

**CHAPTER 23**  
**APPENDIX A. BUILDING ORDINANCES**

**STORMWATER / RAINWATER REGULATIONS FOR**  
**PROPOSED DEVELOPMENTS**

Art. I	General Provisions
Art. II	General Criteria and Standards
Art. III.	Improvement Regulation
Art. IV.	Miscellaneous

**ARTICLE I GENERAL PROVISIONS**

**SECTION 101 - Title** - This ordinance shall be known as "**The Stormwater/Rainwater Regulations For Proposed Developments of the City of Florence, Mississippi**" and may be so cited.

**SECTION 102 - Purpose** - The purpose of this ordinance is to diminish threats to public health and safety caused by the runoff of excessive stormwater; reduce economic losses to individuals and the community at large; and protect, conserve and promote the orderly development of land and water resources. The provisions of this ordinance further regulate, guide and control the following.

- (A) The subdivision layout, redevelopment and improvement of lands located with the City of Florence.
- (B) The construction of buildings and drainage of the sites on which structures are located, including parking and other paved areas.
- (C) The design, construction and maintenance of stormwater drainage facilities and systems.

**ARTICLE II GENERAL CRITERIA AND STANDARDS**

**SECTION 201 - Applicability** - This ordinance shall be applicable within the City of Florence's jurisdictional area and shall apply to any residential development of three (3) acres or more or any nonresidential development of one (1) acre or more. This ordinance shall also apply to any residential development of less than three acres but having fifty percent (50%) or greater impervious surface. Any non-residential development of less than one acre but having fifty percent (50%) or greater impervious surface shall be subject to review by the City to determine the applicability of this ordinance.

**SECTION 202 - Wetlands** - No development shall be undertaken without initial certification by an independent engineer certified by the State of Mississippi that the development is;

- (A) Not in a flood zone, or
- (B) If in a flood zone, it is not in a wetlands area, or
- (C) If in a wetlands area, the project is in compliance with all Federal and State Wetlands Regulations, including 40 CFR Section 230.41, et seq., 16 USCA Section 3822, et. seq. And Sections 404/401 of the Federal Clean Water Act.

No development shall begin until such certification is received by the City of Florence.

**SECTION 203 - Hazardous Waste Site** - No development shall be undertaken in the I-1 Combination Light Industrial/Special Commercial District, nor within 750 feet outside of the boundaries of such I-1 District, without certification by an independent engineer certified by the State of Mississippi that such site does not contain hazardous waste, as defined in 42 USCA Section 6903, et. seq. And Mississippi Department of Environmental Quality (MSDEQ) Rules and Regulations. A finding that the site does contain hazardous waste will preclude beginning of the project until cleanup of the hazardous waste site is complete and so certified by the Mississippi Department of Environmental Quality (MSDEQ).

No development shall begin until such certification is received by the City of Florence.

**SECTION 204 - Limitation on Stormwater Runoff** - No development shall be undertaken that increases the rate of surface runoff to downstream property owners or drainage systems.

**SECTION 205 - Detention of Excess Stormwater Runoff** - The increased stormwater runoff resulting from the proposed development shall be detained by the provision of retention or detention facilities, sometimes referred to as "Stormwater Retarding Structures or Facilities."

**SECTION 206 - Storage Capacity** - Retention or detention facilities shall be designed with sufficient capacity to accommodate all runoff caused by the development in excess of that runoff which would occur from the site if left in its natural, undeveloped condition. This storage shall be sufficient to store all excess flows for the 100-year storm of 24-hour duration.

**SECTION 207 - Channel Stability** - The stormwater runoff from the proposed development shall not increase channel instability downstream.

**SECTION 208 - Retention/Detention Facilities in Floodplains** - If detention storage is provided within a flood plain of a major stream, no storage volume for the facility may be provided below the high water elevations established for the flood plain.

**SECTION 209 - Stormwater Bypass** - Drainage systems shall have adequate capacity to bypass, through the development, the natural flow from all upstream areas.

