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PROOF OF PUBLICATION

STATE OF NEVADA  
COUNTY OF WASHOE

ss. Tana Ciccotti

being duly sworn, deposes and says:  
That as legal clerk of the RENO GAZETTE-  
JOURNAL, a daily newspaper published in Reno,  
Washoe County, State of Nevada, that the notice:  
Ordinance 1022

NOTICE OF ADOPTION  
WASHOE COUNTY  
ORDINANCE NO.1022

NOTICE IS HEREBY GIVEN THAT: Bill  
No. 1198 Ordinance No. 1022 entitled

AN ORDINANCE AMENDING CHAP-  
TER 110 OF THE WASHOE COUNTY  
CODE (DEVELOPMENT CODE) TO  
AMEND ARTICLE 420, STORM  
DRAINAGE STANDARDS, AND OTHER  
MATTERS PERTAINING THERETO.

was adopted on June 16, 1998, by  
Commissioners Joanne Bond, Sue  
Camp, Jim Galloway, Mike Moulot,  
with Jim Shaw absent, and will  
become effective on Wednesday, June  
1, 1998.

Typewritten copies of the ordinance  
are available for inspection by all  
interested persons at the office of the  
County Clerk, 75 Court Street, Reno,  
Nevada

JUDI BAILEY,  
Washoe County Clerk  
No.2659 June 24, July 1, 1998

of which a copy is hereto attached, has been  
published in each regular and entire issue of  
said newspaper on the following dates to wit:

June 24, July 1, 1998

Signed

*[Handwritten Signature]*

Subscribed and sworn to before me on 07/01/98

Notary Public

*[Handwritten Signature: Jo Anne F. Wessel]*

PLEASE STAMP & SIGN FOR PAYMENT  
7/18/98

JO ANNE F. WESSEL  
Notary Public - State of Nevada  
Appointment Recorded in Washoe County  
No: 93-0886-2 - EXPIRES NOV. 18, 2000

P.O. BOX 22000, RENO, NEVADA 89520  
(702) 788-6200

GANNETT

1022

SUMMARY: Amends Chapter 110 of the Washoe County Code (Development Code) by modifying the storm drainage standards.

BILL NO. 1198

ORDINANCE NO. 1022

AN ORDINANCE AMENDING CHAPTER 110 OF THE WASHOE COUNTY CODE (DEVELOPMENT CODE) TO AMEND ARTICLE 420, STORM DRAINAGE STANDARDS, AND OTHER MATTERS PERTAINING THERETO.

THE BOARD OF COUNTY COMMISSIONERS OF THE COUNTY OF WASHOE DO ORDAIN:

SECTION 1. Article 420, "Storm Drainage Standards" of Chapter 110 of the Washoe County Code is hereby amended as set forth in Exhibit "A" which is attached hereto and made a part hereof.

Proposed on the 26th day of May, 1998.  
Proposed by Commissioner Shaw.  
Passed on the 16th day of June, 1998.

Vote:

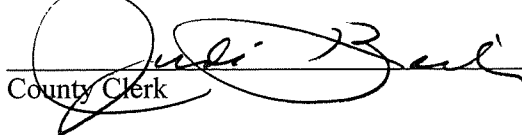
Ayes: **Joanne Bond, Sue Camp, Jim Galloway, and Mike Mouliot**

Nays:

Absent: **Jim Shaw**

  
Chairman  
Washoe County Commission

ATTEST:

  
County Clerk

This ordinance shall be in force and effect from and after the 1st day of July, 1998.

## Article 420

# STORM DRAINAGE STANDARDS

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[This Article added by Ord. 908, provisions eff. 10/15/94.]

