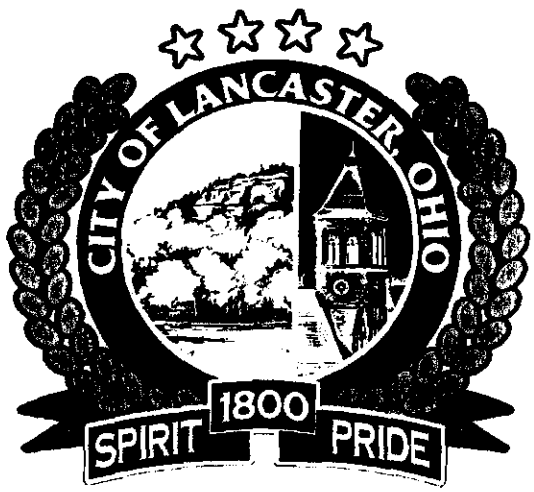
Stormwater Design Manual
City of Lancaster
Department of Engineering



April 2003

This Stormwater Design Manual is hereby approved

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PURPOSE

One effect of development is the increase in stormwater volumes generated from a site. Stormwater and how it is managed affects all the property in the watershed. Upstream property may suddenly find that the old drainage way is changed. Downstream property may be faced with increased volumes of stormwater. It is up to the City, the developer, and the designer to insure that stormwater continues to move to proper outlets with the least impact on the watershed.

It is the City's responsibility to manage stormwater through the review of engineering designs and maintenance of public systems. In order to do this the City must establish design standards to provide adequate design for stormwater systems and to insure maintenance of the system. This manual is to provide awareness to the designer of new development in the City of Lancaster of acceptable local design standards. It is a supplement to standard design procedures. This manual is meant to be a guideline for development in the City and as a supplement to the Subdivision Regulations. The City understands that not all projects will conform to these standards and may require unique solutions suited to the individual site. These situations should be addressed early in the planning stages of the development. The latest edition of the City Zoning Ordinances, Subdivision Regulations, Construction and Materials Specifications, Standard Drawings and General Notes shall be followed.

References to SCS TR-55 are from the Soil Conservation Service Technical Release No. 55 "Urban Hydrology For Small Watersheds" (Second Edition June 1986)

POLICY

It is the policy of the City of Lancaster that the discharge from a developed site during a 100 year storm shall not shall not exceed the discharge during a 2 year storm for the undeveloped site or at the capacity of the downstream outlet, whichever is smaller. In addition, all upstream discharges to the site shall be accommodated on and through the site at the rate existing at the time of development for all storms up to and including the 100 year storm.

HYDROLOGIC METHOD

The first step in designing the stormwater system is in determining the amount of stormwater that must be dealt with. Many different methods are available to calculate stormwater flows. These methods range from simple calculations to complex computer modeling. The following methods are acceptable to the City of Lancaster.

Rational Method

Designs for drainage systems, including offsite drainage, less than 200 acres shall be based on the Rational Method. The Rational Method calculates flow as follows

$$Q=CiA$$

Where

Q=Peak rate of runoff (cfs)
C=Runoff Coefficient
i=Rainfall intensity for the time of concentration (in/hr)
A=Drainage area (acres)

Acceptable C values are:

Paved Areas	0.8-0.9
Single Family Residential	0.4-0.7
Multi-family Residential	0.5-0.8
Commercial	0.8-0.9
Industrial	0.75
Open Spaces or Grass	0.4
Cultivated or Woods	0.4

Weighted C values based on the area in each classification shall be calculated and used.

Technical Release No. 55

For drainage areas, including offsite drainage, over 200 acres, the methods of SCS TR-55 shall be used to determine the peak rate of runoff. For the purposes of SCS TR-55 the following information shall be used where site-specific information is not available.

Rainfall shall be based on Type II storm
Soils shall be Group C
Minimum Time of Concentration shall be 10 minutes or as calculated below
Acceptable CN values shall be

Paved Areas	98
Single Family Residential	77-90
Multi-family Residential	80-90
Commercial	94
Industrial	91
Open Spaces or Grass	79
Cultivated or Woods	77

Weighted CN values based on the area in each classification shall be calculated and used.

Alternate Hydrologic Methods

Alternate hydrologic methods, such as SWMM programs, may be used to determine peak flows with the approval of the City Engineer. The design engineer shall submit all documentation necessary for the review and approval of alternate methods.

RAINFALL

Design Storms

Stormwater management facilities will be designed based on a SCS Type II storm with a duration of 24 hours and the following return periods:

Streets and Gutters-5 year storm
Storm Sewers
- Under 48 inches-5 year with a 10 year hydraulic grade line
- 48 inches and over-5 year with a 10 year hydraulic grade line

Culverts
- Driveway-25 year with 50 year headwater below the street elevation
- Major Channel-25 year non-arterial and 50 year arterial streets with 100 year headwater below the street elevation
- Flood Hazard Area-100 year

Open Channels
- Outside Flood Hazard Area-25 year flowing full
- Flood Routing Path-100 year flowing full
- Flood Hazard Area-100 year flowing full

The 24-hour storms for various frequencies, as defined by SCS TR-55, shall be as follows

1 year	2.3 inches
2 year	2.5 inches
5 year	3.3 inches
10 year	3.7 inches
25 year	4.3 inches
50 year	4.7 inches
100 year	4.9 inches

Flood Hazard Areas, Flood Boundaries and Floodways shall be determined based on the latest Federal Emergency Management Agency (FEMA) Map for the City of Lancaster.

TIME OF CONCENTRATION

Time of concentration is the time it takes water to accumulate and travel from the farthest reaches of the tributary area to the drainage system. Time of concentration is made up of the sum of the time of concentration of the three types of flow

Overland
Shallow Concentrated
Open Channel Flow

Overland Flow

Overland or sheet flow occurs as water begins to accumulate and flow toward the drainage system over the plane surface of the ground. Overland flow is limited to a distance of 300 feet in unpaved areas or 100 feet for paved surfaces. The time of concentration for overland flow can be calculated from the Manning's kinematic solution as found in SCS TR-55 as follows

$$T_c=0.007(n_kL)^{0.8}/(P_2)^{0.5}s^{0.4}$$

Where

T_c=Time of Concentration (hr)
n_k=Manning's roughness coefficient for overland flow
L=Flow length (ft)
P_2=2-year, 24 hour rainfall (in)=2.5 inches for Lancaster OH
S=and slope (ft/ft)

Note that the Manning roughness coefficient for overland flow is not the same as the Manning's coefficient for open channel flow. For the purpose of calculating overland flow, the following Manning's roughness coefficient should be used.

Surface	n_k
Smooth surfaces (paved or bare soil)	0.011
Fallow	0.05
Cultivated Soils (<20% residue)	0.06
(>20% residue)	0.17
Grass	0.15-0.41
Range (natural)	0.13
Woods (light underbrush)	0.40
(dense underbrush)	0.80

Shallow Concentrated Flow

After 300 feet, stormwater accumulates and becomes shallow concentrated flow. Time of Concentration for this type of flow can be calculated using the following the velocity formulas

$V=16.1345\ S^{0.5}$ (Unpaved Areas)

$V=20.3282\ S^{0.5}$ (Paved Areas)

Where

V=average velocity (ft/s)
S=watercourse slope (ft/ft)

Once the velocity is known, the time of concentration is calculated as

$T_c=L/(60V)$

Where

T_c=Time of Concentration (min)
L=Reach Length (ft)
V=Velocity (ft/s)

Open Channel Flow

Water that accumulates in channels, swales, gutters and storm sewers becomes open channel flow. The time of concentration for this flow can be determined by using the Manning's Equation to determine the velocity as follows

$V=1.486/n\ R^{2/3}\ S^{1/2}$

Where

V=average velocity (ft/s)
n=Manning's roughness coefficient
R=hydraulic radius (ft)
S=channel slope (ft/ft)

Once the velocity is known, the time of concentration is calculated as

$$T_c=L/(60V)$$

Where

T_c=Time of Concentration (min)
L=Reach Length (ft)
V=Velocity (ft/s)

Offsite Drainage

Off-site areas that currently drain to the site will be provided with a suitable drainage outlet and provisions shall be made to extend the stormwater system to adjacent properties. Offsite drainage from undeveloped land may, under existing conditions, have a high time of concentration due to overland and shallow concentrated flow. As this property develops, flow will become channelized through swales and storm sewers and the time of concentration will decrease. For this reason, the time of concentration for offsite drainage shall be estimated using a velocity of 3 feet/second as follows

$$Tc=10 + L/ 180$$

Where

T_c=Time of Concentration (min)
L=Reach Length from the farthest point of the offsite drainage to onsite storm system (ft)

The minimum time of concentration shall be 10 minutes.

No storage volume for off-site flow is required. Instead these flows will be routed through the stormwater system at the predevelopment rate for all storms using the above time of concentration. The developer may provide storage volume if necessary to reduce flows from the on-site and off-site areas to meet capacity restrictions downstream.

Stormwater for property in the City of Lancaster that discharges into the system of another jurisdiction shall be designed to meet the requirements of the City of Lancaster or the other jurisdiction, whichever is more stringent.

Minimum Time of Concentration

The minimum time of concentration shall be 10 minutes.

