there is not enough capacity to contain the rainfall, excess stormwater runoff occurs.

Without its vegetated cover, land is less able to absorb stormwater. It does not matter if the natural vegetation is lost from fires, conversion to cropland, conversion to a gravel parking lot or conversion to a strip mall. The loss of natural vegetation results in increased runoff volumes, peak runoff depth, and runoff velocity. Figure J -1 shows the relative amounts of stormwater runoff associated with different land cover types and the accompanying decrease in time of concentration of the runoff flows.

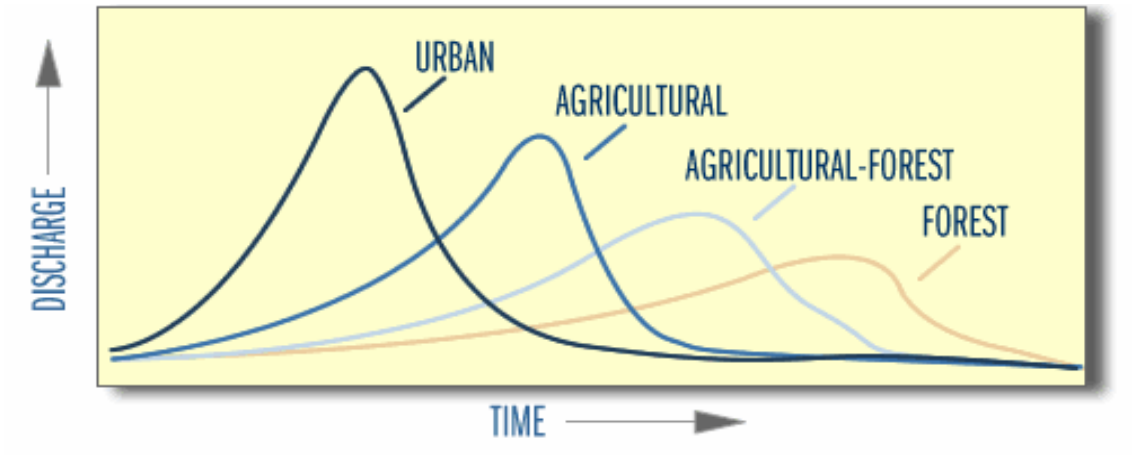

Figure J-1. Stormwater Discharges From Various Land Cover Types

When ten to twenty percent of the land is converted to an impervious surface, the amount of runoff doubles to 20%. This increase in runoff results in both residential and commercial establishments that were on the edges of historic floods, to be in the path of future floods. Buildings, which once had nuisance flooding of basements or water under the house, are now subject to deeper floods for longer periods of time. In short, uncontrolled and unregulated land use conversions can contribute to flash flooding in smaller watersheds and increase the probability of significant damages and loss of life.

Unmanaged stormwater runoff results in an immediate increase in the peak volume of run-off and a shortened period of time between the initiation of rainfall and flooding conditions. The result is larger and more frequent bank-full events that destabilize the stream geometry and ecology. In addition to increased stormwater runoff, most conversions result in temporary or long-term soil erosion. Soil erosion is a naturally recurring process. Stable streams can maintain a sediment load that is balanced to the flow volume during bank- full events and balanced for the stream gradient and soil types within the watershed.

Soil erosion may inhibit the growth of vegetation on steep slopes in the state; thus increasing erosion and decreasing opportunities for re-growth after land disturbances. Also, eroded soil eventually settles in stream channels where it reduces the channel flow capacity and expands the use of the floodplain during subsequent high- water events. It can also destabilize the stream and cause the channel to move and increase filling in and scouring of the channel. Increased sediments in the stream can severely impact the diversity and the health of the aquatic ecosystem. Examples of land use conversions within a watershed that can influence flooding through uncontrolled stormwater and sedimentation include:

Resource extraction (mining, quarrying, timbering, oil and gas wells, agriculture) -- These operations involve removal of vegetation, soil and rock excavation, construction of access roads, waste material disposal areas, debris piles and construction of storage and material shipping areas. In public meetings, mines, timber harvesting, oil and gas wells and other resource extraction operations were repeatedly blamed for increased runoff and sedimentation that contribute to flooding.

These uses do contribute to stormwater runoff and sedimentation, but not to the extent the public believes. The FATT study conducted by the West Virginia Department of Environmental Protection dated June 14, 2002 concluded that land disturbance associated with timber harvesting and mining did influence the volume of runoff in the three watersheds investigated in southern West Virginia. The percentage of additional runoff attributed to mining and logging in this study ranged from a -3% to +21% depending upon the extent of the operation and the length of time that reclamation efforts had been in place. Appendix I contains a more in-depth review of the FATT study and follow-on studies of the effects of timber harvesting and mining on stormwater runoff.

Generally, these resource extraction activities are based on an approved plan and follow best management practices (BMPs). Given proper monitoring and enforcement by State

and Federal inspectors and supervisors, the impacts to runoff volumes in a watershed would be minimal. Where these operations diverge from approved plans or ignore the best management practices or where monitoring and enforcement are not adequate, stormwater runoff can cause significant impacts to water quality and volume downstream of the operations.

