

## Exhibit No. 1

### STORM DRAINAGE NOTES

The following storm sewer and/or storm drainage notes are to be shown on the development plans, when applicable. Also, use the notes that apply to any building permit plans that the Department of Public Works reviews for storm drainage approval.

1. All plans and construction within the unincorporated areas of Hamilton County shall comply with the current "Rules and Regulations" of the Public Works Department of Hamilton County, governing the design, construction, operation, maintenance and use in the County of Hamilton Storm Drainage System. Copies of these "Rules and Regulations" are available at the Department of Public Works, Room 800 County Administration Building, 138 East Court Street, Cincinnati, Ohio 45202.
2. All storm sewer, surface drainage and detention/retention facility construction and material shall be in accordance with the State of Ohio Construction and Material Specifications, current edition.
3. All storm sewer, surface drainage (except for storm sewer within County road right-of-way) and detention/retention facility construction to be under the inspection and supervision of the Hamilton County Department of Public Works. Phone (513) 632-8431 at least two (2) days in advance of construction.

Storm systems constructed within county road right-of-way is to be inspected by the Hamilton County Engineer.

4. Unless otherwise specified, storm sewer pipe shall be Type "C" Conduit 706.02, Class IV with Class B bedding as per ODOT 603.06. Backfilling is to comply with ODOT 603.10 and 603.11 for all storm sewers.
5. Thermoplastic storm sewer pipe may be substituted for concrete pipe. The type of pipe and ASTM or AASHTO numbers must appear on the plans and profiles. Also, the pipes shall be stamped by the manufacturer prior to shipment for field verification. The pipe shall comply with the specifications of the Hamilton County Public Works Rules and Regulations. (Section ST 713(b)).
6. Unless otherwise specified, storm sewer manholes are to be ODOT Std No. 1, Std. No. 3 or Std. No.5, and catch basins are to be ODOT Std. catch basins.

All catch basin outlet pipes connecting to manholes are to be sloped at 2% unless otherwise specified. Maximum permitted depth of ODOT Std Catch Basins shall be as follows:

CB-3A, CB2-2-A and CB2-2-B: 4'-0"

CB-3 and CB-3M: 6'-0"

CB-3MH: 12'-0" Should it become necessary to increase depths beyond 12'-0", reinforced concrete walls shall be used. Developer shall submit design details for approval.

7. All wingwall headwalls designated as (Std. H.W.) or (W.W.H.W.) shall be Hamilton County Department of Public Works Std. Plate 5 Wingwall Headwall.

8. RCP indicates Item 601 Rock Channel Protection. Dimensions on plan indicate size (Type B, C, etc.), width and length and depth.

9. Compacted fills are to be made to a minimum of three feet above the crown of any proposed sewer prior to cutting of trenches for placement of said sewers. All fills shall be controlled, compacted and inspected by an approved testing laboratory or an inspector from the appropriate governmental agency.

10. Area of Subdivision is \_\_\_\_\_ acres.

11. All proposed private storm sewers and surface or other drainage facilities are to be private and maintained by the owner for nonresidential developments. For residential developments, all proposed private storm sewers and surface or other drainage facilities are to be private and maintained by the Home Owner's Association (HOA) or the proportional distribution of the property owners within the development if the (HOA) is dissolved. If a Home Owner's Association (HOA) is not formed the maintenance responsibility will be the proportional distribution of the property owners within the residential development.

12. All ground surface areas that have been exposed or left bare as a result of construction and are to final grade and are to remain so shall be seeded and mulched as soon as practical in accordance with State of Ohio Specification Item 659.

13. CB3-M or CB-3MH catch basins as designated on the plans refers to Hamilton County Department of Public Works latest Std. Drawings.

14. Steps shall be provided in all catch basins where the depth exceeds 4'-0" and shall meet the requirements of the State of Ohio Std. Construction Drawing MH-1.

15. No direct connections of effluent pipes from household sewage disposal systems are permitted to closed public storm drainage systems. Furthermore, the discharge shall not enter the public storm sewer.

16. Temporary erosion, sediment and debris control using the State of Ohio "Bale Inlet Filter" detail on Std. Drawing. MC-11 must be provided for at all catch basins, inlets and the inlet side of all new pipe openings, or approved equal.

17. Temporary erosion, sediment and debris control using the State of Ohio "Bale Ditch Check" detail on Std. Drawing. MC-11 must be provided for at the outlet ditch, swale, watercourse or pipe. See approved plans for any other specific locations, also, or approved equal.

18. In addition to any temporary erosion, sediment, and debris control details and notes shown on the plans, the developer shall construct temporary sediment basins, earth dikes, temporary or permanent seeding, mulching and/or mulch netting or any other generally accepted methods to prevent erosion, mud and debris from being deposited on other property, on newly constructed or existing roads, or into existing sewers or new sewers within the development. The developer shall continually monitor the construction progress and make any necessary temporary adjustments to maintain this control. Consideration should also be given to the "Bale Filter Dike", "Dikes & Slope Protection" and "Sediment Basins and Dams" shown on Std. Drawing. MC-11 for use in temporary erosion, mud and debris control.

**Add the following "Restrictions on Sewer Easements", when following instructions of Section ST 407(a), 407(a)(1) and 407 (a)(2).**

19. "Restriction on Sewer Easements": No structure of any kind which can interfere with access to said public sewer shall be placed in or upon a permanent sewer easement excepting items such as recreational surfaces, paved areas for parking lots, driveways, or other surfaces used for ingress and egress, plants, trees, shrubbery, fences, landscaping or other similar items, being natural or artificial. No items such as recreational surfaces, paved areas for parking lots, driveways, or other surfaces used for ingress and egress, plants, trees, shrubbery, fences, landscaping or other similar items, being natural or artificial shall be placed in a private drainage easement that impedes or diverts the flow. i.e. Typical Section A-A Emergency Overflow Swale.

Any of the aforesaid surfaces, paved areas, plants, trees, shrubbery, fences, landscaping or other similar items which may be placed upon such said permanent easement shall be so placed at the sole expense of the property owner, and the grantees or assigns of any permanent easement henceforth shall not be responsible to any present owners of the property, nor to their heirs executors, administrators or assigns, for the condition, damage to, or replacement of any such aforesaid items, or any other items placed upon the easement, resulting from the existence or use of the said permanent sewer easement by the grantees or assigns.

Any structure construction on said property in which said permanent sewer easement exists shall be kept not less than three (3) feet outside the permanent sewer easement line nearest the site of the proposed structure, except that this restriction is not applicable to all storm sewer easements.

Any deviation from the aforesaid restrictions shall be petitioned by written request to the grantees or their assigns. Each such request shall be considered on an individual basis with approval not to be unreasonably withheld.

20. Private storm sewer easements shown on these plans are not accepted by the Board of County Commissioners of Hamilton County, and the County of Hamilton is not obligated to maintain, repair or operate any private storm sewer line. Operation and maintenance of all private storm sewer lines shown on these plans is the obligation of the owners of the lots using the storm sewer lines.