**SECTION 210 - Drainage way Maintenance** - It shall be unlawful to dump trash, debris, landscape waste and other deleterious materials in any and all drainage ways in the City

**ARTICLE III IMPROVEMENT REGULATION.**

**SECTION 301- Required Information** - The following information and data prepared and certified by a registered professional Engineer in the State of Mississippi shall be furnished with the plans of each proposed residential, commercial and industrial development.

- (A) **Contour Map** - A topographic map with two (2) foot minimum interval contours, meeting National Map Accuracy Standards, of the land to be subdivided and such adjoining land whose topography may affect the layout or drainage of the subdivision. Map shall contain the following:
- (1) The top banks and centerline of streams and channels;
  - (2) The normal shoreline of lakes, ponds and retention/detention basins, and lines of inflow and outflow;
  - (3) The location, size and slope of stormwater conduits and drainage swales;
  - (4) Storm, sanitary and combined sewers and outfalls of record;
  - (5) Delineation of upstream and downstream drainage features and watersheds which might be affected by the development;
  - (6) Base flood (100-year) elevation (BFE) and flood ways for the property, established pursuant to Florence's Flood Ordinance, adopted August 3, 1993 , as Chapter 10 in the Code of Ordinances, updated in Ordinance No. 270, as adopted on February 5, 2008 , an attachment to this ordinance entitled "Attachment A - Design of Storm Drainage Systems"; and,
  - (7) Environmental features including the limits of wetlands areas and any designated natural areas.
- (B) **Drainage Plan** - A comprehensive drainage plan shall be designed to safely and completely handle the stormwater runoff and to detain increased stormwater runoff. This plan shall provide and be accompanied by maps and/or other descriptive material showing the following:
- (1) The extent and area of each watershed tributary to the drainage channels in the development;
  - (2) The storm sewers and other storm drains to be built, the basis of their design, the outfall and outlet locations and elevations, receiving stream or channel and its high water elevation and the functioning of the drains during high water conditions;
  - (3) Existing streams and floodplains to be maintained and new channels to be constructed including their locations, cross-sections and profiles;

- (4) Proposed culverts and bridges to be built including their materials, elevations, waterway openings and basis of design;
  - (5) Existing retention/detention facilities to be maintained, enlarged or altered and new facilities to be built, including their design;
  - (6) The estimated location and percentage of impervious surfaces existing and expected to be constructed when the development is completed;
  - (7) The slope, type and size of all sewers and other waterways;
  - (8) Any proposed environmental enhancement or mitigation features;
  - (9) Retention/detention basis to be built, including a plot or tabulation of storage volumes with corresponding water surface elevations and of the basin outflow rates for those water surface elevations;
  - (10) For all retention/detention basins, design hydrographs of inflow and outflow for the 100-year peak flows from the site under natural and developed conditions;
  - (11) The formula for determining the storage for a retention/detention basin is as follows;
    - (a) The storage capacity of the proposed detention basin shall be computed in acre - feet (in conjunction with its proposed spillway) so that the Q100 (1% chance) urbanized runoff in its cfs shall be reduced to no more than the Q100 (1% chance) rural or natural runoff in cfs;
    - (b) An emergency spillway shall be provided to accommodate or pass flows in excess of the Q100 (1% chance) urbanized runoff; and,
    - (c) Special consideration will be given to areas where the subject developer only owns a portion of the entire drainage basin.
  - (12) The live detention storage to be provided shall be calculated on the basis of the 100-year frequency rainfall as published by the U.S. Weather Bureau for this area;
  - (13) Landscaping plan for retention/detention facility; and,
  - (14) One or more typical cross-sections of all existing and proposed channels or other open drainage facilities, showing the elevation of the existing land and the proposed change thereto, together with the high water elevations expected from stormwater runoffs under the controlled conditions called for by this ordinance, and the relationship of structures, street and other utilities.
- (C) **Detention Basins** - Detention basins shall be constructed to temporarily detain the stormwater runoff in excess of the volumes of runoff occurring on the site before development and will conform to the following standards;
- (1) **Storage Volumes** - The volume of storage provided in these basins, together with such storage as may be authorized in other detention facilities, shall be sufficient to control the excess runoff from the 100-year storm of any duration;
  - (2) **Maximum Depth** - The maximum planned depth of stormwater stored shall not exceed five feet unless natural ground conditions lend themselves to greater depths;
  - (3) **Approach Slopes** - The approach slopes of the basin shall conform as closely as possible to natural land contours. Regrading is preferable if necessary to keep the

