SECTION V - DESIGN CRITERIA AND POLICIES

PART 1 - TREES

1.01 General

Trees shall be planted in new developments as required by the Subdivision Regulations and as outlined in the Tree Ordinance.

Trees shall be installed as the last construction step, or a performance guarantee submitted for their installation.

1.02 Existing Trees

Existing trees may be preserved as street trees, provided the trees:

1. are shown on the preliminary plat
2. are flagged in the field and protected during construction
3. are of a species identified by these specifications
4. do not impose a drainage problem
5. are within 5 feet of the right-of-way line (either side)
6. are not likely to be damaged by construction
7. are not likely to interfere with installation of proposed utilities

1.03 Planting Season

Trees should be planted from November 1 through March 15.

1.04 Planting

Trees and other plantings shall be located in the planting strip outside the street right-of-way. All plantings and improvements along the street or in parking lots shall conform to the City landscape ordinance.

Planting shall be in accordance with North Carolina Department of Transportation's "Guidelines for Planting within Highway Right-of-Way" and American Standard for Nursery Stock ANSI Z60.1. Professional nursery guidelines shall be obtained for individual species requirements.

Trees shall conform to the American Standard for nursery stock for proper relations of height, caliper and root ball diameter. Trees shall, at a minimum, conform to the following:

Mature Tree Size	Average Mature height-ft	Minimum Planting height-ft
Large	45'-up	8'-10'
Medium	35'-45'	6'- 8'
Small	10'-30'	4'- 6'

1.05 Planting Around Obstacles

Plantings around obstacles must be approved by the City. Generally, the following spacings are recommended:

Obstacle	Minimum Clearance feet
water meter	5
fire hydrant	15
utility poles	20
manholes/sewer lines	15

Trees directly under overhead power lines shall be small trees with a mature height of less than 25'.

Trees planted within 15’ of underground utilities shall not be of the invasive type, as identified in the recommended tree list.

Trees shall not be planted in the sight triangles of intersections or the sight triangles of driveways.

1.06 Root Barriers

In an effort to protect both trees and underground utilities, the City encourages the use of root barriers where conflicts are apparent. Many underground utilities have a life-expectancy of approximately 30 years. Mature trees can be severely damaged or even killed if vital roots are cut when replacement lines are installed. The purpose of root barriers is to prevent vital roots from growing towards utility lines.

Trees planted in the street right-of-way, and trees planted near the right-of-way to satisfy zoning requirements, shall be protected by an approved root barrier. At this time, the City is investigating the sufficiency of several types of root barrier.

1.07 Tree Protection Barriers

Tree protection barriers shall be erected around all existing trees to be preserved to meet the City's requirements for street trees or other trees required by City tree ordinance.

1.08 Tree Selection

Large deciduous trees are preferred in most cases.

The following trees are recommended for use. The developer should consider factors of tree shape, maintenance requirements, growth habits, and aesthetics, when selecting street trees.

Small Trees - Less Than 35' At Maturation

COMMON NAME	SCIENTIFIC NAME
Common Witchhazel	Hamamelis viginiana
Spring Witchhazel	Hamamelis vernalis
White Fringe tree	Chionanthens virginicus
Fragrant Wintersweet	Chimonanthus praecox
Loblolly Bay	Gordonia lasinthus
*Gray Birch	Betula populifolia
*Paperbark Maple	Acer griseum
Shadblow Serviceberry	Amelanchier canadensis
Red Chokeberry	Aronia arbutifolio
Ironwood	Carpinus caroliniana
Kousa Dogwood	Cornus Kousa
Fragrant Winterhazel	Corylopsis glabrescens
White Dogwood	Cornus florida
Common Smoketree	Cotinus coggygria
Redvein Enkianthus	Enkianthus camporulatus
Franklinia	Franklinia alatamaha
Rose of Sharon	Hisbiscus syriacus
Florida Anise Tree	Illicium floridanum
Wax Myrtle	Myrica cerifera
Sourwood	Oxydendron arboreum
Mountain Stewartia	Stewartia ovata
American Hophornbeam	Ostrya virginiana
Common Crapemyrtle	Lagerstroemia indica
Chaste tree	Vitex agnus-castus
Eastern Redbud	Cercis canadensis

Large Trees - More Than 35' At Maturation

COMMON NAME SCIENTIFIC NAME	
Sugar Maple	Acer saccharum
*Silver Maple	Acer saccharinum
*Red Maple	Acer rubrum
Ohio Buckeye	Aesculus glabra
Common Persimmon	Diuspyros virginiana
American Beech	Fagus grandiflora
European Beech	Fagus sylvatica
Kentucky Coffeetree	Gmynocladus deoicus
*Sweet Gum	Liquidambar styraciflua
*Yellow Poplar	Liriodendron tulipifera
Saw tooth Oak	Quercus accatissima
Southern Red Oak	Quercus falcata
Willow Oak	Quercus phellos
Ginkgo	Ginkgo biloba
American Linden	Tilia americana
Little leaf Linden	Tilia cordata
*American Plane tree	Platanus occidentalis
Thornless Honey locust	Gledetsia triacanthos inermis
Japanese Zelkova	Zelkova serrata
Katsura tree	Cercidiphyllum japonicum
American Holly	Ilex americana
*Bald Cypress	Taxodium distichum

*Invasive trees not to be planted within 15’ of underground utilities.

1.09 Guarantee

Trees shall be guaranteed for one year from the issuance of the certificate of occupancy. Trees which die or are destroyed shall be replaced as soon as possible within a planting season.

SECTION V - DESIGN CRITERIA AND POLICIES

PART 2 - WATER

2.01 Water System Design Criteria

1. Minimum main line pipe size shall be 6-inches; except that 2" public water mains are allowed under the following conditions:

   (a) Dead-end lines with no possibility for further public extensions or "loop" of water system.

   (b) No public fire hydrant required/requested by authorized fire official or City.

   (c) No more than 10 service connections on the 2" portion of the main.

2. Minimum pressure in system shall be 20 psi at peak demand (fire flow) and 30 psi during normal conditions. Fire flow shall be determined in accordance with ISO (Insurance Services Office) schedule, available from the Fire Marshal.

3. Minimize dead ends (loop lines when possible and/or feasible), and where they must occur provide a fire hydrant per the standard details. The fitting(s) required at a dead end line shall be in accordance with standard detail W-6.

4. Minimum cover shall be 3 feet.

5. Install valves as follows: three at a cross; two at a tee; one on a single hydrant branch; each side of a road bore, stream crossings, railroad bore, and at the end of each phase of construction. The location of the valves shall be subject to approval by Utilities Management.

6. Install valves on loops so a maximum of 600 feet can be taken from service without affecting other areas. Install valves on both sides of the street when a water line crosses a major or minor thoroughfare.

7. Separate water lines 10-feet horizontal distance from sewer lines (existing or proposed), unless local conditions or barriers prevent a 10-foot lateral separation in which case: (1) The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or (2) The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer. Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation in which case both the water main and sewer shall be constructed of mechanical joint ductile iron pipe for a minimum distance of 10 feet on each side of the point of crossing. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of mechanical joint ductile iron pipe for a minimum distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing. When it is not possible to maintain the separations listed above or the sewer line is

located above the water line, both lines must be hydrostatic tested (150 psi for sewer & minimum 200 psi for water).

8. Maximum spacing between fire hydrants shall be 800 feet, (400 foot radius). In closely built areas, hydrant spacing shall not exceed 500 feet unless otherwise directed by the authorized fire official within the municipal jurisdiction and approved by Utilities Management. See Section III, Item 2.02.

9. City of Salisbury approved backflow prevention devices shall be supplied for every service connection.

10. Vaults shall have aluminum hatch doors with lift assist and shall be capable of withstanding expected traffic loads.

11. All bypasses shall have check valves installed.

12. Reduced pressure principle backflow prevention devices are to be installed on all lines to installations involving wet manufacturing processes, sprinkler systems or any other hazardous location as determined by Utilities Management or City's Backflow Administrator.

13. Water line drawings, hydraulic analysis, engineer's report, and specifications shall bear the seal of a registered professional engineer licensed to practice in North Carolina and the installation of the system shall be inspected and certified by the engineer in accordance with N.C.A.C. T15A:18C.0303

14. Water lines shall have a 30' permanent easement (15' each side of center line) in the City's name or installed in a public right-of-way. A 50' temporary construction (25' each side of center line, unless directed otherwise) easement shall be provided.