### Sections:

110.420.00	Purpose
110.420.05	Applicability
110.420.10	Relation to Other Standards
110.420.15	Authorization of Alternative Standards
110.420.20	General Requirements
110.420.25	Drainage Report Contents
110.420.30	Site Drainage and Grading Plans
110.420.35	Design/Improvement Requirements
110.420.40	Easements
110.420.45	Water Supply Ditches

**Section 110.420.00 Purpose.** The purpose of this article, Article 420, Storm Drainage Standards, is to set forth standards for ensuring that both private and public development provides adequate protection for citizens and property, minimizes and controls erosion and pollution impacts on the natural environment, and minimizes maintenance costs for drainage and flood control systems within Washoe County.

**Section 110.420.05 Applicability.** The provisions of this article shall apply to public and private improvements for projects including, but not limited to, the following:

- (a) Projects that will require a Drainage Report:
  - (1) Public Works projects;
  - (2) Subdivisions;
  - (3) Subdivision projects utilizing a grading permit; and
  - (4) Projects in, containing or abutting a floodplain, stream, lake or major drainage facility.
- (b) Projects that may require a Drainage Report:
  - (1) Projects requiring a site plan review;
  - (2) Projects requiring a special use permit;
  - (3) Projects requiring a building permit;
  - (4) Projects requiring a grading permit; and

- (5) Parcel maps.

**Section 110.420.10 Relation to Other Standards.** The standards set forth in this article make reference to and shall be used in conjunction with the *Standard Specifications for Public Works Construction* and *Standard Details for Public Works Construction*, latest editions, and American Association of State Highway Transportation Officials (AASHTO) guidelines.

**Section 110.420.15 Authorization of Alternative Standards.** In instances where unique situations necessitate the application of storm drainage and flood control designs and systems not provided in this article, the following provisions shall apply:

- (a) **Accepted Engineering Practices.** Any storm drainage or flood control systems not allowed by these standards shall be designed in accordance with accepted engineering practices, the *Standard Specifications for Public Works Construction*, and the *Standard Details for Public Works Construction*, and shall be subject to the approval of the County Engineer.
- (b) **Alternative Standards.** The County Engineer may, at his or her discretion, authorize alternative standards not covered in this article, subject to the following:
- (1) The alternative standards shall be the equivalent of the design requirements as set forth in Sections 110.420.20, 110.420.30, and 110.420.35; and
  - (2) The alternative standards shall not be used for purposes of mere convenience or economy unless the alternative has equal or better function and/or quality.

**Section 110.420.20 General Requirements.** The requirements set forth in this section shall apply to all development subject to this article.

- (a) **Required Drainage Report.** Unless waived in advance by the County Engineer, all applicants shall submit for approval a Drainage Report signed and stamped by a Nevada Registered Civil Engineer in accordance with the provisions of this article and other applicable County standards. Drainage Reports shall be based on the land uses allowed in the Comprehensive Plan, existing uses, or Storm Drainage Master Plans, whichever result in the greater runoff. Hydrologic/hydraulic analysis and design shall be based on any existing interim drainage basin master plans, Washoe County flood control master plan concept level report(s), or adopted drainage master plans as determined by the County Engineer. Flows shall be based on the latest edition of NOAA Atlas rainfall data pertaining to Washoe County.
- (b) **5-Year Storm Runoff Improvements.** Whenever a Drainage Report indicates that the 5-year storm runoff from a proposed development cannot be handled by the existing storm drain system, the applicant shall be responsible for accomplishing one (1) or more of the following, as determined by the County Engineer:
- (1) Upgrade the existing off-site system to accommodate the runoff;
  - (2) Provide on-site detention and controls for acceptable discharge into the off-site system; or