slopes under ten percent (10%). Erosion control measures shall be provided as well as devices or measures to insure public safety;

- (4) **Outlet Control Structures** - Outlet control structures shall be designed as simply as possible and shall operate automatically. They will be designed to limit discharges into existing or planned downstream channels or conduits so as not to exceed predetermined safe capacities and not in excess of flows which would have occurred with the land in its natural, undeveloped condition. If necessary, velocity dissipation measures shall be employed to ensure that the discharge does not increase downstream erosion;
  - (5) **Spillway** - Emergency overflow facilities shall be provided unless positive measures are installed to control the inflow so as not to exceed the safe capacity of the basin;
  - (6) **Appearance** - Detention facilities shall where possible, use natural topography and natural vegetation. In lieu thereof, these facilities shall have planted trees and vegetation such as shrubs and permanent ground cover on their borders; and,
  - (7) **Fencing** - Detention structures shall be enclosed by a six foot fence where the depth of the water would reach two feet. Each fenced structure shall be effectively and attractively screened with trees and plant material.
- (D) **Retention Basins** - Basins designed with permanent pools shall conform to the standards for detention basins as specified in paragraph B., unless modified or amended as follows;
- (1) **Minimum Depths** - The minimum normal depth of water before the introduction of excess stormwater shall be four feet;
  - (2) **Facilities for Emptying** - For emergency purposes, cleaning or shoreline maintenance, facilities shall be provided or plans prepared for the use of auxiliary equipment to permit emptying and drainage;
  - (3) **Pollution Abatement** - Aeration facilities may be required, dependent on the quality of the influent and detention time;
  - (4) **Side Slopes** - The side slopes shall be of non-erosive material with a slope of 3:1 or flatter. The ledge shall be four to six feet wide, three feet below normal water depth and sloping gently toward the shore to prevent people or objects from sliding into deep water. There shall be a free-board of 18 inches above the high water elevation on all retention basins. Alternate designs for side slopes may be considered under special circumstances where good engineering practice is demonstrated;
  - (5) **Sediment Storage** - Adequate area for sediment storage shall be provided in all retention basins;
- (E) **Maintenance of Facilities**
- (1) The developer shall be responsible for the maintenance of all improvements until such time as eighty percent (80%) of the lots have been improved with building and occupancy permits issued. However, the developer shall not transfer these improvements for the purpose of maintenance until he has complied with the above and until he has received final approval, final inspection, and a Certificate of Final Acceptance from the City Engineer and the Public Works Director;