15. Water services shall be installed to all newly created parcels (lots) associated with the project or development. Minimum water service size (tap and service line) shall be 1-inch (see standard detail W-12).

16. A minimum of 18" clearance shall be maintained between all water lines and other utilities or structures (catch basins, storm drain pipe/structures, etc.), unless otherwise approved by SRU management.

2.02 Water Plans Checklist

Water line plans should, at the minimum, show the following information:

1. Location and dimension of all existing and proposed public and private utilities, easements, rights-of-way, streets, street rights-of-way, railroad rights-of-way, access easements, and sanitary sewer rights-of-way, etc.

2. Sanitary sewer and storm drain systems dotted in, showing size and material.

3. Invert of storm drains at crossings or where storm drains closely paralleled by water lines.

4. Invert of sanitary sewers at crossings and at upstream and downstream manholes.

5. Size, lengths (or stationing), and type material of water line.

6. All tees, gate valves, fire hydrants and blow offs properly labeled.

7. Legend of symbols.

8. North arrow.

9. Street names.

10. Location(s) of nearest existing valves and public fire hydrants. Show location and size of proposed service lines, meters, and backflow devices. When in close proximity (15') to proposed public utilities or in proposed easements; show proposed & existing landscaping, signs, structures, lighting, fencing, streams, ditches, underground & overhead utilities, pavement, dumpsters & associated screening, sidewalks, retaining walls, etc.

11. Existing pavement, and if applicable, width and length of cut.

12. Include "General Notes" and all applicable City of Salisbury notes and testing requirements on all plans.

13. Registered Engineer's seal and signature.

14. Vicinity map, showing location of lines and a visual plan page index.

15. Date and purpose of issue.

16. All applicable City standard detail drawings shall be shown on the plans (including backflow prevention devices). City standard detail drawings (or text) shall not be altered or changed.

17. All plans shall show a construction sequence.

2.03 Water Lines - General Notes

These notes to appear on all water line plans:

1. Concrete blocking (3000 psi) to be placed at all bends or as required unless Mega Lugs or restrained joints are used.

2. Standard depth of cover to be 3 feet except at valve or hydrant locations or other special situations. Cover is based on elevation below edge or pavement or as indicated on the plans.

3. Provide poured in place concrete pads (18" x 18" x 6") (or concrete "donuts" may be used as an alternative at the discretion of the Utilities Inspector) at all valve boxes.

4. Extensions for valve boxes, when required, are to be valve boxes or DIP (no PVC or C-900).

5. All pavement cuts, concrete or asphalt, are to be replaced according to the standard details or as required by the North Carolina Department of Transportation.

6. Pavement cuts are to be replaced immediately after backfilling of initial cut either with permanent replacement or a temporary replacement of 10" of base if approved by the City (for City maintained streets) or DOT (for state maintained streets).

7. Repairs to main breaks:

   (a) Solid sleeves to be used for connecting spigot ends shall be of the long body type.

   (b) All repairs shall be inspected by City before backfilling.

8. In any instance where it will be necessary to have the water shut off on existing mains in order to make a tie-in, the work must be done by City forces or a contractor working for the City, scheduled 48 hours to 7 days in advance depending on the location and types of businesses that will be affected.

9. When a water main crosses an existing sewer main, the contractor is to replace the sewer pipe spanning the ditch with ductile pipe when the following conditions occur:

   (a) Anytime a water main is installed under a sewer main.

   (b) When a water main is over a sewer main and the vertical distance between the two mains is 18" or less (minimum 12” clearance between water and sewer lines).

10. Water mains shall be installed with a minimum of 10' horizontal separation from sewer lines. Where this is not possible, both the water line and sewer line shall be ductile iron pipe.

11. Water lines shall be disinfected and hydrostatically tested in accordance with all State and City of Salisbury requirements.

12. All plans shall meet all Federal, State, City of Salisbury, and Salisbury-Rowan Utilities regulations, design criteria, and construction standards.

SECTION V - DESIGN CRITERIA AND POLICIES

PART 3 - SANITARY SEWER

3.01 Sanitary Sewer Design Criteria

1. Design capacities shall be designed for the ultimate tributary population including consideration given to the maximum anticipated capacity of institutions, industrial parks, etc. The capacity of downstream sewers to accept future flow shall be evaluated by the engineer. Where future relief sewers are planned, analysis of alternatives should accompany initial permit applications. Wastewater flow rates shall be determined in accordance with 15A NCAC 2T.0114 (or latest revision/update). Design engineer shall contact Salisbury-Rowan Utilities Engineering Department prior to or during initial design

stage to verify downstream pipe, pump station, and treatment plant capacity. A flow acceptance letter will be generated by Salisbury-Rowan Utilities once downstream pipe, pump station, and treatment plant capacities are verified.

2. Sanitary sewer plans and specifications shall be sealed by a Professional Engineer, licensed to practice in North Carolina.

3. Minimum manhole depth shall be 4 feet.

4. Minimum pipe size shall be 8" for mains and 4" for laterals less than 60' in length (unless larger size required for water meter size) 6" for laterals 60' or longer.

5. Sewer laterals in developments with street trees shall be DIP except when the sewer main and laterals are located at the rear of the property.

6. Minimum slope shall be 0.5% for 8" pipe. Maximum slope shall be that which limits the velocity to 10 fps.

7. Sewers on 20% slopes or greater shall be anchored securely with concrete, or equal.

8. Minimum velocity shall be 2 fps, for pipe flowing half full. If the minimum velocities cannot be maintained during initial operation, prior to design capacities being reached, the ability to periodically flush the lines is required. The schedule for flushing the lines shall be reviewed and approved by SRU management.

9. Minimum cover shall be 3.0 feet, unless ductile iron pipe is used.

10. Maximum cover shall be 15 feet, unless ductile iron pipe is used.

11. Changes in sewer pipe size:
    a. When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered to maintain the same energy gradient.
    b. Sewer extensions shall be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension at a manhole, with special consideration of an appropriate slow channel to minimize turbulence when there is a change in sewer size. Justification shall be provided with the certification of completion and as constructed plans indicating that the capacity of the downstream sewer will not be overloaded by the proposed upstream installation. NCDENR may require a schedule for construction of future downstream sewer relief.

12. Manholes shall extend 2 feet above the 100-year flood elevation or be sealed cover and vented 2 feet above the 100-year flood elevation. If the 100-year flood elevation cannot be readily established, Utilities Management shall establish the elevations to which the manhole rims or stack shall be extended.

13. Horizontal and vertical alignment between manholes shall be straight. Uniform slopes shall be maintained between manholes.

14. Provide a minimum 0.2' drop through a manhole.

15. Manhole flow channels:

    a. The flow channel straight through a manhole shall be made to conform as closely as possible in shape and slope, to that of the connecting sewers. The channel walls shall be formed to three quarters (3/4) of the height of the crown of the outlet sewer in a manner to not obstruct maintenance, inspection, or flow in the sewers.
    b. When curved flow channels are specified in manholes, including branch inlets, minimum slopes should be increased to maintain acceptable velocities.

16. Manhole buoyancy: Buoyancy shall be considered and flotation of the manholes shall be prevented with appropriate construction where high groundwater conditions are anticipated.

17. Maximum distance between manholes shall be 500 feet (public sewer) and 425' for private sewer.

18. Use drop manhole where difference between incoming and outgoing pipe inverts is 1.95 feet or greater.

19. The invert elevation of any lateral sewer, service connection, or drop manhole pipe shall be above the bench surface elevation. No Invert shall be located directly on the surface of the bench.

20. Provide wye with lateral to the property line per Detail SS-5.

21. Separate water lines 10-feet horizontal distance from sewer lines (existing or proposed), unless local conditions or barriers prevent a 10-foot lateral separation in which case: (1) The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or (2) The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer. Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation in which case both the water main and sewer shall be constructed of mechanical joint ductile iron pipe for a minimum distance of 10 feet on each side of the point of crossing. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of mechanical joint ductile iron pipe for a minimum distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing. When it is not possible to maintain the separations listed above or the sewer line is located above the water line, both lines must be hydrostatic tested (150 psi for sewer & minimum 200 psi for water).