- (3) Provide an on-site retention/infiltration system verified by a Nevada Registered Civil Engineer as being adequate to accommodate the runoff from the proposed development. The operation and maintenance of such a system shall be the responsibility of the property owner or his or her successors and assigns.
- (c) 100-Year Storm Runoff Improvements. The provisions of this section shall govern 100-year storm runoff improvements:
- (1) Discharge of the 100-year frequency storm drain waters into a major drainage facility or natural water course shall not contribute to increasing the existing peak flow of storm drainage runoff in the drainage facility or natural water course, except as provided in Subsection (c)(2) of this section.
  - (2) The County Engineer may allow an increase in peak flow from the 100-year storm if a Nevada Registered Civil Engineer provides proof in the Drainage Report that any increase in peak flow will not adversely affect or cause damage to any property along the existing drainage facility or natural water course, now or in the future, based on the existing and proposed land uses or the uses allowed in the Comprehensive Plan, whichever is more restrictive.
- (d) Natural Water Facilities. Development of property shall not adversely affect any natural drainage facility or natural water course, and shall be subject to the following provisions:
- (1) Natural facilities shall remain in as near a natural state as is practicable, with any modification proposed, including any erosion mitigating measures, addressed in the Drainage Report and drainage plans; and
  - (2) When the flows, velocity or side slope as determined by the Drainage Report indicates a hazard, the applicant shall provide fencing in accordance with County standards.
- (e) On-Site Facilities. All drainage relating to the proposed development shall be collected on-site by facilities to accommodate, at a minimum, the storm drain waters for the 5-year return frequency storm flow, both entering the site and generated on-site. The drainage shall be piped in accordance with County standards to an existing adequate public storm drain system, major drainage facility, or natural water course. A major drainage facility is a channel or drainage way that has a drainage basin of one hundred (100) acres or more.
- (1) Where by reason of terrain or other circumstances the County Engineer determines that piping storm drain waters is inappropriate or unnecessary, alternative methods may be approved in lieu of piping, including methods pursuant to the provisions set forth in Section 110.420.15 to facilitate transporting such waters; and
  - (2) Easements to access and accommodate storm waters flowing across private property shall be provided as set forth in Section 110.420.45.
- (f) Detention. On-site detention requirements for the 5-year and 100-year frequency storm are as follows:

- (1) For a 5-year frequency storm, detention of the difference in runoff between the developed and undeveloped conditions shall be required if the capacity of the downstream storm drainage facilities will be exceeded; and
- (2) For a 100-year frequency storm, detention of the difference in runoff between the developed and undeveloped conditions may be required if the capacity of the downstream storm drainage facilities will be exceeded.
- (g) Wetlands. When the U.S. Army Corps of Engineers (C.O.E.) has determined there are wetlands on a proposed site, a wetlands delineation map approved by the C.O.E. must be submitted to the Department of Community Development and the County Engineer. Any construction proposed in the wetland will require a 404 Permit from the C.O.E.
- (h) Waters of the State of Nevada. Any work which requires fill intended to be placed within the "waters of the State of Nevada" shall receive permission from the State Division of Environmental Protection prior to beginning construction. The County Engineer shall receive a copy of this permission prior to issuance of any permit.
- (i) Construction within a 100-Year Floodplain. Embankments and other structures shall not be placed within a 100-year floodplain, as determined by the most recent hydrologic study acceptable to the County Engineer, of a major drainage facility without prior approval by the County Engineer. Where such approval is granted, embankments and structures shall be constructed in accordance with the standards outlined in Section 110.416.70. Development within areas shown on the Flood Insurance Rate Map (FIRM) shall comply with Article 416, Flood Hazards.
- (j) Discharge Across Property Lines. Surface drainage from any developed area shall not cross any property line except by way of a natural watercourse, major drainage facility, approved drainage system within a public storm drain easement, or permanent surface drainage easement. The manner of discharge shall be approved by the County Engineer and the discharge must produce no significant adverse impacts to the downhill property. Surface flows should cross a property line within historic drainage ways and in a similar manner and quantity (or less) as the predeveloped conditions.
- (k) Extension of Storm Drain Facilities. Storm drain facilities shall be extended from within a development to adjacent undeveloped properties for future extensions in accordance with approved drainage plans.
- (l) Adjoining Property Surface Drainage. Existing surface drainage from adjoining property shall be perpetuated through a development unless other means of disposal acceptable to the County Engineer are used.
- (m) Irrigation Waters. Irrigation waters not controlled by a ditch or utility company and storm drain waters shall be conveyed by separate systems.