- (2) All improvements, including landscaping, shall be maintained in perpetuity and cannot be developed for any other use which would limit or cause to limit the use of the improvements. The improvements shall be owned and/or maintained by the Property Owner's Association of the development and each property owner shall own a proportionate share of the improvements and shall bear his proportionate responsibility for the continued maintenance in accordance with the above;
- (3) Each property owner shall, within the contents of his deed, be liable for the combined maintenance of the improvements. A special note to this effect shall appear on any final plat of subdivision or any plat of condominium and their declarations;
- (4) The Property Owner's Association shall be formed by the Developer in perpetuity for the maintenance of the improvements. Membership shall be mandatory by all property owners. Articles of agreement of the Property Owner's Association must be approved by the Board of Aldermen of the City of Florence before recording;
- (5) In subdivisions consisting of five single family residential lots or fewer, the provision of a Property Owner's Association may be waived, provided that other parts of this Section have been met;
- (6) The City of Florence will maintain all facilities that are located in dedicated public rights-of-way and/or dedicated easily accessible drainage easements;
- (7) When problems arise due to inadequate maintenance, the City Engineer or Director of Public Works or their Agents of the City of Florence may inspect the improvements and compel the correction of the problem by written notice. Whenever facilities fail, the Property Owner's Association may contract with the City of Florence for the correction of the problem provided the City is adequately reimbursed.
- (F) Dedication of Facilities** - Whenever drainage facilities are planned to service several projects or a specific area deemed necessary by the City of Florence, the drainage facilities may be dedicated to the City. When these projects are of a regional nature, the City of Florence will maintain these facilities. In these cases, access easements shall be provided to the City.
- (G) Inspection Facilities** - The City Engineer shall inspect all drainage facilities while under construction. When facilities are not constructed according to approved plans, the City of Florence has the explicit authority to compel compliance and have any situations corrected which are not according to the approved plans. All drainage facilities located on private property, whether dedicated to the City or not, shall be accessible at all times for inspection by the City Engineer or other responsible public official.
- (H) Regional Detention** - The requirements for site retention/detention facilities may be waived by the City of Florence if it is determined that a development project is too small, or if engineering, aesthetic or economic factors make a combined or regional facility more practical for construction by the City.

In such case, the City of Florence shall require a fee and/or dedication of land from the developer which the City shall use to construct the regional facility. This fee and/or dedication of land shall be based on the proportionate share for

the development in its completely developed state of the present costs of constructing the regional facility.

#### **ARTICLE IV MISCELLANEOUS**

**SECTION 401 - Penalties for Violation** - Any person found to be in violation of any of the terms and provisions of this Ordinance shall be guilty of a misdemeanor and subject to a fine not to exceed one-thousand dollars (\$1,000.00) and/or imprisonment not exceeding ninety (90) days or both, in accordance with Section 21-13-1, Mississippi Code of 1972, as annotated.

**SECTION 402 - Validity** - If any term or provision of this Ordinance shall be held to be unconstitutional or otherwise unenforceable, the remainder thereof shall not be affected thereby and shall remain in full force and effect.

**SECTION 403 - Conflict** - All ordinances heretofore adopted on the subject of this Ordinance which are in conflict herewith are hereby repealed and the applicable provisions of this Ordinance are substituted in the place.

**SECTION 404 - Variances** - The Mayor and Board of Aldermen shall have the power to authorize variances from the provisions and/or requirements of this Ordinance, so long as such variances shall not be contrary to the public interest. No variance from the strict application of any provision shall be granted unless it is found that;

- (A) Literal interpretation of the provisions of his Ordinance would deprive the owner of reasonable use of their land; and
- (B) Granting the variance would be in harmony with the general purpose and intent of this Ordinance and will not be injurious to the neighborhood or otherwise detrimental to the public welfare.

**SECTION 405 - Repealing Clause** - All Ordinances and Resolutions of the Mayor and Board of Aldermen of the City of Florence that conflict with the provisions of his Ordinance shall be, and the same are hereby repealed and rescinded, but only to the extent of such conflict.

**SECTION 406 - Severability** - If any provision of this Ordinance is determined by a court of competent jurisdiction to be invalid or otherwise unenforceable, such findings shall not affect the other provisions hereof which shall remain in full force and effect.

(SEE ATTACHMENT "A")

## ATTACHMENT "A"

### DESIGN OF STORM DRAINAGE SYSTEMS

The design of storm water drainage systems shall insure adequate control of storm water runoff through the use of properly sized and positioned drainage structures including but not limited to curb and gutter, curb and grate inlets, storm drains, box culverts, intersectional drains, open ditches and bridges.

The design of all storm drainage systems (main channels) shall be in accordance with the City of Florence's master drainage plan for the basin in which the development is located and shall provide for potential effects to upstream and downstream developments in the basin. Drainage facilities shall be designed to prevent excessive runoff onto adjacent properties.