Highway construction -- Highway construction, especially limited access Appalachian Corridor highways and interstate highways, is especially important. Although highway design incorporates facilities for stormwater runoff collection and retention, the largely uncontrolled commercial and residential development at interchanges creates acres of impervious surfaces generating enormous amounts of stormwater runoff. The location of highway interchanges with respect to floodplains and developable property is critical to the control of commercial and residential growth and resulting runoff. Figure J -2 shows the array of impervious surfaces that can emerge surrounding a highway interchange.

Interchanges located in the floodplain can be a problem for two reasons. First the location of the interchange can encourage commercial growth within the floodplain (an already recognized problem in floodplain management) and second, stormwater runoff generated by this commercial growth directly enters the stream with limited opportunities for attenuation or retention.

Figure J-2. Development of impervious surfaces at highway interchanges

Commercial and residential development -- Commercial and residential development can contribute substantial stormwater runoff into streams. Many commercial establishments such as banks and fast food stores have reduced parking areas due in part to drive-thru service. However, even these smaller areas of impervious land cover

contribute to the total runoff in the watershed. Malls and large shopping areas have extensive roofs and parking facilities that cover acres of land with impervious surfaces. Figure J -3 shows the extent of impervious surfaces associated with commercial mall development. Without carefully designed retention facilities, these expansive stormwater runoff generators can significantly impact local streams and watersheds.

Figure J-3. Impervious surfaces associated with commercial development

Unfortunately, residential subdivisions can also generate substantial stormwater runoff. When low-density single- family residential development occurs on larger lots with limited clearing of vegetation, stormwater runoff is a minor consequence of the development. However, where residential construction occurs as a multi-lot subdivision without carefully designed retention facilities, stormwater runoff amounts can rival that generated by commercial development. Figure J - 4 shows the types of impervious surfaces associated with residential development. The combination of land clearing, impervious roofs, streets, sidewalks, and driveways in major subdivisions can generate substantial stormwater runoff. The need for enactment of subdivision regulations and enforcement of those regulations is an essential ingredient in solving these problems.

Recreation Facilities -- Certain types of recreation facilities also generate significant stormwater runoff. More passive forms of recreation such as hiking trails, low-density tent and trailer camping, and picnicking where land clearing is kept to a minimum (to enhance the recreation experience) do not generate large amounts of stormwater runoff. However, recreation facilities that require the clearing of significant acreage for facilities, parking, and associated commercial development can generate stormwater runoff. This is especially notable in regional park facilities featuring expansive open fields for soccer, baseball, football, tennis courts, parking, and public facilities. Figure J - 5 shows the type of intensive recreation development that generates high runoff. Although golf courses can require extensive clearing of forested land, normally this construction incorporates retention on site for irrigation, and most course surfaces are dedicated to grasses and

Figure J-4. Impervious surfaces associated with residential subdivisions

other vegetation thereby reducing the stormwater impacts. Most damaging can be intensive-use recreation facilities located within the floodplain where stormwater generated by impervious surfaces is piped directly to the stream channel.

Figure J-5. Impervious surfaces associated with recreation development

Agriculture -- Agriculture can be a contributor to stormwater runoff when land is converted from forest cover to agricultural production uses. Conversion to agricultural uses on steep slopes (an exception to the rule) makes the runoff problem and the erosion associated with soil disturbance worse.

Forest Fires -- Forest fires, whether ignited by mankind or by lightening, present a serious threat to West Virginia watersheds and streams. Intense fires as shown in Figure J-6 can destroy the forest canopy, the shrub under-story, and the duff (humus layer) layer on the forest floor. Repetitive fires can bake the soil and create an impervious surface. Due to the rural nature of West Virginia, including steep slopes and vast areas of forest with limited road access, forest fires can devastate extensive areas of the watersheds.

Figure J-6. Loss of duff layer due to forest fires

Subsequent rainfall events are not absorbed into the soil as efficiently as those occurring before a fire (due to loss of the duff layer and loss of transpiration by vegetation), and the exposed soils are subject to severe erosion. The rate of erosion (tons/acre) increases dramatically following a fire event.

Although forest recovery can occur following a fire, the summer and autumn forest fire season is followed by seasons (winter and spring) of high precipitation and only moderate growth of the forest. Replacing a burned duff layer requires years of forest growth and leaf fall, while rains continue to erode exposed soils. During this period, stormwater runoff and erosion rates remain high. In many ways, fire events can be more threatening to the watersheds in terms of stormwater runoff and soil erosion than many other land-use conversions. While good development regulations and design can incorporate retention facilities into most man-made ventures, forest fires do not provide that opportunity.

For these reasons, the Task Force recommends that the Division of Forestry be provided sufficient funds and personnel to address forest fire prevention and control within the state. (See Appendix I-Resource Extraction.)

There is no simple way to separate stormwater flooding, sometimes called nuisance flooding, from more substantive flooding. In general, stormwater flooding occurs more frequently, is shallower, covers limited areas and is of short duration. Flooded basements, flooded underpasses and blocked streets are the most frequent result from stormwater flooding. Local emergency response units can usually handle stormwater flooding without assistance from the State or Federal government. The Corps of Engineers regards stormwater flooding and the systems used to convey stormwater within urban areas to be the responsibility of local government. Generally, urban watersheds of less than 1.5 square miles in size are regarded to be urban stormwater conditions rather than flood protection situations.