22. Sewers in relation to streams and other water bodies:

    a. Sewers located along streams, lakes, or impoundments, shall be located at least 10 feet outside of the stream bank (unless subject to item b. below) or sufficiently removed therefrom to provide for future possible stream widening and to prevent siltation of the stream during construction.
    b. A distance of 50 feet shall be maintained between sewers and water for water classified

WS (except WS-I or WS-V), B, SA, ORW, HQW, or SB from normal high water and wetlands. (minimum separations shall be as referenced in 15A NCAC 2T Regulations)

c. The sewer outfalls, headwalls, manholes, gate boxes, or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.
d. In areas where the sewer trench has the potential to drain wetlands, anti-seepage collars shall be installed. In the areas, a 401/404 permit may be required.

23. Aerial crossing for sewer must be approved in advance by SRU management. Aerial crossings shall only be considered when no other feasible non-aerial options are available.
    a. Pipe joints shall be flanged or restrained, with adequate supports to prevent excessive flexion, or a combination of both shall be provided for all aerial pipe crossings. Supports shall be designed by a professional engineer and be designed to prevent frost heave, overturning, and settlement.
    b. Precautions against freezing, such as insulation and increased slope, shall be considered. Expansion jointing shall be provided between the above ground and below ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize heaving.
    c. For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 25 year flood. Ductile iron pipe with mechanical joints shall be required. In the event that the 25 year flood elevation cannot be determined or the proposed gravity sewer line must be placed below the 25 year flood elevation, a letter shall be provided by the applicant upon certification stating: “Regular and proper inspection and maintenance of the aerial crossing shall be provided to insure that the creek/stream flow is not impeded and that no damage will be caused to upstream or adjacent properties”

24. Relation of sewer to water supply sources:
    a. A distance of 100 feet shall be maintained between any private or public water supply source, including any WS-1 waters or Class I or Class II impounded reservoirs used as a source of drinking water. If this minimum separation cannot be maintained, ferrous sewer pipe with joints equivalent to public water supply design standards and pressure tested to 150 psi (2 hour pressure test) to assure water tightness, shall be used. The minimum separation shall however not be less than 25 feet from a private well or 50 feet from a public water supply well.
    b. All existing waterworks units, such as basins, wells, or other treatment units, within 200 feet of the proposed sewer shall be shown on the engineering plans.

25. Sewer lines shall have a 30' permanent easement (15' each side of center line) in the City's name. A 50' construction easement (25' each side of center line, unless directed otherwise) shall be provided.

26. When ductile iron pipe is required on a section or portion of sewer line, DIP shall be used for the entire run between manholes (no material transitions on new construction).

27. Private 8” and larger sewer lines and all laterals must meet the requirements of the City of Salisbury’s Uniform Construction Standards for materials, bedding, minimum slope, and testing.

28. All plans shall meet all Federal, State, City of Salisbury, and Salisbury-Rowan Utilities regulations, design criteria, and construction standards.

29. A minimum of 18” clearance shall be maintained between all sewer lines and other utilities or structures, unless otherwise approved by SRU management. A 24” minimum vertical separation shall be maintained between storm sewer and sanitary sewer lines or ferrous pipe shall be specified.

30. All manholes, regardless of sewer line size (public or private) shall meet City of Salisbury Uniform Construction Standards and Specifications.

31. Sewer line conflict structures / interference boxes are prohibited.

3.02 Sanitary Sewer Plans Checklist

Sanitary sewer plans shall contain the following minimum information:

1. Plan and profile on 24" x 36" page.

2. Vertical USGS elevation scale on left of profile and station numbers along bottom of profile.

3. North arrow, all sheets.

4. Plan and profile both run left to right.

5. Centerline intersections of line crossings with sewer noted on profile.

6. Street names above or below corresponding profile, when more than one street is on a page.

7. Identify location of drop manholes in both plan and profile.

8. Invert elevations of all proposed and all existing pipes and pipe sizes entering and leaving all manholes to 0.01' on profile.

9. Rim elevation and vent elevation to 0.1' on profile; existing and proposed grades.

10. Pipe grade to 0.01% and size and type of pipe between manholes.

11. Size and type of existing pipe and direction of flow between each manhole on plan.

12. Station numbers and designation of "Existing" or "New" on each manhole on plan and profile and diameter of manhole (4’ or 5’).

13. Indication of "identical" manholes where profile is broken.

14. Location and size of all existing and proposed street and sewer rights-of-way and public fire hydrants. Show location and size of proposed service lines, meters, and backflow prevention devices. When in close proximity (15’) to proposed public utilities or in proposed easements; show proposed & existing landscaping, signs, structures, lighting, fencing, streams, ditches, underground & overhead utilities, pavement, dumpsters &

associated screening, sidewalks, retaining walls, etc.

15. Existing pavement on plan, indicate width, and any portion to be cut.

16. Where a line is to be bored indicate location and length of casing and type of pipe on plan and profile.

17. All existing and proposed underground utilities in the area shall be dotted in.

18. Where ductile iron is to be used, indicate limits on plan and profile. Show shaded on profile.

19. Use ductile iron where storm drain and sewer have less than 2 feet vertical clearance.

20. On aerial crossings, use concrete piers at l8' intervals, indicate on plans and profile, include details of design for the piers and anchorage.

21. Total distance between existing manholes or proposed manholes on the plan and the bearing if the line is not within the street right-of-way.

22. All lot lines.

23. All street names on plan.

24. Flood plain elevation in all flood plain areas.

25. Creek flow line.

26. All Railroad crossings must be accompanied by a separate encroachment map showing plan and profile and all other information required by the railroad in accordance with their standards.

27. Registered Engineer's seal and signature.

28. Vicinity map showing the location of lines and a visual index of plan sheets.

29. Date and purpose of issue.

30. Type of bedding to be used shall be shown or noted.

31. All plans shall show a construction sequence.

SECTION V - DESIGN CRITERIA AND POLICIES

PART 4 - DRAINAGE

4.01 Storm Drainage Design Criteria

1. All storm drainage shall be designed by qualified engineers or landscape architects

registered to practice in North Carolina. Qualified land surveyors may design storm drainage incidental to subdivisions in accordance with rules and guidelines of the North Carolina Board of Registration.

2. The following definitions and design shall be used:

   Storm Sewer Collector - Storm sewers which run parallel to the road which have as a primary purpose, carrying runoff from adjacent lots and roads to the low point in the system. These sewers shall be designed to carry a 10-year storm, flowing full.

   Culvert - A short run of pipe under a road or driveway which has as a primary purpose to pass water from an open channel to an open channel. These pipes shall be designed for a 10-year storm under driveways and a 25-year storm under roads.

   The classification of pipes into one of the above categories and its subsequent design storm is subject to the discretion of the City Engineer.

3. For drainage areas less than 200 acres, stormwater quantities will be determined by the Rational Method, Q=ciA, where:

   Q = discharge, cubic feet per second
   c = runoff coefficient, unitless, see figures 1 and 2
   i = intensity of rainfall, inches per hour, see figures 3 and 4
   A = drainage area, acres

   For drainage areas greater than 200 acres, the method for determining stormwater quantities must be approved by the City Engineer.

4. The runoff coefficient "C", for site drainage may be based upon the weighted average of the proposed ground cover (fig. 1) or land use - zoning (fig. 2). The runoff coefficient "C", for off site drainage shall be based upon land use - zoning (fig. 2).

5. Pipe systems and open channels shall generally be designed using the Manning formula. If backwater conditions occur, the design method must be approved by the City Engineer.

6. Culverts shall be appropriately sized for each condition of inlet control and outlet control. Headwater depth shall be based upon the flood elevation controlling. In no case shall headwater depth increase ponding elevation on adjacent properties. Headwater to depth ratio shall not exceed 1.2 unless approved by the City Engineer. Inlet control charts are provided in figures 7 through 10.

7. Minimum pipe diameter is 15" within any right-of-way or drainage easement.

8. Minimum velocity is 2.5 feet per second, for pipe flowing just full. Maximum velocity for CMP is 10 feet per second. Maximum velocity for RCP is 20 feet per second.