21. Private individual disposal line easements shown on these plans are not accepted by the Board of County Commissioners of Hamilton County, and the County of Hamilton is not obligated to maintain, repair or operate any private disposal line. Operation and maintenance of all private disposal lines shown on these plans is the obligation of the owners of the lots using the disposal lines.

*The following note is to be used on subdivision or development plans where there is an existing watercourse, swale or drainage channel extending thru two or more lots within the plan limits.*

22. Private drainage easements shown on these plans are not accepted by the Board of County Commissioners of Hamilton County, and the County of Hamilton is not obligated to maintain or repair any watercourses, drainage channels or installations in said easements. The easement area of each lot and all improvements in it shall be maintained continuously by the owner of the lot. Within these easements, no structures, planting or other material shall be placed or permitted to remain which may obstruct, retard or change the direction of the flow of water through the watercourses or drainage channels in the easement.

*The following note is to be used on subdivision or development plans where the proposed home or building low floor elevation (including basement) can be flooded as computed by the methods indicated in the Department of Public Works current Rules and Regulations:*

23. *The following note, or a similar note, must be shown on the Building Permit Plan (Plot Plan) for the following lots if the lowest floor elevation (including basements) is below the elevations stated below.*

"No gravity flow storm drains from any driveway, window well, stairwell, foundation, basement, patio or other source will be permitted to be directly connected to the proposed storm sewer system and/or existing or proposed watercourse below the following elevations:

LOT	ELEVATION	LOT	ELEVATION

If the basement floor is below the above stated elevation, the basement shall be provided with a sump pump well and sump pump. The pump shall be discharged on the lot at or above the elevation stated above.

A gravity flow storm system may be discharged on the lot at a point where the outlet is not affected by flooding from the proposed storm sewer system and/or existing or proposed watercourse."

24. Special flood hazard areas as shown on these plans must be shown on the Building Permit (Plot Plan).

**The Board of County Commissioners has adopted flood damage prevention regulations. These regulations require that an application for a development permit for work within the flood plain limits shall be made to the Public Works/Sanitary Engineer's Department of Hamilton County, Ohio. An approval of said development permit shall be obtained prior to performing any work within these limits.**

25. The easement notes that follow shall be provided on the Improvement Plan.

**Private drainage easement for storm water detention/retention facility**

Private storm drainage limits shown on this plan are not accepted by the Board of County Commissioners of Hamilton County and the County of Hamilton is not obligated to maintain or repair any channels or installations in said limits. The said limit area and all improvements in it shall be maintained continuously by the legal owner(s). No structures, planting or other material, shall be placed or permitted to remain which may obstruct, retard or change the direction of the flow of water through the drainage channel in the said limits.

The location of the Private Storm Drainage Limits must be prepared by the Developer or his Engineer on an easement and/or record plat by the metes and bounds description. The plat is to be submitted to the Hamilton County Department of Public Works for review and approval prior to the Developer or his Engineer having the plat recorded. The Developer or his Engineer is to submit a print of the recorded plat to the Hamilton County Department of Public Works for their file and records prior to approval of the final development plans.

26. The documentation and easement notes that follow shall be provided on the easement and/or record plat.

**DEDICATION OF PERMANENT**

PRIVATE DRAINAGE EASEMENT  
FOR  
STORM WATER DETENTION

Property conveyed to: \_\_\_\_\_

By deed recorded in Deed Book \_\_\_\_\_ Page \_\_\_\_\_

We the undersigned do hereby adopt and confirm this plat of private drainage limits. We also acknowledge that said limits as shown on this plat shall be reserved for storm sewers, surface ditches, primary and emergency structures and detention basin purposes only and subject to the terms and conditions of the private drainage note as described hereon.

Witness:

Signed:

\_\_\_\_\_  
\_\_\_\_\_

State of Ohio, Hamilton county before me a Notary Public in and  
for said County and State personally appeared

\_\_\_\_\_

And acknowledge the signing of the foregoing instrument to be their voluntary act and deed for the uses and purposed therein mentioned in testimony where of i hereto set my hand and official

Seal this \_\_\_\_\_ day of \_\_\_\_\_

\_\_\_\_\_

Notary public, State of Ohio

My commission expires on \_\_\_\_\_

**Private drainage easement for storm water detention/retention facility**

Private drainage easements shown on these plans are not accepted by the Board of County Commissioners of Hamilton County, and the County of Hamilton is not responsible to maintain, repair or replace any channels or installations within said easements.

The easement areas and all improvements within said easements are to be maintained continuously by the legal owner(s), heir(s), assign (s) or successor(s) of the real estate wherein said easements occur.

Or

The easement area of each lot and all improvements in it shall be maintained continuously by the owner of the lot, heir(s) assign (s) or successor (s) of the real estate wherein said easement occur.

Or

The easement areas and all improvements within said easements are to be maintained continuously by the home owners association.

No structures or structure alterations, planting or other materials and modifications may be placed and/or made, nor permitted to remain which will obstruct, retard, alter or adversely effect the integrity of the detention/retention facility in regard to the direction of the flow of water through the drainage channel, quantity of storm water detained or the rate of discharge from the controlled outlet structure as approved by the Hamilton county public works department.

Prior to any changes being made to the storm water detention/retention facility, a written request must be submitted to the director of the Hamilton county public works department for approval.

Storm water detention/retention facility table.

Designation	High water elevation (ft. Above msl)	Pre-dev q <sub>1</sub> (cfs)	Pre-dev q <sub>10</sub> (cfs)	Post-dev q <sub>50</sub> (cfs)	Required storage volume (c.f.)
Detention facility no. 1					
Detention facility no. 2					

"No gravity flow storm drains from any driveway, window well, stairwell, foundation, basement, patio or other source will be permitted to be directly connected to the proposed storm sewer system and/or existing or proposed watercourse below the high water elevations shown in the above table.

If the basement floor is below the above stated elevation, the basement shall be provided with a sump pump well and sump pump. The pump shall be discharged on the lot at or above the elevation stated above.

A gravity flow storm system may be discharged on the lot at a point where the outlet is not affected by flooding from the proposed storm sewer system and/or existing or proposed watercourse."

Approved: \_\_\_\_\_

Gary R. Van Hart, P.E., Director of Public Works



Note: SDS Application must be fully completed before accepted and reviewed !!

### Storm Drainage System Application

#### SDS Review / Inspection

Hamilton County Department of Public Works  
138 East Court Street, Room 800  
Cincinnati, Ohio 45202  
Phone 513-946-4750 Fax 513-946-4744

Application No. \_\_\_\_\_

**DO NOT WRITE IN SPACE**

Date: \_\_\_\_\_

#### 1. Applicant- Complete all applicable spaces on this form.

Identification	Name	Address	City/State	Zip	Phone
A. Owner/Developer					
B. Contractor					
C. Plans By					
D. Person to be billed for review/fees					
E. Person to be billed for inspection fees					

#### 2. Project Information:

Project Title: \_\_\_\_\_ Application No./Case No. \_\_\_\_\_ Present Zoning \_\_\_\_\_  
Job Address: \_\_\_\_\_ Township \_\_\_\_\_ Proposed Zoning \_\_\_\_\_

#### 3. Check Applicable Box:

Type of Project	Concept review	Improvement Plan Review (IP)	Concurrent concept & improvement plan review (C&IP)
Subdivision			
Frontage Subdivision			
Commercial/Industrial			
Building Permit			
Other (Describe)			

\*Improvement plans are detailed construction drawings conforming to rules & regulations of Public Works, Metropolitan Sewer District, and County Engineers.