Storm events are rated by their duration and their statistically derived recurrence period. For instance, a 48-hour, 100- year storm would last two days and has a one percent (1/100) chance of occurring during any one year. Stormwater flooding does damage homes and businesses, some which are not within the regulated flood plain. Frequently stormwater flooding occurs on the edges of general flooding and can hinder the response to disasters by State and Federal units.

Steps taken to reduce the damages from stormwater floods will do little to reduce damages from devastating regional floods. Structures and activities designed to protect from a two to twenty-five year stormwater flood are overwhelmed by a hundred or five hundred year storm. However, it is still important that stormwater flooding be addressed. Addressing stormwater will reduce the peak flow volume and lengthen the time of concentration. This could lower the crest of a river flood by six inches to one foot. The reduced crest could reduce the geographic area impacted by a river flood. It could allow a faster response to the severely flooded areas by Federal and State response units. Finally, taking steps to control the flow of stormwater will improve water quality and allow for an increased rate of aquifer recharge.

Historically we have relied on two ways to control stormwater, increase the carrying capacity of the system that carries water away from the flooded area, and temporary or permanent storage of the excess water until the present carrying capacity can safely transport the excess volume. In the past, man has increased the carrying capacity of streams by widening and dredging them. While this may be adequate for controlling flooding from frequent minor rains, it does little to control the massive flooding from less frequent but more severe storms. In addition, dredging can cause irreparable harm to the ecosystem in and around the stream.

Constructing ponds and lakes has been the preferred method of increasing the storage of stormwater in West Virginia. Unfortunately, these attempts to control nature are not always effective and cost millions of dollars, frequently more than the value of the property they are designed to protect. Some facilities have constructed stormwater

detention basins to reduce the flows of stormwater. These basins may be wet basins (ponds or wetlands) or dry basins (enclosed swales, amphitheaters, or sports facilities). A third method of reducing the effects from stormwater has recently been added to our arsenal, source controls. This includes a series of best management practices (BMPs) that control or reduce the effects of stormwater where it first hits the ground. While source controls can be effective in reducing runoff, a mixture of source controls and structural facilities may be necessary to improve flood protection. Table J-1 provides a listing of Best Management Practices and source controls for controlling the flow of water.

TABLE J-1
BEST MANAGEMENT PRACTICES TO CONTROL FLOW VOLUME AND VELOCITY

BMP	DESCRIPTION
PUBLIC EDUCATION BMP's	
Public Participation / Education Programs	Activities where people learn about and work together to control stormwater.
SOURCE CONTROL BMPs	
Zoning restrictions to reduce population density	A reduction in population density automatically reduces the amount of impervious area.
Minimizing impervious areas	Reducing the size of the impervious areas by making roads narrower, parking lots smaller, use of porous pavement, providing green islands in the middle of paved areas, using green roofs, etc.
Cluster development with surrounding green space	Clustering development allows for shorter roads and reduced impervious areas. The remaining green space slows the run off of stormwater and allows for infiltration into ground water.
Land Use Planning and Management	A comprehensive planning process to control or prevent land uses in areas where development would contribute to flooding.
Stormwater Storage Facilities	Devices designed to retard the flow to reduce downstream flooding or reduce erosive velocities.
Storm Sewer System Cleaning	Removes sediment and allows conveyances to transport the intended flows.
Catch Basin Cleaning	Removes sediment, prevents downstream clogging and allows conveyances to transport the intended flows.
Septic Tank/Sanitary Sewer Maintenance	Reduce flow and pollutants by detection, prevention and control of the flow of sanitary waste into stormwater conveyances.
Illicit Connection Controls	Reduce flow and pollutants by detection, prevention and control of the flow of undesired material into the stormwater conveyances. This includes roof gutters directly connected to municipal storm sewers.
TREATMENT CONTROL BMPs	
Wet Detention Ponds	A small man-made lake with vegetated banks designed to capture and remove sediments and delay the downstream flow of stormwater. Some infiltration to groundwater occurs.

TABLE J-1 BEST MANAGEMENT PRACTICES TO CONTROL FLOW VOLUME AND VELOCITY	
Dry Extended Detention Basin	A basin that is usually dry between storms. It captures runoff and releases it slowly enough that most sediment settles out. Dry Detention Basins are frequently used for sporting events or amphitheaters between storms. Some infiltration to groundwater occurs.
Constructed Wetlands	A man-made basin with a significant percentage covered by wetland vegetation. Some infiltration to groundwater occurs.
Swales and Filter Strips	Channels or flat surfaces lined with vegetation that slows the flow of stormwater and allows it to infiltrate into the ground.
Stormwater Infiltration	A basin, trench, vault, permeable pavement or other system that collects runoff and discharges it into ground water. Some surface runoff may occur.
Combined Sewer Overflow Storage and Treatment	Tunnels or basins that detain combined sewer overflows and prevent them from discharging before treatment.
CHANNEL RESTORATION STABILIZATION BMPs	
Outlet Stabilization	Prevent stream bank erosion due to excessive discharge velocities.
Engineered Stream bank Stabilization Measures	Structures designed to prevent erosion by stabilizing stream banks.
Bio-engineered Stream bank Stabilization Measures	Use of live plants to prevent erosion by stabilizing stream banks.
Bio-technical Stream bank Stabilization Measures	The integrated use of structures and live plants to prevent erosion by stabilizing stream banks.
Habitat Restoration Techniques	The integrated use of structures and live plants to restore the habitat along the base of eroding streams.
Stream Obstruction Prevention and Removal	Identifying and removing items from the waterways that reduce the carrying capacity of the waterway. These items may include: trash, appliances, and woody debris. This BMP also includes preventing such items from entering the waterways by anti-liter campaigns, appliance drop off points, enforcement of the mandatory garbage disposal law and elimination of floatable material stored in the floodway.
AGRICULTURAL BMPs	