9. Headwalls or flared end sections will be used at the influent and effluent of all pipe systems. Flared end sections are preferred in locations near existing highways. Maximum velocity at effluent discharge shall be no greater than 9 feet per second, flowing full (calculated with Manning's Equation). Outlet protection shall be provided per figures 5 and

6 and Standard Detail SD-12.

10. Catch basins in roadways shall be spaced to collect runoff from a rainfall intensity of 4 inches-per-hour with no more than 8 feet of spread from the face of vertical curb or the back of valley gutter. To meet this criteria, the maximum area draining to a catch basin shall be calculated as:

$$\text{Maximum Drainage Area} \quad \leq \frac{4\sqrt{S_L}}{C}$$

Where area is in acres, C is the runoff coefficient, and S_L is the longitudinal tangent slope of the road (for a 1% slope, $S_L = 0.01$).

In single family residential subdivisions, curb inlets which receive flow from less than 150 linear feet of gutter are exempt from the spacing criteria above, provided the gutter flow does not turn the corner at an intersection. If this exemption is utilized in a sump condition, the curb inlet shall be a double basin.

In Residential Subdivisions, street catch basins shall be located such that the gutter capacity will not be exceeded by the runoff from the fully developed drainage area.

In Commercial and Industrial Subdivisions, street catch basins may be located assuming either the developed or the non-developed condition; however, if design is for the non-developed condition, drainage laterals must be stubbed out to private property for each lot which drains toward the street.

Less spread may be required on major and minor thoroughfares at the discretion of the City Engineer.

11. Maximum distance between catch basins is 600 feet.

12. Drop inlets shall be sized to collect the 10-year design flow with no more head on the grate than is suitable for the situation. (Show limits of maximum ponding on the plans). In no case shall headwater depth exceed .4 feet in traffic areas or .8 feet in landscaped areas, unless specifically approved by the City Engineer.

13. Storm drainage structures over 3'-6" deep shall have steps. See sanitary sewer detail SS-7.

14. All turns and changes in pipe size shall be accommodated by an accessible structure (i.e., catch basin or manhole).

15. Minimum cover, except at influent and effluent flared end sections, is 2'-0". Exceptions may be granted at the option of the City Engineer, if adequate treatment is provided.

16. Not more than 1/4 acre may drain into the street at a single concentrated point (i.e., driveway or sidewalk flume).

17. All ditches and swales shall be indicated with grades, cross section(s) and liner material (grass, stone, concrete, etc.) shown.

18. Where possible, pipes shall be located in the street right-of-way. All pipes and ditches which are not in the street right-of-way, but carry off site drainage through the property must have a storm drainage easement to guarantee passage of runoff. The City will not maintain these drainage easements. Maintenance is the responsibility of the respective property owners. Easement widths for pipes shall be based on the pipe size as follows:

Pipe Size	Easement Width
15" - 36"	10'
42" - 60"	20'
greater than 60"	As directed by City Engineer

Easement widths for ditches shall be based on the 10-year runoff as follows:

Runoff (CFS)	Easement Width
Q less than 10	10'
10 less than Q less than 30 (Q=10 to 30)	20'
30 less than Q less than 100 (Q=30 to 100)	40'
Q greater than 100	As directed by City Engineer

19. No structures may be built over drainage easements, drainage pipes, creeks and/or apparent drainage paths, unless an engineering plan has been approved showing the relocated drainage path and a recorded drainage easement.

20. No water shall be allowed to discharge in a concentrated manner across a sidewalk or driveway.

21. Diversion of drainage is prohibited.

22. All sites must provide for positive drainage.

23. All drainage systems must be adequately sized to accept runoff from up-stream properties in their most likely developed condition, as based upon City Zoning.

24. A 24” minimum vertical separation shall be maintained between storm sewer and sanitary sewer lines or ferrous pipe shall be specified.

4.02 Plan and Calculation Checklist

Storm drainage plans and calculations should, at a minimum, show the following:

Plans

1. Area drained.
2. Off-site areas and their zoning.
3. Existing and proposed contours.

4. Important spot elevations.
5. Delineated areas draining to each inlet, swale, etc. and area of maximum ponding on drop inlets and culverts.
6. Drainage patterns on and off-site before and after development.
7. Off-site swales, pipes and structures adjacent to the site.
8. Pipe size, length, slope and material.
9. Show swales and ditches, indicate grade, cross-section(s) and liner material.
10. Invert elevations in and out on all pipes.
11. Catch basin rim elevations.
12. Riprap width, depth, length and size.
13. Must be to an acceptable engineering scale.

Calculations - Calculations should be presented in a neat, accurate and organized manner.

1. Drainage area - individual and cumulative.
2. Runoff coefficients.
3. Storm intensity.
4. Runoff flow.
5. Pipe slope.
6. Manning coefficient of roughness.
7. Pipe diameter (culvert size).
8. Maximum flow capacity.
9. Velocity at design storm or maximum probable velocity.
10. Inlet control, outlet control conditions and maximum headwater depth.

4.03 Figures and Charts

Figure 1

Runoff Coefficient "C"
Based on Ground Cover

lawns (average slopes)	.22
lawns (slopes greater than 7%)	.35
gravel	.50
brick	.60
asphalt and concrete	.95
roofs	.95
natural areas	.30

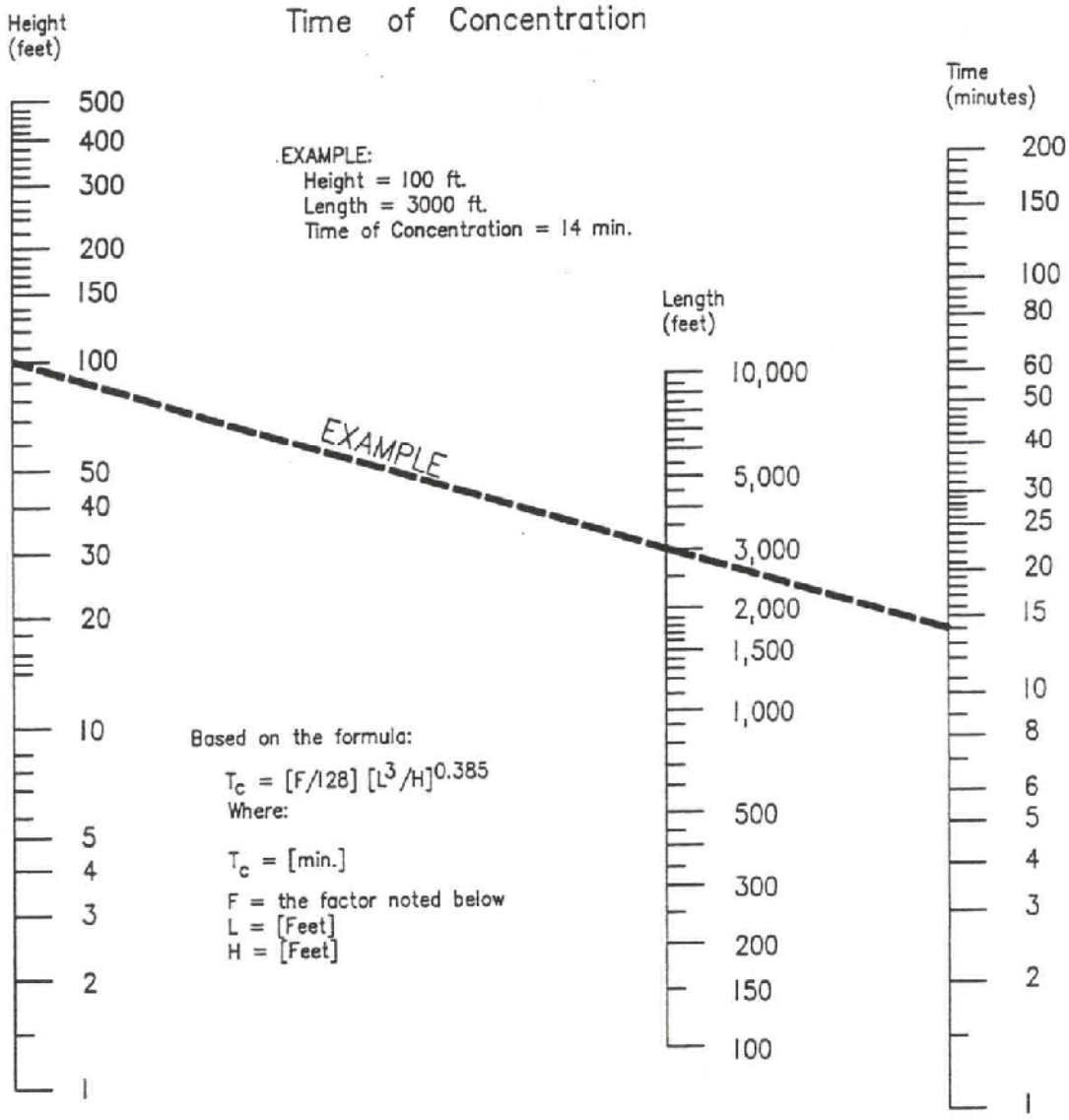
Figure 2

Runoff Coefficient "C"
Based on Land Use (Zoning)