4. THE OWNER OF THE DEVELOPMENT AND UNDERSIGNED, DO HEREBY COVENANT AND AGREE TO COMPLY WITH ALL THE LAWS OF THE STATE OF OHIO AND THE REGULATIONS OF THE COUNTY OF HAMILTON, PERTAINING TO EARTH MOVEMENT, AND THAT SAID CONSTRUCTION WILL BE IN ACCORDANCE WITH PLANS AND SPECIFICATIONS SUBMITTED HEREWITH AND CERTIFY THAT THE INFORMATION AND STATEMENT GIVEN ON THIS APPLICATION ARE TRUE.

#### 5. Review Application By:

\_\_\_\_\_  
(Must be the same as 1-D) (PRINT COMPANY NAME & YOUR NAME)

#### 6. Inspection Application By:

\_\_\_\_\_  
(Must be the same as 1-E) (PRINT COMPANY NAME & YOUR NAME)

SIGNATURE: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

### Exhibit No. 3

#### Subdivision Check List Design Aid

Development Name \_\_\_\_\_

Date \_\_\_\_\_ Checked By \_\_\_\_\_ Project # \_\_\_\_\_

Owner/Developer \_\_\_\_\_

Civil Engineer \_\_\_\_\_ Township \_\_\_\_\_

#### GENERAL

- SDS Application received.
- Special Flood Hazard Area, Development Application and No-Rise form required.
- Departmental approval, notify Regional Planning Commission.
- Permits Plus final approval and plans to Public Works Inspectors.
- Permits Plus storm review charges.
- Record Plat approval. Check with Inspector for bond.
- Plot CAGIS map.

#### SPECIAL FLOOD HAZARD AREA

- This Development is located in FEMA numbered stream.
- This Development is located in SFHA Consoer - Townsend stream.
- HEC-RAS required.
- Bulletin 45 required for drainage areas over 200 acres.
- Print FEMA and or Consoer – Townsend maps and data tables.
- Show SFHA elevations and limits.
- Show BFE (Base Flood Elevation).
- Show FPR (Flood Protection Elevation). Basement elevation 1'- 0" above BFE.
- Flood Application and No-Rise Form.

#### STORM WATER MANAGEMENT

- Exhibit 33 - Detention/Retention orifice and volume calculations.
- Private Drainage Easement for Storm Water Detention/Retention Plat.
- Storm water detention As-Built.
- MOE (Minimum low floor, basement, or window Opening Elevation).
- Earthen dikes to be provided downstream of field Inlets in most cases. Show the Q100 year elevations.
- Plate 5 wing wall headwall at inlet and outlet with rock channel protection to be used in all developments. Engineer to submit Q100 year head water depths, and Q100

- year high water elevation and limits on grading plan.
- Storm sewer pipe design, material, class, size, capacity, and velocity. Also, check for significant diversion. Minimum velocity in storm sewer pipes when flowing full shall not be less than 2.5 f.p.s. Maximum velocity in storm sewer pipe shall be 16 f.p.s.
- Storm sewer pipe with flow velocities that exceed 16 f.p.s. and/or slopes greater than 15% will require special pipe as per Section ST 713(c). Maximum velocity at outlets to be 12 f.p.s. unless an energy dissipater design is submitted.
- Double grates required at all low point sags in pavement.
- Vane grates provided where street profile grade exceeds 8%.
- 1.0 c.f.s. maximum by-pass for street inlets with 8'-0" spread.
- 0.5 c.f.s. maximum by-pass at intersections.
- CB-3M and CB-3MH catch basins are used properly.
- Field inlets, number and size of windows to accept Q100 design.
- Provide Section A-A 10' width emergency overflow "V" swale and 10' Private Drainage Easement to rear of lot on downstream side at all low point sags in the pavement or cul-de-sac.
- No diagonal emergency overflow swales permitted in the front yards.
- Public and private storm sewer easements are properly shown.
- Manholes are properly specified, located and spaced.
- 20' Private Drainage Easements, minimum.
- Separate sentiment basin when possible.
- Lot-by-lot check for storm water entering or leaving. Minimum low floor elevations as required.
- Do not raise the Q100 year elevation at the upstream property line.
- Show the Q100 year hydraulic gradient on all storm sewers in the profile.
- 10' ingress and egress easement for storm water detention/retention maintenance.
- Storm sewer notes.

#### **Exhibit No. 4**

The Data Shown On The Charts And Computation Sheets That Follow May Be Submitted By The Designer On Computer Output Sheets In A Different Form:

Exhibit No5: Overland Flow Chart Duration Of Time "T" Of Concentration (In Minutes)

Exhibit No 6: Nomograph For Pipe Selection

Exhibit No 7: Nomograph For Solution Of Manning Formula

Exhibit No 8: Storm Sewer Computation Sheet A

Exhibit No 9: Storm Sewer Computation Sheet B

Exhibit No 10: Pavement Drainage Computation Sheet

Exhibit No 11: Catch Basin Design Sheet

Exhibit No 11.1 Optional: Pavement Drainage Computations And Catch Basin Analysis