Alternate Calculations

There may be cases where site conditions warrant more detailed evaluations of the time of concentration. This may occur due to upstream drainage system or the presences of streams, wetlands or other hydraulic conditions. In these cases the engineer shall submit to the City Engineer time of concentration calculations and any background documentation for review and approval.

STREETS AND INLETS

In most developments the street system provides a path for the stormwater to reach the stormwater system. Pavement, gutters and inlets must be designed with the movement of stormwater in mind. In order to provide for the movement of stormwater and to minimize flooding, streets shall be designed in accordance with the following standards.

Street design

All streets shall be provided with standard curb and gutter except for streets in areas zoned Estate Residential (ER). The minimum gutter slope shall be 0.4% and the Manning's "n" value shall be 0.015. Curb underdrains shall be provided. All underdrains shall be connected to the stormwater system.

Areas without curb and gutter shall have adequate drainage systems to remove stormwater and prevent roadway flooding. Side ditches and swales shall be designed to meet the standards of open channels and shall have a minimum bottom slope of 0.4%. Underdrains shall be provided at the pavement shoulder. These underdrains shall be connected to the stormwater system or daylighted to the side ditch if adequate depth is available.

Where approved by the City Engineer, "v" shaped pavement with a center storm drainage system may used. Underdrains connected to the stormwater system will be provided along the centerline where street grades are less than 1.0%. Catch basin spacing shall comply with the requirements for inlet location and spacing.

Cul-de-sacs, eyebrows, and other special pavement sections shall be designed to provide adequate drainage. Pavement slopes shall be increased to provide a minimum gutter slope of 0.4% in the longer gutter section. Islands shall be designed to slope to the outside gutter.

Inlet Location and Spacing

Curb Inlets shall be provided upstream of radius turns, at all pavement sag points, at the low points of street intersections, at points of maximum pavement encroachment. Runoff will not be allowed to enter the intersection, except for approved "v" pavement areas. The maximum curb inlet spacing shall be 350-400 feet. A double inlet shall be used in sag points.

Consideration must be given to the location of proposed curb ramps. Curb inlets shall be located upstream from the curb ramp. Curb inlets shall be located on the property line whenever possible to avoid conflicts with driveways and other utilities.

Flood Routing

Streets shall provide the primary flood routing path for storms that exceed the design storm of the drainage system. Streets shall be graded to provide a flood routing path capable of conveying the residual of the 100 year storm to a suitable outlet, or if runoff control is required, to the control facility.

The major storm runoff is to be routed through the drainage system to determine if the combined capacity of the routing path and storm sewer is sufficient to maintain surface flows within permissible limits. The capacity of the conduit at any given point is assumed to be the same for the major storm as for the initial design storm for preliminary design purposes. If the major storm runoff exceeds the combined capacity of the street and storm sewer drainage system, revision in the major drainage design is required.

Where the street is designed as the major drainage way, the depth of flow shall not exceed 18-inches at centerline for local and collector streets and shall not exceed 6-inches depth at crown for arterial streets. The same maximum depth criteria shall apply where a major drainage way crosses the street.

Routing of the major storm at culvert locations shall be at low areas of sags of vertical curves of streets. Elevations for the design of the street shall be such to permit the major storm to flow across the street and to prevent damage to any existing or proposed building structure. Routing shall be continuous from one development to the next.

Where a major drainage way is located outside a street right-of-way, easements shall be provided and a grading plan shall be submitted with detailed engineering plan submission. The grading plan shall include elevations along the routing path and other elevations necessary to show that the major storm is contained within the planned area.

Spread Calculations

The maximum pavement encroachment for stormwater shall be one-half lane width. Multi-lane facilities may have one travel lane on each side of the roadway flooded. The allowable storm capacity of each street gutter section may be calculated based on the modified Manning's formula as follows

$$Q=0.56/nS_x^{1.67} S^{0.5} T^{2.67}$$

Where

Q=Flow (cfs)
N=Manning's roughness coefficient=0.015
Sx=Cross slope of the pavement (ft/ft)
S=Longitudinal grade of street (ft/ft)
T=top width of water from vertical gutter face (ft)

When requested by the City Engineer, spread calculations shall be submitted.

Inlet Specifications

Inlets shall be designed to meet the standards of the City of Lancaster and/or the Ohio Department of Transportation.

Precast concrete modular units shall be in accordance with the applicable standard construction drawing or as approved by the City Engineer. Precast bases shall be placed on a foundation as noted on the standard drawings and CMSL, a minimum of 3-inches of compacted sand, or as approved by the City Engineer. The compacted foundation shall be leveled to provide a uniform support for the entire area of the base.

All joints between modules shall be in conformance with ASTM C443, 706.10 or 706.11.

Pipe entrances to the precast modular sections shall be in accordance with 706.15 or neatly grouted in place.

All lift holes and other openings in the structure shall be thoroughly and neatly grouted with cement mortar or other suitable material approved by the City Engineer, after all pipes are placed into the structures.

Frames, grates and castings shall be in accordance with the applicable standard construction drawing and CMLS or as approved by the City Engineer and shall be set in a mortar bed at the locations and elevations specified. Curb inlet castings which have grate bars parallel to traffic flow will not be accepted. All openings within pavement areas shall be bicycle safe.

STORM SEWERS

While streets provide the initial collection of stormwater, storm sewers convey the stormwater to the outlet. Storm sewers shall be designed to adequately convey the design storm within the pipe system and minimize the surface ponding of water at inlets.

Design Criteria

Storm sewers shall be designed to receive stormwater from the entire tributary area. The minimum cover for storm sewers crossing streets with curb and gutter shall be nine-inches from the subgrade, but shall be concrete encased where the cover is less than thirty inches. Storm sewers outside the pavement but inside the right-of-way shall have 30-inches of cover. All other storm sewers shall have a minimum of two feet of cover. If this cover cannot be maintained, concrete encasement will be required. Trench backfill shall be as per the requirements of the City of Lancaster. The maximum cover shall be determined based on the supporting strength of the conduit, as installed, divided by a suitable factor of safety, must equal or exceed the loads imposed upon it by the weight of earth plus any superimposed loads.

The design procedure recommended for use in structural design of storm sewers is the Design Manual Concrete Pipe available form American Concrete Pipe Association, wide trench installation.

The minimum storm sewer size is 12-inches for all mainline storm sewers and 12-inches for storm laterals. All new storm sewers shall be constructed of concrete pipe. Storm sewers shall be sized using the Manning's equation:

$$V=1.486/n\ R^{2/3}\ S^{1/2}$$

Where

V=average velocity (ft/s)
n=Manning's roughness coefficient=0.013
R=hydraulic radius (ft)
S=channel slope (ft/ft)

A Manning's "n" of 0.013 shall be used.

The storm sewer shall be designed to insure self-cleaning. The minimum velocity shall be 3 fps. The maximum velocity shall be 15 fps. The size of the sewer must be adequate for flowing full, based on the design storm.

The main pipe, if over 24-inches, in a sewer system will be required to be separated from all inlets unless a special design is submitted for approval. The flow line of pipes should be set such that the crown of the pipes, at junctions, are at the same elevation; if the outlet elevation permits, the crown of the outlet pipe may be lower. The flow line elevations of sewers should be set to avoid using concrete encasement.

A minimum separation of 18 inches shall be maintained between the storm sewer and all water and sanitary sewer lines. A 12-inch separation shall be maintained between the storm sewer and all other buried utilities. It is the responsibility of the designer to locate all buried utilities to the best of their ability.

The design storm for storm sewers is 5 years for sewers under 48 inches and 5 years for sewers 48 inches and over. The hydraulic gradient shall be such that the 10-year storm does not exceed the window or grate elevation. The hydraulic grade line shall be based on the downstream tailwater or 0.8D at the outlet or any other critical points within the system or upon the projected elevation of the applicable storm at the outlet stream. Hydraulic grade calculations shall be submitted to the City Engineer if requested.

Pipe Standards

All storm sewers shall be constructed of concrete pipe meeting the requirements of CMSL 901. Alternate materials may be approved by the City Engineer under special design conditions.

Manholes and Catch Basins

Manholes and catch basins shall be designed to meet the standards of the City of Lancaster and/or the Ohio Department of Transportation.

Precast concrete modular units shall be in accordance with the applicable standard drawing or as approved by the City Engineer. Precast bases shall be placed on a foundation as noted on the standard drawings, a minimum of 3-inches of compacted sand, or as approved by the City Engineer. The compacted foundation shall be leveled to provide a uniform support for the entire area of the base.

All joints between modules shall be in conformance with ASTM C443, 706.10 or 706.11 per the CMLS.

Pipe entrances to the precast modular sections shall be in accordance with 706.15 or neatly grouted in place per the CMLS.

All lift holes and other openings in the structure shall be thoroughly and neatly grouted with cement mortar or other suitable material approved by the City Engineer, after all pipes are placed into the structures.

Frames, grates and castings shall be in accordance with the applicable standard drawing or as approved by the City Engineer and shall be set in a mortar bed at the locations and elevations specified per the CMLS.