parks and cemeteries (OSP)	.25
playgrounds	.35
agricultural (RR)	.40
colleges (IC)	.60
single and multi-family residential	
(GR3)	.50
(GR6, HR)	.60
(UR8)	.70
(UR12)	.80
landscaped office and business	
(RMX)	.80
moderate business and industrial	
(NMX, LI, HI)	.80
urban business	
(DMX, HB, CMX, HS, TNB)	.90

Note: Time of concentration, tc, shall be appropriate for developed conditions.

Figure 3



Notes:
1. Use nomograph value for natural basins with well defined channels.
2. For overland flow, grassed surfaces, multiply Tc by 2.
3. For property zoned for single family residential use, multiply Tc by 0.75.
4. For property zoned for multi-family, multiply Tc by 0.5.
5. For property zoned for business or industrial use, multiply Tc by 0.4.
6. For overland flow, concrete or asphalt surfaces, multiply Tc by 0.4.

Figure 4

Rainfall Intensity "I"

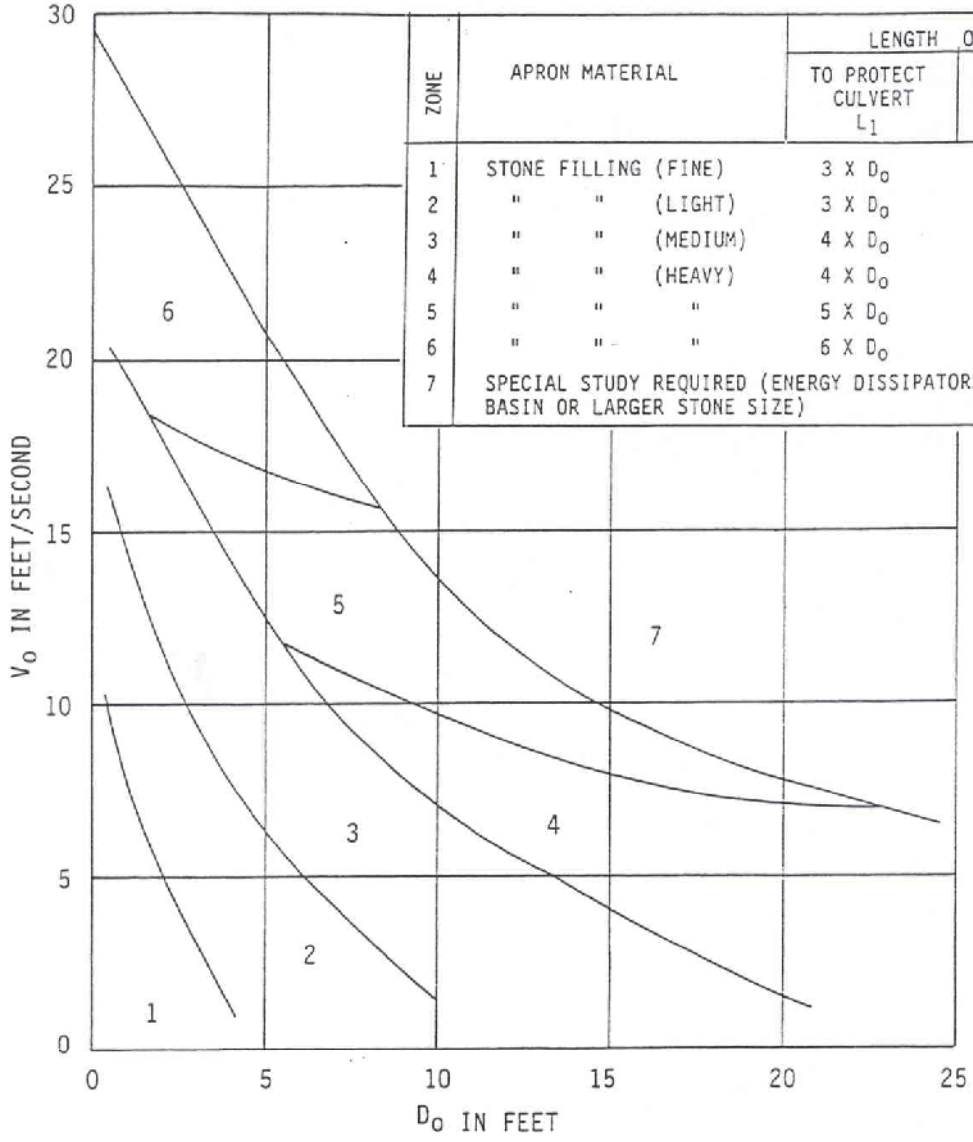
Duration (min)	Intensity (in/hr)			
	10-year	25-year	50-year	100-year
5	6.8	7.6	8.3	9.0
10	5.7	6.5	7.1	7.7
15	4.9	5.6	6.0	6.6
20	4.4	4.9	5.3	5.8
25	4.0	4.5	4.8	5.3
30	3.5	4.0	4.3	4.7
35	3.2	3.7	4.0	4.4
45	2.7	3.2	3.5	3.8
60	2.2	2.6	2.9	3.2

Figure 5

Riprap Sizes

Riprap class	Size Range inches	d_{50} inches (approx.)	NY Designation
A	2-6	3"	fine
B	5-15	10"	light
I	4-15	12"	medium
II	6-18	15"	medium

FIGURE 6 - RIPRAP APRON DIMENSIONS



ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L_1	LENGTH OF APRON: TO PROTECT SCOUR HOLE L_2
1	STONE FILLING (FINE)	3 X D_o	4 X D_o
2	" " (LIGHT)	3 X D_o	6 X D_o
3	" " (MEDIUM)	4 X D_o	8 X D_o
4	" " (HEAVY)	4 X D_o	8 X D_o
5	" " "	5 X D_o	10 X D_o
6	" " "	6 X D_o	12 X D_o
7	SPECIAL STUDY REQUIRED (ENERGY DISSIPATORS, STILLING BASIN OR LARGER STONE SIZE)		

1. V_o = Flow velocity at culvert or paved channel outlet.
2. For pipe culverts, D_o = diameter.
3. For pipe-arch, arch, and box culverts, and paved channel outlets, $D_o = \sqrt{A_o}$, where A_o = cross-sectional area of flow.
4. For multiple culverts use D_o = 1.25 x D_o of single culvert.
5. For apron grades of 10% or steeper use recommendations for next higher zone (zones 1 through 6).

From: "Bank and Channel Protective Lining Design Procedures" State of New York, Department of Transportation, Division of Design and Construction.