EXHIBIT NO. 5

Overland Flow Chart

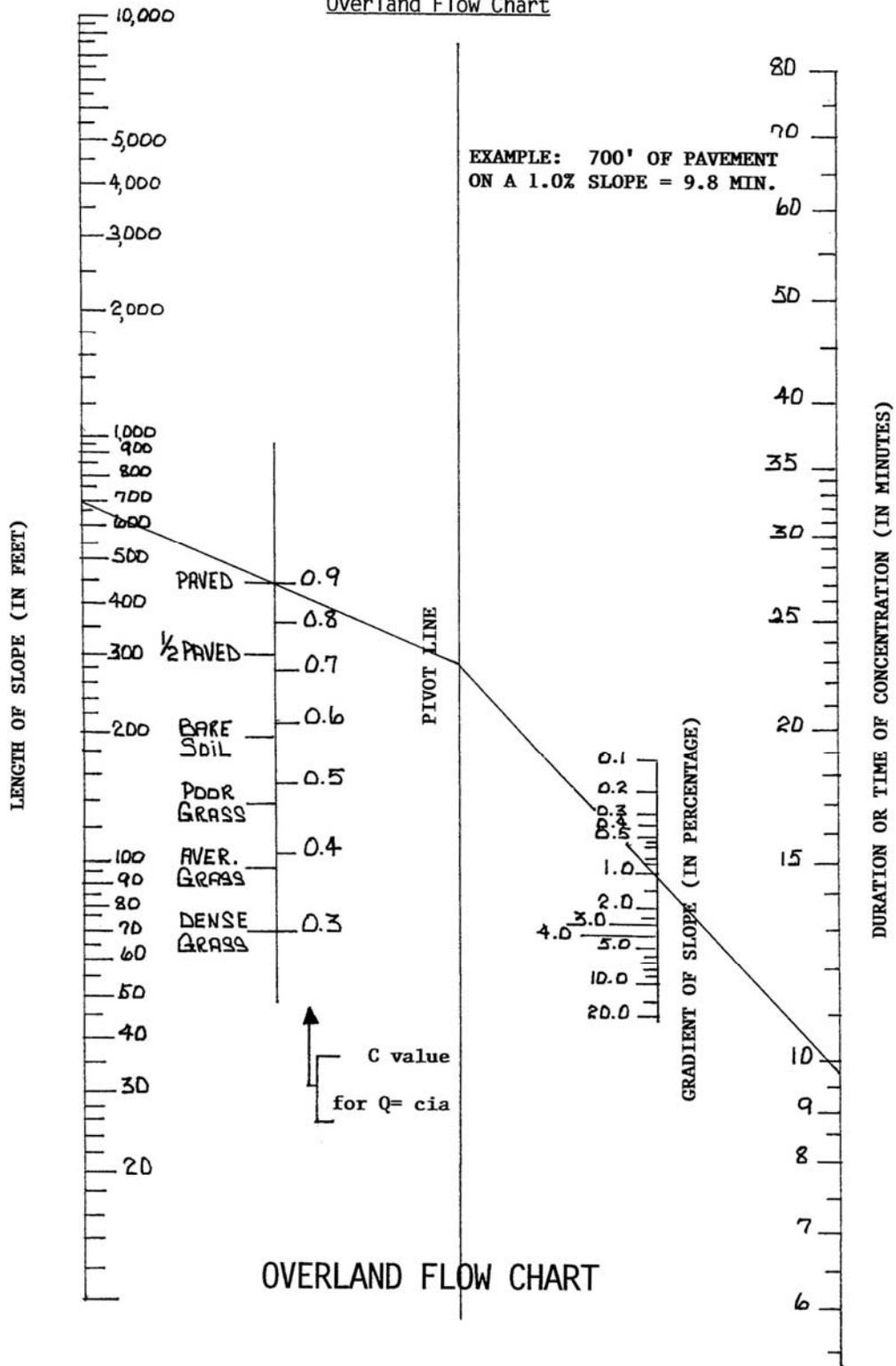
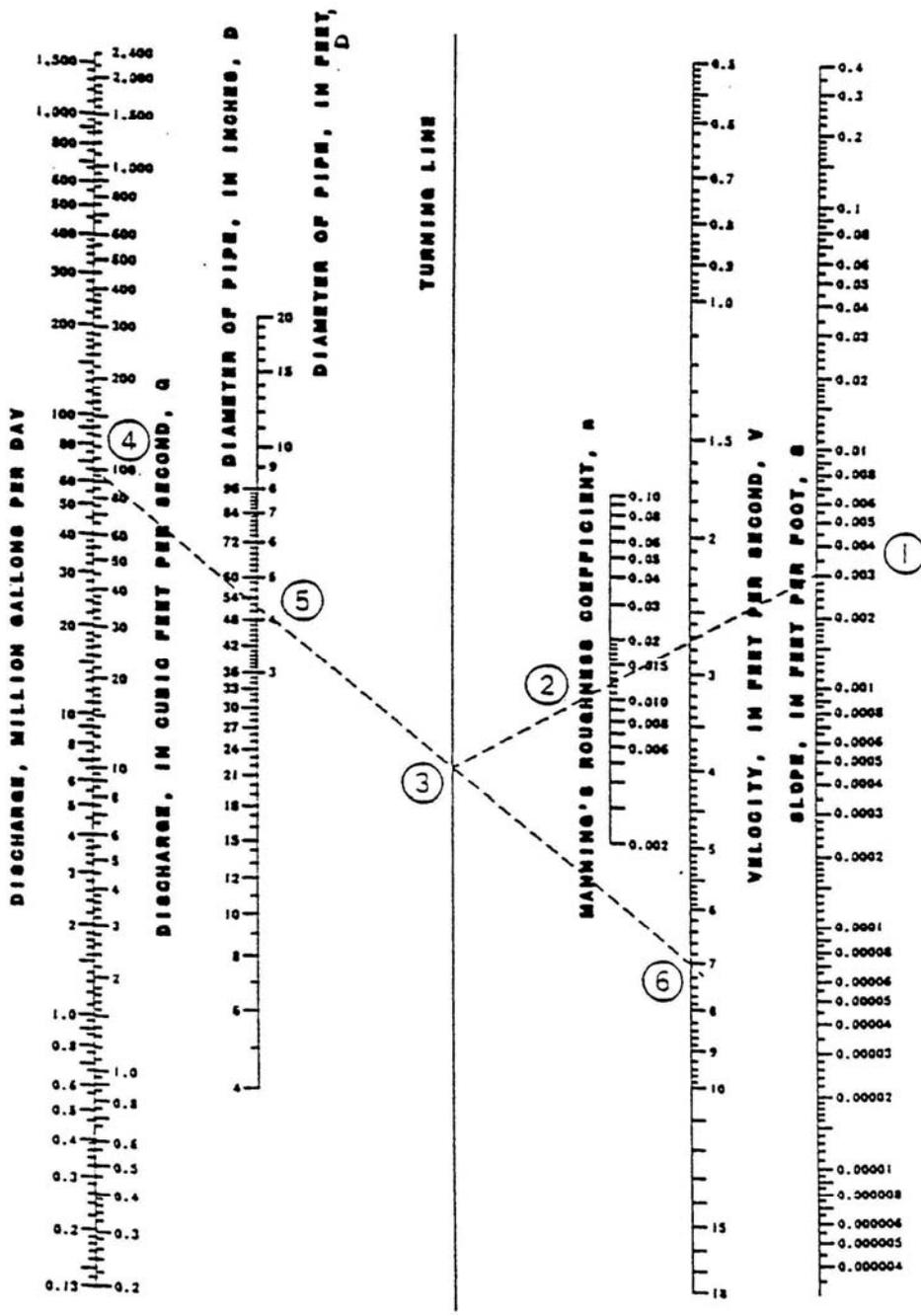
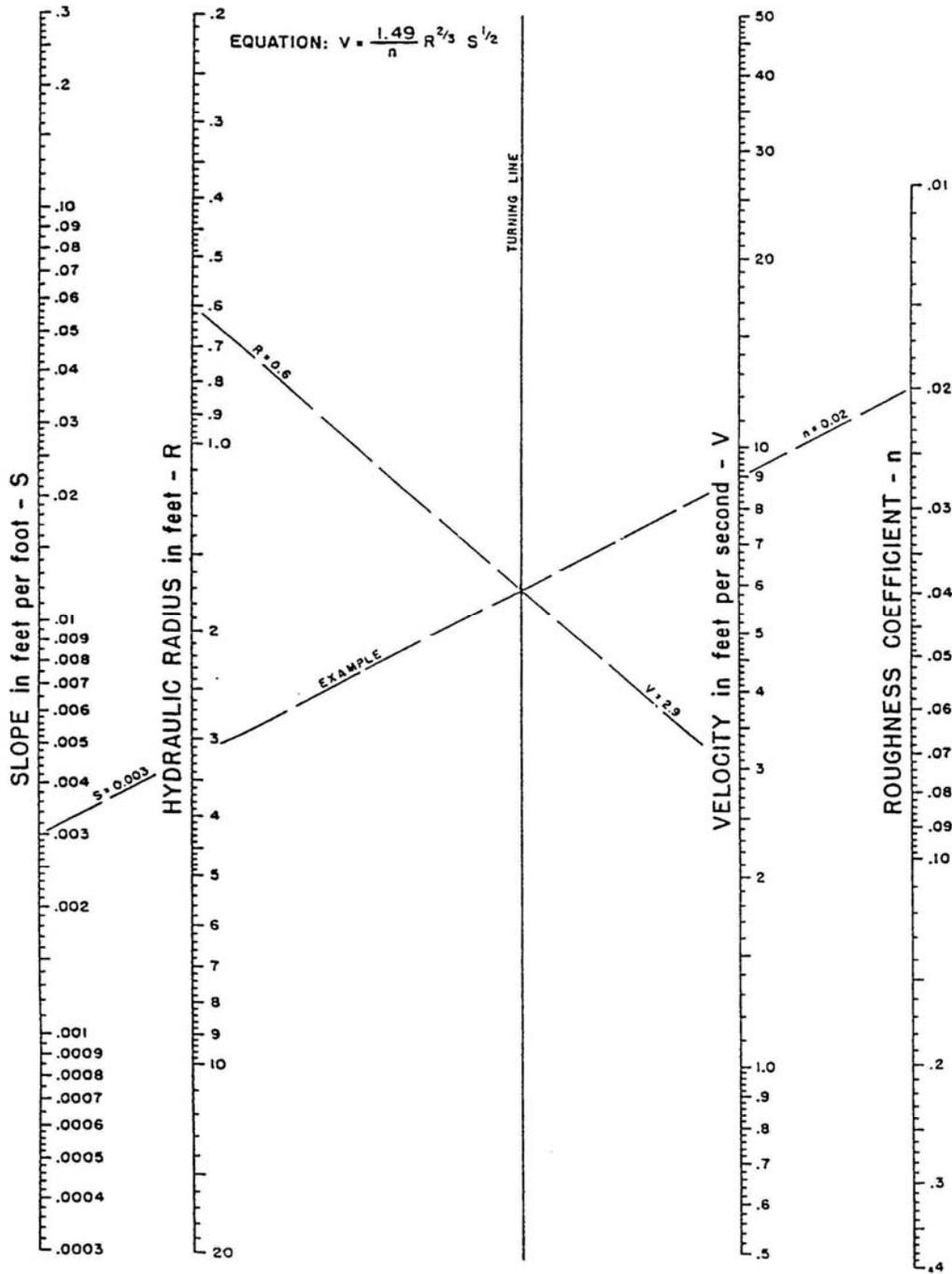