**Section 110.420.25 Drainage Report Contents.** Drainage Reports shall contain, at a minimum, the provisions set forth in this section.

- (a) Title Page. The title page of the Drainage Report shall contain the following:

- (1) Project name;
  - (2) Preparer's name, firm and date; and
  - (3) Professional Engineer's Seal of preparer and signature.
- (b) Introduction. The introduction of the Drainage Report shall include, at a minimum, the following:
- (1) Street location, Assessor's parcel number(s), section reference, and adjacent developments;
  - (2) Topography, ground cover, existing drainage facilities, major drainage facilities, flood hazard areas, irrigation ditches, and other site conditions, using maps to complement and clarify the project description whenever possible; and
  - (3) Proposed project description, including other previous studies relevant to the site.
- (c) Pre-development Drainage System. The Drainage Report shall provide sufficient information, including text and maps where possible, pertaining to the pre-development drainage system, including:
- (1) Major basins (100 acres or more), including relationship to major drainage facilities and major basin drainage characteristics (topography, runoff, cover, use, erosion); and
  - (2) Sub-basin and site drainage, including 5-year and 100-year storm flows for each sub-basin affecting the site, existing drainage patterns, channeled or overland flow, points of entrance and discharge, and effect of historic flows on adjacent properties. All items listed in this subsection, excluding the effects of historic flows on adjacent properties, may be tabulated on a map.
- (d) Proposed (Developed) Drainage System. At a minimum, the following information regarding the proposed drainage system shall be provided in the Drainage Report. Maps shall be used to complement and clarify the description where appropriate.
- (1) Size of major basins and tributary sub-basins, hydrologic method to be used for analysis (Rational, Soil Conservation Service or Hydrologic Engineering Center), and design storm intensities for 5-year and 100-year storms.
  - (2) Runoff analysis based on the latest edition of the NOAA Atlas Rainfall Data pertaining to Washoe County, including pre-development storm flow rates and paths, and developed storm flow rates and paths for 5-year and 100-year storms.
  - (3) Design of the storm drain system to pass the 5-year storm, including all downstream improvements, with an overland system to pass up to the 100-year storm, and verified storm flows from inlets to ultimate outlets of the drainage system.

- (4) Detention/retention/infiltration information for the 5-year and 100-year storm(s) may be required based on limiting conditions downstream. (For example, if the off-site piped system cannot pass the 5-year storm, the portion of the 5-year storm flow exceeding the capacity of the downstream drainage facilities shall be detained on-site. If the off-site overland flow facilities cannot pass the 5-year [up to the 100-year] storm, on-site detention for all storms exceeding that capacity shall be provided.) Information should include the following:
- (i) Detention/retention/infiltration volume provided;
  - (ii) Release rates and methods;
  - (iii) Passage of storms exceeding the 5-year up to the 100-year storm;
  - (iv) Emergency overflow provisions which will not cause a direct impact to neighboring sites;
  - (v) A detailed description provided by a Nevada Registered Civil Engineer of any downstream constraints, design calculations, and mitigation recommendations; and
  - (vi) Detention area(s) clearly identified in preliminary or schematic plan and the necessary area(s) identified on preliminary plans.
- (5) For 5-year and 100-year storms, show on plan maps the depth and velocity of flow on streets and the drainage system for the streets.
- (6) The type, depth and velocity of open channel flow shall be shown on plan maps.
- (7) Storm drains and culvert layouts and all relevant data shall be shown on plan maps.
- (e) Areas within Flood Hazard Zone. Where the proposed development is located within a flood hazard area or limited flooding area as defined in Article 416, Flood Hazards, sufficient information shall be provided for the following:
- (1) Impacts;
  - (2) Protection; and
  - (3) Compliance with Federal Emergency Management Agency requirements and Article 416, Flood Hazards, of this Development Code.
- (f) Conclusions. The Drainage Report shall include a conclusion which discusses the impacts of the proposed drainage system improvements including:
- (1) Benefits; and
  - (2) Adverse effects with mitigation measures for these effects.