Manholes shall be located at points in the storm sewer where the following occur

Junctions of Pipes
Change in Direction
Change in Slope
Change in Pipe Size
Change in Pipe Material
End of Pipe Run
Maximum Spacing of 300 feet

Where drainage is needed, the manhole will be equipped with a grate top or a catch basin will be substituted. Catch basins and manholes located in paved areas where there are no curb underdrains shall be provided with a minimum of 10 feet of underdrain upstream of the storm sewer to remove subsurface drainage.

Catch basins will be located outside of the pavement at points where drainage is collected. Where "v" pavement is approved, catch basins may be used in lieu of manholes. Catch basins located in paved areas or in the right-of-way will be equipped with a heavy-duty grate and frame suitable for the application.

Yard Drains

Yard drains meeting the standards of the City of Lancaster may be used at locations approved by the City Engineer.

Roof Drains

All new curb and gutter construction will include the provision for two drain outlets for each property through the curb to the gutter. Where roof pipe leaders are present in replacement sections of curbing, provisions shall be made in the new curbing to accommodate those leaders. Roof drains may discharge to drainage swales where sufficient depth is available. New roof drain connections to the gutter shall be core drilled.

Roof drains, foundation drains and other clean water connections to the sanitary sewer system are prohibited in the City of Lancaster.

Field Tiles

Field tiles may be used only for sub-surface drainage. Surface drainage connections shall not be approved. Field tiles shall not be used for retention facility outlets.

Field tiles encountered during construction shall be connected to the stormwater management system.

Headwalls

Storm sewers that discharge to surface waters shall be provided with a suitable concrete full height headwall meeting the requirement of Standard Construction Drawing D-2. The invert of the storm sewer shall be set no lower than 6 inches above the bottom of the channel. In flood hazard areas, the invert at the half height headwall shall be set no lower than 6 inches above the 100 year water level.

Channel erosion control shall be provided at the outlet of all storm sewers. Rock channel protection shall meet the requirements of CSML 601.09.

Easements

Storm sewers outside the public right-of-way shall be provided with an easement for maintenance and repair. A specifically located and described, 20 feet minimum width access easement shall be required from the maintenance easement to the nearest public right-of-way. Maintenance and access easements are to be kept free of obstructions. Additional easements may be required for storm sewers that are located in the public right-of-way if necessary to provide room for maintenance and repair activities.

CULVERTS

A culvert is a pipe with open ends, designed to carry water across an obstruction in a drainage course such as roadways. This ensures the movement of stormwater while protecting the roadway from flooding. The size and shape of the culvert should be such that it will carry a predetermined design peak discharge without exceeding the depth of water at the entrance or the velocity at outlet exceeding allowable limits.

Design Criteria

Single span culverts, including concrete box or slab top, should always be considered in lieu of multiple cell pipe culverts when they are the only structures that will meet the physical requirements introduced by rigid headwater controls. Culverts should be located along the flowline of the ditch or swale that it is draining.

The plan for each culvert shall have the drainage area in acres and the estimated runoff or design discharge in cubic feet per second shown.

The culvert inlet flow line elevation should be set such that it will be deep enough to provide an adequate outlet for future storm sewer improvements upstream.

Culverts shall be sized utilizing orifice and weir flow equations where applicable for individual site conditions and storm frequencies. Inlet and outlet control nomographs for evaluation of culvert hydraulics may also be utilized to evaluate culvert hydraulics.

Culverts shall be designed for the design storm with a maximum allowable headwater elevation

1. 18 inches below top of curb
2. 12 inches below edge of pavement
3. 1.2 time Diameter
4. Not greater than any existing or proposed building first floor elevation.
5. Diameter or rise plus 4 feet or 2D, whichever is lower, in deep ravines.

Culverts except for driveway culverts shall maintain a headwater of no more than 2D or the edge of pavement for the 100-year storm. There shall be no increase in the 100-year headwater in a FEMA designated floodway.

The acceptable Manning's "n" value shall be

Box Culvert	0.011
Slab Top Culvert	0.03 to 0.05
Concrete Pipe	0.013
Corrugated Metal	.0024

Entrance Loss Coefficient acceptable for design shall be

Box Culvert and Slab	0.2 to 0.5
Concrete Pipe	0.2
Corrugated Metal	0.9

The minimum cover desired is 30 inches to pavement subgrade. The maximum cover shall be determined based on the supporting strength of the conduit. The structural design criteria for culverts will be the same as that required by the Ohio Department of Transportation.

Pipe Standards

All storm sewers shall be constructed of concrete pipe meeting the requirements of CMSL 901. The City Engineer, under special design conditions, may approve alternate materials.

Drainage Structures

Open culverts will not generally contain manholes, surface inlets or catch basins. Special design considerations such as site topography or maintenance considerations may require that drainage or access structures be included in the design, with the approval of the City Engineer. These structures shall meet the same requirements as structures used in the storm system.

Headwalls and End Treatments

Headwalls or other approved end treatments will be required for all culverts. At a minimum, a full headwall, with or without wings, will be installed. Half height headwalls may be approved on a case-by-case basis.

Energy dissipators and erosion protection shall be required when the velocity of the flow from the culvert exceeds the allowable velocity. The maximum allowable outlet velocity is

Bare Earth Channel	6 fps
Rock Protection	18 fps
Stilling Basin	Over 18 fps

The ability of the downstream channel to handle the flow satisfactorily

Channel Protections and Erosion Control

Channel erosion control shall be provided at the outlet of all culverts and at the inlet wingwalls of full height headwalls. Rock channel protection shall meet the requirements of CSML 601.09.

OPEN CHANNELS

Open channels may be naturally occurring small streams or man made ditches and swales. Their purpose is to carry large amounts of water away from property to the final discharge at the stream, river or lake. Open channels shall be design to insure the passage of major storms without damage to local property.

Enclosure of Open Channels

All open channels (Natural or Man Made) will be enclosed with a storm sewer when an area is developed. This policy will apply even when the open watercourse is located on a property line or the channel receives no direct discharge from the development.

The City Engineer may grant an exemption for individual channels, upon written request justifying one or more of the following conditions:

A. Would require a 24-inch pipe or larger based on a two year design
B. Involve ravines or other scenic areas having natural attributes that should be preserved such as large diameter trees, rare vegetation, or unusual geologic formations. Such drainage courses must be of sufficient depth and grade to satisfactorily carry the design flow without improvement. The developer must agree to prevent the scenic or natural quality of the protected areas form being destroyed by any aspect of the development.
C. Is on a FEMA regulated drainageway.

If exemptions are made on a project, it will be with the requirement that complete computations be submitted. The computations should show good flow characteristics at times of low flow as well as at peak flow. Channels exempted under sections A , B or C above shall be improved as necessary to carry the design flow without erosion.

Design Criteria

Open channel flow may be evaluated utilizing Manning's equation.

$$V=1.486/n\ R^{2/3}\ S^{1/2}$$

Where

V=average velocity (ft/s)
n=Manning's roughness coefficient=0.013
R=hydraulic radius (ft)
S=channel slope (ft/ft)

Acceptable Manning's "n" shall be:

Sod or Jute Mat Lining	0.05
Paved Lining	0.015
Rock Protection	0.08
Existing Lining	0.025 to 0.20

The desirable minimum grade is 0.50%. All improved channels and other open watercourses that have a gradient of less than 0.50% shall be paved. Paving shall be 6-inch minimum concrete paving, reinforced with steel mesh to accommodate temperature stresses. Paving shall be air-entrained class C concrete, with synthetic or linseed oil waterproofing treatment. Paved ditches shall be to the depth of a two-year storm, with a minimum depth of one-foot.

Site-specific conditions, such as culverts, floodplains, or stormwater management systems, may require more detailed evaluation.

Storm drainage ditches and channels shall be designed to protect against erosion under high water conditions. The allowable design storm velocities for all new ditches shall be as follows:

3.0 fps with seeding
5.0 fps with sod or jute mat lining
Over 5 fps special lining

The allowable velocities in existing channels shall be determined by the ability of the channel to handle the flow satisfactorily.

The side slope of stormwater drainage ditches and channels shall be designed to insure maintenance. The maximum side slopes shall be:

Soil	4:1
Concrete Paved	2:1
Rock	2:1

Easements

Access to storm drainage ditches and channels shall be by means of maintenance easements. Such maintenance easements shall be not less than the width of the ditch at the top of the bank plus twenty feet each side, measured horizontally, from the top of banks. A specifically located and described, 20 feet minimum width access easement shall be required from the maintenance easement to the nearest public right-of-way. Maintenance and access easements are to be kept free of obstructions.

Surface water collector swales within rear yard and side yard areas of residential subdivisions and on all non-residential parcels draining more that 5 acres shall be constructed within a drainage easement possessing a minimum width of twenty feet. For residential properties the drainage swale should be generally constructed approximately in the middle of the easement.

RUNOFF CONTROL

An unavoidable effect of development is the alteration of existing conditions. To reduce the impact to surrounding areas, stormwater must be controlled in some fashion. Methods for controlling increases in stormwater runoff peaks and volumes may include retarding flow velocities, grading to slow runoff, induced infiltration, or provisions for either detention or retention.

Runoff Control Requirements

The parking areas and impervious areas for all proposed site developments shall be designed to provide drainage of surface water to natural watercourses or storm sewers and to prevent draining of such water onto adjacent properties or across public walkways. The parking lots shall be drained by means of catch basins and storm sewers to an adequate outlet.