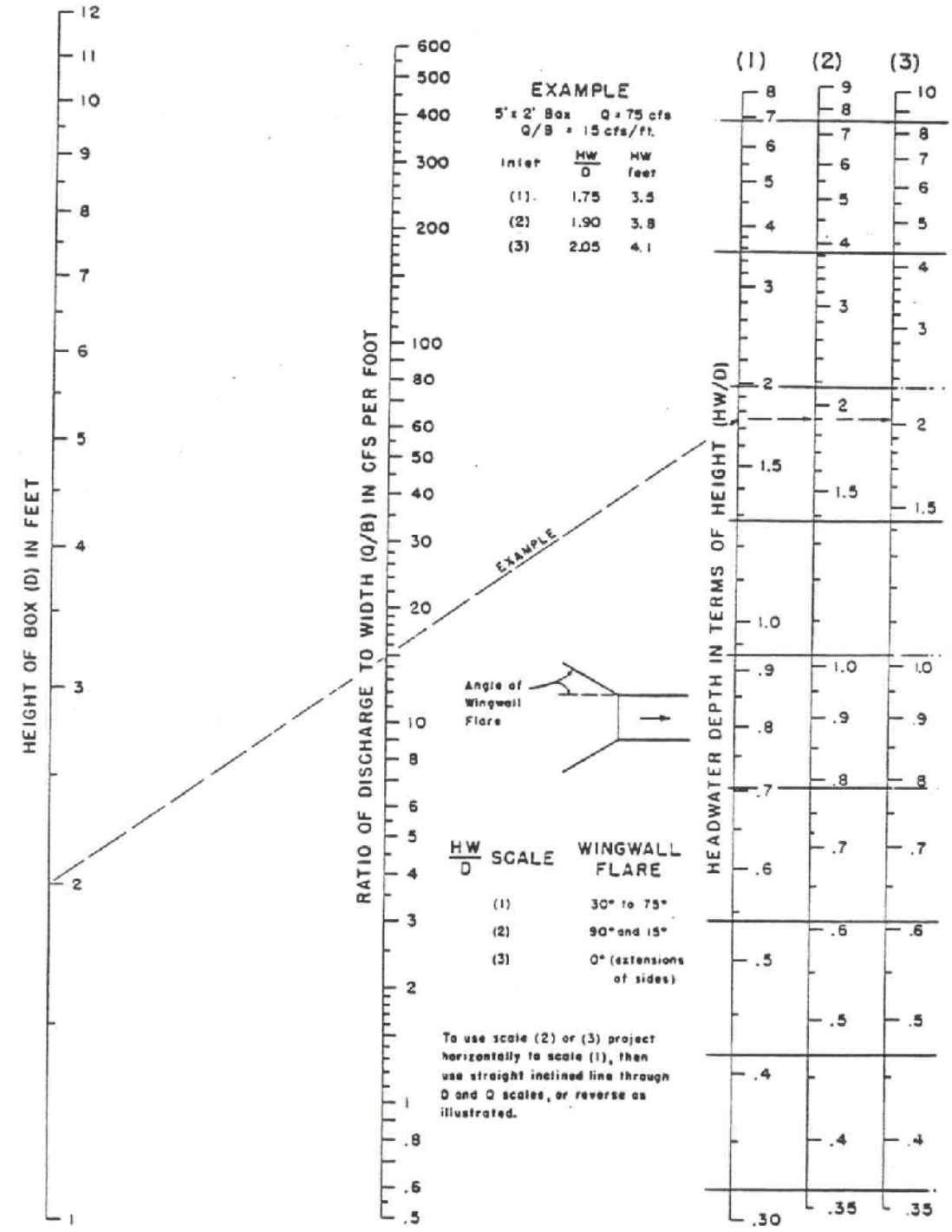
FIGURES 7 -- 10

INLET-CONTROL NOMOGRAPHS

Instructions for Use

1. To determine headwater (HW), given Q, and size and type of culvert.
   a. Connect with a straightedge the given culvert diameter or height (D) and the discharge Q, or $\frac{Q}{B}$ for box culverts; mark intersection of straightedge on $\frac{HW}{D}$ scale marked (1).
   b. If $\frac{HW}{D}$ scale marked (1) represents entrance type used, read $\frac{HW}{D}$ on scale (1). If another of the three entrance types listed on the nomograph is used, extend the point of intersection in (a) horizontally to scale (2) or (3) and read $\frac{HW}{D}$.
   c. Compute HW by multiplying $\frac{HW}{D}$ by D.
2. To determine discharge (Q) per barrel, given HW, and size and type of culvert.
   a. Compute $\frac{HW}{D}$ for given conditions.
   b. Locate $\frac{HW}{D}$ on scale for appropriate entrance type. If scale (2) or (3) is used, extend $\frac{HW}{D}$ point horizontally to scale (1).
   c. Connect point $\frac{HW}{D}$ scale (1) as found in (b) above and the size of culvert on the left scale. Read Q or $\frac{Q}{B}$ on the discharge scale.
   d. If $\frac{Q}{B}$ is read in (c) multiply by B (span of box culvert) to find Q.
3. To determine culvert size, given Q, allowable HW and type of culvert.
   a. Using a trial size, compute $\frac{HW}{D}$.
   b. Locate $\frac{HW}{D}$ on scale for appropriate entrance type. If scale (2) or (3) is used, extend $\frac{HW}{D}$ point horizontally to scale (1).
   c. Connect point on $\frac{HW}{D}$ on scale (1) as found in (b) above to given discharge and read diameter, height or size of culvert required for $\frac{HW}{D}$ value.
   d. If D is not that originally assumed, repeat procedure with a new D.

FIGURE 7



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

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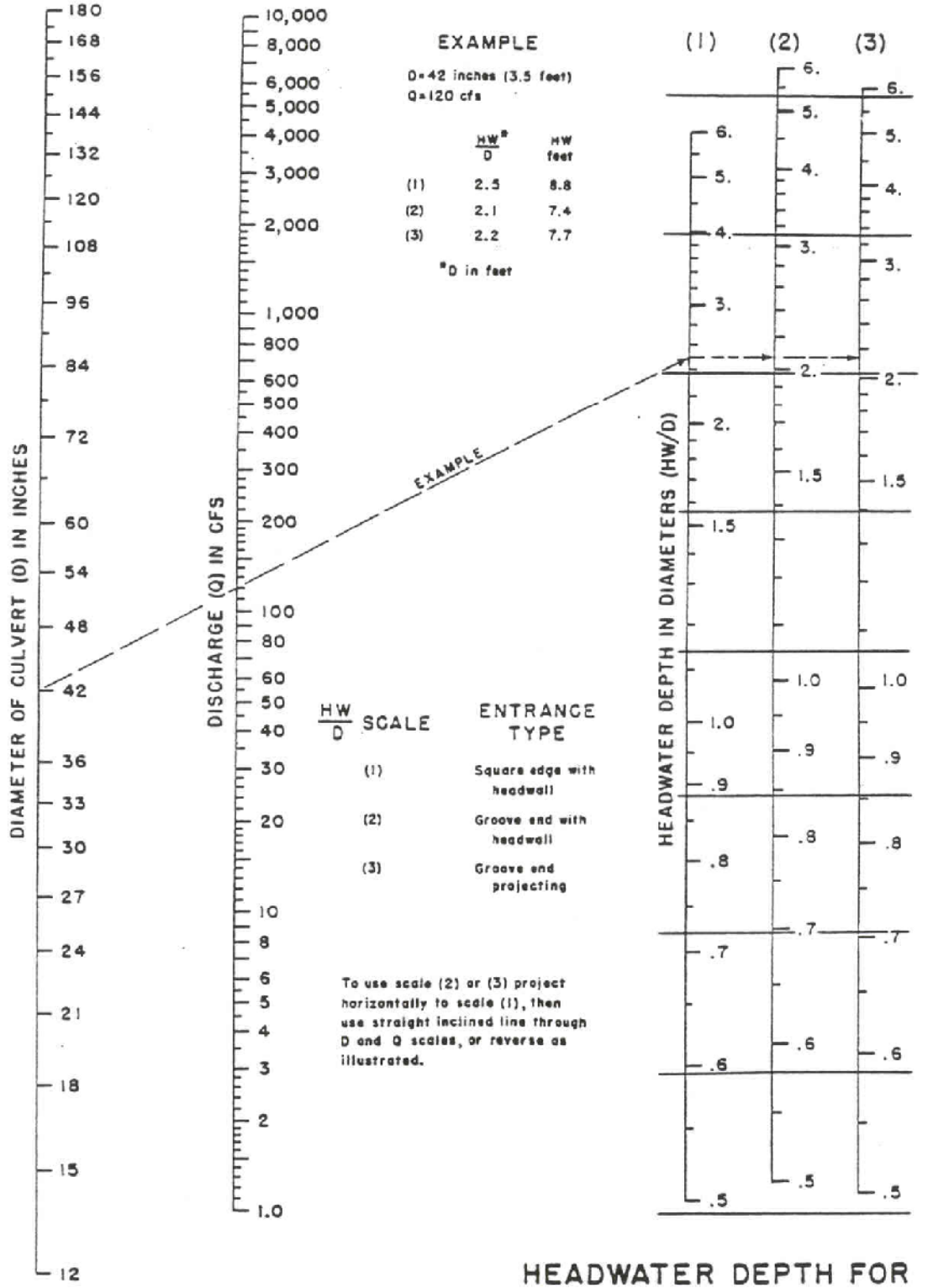
FIGURE 8