TABLE J-1 BEST MANAGEMENT PRACTICES TO CONTROL FLOW VOLUME AND VELOCITY	
Conservation Tillage	Any tillage practice that reduces the loss of moisture and soil.
Agricultural Filter Strips	Vegetated areas that slow stormwater run off and allow it to infiltrate into the soil.
Livestock Pasture Management	Reduce overgrazing of pastures to decrease erosion and sediment transport. Increased vegetation also slows stormwater runoff and allows it to infiltrate into the soil.

Many of the above Best Management Practices are directed towards reducing the impervious cover. The effects of impervious cover are directly related to the size of the watershed being addressed. A fifty-acre site with an impervious cover located on the banks of the Kanawha River will not have the same effect as a five-acre parking lot located on Knapps Creek above Marlinton.

It is not realistic to expect individual landowners or local jurisdictions to spend enough money to control flooding caused by very large, infrequent storm events. Therefore, different areas should have different levels of protection. County roads along headwater streams are frequently allowed to flood. Typically, the floodwaters here are “flashy”, quick to rise and quick to fall. Relocating the road or taking other measures to prevent it from being blocked by floodwaters would cost much more than the few hours of inconvenience of blocked road.

Major highways and interstates, on the other hand, carry vital supplies to businesses and retail establishments across the State and serve as evacuation routes for hundreds of thousands of people. These routes are located were delays may cause loss of life and millions of dollars in damages. These roads are generally constructed to avoid inundation from regional floods and therefore, do not flood during the smaller, more frequent storms.

The Task Force recommends that the Department of Transportation install signage similar to the “Bridge Freezes Before Road” sign to identify roads that are frequently blocked by stormwater. Suggestions include: “High Water May Block Road”, “Do Not Drive Through Water”, or a graphic representation with the same meaning. This topic is also addressed in Appendix G: Stream Crossings and Access Roads and Appendix B – Flood Warning System.

Historically, the control of stormwater runoff has been limited to planning, designing and implementing improvements focused on the site being developed. This level of planning is typically found in jurisdictions where a regulation requires that post-development peak runoff from a site be equal to or less than pre-development peak runoff. This allows the total volume of runoff to increase, which may still cause some flooding. This results in numerous small stormwater structures that require, but don’t usually get, routine inspection and maintenance.

Recent efforts have been expanded to include planning for entire catchments. A catchment is defined as the total area draining to the first stream intersection below the development site. This expanded level of planning allows protection for both current and future development to be achieved. It usually results in regional facilities built by some level of government. Regional facilities are more likely to attract public funding and receive the necessary inspection and maintenance.

While building and maintaining these facilities requires more planning and can be expensive, studies have shown that the net cost to the community can be one half to one third the cost of numerous small detention facilities. In addition, funding can be obtained by charging a stormwater management fee for service. These fees should be based on the area of the development in selected categories based upon the degree of imperviousness. An ancillary benefit of managing the quantity of stormwater is that it also provides an improvement in stormwater quality. Facilities intended to manage stormwater quality are sized for protection from smaller more frequent storms (See Figure J-7). Facilities intended to manage stormwater for quantity are larger and are sized for protection from larger less frequent storms. These larger facilities also provide improved stormwater quality by containing the "first flush" of stormwater. This first flush contains most of the runoff pollutants. Containment allows many of the pollutants to settle out of the water before it is released downstream. Addressing stormwater management for both flood control and water quality protects the entire environment.

Figure J-7. Stormwater retention facility

An ongoing operations and maintenance program with an annual inspection is essential to obtain to maximum benefit from stormwater management facilities. Detention ponds need periodic sediment removal, clogged outlets need to be cleared, infiltration trenches

need inspection to prevent clogging, and all facilities should be maintained in an aesthetically pleasing condition. If not, detention basins will fill with sediment, outlets may plug, and the resulting system may create more problems than if no controls existed at all. Stormwater ordinances should require a long term operations and maintenance program paid for by the developer.
Municipalities and counties in selected urbanized areas will soon be required to obtain stormwater permits under the National Pollutant Discharge Elimination System (NPDES). These urbanized areas in West Virginia are: Charleston, Huntington, Parkersburg, Morgantown, Weirton, Wheeling, and Hagerstown Maryland. Jurisdictions within these areas required to obtain a stormwater permit include: Bancroft, Barboursville, Belle, Benwood, Berkeley County, Bethlehem, Brooke County, Cabell County, Cedar Grove, Ceredo, Charleston, Chesapeake, Clearview, Dunbar, East Bank, Follansbee, Glasgow, Glen Dale, Hancock County, Huntington, Hurricane, Kanawha County, Kenova, Marmet, Marshall County, McMachen, Mineral County, Moundsville, Nitro, North Hills, Ohio County, Parkersburg, Poca, Putnam County, Ridgeley, South Charleston, Saint Albans, Triadelphia, Vienna, Wayne County, Weirton, Wheeling, and Wood County.