- (g) Drainage Report Appendices. The Drainage Report shall include the following information in the Appendices.
- (1) Computations. Hydrologic and hydraulic computations including:
    - (i) Off-site and on-site historic runoff;
    - (ii) Off-site and on-site developed runoff;
    - (iii) Detention/retention/infiltration for up to the 100-year storm; and
    - (iv) Hydraulic grade line (HGL) for 5-year storms and 100-year storms.
  - (2) Site Location Map. Site location map on a USGS map, at a scale appropriate to show relation of site to major drainage basin(s) and sub-basin(s), showing flood hazard areas and 100-year flood plains, if applicable, and off-site flows through project.

**Section 110.420.30 Site Drainage and Grading Plans.** The contents of these plans shall include:

- (a) Provide existing and proposed contours at a distance beyond the property lines that is sufficient to analyze drainage impacts on adjacent properties, but in no case shall this distance be less than 100 feet.
- (b) Similar scales.
- (c) All sub-drainage areas per catch basin or channel.
- (d) Tabulation of existing and proposed drainage, showing length and time of concentration on various runs of materials such as grass and gutters, time of concentration, average rainfall intensity, area, runoff coefficient build-up if necessary, and peak flows for 5-year and 100-year storms.
- (e) Labels of all inlets and manholes to correspond to tabular numbering system.
- (f) Pipe sizes, grades, velocities, peak flows and hydraulic grade lines for all parts of the system in a tabular form on the plans.
- (g) Location plan (overall drainage) and sub-drainage plan signed and sealed by a Nevada Registered Civil Engineer and included in the construction plans for the development.
- (h) Tables detailing design data of rational formula and inlet, pipe and channel design on the plan.
- (i) On grading plans, peak flows for 5-year and 100-year storms at inlets and other sub-basin points of concentration, and at discharge points and in channels.
- (j) Peak flows entering and leaving the site, tracing path leaving the site to the nearest major drainage facilities without adverse impact to downstream owners.

- (k) On plan and profile sheets, peak flows for 5-year and 100-year storms at all inlets and shows peak flows, velocity, and hydraulic grade line if above top of pipe.
- (l) Benchmarks shown on plans with description and elevation.
- (m) Existing and proposed property lines.
- (n) Existing and proposed drainage easements and facilities.
- (o) Street names, grades and widths.
- (p) Show routing and accumulative water flows at the upstream and downstream ends of the site and at various critical points on-site for both the 5-year and 100-year storms.
- (q) Inflow and outflow for both 5-year and 100-year storms for all sub-basins.
- (r) Street cross sections showing 100-year flood levels.
- (s) Open channel flows in major channels shall be identified with the following information on plans:
  - (1) Channel and hydraulic grade line (HGL) profiles;
  - (2) Cross sections and required rights-of-way at 100-foot intervals;
  - (3) Location and size of all existing and proposed structures; and
  - (4) Channel sections and lining details.
- (t) Storm sewers shown on plans and shall include the following information:
  - (1) Hydraulic grade line (HGL) profiles;
  - (2) Location and size of all existing and proposed structures;
  - (3) Proposed materials; and
  - (4) Pertinent elevations and slopes.

**Section 110.420.35 Design/Improvement Requirements.** Design and improvement requirements for storm drainage systems shall be in accordance with this section.

- (a) Minimum Pipe Diameter. Minimum pipe diameter for any public storm drain shall be twelve (12) inches.
- (b) Drainage Channel Lining. Lining for drainage channels shall conform to the requirements of this subsection.
  - (1) For design velocity less than six (6) feet per second (FPS), the following standards shall apply:
    - (i) Channel lining shall be a non-eroding, long-life, low maintenance material as approved by the County Engineer; and

- (ii) Side slopes shall be a maximum of three horizontal to one vertical proportion (3:1) unless otherwise approved by the County Engineer.
- (2) For design velocity between six (6) and ten (10) FPS, the following standards shall apply:
  - (i) Channel lining shall consist of loose rock rip rap sized for design velocity; and
  - (ii) Side slopes shall be a maximum of two horizontal to one vertical proportion (2:1).
- (3) For a design velocity greater than ten (10) FPS, channel lining of concrete or an engineered equivalent shall be required.
- (4) Access roads shall be constructed when required by the County Engineer.
- (c) Corrugated Metal and Plastic Piping. Corrugated metal pipe or thermoplastic pipe for public improvements may be used only at specific locations approved by the County Engineer. Corrugated metal pipe shall not be acceptable for County-owned storm drain systems. Thermoplastic pipe with a minimum pipe stiffness of 46 psi may be allowed for County-owned storm drain systems when the proper installation and testing procedures have been adopted in the Standard Specifications for Public Works Construction (Orange Book).
- (d) Storm Water Piping. Storm drains to a major drainage facility shall extend, at a minimum, to the 100-year flood line and be rip rapped from the outlet to the bottom of the channel in the direction of the flow. Channel modifications for erosion control shall be designed so that the receiving channel or entering channel will contain the flows without erosion.
- (e) Overland Flow. Overland flow shall be provided for and channeled to County standards within dedicated easements or public rights-of-way to protect structures from flood during storms that exceed the 5-year storm, up to and including the 100-year return frequency storm.
- (f) Public Drainage Facilities. Constructed public drainage facilities with design flows of sixty (60) cubic feet per second or less shall be piped in accordance with County standards. Constructed drainage facilities with flows exceeding sixty (60) cubic feet per second may be open channel construction in accordance with County standards, when approved by the County Engineer.
- (g) Piping in County Right-of-Way. The storm drain piping contained within County right-of-way shall be a minimum of Reinforced Concrete Pipe (RCP) Class III or the appropriate class when design requires a higher pipe support strength. Thermoplastic pipe with a minimum pipe stiffness of 46 psi or the appropriate class or stiffness when design requires a higher pipe support strength may be allowed when the proper installation and testing procedures have been adopted in the Standard Specifications for Public Works Construction (Orange Book).
- (h) Headwalls. Standard headwalls shall be placed on the inlet and outlet of all public pipe culverts. Pipes up to and including seventy-two (72) inches in

diameter shall comply in all cases with County design, size and material standards. Headwalls for pipes exceeding seventy-two (72) inches require special design approved by the County Engineer.

- (i) Trash Racks. Trash racks shall be provided at the upper end of all closed public conduits as approved by the County Engineer.
- (j) Interceptor Swales. Paved interceptor swales, as per Washoe County *Standard Details for Public Works Construction*, shall be provided along the top of retaining walls and cut slopes to intercept drainage. When required by the County Engineer, paved swales shall be provided to intercept drainage from adjacent property.
- (k) Manholes. Manholes for public improvements shall be located at junction points, at changes in horizontal or vertical alignment exceeding the minimum allowable pipe deflection, at changes in conduit size, and at the end of public lines, unless otherwise approved by the County Engineer.
  - (1) When permitted by the County Engineer, pipe placed on curves (horizontal and vertical) shall meet manufacturer's recommendations for curved alignment.
  - (2) All curves, radii, length of pipe joints, and types of pipe shall be shown on the plans.
  - (3) Manholes shall be spaced at intervals not greater than three hundred (300) feet unless otherwise approved by the County Engineer.
- (l) Catch Basins. Catch basins are to be designed and located in accordance with the following criteria:
  - (1) Catch basins shall be installed at low points of vertical curves, at all major street intersections where appropriate, and at sufficient intervals to intake the peak flow for the 5-year return storm runoff, such that flows will not interfere with traffic or flood adjoining property;
  - (2) In no instance shall the flow from a 5-year return storm extend more than fifty (50) percent onto the travel lane adjacent to the curb;
  - (3) Laterals from catch basins are to tie into manholes in the direction of the flow (catch basins shall not tie into each other unless otherwise approved by the County Engineer);
  - (4) Flow along gutters and into inlets shall be computed by the Rational Method or other recognized industry standards using coefficients based on planned land use and ultimate future development;
  - (5) Sur-traps, or an appropriate equal, shall be installed within all catch basins to provide pre-treatment for petrochemicals and silt;
  - (6) Sheet flow across intersections is not permitted; and
  - (7) "Bubble up" type outlet basins are not permitted.

- (m) Structures Under County Roadways. Drainage structures located under County roadways shall be designed to pass the 100-year storm flow resulting from a fully developed condition within the watershed.
- (n) Valley Gutters. Reinforced concrete valley gutters for public improvements may be placed at street intersections only when approved by the County Engineer, and shall not be placed transverse to collector and arterial streets.
- (o) Floodplains. Embankment shall not be placed within the 100-year flood plain of a major drainage facility without prior approval by the County Engineer. Where such approval is given, the embankment shall be faced with rip rap or an approved lining designed for velocity to a minimum of one (1) foot above the 100-year flood line. Development within areas shown on the Flood Insurance Rate Map (FIRM) shall comply with Article 416, Flood Hazards.
- (p) Sump Conditions. Sump conditions within streets shall require paved overland concrete swales in drainage easements and a storm drain system for conveyance of storm water.
- (q) Lot Drainage Swales. Lot drainage swales on private property shall be provided in accordance with the provisions of this subsection.
  - (1) Surface drainage swales shall be maintained and perpetuated by the property owners. Lining shall be required for rear or common side lot drainage swales if the 5-year flow will cause erosion or if the flow depth is greater than one-half (0.5) foot. Lining is not required for common side lot swales serving only two (2) adjacent lots. A geotechnical investigation shall be conducted to evaluate soil erosion potential for use in the design of drainage swales.
  - (2) Standard lot line drainage swales shall be designed to carry the waters generated by a 100-year frequency storm.
    - (i) Discharge from swales shall be conveyed to an acceptable drainage facility;
    - (ii) When inlets and piping are used, inlets shall be approved by the County Engineer, and the pipes shall have a minimum diameter of twelve (12) inches;
    - (iii) Provisions shall be made for overland flow in the event that catch basins plug; and
- (r) Design Computations. Storm drainage systems, for both public and private improvements, shall be designed in accordance with this section.
  - (1) Mannings Formula. Mannings Formula shall be used in computing capacities of all open channels and closed conduits with the following minimum values for roughness coefficient "n":

Channel/Conduit	"n"
PVS or ABS	0.010
Concrete Pipe	0.014

Corrugated Metal Pipe (100% paved)	0.015
Corrugated Metal Pipe (paved invert)	0.019
Corrugated Metal (plain)	0.024
Open channels with gunite lining	0.019
Open channels with paved bottom	0.025
Earth channels (no rock or gravel)	0.030
Rock or gravel - per approved Engineers Manual based on size and placement of materials.	

(2) Rational Method. The Rational Method may be used in computations for the rate of runoff for urban and small watersheds (500 acres or less). The SCS (Soil Conservation Service) method, SCS TR-55 "Urban Hydrology for Small Watersheds," or other acceptable method may be used for larger watersheds.

(i) The design flow for the Rational Method is expressed as  $Q = CiA$ , where:

Q = peak rate of runoff, cubic feet per second;

C = runoff coefficient;

i = average rainfall intensity, inches per hour; and

A = watershed area, acres.

(ii) The following listed runoff coefficients shall be used in performing computations with the Rational Method. A "build up" C value may be required in special conditions such as very small lots with large houses or duplexes.