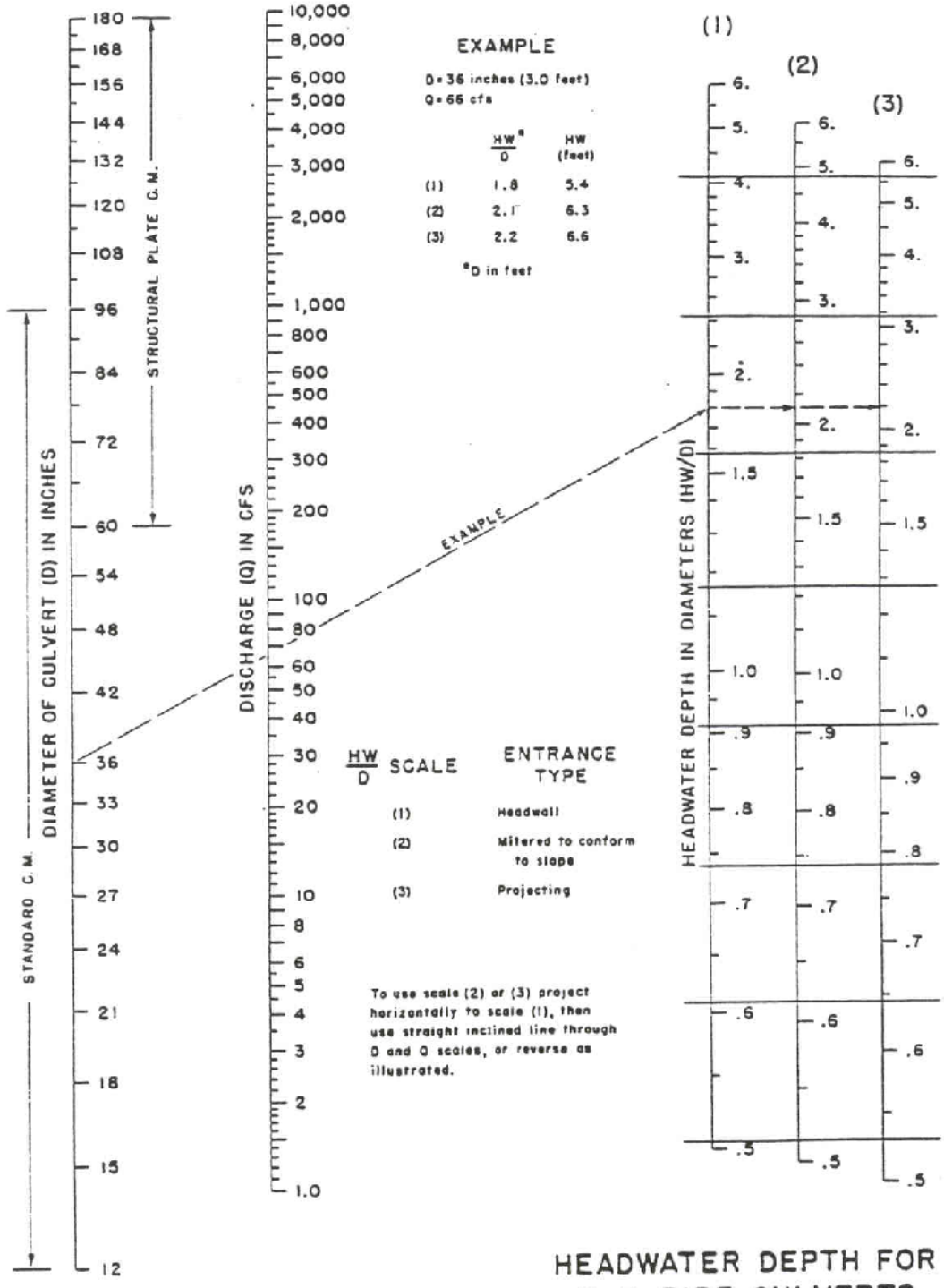


HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

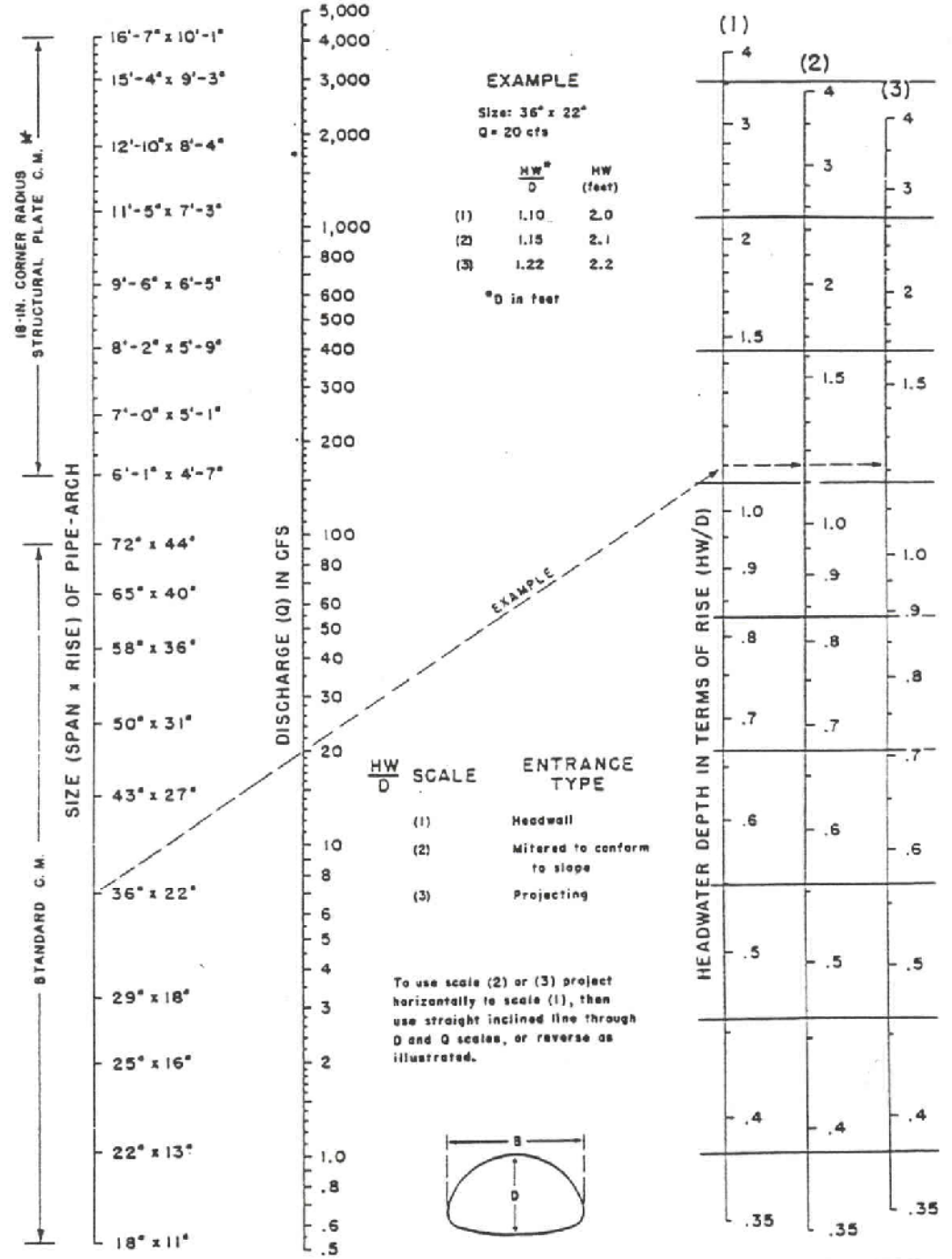
FIGURE 9



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

FIGURE 10



*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

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HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

Figure 11

Manning's Roughness Coefficient "n"

For straight, uniform channels, Manning's roughness coefficient shall be as follows:

Channel Lining Material		"n"
mown grass		.030
tall grass or weeds		.035
class A rip rap		.035
class B rip rap		.037
class 1 rip rap		.037
class 2 rip rap		.040
for winding channels	add	.002
for non-uniform channels	add	.005

Figure 12

Maximum Permissible Velocities, V
Based on Channel Lining

Channel Lining Material	V [FPS]
non-maintained clay and/or weeds	4
well-maintained grass	5
class A rip rap	6
class B rip rap	10
class 1 rip rap	10
class 2 rip rap	12

SECTION V - DESIGN CRITERIA AND POLICIES

PART 5 - ROADS

5.01 Road Design Criteria

General

1. Road plans and specifications shall be sealed by a Professional Engineer or Registered Land Surveyor, licensed to practice in North Carolina and qualified in roadway design.