The NPDES stormwater permits are primarily intended to protect water quality. Meeting the requirements for these permits would also help control stormwater quantity for very little addition expenditure of time and resources.

The Task Force recommends that all counties in West Virginia implement a stormwater ordinance to control the quantity and quality of stormwater and to guide the development and implementation of a stormwater management plan. These local ordinances should be at least as strict as State regulations. Local jurisdictions must provide for enforcement of their own ordinances. A model county stormwater ordinance is included at the end of this appendix. Enforcement of stormwater management is an area frequently overlooked and under-funded. Enforcement will become increasingly important as water controls are built into the stormwater management system.

The Task Force recommends that a State agency such as the Office of Environmental Enforcement within the Department of Environmental Protection inspect stormwater facilities. This agency would serve as a back up for local inspection and enforcement of regulations on design, installation, operation and maintenance of these facilities. The agency assigned to enforce stormwater regulations should consult with the Statewide Flood Protection Task Force in drafting the regulations for presentation to the legislature.

Care should be taken to ensure any stormwater regulations comply with regulations concerning the Total Maximum Daily Load, the National Pollution Discharge Elimination System, the Clean Water Act and the Endangered Species Act, and other appropriate laws and regulations.

In the event no suitable State agency is found to provide the technical assistance and enforcement support needed, the Task Force recommends that the State organize no more than twenty regional watershed authorities based on the eight digit watershed basins to

provide technical assistance. The Task Force also recommends establishment of a State wide Watershed Council to provide technical assistance and enforcement support to the regional watershed authorities.

The Task Force recommends that all stormwater conveyances (ditches, culverts, piping etc.) be sized no smaller than the nearest appropriate downstream Department of Transportation stormwater conveyance. It is further recommended that the Department of Transportation provide technical assistance on determining the appropriate size to persons installing stormwater conveyances.

The Task Force recommends that any development of greater than 3 acres during any 5 year period must provide stormwater management plan that addresses the total run off to the entire catchment.

West Virginia has numerous cold-water naturally reproducing trout streams. Detention and subsequent release of stormwater into these streams may remove some pollutants and reduce the peak volume and velocity of the flow and still adversely impact the trout by raising the normal temperature of the waters. Therefore, the Task Force recommends that any stormwater detention facilities that discharges to a cold-water trout stream are designed to detain water no more than twelve hours. In addition, the pond should be designed so that it discharges from near the bottom, cooler portion of the pond. Detention facilities that discharge into warm water streams should be designed to detain stormwater at least twenty-four hours.

West Virginia has seventeen counties with karst topography. These include, Jefferson, Berkeley, Morgan, Hampshire, Hardy, Mineral, Grant, Pendelton, Monongalia, Preston, Tucker, Randolph, Pocahontas, Greenbrier, Summers, Monroe and Mercer. (See Figure J –8). Karst topography presents unusual challenges to managing stormwater.

Some stormwater ponds are identified as "non-discharge' because they have no surface discharge. For ponds with an impervious liner, this means the evaporation rate exceeds the rate stormwater flows into them. Ponds in karst topography may have a sub-surface discharge to caverns, large solution cavities or subterranean streams. Many people mistakenly believe this subterranean discharge solves the stormwater problem. Often flows directed into these subterranean routes resurface a few miles away to create problems for unsuspecting landowners. A large development directed stormwater from their parking lots into a pond occupying a small sinkhole. This pond has never had a surface discharge. Subsequently water has been appearing in basements and garages in a near by subdivision that is "downstream" from the sinkhole. This nuisance flooding is a result of the increased peak flows from the new development.

In addition, the increased flow increases the rate of dissolution of the walls of the subterranean conduits. The enlargement of these conduits can create new sinkholes or cause the cavern to collapse, partially or totally blocking the underground water flow. This subterranean erosion causes the collapse of buildings and streets, creating hazards for livestock and farm equipment and causing additional problems for landowners.

The Groundwater Program within the Department of Environmental Protection's Division of Water Resources requires any structure with a direct connection to ground water such as stormwater ponds, constructed wetlands, sinkholes, improved sinkholes, and infiltration trenches to obtain an Underground Injection Control Permit. All such structure should have a Groundwater Protection Plan even if it is determined that they do not require an Underground Injection Control Permit. In addition, WVDEP would like all ponds to have a semi-permeable layer that allows for some attenuation of pollutants before the stormwater becomes ground water.

The Task Force recommended that special stormwater regulations be prepared for karst areas in West Virginia.