Land Use Type	Runoff Coefficient "C"
LDR, MDR, HDR, GR	0.25 - 0.35
LDS, MDS, HDS	0.45 - 0.60
LDU, MDU, HDU	0.60 - 0.70
Community Commercial	0.85
Tourist Commercial	0.85
Office Commercial	0.85
Industrial	0.85 - 0.90
Public Services and Facilities	0.50 - 0.85
Pavement and Concrete Surfaces	0.90 - 0.95
Parks and Recreation	0.25
Open Space (0-5% grade-vegetated)	0.20 - 0.30
Open Space (0-5% grade-no vegetation)	0.30 - 0.40
Open Space (5-15% grade-vegetated or unvegetated)	0.40 - 0.50
Open Space (Over 15% grade-sparsely vegetated, rock or clayey soils)	0.40 - 0.60

- (iii) The rainfall intensity curve shall be used for determining the average intensity. The time of concentration, with a minimum build up time of ten (10) minutes is expressed as:

$$tc_1 = 10 \text{ or } \frac{L}{V \times 60} \text{ (whichever is greater)}$$

where:

$tc_1$  = time of concentration at initial inlet (in minutes)

L = length from uppermost point of watershed inlet (in feet)

V = channel or overland velocity (in feet per second)

- (iv) Given the time of concentration at a design point, the time of concentration at the next design point is determined by adding travel time, expressed as:

$$t = \frac{L}{V \times 60}$$

where:

t = travel time (in minutes)

L = length of channel or conduit between design points (in feet)

V = channel or conduit velocity (in feet per second)

- (3) HEC-1 Method. HEC-1 with the SCS subroutine may be used in computations for urban and small watersheds (500 acres or less). HEC-1 method may be used to calculate the rate of runoff for large watersheds.
- (4) Minimum Design Velocity. Minimum design velocity shall be three (3) feet per second for closed conduits.

**Section 110.420.40 Easements.** Easements shall be provided in accordance with the provisions set forth in this section.

- (a) Vehicular Access. Easements with improved vehicular access in accordance with County standards shall be provided to publicly-owned storm drain manholes, storm drain inlets and outlets, ditches and associated structures not located within an improved street section. Improved vehicular access may be waived by the County Engineer due to rough terrain. (Refer to Article 436, Street Design Standards.)
- (b) 100-Year Floodplain. Easements for access to, and maintenance of, the 100-year storm floodplain associated with a major drainage facility or natural water course shall be provided. Improved vehicular access in accordance with County standards shall be provided when determined necessary by the County Engineer.

- (c) Public Improvements. Storm drain easements for public improvements shall be a minimum width of fifteen (15) feet. The final easement width shall be determined by pipe width, required trench clearance, and excavated trench side slopes not less than one horizontal to one vertical proportion (1:1), and as approved by the County Engineer.
- (d) Private Property. Storm drainage easement(s) will be required for storm waters generated within the boundaries of a development that discharge onto or across private property. If the storm drain waters generated within the boundaries of a development discharges from a public drain system onto and across private property, a permanent easement for access and maintenance shall be granted to the County from the property boundary to the point of discharge into an existing public storm drain system, major drainage facility, or natural water course. Improvements to County standards shall be required if the County is to maintain the easement. The County Engineer shall determine if the easement is to be accepted for maintenance.

**Section 110.420.45 Water Supply Ditches.** Water supply ditches shall be designed in accordance with the conditions set forth in this section.

- (a) Public Storm Drainage Runoff. No public storm drainage runoff shall be allowed to flow or discharge into any water supply ditch without approval of the ditch company or utility company.
- (b) Private Storm Drainage Runoff. No private storm drainage runoff shall be allowed to flow or discharge into any water supply ditch without the approval of the ditch company or utility company.
- (c) Discharge into Water Supply Ditch. Discharge of storm drain waters into a water supply ditch shall not contribute to increasing the peak flow or total volume of water in the ditch for a twenty-four (24) hour period, based on a 10-year frequency storm.
- (d) Improvements and Access. Where water supply ditches are located within or adjacent to a proposed development, access and maintenance of the ditch shall not be hindered.
- (e) Improvements within Easements. Any improvements within the ditch company's easements are subject to the ditch company's approval.
- (f) Ditch or Watercourse Hazard. Fencing is required in accordance with Development Code Section 110.610.30(f).