The parking lot shall be graded such that the surface water will drain to the catch basin or basins in a low area to permit detention of the runoff.

All roof top areas and/or building storm water drainage systems shall drain to the parking lot system for controlling stormwater rate of runoff prior to its release to downstream properties.

The catch basins must pick up the water on the paved surface. Sheet flow will not be permitted.

The detention or ponding area shall be designed as explained in the section under detention or retention.

Storage Volume Calculations

The amount of storage required to meet the stormwater control regulations shall be calculated as follows:

For small sites under 10 acres

$$S=\text{Maximum Value } (60t(Q_i-Q_o))$$

Where

S=Storage volume in cu. ft.
t=Elapsed time in minutes
Q_i=Flow into Stormwater Control in cfs
Q_o=Allowable Flow out of Stormwater Control in cfs

Sites over 10 acres shall be calculated using the Graphical Flow Routing Method or the Storage-Indication Method.

The Graphical Flow Routing Method is detailed in SCS TR-55. This method uses a graph relating inflow volumes to determine storage volumes. A copy of the SCS TR-55 graphs is found in the appendix.

Storage-Indication Flow Routing is based on the continuity equation

$$S=t_d(I_{ave}-O_{avg})$$

Where

S=Change in volume of storage during the time interval
t_d=the time interval
I_{avg}=Average Rate of Inflow during the time interval
O_{avg}=Average Rate of Outflow during the time interval

The average rate of inflow is determined from the inflow hydrograph for the tributary area. The average rate of outflow is determined by an elevation-discharge curve developed for the storage basin. The elevation discharge curve is dependent on the hydraulic characteristics of the outlet structure and is unique for each basin. Storage-Indication Flow Routing can involve lengthy calculations that can be replaced with computer modeling. Storage-Indication Flow Routing is only recommended for extremely complex sites.

Control Options

Parking Lot Detention

Parking Lot Detention can be used in commercial, industrial and multi-family developments to store stormwater from paved areas.

Parking lot storage is surface storage where shallow ponding is designed to flood specific graded areas of the parking lot. Controlled release features are incorporated into the surface drainage system of the parking lot. Parking lot design and construction grades are critical factors in the design of parking lot storage.

Parking lot storage is a convenient multi-use structural control method where impervious parking lots are planned. Design features include small ponding areas with controlled release by pipe-size and slope, and increased curb heights. Ponding areas in parking or traffic areas shall be designed for a maximum potential depth of 12-inches. Flood routing or overflow must occur after the maximum depth is reached. . This method is intended to control the runoff directly from the parking area, and is usually not appropriate for storing large runoff volumes.

Detention Ponds

Detention Ponds are dry basin storage areas created by constructing a typical excavated or embankment basin. There is no normal pool level and a specific controlled release feature is included to control the rate of discharge.

Detention basin bottoms shall be sloped to drain, and such slopes shall be sufficient to mitigate against "flat spots" developing due to construction errors and soil conditions; or, such bottoms

shall be paved. The absolute minimum transverse slope for the bottoms of such facilities shall be 0.50% and 1.0% is the recommended transverse slope. All transverse bottom slopes flatter than 1.0% to, and including, 0.5%, shall be 6-inch minimum thickness concrete, reinforced with steel mesh to accommodate temperature stresses, of air-entrained Class C concrete, and with synthetic or linseed oil waterproofing treatment.

Embankments shall be no steeper than 3:1 slopes with 4:1 slopes preferred. Where berms constructed of fill which will be over 6 feet high are proposed, calculations supporting the stability of the fill berms are to be submitted by a Geotechnical Engineer.

Emergency spillways shall be provided. The spillway shall be capable of handling the peak discharge and peak velocity from the 100-year or larger storm event under post-development conditions. A minimum of 1 foot of freeboard shall be provided in the pond.

Retention Ponds

Retention Ponds are permanent ponds where additional storage capacity is provided above the normal water level and special features for controlled release are included. Historically, wet ponds have proven extremely effective in abating increased runoff and channel erosion from urbanized areas. They are major Soil Conservation land treatment practice.

Retention ponds shall be graded to provide a 6:1 slope above the normal water surface. Below the normal water surface the slope shall be 3:1 in 3 feet to a 5-foot safety bench. Below the safety bench the slope shall be at least 3:1 and no steeper than 2:1. The minimum pond depth from normal water level to the bottom shall be 8 feet and the maximum depth shall be 10 feet. Where berms constructed of fill which will be over 6 feet high are proposed, calculations supporting the stability of the fill berms are to be submitted by a Geotechnical Engineer.

Emergency spillways shall be provided. The spillway shall be capable of handling the peak discharge and peak velocity from the 100-year or larger storm event under post-development conditions. A minimum of 1 foot of freeboard shall be provided in the pond.

Rock channel protection, type D, must be placed at the normal water elevation, around the entire perimeter of the basin, five feet wide, centered on the normal water elevation.

Other

Underground Storage is an underground tank or chamber, either prefabricated or constructed in place, which has a special controlled release feature. This method is most applicable where land area is very valuable; such are in industrial and commercial areas. Construction cost and operation costs, which may include pumps, make this method relatively expensive. Storage trenches, a variation on basic tank storage, are rock filled underground storage tanks. The storage is provided within the void spaces between the rock material.

Rooftop Storage is surface storage provided on flat rooftops designed with provision for temporary ponding and with special roof-drain-controlled release features. Rooftop storage utilizes the built-in structural capability of rooftops to store certain amounts of rainfall.

Infiltration methods such as Dry Wells, Infiltration Trenches and Storage Trenches seek to resort the naturally occurring process of the hydrologic system by permitting stormwater to percolate into the ground. The degree to which infiltration of stormwater can be utilized depends on the physical characteristics of the soil or soils and the groundwater system of the area. Infiltration methods will not be allowed in the Wellhead Protection Zone 1.

Because of the limited ability of these other systems to handle large amounts of stormwater, these other systems are generally used only for roof drains and small paved areas. Designers wishing to incorporate alternative runoff control methods shall contact the City Engineer for guidance.

Orifice Plates and Control Structures

Flows from the stormwater control facility shall be regulated by means of weirs or orifices or a combination or both.

The equation for determining orifice flow is

$$Q=CA(2gH)^{0.5}$$

Where

Q=Flow in cfs
C=Coefficient of Discharge
A=Cross sectional area of the orifice in sq. ft.
g=acceleration due to gravity=32.2 ft/sec/sec
H=head on the orifice in ft.

Head shall be calculated as the difference between the upstream and downstream water surfaces for submerged orifices and between the upstream water surface and the center of the orifice for free discharge. The water surface shall be the surface at the maximum storage capacity. The C value shall be selected based on the orifice type. A C value of 0.6 may be used for most standard orifice plates.

Weirs shall be designed based on the type of weir and the end constrictions. The general weir equation is

$$Q=CLH^{1.5}$$

Where

Q=Flow in cfs
C=Coefficient of Discharge
L=Length of weir in ft
H=Head on weir in ft.

Head shall be measured as the difference in elevation between the weir crest and the water surface measured at the maximum water storage level upstream of the weir.

Easements

Easements are required if the City is to maintain the basin or if the facility is located in an area where the City will need access through personal property to perform necessary maintenance of all stormwater facilities. Generally, a maintenance easement of 20-foot minimum width, in addition to the size of the stormwater facility when flooded, is required. A specifically located, 20 foot minimum width access easement shall also be required, from the easement at, alongside or around the stormwater facility, to the nearest public right-of-way. Maintenance responsibilities will be determined and so stated in the easement.

EROSION AND SEDIMENTATION CONTROL

Construction activities required as part of land development necessitate the removal of natural ground cover, creating the potential for erosion to occur. Erosion, and the movement of the soil off the site and into the stormwater control system, can lead to water quality impacts. Excessive soil in the stormwater system can also cause the system to malfunction or require excessive maintenance to keep the system operational. Proper erosion control techniques can minimize the loss of soil on the site.

Policy

The policy of the City of Lancaster is that no person shall cause or allow earth-disturbing on a development prior to submittal and approval of an erosion and sediment control plan showing compliance with the City standards.

Design Criteria

Permanent control provisions shall be coordinated with the temporary erosion control to the extent possible to assure economical, effective and continuous erosion control throughout the construction and post-construction period.

Perimeter control and other sediment trapping measures shall be installed to stop the movement of sedimentation off the site. Such controls will include: stabilized construction entrances, straw bale dams and fabric fencing, temporary sediment traps, sediment basins and diversions. Storm drains, both on and off the site, shall be protected from sedimentation. Stormwater retention or detention facilities shall not be used as sedimentation traps without the approval of the City Engineer. If such facilities are used as a sedimentation trap or sedimentation basin, the facility shall be thoroughly cleaned of all sedimentation and returned to full design capacity prior to the release of the construction bond.

Construction shall be scheduled to minimize the amount of area disturbed at any one time. Disturbed areas that are at finish grade shall be permanently seeded within seven days. Other areas of disturbed soil shall be rough graded to provide drainage and temporarily seeded if they are to remain dormant for more than 30 days.