2. Roads shall meet all City of Salisbury standards prior to being accepted by the City for maintenance. If items are unspecified in City Standards, the NC Department of Transportation Manual "Subdivision Roads - Minimum Construction Standards" shall be used as a guide.

3. All street plans must be consistent with the Officially Adopted Salisbury Thoroughfare Plan.

4. In residential, commercial and industrial subdivisions, driveway access generally will not be allowed directly onto thoroughfares. In group developments, driveway access to thoroughfares must be minimized, and is subject to the approval of the City and/or State.

5. Wheelchair ramps shall be provided at all intersections and large driveways in accordance with North Carolina State Statutes.

6. Public streets shall not be constructed on embankments which serve as dams for ponds or lakes.

7. Subsurface drains shall be required where soil tests and/or construction indicate the presence of springs or other subsurface water.

8. A report and recommendation from an approved soils testing firm must be submitted prior to final approval of street design. Test bores or test pits shall be located at a distance of 300 feet apart and at all sump locations. Test bores or pits shall be located at the approximate street centerline, and extend to a depth of 8 feet below proposed finished grade, or until auger refusal, whichever is less. If auger refusal is obtained, an offset should be made to determine if the rock is continuous.

9. Unsuitable subbase material not identified by the soil tests, but located during construction, must be removed from the right-of-way and replaced with backfill as described in Section 2, Item 1.02 and compacted per Section 3, Item 1.04.

10. "Stub" streets and streets intended for extension during future phases shall be constructed as close as practical to the property/phase line. If the end of the road does not match natural grade, a 2:1 cut or fill shall be provided and a NCDOT type dead end street barricade shall be installed. The design profile shall extend far enough beyond the property/phase line to indicate the extension can meet current design standards. It shall be the responsibility of the second development to construct the connection to a stub street, even if the stub street was built prior to adoption of these standards.

11. Private irrigation systems generally are prohibited within the street right-of-way. However, irrigation systems for planted medians and neighborhood entrances may be approved, provided:

- the irrigation system has a separate meter and is not connected to water lines serving any structure;

- the maintenance responsibility for the irrigation system is clearly assigned to the developer and/or homeowners association;

- a right-of-way encroachment agreement is executed between the City and the party responsible for the irrigation system;

- subsurface drains connecting to the street storm drainage system are installed

Intersections

1. Intersections shall be as close to 90 degrees as possible, and never less than 60 degrees.

2. Intersections with thoroughfares shall have a centerline offset of at least 800 feet unless varied by the Planning Board.

3. Intersections on local streets shall have a centerline offset of at least 200 feet unless varied by the Planning Board.

4. Where a proposed road intersects an existing thoroughfare, the crown slope of the thoroughfare shall be extended to allow for future widening, as directed by the City Engineer.

5. Intersections with thoroughfares, commercial streets and industrial streets shall have a minimum radius of 30 feet at the right-of-way, and at the face of curb for vertical curb, or at the back of curb for valley gutter. Intersections on residential streets shall have a minimum radius of 20 feet at those locations. A larger radius as determined by the City and/or State may be required on a case-by-case basis. It shall be acceptable to indicate right-of-way intersections with straight lines if it is noted "R/W intersection subject to __-foot radius".

6. The maximum grade of any street within 100 feet of an intersection shall be 5% unless varied by the City Council.

7. Site triangles shall be in accordance with standard R-8 and shall be so noted on the final subdivision plat as well as on the engineering plans.

8. For the following items, it will be necessary to identify one street at an intersection as the major (or through) street, and the other street as the minor (or intersecting) street.

   - The crown of the minor street shall be flattened and sloped to match the gutter line of the major street. A minimum distance of 30 feet shall be noted for the transition from normal crown. Adequate drainage must be provided to prevent runoff from entering the street, or ponding in the transition zone.

   - No more than 1 CFS of drainage may cross the minor street at an intersection (for the 10 year storm). No drainage shall cross the major street at an intersection.

   - The plans shall indicate with an arrow which direction drainage is intended to flow at the intersection.

Cul-de-sacs

1. All permanently dead-ended streets regardless of length, shall end in a cul-de-sac with a planted median and dimensions in accordance with standard detail R-5.
   (revised September 6, 2006)

2. All temporarily dead-ended streets may be required to end in a temporary cul-de-sac approved by the City Engineer and the City Fire Department.

3. For the above situations, street distances are measured from the center of the nearest intersection to the center of the cul-de-sac. Radial pavement is measured to the face of vertical curb, or to the back of valley gutter.

4. Dead-end residential streets with a centerline grade greater than 3% draining towards the cul-de-sac shall have catch basins to intercept gutter flow before it enters the cul-de-sac.

5. At the discretion of the City Engineer, vertical curve K-values in cul-de-sacs may be reduced to 16 for crest curves, and 24 for sag curves.

Driveways

1. Residential driveways shall be in accordance with Chapter 24, Article III of the City Code.

2. Commercial driveways shall be in accordance with the City Code and with NC Department of Transportation's "Policy on Street and Driveway Access to North Carolina Highways", January, 1987.

3. Where vertical curb and gutter exist, all driveway ramps shall be constructed of portland cement a minimum of six (6)-inches deep. The ramp must rise four (4)-inches above the flow line of the gutter at a point no closer than two feet from the gutter.

4. Driveway ramps shall not obstruct sidewalks and must incorporate wheelchair ramps if necessary.

5.02 Design Criteria by Street Classification

General

Streets are to be identified as to classification during the preliminary plat review. The TRC shall make the final determination of proposed street classifications in conjunction with preliminary plat approval.

Thoroughfare Streets

Existing and proposed thoroughfares are identified on the officially adopted Salisbury Thoroughfare Plan. All proposed streets identified as thoroughfares shall be designed in accordance with American Association of State Highway and Transportation Officials (AASHTO) and Institute of Transportation Engineers (ITE) design procedures. Plans are subject to the review and approval of the City and the State.

Urban Residential Streets

Urban residential streets are intended to serve traffic with origins and destinations specifically within a residential subdivision. These streets shall generally have a 50-foot right-of-way, a 26-foot back-of-curb to back-of-curb width, 2-foot valley gutter, and shoulder sections as prescribed in the standard details R-3 and R-4. Specific design standards shall be as follows:

Minimum centerline radius	100 feet
Minimum tangent length	50 feet
Minimum site distance	200 feet
K value (crest)	28
K value (sag)	35
Minimum length of a vertical curve = K x (algebraic difference in grades)	
Maximum grade	10.0 %
Minimum grade	0.5 %

Commercial and Industrial Streets

Commercial and industrial streets generally serve traffic in business areas. There is likely to be a high percentage of truck traffic, drivers who may not be familiar with the area, and on-street parking. These streets shall generally have a 60-foot right-of-way, a 39-foot back-of-curb to back-of-curb width, 2'6" vertical curb and gutter, and shoulder sections as prescribed in the standard details R-2 and R-4. However, in areas where on-street parking is specifically prohibited, commercial and industrial streets may have a 50-foot right-of-way and a 29-foot back-of-curb to back-of-curb width. This lesser cross section must be approved by the Planning Board in conjunction with the Preliminary Plat approval. Specific design standards shall be as follows:

Minimum centerline radius	590 feet
Minimum tangent length	100 feet
Minimum sight distance	275 feet
K value (crest)	40
K value (sag)	45
Minimum length of a vertical curve = K x (algebraic difference in grades)	
Maximum grade	7.0 %
Minimum grade	0.5 %