Cross drains shall be provided to accommodate all natural water flow and shall be of sufficient length to permit construction of a full width roadway including side slopes. Headwalls or flared end sections, aprons, channel bottom and slope protection shall be provided at the upstream and discharge end of the cross-drain as required by the Director of Public Works or City Engineer.

The following storm water design frequencies shall be used in computing design distribution:

- 100-Year: All major streams channels, open ditches or drains within the corporate limits of Florence. All street profile grades must be above the 100-year urban stormwater elevation/base flood elevation.
- 50-Year: Minor streams, channels, open ditches or subdrains tributary to main streams.
- 25-Year: Side drains and miscellaneous culverts where flooding would cause minor adverse affects.

No individual, partnership or corporation shall deepen, widen, fill, reroute or change the location of any existing ditch, stream or drainage canal without first submitting plans and obtaining written permission from the Director of Public Works or City Engineer.

The following design criteria shall apply to all storm drainage pipe and culverts:

1. Calculation of design flows for drainage areas less than ten (10) acres:

All pipes, sidedrains and open ditches shall be designed using the applicable frequency curve. The minimum storm drainage pipe shall be fifteen inches (15") and shall be obtained using the Rational Formula (below).



Storm sewer design velocities shall not exceed ten feet (10') per second.

For small, compact drainage basins less than ten (10) acres, the peak runoff shall be computed from the Rational Formula.

**RATIONAL FORMULA:  $Q=CIA$  (cfs)**

<u>SYMBOL</u>	<u>UNIT</u>	<u>DESCRIPTION</u>
Q	cfs	Discharge Computed by Rational Method
C	*	Coefficient of Runoff
I	in/hr	Intensity of rainfall
A	Acres	Area of Drainage basin

\*The value of "C" is obtained from Table A (below)

**TABLE "A"**

**RUNOFF COEFFICIENT "C"**

**VALUE OF "C"**

<u>TYPE OF AREA</u>	<u>SLOPES LESS THAN 3.5%</u>	<u>SLOPES TO 3.5% TO 5.5%</u>	<u>SLOPES GREATER THAN 5.5%</u>
Woodland	0.25-0.35	0.35-0.70	0.70-0.80
Grassed Areas	0.35-0.45	0.45-0.70	0.70
Paved (Imperv) Areas	0.95	0.95	0.95
Residential*	0.55-0.65	See Note	See Note
Commercial*	0.70-0.90		

\*Value of C for these areas are computed as weighted average of grassed areas and impervious areas

$$\text{Weighted "C"} = \frac{C_{\text{grass}} \text{ Grass Area}}{\text{Total Area}} + C_{\text{Imper.}} \frac{\text{Imper. Area}}{\text{Total Area}}$$

For average residential development the value of "C" shall be taken as 0.75

**FORMULA NO. 1:**  
**TIME OF CONCENTRATION**

The following formula shall be used to calculate the time of concentration (min.) and rainfall intensity (in/hr) for use in the rational method.

$$t_c = \frac{10 \times L^{-0.37}}{17^C \times S^{-0.21}}$$

$t_c$  - Time of concentration, minutes

L= overland flow length, feet

S= Average slope of length of flow, ft./ft.

C- runoff coefficient (rational)

The rainfall intensity "I" in inches per hour shall be estimated from Chart Number One (1) by using Formula No. One (1) to estimate the duration in minutes.

Table "B" shall be used as a "rough" check on calculation of the time of concentration.