EXHIBIT NO. 6  
 NOMOGRAPH FOR SOLUTION OF THE MANNING FORMULA



NOMOGRAPH FOR SOLUTION OF THE MANNING FORMULA  
 $Q = AV = A \frac{1.49}{n} r^{2/3} s^{1/2}$

EXHIBIT NO. 7  
NOMOGRAPH FOR SOLUTION OF THE MANNING FORMULA



NOMOGRAPH FOR SOLUTION OF THE MANNING FORMULA

		INLET LOCATION (DESIGN POINT)	1
SITE SPECIFIC SEE CHAPTER 6		RUNOFF COEFFICIENT C	2
DRAINAGE AREA TO INLET	ACRES	DRAINAGE AREA A	3
COLUMN 2 & COLUMN 3		CA	4
SUMMATION OF COLUMN 4		CA	5
TIME OF CONCENTRATION TO INLET SEE CHAPTER 6 OR COLUMN 14/COLUMN 20	MIN.	INLET OR CONDUIT TRAVEL TIME	6
CURRENT INLETS INLET TIME COLUMN 6 OR PRECEDING INLET TIME - CONDUIT TRAVEL TIME COLUMN 6 WHICHEVER IS GREATER	MIN.	TIME OF CONCENTRATION Tc	7
EXHIBIT V-1 OR V-2 WITH COLUMN 7	IN/HR	RAINFALL INTENSITY ____ YEAR FREQUENCY I	8
COLUMN 5 & COLUMN 8	GFS	RUNOFF (CA)	9
ANY OTHER RUNOFF ENTERING STORM SEWER PIPE	GFS	OTHER CONTROLLED RUNOFF	10
COLUMN 9 & COLUMN 10	GFS	TOTAL RUNOFF, Q	11
SITE SPECIFIC		PIPE LINE DESIGNATION	12
ASSUME	IN	PIPE DIAMETER	13
SITE SPECIFIC	FT	LENGTH, L	14
SITE SPECIFIC	FT/FT	SLOPE	15
SEE STREET INLET CALCULATION		GUTTER AT INLET OR COVER ELEVATION	16
SET FOR FIRST INLET THEN CALCULATE AS INLET ELEVATION - COLUMN 14 - COLUMN 15		INLET OR MANHOLE BOTTOM	17
COLUMN 16 - COLUMN 17	FT	PIPE COVER	18
		MEETS COVER DESIGN CRITERIA	19
EXHIBIT IX-I WITH COLUMNS 13, 15 & PIPE ROUGHNESS	GFS	JUST FULL CAPACITY	20
EXHIBIT IX-I WITH COLUMNS 11 AND 13 AND EXHIBIT X-6 WITH RATIO OF COLUMN 11 TO 20	FPS	VELOCITY	21
		MEETS VELOCITY DESIGN CRITERIA	22
EXHIBIT V-1 OR V-2 W/COL 7 FOR LAST DN STRN INL IS CONST TILL NO LONGER PRESS FLOW THEN START AGAIN WITH NEW COLUMN 7	IN/HR	RAINFALL INTENSITY ____ YEAR FREQUENCY I	23
COLUMN 5 X COLUMN 23	GFS	TOTAL RUNOFF Q	24
EXHIBIT IX-1 WITH COLUMN 13, 24 AND PIPE ROUGHNESS	FT/FT	SLOPE	25
COLUMN 14 AND COLUMN 25	FT	HEADLOSS	26
DOWNSTREAM HYDRAULIC GRADIENT PLUS COLUMN 26 IF NOT PRESSURE FLOW USE CROWN OF PIPE		ELEVATION OF HYDRAULIC GRADIENT	27
COLUMN 13 AND COLUMN 17		CROWN PIPE	28
		PRESSURE FLOW	29

PROJECT

DESIGNER

EXHIBIT NO. 8  
STORM SEWER COMPUTATIONS

DATE

							1	INLET LOCATION (DESIGN POINT)	
							2	RUNOFF COEFFICIENT C	
					ACRES		3	DRAINAGE AREA A	
							4	CA	
							5	CA	
					MIN.		6	INLET OR CONDUIT TRAVEL TIME	DISCHARGE
							7	TIME OF CONCENTRATION T <sub>c</sub>	
					MIN.		8	RAINFALL INTENSITY ____ YEAR FREQUENCY I	
					IN/HR		9	RUNOFF (CA)	
					CFS		10	OTHER CONTROLLED RUNOFF	
					CFS		11	TOTAL RUNOFF, Q	
							12	PIPE LINE DESIGNATION	
					IN		13	PIPE DIAMETER	
					FT		14	LENGTH, L	
					FT/FT		15	SLOPE	
							16	GUTTER AT INLET OR COVER ELEVATION	
							17	INLET OR MANHOLE BOTTOM	STORM SEWER SIZE
					FT		18	PIPE COVER	
							19	MEETS COVER DESIGN CRITERIA	
					CFS		20	JUST FULL CAPACITY	
					FPS		21	VELOCITY	
							22	MEETS VELOCITY DESIGN CRITERIA	
					IN/HR		23	RAINFALL INTENSITY ____ YEAR FREQUENCY I	
					CFS		24	TOTAL RUNOFF Q	
					FT/FT		25	SLOPE	HYDRAULIC GRADIENT
					FT		26	HEADLOSS	
							27	ELEVATION OF HYDRAULIC GRADIENT	
							28	CROWN PIPE	
							29	PRESSURE FLOW	

PROJECT \_\_\_\_\_

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

EXHIBIT NO. 8  
STORM SEWER COMPUTATIONS

EXHIBIT NO. 9

Storm Sewer Computation Sheet B

LOCATION \_\_\_\_\_ SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_ BY \_\_\_\_\_  
 \_\_\_\_\_ SUB-DIST. \_\_\_\_\_  
 \_\_\_\_\_ DRAINAGE DIST. \_\_\_\_\_

DATE \_\_\_\_\_  
 MOTIVE \_\_\_\_\_  
 COEF. -C- \_\_\_\_\_ TOPO \_\_\_\_\_

LOCATION	FROM	TO	T <sub>m</sub>	I	A	ΣA	c	Ac	ΣAc	Q	D	S	C	V	L	Ts	REMARKS

EXHIBIT NO. 10

Pavement Drainage Computation Sheet

PAVEMENT DRAINAGE COMPUTATIONS

PROJECT	DESIGNER	DATE
1	INLET STATION	
2	UPSTREAM STATION	
3	LENGTH	FT
4	WIDTH	FT
5	A	ACRES
6	C	ACRES
7	CA	ACRES
8	TIME	MIN
9	YEAR FREQUENCY	IN/100
10	Q <sub>0</sub>	CFS
11	GUTTER SLOPE (S <sub>1</sub> )	FT/FT
12	CROSS SLOPE (Z <sub>1</sub> )	FT/FT
13	DEPTH AT CURB (D <sub>1</sub> )	FT
14	SPREAD	FT
15	TYPE OF INLET	SELECT
16	WIDTH OF FLOW OUTSIDE OF GRATE	FT
17	DEPTH OUTSIDE EDGE OF GRATE (D <sub>2</sub> )	FT
18	FLOW OUTSIDE OF GRATE (Q <sub>2</sub> )	CFS
19	FLOW AT END OF GRATE (Q <sub>0</sub> -Q <sub>2</sub> )	CFS
20	0.0% CURB OPENING	
21	100% PICKUP LENGTH (L <sub>0</sub> )	FT
22	L/L <sub>0</sub>	
23	0.0% CURB OPENING	
24	0.0% CURB OPENING	
25	FLOW OVER SIDE OF GRATE (Q <sub>1</sub> )	CFS
26	TOTAL FLOW INTERCEPTED (Q <sub>1</sub> )	CFS
27	CARRY OVER FLOW	CFS
28	% PICKUP	
29	INLET OK	CHECK

EXHIBIT NO. 11

Catch Basin Design Sheet

CATCH BASIN DESIGN		Sh. _____ of _____ By _____	
Project _____ Date _____	Catch Basin Location, Station, Letter, or Number	Design Frequency _____ Yrs.	
		1	Type of Catch Basin Used
		2	Length of Drainage Area
		3	Runoff Coefficient (c) Assuming Ultimate Upstream Development
		4	Slope of Drainage Area
		5	Time of Concentration (tc)
		6	Rainfall Intensity (i)
		7	Drainage Area to Catch Basin (a)
		8	Peak Discharge (Q = Cols. 3 x 6 x 7 = cia)
		9	Transverse Slope of Pav't Use Exhibit Nos. 10 thru 12 for St'd Sub'd. Pav'ts. to Complete Col's 13 and 14
		10	Longitudinal Slope of Gutter
		11	Flow Carried Over From Upstream Catch Basin
		12	Total Gutter Flow to Catch Basin (Cols. 8 + 11)
		13	Spread (Width of Flow)
		14	Flow By-passing Catch Basin
		15	Col. 12 - Col. 14 Flow Intercepted by Catch Basin
		16	Flow Thru Grate (Exhibit No. 13)
		17	Flow Thru Curb Opening (Exhibit No. 14)
		18	Depth of Ponding

EXHIBIT NO. 11.1 OPTIONAL  
PAVEMENT DRAINAGE COMPUTATIONS AND CATCH BASIN ANALYSIS

CATCH BASIN ANALYSIS  
PROJECT: \_\_\_\_\_

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_ BY \_\_\_\_\_  
 SUB-DIST \_\_\_\_\_  
 DRAINAGE DIST \_\_\_\_\_  
 TOPO \_\_\_\_\_

DATE: \_\_\_\_\_  
 MOTIVE \_\_\_\_\_  
 COEF. -C \_\_\_\_\_  
 TIME \_\_\_\_\_  
 I 10 \_\_\_\_\_

\*Catch Basins are to intercept 85% of run-off  
 CB 3 A Maximum Capacity 2 cfs  
 CB3 Maximum Capacity 4 cfs

LOCATION	RIGHT	LEFT	TYPE	AREA NO.	A	ca	Q 10	EQ 10	S	SPREAD	BYPASS	REMARKS

## **Exhibit No. 12**

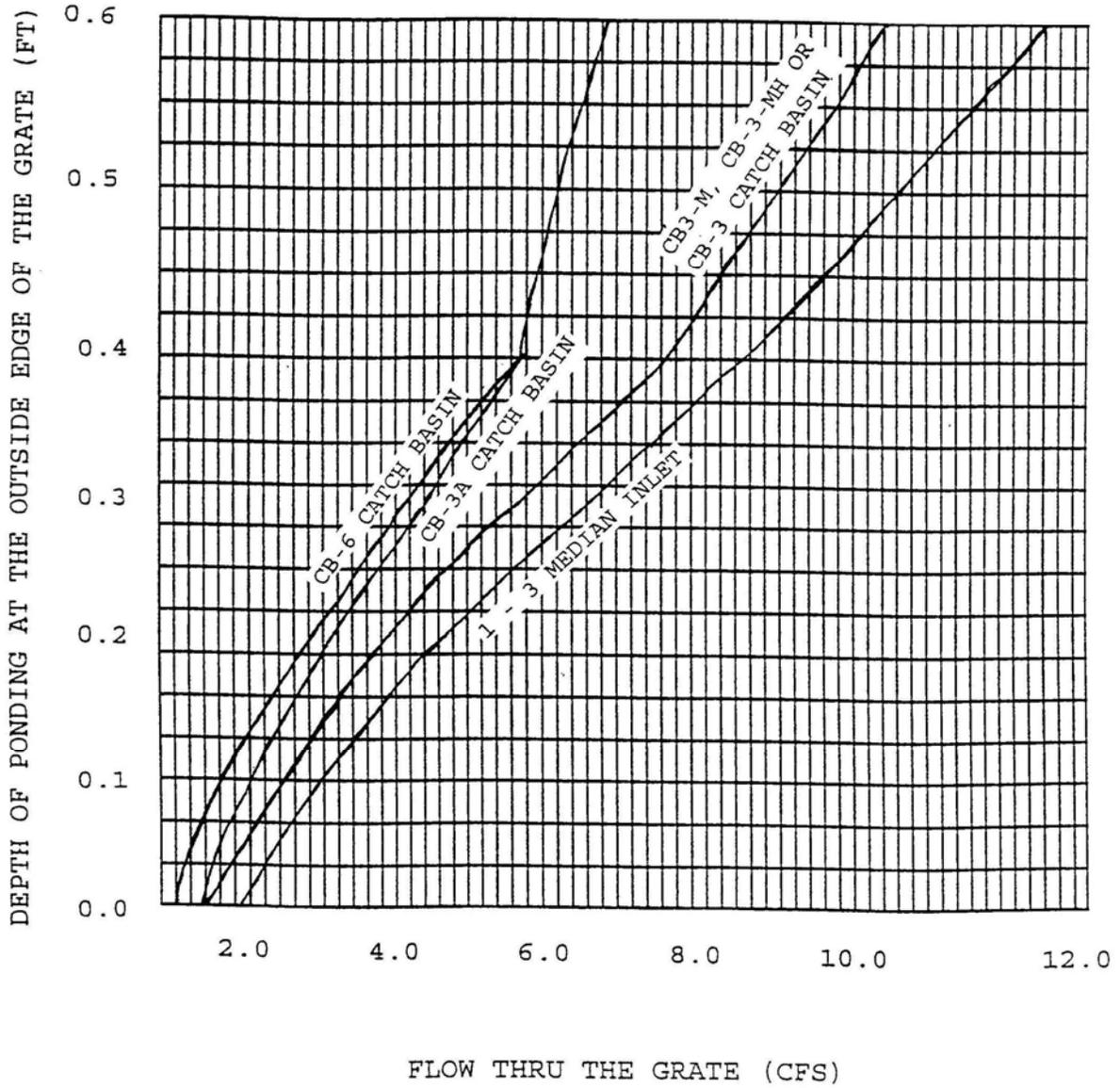
### **Private Storm Water Detention / Retention Maintenance Checklist**

1. Rock Channel Protection is in place and functioning properly.
2. Outfall pipe is clear of obstructions.
3. Dam shows no signs of leakage, failure or erosion.
4. Control structure is free of debris and all grates are in place.
5. Low flow channel has no standing water.
6. Grass is mowed.

**Exhibits 13 and 14 - NOT USED**

EXHIBIT NO. 15

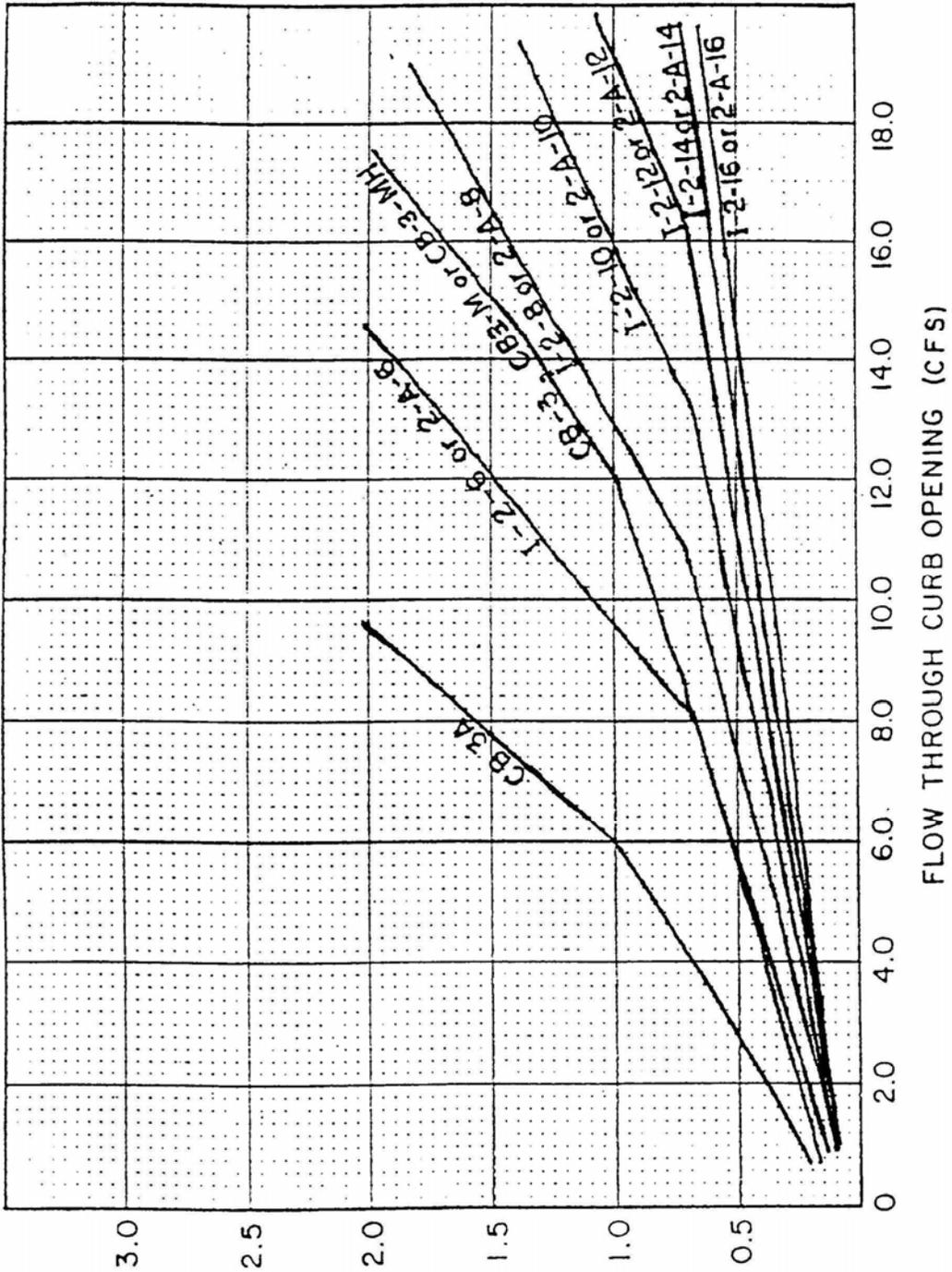
Capacity of Std. CB-3A, CB-3, CB3-M, or CB-3-MH Grates in Pavement Sags