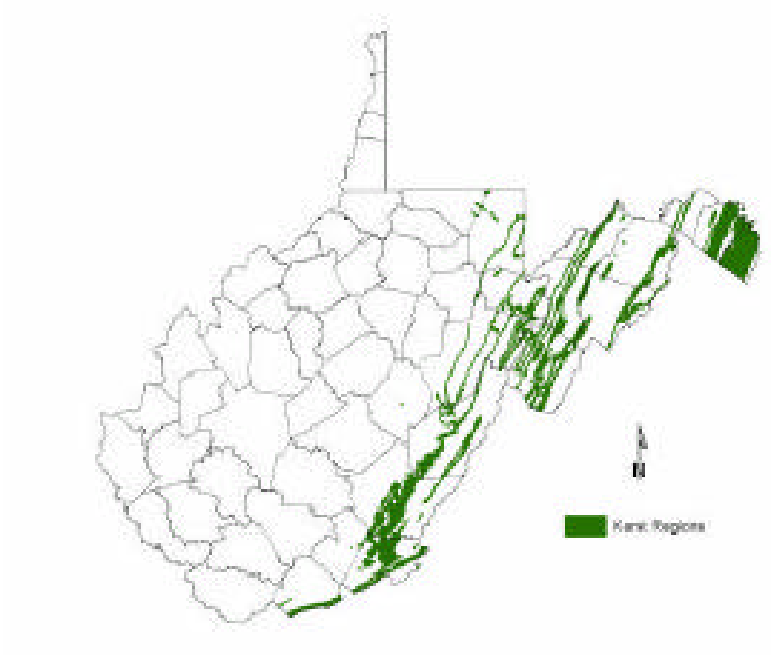

Figure J-7. Regions with Karst topography in West Virginia

Like all other areas relating to flood protection, there is insufficient education and outreach about stormwater management. The Task Force recommends convening an "Education Summit" or conference of all training officers, pubic information officers and other outreach specialists in Federal and State agencies to review the current status of education and outreach on flooding and develop methods of improving it.

The following model stormwater regulations have been compiled from regulations currently in place in some West Virginia counties.

MODEL COUNTY STORMWATER REGULATIONS

I. Title, Authority, and Purpose

A. This article shall be known as: The XXXX County Stormwater Management Ordinance.

II. Authority and Purpose

A. This ordinance is adopted by the authority of the West Virginia Code 8-24-1 to 35 seq.
B. This ordinance is adopted for the following purposes:
1. To protect and provide for the public health, safety, and general welfare of the citizens of XXXX County;
2. To mitigate the impact of increased stormwater runoff due to change in land use; and
3. To safeguard lives and property from loss by flood and erosion.

III. Applicability, Definitions, Exemptions, Waivers, and Variances

A. No person shall develop any land for residential, commercial, industrial, or institutional use without providing adequate stormwater management measures that control and manage stormwater runoff from such development, except as provided herein.
B. A stormwater management plan, signed and sealed by a professional engineer, for providing adequate stormwater management must be submitted to the county planning commission for approval prior to any development. The stormwater management plan shall include all items listed in Item 6. of these regulations.
C. **Exemptions**: The following activities are exempt from the requirement to provide Stormwater Management measures:
1. Agricultural land management activities;
2. Additions or modifications to existing single family detached residential structures; and
3. The development consists of single-family detached residences, each on a lot of two acres or greater.
D. **Waivers**: A waiver of the stormwater management ordinances may be granted for individual developments provided a written request is submitted by the applicant containing descriptions, drawings, and any other information that is necessary to evaluate the proposed development. If there are subsequent additions, extensions, or modifications to a development receiving a waiver, a separate written waiver request shall be required in accordance with the provisions of this section. A development shall be considered for a waiver if the applicant can conclusively demonstrate that:
1. The proposed development will not generate an increase in the 2-year 24- hour post-development peak discharge rate over the 2-year 24 hour predevelopment peak discharge rate; and that the development will not cause an adverse impact on the receiving wetland, watercourse, or water body; or
2. The site is completely surrounded by existing developed areas that are served by an existing network of public storm drainage systems of adequate capacity with stable outfalls to accommodate the runoff from the additional development.
E. **Variances**: A written variance from the stormwater management ordinances may be granted if there are exceptional circumstances applicable to the site such that strict

adherence to the provisions of these regulations will result in an unnecessary hardship and/or will not fulfill the intent of these requirements. The applicant shall submit a written request to the county planning commission stating the specific variances sought and reasons for the request.

IV. Stormwater Management Minimum Control Requirements:

A. Stormwater management facilities shall control post-development runoff for the 24-hour, 2 year, and 10 year frequency storms to a level equal to or less than the pre-development levels for the 24-hour, 2 year, and 10 year frequency storms, respectively, and shall pass the 24-hour 100 year frequency storm without damage to the facilities. Both the volume and rate of runoff shall be controlled.

V. Specific Design Criteria

A. Infiltration measures, where feasible, shall be preferred to detention or retention systems. Supporting documentation demonstrating that infiltration measures are not feasible must be included in the stormwater management plan.