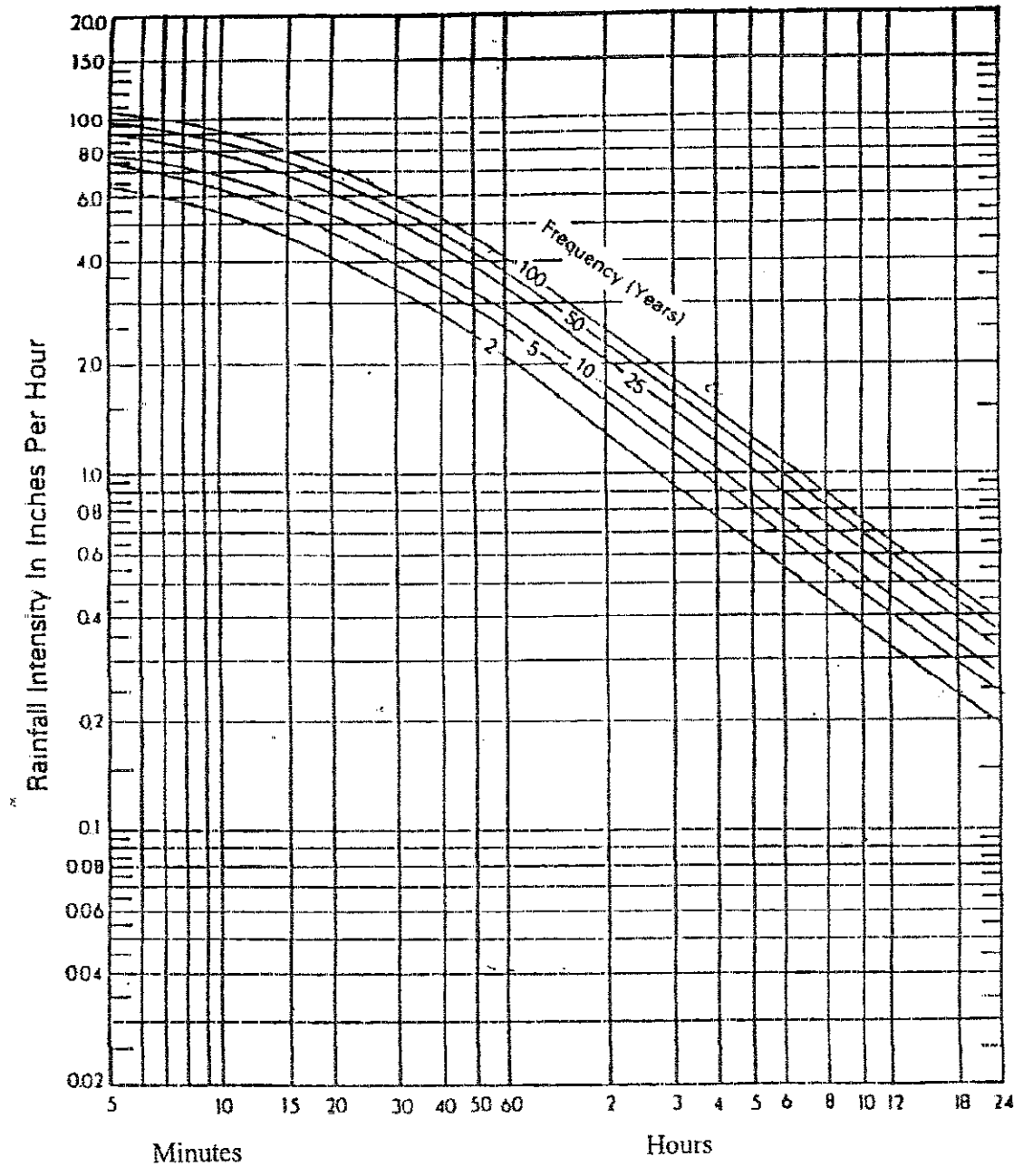
**TABLE "B"**

VELOCITY ESTIMATE GUIDE

AVERAGE SLOPE OF CHANNEL FROM FURTHEST POINT OF <u>OUTLET, IN PERCENT</u>	AVERAGE VELOCITY	AVERAGE VELOCITY
	FEET PER SECOND (FOR SMALL, <u>SHALLOW CHANNELS</u> )	FEET PER SECOND (FOR MAIN DRAINAGE CHANNELS IN <u>NATURAL STATE</u> )
1 to 2	2.0	3.0 - 5.0
2 to 4	3.0	5.0 - 8.0
6 to 10	5.0	

