ORDINANCE # 302
STORMWATER MANAGEMENT

SECTION 1-1 <u>Purpose and Scope</u>

It is the intent of this ordinance to protect the general health, safety and welfare of the public from the hazards and damages of flooding from the various drainage areas in the City/County; to provide clean and sanitary channels for runoff; to prevent the encroachment of buildings or improvements on natural drainage channels; to equitably apportion the cost of improvements to the stormwater management system; to protect natural, scenic areas, including wetlands; and to provide for conservation of the natural resources of the area. All subdivisions of land and all developments or improvements of any character which affect drainage in any part of the City/County will be subject to the provisions of this ordinance.

SECTION 1-2 <u>Warning and Disclaimer of Liability</u>

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur, and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the floodplains areas or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the City/County or any officer or employees thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

SECTION 1-3 <u>Definitions</u>

The following word, terms and phrases, when used in this ordinance, shall have the meaning ascribed to them in this section:

(1) **<u>Administrator:</u>** means the Federal Insurance Administrator, to whom the Secretary of HUD has designated the administration of the National Flood Insurance Program.

(2) **Angle of Flare:** means angle between direction of a wing wall and centerline of culvert or storm drainage outlet or inlet.

(3) **Appeal:** a request for review or interpretation of any provisions of this ordinance or a request for a variance.

(4) **Area of Shallow Flooding:** a designated AO Zone on the Flood Insurance Rate Map (FIRM) with base flood depths from one to three feet where a clearly defined channel does not exist, where the path of flooding is unpredictable and indeterminate, and where velocity flow may be evident.

(5) **Area of Special Flood Hazard:** the land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year.

(6) **Base Flood:** the flood having a one percent chance of being equaled or exceeded in any given year, determined based upon FEMA guidelines and as shown in the current effective Flood Insurance Study.

(7) **Base Flood Elevation:** the water surface elevation resulting from the base flood.

(8) **Conduit:** any closed device for conveying flowing water.

(9) **Critical Feature:** an integral and readily identifiable part of a flood protection system without which the flood protection provided by the entire system would be compromised.

(10) **Design Flood:** the flood having a one percent chance of being equaled or exceeded in any given year based upon fully developed watershed conditions.

(11) **Detention Basin:** a dry basin or depression constructed for the purpose of temporarily storing stormwater runoff and discharging all of that water over time at a reduced rate than would have otherwise occurred.

(12) **Developer/Builder:** a person, partnership, or corporation engaged in the development of land and/or building of structures and not excluded by exemption sections of this ordinance.

(13) **Development:** any man-made change to improved or unimproved real estate including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations, or clearing.

(14) **Elevated Building:** building elevated by means of fill so that the finished floor of the building is at least one foot above the water surface elevation of the design flood.

(15) **Entrance Head:** the head required to cause flow into a conduit or other structure; it includes both enterance loss and velocity head.

(16) **Entrance Loss:** head lost in eddies or friction at the inlet to a conduit, headwall, or structure.

(17) **Equal Conveyance:** principle of reducing stream conveyance for a proposed alteration with a corresponding reduction in conveyance to the opposite bank of the stream. The right of equal conveyance applies to all owners and uses and may be relinquished only by written agreements.

(18) **Existing Construction:** structures for which the start of construction commenced before the adoption of this ordinance. Existing construction may also be referred to as existing structures.

(19) **Federal Emergency Management Agency** (FEMA): Federal agency which administers National Flood Insurance Program.

(20) **Fifty-year Floodplain:** that maximum area of the floodplain that on the average is likely to be flooded once every 50 years.

(21) **Flood or Flooding:** means a general and temporary condition of partial or complete inundation of normally dry land areas from the over flow of streams, rivers or other inland water.

(22) **Flood Hazard Boundary Map:** an official map furnished by the Administrator on which the Administrator has identified the riverine floodplain area having special flood hazards, has provided water surface elevation data for the one-hundred-year flood, and has provided floodway data.

(23) **Floodplain or Flood-prone Area:** a land area adjoining a river, stream, watercourse or lake which is likely to be flooded.

(24) **Floodplain Management:** operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and land use and control measures.

(25) **Flood-prone or Floodplain Map:** official map on which Federal, State and Local agencies have delineated one or more areas subject to flooding, pending receipt of data from the Federal Insurance Administrator; however, when special hazard area designations and water surface elevations have been furnished by the Administrator, they shall apply.

(26) **Floodproofing:** combination of structural and nonstructual additions, changes or adjustments to properties and structures which reduce or eliminate flood damage to lands, water and sanitary contents of buildings.

(27) **Floodway:** channel of a river or other water course and the adjacent land areas required to carry and discharge a flood of a given magnitude.

(28) **Floodway Encroachment Lines:** lines marking the limits of floodways on official Federal State and local floodplain maps.

(29) **Major River Channels:** in Middle Tennessee shall mean the Cumberland, Harpeth, Stones, Tennessee and Red Rivers.

(30) **One Hundred-year Floodplain:** that maximum area of the floodplain that on the average is likely to be flooded once every one hundred (100) years (i.e. that has a one percent chance of being flooded each year).

(31) **Primary Drainage Channels:** all drainage channels, streams or creeks which drain an area of five hundred (500) acres or more, excluding those areas defined as major river channels.

(32) **Secondary Drainage Channels:** all drainage channels, streams and creeks which drain an area of less than five hundred (500) acres, excluding those areas defined as major river channels.

(33) **Special Flood Hazard Map:** an official map furnished by the Administrator, on which the Administrator has identified the floodplain area having special flood hazards, but has produced neither water surface elevation data nor data sufficient to identify the floodway.

(34) **Start of Construction:** land preparation, land clearing, grading, filling or excavation occurring after approval of Preliminary Plat (for development) or after purchase of a Building Permit (to erect a structure).

(35) **Structure:** any building which is used for residential, business, industrial, institutional or religious purposes, or which is occupied by a private nonprofit organization, or which is owned by a State or local government or any agency thereof. The term includes a building while in the course of construction, alteration or repair but does not include building materials or supplies intended for use in such construction, repair or alteration unless such materials or supplies are within an enclosed building on the premises.

(36) **Substantial Improvements:** any repairs, reconstruction, or improvement of a structure, the cost of which equals or exceeds fifty (50) percent of the fair market value of the structure either:

a. Before the improvement is started; or

b. If the structure has been damaged and is being restored.

Substantial improvement is started when the first alteration of any structural part of the building commences.

(37) **Water Surface Elevation:** the heights in relation to mean sea level expected to be reached by floods of various magnitudes and frequencies at pertinent points in the floodplains or riverine areas.

SECTION 1-4 **Responsibility For Improvements**

(1) It is the intent of this ordinance that the improvements of primary drainage and major river channels shall be the long range responsibility of the developer (during development) and the City or County (after completion by the developer and acceptance by the City, County, or State). The developer of land or improvements within an area containing a primary drainage channel shall design, plan, and carry out his development in a manner that will not interfere with or restrict the natural flow of water or materially change the condition of runoff within the calculated area. Increased runoff and changes in primary channels which are created by such development within primary drainage areas shall be the planning responsibility of the developer and shall be in accordance with this Stormwater Management Ordinance adopted by the City/County. The improvements of secondary drainage channels shall be the responsibility of the developer, since the primary benefit is to the area developed and not the community as a whole.

(2) Where construction of a storm drainage facility is required along a property line common to two (2) or more owners, the owner proposing development or use of his property, shall be responsible for meeting the required improvements at the time of development, including the dedication of the necessary easements, to accommodate the improvements.

SECTION 1-5 **Methods Of Calculating Stream Flow & Runoff**

The maximum condition of rainfall for a one-hundred year frequency shall be used for the purpose of determining all runoff for the sizing of drainage channels and structures, unless otherwise specified herein. The following formula and values shall be used for calculating all stream flow and runoff for the policies and regulations established herein unless otherwise specified in this ordinance:

(1) Runoff from drainage areas of two hundred (200) acres or less shall be determined by the Rational Formula: $Q = CIA$

Q = flow in cubic feet per second.

A = area to be drained in acres determined by field surveys for areas less then 100 acres and by latest government quadrangle maps for larger areas.

C = Percent of imperviousness of the soil; may vary from 25% (park land) to 90% (industrial development). See Exhibit A for values of C.

I = Rainfall intensity over entire drainage basin expressed in inches per hour, based on time of concentration and latest government records for the area.

(2) Runoff from drainage areas greater than two hundred (200) acres will be determined by the use of a unit hydrograph method based upon standard and accepted Engineering Principles normally used in the profession subject to the approval of the City/County Engineer. Some of the acceptable methods include the Soil Conservation Service (SCS) Technical Release Number 55 for drainage areas from 200 acres to 2,000 acres, and SCS's TR 20 or the Corps of Engineers HEC-1 models for drainage areas 160 acres or more.

(3) The size of closed storm sewers, open channels, culverts, and bridges shall be determined by using the Manning Formula which may be modified for use with runoff determined by the Rational Formula to:

$$Q = \frac{1.486 \ r \ 1/2 \ s \ 2/3 \ A}{n}$$

Q = Discharge in cubic feet per second

A = Cross-sectional area of water in conduit in square feet.

r = Hydraulic radius of water in conduit.

s = Mean slope of hydraulic gradient in feet of vertical rise per foot of horizontal distance.

n = Roughness coefficient of conduit.

Other design methods may be required to maintain hydraulic grade line below the ground and/or gutter elevation to eliminate flooding of the inlets or manholes.

SECTION 1-6 **Primary Drainage Channel Requirements**

(1) Channel shall remain open and an easement provided for maintenance

(2) Keep structures at least 1' above 100 year floodplain

(3) Erosion control required for channel improvements

(4) Culverts, bridges and other drainage structures must be constructed to City/County specifications and must comply with State and Corps of Engineers requirements.

SECTION 1-7 **Secondary Drainage Channels & Surface Drainage Requirements**

(1) Easements dedicated for drainage and utility use.

(2) Primary function is to collect water from cross channels

Area < 40 acres requires storm sewers.

Area > 40 acres storm sewer or ditch.

(3) Structures 1' above `100 year floodplain.

(4) Drainage channels shall not be located in street rights-of-way unless they are placed in an enclosed storm sewer.

(5) Residential developments - surface water must flow to storm sewer, improved channel, swale or paved street.

(6) Surface water collected in streets shall be diverted to storm drains. Storm drains and street must carry 25 year flood; 100 year flood must be carried within street right-of-way.

(7) Drainage easements required - minimum of 15'.

(8) Open channels shall be natural, sodded, rip rapped or paved according to engineer and/or planning commission specifications.

SECTION 1-8 **Rural Subdivisions***

(1) Surface water to flow to roadway side ditch, swale, channel or natural creek.

(2) Roadway ditches and driveway pipes will be sized to handle the 25 year flood.

(3) Channels, creeks, and any structures that are needed for street crossing shall be sized to accommodate the 100 year flood.

(4) All buildings must be at least one foot above the 100 year flood elevation.

***Rural Subdivision in this ordinance is defined as a subdivision that has no storm sewer system.**

SECTION 1-9 Providing For The Detention Of Storm Water

Run-off from privately and publicly, owned property by detention of water in natural bodies of water or artificial impoundment; by detention of water within man-made facilities where these features are designed to detain flow; and by sizing outlet pipes and structures to reduce flow to tolerable volumes, or by a combined use of all of these features.

(1) Purpose This ordinance was duly adopted, after public notice and hearing, as provided by law, in order to establish procedures to control the flow of storm water from developing areas so as to maintain the rate of the flow in natural or man-made channels equal to the rate of flow from those areas in their undeveloped state, so as to provide for the safety, health and well-being of those living within the developing area as well as those downstreams who will be affected by its development.

(2) Applicability The provisions of this section are applicable to:

(a) All new residential, commercial, and industrial developments in excess of four (4) acres, or as per EPA and/or State regulations.

(b) Any new development, less than four (4) acres, where the percentage of the impervious area of the lot is fifty percent (50%) or greater.

(c) Any new development, less than four (4) acres, which in the opinion of the City/County Engineer lacks an adequate outlet for the passage of storm waters.

(3) Release Rate

The release rate of storm water from any detention basin required under this ordinance shall not exceed the storm water runoff rate from the drainage area in its natural state for determined frequencies of storms. Applicants may claim a higher natural rate of runoff if documented by detailed computations to show that higher capacity exists in the natural outlets serving the area. However, only the "safe storm drainage capacity"

(standard engineering calculations of capacity for pipe or open channel of the Conduit or channel may be included in these calculations.

Design of the floodway system shall also take into consideration control of storm water velocity to prevent erosion or other damage to the facility, which will restrict it's primary use. Depths of flow shall be consistent with the "safe storm drainage capacity" of the facility, and detention or channel configurations shall be approved by the city/county engineer (planning commission etc.)

(4) Detention Requirements

The required volume of storm water detention shall be the necessary to handle the runoff of a 50-year rainfall, for any and all duration's (as shown by Exhibit B) from the drainage area tributary to the storm water storage area based on full development of said tributary area, less the volume discharge during the same duration at the approved release rate. The storm water release rate shall be considered when calculating the storm capacity and the control structure shall be designed to maintain a relatively uniform rate regardless of the depth of storm water in the storm area.

Thus, the "Required Detention Storage" (RDS) will be that found to be the most critical Resulting from the inflow from the runoff of a fully developed tributary area from a 10-year Storm and the outflow of the 10 year storm with the same area in its unurbanized or natural State. This can be expressed by the following equation:

Inflow rate from RDS= critical ____-year storm, fully developed water shed (cfs)	-	Release rate from _____-year storm with duration = Tc, natural water-shed (cfs)	=	Duration of the critical _____-year storm (seconds)

OR

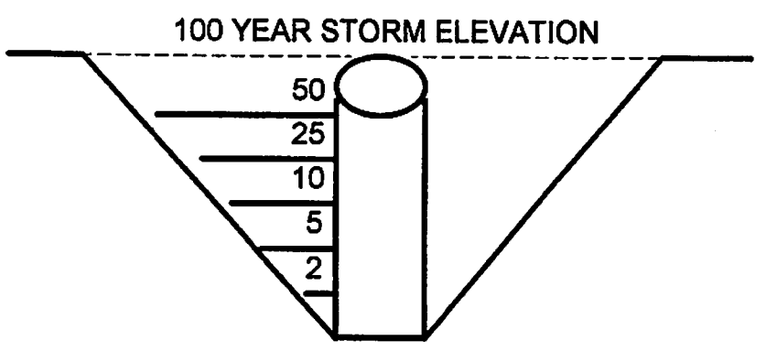
50-year Developed - 50-year natural = Duration of the critical 50-year storm

25-year Developed - 25-year natural = Duration of the critical 25-year storm

10-year Developed - 10-year natural = Duration of the critical 10-year storm

5-year Developed - 5-year natural = Duration of the critical 5-year storm

2-year Developed - 2-year natural = Duration of the critical 2-year storm



(5) Detention storage may be provided as a "Dry Bottom" or "Wet Bottom" storm area.

Dry Bottom Storm Water Storage Area - A facility designed to be normally dry and contain water only when excess storm water runoff occurs.

Wet Bottom Storm Water Sotrage Area - A facility designed to be maintained as a pond or free water surface, and which has the capacity to contain excess storm water runoff.

(a) Dry Bottom storm water storage areas shall be designed to serve a secondary purpose for recreation, open space or other types of uses that will not be adversely affected by intermittent flooding.

(i) A method of carrying the low flow through these areas shall be provided in addition to a system of drains to prevent soggy areas. Both shall be provided with an outlet to a natural channel or storm sewer with adequate capacity as described in Section 5 (d), By-Pass Channel. Dry bottom storm water storage areas should be designed to drain completely within twenty-four (24) hours after a storm.

(ii) Outlet control structures shall be designed as simply as possible and shall require little or no attention for proper operation. Each storm water storage area shall be provided with a method of emergency overflow in the event that a storm in excess of the 2 -year frequency storm occurs. This emergency overflow facility shall be designed to function without attention and shall become part of the "natural" or surface channel system described in Section 5 (d). Hydraulic calculations shall be submitted to substantiate all design features.

(iii) Both outlet control structure and emergency overflow facilities shall be designed and constructed to fully protect the public health, safety and welfare. Existing downstream hazards (garages, houses,) must be considered. Storm water runoff velocities shall be kept at a minimum and turbulent conditions at an outlet control structure will not be permitted without complete protection for the public safety. The use of fences shall

be kept to a minimum and used only as a last resort when no other method is feasible.

(iv) Paved surfaces that are to serve as storm water storage areas and rooftop storage shall be designed with permanent-type control inlets and retaining or parapet walls to contain runoff on the surface. Emergency overflow areas shall be provided.

(b) Wet Bottom storm water storage areas shall be designed with all of the items required for dry bottom storm water storage area, except that the provisions of Section 1-9(5) (a) (i) shall not be required. However, the following additional conditions shall be complied with:

(c) Both Dry and Wet Bottom water storage areas shall be regularly maintained to prevent the accumulation of silt, debris, and chemical or oil base products.

(i) Water surface area shall not exceed 1/15 of the tributary drainage area.

(ii) Facilities shall be provided to lower the pond elevation by gravity flow for cleaning purposes and shoreline maintenance. Shoreline protection shall be provided to prevent erosion from wave action.

(iii) Minimum normal water depth shall be four (4) feet. If fish are to be maintained, some portion of the pond area should be a minimum of nine feet (9') deep.

(iv) Control structures for storm water release shall be designed to operate at full capacity with only a minor increase in the water surface level. Hydraulic calculations shall be submitted to the County or City Engineer to substantiate all design features.

(v) Only that portion of the detention area above the normal water level shall be used in calculating the storage capacity. Wet bottom storm water storage areas shall be designed to provide a storage duration not exceeding twenty-four (24) hours after a storm.

(d) By-pass Channel - A By-pass Channel is a channel formed in the topography of the earth's surface to carry storm water runoff through a specific area.

A natural or surface channel system shall be designed with adequate capacity to convey through the development the storm water runoff from all tributary upstream areas. This "by-pass" channel shall be designed to carry the peak rate of runoff from a 25 -year storm, assuming all storm sewers are blocked and the upstream areas fully developed. The by-pass flow rate shall be computed utilizing a runoff coefficient of not less than 0.35.

No habitable structure shall be constructed within this bypass channel area; however, streets and parking, parks, playground or open space areas and utility easements shall be considered compatible primary uses. In the event that the area within a "by-pass" channel is re-shaped or the area designated for use as a floodway, the City or County will cause the restrictions to be removed at the expense of the parties causing said restrictions. Should the development contain an existing "natural" waterway this land configuration shall be preserved or improved as part of the "by-pass" channel system.

(6) **CONSTRUCTION.**

(a) Where development of a property presents the threat of flooding or damage by flash runoff to downstream residents, the facilities for storm water runoff control shall be constructed as a part of the first phase of construction of that project.

(b) The construction of the storm water control system shall be accomplished as part of the cost of land development. If the amount of storage capacity can be increased to provide benefit to other areas of the City or County, negotiations for public participation in the cost of development shall be initiated.

(c) All flood control items such as earthen embankments, conduits, outlet structures, flood control structures, spillways, by-pass channels, etc., shall be built as permanent facilities and all materials and their manner of construction shall be assembled to accomplish as much permanency as is possible.

(7) **MAINTENANCE**

All plans submitted for storm water detention systems shall describe an adequate procedure of normal maintenance by the property owner for the detention system. Any failure of the storm water detention system, due to inadequate normal or capital maintenance, shall be the responsibility of the owner of the property on which the detention system is located. It shall also be the property owner's responsibility to remedy any negligence in maintenance that resulted in the failure of the system. The submittal of plans for such a system or the purchase of property on which such system is located shall be deemed as acceptance of responsibility for normal and capital maintenance of the system.

(8) **EASEMENTS**

Drainage easements shall be provided for all conduits and those by-pass channels where the __2__-year runoff exceeds one (1) cubic foot per second.

(9) **PROCEDURE**

(a) Plans, specifications and all calculations for storm water runoff control shall be submitted for review and approval by the city/county engineer prior to the approval of a final plat (in the case of a subdivision or planned unit development) or prior to approval of a site plan (in case of commercial or industrial construction).

(b) No Certification of Occupancy for any building in the development will be issued until the storm detention facilities are constructed, inspected and approved.

Section 2. All ordinances of parts of ordinances in conflict with the provisions of this ordinance are hereby repealed.

Section 3. This ordinance shall be in full force and effect after its passage, approval and publication as provided by law.

PASSED at County or City, this 14th day of February, 2003

Mayor or County Executive

ASSEST:

County or City Clerk

APPROVED AS TO FORM:

City or County Attorney

EXHIBIT A
RUNOFF COEFFICIENTS

1. DESCRIPTION OF AREA	RUNOFF COEFFICIENTS
(a) Business	
Downtown	.80
Neighborhood	.65
(b) Residential	
Less than 4 DU/AC	.35
4 to 10 DU/AC	.50
10 or more DU/AC	.65
(c) Industrial	
Light	.65
Heavy	.75
(d) Parks, Cemeteries	.20
(e) Railraod yards	.30
(f) Unimproved	.15
2. CHARACTER OF SURFACE	
(a) Pavement	
Asphalt or concrete	.70 to .95
Brick	.70 to .85
(b) Roofs	.75 to .95
(c) Lawns, sandy soil	
Flat, 2 percent	.05 to .10
Average, 2-7 percent	.10 to .15
Steep, 7 percent or more	.15 to .20
(d) Lawns, heavy soil	
Flat, 2 percent	.13 to .17
Average, 2-7 percent	.18 to .22
Steep, 7 percent or more	.25 to .35

EXHIBIT B
RAINFALL INTENSITY DURATION FREQUENCY CURVE

Lakewood, Tennessee