B. Infiltration measures shall be designed in accordance with accepted engineering practices and published design criteria, and shall meet the following requirements:

1. The requirements for demonstrating that infiltration measures are feasible, or are not feasible, shall be the same as those required by the West Virginia Department of Health for demonstrating that a site is suitable for the use of an individual on-site septic drain field, except that:

a) Infiltration (perc) tests shall be made at the elevation or depth of the proposed bottom of the stormwater management facility;

b) The number of tests shall be sufficient to show the suitability of soil over the entire area of the proposed facility;

c) Where more than one facility is proposed for a site, tests demonstrating the feasibility of each facility shall be provided;

d) Tests shall be made by a certified septic installer or other qualified professional; and

e) The minimum acceptable rate of infiltration shall be one-half inch (1/2") per hour.

2. Infiltration measures shall be:

a) Constructed with the bottoms at least three (3) feet above seasonal high water table; and

b) Located at least 25 feet and down slope from all buildings on permanent foundations.

3. Infiltration measures designed to accept runoff from commercial or industrial impervious parking areas shall:

a) Be a minimum of 100 feet from any water supply well;

b) Include an oil/water separator; and

c) Provide pretreatment for 25% of the design volume using grass filter strips or other acceptable measure.

4. The facility design shall include an overflow system designed to provide a non-erosive velocity of flow along its length and at the outfall.

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5. Infiltration measures shall not receive runoff until the entire contributory drainage area to the infiltration system is stabilized or the system is protected by satisfactory sediment control measures;

6. Sediment which has accumulated in the measure during construction shall be removed and the bottom scarified before final seeding and mulching; and
7. A certified septic installer or other qualified professional shall make postconstruction infiltration tests showing that the facilities will function as intended. The results shall be submitted in writing.
C. Retention and detention ponds shall be designed and constructed in accordance with the criteria of the US Department of Agriculture, Natural Resource Conservation Service, and shall include the following:
1. Velocity dissipation devices shall be placed at the outfall of all retention or detention structures and along the length of any outfall channel as necessary to provide a non-erosive velocity of flow from the structure to a watercourse.
2. Stormwater management design shall include an analysis of the impacts of stormwater flows downstream in the watershed. The analysis shall include hydrologic and hydraulic calculations necessary to determine the impact of the proposed development upon a dam, highway, structure, or natural point of stream flow restriction, downstream to a tributary of the following size:
a) The first downstream tributary whose drainage area equals or exceeds the contributing area to the pond; or
b) The first downstream tributary whose peak discharge exceeds the largest designed release rate of the pond.
3. The designed release rate of the structure shall be modified if any increase in flooding or stream channel erosion would result at the downstream point.
D. For the determination of pre-development peak discharge, all land uses shall be assumed to be in good hydrologic condition; and land use shall be based on the average use of the land in question for the five (5) years preceding the proposed change in the utilization of said land.
E. Where a Stormwater Management system involves redirection of some or all runoff off the site, it shall be the responsibility of the developer to obtain permission from property owners impacted by such redirection. Approval of a Stormwater Management plan does not create or affect any such rights; nor does it relieve the developer from any liability incurred due to flooding.
F. The basic design and analysis criteria, methodologies and construction specifications shall be those of the Natural Resource (Soil) Conservation Service (or equal) found in the most current edition of the following publications:
1. "Urban Hydrology for Small Watersheds", Technical Release No. 55;
2. "Natural Resource Conservation Service Engineering Field Handbook";
3. "Natural Resource Conservation Service Field Office Technical Guide Standard 378"; and
G. The methodology used to determine rainfall runoff shall be Technical Release 20 or Technical Release 55 (TR-20 or TR-55).

VI. Stormwater Management Plan

A. Review and Approval of Stormwater Management Plan
The Stormwater Management Plan and Design Report shall contain supporting computations, drawings and sufficient information describing the manner, location and type of measures by which stormwater runoff from the entire development will be

managed. The county planning commission shall review all plans and supporting information. The approved plan shall serve as the basis for all subsequent construction. Any deviations from the plan must be approved in writing.

B. Contents of the Stormwater Management Plan

The developer is responsible for submitting a Stormwater Management Plan that meets the requirements contained herein. The plan shall include sufficient information to evaluate the environmental characteristics of the affected areas, the potential impacts of the proposed development on water resources, and the effectiveness and acceptability of measures proposed for managing runoff. The minimum information submitted for a Stormwater Management plan or request for a waiver shall be as follows:

1. Design

a) USGS topographic map showing the project site.

b) Soils map showing the project site.

c) Test results showing the feasibility or lack thereof of infiltration measures.

d) Narrative describing:

(1) Existing conditions and character of the site;

(2) The nature and extent of the proposed development;

(3) The measures proposed for stormwater management;

(4) A summary of pre- and post-development runoff for the 2, 10, and 100 year frequency storms;

(5) The impact of the proposed development downstream from the site; and

(6) Organization of data and computations in the remainder of the report.

e) Computations, including:

(1) Pre- and post-development hydrology computations including curve number weighting, time of concentration and travel time, and subarea, combination and routing hydrographs for the 2, 10, and 100 year storms; and

(2) Hydraulic computations including structure sizing and performance for the 2, 10, and 100 year storms, resistance to overturning and flotation, and location and sizing of anti-seep collars, as applicable.

f) Pre- and post-development drainage maps showing existing and proposed contours, as applicable, at a scale and contour interval appropriate for the design of the development and the stormwater management facilities, and including as applicable:

(1) Extent of soils of each classification;

(2) Extent of land use of each classification;

(3) Drainage sub-areas labeled to correspond with computations;

(4) Flow paths showing each segment with length, type of flow, and slope; and

(5) Location of drainage structures and stormwater management facilities.