Slope protection shall be provided by use of temporary and permanent diversion dikes, vegetative cover and slope drains. Concentrated stormwater flows shall not be allowed to flow down cut or fill slopes without proper slope stabilization.

Concentrated stormwater runoff leaving a development site shall be outletted to an open channel, storm sewer inlet or culvert which is capable of receiving the discharge. Runoff velocities shall be controlled to prevent erosion.

Appropriate measures shall be taken to minimize or eliminate wastes and unused building materials and all pollutants from being carried from the site by runoff. Proper storage, handling and use of all potentially polluting substances shall be employed.

Public and private roadways shall be kept cleared of accumulated sediment. Provisions for proper dust control may be required as deemed necessary.

Where construction crosses a stream or channel, a temporary stream crossing will be needed.

Erosion Control design shall meet the requirements of the City of Lancaster Standard Drawings and Standard Notes.

Maintenance During Construction

All disturbed areas that are exposed to precipitation, structural control measures and locations of vehicle entrance and exit shall be inspected at least once every seven days and within twenty-four hours of a storm event greater than 0.5 inches. Inspection shall be continued until all disturbed areas are stabilized; structural controls are removed or converted to stormwater management facilities. Corrective action will be taken for all noted deficiencies. Such actions shall be initiated within 24-hours of inspection notification.

Sediment deposits shall be removed from straw bale and filter fence barriers upon reaching approximately one-half the height of the barrier at its lowest point or causes a silt fence to bulge and should be deposited at a controlled fill area.

Sediment deposits shall be removed from diversion channels, dikes, outlet channels and stabilized areas after every rainfall. Any area damaged by erosion shall be repaired and reseeded within 24-hours or as soon as the soil dries sufficiently to allow work to proceed.

Temporary stream crossings shall be inspected after every rainfall and at least weekly for assessment of damage due to stormwater flows or construction equipment. Necessary repairs shall be made within 24-hours or as soon as the soil dries sufficiently to allow work to proceed.

The City maintains the right to inspect any site of land disturbance at any reasonable time and to require compliance with regulations and soil erosion control plan.

Plans

Construction plans shall be submitted on archival quality mylar with the City title block. Mylar or a disk with the title block in AutoCad format is available through the City Engineering Department. Text size should be no less than 0.08 inch. A set of construction drawings should contain the following sheets as applicable:

1. Cover/Title Sheet
2. General Notes Sheets
3. Street Plan view and Profile Sheets
4. Basin Sheets
5. Storm Sewer Profile Sheets
6. Sanitary Plan view and Profile Sheets
7. Grading Plan Sheets
8. Erosion and Sediment Control Plan Sheets
9. Street Lighting Sheets
10. Turn Lane / Berm and Ditch Improvement Sheets
11. Street Cross Section Sheets

Plans for sanitary sewers may be submitted separately to allow for earlier approvals and start of construction. This should only be done with the knowledge that revisions and field adjustments may be needed once street plans are approved. It is the responsibility of the designer to coordinate any changes between the sanitary plans and the street, water, storm and grading plans. In the case of large developments or phased developments, a master utility plan my be required. The minimum plan requirements shall be

I. Cover Sheet

1. Vicinity Map.
2. Bench Marks.
3. Estimate of Quantities.
4. List of applicable Standard Construction Drawings.
5. List of applicable General Notes.

6. Any required Special Notes.
7. Ohio Professional Engineer's signature.
8. Owner/Developer's signature to agree with intent of plans.
9. Index/Overall tributary area map at a 1" = 200' scale.
10. OUPS symbol and phone number.
11. Any special details required for construction of the proposed sewer.

II. General Notes Sheet

1. These sheets should contain a listing of the current General Notes that apply to what is being constructed by the plans. The note number and note should be shown in numerical order.

III. Plan view Guidelines

1. North Arrow pointing either to the top or the left of the sheet.
2. Scale shall be no less than 1" = 50'.
3. Proposed work shall be the heaviest line weight on the sheet.
4. All new structures shall be located by dimensions or station offsets and numbered.
5. All new mains shall be located by bearings and distances.
6. The proposed sewer line will be stationed increasing from the downstream most end.
7. If any match lines are required, they shall be at even 100 foot stations.
8. Label adjacent property owners.
9. Label pavement replacement type and location, if required.
10. Show all existing utilities as dashed lines and label type and size.
11. Note type of pipe that is to be used.
12. Note type of bedding that is to be used.
13. Label location where tunneling or steel casing pipe is to be used, especially under streams and railroads, if required.

IV. Profile Guidelines

1. Scales shall be a minimum 1" = 50' horizontal and 1" = 5' vertical.
2. Stationing and numbering of proposed sewer and structures shall match plan view.
3. Show and label all proposed and existing utility crossings and street

crossings.

4. Label proposed structure types and stationing with regards to the sewer.
5. Label sewer pipe with respect to type, size, length and slope.
6. Show any existing features as a dashed line type and label with an existing drawing number.
7. Show special backfill limits with appropriate stationing.
8. Show and label existing and proposed ground surfaces which are to be cut along centerline of sewer.
9. Label elevations of stubs or bricked openings in manholes that are for future use.

V. Basin Sheet Guidelines

1. Scale shall not be less than 1" = 50' horizontal and 1" = 5' vertical.
2. Plan and cross sectional view should be provided.
3. Information on field staking/locating should be included.
4. Plan view should include:
    a. Existing grades
    b. Proposed grades
    c. Appropriate storm sewers
    d. Property lines
    e. The view port should show enough around basin to be able to easily locate it in project.
    f. Show emergency spillway
    g. Any other information to aid in construction and clarification of operation
5. Cross sections should include:
    a. Existing ground.
    b. Proposed grade.
    c. Label normal water surface (if applicable).
    d. Label 100 year water elevation.
    e. Label safety bench.
    f. Label emergency spillover elevation.

g. Any other information to aid in construction and clarification of operation.

6. Any special notes required for this construction should be included

VI. Grading Plan Guidelines

1. Scale shall not be less than 1" = 50'.
2. A sufficient number of spot grades to build the site from and to demonstrate drainage scheme of development should be shown. A commercial or multi-family site will need a staking plan to layout the site for construction. The plat serves this purpose for a subdivision.
3. Finished ground elevations and first floor elevations for all proposed buildings should be shown.
4. Site layout including street centerlines, curb, right-of-way, building line, lot lines and street names.
5. The path of the 100 year storm water routing should be shown.

VII. Erosion and Sediment Control Plan Guidelines

1. Scale shall not be less than 1" = 100'
2. Site layout
3. Proposed control measures in the heaviest line weight on the page
4. Legend for the drawing
5. Any special notes required
6. Flood routing information
7. Erosion and Sedimentation Control Narrative including

Name and Address of Owner or Operator
Facility Name and Address
Type of Facility
Name of Receiving Water
Description of Project
Estimated Timetable
Acres to be Disturbed
Location and Type of Construction Activity
Map of Site
Proposed measures to control stormwater pollution
Existing site conditions
Soils
Land use
Areas of Concern

Calculations

Appropriate calculations to document and justify the engineering design of the project shall be submitted for review. The calculations shall be stamped by the design engineer. A partial list of calculations is given below. All of these calculations may not apply to every project.

Spread Calculations-Indicating the gutter capacity of streets and amount of pavement flooded (if requested)
Grate Calculations-Indicating the capacity of inlet grates to handle storms (if requested)
Storm Sewer Design Calculations-Indicating drainage to and capacity of storm sewers (required)
Culvert Design Data Sheet Calculations-Indicating drainage to and capacity of culverts (required)
Channel Calculations-Indicating drainage to and capacity of all channels (required for new or as requested)
Storage Calculations-Indicating the amount of storage required and amount provided (required)
Orifice Calculations-Indicating sizing (required)
Weir Calculations-Indicating sizing (required)
Time of Concentration Calculations-Documenting existing and design time of concentration (if requested)
C and CN Calculations-Documenting existing and design C and CN values (if requested)
Downstream Capacity Calculations-Verifying capacity of downstream systems (required)
Other Calculations

Tributary Map

A tributary map showing all areas draining to the proposed stormwater system shall be provided. The map shall be no smaller than 1"=100' and include both upstream and downstream areas tributary to the drainage system. All proposed stormwater facilities shall be shown with the appropriate tributary boundaries for each inlet, structure or basin. The routing path for major storms shall be indicated.

APPENDIX

A. Rainfall Intensity for City of Lancaster
B. Graphical Flow Routing Method
C. Standard Forms
D. Legislation
E. Contact Numbers

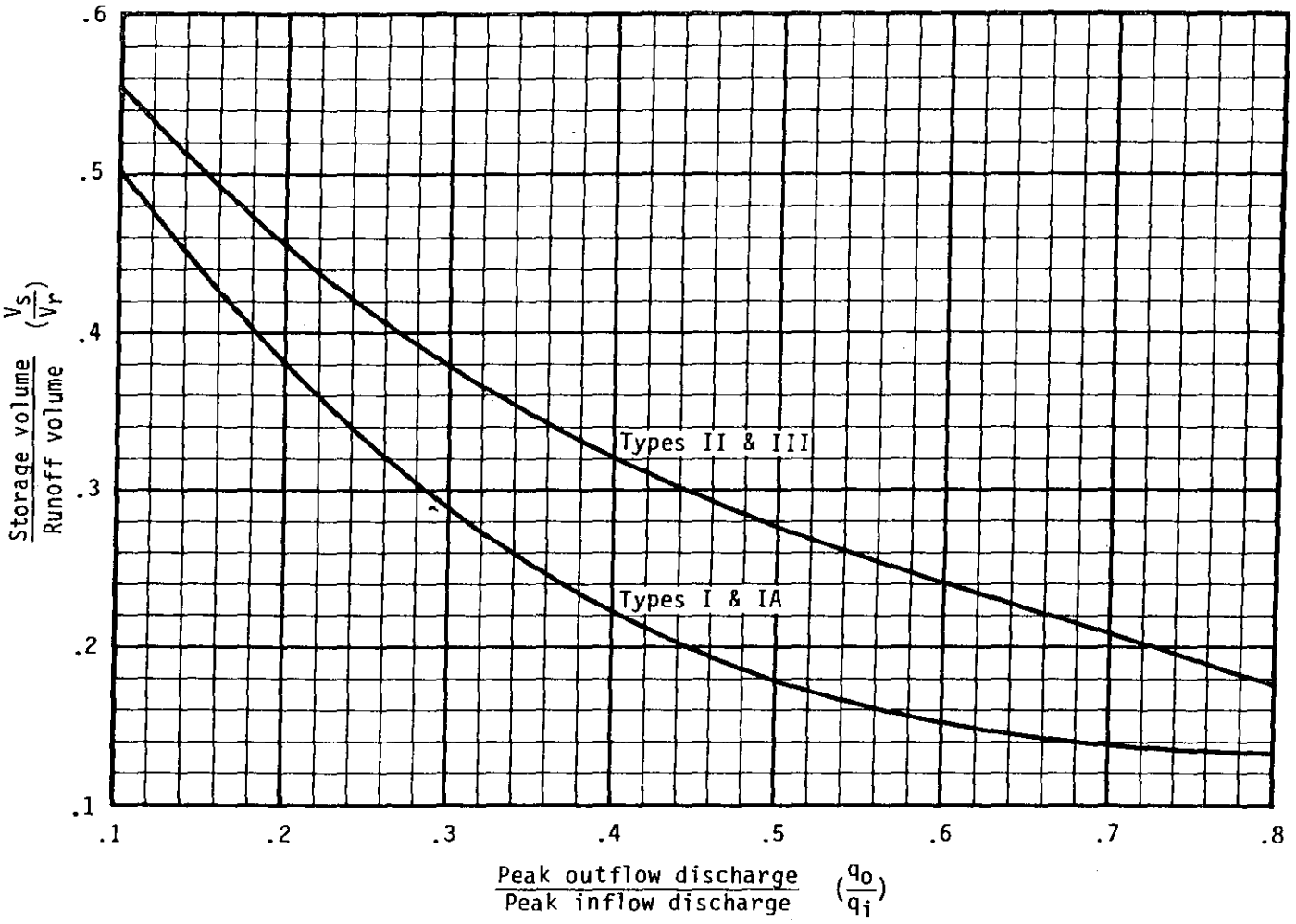
Rainfall Intensity for City of Lancaster

Rainfall Intensity: Inches Per Hour

Time (min)	100 year	50 year	25 year	10 year	5 year	2 year	1 year
10.0	6.47	5.76	5.36	4.92	4.63	3.81	3.05
10.1	6.45	5.75	5.35	4.91	4.62	3.80	3.04
10.2	6.43	5.73	5.33	4.90	4.61	3.79	3.03
10.3	6.41	5.72	5.32	4.88	4.60	3.78	3.02
10.4	6.39	5.70	5.30	4.87	4.59	3.77	3.01
10.5	6.37	5.69	5.29	4.86	4.58	3.76	3.00
10.6	6.35	5.68	5.27	4.85	4.56	3.74	2.99
10.7	6.33	5.66	5.26	4.84	4.55	3.73	2.98
10.8	6.31	5.65	5.24	4.82	4.54	3.72	2.97
10.9	6.29	5.63	5.23	4.81	4.53	3.71	2.96
11.0	6.27	5.62	5.21	4.80	4.52	3.70	2.95
11.1	6.25	5.61	5.20	4.79	4.51	3.69	2.94
11.2	6.23	5.59	5.18	4.78	4.50	3.68	2.93
11.3	6.21	5.58	5.17	4.77	4.48	3.66	2.92
11.4	6.19	5.56	5.15	4.76	4.47	3.65	2.91
11.5	6.18	5.55	5.14	4.75	4.46	3.64	2.91
11.6	6.16	5.54	5.13	4.74	4.45	3.63	2.90
11.7	6.14	5.52	5.11	4.73	4.44	3.62	2.89
11.8	6.12	5.51	5.10	4.72	4.42	3.60	2.88
11.9	6.10	5.49	5.08	4.71	4.41	3.59	2.87
12.0	6.08	5.48	5.07	4.70	4.40	3.58	2.86
12.1	6.07	5.47	5.06	4.69	4.39	3.57	2.85
12.2	6.06	5.46	5.04	4.68	4.38	3.56	2.84
12.3	6.04	5.44	5.03	4.67	4.37	3.55	2.84
12.4	6.03	5.43	5.02	4.66	4.36	3.54	2.83
12.5	6.02	5.42	5.01	4.65	4.35	3.53	2.82
12.6	6.01	5.41	4.99	4.64	4.34	3.52	2.81
12.7	6.00	5.40	4.98	4.63	4.33	3.51	2.80
12.8	5.98	5.38	4.97	4.62	4.32	3.50	2.80
12.9	5.97	5.37	4.95	4.61	4.31	3.49	2.79
13.0	5.96	5.36	4.94	4.60	4.30	3.48	2.78
13.1	5.95	5.35	4.93	4.59	4.29	3.47	2.77
13.2	5.94	5.34	4.93	4.58	4.28	3.45	2.76
13.3	5.92	5.33	4.92	4.57	4.27	3.44	2.75
13.4	5.91	5.32	4.91	4.56	4.26	3.42	2.74
13.5	5.90	5.32	4.91	4.55	4.25	3.41	2.74
13.6	5.89	5.31	4.90	4.54	4.23	3.40	2.73
13.7	5.88	5.30	4.89	4.53	4.22	3.38	2.72
13.8	5.86	5.29	4.88	4.52	4.21	3.37	2.71
13.9	5.85	5.28	4.88	4.51	4.20	3.35	2.70
14.0	5.84	5.27	4.87	4.50	4.19	3.34	2.69
14.1	5.83	5.26	4.86	4.49	4.17	3.33	2.68
14.2	5.82	5.25	4.85	4.48	4.15	3.32	2.67
14.3	5.81	5.24	4.84	4.47	4.13	3.31	2.66
14.4	5.80	5.23	4.83	4.46	4.11	3.30	2.65
14.5	5.79	5.22	4.82	4.45	4.10	3.29	2.64
14.6	5.77	5.21	4.81	4.43	4.08	3.28	2.63
14.7	5.76	5.20	4.80	4.42	4.06	3.27	2.62
14.8	5.75	5.19	4.79	4.41	4.04	3.26	2.61
14.9	5.74	5.18	4.78	4.40	4.02	3.25	2.60

Graphical Flow Routing Method

Graphical Flow Routing Method



Approximate detention basin routing for rainfall types I, IA, II, and III.

(210-VI-TR-55, Second Ed., June 1986)

Standard Forms

BY:_____DATE:_____

Drainage Area _____ Ac

Q_D= TW_D=

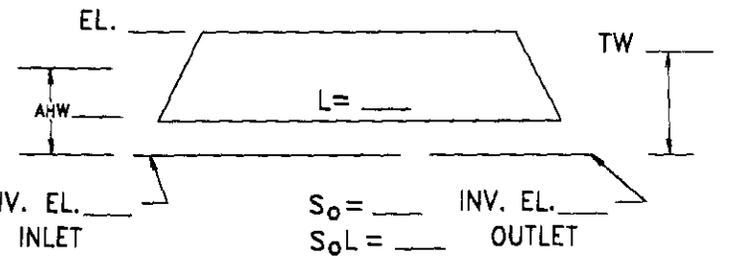
Q_C= TW_C=

QD=Design Discharge ____ Yr. Storm

Q_C=Check Discharge ____ Yr. Storm

Max. Cover Elevation_____

Min. Cover Elevation_____



CULVERT DESCRIPTION (Entrance type)	Q (CFS)	SIZE	HEADWATER COMPUTATION										Controlling HW	Outlet Velocity	Size Check	
			Inlet Control		OUTLET CONTROL HWO=H+h_o−LS_o										HW >	
			HWI/D	HWI	K_e	H	d_c	TW	(dc+D)/2	h_o	LS_o	HWO			$\frac{D+(1+K_e)V^2}{2g}$	.75D

Ditch break_____-_____=_____AHW

Edge of pavement_____-_____-_____=_____AHW

Critical Property_____-_____=_____AHW

Headwall Type _____

Endwall Type _____

Channel Protection Type _____

Cover on final selection

(1)	(2)
Min._____	Min._____
Max._____	Max._____

STREET_____STREAM_____

NEAREST INTER. STREET_____DISTANCE_____

c:\ddk\r14\stdform\culvert analysis

City of Lancaster
Department of Engineering

ORIFICE PLATE CALCULATIONS

JOB:
ENGINEER:
DATE:

Location [ ]

	Q =	[ ]
	INV. =	[ ]
	CENTER OF ORIFICE =	
	POND ELEV =	[ ]
	H =	
**	**PROP.d (in.)=**	[ ]
	C =	
	g =	

$A * A = Q * Q / (C*C(2gH))$

City of Lancaster
Engineering Department
Stormwater Storage Checksheet

Project: Consultant:
Calc By: dlc Date:

Acres
C(100)

Predeveloped release rate "Q=C(unimproved)xI(2)xA
I(2) C(unimproved) Q(out)
Tc(2)

C(100)xA Acres	I(100) Inch/Hr	Minutes	Volume In Cu Ft	Volume Out Cu Ft	Storage Required Cu Ft
	6.47	10			
	5.25	20			
	4.50	30			
	3.93	40			
	3.46	50			
	3.05	60			
	2.70	70			
	2.40	80			
	2.17	90			
	1.95	100			
	1.80	110			
	1.65	120			
	1.55	130			
	1.48	140			
	1.40	150			

Storage Required Cu Ft Acre-Ft

Legislation

(8/03)

ORDINANCE NO. 9-03

AN ORDINANCE TO ADOPT A STORM WATER ORDINANCE FOR THE PURPOSE OF CONTROLLING THE POLLUTION OF PUBLIC WATERS BY SEDIMENT FROM ACCELERATED SOIL EROSION AND ACCELERATED STORMWATER RUNOFF CAUSED BY EARTH DISTURBING ACTIVITIES AND LAND USE CHANGES CONNECTED WITH DEVELOPING URBAN AREAS

NOW, THEREFORE, BE IT ORDAINED, by the Council of the City of Lancaster, Fairfield, Ohio, that:

SECTION 1. That a stormwater ordinance be adopted as follows:

Chapter _____

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MAYOR

xxx.01 Purpose
xxx.02 Definitions
xxx.03 Scope
xxx.04 Disclaimer of Liability
xxx.05 Severability
xxx.06 Requirements
xxx.07 Exceptions
xxx.08 Standards and criteria
xxx.09 Sheet and rill erosion
xxx.10 Concentrated water erosion
xxx.11 Sloughing, landsliding and dumping
xxx.12 Stream channel and floodplain erosion
xxx.13 Sediment Control Plan content
xxx.14 Exceptions
xxx.15 Plan review
xxx.16 Inspection to ensure compliance
xxx.17 Appeals
xxx.18 Maintenance
xxx.99 Penalty

xxx.01 PURPOSE

This chapter is adopted for the purpose of controlling the pollution of public waters by sediment from accelerated soil erosion and accelerated stormwater runoff caused by earth-disturbing activities and land use changes connected with developing urban areas. Control of such pollution shall promote and maintain the health, safety and general well-being of all inhabitants of the City.

xxx.02 DEFINITIONS

For the purpose of this chapter, certain rules or word usage apply to the text as follows:

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(a) "City" means the City of Lancaster, Ohio or its duly designated representative.
(b) "Channel" means a natural stream that conveys water; a ditch or channel excavated for the flow of water.
(c) "Development area" means any contiguous area owned by one person or operated as one development unit and used or being developed for nonfarm commercial, industrial, residential or other nonfarm purposes upon which earth-disturbing activities are planned or under way.
(d) "District" means the Fairfield Soil and Water Conservation District.
(e) "Ditch" means an excavation either dug or natural for the purposes of drainage or irrigation with the intermittent flow.
(f) "Drainageway" means an area of concentrated water flow other than river, stream, ditch or grassed waterway.
(g) "Dumping" means leveling, pushing, piling, throwing, unloading or placing.
(h) "Earth-disturbing activity" means any grading, excavating, filling or other alteration of the earth's surface where natural or manmade ground cover is destroyed and which may result in or contribute to erosion and sediment pollution.
(i) "Earth material" means soil, sediment, rock, sand, gravel and organic material or residue associated with or attached to the soil.
(j) "Erosion" means
    (1) The wearing away of the land surface by running water, wind, ice, or other geological agents including such processes as gravitational creep.
    (2) Detachment and movement of soil or rock fragments by wind, water, ice or gravity.
    (3) "Erosion" includes
        A. "Accelerated erosion": erosion occurring much more rapid than normal, natural or geologic erosion, primarily as the result of the influence of the activities of man.
        B. "Floodplain erosion": abrading and wearing away of the overbank areas situated on either side of a channel due to overflow flooding.
        C. "Gully erosion": the erosion process whereby water accumulates in narrow channels during and immediately after rainfall or snow or ice melt and actively removes the soil from this narrow area to considerable depths such that the channel would not be obliterated by normal smoothing or tillage operations.
        D. "Natural erosion": geologic erosion or the wearing away of the earth's surface by water, ice or other natural environmental conditions of climate, vegetation, etc., undisturbed by man.
        E. "Normal erosion": the gradual erosion of land used by man which does not greatly exceed natural erosion.
        F. "Rill erosion": an erosion process in which numerous small channels only several inches deep are formed, occurs mainly on recently disturbed soils.

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G. "Sheet erosion": the removal of a fairly uniform layer of soil from the land surface by wind or runoff water.

(k) "Grassed waterway" means a broad or shallow natural course or constructed channel covered with erosion-resistant grasses or similar vegetative cover and used to conduct surface water.

(l) "Landside" means the rapid downward and outward movement of large rock matter and/or soil mass under the influence of gravity in which the movement of the soil mass occurs along an interior surface of sliding.

(m) "Public waters" means water within rivers, streams, ditches and lakes except private ponds and lakes wholly within single properties or waters leaving property on which surface water originates.

(n) "Sediment" means solid material both mineral and organic, that is in suspension, is being transported or has been moved from its site of origin by wind, water, gravity or ice, and has come to rest on the earth's surface above or below sea level.

(o) "Sediment basin" means a barrier, dam or other suitable detention facility built across an area of waterflow to settle and retain sediment carried by the runoff waters.

(p) "Sediment Control Plan" means a written description and graphical exhibit, acceptable to the City of methods for controlling sediment pollution from accelerated erosion on a disturbed development area of one or more contiguous acres or smaller areas that are part of a larger development over one acre.

(q) "Sediment pollution" means failure to use management or conservation practice to abate wind or water erosion of the soil or to abate degradation of the waters of the State by soil sediment in conjunction with land grading, excavating, filling or other soil-disturbing activities.

(r) "Slip" means a landslide as defined in subsection (l) hereof.

(s) "Sloughing" means a slip or downward movement of an extended layer of soil resulting from the undermining action of water or the earth-disturbing activity of man.

(t) "Soil loss" means soil relocation on or removed from a given site by the force of erosion and redeposit of the soil at another site on land or in a body of water.

(u) "Storm frequency" means the statistical average time within which a storm of a given duration and intensity can be expected to be equaled or exceeded.

(v) "Stream" means a body of water running or flowing on the earth's surface or channel in which such flow occurs. Flow may be seasonally intermittent.

(w) "Topsoil" means surface and upper surface soils which presumably are darker colored, fertile soil materials, ordinarily rich in organic matter or humus debris.

xxx.03 SCOPE

(a) This chapter shall apply to earth-disturbing activities to areas designated below which are within the jurisdiction of the City unless otherwise excluded within this chapter or unless expressly excluded by State law; land used or being developed for commercial, industrial, residential, recreational, public service or other nonfarm purposes.

(b) This chapter shall not apply to:

(1) Strip mining operations regulated by Ohio R.C. Chapter 1513; or

(2) Surface mining operations regulated by Ohio R.C. Chapter 1514.

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xxx.04 DISCLAIMER OF LIABILITY

Neither submission of a plan under provisions of this chapter nor compliance with provisions of this chapter shall relieve any person from responsibility for damage to any person or property otherwise imposed by law, nor impose any liability upon the City for damage to any person or property.

xxx.05 SEVERABILITY

If any clause, section or provision of this chapter is declared invalid or unconstitutional by a court of competent jurisdiction, the validity of the remainder shall not be affected thereby.

xxx.06 REQUIREMENTS

No person shall cause or allow earth-disturbing activities on a development area prior to submittal and approval of a sediment control plan showing compliance with the standards and criteria set out in Chapter xxx.

No storm sewer tap under Section 913.10, zoning clearance under Section 1155.02, approval of plans under Section 1105.08, or Flood Plain development permit under Section 1331.12 shall be issued until the developer receives approval of a sediment control plan and methods for control of stream channel and floodplain erosion control showing compliance with the standard and criteria set out in Chapter xxx.

xxx.07 EXCEPTIONS

(a) When the proposed earth-disturbing activity includes less than one acre and the development is exclusively one-, two- and three family housing not part of a larger development, it is not necessary to submit a sediment control plan; however, compliance with the other provisions of this chapter is required.

(b) No sediment control plan shall be required for public roads, highways, other transportation or drainage improvements or maintenance thereof, undertaken by a government agency or entity if such agency or entity plans to follow a sediment control policy which complies with this chapter.

xxx.08 STANDARDS AND CRITERIA

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In order to control sediment pollution of water resources, the owner or person responsible for the development area shall use conservation planning and practices to maintain the level of conservation established by standards set forth by the Ohio Department of Natural Resources, Division of Soil and Water Conservation and the City Engineer.

xxx.09 SHEET AND RILL EROSION

To control pollution of public waters by soil sediment form accelerated sheet and rill erosion of development areas, the person responsible shall:

(a) Construct and maintain sediment basins sized in accordance with the Ohio Department of Natural Resources handbook, "Rainfall and Land Development"; or

(b) Use other Best Management Practices designed in accordance with the Ohio Department of Natural Resources handbook "Rainfall and Land Development" to control sediment pollution, provided those methods are acceptable to the City.

xxx.10 CONCENTRATED WATER EROSION

To control pollution of public waters by soil sediment form accelerated erosion in drainageways, grassed waterways, streams and ditches disturbed or modified in conjunction with the development process, the person responsible for the change shall:

(a) Design, construct and maintain sediment basins sized in accordance with the Ohio Department of Natural Resources handbook, "Rainwater and Land Development"; or,

(b) Use other Best Management Practices designed in accordance with the Ohio Department of Natural Resources handbook "Rainfall and Land Development" to control sediment pollution provided those methods are acceptable to the City.

xxx.11 SLOUGHING, LANDSLIDING AND DUMPING

To control sediment pollution of public waters caused by sloughing, landsliding or dumping of earth material, or placing of earth material into such proximity that it may readily slough, slide or erode into public waters by natural forces, no person shall:

(a) Dump or place earth material into public waters or into such proximity that it may readily slough, slide or erode into public waters unless such dumping or placing is authorized by the City for such purposes as constructing bridges, culverts, erosion control structures and other in-stream or channel bank improvement works; or,

(b) Grade excavate, fill or impose a load upon any soil or slope known to be prone to slipping or landsliding, thereby causing it to become unstable, unless qualified engineering assistance has been employed to explore the stability problems and make recommendations to correct, eliminate or adequately address the problems. Grading, excavating, filling or construction shall commence only after the City has reviewed and approved the exploratory work and recommendations and only in accordance with the approved recommendations.

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xxx.12 STREAM CHANNEL AND FLOODPLAIN EROSION

(a) To control pollution of public waters by soil sediment from accelerated stream channel erosion and to control floodplain erosion caused by accelerated stormwater runoff from the development areas, the increased peak rates and volumes of runoff shall be controlled such that the peak rate of runoff from the twenty four hour storm having a recurrence frequency of 100 years occurring on the development area does not exceed the peak rate of runoff from a two year frequency, twenty four hour storm occurring on the same area under predevelopment conditions.

(b) Methods for controlling increases in stormwater runoff peaks and volumes may include but are not limited to:

(1) Retarding flow velocities by increasing friction; for example, grassed road ditches rather than paved street gutters where practical, low density development areas, access roads, etc; discharging roof water to vegetated areas; or grass- and rock-lined drainage channels;

(2) Grading and construction of terraces and diversions to slow runoff and use of grade control structures to provide a level of control in flow paths and stream gradients;

(3) Inducted infiltration of increase stormwater runoff into the soil where practical; for example, constructing special infiltration area where soils are suitable; retaining topsoil for all areas to be revegetated; or providing good infiltration areas with proper emergency overflow facilities; and,

(4) Provisions for detention and retention; for example, permanent ponds and lakes with stormwater basins provided with proper drainage, multiple use areas for stormwater detention and recreation, wildlife, transportation, fire protection, aesthetics or subsurface storage areas.

xxx.13 SEDIMENT CONTROL PLAN CONTENT

In compliance with Section xxx.06 a Sediment Control Plan for the proposed development area, with maps drawn to scale of not less than one inch equals one hundred feet shall be submitted containing the following information:

(a) Location of the area and its relation to its general surroundings including but not limited to:

(1) Adjacent properties

(2) Major drainage and waterways

(3) Off-site areas susceptible to sediment deposits or to erosion caused by accelerated runoff from the site.

(4) Off-site areas affecting potential accelerated runoff and erosion control.

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(b) Existing topography of the development area and adjacent land within 100 feet of the boundaries. A topographic map should contain an appropriate contour interval to clearly portray the drainage pattern of the area;

(c) The location of existing buildings, structures, utilities, water bodies, drainage facilities, vegetative cover, paved areas and other significant natural or manmade feature on the development area and adjacent land within 100 feet of the boundaries;

(d) A general description of the predominate soil types, their location and their limitations for the proposed use;

(e) Proposed use of the development area including present development and ultimate utilization with detail on soil cover, both vegetative and impervious;

(f) All proposed earth disturbance including:

(1) Areas of excavating, grading and filling.

(2) The finished grade, stated in feet horizontal to feet vertical of cut and fill slopes.

(3) Kinds of utilities and proposed areas of installation.

(4) Proposed total paved and covered areas in square feet or to scale on a plan map.

(5) Makeup of proposed surface soil, the upper six inches, on areas not covered by buildings, structures or pavement. Description shall be in such terms as: original surface soil, subsoil, sandy, heavy clay, stony, etc.

(6) Proposed kind of cover of areas not covered by buildings, structures or pavement. Description shall be in such terms as: lawn, turfgrass, shrubbery, trees, forest cover, rip-rap, mulch, etc.

(g) Provisions for temporary and permanent erosion control;

(h) Provisions for construction site waste management including but not limited to demolition and debris, material storage, sanitary waste, wash water, chemicals and petroleum.

(i) Provisions for the management of stormwater, derived both on-site and from upper watershed areas, including the control of accelerated on-site runoff, to a stable receiving outlet;

(j) Provisions for inspection and maintenance of control facilities including easement to insure short- as well as long-term erosion and sediment pollution control and stormwater management;

(k) Proposed construction sequence and time schedule for all earth-disturbing activities and installation of facilities for erosion and stormwater management;

(l) Design computation and applicable assumptions for all structural measures for erosion and sediment pollution control and water management. Volume and velocity of flow shall be given for all surfaces provided for surface water outlets.

(m) Seeding mixtures and rates, lime and fertilizer application rates and kind and quantity of mulching for both temporary and permanent vegetative control measures;

(n) Estimate of the cost of erosion and sediment control and water management structures and features;

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(o) Title, scale, direction, legend and date of all plan maps;
(p) Name and address of the person(s) preparing the plan, the owners and the person responsible for the development area.

xxx.14 EXCEPTIONS

The City Engineer may waive specific requirements for the plan detail if the area is covered by a previously approved plan or is incorporated into a development permit under Chapter 1331.

xxx.15 PLAN REVIEW

The City shall, in a reasonable time period, indicate its approval or disapproval to the person who filed the plan. Indication of disapproval shall include the plan deficiencies and the procedures for filing a revised plan. Pending preparation and approval of a revised plan, earth disturbing activities shall proceed only in accordance with conditions outlined by the City.

xxx.16 INSPECTION TO ENSURE COMPLIANCE

The City or its authorized representative may inspect development areas to determine compliance with these regulations and the approved sediment control plan. If it is determined that a violation of these regulations exists, the responsible person shall be notified of the deficiencies or noncompliance. After a reasonable time for voluntary compliance, the inspector or inspecting agency shall report the deficiency or noncompliance to the City. The City, upon determining that a person is not complying with these regulations, may issue an order to comply. The order shall describe the problem and the work needed, and specify a date when the work shall be completed. The City maintains the right to issue a stop-work order for non-compliance with specified time schedule or upon City determination of a need to remedy of a serious problem.

xxx.17 APPEALS

Any person aggrieved by any order, requirement, determination or any other action or inaction in relation to this chapter may appeal to the Board of Zoning Appeals.

xxx.18 MAINTENANCE

(a) When a site is developed under single ownership, the costs of maintaining any soil sediment control facilities shall be the responsibility of the property owner.
(b) When the benefiting area will involve two or more property owners, the person(s) developing the site shall provide for the permanent maintenance of structures and other facilities designed to control erosion and manage stormwater through the formation of an owners association. The cost of maintenance of all stormwater facilities shall be the responsibility of the association.

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xxx.99 PENALTY

Whoever violates any provision of this chapter shall be deemed guilty of a 4th degree misdemeanor subject to a $1000 per day penalty.

Section 2. This ordinance shall take effect and be in full force from and after the first day of the month following the earliest day allowed by law after its passage by Council and approval by the Mayor.

Passed: 4/14/03 after 3RD reading. Vote: Yeas 7 Nays 0

Approved: 4/15/03

President of Council

Attest:

Mayor

Offered by:

Second by:

Requested by Law Committee

I, _____, Clerk of Council do hereby certify that on _____, 20 and _____, 20____ the Lancaster Eagle Gazette published the summary of this ordinance in accordance with Ohio Revised Code 731.24.

_____
Clerk of Council

Contact Numbers

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Fax: (740) 681-5030

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Phone: (740) 687-6670
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Street Department
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Lancaster, Ohio 43130

Phone: (740) 687-6668
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Water Department
225 N. Memorial Drive
Lancaster, Ohio 43130

Phone: (740) 687-6630
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Water Pollution Control Facility
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