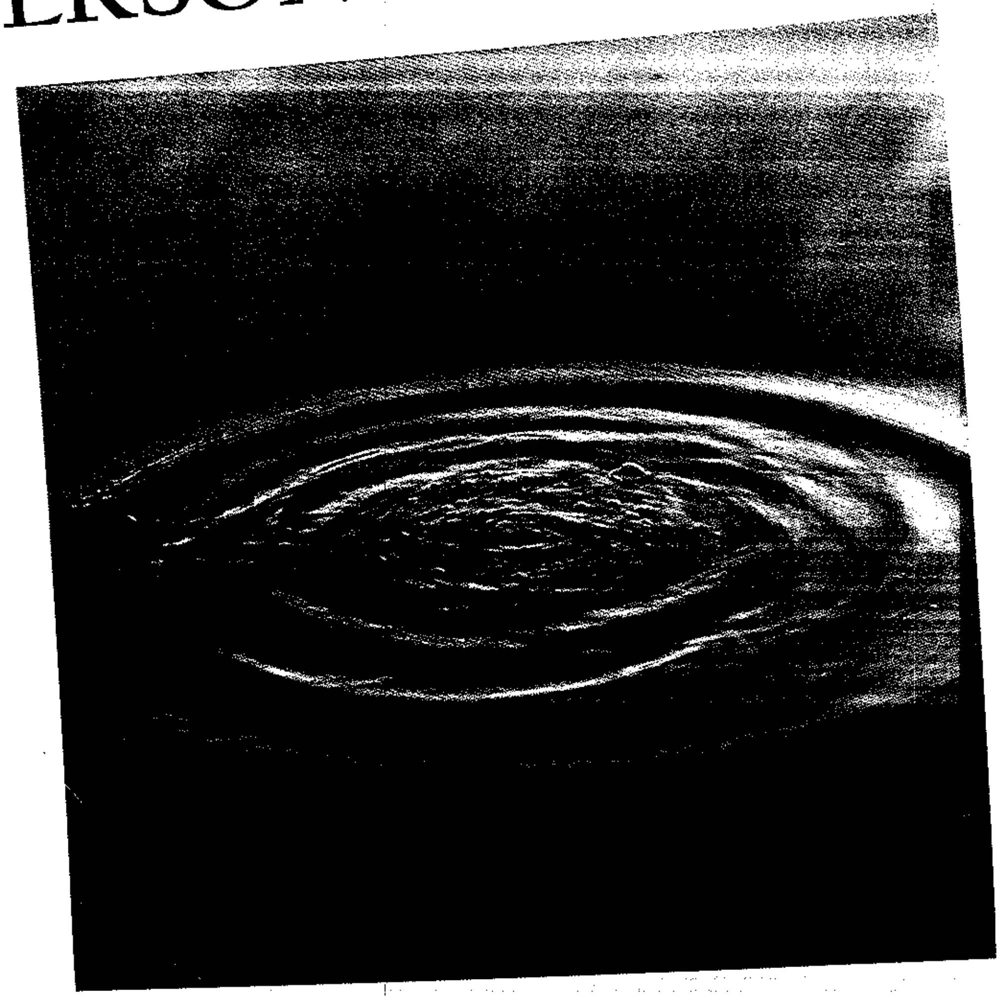
ORDINANCE 2006-OR-20

CITY OF JEFFERSONVILLE, INDIANA



DRAINAGE ORDINANCE

SECTION 1 - PURPOSE AND INTENT

The purpose of this ordinance is to provide for the health, safety, and general welfare of the citizens of Jeffersonville through the regulation of storm water runoff. This ordinance establishes guidelines for construction of residential and commercial properties within the jurisdiction of the Jeffersonville Drainage Board.

SECTION 2 - ACRONYMS

For the purposes of this ordinance, the following shall mean:

1.	ASTM	American Society for Testing Materials
2.	JDB	Jeffersonville Drainage Board
3.	DGA	Dense Graded Aggregate
4.	FEMA	Federal Emergency Management Agency
5.	HAC	Hot Asphalt Concrete
6.	INDOT	Indiana Department of Transportation
7.	NGVD	National Geodetic Vertical Datum
8.	NRCS	USDA Natural Resources Conservation Service
9.	RCP	Reinforced Concrete Pipe
10.	SCS	Soil Conservation Service (now known as the USDA Natural Resources Conservation Service)

SECTION 3 - DEFINITIONS

1. **ASTM**. American Society for Testing Materials, an association that publishes standards and requirements for materials used in the construction industry.
2. **Blue Line Stream**. Any stream depicted blue in color, solid or dashed, on a USGS Quad Map.
3. **Capacity of a Storm Drainage Facility**. The maximum flow that can be conveyed or stored by a storm drainage facility without causing damage to public or private property.
4. **Catch Basin**. A chamber usually built at the curb line of a street for the admission of surface water to a storm sewer or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.
5. **Channel**. A portion of a natural or artificial watercourse which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. It has a defined bed and banks, which serve to confine the water.
6. **Contour**. An imaginary line on the surface of the earth connecting points of the same elevation.
7. **Contour Line**. Line on a map, which represents a contour or points of equal elevation.
8. **Crown of Pipe**. The elevation of the top of pipe.
9. **Culvert**. A closed conduit used for the conveyance of surface drainage water under a roadway, railroad, canal or other impediment.
10. **Datum**. Any level surface to which elevations is referred, usually using Mean Sea Level.
11. **Dense Graded Aggregate**. Indiana No. 9 Crushed Stone.
12. **Design Storm**. A selected storm event, described in terms of the probability of occurring

once within a given number of years, for which drainage of flood control improvements are designed and built.

13. **Detention**. Managing storm water runoff by temporary holding and controlled release.
14. **Detention Basin**. A facility constructed or modified to restrict the flow of storm water to a prescribed maximum rate, and to detain concurrently the excess waters that accumulated behind the outlet.
15. **Detention Storage**. The temporary detaining of storm water in storage facilities, on rooftops, in streets, parking lots, school yards, parks, open spaces or other areas under predetermined and controlled conditions, with the rate of release regulated by appropriately installed devices. (Refer to Section 8).
16. **Detention Time**. The theoretical time required to displace the contents of a tank or unit at a given rate of discharge (volume divided by rate of discharge).
17. **Discharge**. Usually the rate of water flow. A volume of fluid passing a point per unit time commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, or millions of gallons per day.
18. **Drainage Area**. The area draining into a stream at a given point. It may be of different sizes for surface runoff, subsurface flow and base flow, but generally the surface runoff area is considered as the drainage area.
19. **Drainage Board**. The Jeffersonville Drainage Board
20. **Drainage Improvement**. An activity within or adjacent to a natural stream or a man-made drain primarily intended to improve the flow capacity, drainage, erosion and sedimentation control, or stability of the drainage way.
20. **Drop Inlet**. A structure in which water drops through a vertical riser connected to a discharge conduit or storm sewer.
21. **Earth Embankment**. A man-made placement of soil, rock, or other material often used to form an impoundment.
22. **Easement**. A right of use over designated portions of the property of another for a clearly specified purpose.
23. **Emergency Spillway**. Usually a vegetated earth channel used to safely convey flood discharges around an impoundment structure.
24. **Flood Elevation**. The maximum level of high waters for a flood of a given return period and rainfall duration.
25. **Flood or Flood Water**. Water that overflows the banks of a lake or watercourse.
26. **Flood Hazard Area**. Any floodplain, floodway, floodway fringe, or any combination which is subject to inundation by the regulatory flood elevation or any floodplain as delineated by Zone A on the current Flood Hazard Boundary Map of the Federal Emergency Management Agency.
27. **Floodplain**. The area adjoining the river or stream that has been or may be covered by floodwaters. It consists of both the floodway and the floodway fringe.
28. **Floodway**. The channel of a river or stream and those portions of the flood plains adjoining the channel, which is reasonably required to, efficiently carry and discharge the peak flow of the regulatory flood of any river or stream.
29. **Floodway Fringe**. That portion of the floodplain lying outside the floodplain lying outside the floodway that is inundated by the regulatory flood.

30. **Grade**. (1) The slope of a road, a channel, or natural ground. (2) The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared to a

design elevation for the support of construction, such as paving or the laying of a conduit. (3) To finish the surface of a channel bed, roadbed, top of embankment, or bottom of excavation, or other land area to a smooth, even condition.

31. **Head**. (1) The height of water above any plane of reference. (2) The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit would have to fall to release the average energy possessed. Used in various compound terms, such as pressure head or velocity head.
32. **Head Loss**. Energy loss due to friction, eddies, changes in velocity, elevation, or direction of flow.
33. **Headwater**. (1) The source of a stream. (2) The water upstream from a structure or point on a stream.
34. **Hydrograph**. A graph showing for a given point on a stream the discharge, stage (depth), velocity, or other property of water with respect to time.
35. **INDOT**. Indiana Department of Transportation. Generally used here to refer to specifications contained in the publication "INDOT Standard Specifications."
36. **NGVD**. A particular elevation datum known as the National Geodetic Vertical Datum of 1929 (NGVD 1929).
37. **Inlet**. An opening into a storm sewer system for the entrance of surface storm water runoff more completely described as a storm sewer inlet.
38. **Invert**. The inside bottom of a culvert or other conduit.
39. **Manhole**. Storm sewer structure through which a person may enter to gain access to a storm sewer or enclosed structure. A manhole may also be an inlet for the storm sewer system.
40. **Professional Land Surveyor**. A person licensed under the laws of the State of Indiana to practice land surveying.
41. **Professional Engineer**. A person licensed under the laws of the State of Indiana to practice professional engineering.
42. **Rainfall Intensity**. The rate at which rain is falling at any given instant, usually expressed in inches per hour.
43. **Rational Method**. A means of computing storm drainage flow rates (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the rainfall intensity and A is the area.
44. **Regulatory Flood**. A flood with a peak having a probability of occurrence of one (1) percent in any given year, which is commonly referred to as a one hundred (100) year flood as calculated by a method and procedure, which is acceptable to the Board. If a permit for construction in a floodway is required by the Indiana Department of Natural Resources, the regulatory peak discharge must be calculated by the method and procedure acceptable to the Board and the Indiana Department of Natural Resources.
45. **Regulatory Floodway**. The channel of a river or stream and those portions of the floodplain adjoining the channel which are reasonably required to carry and discharge the peak flow of the regulatory flood of any river or stream.
46. **Retention Facility**. A facility designed to completely retain a specified amount of storm water runoff without release except by means of evaporation, infiltration or pumping.

47. **Runoff**. That portion of precipitation that flows from a drainage area on the land surface, in open channels, or in storm water conveyance systems.
48. **Sinkholes**. A sinkhole is any closed depression in a limestone region formed by the removal of water, surficial soil, rock or other material, that is connected to a cavern or underground

passage. The sinkhole drainage area shall include any area that contributes surface water directly to the sinkhole.

49. **Slope**. Degree of deviation of a surface from the horizontal, measured as a numerical ratio or percent. Expressed as a ratio, the first number is commonly the horizontal distance (run) and the second is the vertical distance (rise) - e.g., 2:1. However, the preferred method for designation of slopes is to clearly identify the horizontal (H) and vertical (V) components (length (L) and Width (W) components for horizontal angles). Also note that according to international standards (Metric), the slopes are presented as the vertical or width component shown on the numerator - e.g., 1V: 2H. Slope expressions in this handbook follow the common presentation of slopes - e.g., 2:1 with the metric presentation shown in parenthesis - e.g., (1V: 2H). Slopes can also be expressed in "percents". Slopes given in percents are always expressed as (100V/H) -e.g.; a 2:1 (1V: 2H) slope is a 50% slope.
50. **Soil**. The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Also see alluvial soil, Clay, Cohesive soil, Loam, Permeability (soil), Sand, Silt, Soil horizon, Soil profile, Subsoil, Surface soil, Topsoil.
51. **Storm Event**. An estimate of the expected amount of precipitation within a given period of time. For example, a 10-yr. frequency, 24-hr. duration storm event is a storm that has a 10% probability of occurring in any one year. Precipitation is measured over a 24-hr. period.
52. **Storm Frequency**. The time interval between major storms of predetermined intensity and volumes of runoff - e.g., a 5-yr., 10-yr. or 20-yr. storm.
53. **Storm Sewer**. A sewer that carries storm water, surface drainage, street wash, and other wash waters but excludes sewage and industrial wastes. Also called a storm drain.
54. **Storm water**. Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.
55. **Surface Runoff**. Precipitation that flows onto the surfaces of roofs, streets, the ground, etc., and is not absorbed or retained by that surface but collects and runs off.
56. **Time of Concentration (Tc)**. The travel time of a particle of water from the most hydraulically remote point in the contributing area to the point under study. This can be considered the sum of an overland flow time and times of travel in street gutters, storm sewers, drainage channels, and all other drainage ways.
57. **Watershed Area**. All land and water within the confines of a drainage divide.
58. **Zoning Ordinance**. Jeffersonville Indiana Zoning Ordinance or any replacement zoning ordinance and its amendments.

SECTION 4 - GENERAL PROVISIONS

APPLICABILITY

1. This section shall apply to all developments requiring a permit or approval, from the Jeffersonville Plan Commission, or any other agency of Jeffersonville, subject to the following exceptions:
    1. Projects that require only individual Improvement Location Permits for a single family dwelling, a two-family dwelling, or their accessory structures are not subject to these requirements.
    2. Projects that are agricultural structures in locations included in current soil and waster conservation plans that have been approved by the Clark County Soil and Water Conservation District are also exempt from these requirements.

3. The provisions of this section shall be deemed as additional requirements to minimum standards required by other ordinances of the City. In the case of conflicting requirements, the most restrictive shall apply.
4. The Drainage Board may grant a waiver from any requirements of these regulations if there are exceptional circumstances applicable to the site such that strict adherence to the provisions of these regulations will result in unnecessary hardship and not fulfill the intent of these regulations.

RESPONSIBILITY FOR ADMINISTRATION
The Jeffersonville Drainage Board (JDB) shall administer, implement, and enforce the provisions of this ordinance. Any powers granted or duties imposed upon the JDB may be delegated in writing by the Drainage Board to the enforcement personnel.

SEVERABILITY
The provisions of this ordinance are hereby declared to be severable. If any provision, clause, sentence, or paragraph of this Ordinance or the application thereof to any person, establishment, or circumstances shall be held invalid, such invalidity shall not affect the other provisions or application of this Ordinance.

ULTIMATE RESPONSIBILITY
The standards set forth herein and promulgated pursuant to this ordinance are minimum standards.

NOTICE OF VIOLATION
Whenever the Jeffersonville Drainage Board finds that a person or developer has violated or failed to meet a requirement of this Ordinance, the JDB may order compliance by written notice of violation to the responsible person.

APPEAL OF NOTICE OF VIOLATION
Any person receiving a Notice of Violation may appeal the determination of the JDB. The notice of appeal must be received within 10 calendar days from the date of the Notice of Violation. Hearing on the appeal before the JDB shall take place within 30 calendar days from the date of receipt of the notice of appeal. The decision of the JDB shall be final.

ENFORCEMENT MEASURES AFTER APPEAL
If the violation has not been corrected pursuant to the requirements set forth in the Notice of Violation, or, in the event of an appeal, within five days of the decision of the JDB, the JDB may pursue all remedies provided for in this ordinance or by law.

INJUNCTIVE RELIEF
It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of this ordinance. If a person has violated or continues to violate the provisions of this ordinance, the JDB may seek any remedies available under any applicable law, including, but not limited to the following:
1. Preliminary or permanent injunction
2. Stop work order.

CIVIL PENALTIES

Any person, firm, or corporation who shall violate or fail to comply with any of the provisions of this ordinance shall be liable for civil penalties to the JDB up to $2,500.00. Each day that the violation exists or continues shall be deemed a separate offense. Any such person, firm or corporation shall also reimburse the JDB for all attorneys' fee incurred in any enforcement action.

VIOLATIONS DEEMED A PUBLIC NUISANCE
In addition to the enforcement processes and penalties provided, any condition caused or permitted to exist in violation of any of the provisions of this ordinance may be summarily abated or restored at the violator's expense, or a civil action to abate, enjoin, or otherwise compel the cessation of such nuisance may be taken.

REMEDIES NOT EXCLUSIVE
The remedies listed in this ordinance are not exclusive of any other remedies available under any applicable federal, state or local law. It is within the discretion of other authorized enforcement agencies to seek cumulative remedies.

PERMITS FOR CONSTRUCTION IN A FLOODWAY
The 1945 Flood Control Act (Indiana Code 13-2-22) of the State of Indiana prohibits the construction of abodes or residences in or on a floodway. Prior approval of the Department of Natural Resources is required for any type of construction, excavation, or filling in or on a floodway.

WETLANDS
Landowners and/or developers must notify and make application to all appropriate state and federal agencies with authority for wetland protection. In cases where federal or state jurisdictional wetlands have been determined to exist, those wetland areas and boundaries must be indicated on preliminary and final drainage plans.

The Board will not make determinations of the accuracy of delineation or extent of jurisdictional wetlands. Approvals required by this ordinance may be deferred until wetland-related approvals have been obtained.

SECTION 5 - DESIGN METHODOLOGY FOR STORM SEWER

This chapter establishes the minimum required standards for the planning and design of drainage systems and storm water management facilities within Jeffersonville. All plans concerning drainage shall be prepared under the supervision of and certified by a Registered Land Surveyor or Professional Engineer licensed by the State of Indiana. It is assumed that practicing Engineers/Surveyors involved with preparing drainage plans have adequate knowledge of the recommended procedures; therefore, there is no attempt in the document to provide step-by-step calculation methodologies.

STORM SEWER DESIGN PARAMETERS
All storm sewers, whether private or public, and whether constructed on private or public property shall be designed to handle the flow for a minimum storm return period of 10 years (10 year storm). In addition, storm systems shall be designed to store the return period of 100 years (100 year storm). These design parameters will allow surface water to drain into the storm system and not allow water to stand outside the public right-of-way and easements.

The runoff calculation procedures to be utilized depends upon the size of the proposed development or project as follows:

1. If the total tributary area to an existing or proposed storm water facility project watershed is 100 acres or less, or storage design is required for a site containing one acre or less, the method of runoff calculation shall be the Rational Method.
2. If the total project drainage area is greater than 100 acres, or storage design is required for a site containing more than one acre, a discharge hydrograph must be calculated using the NRCS method or another method that has been approved by the JDB.
3. The Rational Method may be used to design through drainage channel if the drainage area of the channel is 100 acres or less, otherwise, the channel shall be designed by NRCS runoff calculation methodology or another method that has been approved by the JDB.

FREQUENCY/RETURN PERIOD

The elevation of the 100-year pre- and post- development discharge shall be checked for all drainage system designs to assure conformance with the guidelines of the FEMA Program. In the areas of the City not covered by a Flood Insurance Study, the Design Engineer or Land Surveyor must determine the pre-development 100-year Flood Elevation. The elevation for the 100-year post-development discharge shall be conveyed within the limits of the proposed easement.

RAINFALL DURATION

The minimum design storm duration for planning and design is dependent upon the runoff method used.

1. The Rational Method calculates peak discharge only (as opposed to developing a runoff hydrograph for an area). It makes a basic assumption that the design storm has constant rainfall intensity for a time period (storm duration) equaling the project area time of concentration.
2. The NRCS Method will utilize the NRCS Type II 24-hour rainfall distribution. The exception is for the design of detention/retention basins where the 6-hour storm is used.

RAINFALL DEPTH

Rainfall Intensity-Duration Curves for Louisville, Kentucky shall be utilized in the Rational Method to determine rainfall depths and storm intensities for Jeffersonville.

SURFACE CONDITION DATA

Maps depicting the NRCS Hydrologic Soil Groups, Existing Land Use, and Projected Land Use for each watershed shall be evaluated to determine the appropriate surface condition factors for use in runoff calculations.

RUNOFF CALCULATION METHODS (DESIGN FLOW)

Determination of Runoff Quantities:

Runoff quantities shall be computed for the area of the parcel under development plus the area of the watershed flowing into the parcel under development. The quantity of runoff which is generated as the result of a given rainfall intensity shall be calculated as follows:

For areas up to and including 100 acres and storage design required for a site containing one acre or less the Rational Method may be used. In the Rational Method, the peak rate of runoff, Q, in cubic feet per second is computed as:

$Q = CIA$

Where: C = Runoff coefficient, representing the characteristics of the drainage area and defined as the ratio of runoff to rainfall.

I = Average intensity of rainfall in inches per hour for a duration equal to the time of concentration (Tc) for a selected rainfall frequency.

A = Tributary drainage area in acres.

The rainfall intensity factor, I, should be obtained from the Louisville, Kentucky Rainfall Intensity-Duration Curves.

The time of concentration (Tc) to be used shall be the sum of the inlet time and flow time in the drainage facility from the most remote part of the drainage area to the point under consideration. The flow time in the storm sewers may be estimated by the distance in feet divided by velocity of flow in feet per second. The velocity shall be determined by the Manning's Formula. Inlet time is the combined time required for the runoff to reach the inlet of the storm sewer. It includes overland flow time and flow time through established surface drainage channels such as swales, ditches and sheet flow across such areas as lawns, fields and other graded surfaces.

The time of concentration, Tc, shall be determined by calculating the time for a particle of water to travel from the most hydrological remote point of the project area to the point of interest. Time of concentration to the first inlet or structure may be estimated by the Kirpick Equation (Tc = 0.0078*L^0.77*s^-0.385) where L equals length of travel in feet and S equals slope in foot per foot. Other methods to derive time of concentration such as TR-55, Kerby's Equation and the Kinematic Wave method will be acceptable. The minimum Tc shall not be less than 10 minutes. Manning's Equation should be used to estimate any in-pipe or channel travel.

Guidance to selection of the runoff coefficient "C" is provided by Table 1, which shows values for different types of surface and local soil characteristics. The composite "C" value used for a given drainage area with various surface types shall be the weighted average value for the total area calculated from a breakdown of individual areas having different surface types.
A listing of soils groups with their corresponding Hydraulic Soil Group can be found in the Appendix. They are classified into four categories: A, B, C, and D.

TABLE 1
RUNOFF COEFFICIENTS BASED ON LAND USE, SOIL GROUPS AND SLOPE RANGE (%)

		A			B			C			D		
LAND USE	% IMP	0-2	2-7	7+	0-2	2-7	7+	0-2	2-7	7+	0-2	2-7	7+
Residential	25	.31	.35	.39	.33	.38	.43	.37	.41	.48	.40	.44	.52
	38	.42	.45	.49	.44	.48	.52	.47	.50	.56	.50	.53	.59
	65	.65	.67	.69	.66	.68	.71	.68	.70	.73	.69	.71	.75
	75	.73	.75	.77	.75	.76	.78	.76	.77	.79	.77	.78	.80
Commercial Business	85	.82	.83	.84	.83	.84	.85	.84	.85	.86	.84	.85	.86
Industrial	72	.71	.73	.74	.72	.74	.76	.73	.75	.77	.75	.76	.79
Roofs, Driveways, Streets, etc.	100	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
Open Spaces, Lawns, Parks, etc.	0	.09	.15	.21	.13	.19	.26	.18	.23	.32	.22	.27	.37
Woodlands	0	.09	.15	.20	.13	.18	.23	.17	.22	.26	.20	.25	.30
Pasture, Grass and Farmland	0	.15	.20	.25	.18	.23	.30	.22	.26	.35	.25	.30	.40
Newly Graded/Disturbed		.65	.67	.69	.66	.68	.71	.68	.70	.73	.69	.71	.75

USDA NATURAL RESOURCES CONSERVATION SERVICE METHODS
The NRCS Methods are required for runoff calculation procedures for project sites where the total project area is greater than 100 acres or the storage design required for a site is more than one acre.

METHODS
The NRCS methods also include the TR-20 and TR-55 Methods. Detailed descriptions, example calculations <u>and</u> worksheets for these methods are available in:
1. Project Formulation - Hydrology, Technical Release No. 20 User's Manual;
2. Urban Hydrology for Small Watersheds Technical Release No. 55; and
3. A guide to Hydrologic Analysis Using NRCS Methods.

CURVE NUMBER
The curve number is similar to the Rational Method C-Factor in that it is based on the surface condition of the project site.

For through drainage systems, post developed curve numbers shall be based on a watershed as developed at the time of design.

DESIGN FLOWS
At a minimum, the facility must have the capacity to transport the 10-year post-development discharge except in unusual cases, such as retrofit projects. The JDB shall determine design criteria for retrofit projects or other unusual cases. The water surface profile and through system capacity shall be checked for the 100-year post-development discharge. All drainage systems shall be capable of passing the 100-year design flow within the drainage easement. Additional facility specific

requirements are found in the following portions of this ordinance.

SECTION 6 - STORM SEWER DESIGN STANDARDS

The Professional Engineer or Professional Land Surveyor shall refer to the Ten State Standards for design methodology for storm sewers. The exception being that all storm sewer systems will be designed for the 10-year event. The 100-year discharge elevation must be checked for all locations to avoid flood damage to adjacent structures. Manning's Equation is recommended to calculate pipe flow and velocity. The storm sewer hydraulic grade line for the 100-year event shall be contained within the storm sewer system.

Hydraulic Capacity

The hydraulic capacity of storm sewers shall be determined using Manning's Equation:

$$Q = \frac{1.486\, R^{2/3}\, S^{1/2}\, A}{n}$$

Q = volumetric flowrate (cfs)

R = the hydraulic radius in feet

S = the slope of the energy grade line in feet per foot

n = roughness coefficient (for reinforced concrete pipe, n = 0.013)

A = cross-sectional area (Ft^2)

Roughness coefficient (n) values for other sewer materials can be found in standard hydraulics texts and references.

Minimum Size:

To minimize the potential for pipes to become clogged, the minimum size of all storm sewers shall be 12 inches. This does not pertain to outlet structures for detention/retention basins. (The rate of release for detention storage shall be controlled by an orifice plate of other devices, subject to approval of the Board, where the 12-inch pipe will not limit rate of release as required.)

Grade:

Sewer grade shall be such that, in general, a minimum of 18 inches of cover will be maintained over the top of the pipe when reinforced concrete pipe is used. Pipe cover less than the minimum may be used only upon approval of the Board. Uniform slopes shall be maintained between inlets, manholes and inlets to manholes. Final grade shall be set with full consideration of the capacity required, sedimentation problems and other design parameters. Minimum and maximum allowable slopes shall be those capable of producing velocities of two and 15 feet per second, respectively, when the sewer is flowing full.

Alignment:
In general, storm sewers shall be straight between structures. Where long radius curves are necessary to conform to street layout, the minimum radius of curvature shall be no less than 100 feet for sewers 42 inches and larger in diameter. Deflection of pipe sections shall not exceed the maximum deflection recommended by the pipe manufacturer. The deflection shall be uniform and finished installation shall follow a smooth curve.

Manholes:
Structures shall be installed to provide access to continuous underground storm sewers for the purpose of inspection and maintenance. Manholes shall be provided at the following locations:

1. Where two or more storm sewers converge.
2. Where pipe size changes.
3. Where an abrupt change in alignment occurs.
4. Where a change in grade occurs.
5. At suitable intervals in straight sections of sewer.
6. Pipe materials change.

The maximum distance between storm sewer manholes shall be as follows:

Size of Pipe (inches)	Maximum Distance (feet)
12 thru 42	400
48 and larger	600

Inlets:
Inlets or drainage structures shall be utilized to collect surface water through grated openings and convey it to storm sewers, channels or culverts. Inlets contained within roadways shall be placed at low points with a maximum spacing of 400 feet from high points and addition inlets upstream and downstream. The inlet grate opening provided must be adequate to pass the design 10-year flow with 50% of the sag inlet areas clogged. Additional, positive drainage shall be designed in low areas to minimize property damage.

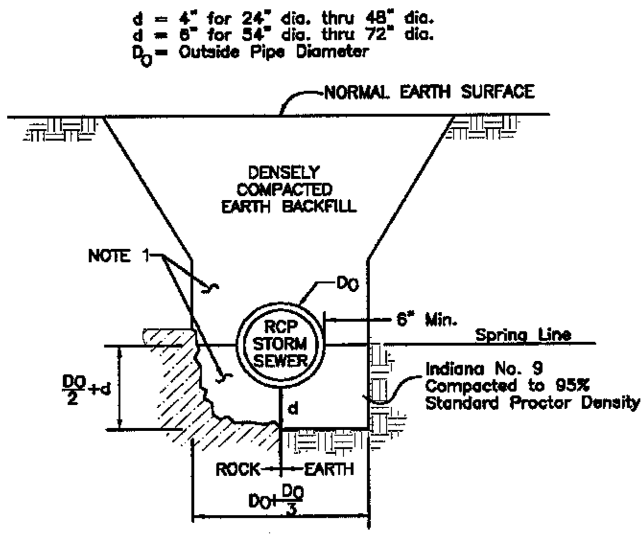
Workmanship and Materials:
The specifications for the construction of storm sewers shall not be less stringent than those set forth in the latest revision of the Indiana Department of Highways' "Standard Specifications."

Materials:
Storm sewer manholes and inlets shall be constructed of cast in place concrete or precast reinforced concrete. Material and construction shall conform to Indiana Department of Highways' "Standard Specifications," Section 720.

Pipe and fittings used in storm sewer construction must be reinforced concrete pipe (ASTM C-76). In areas where there is no anticipation of heavy loads (i.e. trucks, tractors, farm equipment), ADS and/or Hancor pipe can be installed using the manufacturer's specifications and proper bedding material.

Inlets contained within the roadways at the low points shall be Neenah type R - 3260 - A. Inlets in ditches shall be Neenah type R - 4353. Equivalent type inlets may be used only with the approval of the City.

Pipe Bedding, Backfill and Surface Restoration:
All pipes must be bedded according to the detail below, but not limited to the following:



STORM SEWER TRENCH & BEDDING DETAIL

1. Where pipe is installed in earth areas, not immediately adjacent to a street or road, place Indiana No. 9 crushed stone to the spring line for RCP. The remainder of the trench must be backfilled with selected earth materials, humped over the trench to allow for settling.
2. Where pipe is installed in a graveled area, the remainder of the trench must be backfilled with Indiana No. 9 to a point eight (8) inches below original grade.
3. Where pipe is installed in an asphalt street, driveway, or parking area, the remainder of the trench must be backfilled with Indiana No. 9 to the subgrade. The trench must then be trimmed back six (6) inches on each side and filled with 3000-psi concrete. After all construction is completed, the trench must be cleaned, primed and paved with a one (1) inch compacted thickness of INDOT HAC Surface to be flush with the surrounding area. All patch seams can only be saw cut, cut smooth, straight and tarred.
4. Where pipe is installed in a concreted area, the remainder of the trench must be backfilled with DGA to a point nine (9) inches below original grade. The trench must then be trimmed back six (6) inches along each side and filled with 3000-psi concrete flush with original grade. All patch seams must be saw cut only, smooth and straight.
5. All cutting of trenches in existing asphalt or concrete pavements must be done with a saw only to provide a straight, smooth joint when new paving is done.
6. In areas where rock is encountered, all rock shall be removed from the trench. Voids created

by such removal shall be refilled with Indiana No. 9 crushed stone.

7. Before placing of the aggregate base course, the upper six inches of all subgrade and subbase shall be compacted to a minimum of ninety five (95) percent of maximum dry density as determined in accordance with AASHTO T99, as modified in 203.24.

SECTION 7 - OPEN CHANNEL DESIGN STANDARDS

This section describes the technical criteria necessary to design storm water channels and ditches using conventional design procedures. These procedures shall be applied to roadside and rear yard ditches and highly urbanized channel. All blue line streams (especially in undisturbed areas) shall be designed using Natural Channel Design techniques, if possible. This criterion represents minimum requirements.

Manning's equation is required, except in cases where backwater conditions are significant. All calculations must be submitted for review.

Channels and ditches should be capable of conveying the 10-year storm flow within their banks. Through drainage systems (culverts, storm sewers, etc.) shall generally be designed to collect and transport the post-development rate of runoff for the 10-year design storm. In all cases, the 100-year discharge elevation shall be checked to ensure that adjacent structures do not suffer flood damage.

All through systems constructed must be capable of passing the 100-year design flow within the drainage easement.

All open channels, whether private or public, and whether constructed on private or public land, shall conform to the design standards and other design requirements contained herein.

Manning Equation:
The waterway for channels shall be determined using Manning's Equation.

Where:

$$Q = \frac{1.486\, R^{2/3}\, S^{1/2} A}{n}$$

Q = volumetric flow rate (cfs)

R = the hydraulic radius in feet

S = the slope of the energy grade line in feet per foot

n = roughness coefficient

A = cross-sectional area

The hydraulic radius, R, is defined as the cross sectional area of flow divided by the wetted flow surface or wetted perimeter.

Channel Cross Section and Grade:
The design capacity, the material in which the channel is to be constructed, and the requirements for maintenance determine the required channel cross-section and grade. The channel grade shall be such that the velocity in the channel is high enough to prevent siltation but low enough to prevent erosion.

Velocities less than 1.5 feet per second should be avoided because siltation will take place and ultimately reduce the channel cross-section.

Side Slopes:
Earthen channel side slopes shall be no steeper than 3 to 1. Flatter slopes may be required to prevent erosion and for ease of maintenance. Where concrete lined channels are required, side slopes shall be no steeper than 1½ to 1 with adequate provisions made for weep holes or subsurface drainage. Side slopes steeper than 1½ to 1 may be used for lined channels provided that the side lining is designed and constructed as a retaining wall with provisions for live and dead load surcharge.

Channel Stability:

1. All channels constructed shall have the following characteristics:
    1. It neither aggrades nor degrades beyond tolerable limits.
    2. The channel banks do not erode to the extent that the channel cross-section is changed appreciably.
    3. Excessive sediment bars do not develop.
    4. Excessive erosion does not occur around culverts, bridges or elsewhere.
    5. Gullies do not form or enlarge due to the entry of uncontrolled surface flow to the channel.

2. Channel stability shall be determined for an aged condition and the velocity shall be based on the design flow or the bank full flow, whichever is greater, using "n" values for various channel linings. In no case is it necessary to check channel stability for discharges greater than that from a 100-year return period storm.

SECTION 8 - DETENTION BASINS

Detention basins shall be designed in accordance with the following criteria:

Detention basins are typically designed to remain empty during dry weather and to backup or detain excessive runoff generated during a storm.

Fencing must be provided if deemed necessary by the Board. The Board must approve design and locations.

Basin Volume Design

1. A minimum basin volume shall be the difference in runoff volume discharged from the project area to the basin site between the pre-development and post-development 100-year storm. In cases where the volume requirement governs, the design calculations must not only show that the required volume has been created, but that the basin functions to detain the volume difference.
2. In many areas of the City the increased runoff volumes can be as critical, if not more critical, than the rate of discharge. JDB will address this issue on a site-specific basis. All development submittals will be evaluated for the impacts of increased runoff and volume control. Satisfying the volume requirement may be met onsite, at approved off-site locations, or by purchase of volume in a Flood Compensation Bank if one is available in the watershed.
3. Maximum basin side slopes shall be 3:1, unless paved.
4. Low flow channels shall be grass if the channel grade is greater than 1.0%.

5. Basin design must include maintenance accessibility and responsibility.
6. The Professional Engineer shall address provisions for anti-seep collars, extended detention basins, wet ponds, soil bioengineering, baffles, outlet protection and length to width ratios.
7. Detention basins must be completely within a recorded permanent Detention Basin Easement.

Basin discharge shall be designed with the following criteria:
1. Discharge control structures shall be multi-stage and capable of limiting 2, 10, and 100-year post-development discharges to the respective pre-development peak discharge rates or downstream system capacity and shall be constructed of concrete or approved alternate.
2. The emergency spillway shall be sized to accommodate a flow equal to the design overflow of the 100-year storm post-development discharge without overtopping the dam. Erosion protection must be provided for the spillway and receiving stream.
3. The dam elevation shall not be less than one foot above the 100-year storm storage and overflow elevation.
4. Appropriate downstream channel protection must be installed.
5. Storage, discharge, and routing calculations for the 2-, 10-, and 100-year discharges must be submitted for review.
6. Spillways shall be protected from erosion and shall employ energy dissipation, if necessary.
7. Detention basins shall be fully discharged within 36 hours after the storm event unless specifically approved by the Jeffersonville Drainage Board.
8. The detention basin shall be the first item of construction prior to any other earth moving or land disturbing activities and must be designed to function as a sediment basin through the construction period. The Basin design must be checked for capacity due to additional runoff generated by disturbed site conditions.

Parking Lot Storage

Paved parking lots may be designed to provide temporary detention storage of storm water directly from the parking area, but are not appropriate for storing large volumes. Ponding should, in general, be confined to those positions of the parking lots farthest from the area served. Ponding areas must not conflict with handicapped parking and access routes. Such ponding areas should be exposed to sunlight in winter months to minimize icing. Storage depth must be limited so as not to conflict with parking lot use. Any detention facility utilizing a parking lot must take resurfacing and other parking lot maintenance activities into consideration during design.

Facility Maintenance Responsibility

Maintenance of drainage facilities during construction must be the responsibility of the land developer. Maintenance responsibilities must be documented by appropriate restrictive covenants to property deeds prior to final drainage plan approval. Routine maintenance is the developer's responsibility for a minimum of five (5) years after completion of the drainage facility. After that time, upon the approval of the City Engineer and the City Council, the City may accept responsibility for routine maintenance of the drainage facility. The permanent pool of a wet bottom basin is the responsibility of the developer or homeowners' association. Routine maintenance must, at a minimum, assure that the drainage facility performs the functions for which it was designed and constructed. **Unless specifically accepted by the City, all drainage facilities must be privately owned and funded.** The detention basin must be mowed a minimum of once a year and be kept free of trees and shrubs.

SECTION 9 - SINKHOLES

General
The use of sinkholes as storm water management is not permitted, unless there are no other alternatives.

The City of Jeffersonville does not encourage the use of natural sinkholes as outlets for drainage from developed areas and will avoid requests for modifications to sinkhole entrances. The proposed use of sinkholes as outlets for development must be approved by the City Engineer and the Jeffersonville Plan Commission.

For circumstances that have no other means for drainage, the following criteria shall be implemented:

Design
Specific design requirements for the use of sinkholes, when permitted, include but are not limited to:

1. The sinkhole shall have the volume to store a 100-year, 24-hour NRCS storm with a no outlet condition.
2. Storm water discharge into a sinkhole shall not be increased over its preexisting rate according to standards as established by the Jeffersonville Drainage Board. Depressions containing sinkholes shall not be utilized for storm water detention unless no other alternatives exist.
3. Photographic evidence should be submitted to the Board showing the current condition of the sinkhole feature. If recent subsidence is evident, the sinkhole shall not be used for storm water drainage unless the feature has been evaluated by a Geotechnical Engineer, and he/she has determined that the feature can be treated so that significant future subsidence is not likely.
4. To confirm the suitability for an existing feature to accept a given runoff volume, the feature must be pump tested using at least 80% of the 100-year design storm for an 8-hour duration. The condition of the sinkhole before and after the pump test should be documented by a licensed professional engineer registered in the State of Indiana. Any evidence of significant subsidence that occurs during or after the test will be taken as unsuitability of the feature to accept runoff. To confirm that runoff into the sinkhole feature will not affect adversely adjacent properties, fluorescent dye should be injected into the sinkhole during the pump testing. A Geotechnical Engineer, registered in the State of Indiana, should be retained to make observations of the fate of the dye in the surrounding area.
5. Protective measures for the sinkhole inlet must be applied prior to the start of construction activities. Surface water runoff from stripped areas should be directed away from the sinkhole until the areas have been developed or ground cover has been installed and has become established.
6. An alternate means of surface water disposal must be provided in the event that the sinkhole ceases to accept runoff or significant subsidence occurs in the feature.
7. Storm water runoff from paved areas or structures shall not directly enter a sinkhole. Drainage plans shall be designed to route runoff through vegetative filters or other filtration measures before it enters a sinkhole. Such filters or filtration methods must be reviewed by the board.
8. A Geotechnical Engineer, licensed in the State of Indiana, must supervise the design and installation of sinkhole treatment measures. The engineer shall also observe installation of

treatment measures and shall document that treatment measures comply with approved plans. The engineer shall be responsible for documenting significant subsidence or other changes in the existing sinkhole feature during treatment that may affect the effectiveness or practicality of the approved treatment method.

9. Any instances of significant subsidence must be fully documented and a Geotechnical Engineer, licensed in the State of Indiana, must supervise design of treatment measures, must inspect treatment installation, and must document construction of repairs prior to bond release.

SECTION 10 - FINAL DRAINAGE PLANS

Final drainage plans shall be submitted to the JDB. Before final subdivision plat approval or before construction for all other developments, the final construction plans shall provide or be accompanied by calculations, maps and/or other descriptive material including:

Cover Sheet

1. Location map with the site outlined.
2. Title block: title of development, name and address of developer, name and address of Professional Engineer or Professional Land Surveyor, date of preparation, revision dates.
3. Index of sheets.
4. Engineer's or Land Surveyor's seals and signatures.
5. Construction notes.

Composite Drainage Plan

1. Topography: minimum scale 1" = 100' with existing contours at two-foot intervals, NGVD datum. Contours to extend a minimum of 50 feet beyond property lines.
2. Proposed development: street rights-of-way, street names, street centerline stationing, lot lines, lot numbers, property boundary, existing drainage structures, proposed drainage structures (labeled by number or other designation) and easements with widths shown.
3. Hydrologic data: designate drainage areas (in acres) to individual inlets, and off-site drainage areas (acres), which generate through drainage.
4. Pipe chart: pipe number, drainage area, coefficient of runoff (c), time of concentration, intensity, discharge (Q), size, length, slope, capacity, velocity *(refer to example #1)*.
5. 100-year FEMA and local regulatory floodplain and conveyance zone, if applicable, with flood elevations noted.
6. Identification of outlet system.

PLAN AND PROFILE (ROAD) SHEETS

Plan View

1. Catch basins: line and station number (structure number), grate type and elevation, invert elevation(s).
2. Pipes: length, size, type, slope, pipe number of designation.
3. Headwalls: type, invert elevation.
4. Ditches and swales: number or designation, type, stations.
5. Easements: type, size, existing with deed book and page numbers, proposed.
6. Utilities: existing and proposed (including sanitary sewers).
7. Other drainage structures to be labeled accordingly.

(Refer to example #2 for matters pertaining to Items a. through g.).

Profile View

1. Storm lines and structures to be shown on road profiles.
2. Utility and sanitary sewer crossings.

Storm Drainage Profiles (pipes, ditches, box culverts)

1. Catch basins: station or number, type, grate type and elevation, invert elevation(s).
2. Pipes: length, size, type, class, grade, line number, headwater elevations for the 100-year storm (determined from inlet and outlet control analysis).
3. Ditches:
   Type
   Grade
   Flow line elevation at grade changes (P.V.I)
   Design depth
   Manning's "n"
   Slope
   10-year velocities
   100-year velocities
   100-year discharge depths
4. Headwalls: type and invert elevation.
5. Existing and proposed ground surfaces.

(Refer to example #3 for matters pertaining to Items a. through e.).

SECTION 11 - SUBMITTALS AND FEES

Plans shall be submitted twenty (20) working days prior to the scheduled Drainage Board meeting. In addition to the plans, the design professional shall submit the following:

1. Drainage Plan Review application
2. Drainage Plan Review Checklist
3. Detention Analysis Checklist

Items 1 through 3 can be found in Section 2 of the Appendix or can be picked up at the office of the City Engineer.

This ordinance shall be in full force and effect immediately ~~days~~ after its final passage and adoption. All prior ordinances and parts of ordinances in conflict with this ordinance are hereby repealed.

PASSED AND ADOPTED THIS 3 DAY OF April 2006.

COMMON COUNCIL OF
CITY OF JEFFERSONVILLE, INDIANA

By:

Robert L. Waiz, Jr.
Presiding Officer

ATTEST:

Peggy Wilder
Clerk and Treasurer

Presented by me as Clerk and Treasurer to the Mayor of said City of Jeffersonville this 13th day of April 2006 at 2:00 a.m./p.m.

Peggy Wilder
Clerk and Treasurer

Approved and signed by me this 17 day of April 2006 at 4:00 [redacted] p.m.

Robert L. Waiz, Jr., Mayor

APPENDIX

SECTION 1:

EXAMPLE #1
PIPE CHART

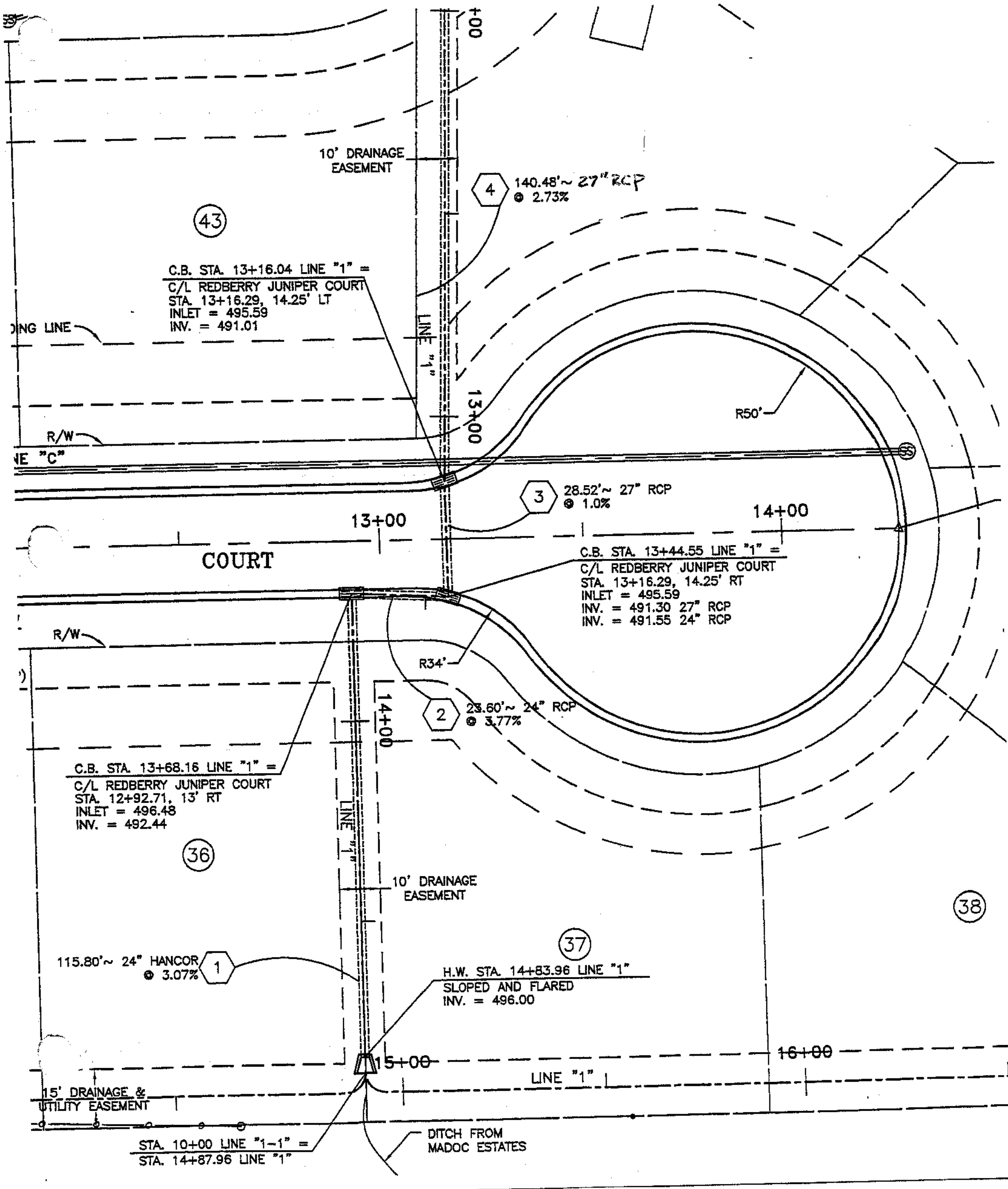
EXAMPLE #2
PLAN SHEET EXAMPLE

EXAMPLE #3
PROFILE SHEET EXAMPLE

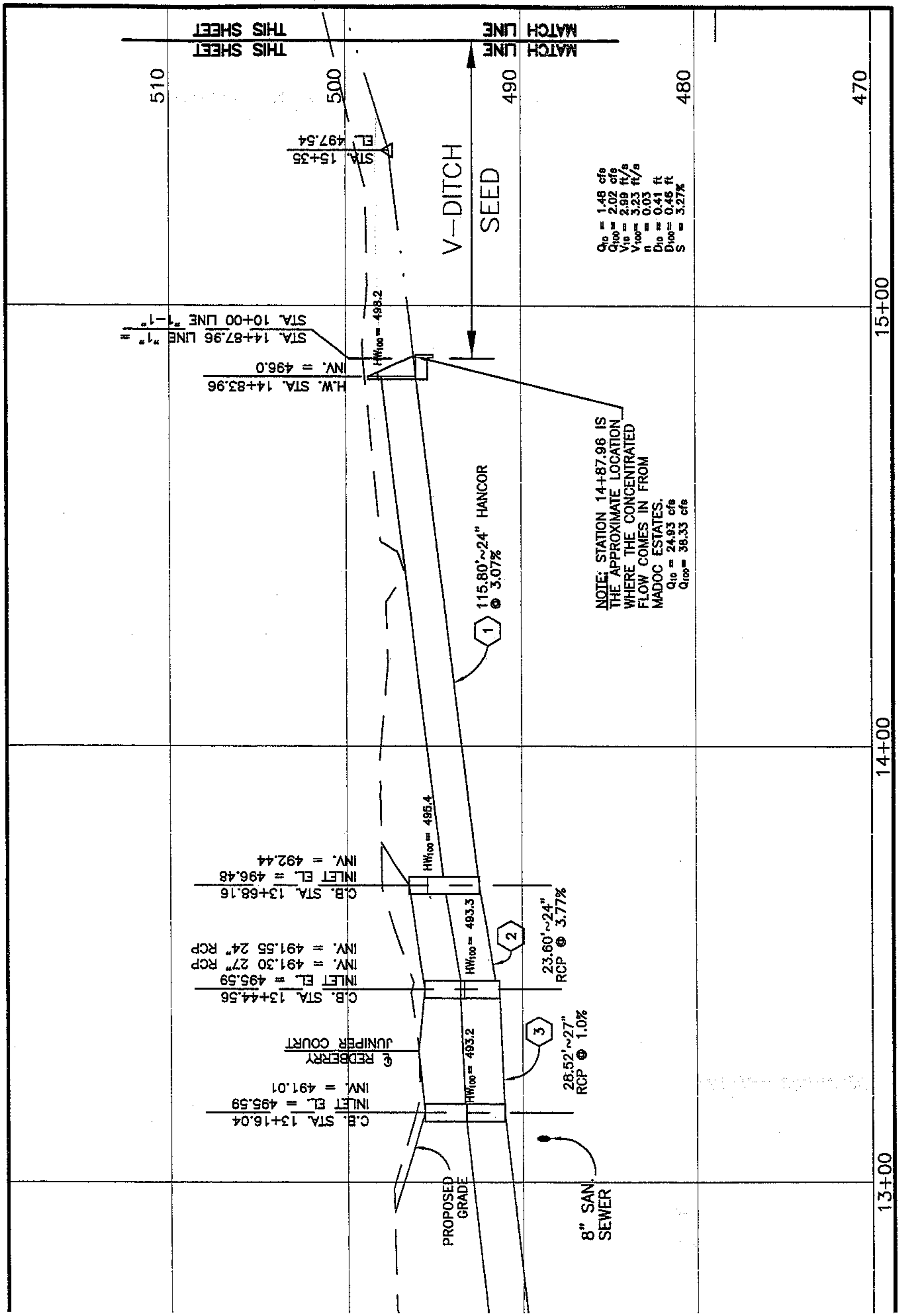
EXAMPLE #1

PIPE CHART										
PIPE NO.	A (ACRES)	Q (C.F.S.)	LENGTH (FEET)	SIZE (INCHES)	SLOPE (%)	V (FT/SEC)	Tc (MINUTES)	I (IN/HR)	Q FULL (C.F.S)	V FULL (FT/SEC)
1										
2										
3										
4										
5										
6										
7										
8										

EXAMPLE #2


10' DRAINAGE EASEMENT
140.48'~ 27" RCP @ 2.73%
43
C.B. STA. 13+16.04 LINE "1" =
C/L REDBERRY JUNIPER COURT
STA. 13+16.29, 14.25' LT
INLET = 495.59
INV. = 491.01
LINE "1"
13+00
R/W
R50'
28.52'~ 27" RCP @ 1.0%
13+00
14+00
COURT
C.B. STA. 13+44.55 LINE "1" =
C/L REDBERRY JUNIPER COURT
STA. 13+16.29, 14.25' RT
INLET = 495.59
INV. = 491.30 27" RCP
INV. = 491.55 24" RCP
R/W
R34'
14+00
23.60'~ 24" RCP @ 3.77%
C.B. STA. 13+68.16 LINE "1" =
C/L REDBERRY JUNIPER COURT
STA. 12+92.71, 13' RT
INLET = 496.48
INV. = 492.44
LINE "1"
36
10' DRAINAGE EASEMENT
38
37
115.80'~ 24" HANCOR @ 3.07%
H.W. STA. 14+83.96 LINE "1"
SLOPED AND FLARED
INV. = 496.00
15+00
16+00
LINE "1"
15' DRAINAGE & UTILITY EASEMENT
STA. 10+00 LINE "1-1" =
STA. 14+87.96 LINE "1"
DITCH FROM MADOC ESTATES

EXAMPLE #3



THIS SHEET
THIS SHEET
MATCH LINE
MATCH LINE
510
500
490
480
470
13+00
14+00
15+00
STA. 15+35
EL. 497.54
V–DITCH
SEED
STA. 14+87.96 LINE "1" =
STA. 10+00 LINE "1–1"
H.W. STA. 14+83.96
INV. = 496.0
HW100 = 498.2
115.80'~24" HANCOR
@ 3.07%
NOTE: STATION 14+87.96 IS THE APPROXIMATE LOCATION WHERE THE CONCENTRATED FLOW COMES IN FROM MADOC ESTATES.
Q10 = 24.93 cfs
Q100 = 38.33 cfs
Q10 = 1.48 cfs
Q100 = 2.02 cfs
V10 = 2.99 ft/s
V100 = 3.23 ft/s
n = 0.03
D10 = 0.41 ft
D100 = 0.46 ft
S = 3.27%
C.B. STA. 13+68.16
INLET EL. = 496.48
INV. = 492.44
HW100 = 495.4
C.B. STA. 13+44.56
INLET EL. = 495.59
INV. = 491.30 27" RCP
INV. = 491.55 24" RCP
HW100 = 493.3
23.60'~24"
RCP @ 3.77%
℄ REDBERRY
JUNIPER COURT
C.B. STA. 13+16.04
INLET EL. = 495.59
INV. = 491.01
HW100 = 493.2
28.52'~27"
RCP @ 1.0%
PROPOSED GRADE
8" SAN. SEWER

APPENDIX

SECTION 2:

DRAINAGE PLAN REVIEW APPLICATION

DRAINAGE PLAN REVIEW CHECKLIST

DETENTION ANALYSIS CHECKLIST

CITY OF JEFFERSONVILLE
501 E. Court Avenue
Jeffersonville, Indiana 47130

DRAINAGE PLAN REVIEW APPLICATION

SECTION 1: PROJECT INFORMATION

To be completed by the applicant.

Project Name: ______________________ Key Number: ______________

Project Address: ______________________ Deed Drawer: ________ Instrument ________

Subdivision Name/Lot #: ______________________ Deed Book: ________ Page #: ________

☐ Residential Subdivision ☐ Site Plan for Commercial Development

Plan/plat previously submitted? ______(y/n) If yes, explain ______________________

SECTION 2: CONTACT INFORMATION

Check the appropriate box to indicate who is to be designated as the responsible entity for the land disturbing activity.

☐ Property Owner: ______________________ Contact Person: ______________

Address: ______________________

City: __________ State: ______ Zip: ______ Phone:( ) __________ Fax:( ) __________

☐ Developer: ______________________ Contact Person: ______________

Address: ______________________

City: __________ State: ______ Zip: ______ Phone:( ) __________ Fax:( ) __________

Design Firm: ______________________ Contact Person: ______________

Address: ______________________

City: __________ State: ______ Zip: ______ Phone:( ) __________ Fax:( ) __________

I, ______________________, being the Design Professional (Professional Engineer and/or Professional Land Surveyor of ______________________ *(Name of Development)* shall submit Final Record Drawings including a digital file (AutoCAD format) within three months after the completion of the installation of the drainage infrastructure.

Signature: ______________________

*Contractor: ______________________ Contact Person: ______________

Address: ______________________

City: __________ State: ______ Zip: ______ Phone:( ) __________ Fax:( ) __________

* If the Contractor is unknown at the time of submittal it shall be the responsibility of the responsible entity to inform the Planning and Zoning Office prior to final plat approval.

Planning and Zoning Date Submitted: ______________

Development Number: ______________

Fee: ______________________ Paid: ______________________

Seven copies of plans and calculations: ________(y/n)

Drainage Board

Date of Meeting: ______________ Approved: __________ Denied: __________

____

Signature of Chairman

CITY OF JEFFERSONVILLE
501 E. Court Avenue
Jeffersonville, Indiana 47130

DRAINAGE PLAN REVIEW CHECKLIST

Project Name ____________________
Developer ____________________
Address ____________________

Date ____________________ ***Jeffersonville Development No.** ____________

The purpose of this checklist is to expedite and facilitate the review process. This checklist gives the minimum requirements needed for review. All items shall be checked as included or marked N/A. The omission of required items may be cause for rejection of the submittal without review.

REQUIRED ITEMS TO BE SHOWN ON THE PLANS

_____ CDB Plan Review Application
_____ Location Map
_____ Registered Professional Stamp and Signature
_____ Property Boundaries
_____ Offsite Drainage Areas
_____ Drainage Flow Arrows
_____ Pipe, Length, Size, Slope, Type and Number
_____ Pipe Profiles for Through Drainage
_____ Adjacent Property Owners
_____ Existing and Proposed Easements
_____ Existing and Proposed Structures
_____ Erosion and Sediment Controls
_____ Headwater at Culvert Pipes (100-year)
_____ Standard Underground Utility Notes

_____ Owner Name/Address
_____ Street Name and R/W
_____ Inlet Drainage Areas
_____ Inlet Grate/Invert Elevation
_____ Existing Sanitary Sewers
_____ Channel Profiles for Through Drainage
_____ Existing and Proposed Utilities
_____ Existing and Proposed Impervious Areas (clearly depicted)
_____ Existing and Proposed Drainage Structures
_____ Proposed Sanitary Sewers Location & Elevation
_____ 100-Year Flood Plain Limits
_____ North Arrow
_____ Scale
_____ Legend
_____ Total Project Acreage and Number of Lots

_____ Plan Date
_____ Revision Date
_____ Inlet Type
_____ Headwall Type
_____ Pipe Chart (refer to attached example)

_____ Existing and Proposed Topography and Contours, including area 25' outside of property
_____ Adequate information/details pertaining to storage basin and drainage structures

The Design Professional that stamped and submitted plans must sign the checklist.

____
Design Professional's Signature   Date

* To be assigned by the Jeffersonville Planning Commission

CITY OF JEFFERSONVILLE
501 E. Court Avenue
Jeffersonville, Indiana 47130

DETENTION ANALYSIS CHECKLIST

Project Name ______________________________

Submission Date ______________ ***Jeffersonville Development No.** ____________

The purpose of this checklist is to expedite and facilitate the review process. This checklist gives the minimum requirements needed for review. All items shall be checked as included or marked N/A. The omission of required items may be cause for rejection of the submittal without review.

_____ Table of Contents
_____ Explanation of Analysis with Assumptions
_____ Analysis of Downstream Capacity Limitations
_____ Composite Drainage Area Map(s) - Pre-development
_____ Composite Drainage Area Map(s) - Post-development
_____ Time of Concentration (Tc) Supporting Calculations - Pre-development
_____ Time of Concentration (Tc) Supporting Calculation - Post-development
_____ Runoff Coefficient or Curve Number Calculations & Map - Pre-development
_____ Runoff Coefficient or Curve Number Calculations & Map - Post-development
_____ Calculations of 100-year Peak Flow Pre-development Runoff
_____ Calculations of 100-year Peak Flow Post-development Runoff
_____ Calculations of 2, 10 and 100-year By-passing or Unmitigated - Post-development
_____ Basin Volume Data (Elevation/Storage)
_____ Basin Grading Plan
_____ Basin Outlet Structure Data and Construction Details
_____ Basin Overflow Component (Positive Through Drainage Outlet)
_____ Additional 100-year Analysis Check of Overflow Function (Upstream Developed Condition)
_____ Basin Routing Data (Stage, Storage, Peak Elevation, Peak Inflow and Outflow)
_____ Combined Hydrographs (2, 10 and 100-year peak flows) Routed and Unmitigated
_____ Velocity Dissipation Calculation is (Property Line Point Discharge)
_____ Complete Summary of Drainage Analysis

I, the undersigned, acknowledge by signature that these documents meet or exceed the design standards of the Drainage Ordinance of the City of Charlestown and that they were prepared under my supervision. I, the undersigned, further acknowledge that to the best of my knowledge and belief, the products resulting from these documents will function as intended.

____
Design Professional's Signature   Date

Please use this checklist for all future submittals. Although we feel this checklist is complete, we recognize there is room for improvements, so please give us your feedback. By working together on this, we can make the review process better for everyone involved.

* To be assigned by the City.

APPENDIX

SECTION 3:

SOIL GROUPS

Soil Map Legend

HSG	*Symbol*	*Soil Name*
D	AddA	Avonburg silt loam, 0 to 2 percent slopes
D	AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded
D	AvA	Avonburg silt loam, 0 to 2 percent slopes
D	AvB	Avonburg silt loam, 2 to 4 percent slopes
D	Ba	Bartle silt loam
D	BbhA	Bartle silt loam, 0 to 2 percent slopes
B	BcrAW	Beanblossom silt loam, 1 to 3 percent slopes, occasionally flooded, very brief duration
B	BcrAQ	Beanblossom silt loam, 1 to 3 percent slopes, rarely flooded
C	BdA	Bedford silt loam, 0 to 2 percent slopes
C	BdB	Bedford silt loam, 2 to 6 percent slopes
C	BdoA	Bedford silt loam, 0 to 2 percent slopes
C	BdoB	Bedford silt loam, 2 to 6 percent slopes
C	BeF	Berks channery silt loam, 18 to 35 percent slopes
C	BfcC3	Blocher, soft bedrock substratum-Weddel complex, 6 to 12 percent slopes, severely eroded
C	BfbC2	Blocher, soft bedrock substratum-Weddel silt loams, 6 to 12 percent slopes, eroded
C	BnyD3	Bonnell clay loam, 12 to 22 percent slopes, severely eroded
C	BobE5	Bonnell-Hickory clay loams, 15 to 30 percent slopes, gullied
C	Bo	Bonnie silt loam
C/D	BodAW	Bonnie silt loam, 0 to 1 percent slopes, occasionally flooded, very brief duration
B	BvoG	Brownstown-Gilwood silt loams, 25 to 75 percent slopes
C	CcaG	Caneyville-Rock outcrop complex, 25 to 60 percent slopes
C	CcB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded
C	CcC2	Cincinnati silt loam, 6 to 12 percent slopes, eroded
C	CcC3	Cincinnati silt loam, 6 to 12 percent slopes, severely eroded
C	CcD2	Cincinnati silt loam, 12 to 18 percent slopes, eroded
C	CcD3	Cincinnati silt loam, 12 to 18 percent slopes, severely eroded
C	CkkB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded
C	CldC2	Cincinnati-Blocher silt loams, 6 to 12 percent slopes, eroded

Soil Map Legend

HSG	Symbol	Soil Name
C	CldC3	Cincinnati-Blocher silt loams, 6 to 12 percent slopes, severely eroded
D	Ce	Clermont silt loam
C(drained)	ClfA	Cobbsfork silt loam, 0 to 1 percent slopes
D	ChF	Colyer shaly silt loam, 18 to 35 percent slopes
C	ComC	Coolville silt loam, 6 to 12 percent slopes
C	ConD	Coolville-Rarden complex, 12 to 18 percent slopes
C	ConC3	Coolville-Rarden complex, 6 to 12 percent slopes, severely eroded
D	CoE	Corydon stony silt loam, 12 to 25 percent slopes
D	CoG	Corydon stony silt loam, 25 to 70 percent slopes
B	CspA	Crider silt loam, 0 to 2 percent slopes
B	CspB2	Crider silt loam, 2 to 6 percent slopes, eroded
C	CrA	Crider silt loam, 0 to 2 percent slopes
C	CrB2	Crider silt loam, 2 to 6 percent slopes, eroded
C	CrB3	Crider silt loam, 2 to 6 percent slopes, severely eroded
C	CrC2	Crider silt loam, 6 to 12 percent slopes, eroded
C	CrC3	Crider silt loam, 6 to 12 percent slopes, severely eroded
C	CrD2	Crider silt loam, 12 to 18 percent slopes, eroded
C	CrD3	Crider silt loam, 12 to 18 percent slopes, severely eroded
B	CtrB2	Crider silt loam, karst, undulating, eroded
B/C/B	CtwB	Crider-Bedford-Navilleton silt loams, 2 to 6 percent slopes
B	CxgC3	Crider-Haggatt complex, 6 to 12 percent slopes, severely eroded
B	CxnC3	Crider-Haggatt complex, karst, rolling, severely eroded
B	CxhC2	Crider-Haggatt silt loams, 6 to 12 percent slopes, eroded
B	CxmC2	Crider-Haggatt silt loams, karst, rolling, eroded
B	CwaAQ	Cuba silt loam, 0 to 2 percent slopes, rarely flooded
C	DbrG	Deam silty clay loam, 20 to 55 percent slopes
B	DdsAW	Dearborn silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration
C	DtyC2	Deputy-Trappist silt loams, 6 to 12 percent slopes, eroded

Soil Map Legend

HSG	Symbol	Soil Name
C	DfnA	Dubois silt loam, 0 to 2 percent slopes
C	EbpD2	Eden silty clay loam, 12 to 25 percent slopes, eroded
C	EsaG	Eden silty clay loam, 25 to 60 percent slopes, very rocky
B	EesA	Elkinsville-Millstone silt loams, 0 to 2 percent slopes
B	EesD2	Elkinsville-Millstone silt loams, 12 to 18 percent slopes, eroded
B	EesFQ	Elkinsville-Millstone silt loams, 18 to 40 percent slopes, rarely flooded
B	EesB	Elkinsville-Millstone silt loams, 2 to 6 percent slopes
B	EesC2	Elkinsville-Millstone silt loams, 6 to 12 percent slopes, eroded
D	FaE	Fairmount silty clay loam, 12 to 25 percent slopes
D	FcG	Fairmount stony silty clay loam, 25 to 70 percents slopes
C	GlC2	Gilpin silt loam, 6 to 12 percent slopes, eroded
C	GlC3	Gilpin silt loam, 6 to 12 percent slopes, severely eroded
C	GlD2	Gilpin silt loam, 12 to 18 percent slopes, eroded
C	GlD3	Gilpin silt loam, 12 to 18 percent slopes, severely eroded
C	GlE2	Gilpin silt loam, 18 to 25 percent slopes, eroded
B	GgbG	Gilwood-Brownstown silt loams, 25 to 75 percent slopes
B	GgfE2	Gilwood-Wrays silt loams, 12 to 25 percent slopes, eroded
B	GgfD	Gilwood-Wrays silt loams, 6 to 18 percent slopes
C(B/C)	GmaG	Gnawbone-Kurtz silt loams, 20 to 60 percent slopes
B	GrA	Grayford silt loam, 0 to 2 percent slopes
B	GrB2	Grayford silt loam, 2 to 6 percent slopes, eroded
B	GrC2	Grayford silt loam, 6 to 12 percent slopes, eroded
B	GrC3	Grayford silt loam, 6 to 12 percent slopes, severely eroded
B	GrD2	Grayford silt loam, 12 to 18 percent slopes, eroded
B	GrD3	Grayford silt loam, 12 to 18 percent slopes, severely eroded
B	GrE2	Grayford silt loam, 18 to 25 percent slopes, eroded
	Gu	Gullied land
B	GyaD2	Grayford silt loam, 12 to 25 percent slopes, eroded

Soil Map Legend

HSG	Symbol	Soil Name
B	GyaD5	Grayford silt loam, 12 to 25 percent slopes, gullied
B	GyaD3	Grayford silt loam, 12 to 25 percent slopes, severely eroded
B	GykD2	Grayford silt loam, karst, hilly, eroded
B	GykD3	Grayford silt loam, karst, hilly, severely eroded
C	HaC2	Hagerstown silt loam, 6 to 12 percent slopes, eroded
C	HaD2	Hagerstown silt loam, 12 to 18 percent slopes, eroded
C	HaE2	Hagerstown silt loam, 18 to 25 percent slopes, eroded
C	HcC3	Hagerstown silty clay loam, 6 to 12 percent slopes, severely eroded
C	HcD3	Hagerstown silty clay loam, 12 to 18 percent slopes, severely eroded
C	HcE3	Hagerstown silty clay loam, 18 to 25 percent slopes, severely eroded
C(B/C)	HtzD3	Haggatt-Caneyville complex, 12 to 25 percent slopes, severely eroded
C(B/C)	HujD3	Haggatt-Caneyville complex, karst, hilly, severely eroded
C(B/C)	HtwD2	Haggatt-Caneyville silt loams, 12 to 25 percent slopes, eroded
C(B/C)	HuhD2	Haggatt-Caneyville silt loams, karst, hilly, eroded
C	HcaA	Hatfield silt loam, 0 to 2 percent slopes
C	HccB2	Haubstadt silt loam, 2 to 6 percent slopes, eroded
C	HceC3	Haubstadt-Shircliff complex, 6 to 15 percent slopes, severely eroded
C	HcdC2	Haubstadt-Shircliff silt loams, 6 to 15 percent slopes, eroded
B	Hd	Haymond silt loam
B	HcgAH	Haymond silt loam, 0 to 2 percent slopes, frequently flooded, brief duration
B	HcgAV	Haymond silt loam, 0 to 2 percent slopes, frequently flooded, very brief duration
B	HcgAW	Haymond silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration
C	HeA	Henshaw silt loam, 0 to 2 percent slopes
C	HkE2	Hickory silt loam, 18 to 25 percent slopes
C	HerE	Hickory-Bonnell complex, 12 to 25 percent slopes
C	HoA	Hosmer silt loam, 0 to 2 percent slopes
C	HoB2	Hosmer silt loam, 2 to 6 percent slopes, eroded
C	HoC2	Hosmer silt loam, 6 to 12 percent slopes, eroded

Soil Map Legend

HSG	Symbol	Soil Name
C	HoC3	Hosmer silt loam, 6 to 12 percent slopes, serverely eroded
C	HoD2	Hosmer silt loam, 12 to 18 percent slopes, eroded
B	Hu	Huntington silt loam
B	HufAK	Huntington silt loam, 0 to 2 percent slopes, occasionally flooded, brief duration
C	JaeB2	Jennings silt loam, 2 to 6 percent slopes, eroded
C	JafC2	Jennings-Blocher hard bedrock substratum, silt loams, 6 to 12 percent slopes, eroded
C	JafC3	Jennings-Blocher hard bedrock substratum, silt loams, 6 to 12 percent slopes, severely eroded
C	JeA	Jennings silt loam, 0 to 2 percent slopes
C	JeB2	Jennings silt loam, 2 to 6 percent slopes, eroded
C	JhB2	Jennings silt loam, heavy subsoil variant, 2 to 6 percent slopes, eroded
C	JhC2	Jennings silt loam, heavy subsoil variant, 6 to 12 percent slopes, eroded
C	JhC3	Jennings silt loam, heavy subsoil variant, 6 to 12 percent slopes, severely eroded
C	JhD2	Jennings silt loam, heavy subsoil variant, 12 to 18 percent slopes, eroded
D	JoA	Johnsburg silt loam, 0 to 2 percent slopes
C(C/B/C)	KxlE3	Knobcreek-Haggatt-Caneyville complex, 12 to 25 percent slopes, severely eroded
C(C/B/C)	KxlC3	Knobcreek-Haggatt-Caneyville complex, 6 to 12 percent slopes, severely eroded
C(C/B/C)	KxmE2	Knobcreek-Haggatt-Caneyville silt loams, 12 to 25 percent slopes, eroded
C	KxpD2	Knobcreek-Haggatt-Caneyville silt loams, karst, hilly, eroded
C(C/B)	KxkC2	Knobcreek-Navilleton silt loams, 6 to 12 percent slopes, eroded
C(C/B/B)	KxoC2	Knobcreek-Navilleton-Haggatt silt loams, karst, rolling, eroded
C	LpoAK	Lindside silt loam, 0 to 2 percent slopes, occasionally flooded, brief duration
C	MdqDQ	Markland silt loam, 12 to 25 percent slopes, eroded, rarely flooded
C	McnGQ	Markland silt loam, 18 to 50 percent slopes, eroded, rarely flooded
C	McgC2	Markland silt loam, 6 to 12 percent slopes, eroded
C	McuDQ	Markland silty clay loam, 12 to 25 percent slopes, severely eroded, rarely flooded
C	McpC3	Markland silty clay loam, 6 to 12 percent slopes, severely eroded
C	MhuA	McGary silt loam, 0 to 2 percent slopes
C	MhyA	Medora silt loam, 0 to 2 percent slopes

Soil Map Legend

HSG	Symbol	Soil Name
C	MhyB2	Medora silt loam, 2 to 6 percent slopes, eroded
C	MhyC2	Medora silt loam, 6 to 12 percent slopes, eroded
C	MhyC3	Medora silt loam, 6 to 12 percent slopes, severely eroded
D	Mo	Montgomery silty clay
D	MsvA	Montgomery silty clay loam, 0 to 1 percent slopes
C	NaaA	Nabb silt loam, 0 to 2 percent slopes
C	NaaB2	Nabb silt loam, 2 to 6 percent slopes, eroded
C	Ne	Newark silt loam
C	NbhAK	Newark silt loam, 0 to 2 percent slopes, occasionally flooded, brief duration
B	OfbAW	Oldenburg loam, 0 to 2 percent slopes, occasionally flooded, very brief duration
C	PcrB2	Pekin silt loam, 2 to 6 percent slopes, eroded
C	PcrC2	Pekin silt loam, 6 to 12 percent slopes, eroded
C	PcrC3	Pekin silt loam, 6 to 12 percent slopes, severely eroded
C	PeB2	Pekin silt loam, 2 to 6 percent slopes, eroded
C	PhaA	Peoga silt loam, 0 to 1 percent slopes
	Pml	Pits, quarry
	Ppu	Pits, sand and gravel
B	Pt	Pope silt loam
C	RblD3	Rarden silty clay loam, 12 to 18 percent slopes, severely eroded
C	RbmD5	Rarden silty clay, 6 to 18 percent slopes, gullied
C	RdC2	Rarden silt loam, 6 to 12 percent slopes, eroded
C	RdD2	Rarden silt loam, 12 to 18 percent slopes, eroded
C	ReC3	Rarden silty clay loam, 6 to 12 percent slopes, severely eroded
C	ReD3	Rarden silty clay loam, 12 to 18 percent slopes, severely eroded
D	RkF	Rockcastle silt loam, 18 to 55 percent slopes
D(D/B)	RptG	Rohan-Jessietown complex, 25 to 60 percent slopes, rocky
C	RoA	Rossmoyne silt loam, 0 to 2 percent slopes
C	RoB2	Rossmoyne silt loam, 2 to 6 percent slopes, eroded

Soil Map Legend

HSG	Symbol	Soil Name
C	RoB3	Rossmoyne silt loam, 2 to 6 percent slopes, severely eroded
B	RtcA	Ryker silt loam, 0 to 2 percent slopes
B	RtcB2	Ryker silt loam, 2 to 6 percent slopes, eroded
B	RzrB2	Ryker silt loam, karst, undulating, eroded
B	RztC2	Ryker-Grayford silt loams, 6 to 12 percent slopes, eroded
B	RztC3	Ryker-Grayford silt loams, 6 to 12 percent slopes, severely eroded
B	RzvC2	Ryker-Grayford silt loams, karst, rolling, eroded
B	RzvC3	Ryker-Grayford silt loams, karst, rolling, severely eroded
C	SceB2	Scottsburg silt loam, 2 to 4 percent slopes, eroded
C	SfyB	Shircliff silt loam, 2 to 6 percent slopes
C	SfyB	Shircliff silt loam, 2 to 6 percent slopes
C	SoaB	Spickert silt loam, 2 to 6 percent slopes
C	SodB	Spickert silt loam, terrace, 1 to 4 percent slopes
C(C/B)	SolC2	Spickert-Wrays silt loams, 6 to 12 percent slopes, eroded
C	StaAQ	Steff silt loam, 0 to 2 percent slopes, rarely flooded
C	StdAW	Stendal silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration
C	StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded
C	ThbD5	Trappist silty clay loam, 6 to 18 percent slopes, gullied
C	TsaC3	Trappist-Deputy complex, 6 to 12 percent slopes, severely eroded
D(C/D)	ThcD3	Trappist-Rohan complex, 12 to 25 percent slopes, severely eroded
D(C/D)	ThdD	Trappist-Rohan silt loams, 12 to 25 percent slopes
C	TrC2	Trappist silt loam, 6 to 12 percent slopes, eroded
C	TrC3	Trappist silt loam, 6 to 12 percent slopes, severely eroded
C	TrD2	Trappist silt loam, 12 to 18 percent slopes, eroded
C	TrD3	Trappist silt loam, 12 to 18 percent slopes, severely eroded
	UaoAK	Udifluvents, cut and filled-Urban land complex, 0 to 2 percent slopes, occasionally flooded, brief duration
	Uaa	Udorthents, cut and filled
B	UnB2	Uniontown silt loam, 2 to 6 percent slopes

Soil Map Legend

HSG	Symbol	Soil Name
B	UnC2	Uniontown silt loam, 6 to 12 percent slopes
	UedA	Urban land-Aquents, clayey substratum, complex, lake plain, 0 to 3 percent slopes
	UnsB	Urban land-Udarents, clayey substratum, complex, hills, 2 to 10 percent slopes
	UngB	Urban land-Udarents, fragipan substratum, complex, till plain, 0 to 12 percent slopes
	UnpA	Urban land-Udarents, loamy substratum, complex, terrace, 0 to 3 percent slopes
	UnkB	Urban land-Udarents, silty substratum, complex, terrace, 0 to 6 percent slopes
	UndAY	Urban land-Udifluvents complex, leveed, 0 to 2 percent slopes
C	Wa	Wakeland silt loam
C	WaaAV	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, very brief duration
C	WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration
	W	Water
C	WedB2	Weddel silt loam, 2 to 6 percent slopes, eroded
C/D	WcG	Weikert channery silt loam, 35 to 90 percent slopes
C	WeA	Weinbach silt loam, 0 to 2 percent slopes
B	WhcD	Wellrock-Gnawbone silt loams, 6 to 20 percent slopes
B	WhB2	Wheeling fine sandy loam, 2 to 6 percent slopes, eroded
B	WhC2	Wheeling fine sandy loam, 6 to 12 percent slopes, eroded
B	WlA	Wheeling silt loam, 0 to 2 percent slopes
B	WlB2	Wheeling silt loam, 2 to 6 percent slopes, eroded
B	WlC2	Wheeling silt loam, 6 to 12 percent slopes, eroded
B	WlD2	Wheeling silt loam, 12 to 18 percent slopes, eroded
C	WnmA	Whitcomb silt loam, 0 to 2 percent slopes
B	Wm	Wilbur silt loam
B	WokAV	Wilbur silt loam, 0 to 2 percent slopes, frequently flooded, very brief duration
B	WokAW	Wilbur silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration
B	WprAW	Wirt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration
C	ZaB3	Zanesville silt loam, 2 to 6 percent slopes, severely eroded
C	ZaC2	Zanesville silt loam, 6 to 12 percent slopes, eroded

Soil Map Legend

HSG	Symbol	Soil Name
C	ZaC3	Zanesville silt loam, 6 to 12 percent slopes, severely eroded
C	ZaD2	Zanesville silt loam, 12 to 18 percent slopes, eroded
C	ZaD3	Zanesville silt loam, 12 to 18 percent slopes, severely eroded
D	Zp	Zipp silty clay