AVERAGE VELOCITY  
FEET PER SECOND  
(FOR OVERLAND FLOW)

SLOPE IN PERCENT	WOODLANDS (UPPER PORTION WATERSHED)	PASTURES (UPPER PORTION WATERSHED)	NATURAL CHANNEL (NOT WELL DEFINED)
1 - 3	1.0	1.5	1.0
4 - 7	2.0	3.0	3.0
8 - 11	3.0	4.0	5.0
12 - 15	3.5	4.5	8.0



Note Based on data for Vicksburg, Jackson, & Meridian, MS

RAINFALL INTENSITY - DURATION- FREQUENCY CURVES  
Region II

Chart 1

Calculation of design flow for drainage areas greater than ten (10) acres: Design flows shall be obtained by using the "Regional Flood-Frequency Equations for Urbanized Streams" as developed by the U.S. Geological Survey.

All pipes, side drains and open ditches shall be designed using the applicable frequency curve. Storm sewer design velocities shall not exceed the feet (10') per second.

The following requirements shall apply to the construction of streets, curb and gutter, inlets and minimum habitable building floor elevations:

1. The horizontal and vertical alignment of streets shall be compatible with the storm water runoff system and drainage design.
2. Street Grades shall be coordinated with lot drainage as proposed in the grading plan. Street grades shall be above the 100-year frequency flood level.
3. The hydraulic capacity of curb inlets shall be determined by generally accepted engineering procedures taking into consideration roughness and street cross slope. The design depth of flow in the curb and gutter section shall not exceed 4".
4. The hydraulic capacity of curb inlets shall be determined by generally accepted engineering procedures taking into consideration inlet geometry and characteristics of the gutter flow. Curb inlets shall be spaced to limit the spread of water to not more than one quarter (1/4) of the street width during a design storm of five (5) year return period and fifteen (15) minute duration. Inlets shall also be placed at all low points in the gutter grade, at intersection where necessary to prevent gutter flow from crossing traffic lanes of an intersecting street or at points of special concern designated by the Director of Public Works/City Engineer.
5. Finished floor of all buildings shall be a minimum of two feet (2') above the 100 year flood elevation, commonly referred to as the base flood elevation (BFE).

The structural design of all box culverts or bridges shall conform to the standards of the Mississippi Department of transportation for a load capacity of HS-20 minimum.

All culverts, cross-drains and storm sewers shall be constructed in accordance with the technical specifications contained herein

The following equations, developed by the U.S. Geological Survey, shall be used to determine the 25, 50 or 100 year flow.

$$UQ_{25} = 2.78A^{0.31}SL^{0.15}(R12+3)^{1.76}(ST+8)^{-0.55}(13-BDF)^{-0.29}IA^{0.07}RQ_{25}^{0.60}$$

$$UQ_{50} = 2.67A^{0.29}SL^{0.15}(R12+3)^{1.74}(ST+8)^{-0.53}(13-BDF)^{-0.28}IA^{0.06}RQ_{50}^{0.62}$$

$$UQ_{100} = 2.50A^{0.29}SL^{0.15}(R12+3)^{1.76}(ST+8)^{-0.52}(13-BDF)^{-0.28}IA^{0.06}RQ_{100}^{0.61}$$

where

- UQ<sub>I</sub>** is the urban peak discharge, in cubic feet per second, for the recurrence interval of I years;
- A** is the contributing drainage area, in square miles;
- SL** is the main channel slope, in feet per mile, measured between points which are 10 percent and 85 percent of the main channel length upstream from the study site (for sites where SL is greater than 70, 70 is used in the equations);
- RI<sub>2</sub>** is rainfall intensity, in inches, for the 2-hour 2-year occurrence (U.S. Weather Bureau, 1961).

**ST** is basin storage the percentage of the drainage basin occupied by lakes, reservoirs, swamps, and wetlands

(in-channel storage of a temporary nature, resulting from detention ponds or roadway embankments, is not included in the computation of ST);

**BFD** is the basin development factor;

**IA** is the percentage of the drainage basin occupied by impervious surfaces, such as houses, buildings, streets, and parking lots; and

**RQ<sub>T</sub>** is the peak discharge, in cubic feet per seconds, for an equivalent rural drainage basin in the same hydrologic area as the urban basin, and for recurrence interval of T years.

The basin development factor (**BDF**) describes the conditions of the drainage system. The following description of the **BDF** and how it is computed is a quotation from Sauer and others (1983).

The most significant index of urbanization that results from this study is a basin development factor (**BDF**), which provides a measure of the efficiency of the drainage system.

This parameter, which proved to be highly significant in the regression equations, can be easily determined from drainage maps and field inspections of the drainage basin. The basin is first divided into thirds. Then, within each third, four aspects of the drainage system are evaluated and each assigned a code as follows:

1. Channel improvements. -- If channel improvements such as straightening, enlarging, deepening, and clearing are prevalent for the main drainage channels and principal tributaries (those that drain directly into the main channel), then a code of 1 is assigned. Any or all of these improvements would qualify for a code of 1. To be considered prevalent, at least 50 percent of the main drainage channels and principal tributaries must be improved to some degree over natural conditions. If channel improvements are not prevalent, then a code of zero is assigned.
2. Channel linings. -- If more than 50 percent of the length of the main drainage channels and principal tributaries has been lined with an impervious pervious material, such as concrete, then a code of 1 is assigned to this aspect. If less than 50 percent of these channels is lined, then a code of zero is assigned. The presence of channel linings would obviously indicate the presence of channel improvements as well. Therefore, this is an added factor and indicates a more highly developed drainage system.

3. Storm drains, or storm sewers. -- Storm drains are defined as enclosed drainage structures (usually pipes), frequently used on the second tributaries where the drainage is received directly from streets or parking lots. Many of these drains empty into open channels; however, in some basins they empty into channels enclosed as box or pipe culverts. When more than 50 percent of the secondary tributaries within a subarea (third) consists of storm drains, then a code of 1 is assigned to this aspect; if less than 50 percent of the secondary tributaries consists of storm drains, then a code of zero is assigned. It should be noted that if 50 percent or more of the main drainage channels and principal tributaries are enclosed, then the aspects of channel improvements and channel linings would also be assigned a code of 1.
  
4. Curb and gutter streets. -- If more than 50 percent of a subarea (third) is urbanized (covered by residential, commercial, and/or industrial development), and if more than 50 percent of the streets and highways in the subarea are constructed with curbs and gutters, then a code of 1 would be assigned to this aspect. Otherwise, it would receive a code of zero. Drainage from curb-and-gutter streets frequently empties into storm drains. The above guidelines for determining the various drainage-system codes are not intended to be precise measurements. A certain amount of subjectivity will necessarily be involved. Field checking should be performed to obtain the best estimate. The basin development factor (**BDF**) is the sum of the assigned codes; therefore, with three subareas (thirds) per basin, and four drainage aspects to which codes are assigned in each subarea, the maximum value for a fully developed drainage system would be 12. Conversely, if the drainage system were totally undeveloped, then a **BDF** of zero would result. Such a condition does not necessarily mean that the basin is unaffected by urbanization. In fact, a basin could be partially urbanized, have some impervious area, have some improvement of secondary tributaries, and still have an assigned **BDF** of zero.

The **BDF** is a fairly easy index to estimate for an existing urban basin. The 50-percent guideline will usually not be difficult to evaluate because many urban areas tend to use the same design criteria, and therefore have similar drainage aspects, throughout. Also, the **BDF** is convenient for projecting future development. Obviously, full development of the drainage system and maximum urban effects on peaks would occur when **BDF**=12. Projections of full development or intermediate stages of development can usually be obtained from city engineers.

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