2. Stormwater management plans shall include, in addition to information required by the Subdivision Ordinance and/or the Commercial and Industrial Ordinance:

a) Dimensions sufficient to show location, size, depth and volume of each stormwater management facility and structure;

b) Details and specifications for each structure including (but not limited to) culverts, orifices, risers, inlet boxes, weirs, trash racks, spillways, riprap lining, and anti-seep collars;

c) Location of existing and proposed easements and/or right-of-ways required for stormwater management facilities; and
d) Other information as may be required for specific site conditions and developments.

VII. Construction, As-Built Plans, and Final Approval
A. The developer shall install and/or construct all required stormwater management facilities.
B. As-built plans showing the completed location, size, volume and structure components shall be submitted to and approved by the county planning commission prior to the final approval of a subdivision or the issuance of an occupancy permit for a commercial or industrial development.
C. As-built plans shall be based on actual field measurements and shall be prepared by a registered professional surveyor or engineer licensed in West Virginia.

VIII. Inspections
A. Construction, operation and maintenance of all Stormwater Management facilities shall be subject to inspection by any county or State regulatory authority.
Any deficiencies noted will be forwarded to the owner in writing for correction within sixty days.
B. The developer may be required to hire a West Virginia licensed professional engineer to inspect the project and provide a report to the county planning commission. The report shall contain an engineer's certification of compliance as well as any "as built" plans, supplementary inspection reports, and laboratory or field test results.
C. If the owner shall assign his rights of ownership of a Stormwater Management system to another person or entity, notice of such change of ownership must be made to the county planning commission in writing within 10 days of such assignment.
D. Prior to granting final approval to a project, the owner shall be required to enter into an "Inspection and Maintenance Agreement of Private Stormwater Management Facilities".

INSPECTION AND MAINTENANCE AGREEMENT
OF PRIVATE STORMWATER MANAGEMENT FACILITIES
THIS AGREEMENT, made this _____ day of _____, 20___, by and between hereinafter referred to as the “OWNER(S)” of the following property: and the XXXX County Planning Commission, hereinafter referred to as the "Commission."

WITNESSETH:
We, the OWNER(S), with full authority to execute deeds, mortgages, other covenants, all rights, titles, and interests in the property described above, do hereby covenant with the Commission and agree as follows:
1. THE OWNER(S) shall provide for the maintenance of the stormwater management facility to ensure that the facility is and remains in proper working condition in accordance with approved design standards, rules and regulations, and applicable laws. The OWNER(S) shall perform necessary landscaping (grass cutting, etc.) and trash removal as part of regular maintenance.

2. If necessary, the OWNER(S) shall levy regular or special assessments against all present or subsequent owners of property served by the facility to ensure that the facility is properly maintained.
3. The OWNER(S) shall grant the Commission, its agent and contractor and any State or county regulatory authority the right of entry at reasonable times and in a reasonable manner for the purpose of inspecting, operating, installing, constructing, reconstructing, maintaining, or repairing the facility.
4. Should the OWNER(S) fail to maintain the facility or correct any defects within a reasonable period of time (60 days maximum) after proper written notice by the Commission, the Commission is authorized to perform the necessary maintenance or repairs and may assess the OWNER(S) served by the facility for the cost of the work, and applicable penalties, and legal fees and court costs, if any. Said assessment shall be a lien against all properties served by the facility and may be placed on the property tax bill of said property and collected as ordinary taxes by the Commission. The OWNER(S) shall maintain perpetual access from public rights-of-way to the facility for the Commission or its agent and contractor.
5. The OWNER(S) shall indemnify and save the Commission harmless from any and all claims for damages to persons or property arising from the construction, maintenance, and use of the facility.
6. The agreement and covenants contained herein shall apply to and bind the OWNER(S) and the OWNER(S) heirs, executors, successors, and assigns, and shall bind all present and subsequent owners of the property served by the facility.
7. The COMMISSION shall record this AGREEMENT in the land records of the COUNTY.

IN WITNESS WHEREOF, the OWNER(S) and the COMMISSION executed this AGREEMENT as of this _____ day of _____, 20___.

ATTEST: FOR THE OWNER(S)

ATTEST: FOR THE COMMISSION
STATE OF COUNTY OF, TO WIT:
I hereby certify that on this _____ day of _____, 20____, before the subscribed, a Notary Public of the State of West Virginia, and for the County of _____, aforesaid personally appeared _____ for the Commission and did acknowledge the foregoing instrument to be their Act.
In testimony whereof, I have affixed my official seal,
_____ My Commission Expires: _____
NOTARY PUBLIC
SEAL: