

## ORDINANCE NO. 972(21)

AN ORDINANCE AMENDING PART 12, CHAPTER 5, ARTICLE J, SECTION 12-591 OF THE MOORE MUNICIPAL CODE BY DELETING REFERENCES TO STORMWATER DRAINAGE SYSTEM DESIGN AND METHODS AND ADOPTING THE 'STORMWATER MANAGEMENT CRITERIA UPDATE' MANUAL AS THE DRAINAGE REGULATIONS FOR THE CITY OF MOORE; DELETING SECTIONS 12-592 THROUGH 12-601; PROVIDING FOR SEVERABILITY; AND REPEALING ANY INCONSISTENT ORDINANCES OF THE CITY OF MOORE, STATE OF OKLAHOMA.

BE IT ORDAINED BY THIS COUNCIL OF THE CITY OF MOORE, OKLAHOMA THAT PART 12, CHAPTER 5, ARTICLE J IS HEREBY AMENDED AND READS AS FOLLOWS:

### PART 12 – LAND DEVELOPMENT CODE

#### CHAPTER 5- SUBDIVISION REGULATIONS

#### ARTICLE J- DRAINAGE AND EROSION CONTROL

#### SECTION 12-591 - GENERAL.

- (a) It is the goal of this article to limit stormwater runoff rates after development to their historic rates or less, as an aid in erosion control and to decrease the probability of downstream flooding.
- (b) The purpose of this article is to establish standard principles and practices for the design and construction of drainage systems within the city. ~~The design factors, formulae, graphs and procedures are intended for use as an engineering guide in the solution of drainage problems involving determination of the quantity, rate of flow, method of collection, storage, conveyance and discharge of stormwater.~~
- ~~(c) Methods of design other than those indicated herein may be considered where experience clearly indicates they are preferable and they exceed the minimum requirements as listed herein. However, there should be no extensive variations from the practices established herein without the express approval of the city engineer and/or the community development director. Post development runoff calculations must meet or be less than the maximum flow rates using the methods and procedures presented in this article.~~ *The City's design criteria and minimum drainage requirements are published in the City of Moore, Oklahoma Stormwater Management Criteria Update, latest edition, and shall be utilized for all new development and redevelopment within the City of Moore.*

## **SECTION 12-592—MINIMUM DRAINAGE REQUIREMENTS FOR THE CITY**

(a) ~~General design criteria. Drainage facilities shall be designed to convey runoff for the following frequency storms:~~

- ~~1. Inlets on grade: Ten-year storm event.~~
- ~~2. Inlets in a sump and all storm sewer downstream from that point: 50-year storm event with provisions for 100-year storm event overflow.~~
- ~~3. Curbed streets in a residential district: 25-year storm event.~~
- ~~4. Bridges and bridge boxes: 50-year storm event with provisions for 100-year storm event overflow.~~
- ~~5. Open channels: 50-year storm event and concrete lined to contain the 25-year storm event for channels with a drainage area greater than ten acres.~~
- ~~6. Detention facilities: Multiple storm events, including the two-, five-, ten-, 25-, 50- and 100-year storm events.~~
- ~~7. Culverts under any street: 50-year storm event.~~
- ~~8. Driveway culverts: 25-year storm event.~~
- ~~9. Side ditches in rural estates type subdivisions: 25-year storm event.~~
- ~~10. Any other facilities in commercial, institutional and other high value districts: Ten-year storm event.~~

(b) ~~Dedicated easement. Dedicated drainage easements shall encompass all land lying below the water surface elevation of the 100-year flood.~~

(c) ~~Access. Private streets shall include a drainage easement which includes the street and any side ditches so that access can be maintained to the drainageways.~~

(d) ~~Detention facilities. Stormwater detention shall be required for all developments at the time of their construction. This shall include all subdivisions of land and any new construction of a commercial or industrial nature. Exclusions shall be considered for individual residential construction on a lot of two acres or more; however, in basins where the community development director determines that there has been historical flooding, detention will be required. Residential construction in an approved addition prior to this article shall not require detention. New developments shall employ the use of a regional detention pond and shall not use multiple individual ponds unless approved by the city engineer or the community development director. All detention facilities shall remain in the care of the~~

~~private sector and shall be the responsibility of the property owners' association. All maintenance shall be the responsibility of the property owners' association.~~

## **SECTION 12-593 — DRAINAGE AND DETENTION FEE IN LIEU OF**

- ~~(a) All development except for the following specific exclusions shall be subject to the requirements of this section:~~
- ~~1. Single family residential homes being constructed on unplatted properties;~~
  - ~~2. Agricultural facilities being constructed in A-1 or A-2 zoning;~~
  - ~~3. Additions or alterations to single family residential homes~~
- ~~(b) In drainage areas with known downstream flooding of structures, or if it is determined that development of subject property will cause or contribute to flooding or sedimentation of existing structures downstream, the developer shall install detention facilities meeting all requirements of this article.~~
- ~~1. Detention shall be required for any multifamily development within zoning districts R-3 and R-4.~~
  - ~~2. Detention shall be required for any development exceeding 20 acres, or as determined by the community development director. If on-site detention is not required, a fee in lieu of detention shall be required.~~
- ~~(c) Detention shall not be required in drainage areas where the city has no record of downstream flooding of structures and drainage calculations provided by the developer or the city indicate projected flooding of existing downstream structures would not occur assuming the drainage basin were totally developed utilizing maximum projected land use as indicted in the long range city plan.~~
- ~~(d) When it has been determined on-site detention is required, engineering plans and drainage calculations shall be provided to the community development director or his designee for review and approval when filing a final plat or applying for a building permit.~~
- ~~(e) When it has been determined by the community development director that alternative methods of protecting downstream properties can be accomplished without causing substantial detriment to the public good, safety or welfare or without being contrary to the spirit, purpose and intent of this article, the community development director may accept a fee in lieu of requiring on-site detention facilities. The fees shall be determined by the average impervious surface per lot of each zoning district.~~

~~a file of such designations. Unless otherwise declared in writing by the city engineer, the descending order of floodplain studies shall be as follows:~~

- ~~1. An officially ordered study such as those watershed studies completed as a part of a master drainage study.~~
- ~~2. Individual basin studies approved and accepted by the city engineer.~~
- ~~3. Maps of the flood insurance administration of the Federal Emergency Maintenance Agency on which floodprone areas are delineated.~~

~~(b) The highest available order of study shall be the basis of design unless it can be clearly shown that the subject study is in error. Contested studies shall be brought to the attention of the city engineer who will submit the claim of error along with supporting data to the study author for consideration. Final decision as to the credibility of the study will be rendered in writing by the city engineer or the community development director.~~

~~(c) Drainage plan preparation. Drainage plans shall be submitted as follows:~~

- ~~1. Plan and profile shall be drawn on sheets 24 inch by 36 inch to a horizontal scale of one inch equals 20 feet or one inch equals 40 feet and vertical scale of one inch equals two feet or one inch equals four feet (except that scales may vary on special projects, such as culverts and channel cross sections). All plans shall be prepared by a registered professional engineer licensed to practice in the state and shall bear the engineer's seal.~~
- ~~2. Plans for the proposed drainage system shall include, as a minimum: property lines, lot and block numbers, dimensions, right of way and easement lines, floodplains, street names, paved surfaces (existing or proposed), contract limits, location, size and type of inlets, manholes, culverts, pipes, channels and related structures, outfall details, miscellaneous riprap placement, two foot contour lines (minimum) and title block. Stationing shall be provided along the construction centerline. The north arrow shall remain pointing to the top of the sheet, or to the left.~~
- ~~3. Profiles shall indicate the proposed system (size and material) with elevations, flow lines, gradients, left and right bank channel profiles, station numbers, maximum water elevations of any standing body of water, inlets, manholes, ground line and curblines elevations, typical sections, riprap construction, filling details, minimum permissible slab elevations adjacent to 100-year floodplains, open drainage features, pipe crossings, design flow capacities, title block and any other necessary information.~~

~~4. When official floodplain designations and delineations of floodways denoting limits of permissible flood flow restricting developments exist, they shall be shown on all preliminary plats and final plans submitted for approval wherever such plans and plats contain floodplains and/or floodway segments. In any case in which official floodplains are not delineated they shall be determined on the basis of standard Corp of Engineers HEC I and HEC II or other methods approved by the city engineer, and shall be shown on all preliminary plats and final plans submitted for approval.~~

~~(d) Submittals.~~

~~1. Computations and plans to support all drainage designs shall be submitted to the city engineer for review. The computations and plans shall be in such form as to provide the basis for timely and consistent review and will be made a part of the permanent record for future evaluation. The computations and plans shall be accompanied by the certification of a registered professional engineer licensed to practice in the state. Before final approval, the submitting engineer shall provide an as built plan accompanied with a letter of certification stating that the submitted plan complies with all governing ordinances and adopted drainage standards of the city. In addition to the required paper copy, as built plans for drainage improvements shall be submitted electronically in either AutoCAD or GIS shapefile formats, and shall be submitted in NAD 1983 HARN Oklahoma State Plane South, US feet coordinates using city survey monuments.~~

~~2. Specified minimum drainage parameters for historic, developed or proposed conditions that must be shown prior to approval are as follows:~~

- ~~1. Drainage area.~~
- ~~2. Length and slope of drainage basin.~~
- ~~3. Time of concentration (in minutes).~~
- ~~4. Intensity (in inches/hour) (for specified storm).~~
- ~~5. Runoff coefficients (C values for rational method if used).~~
- ~~6. Q (flow rate in cfs).~~
- ~~7. Design slope and length for all culverts.~~
- ~~8. Roughness coefficient for all channels and culverts.~~
- ~~9. Q flow rate (in cfs) for all channels and culverts.~~
- ~~10. Velocity (in ft/s) corresponding with each calculated Q.~~

11. Designation of material types for all channel and culverts.
12. Specific materials and/or methods for erosion and sedimentation control.
13. Detention pond volume calculations.
14. Detention pond depth vs. storage curve.
15. Detention pond depth vs. discharge curve.
16. Detention pond location, elevations and dimensions.
17. Detention storage calculations with inflow and outflow hydrographs

## **SECTION 12-595 DETERMINATION OF STORMWATER RUNOFF**

(a) General. The rational method will be accepted as adequate for drainage areas up to 640 acres. For larger areas, other methods may be used. The methodology developed by the U.S. Geological Survey titled "Techniques for estimating flood discharges for Oklahoma streams" will be acceptable as adequate for drainage basins in excess of 640 acres. Other hydrographic models or methods may be approved by the city engineer. The rational method is based on the following assumptions:

1. The peak rate of runoff at any point is a direct function of the average rainfall intensity during the time of concentration to that point.
2. The frequency of the peak discharge is the same as the frequency of the average rainfall intensity.
3. The time of concentration is the time required for the runoff to become established and flow from the most remote part of the drainage area to the point under design.

The latter assumption applies to the part most remote in time, not necessarily in distance. In the rational method, average intensities have no time sequence relation to the actual rainfall pattern during the storm. The intensity duration curve is not a time sequence.

(b) Rational method of runoff computation. The rational formula is defined as follows:

$$Q = CIA$$

Where:

Q = Runoff volume in cubic feet per second (cfs).

A = Area to be drained in acres (AC).

C = Runoff coefficient.

I = Rate of rainfall over the entire drainage area in inches per hour, based on the time of concentration.

1. Runoff coefficient (C). It should be noted that the runoff coefficient (C) is the variable of the rational method which is least susceptible to precise determination. Its use in the formula implies a fixed relation for any given drainage area, which in reality is not the case. A reasonable coefficient must be chosen to represent the integrated effects of infiltration, detention storage, evaporation, retention, flow routing, and interception. All of these affect the time distribution and peak rate of runoff.

Ranges for C values are as follows:	
Single-family residence	0.70
Multifamily	0.75
Apartments	0.80
Commercial/industrial	0.90
Parks-golf courses	0.40
Undeveloped, pasture and cultivated	0.40
Acreage development less than two acres per lot	0.60
Two acres per lot or more development	0.50

2. Rainfall intensity (I) is the average rainfall rate in inches per hour which is considered for a particular drainage basin or sub-basin and is selected on the basis of design rainfall duration and design frequency of occurrence. The design duration is equal to the time of concentration for the drainage area under consideration. Intensity duration curves for this region are included herein.
  - a. The time of concentration used in the rational equation is the critical time of concentration for the point of interest. The critical time of concentration is the time associated with the peak runoff from the watershed to the point of interest. The time of concentration to any point in a storm drainage system

is a combination of the inlet time and the time of flow in the conduit. Street flow shall be considered as being in an open paved channel. Manning's equation is acceptable for determining open channel and free water surface flows.

b. An acceptable formula for use in determining overland time of concentration is:

$$T_c = k (L^{.375}/S^{.2})$$

Where:

L = Length of flow in feet.

S = Average slope in feet/foot.

k = Constant for character of surface. Values of k:

Pavement 0.372. Bare soil 0.604.

Poor grass 0.942.

Average grass 1.04.

Dense grass 1.13.

c. An acceptable formula for determining channel flow time is:

$$T_c = k (L^2/S^{.385})$$

Values of k:

Curbed street 0.0035.

Concrete lined channel 0.006.

Sodded swale 0.008.

~~Bar ditch 0.012.~~

~~d. The time of flow in a closed conduit is the quotient of the length of the conduit and velocity of flow as computed using the hydraulic characteristics of the conduit. The time required to fill the conduit shall be neglected even though it may represent an appreciable percentage of total time of concentration.~~

~~3. Drainage area (A). The size, shape and characteristics of the watershed must be determined. Drainage areas shall be determined through the use of planimetric topographic maps, supplemented by field surveys where topographic data has changed or where the map relief makes it difficult to distinguish the direction of flows. A drainage area map shall be provided for each project. The drainage area contributing to the system being designed and drainage sub-area contributing to each inlet point shall be identified. The outlines of the drainage divides must follow actual lines rather than artificial land divisions.~~

## SECTION 12-596 FLOW IN STREETS

~~(a) General. The location of inlets and permissible flow of water in the streets shall be related to the extent and frequency of interference to traffic and the probability of flood damage to surrounding property. Interference to traffic is regulated by design limits of the spread of water into traffic lanes, especially in regard to collector streets and arterials.~~

~~(b) Design criteria.~~

- ~~1. Flow in gutters on straight or parabolic crown paved streets or roads may be determined by using Manning's formula for channel flow.~~
- ~~2. Minimum gutter slope on residential streets shall not be less than 0.004 ft./ft. (0.4 percent).~~
- ~~3. Maximum gutter slope shall not be more than 0.08 ft./ft. (eight percent).~~
- ~~4. Lowering of the standard height of street crown or splitting of curb heights shall not be allowed for the purpose of hydraulic design unless approved by the city engineer. In no case will it be allowed on collector or arterial streets.~~
- ~~5. All street sections shall have a positive crown.~~

- ~~6. Street capacity. The flow depth at the gutters shall not exceed six inches for a 50-year storm. A concrete overflow flume shall be provided at all sump locations to provide for the 100-year overflow.~~
- ~~7. The use of a cul-de-sac or dead-end street as the terminal point of residential street flow shall not be allowed for drainage areas exceeding five acres. A minimum of 70 percent of the flow in a residential street shall be removed to a storm sewer or drainage system prior to reaching the point of curvature of a cul-de-sac or the end of the street for drainage areas exceeding five acres in size, but in no case shall the sum of the bypassed flow equivalent drainage area and the drainage area to the end of the cul-de-sac exceed five acres.~~
- ~~8. The maximum drainage area that may be conveyed on a curbed street is 20 acres.~~

## **SECTION 12-597 ENCLOSED STORM SEWERS**

~~(a) General. All storm sewers shall be designed by the application of the Manning's or Kutter's equations either directly or through appropriate charts or nomographs. In the preparation of hydraulic designs, investigations shall be made of all existing structures and their performance on the waterway in question. Sewer sizing based on storm frequency shall be as set forth in section 12-582. In addition, runoff from storms exceeding the design storm up to the 100-year storm should be anticipated and disposed of with minimum damage to surrounding property and the sewer must be accessible for maintenance. Drainage between lots will be conveyed in an enclosed storm sewer with a concrete flume for overflow conditions.~~

~~(b) Materials of construction.~~

- ~~1. Reinforced concrete pipe shall conform to the requirements of ASTM C76. Unless otherwise specified, all pipe shall be Class III for 24-inch and smaller and Class II for 27-inch and larger in accordance with ASTM C76, wall b. If a closed box design is used in lieu of pipe, the design shall conform to state department of transportation RCB standards or structural design calculations shall be provided.~~
- ~~2. Corrugated metal pipe wall thickness shall meet ODOT fill height table for metal pipe (FHTMP-4-00E).~~
- ~~3. Corrugated metal pipe shall not be placed under paved public streets unless approved by the city engineer.~~

(c) Design criteria.

1. Pipes which are a part of the storm sewer system shall have a minimum diameter of 18 inches.
2. Enclosed storm sewers shall be designed for open channel flow to satisfy, as well as possible, the requirements for unsteady and non-uniform flow. Sealed joints are required for any pipe that can operate under head. Any pipe under any paving shall be "O" ring type pipe and wrapped to prevent infiltration of the fill material into the pipe.
3. Grades. The minimum slope shall be such to maintain a minimum velocity of 2.5 fps flowing full. The maximum slope shall be such that the velocity does not exceed 20 feet per second.
4. Flows may be computed by either the Kutter or Manning equation. The Kutter and the Manning equations are used for pipes and conduits of all shapes flowing either full or partially full.
5. Roughness coefficient "n" for storm sewers:

Materials of construction	Design coefficient Manning's
Box culverts	0.013
Concrete pipe	0.013
Annular plain corrugated metal pipe	0.024, 0.027
Smooth flow helical plain corrugated metal pipe	0.018, 0.024
Special cases: "n" as approved by city engineer	

6. General rules to be observed.

- a. Pipe size and slope selected so that flow will not decrease at inlet, manholes or other changes in geometry.
- b. Do not discharge a larger pipe into a smaller one.
- c. At change in pipe size, match top of pipes.
- d. Design capacity of the conduit shall not exceed the conduit capacity at critical slope.
- e. A one-foot freeboard shall be maintained below the proposed finish grade through the storm sewer system. The submittal of energy calculations shall

~~be required on any reach of a system which exceeds 500 lineal feet; on the total system that exceeds 1,500 lineal feet; on a reach of a system which has an elevation change exceeding ten feet.~~

~~An acceptable critical slope formula is:~~

$$~~S_c = 111 N^2 / D^{1/3}~~$$

~~Where:~~

~~S<sub>c</sub> = Critical slope.~~

~~N = Manning's "n".~~

~~D = Circular pipe diameter feet.~~

- ~~7. Manhole locations. Manholes shall be located at intervals not to exceed 350 feet for pipe sizes 42 inches or less. For pipe sizes larger than 42 inches, manholes shall be located as determined by the city engineer. Manholes shall be located at conduit junctions, changes of grade, and changes of alignment for all pipe sizes.~~
- ~~8. Pipe connections. Manholes, junction boxes or inlets shall be used at all pipe connections and/or changes in pipe size.~~
- ~~9. Head losses at structures. Minor energy head losses at structures shall be disregarded. Major losses shall be taken into account if they significantly affect the sewer performance.~~
- ~~10. Pipe extensions. The use of one material to extend a sewer constructed of a different material shall not be allowed except at manholes, junction boxes or inlets.~~
- ~~11. Pipe laid on curves. Degree of curvature shall be as per manufacturer's recommendations.~~
- ~~12. Outlet erosion protection. All storm sewer outlets shall have erosion protection provided by headwalls, flared end sections, curtain walls, energy dissipators, rip rap, etc., as required by accepted engineering practices and approved by the city engineer.~~

~~(d) Inlet system.~~

1. ~~Inlet design and location in street sections must be compatible with the allowable spread of water on the street section as established in section 12-596.~~
2. ~~Inlet location shall not interfere with vehicular or pedestrian traffic.~~
3. ~~Whenever possible, inlets will intercept water before it reaches a pedestrian crosswalk.~~
4. ~~Inlets shall not be located in a curb radius. Where existing conditions exist that require an inlet in the radius, the radius shall not be less than 38 feet.~~
5. ~~Inlets shall be sized to prevent water from minor streets spilling over and flooding major streets.~~
6. ~~Where a curbed street crosses a bridge, gutter flow shall be intercepted and not allowed to flow onto the bridge.~~
7. ~~Inlets shall be installed at a low point or on the minimum slope of 0.4 percent and shall have the following accepted capacities:~~

Standard Inlet Design	Grate (cfs)	Hood (cfs)	Total (cfs)
1-0	1.6	2.5	4.1
2-0	3.2	5.0	8.2
2-1	3.2	10.1	13.2
2-2	3.2	15.0	18.2
2-3	3.2	20.0	23.2
2-4	3.2	25.0	28.2
2-5	3.2	30.0	33.2

~~The above inlet designation is as follows: The first number represents the number of grates with matching hoods. The second number represents the number of additional pairs of hoods.~~

8. ~~The storm sewer system at a low point (sump) must provide a concrete overflow channel capable of carrying the 100 year frequency storm in a designated drainage easement.~~
9. ~~Any inlet grates over which a bicyclist can ride shall be of a design considered bicycle safe.~~

## **SECTION 12-598 OPEN DRAINAGE CHANNELS**

(a) ~~Natural drainage flow. Increases in runoff which change the equilibrium of natural areas in~~

~~the system mandate specific engineering solutions to conserve these natural systems and the pre-development characteristics of the area.~~

~~(b) Open storm drainage requirements.~~

- ~~1. All land adjoining open natural or improved storm drainage channels having an elevation below the 100-year flood elevation of the channel shall be dedicated for the purpose of providing drainage, public park and/or utility easement.~~
- ~~2. All channel improvements shall be approved by the city engineer prior to the commencement of any work thereon.~~
- ~~3. Whenever channel improvements are carried out, sodding, back sloping, cribbing and other bank protection shall be designed and constructed to control siltation and erosion for the anticipated conditions and flow resulting from a 100-year frequency rainfall.~~
- ~~4. Any channel grading shall be such that water will not gather in pools.~~
- ~~5. Drainage easements of satisfactory width to provide working room for construction and access for channel maintenance shall be provided. An open drainage channel shall not be located in a street easement except where a paved street surface is at least two lanes wide and is provided on both sides of a channel so as to provide access.~~

~~(c) Design considerations.~~

- ~~1. Channel profile. Channels should be as wide and shallow, and on as flat a grade as hydraulics and topography will allow.~~
- ~~2. Channel hydraulics. Hydraulic characteristics of channels shall be determined by Manning's equation. The "n" value used for channels shall be based on the design engineer's experience and judgement in regard to the individual channel characteristics and approved by the city engineer. When submitting calculations, include the source.~~
- ~~3. Constructed channel geometry. Whenever a trapezoidal channel is constructed, the minimum bottom width shall be four feet with side slopes of not steeper than four to one for sodded sections and a minimum bottom width of three feet with side slopes of not steeper than one to one for paved or rock lined sections. If the radius of the centerline of the channel is less than three times b, additional outside bank height is required and may be determined by the following:~~

$$= \frac{v^2(t+b)}{2gr}$$

Where:

H = Additional height on outside edge of channel (ft.).

v = Velocity of flow in channel (fps).

t = Width of flow at water surface (ft.).

b = Bottom width of channel (ft.).

r = Centerline radius of turn (ft.).

g = Acceleration of gravity (32.3 ft./sec<sup>2</sup>).

4. ~~Flow velocities in channels. Velocities shall not exceed six fps for sections sodded in Bermuda grass. Velocities in concrete lined or paved sections shall not exceed 15 fps. Whenever improved conduits carrying water discharge into channels either natural or manmade scour protection shall be installed.~~

5. ~~Trickle channels. All channels altered or improved from the natural state will require a minimum three foot wide paved trickle channel. The paved trickle channel shall be designed in a manner that will minimize erosion or undermining of the improvement. Sodding, soil stabilization, or other methods of erosion control shall be required adjacent to the paved channel.~~

6. ~~Concrete flumes. Concrete flumes in lieu of enclosed pipe shall not be allowed except under the following conditions:~~

a. ~~Drainage area shall not exceed five acres.~~

b. ~~The structure shall extend to the rear of the adjacent lots and shall lie within an easement, or common area and discharge into a drainage easement, park or common area maintained by the city or property owners association.~~

c. ~~A curtain wall shall be provided at the discharge end.~~

d. ~~The entrance to the flume shall be sized based on the following weir equation:~~

$$Q = C L h^{3/2}$$

Where:

Q = Runoff volume in cubic feet per section.

L = Weir opening.

h = Height of weir opening.

~~C = 3.0.~~

~~Where h does not exceed the height of the curb at the entrance.~~

- ~~e. The water surface in the flume shall never be higher than the top of the curb at the entrance during any flow condition.~~
- ~~7. Exit provisions. Any paved channel more than three feet deep with slopes steeper than 2:1 shall have recessed hand/toe pockets in the channel wall spaced vertically on 15 inch centers alternating on a 12 inch width. The pockets (steps) shall be located a maximum of 200 feet apart along the channel and alternate from side to side.~~
- ~~8. Outlet stabilization. Rip rap outlet stabilization shall be constructed at the discharge end of the open drainage channel when the new channel discharges into a undeveloped channel or when the discharge velocities are erosive.~~
- ~~9. Limitation on fences. Fences shall not be erected below the shoulder of the sodded section or below limits of the 100 year flood line, and in no case shall fences be closer than six feet measured horizontally to the edge of the paved section, unless paved section is sized for the 100 year flood then the fence may be set next to the paved channel. In all other situations, fences shall be a minimum of six feet away from channel.~~

## **~~SECTION 12-599 BRIDGES AND CULVERTS~~**

### ~~(a) Materials and size.~~

- ~~1. Culverts under private drive approaches may be reinforced concrete pipe or corrugated metal pipe. Size shall be not less than 18 inches or 21 inches in length times 15 inches in width corrugated metal pipe arch.~~
- ~~2. Culverts under public streets shall be reinforced concrete conforming to state department of transportation standards.~~

### ~~(b) General design requirements.~~

- ~~1. Bridges and culverts shall be designed to pass the 50 year storm unless used as an outlet for a detention pond. Structures under residential streets shall be designed so that water overtopping the structure from a 100 year frequency storm shall not flood the street to a depth greater than six inches above the street crown. Structures crossing under arterial or collector streets shall be designed so that waters overtopping the structure from a 100 year frequency storm shall not flood the street to~~

~~a depth greater than six inches above the street crown. Allowable spread of waters shall not exceed the adjacent floodway.~~

~~2. Scour protection shall be provided to control erosion.~~

~~3. Flared end sections with curtain walls may be used in lieu of headwalls on culverts of 48 inches or less. Concrete flared end sections discharging water shall be tied back a minimum of three pipe lengths.~~

## **SECTION 12-600 STORMWATER STORAGE**

~~(a) General. Stormwater detention shall be required for all developments at the time of their construction. This shall include all subdivisions of land and any new construction of a commercial or industrial nature. Exclusions may be considered for individual residential construction not associated with a multi-lot development. Exclusions may also be considered for residential construction on a lot of five acres or more. Residential construction in an approved addition prior to the effective date of the ordinance from which this article is derived shall not require detention. New developments shall employ the use of a regional detention pond and shall not use multiple individual ponds unless approved by the city. All detention facilities shall remain in the care of the private sector and shall be the responsibility of the property owners' association. All maintenance shall be the responsibility of the property owners' association.~~

~~(b) Rainfall storage.~~

~~1. Rooftop storage or underground storage shall not be permitted.~~

~~2. Parking lot storage, if used, may employ ponding areas with a controlled outlet structure to control the discharge. Special attention shall be given to the potential flooding of parked cars.~~

~~3. Property line swale ponding and small on-site ponds, if used, shall be examined for possible adverse effects on building foundations due to saturation of the subsoil.~~

~~(c) Design considerations for rainfall and runoff storage.~~

~~1. Sizing of detention facilities shall be by approved methods such as APWA unit hydrograph, SCS method, etc.~~

~~2. The storage facility shall be designed to pass, as a maximum, the historic runoff rate and shall control the increased runoff due to the development under consideration.~~

~~3. Release rates shall be based on head over the outlet and shall not exceed the historic flow for the two, five, ten, 25, 50 and 100 year design frequency storm discharges.~~

- ~~4. When a combination of storage facilities are used to control runoff, the system as a whole shall be designed with the capacity to detain the design storms with discharge rates in accordance with subsections (b) and (c) of this section.~~
- ~~5. All facilities shall be provided with an emergency spillway with scour protection. Earth embankments shall have side slopes not steeper than 3:1. Proper materials shall be used to provide stability and minimum seepage.~~
- ~~6. The storage volume of a detention facility shall be oversized by ten percent to allow for sedimentation. Exception: concrete with sedimentation control or written maintenance program to allow for sediment control.~~
- ~~7. All detention ponds shall be provided with a paved trickle channel from the main inlet point to the outlet structure to transmit low flows; except where it is not required by the design as approved by the city engineer.~~
- ~~8. Erosion control for storage and/or detention facilities shall be in accordance with EPA requirements.~~
- ~~9. A paved access road shall be provided to all detention areas for maintenance purposes. The paved access road shall be dedicated as part of the detention area.~~
- ~~10. Earth dams and other earth embankments shall be designed by a licensed professional engineer in accordance with accepted engineering practices to ensure that dam failures will not occur. Design criteria used by the soil conservation service in the selection of materials and construction procedures will be accepted.~~
- ~~11. Energy dissipators shall be installed downstream of the outlet structure to return flow to channel design velocity.~~

## **SECTION 12-601 EROSION AND SEDIMENTATION**

~~(a) General. The purpose of this section is to provide effective management for the control of erosion and sedimentation and to protect water quality and the general health, safety and welfare of the residents of the city. The items detailed herein are to be considered as a minimum. EPA and ODEQ guidelines shall be followed where more restrictive.~~

- ~~1. Appropriate erosion and sedimentation facilities shall be installed and maintained throughout the construction period for any construction activity on individual tracts or lots.~~
- ~~2. All erosion and sediment control methods necessary for land treatment measures~~

~~which will effectively minimize and control erosion and sedimentation during and following any proposed construction activity shall be indicated on the final construction and/or building permit plans.~~

- ~~3. All earth slopes and earth areas new or existing subject to erosion, such as adjacent to trickle channels, inlet structures, and outlet structures, within any area designated for detention or drainage shall be slab sodded with Bermuda sod or have permanent established growth of vegetation. All vegetation areas shall be fertilized, watered, and in an established growing condition prior to completion or acceptance of any drainage facility. Drainage channels shall be slab sodded to the limits of the 100-year design storm.~~
- ~~4. Erosion and sediment control on urban areas established by the county conservation district shall be used to determine best practices, define terms and provide basic methodology.~~

~~(b) Design considerations; general design principles. Practical combinations of the following principles shall be utilized, as a minimum, in planning measures to be installed for any land disturbing activity:~~

- ~~1. The land disturbing activity shall conform to existing topography and soil type so as to create the lowest practicable erosion potential.~~
- ~~2. The disturbed area and the duration of exposure to erosive elements shall be kept to a practicable minimum through construction scheduling and management.~~
- ~~3. Cut and fill operations should be kept to a minimum.~~
- ~~4. Disturbed soil shall be stabilized as quickly as practicable.~~
- ~~5. Natural vegetation shall be retained, protected, and supplemented whenever feasible.~~
- ~~6. Temporary vegetation or mulching shall be employed to protect exposed critical areas during development.~~
- ~~7. Permanent vegetation and structural erosion control measures shall be installed as soon as practicable.~~

~~(c) General practice. Soil and water conservation measures include, but are not necessarily restricted to, vegetation, sediment basins, dikes, grade stabilization structures, sediment traps, land grading, diversions, waterways or outlets, and rip rap. Vegetative practices shall be applied to control erosion. The practice can be either temporary and/or permanent depending on the site specific needs.~~

(d) ~~Erosion and sediment control criteria.~~

- ~~1. Long term permanent seeding, sprigging, or planting producing vegetative cover. Bermuda grass, Kentucky 31 tall fescue and weeping lovegrass are some of the types of permanent vegetation that shall be used to control erosion.~~
- ~~2. Short term seeding, producing temporary vegetative cover. Small grains like oats, rye and wheat, and sudans and sorghums are the most feasible temporary vegetation and shall be used to control erosion. This practice is effective for areas where soil is left exposed for a period of six to 12 months. The time may be shorter during periods of erosive rainfall.~~
- ~~3. Sodding. Areas should be covered with a turf of perennial sod forming grass.~~
- ~~4. Dikes and swales. The design drainage areas for dikes and swales shall not exceed five acres. The minimum dimensions shall be in accordance with EPA guidelines.~~
  - ~~a. Diversion dike.~~
  - ~~b. Interceptor dike or swale.~~
  - ~~c. Perimeter dike or swale.~~
  - ~~d. Straw bale dike. Where no other practice is feasible, a temporary barrier with a life expectancy of three months or less can be installed across or at the toe of a slope for the contributing drainage areas, in accordance with the EPA standards.~~
- ~~5. Stabilized entrance. A stabilized construction entrance shall be built in accordance with the EPA standards to reduce or eliminate the tracking or flowing of sediment onto public right of way.~~
- ~~6. Outlet. A concrete or stone outlet structure shall be constructed in areas where the entire drainage area to the structure is not stabilized or where there is a need to dispose runoff at a protected outlet or where concentrated flow for the duration of the period of construction needs to be diffused.~~
- ~~7. Chute stabilization. A grade stabilization structure in the form of a paved chute or flume shall be constructed to prevent erosion, where concentrated flow of surface runoff is to be conveyed down a slope, in accordance with EPA standards. The maximum allowable drainage area upstream of such a structure shall not exceed 36 acres.~~
- ~~8. Pipe stabilization. A grade stabilization structure in the form of a pipe slope drain shall~~

~~be constructed to prevent erosion, where concentrated flow of surface runoff is to be conveyed down a slope, in accordance with EPA standards. The maximum allowable drainage area upstream of such a structure shall not exceed five acres.~~

~~9. Stormwater detention facilities may be used temporarily as sediment basins. A temporary outlet structure for the stormwater detention facility to work as a sediment pond shall be constructed. At the end of the construction activity, the developer shall make sure that the outlet structure shall meet the design requirements of a stormwater detention facility. The EPA general permit requires that, where it is attainable, a temporary or permanent sediment basin be installed in any drainage location where more than ten acres in the upstream drainage area are disturbed at one time. The sediment basin must provide at least 3,600 cubic feet of storage for every acre of land which it drains (flows from upland areas that are undisturbed may be diverted around the basin). For drainage locations with ten or fewer disturbed acres, sediment traps, filter fences, or equivalent measures must be installed along the downhill boundary of the construction site.~~

~~10. Mulch stabilization. Hay and sod mulching, as a temporary measure, may be used for embankment stabilization in areas where surface runoff is to be directed down a slope.~~

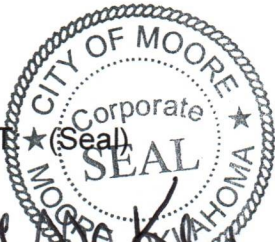
~~11. Mat stabilization. Erosion matting may be used for embankment and slope stabilization where appropriate. The specified use must be recommended by the manufacturer for the proposed material.~~

~~12. Fence stabilization. Silt fencing may be used for slope stabilization where appropriate. The specified use must be recommended by the manufacturer for the proposed material.~~

**SEVERABILITY:** If any of the provisions of this ordinance are determined to be unconstitutional or unlawful by any court of competent jurisdiction, the remainder shall be several and unaffected.

**REPEALER:** Any ordinance or parts thereof in conflict with this section are hereby repealed.

PASSED AND APPROVED this 21 day of June, 2021.



ATTEST

(Seal)

*Vanessa Kemp*  
VANESSA KEMP, City Clerk

*Glenn Lewis*  
GLENN LEWIS, Mayor

APPROVED AS TO FORM & LEGALITY:

*Randy C Brink*  
RANDY BRINK, City Attorney

**EMERGENCY:** Whereas, it being immediately necessary for the preservation of the peace, health, safety and public good of the City of Moore and the inhabitants thereof that the provisions of this ordinance be put into full force and effect, an emergency is hereby declared to exist by reason whereof this ordinance shall take effect and be in full force and effect from and after the date provided herein as provided by law.

PASSED AND APPROVED this 21 day of JUNE, 2021.



ATTEST:

(Seal)

*Vanessa Kemp*  
VANESSA KEMP, City Clerk

*Glenn Lewis Mayor*  
GLENN LEWIS, Mayor

APPROVED AS TO FORM & LEGALITY:

*Randy C Brink*  
RANDY BRINK, City Attorney