CAPACITY OF STANDARD CATCH BASIN GRATES  
IN PAVEMENT SAGS

EXHIBIT NO. 16

Capacity of Std. CB-3A, CB-3, CB3-M, or CB-3-MH Curb Openings in Pavement Sags



CAPACITY OF STANDARD INLETS AND CATCH BASINS IN PAVEMENT SAGS

**EXHIBIT NO. 17**  
Capacity of Catch Basins With No Clogging

CB2-2-A H measured vertically from window sill in feet; Top of Grate is 6" above window sill						CB2-2-B No Windows	
H (Ft.)	Q (cfs) Total Width of Window Openings					H (Ft.)	Q (cfs)
	0	2'	4'	6'	8'		
	Flow thru grate only, assuming no window/s	Sum of flow thru one-2' window opening and grate	Sum of flow thru two-2' window openings and grate	Sum of flow thru three-2' window openings and grate	Sum of flow thru four-2' window openings and grate		
.0	.0	0.0	0.0	0.0	0.0	.0	.0
.1	.0	1.6	3.2	4.9	6.5	.1	.7
.2	.0	2.3	4.6	6.9	9.2	.2	2.0
.3	.0	2.8	5.7	8.5	11.3	.3	3.7
.4	.0	3.2	6.5	9.8	13.1	.4	5.8
.5	.0	3.6	7.3	11.0	14.7	.5	8.1
.6	.7	4.7	8.8	12.8	16.8	.6	10.6
.7	2.0	6.4	10.7	15.1	19.4	.7	11.4
.8	3.7	8.4	13.1	17.7	22.4	.8	12.2
.9	5.8	10.7	15.7	20.6	25.6	.9	12.9
1.0	8.1	13.3	18.5	23.7	28.9	1.0	13.7
1.1	10.6	16.0	21.5	27.0	32.5	1.1	14.3
1.2	11.4	17.1	22.8	28.6	34.3	1.2	15.0
1.3	12.2	18.2	24.1	30.0	36.0	1.3	15.6
1.4	12.9	19.1	25.3	31.5	37.7	1.4	16.2
1.5	13.7	20.0	26.4	32.8	39.2	1.5	16.7
1.6	14.3	20.9	27.5	34.1	40.7	1.6	17.3
1.7	15.0	21.8	28.6	35.4	42.2	1.7	17.8
1.8	15.6	22.6	29.6	36.6	43.6	1.8	18.3
1.9	16.2	23.4	30.5	37.7	44.9	1.9	18.8
2.0	16.7	24.1	31.5	38.9	46.3	2.0	19.3
2.1	17.3	24.8	32.4	40.0	47.6	2.1	19.8
2.2	17.8	25.5	33.3	41.0	48.7	2.2	20.3
2.3	18.3	26.2	34.2	42.1	50.0	2.3	20.7
2.4	18.8	26.9	35.0	43.1	51.2	2.4	21.2
2.5	19.3	27.6	35.8	44.1	52.3	2.5	21.6
2.6	19.8	28.2	36.6	45.0	53.4	2.6	22.0
2.7	20.3	28.8	37.4	46.0	54.5	2.7	22.5
2.8	20.7	29.5	38.2	46.9	55.6	2.8	22.9
2.9	21.2	30.1	38.9	47.8	56.7	2.9	23.3
3.0	21.6	30.6	39.7	48.7	57.7	3.0	23.7
3.1	22.0	31.2	40.4	49.6	58.8	3.1	24.1
3.2	22.5	31.8	41.1	50.5	59.8	3.2	24.5
3.3	22.9	32.4	41.8	51.3	60.8	3.3	24.8
3.4	23.3	32.9	42.5	52.1	61.7	3.4	25.2
3.5	23.7	33.4	43.2	53.0	62.8	3.5	25.6
3.6	24.1	34.0	43.9	53.8	63.7	3.6	25.9
3.7	24.5	34.5	44.5	54.6	64.6	3.7	26.3
3.8	24.8	35.0	45.2	55.3	65.5	3.8	26.7
3.9	25.2	35.5	45.8	56.1	66.4	3.9	27.0
4.0	25.6	36.0	46.4	56.9	67.3	4.0	27.3

**EXHIBIT NO. 18**  
Capacity of Catch Basins With No Clogging

<b>CB2-3 OR CB2-4</b> H measured vertically from window sill in feet; Top of Grate is 11" above window sill						
<b>H</b> (Ft.)	<b>Q (cfs)</b> Total Width of Window Openings					
	0	2'	3'	4'	6'	8'
	Flow thru grate only, assuming no window/s	Sum of flow thru one-2' window opening and grate	Sum of flow thru one-3' window opening and grate	Sum of flow thru one-4' window opening and grate	Sum of flow thru two-3' window opening and grate	Sum of flow thru two-4' window openings and grate
.0	.0	0.0	0.0	0.0	0.0	0.0
.1	.0	1.6	2.4	3.2	4.9	6.5
.2	.0	2.3	3.4	4.6	6.9	9.3
.3	.0	2.8	4.2	5.7	8.5	11.4
.4	.0	3.2	4.9	6.5	9.8	13.1
.5	.0	3.6	5.5	7.3	11.0	14.7
.6	.0	4.0	6.0	8.0	12.1	16.1
.7	.0	4.3	6.5	8.7	13.0	17.4
.8	.0	4.6	6.9	9.3	13.9	18.6
.9	.0	4.9	7.4	9.8	14.8	19.7
1.0	.7	5.9	8.5	11.1	16.3	21.4
1.1	2.0	7.5	10.2	12.9	18.4	23.7
1.2	3.7	9.4	12.3	15.2	20.9	26.6
1.3	5.8	11.7	14.7	17.7	23.5	29.6
1.4	8.1	14.3	17.3	20.4	28.2	32.7
1.5	10.6	17.0	20.1	23.3	29.7	36.0
1.6	11.4	18.0	21.3	24.6	31.2	37.8
1.7	12.2	19.0	22.4	25.8	32.6	39.4
1.8	12.9	19.9	23.4	26.9	33.9	40.9
1.9	13.7	20.8	24.4	28.0	35.2	42.4
2.0	14.3	21.7	25.4	29.1	36.4	43.8
2.1	15.0	22.5	26.3	30.1	37.6	45.1
2.2	15.6	23.3	27.2	31.0	38.8	46.4
2.3	16.2	24.1	28.0	32.0	39.9	47.7
2.4	16.7	24.8	28.9	32.9	41.0	49.0
2.5	17.3	25.5	29.7	33.8	42.0	50.3
2.6	17.8	26.2	30.4	34.6	43.0	51.5
2.7	18.3	26.9	31.2	35.5	44.0	52.7
2.8	18.8	27.6	31.9	36.3	45.0	53.8
2.9	19.3	28.2	32.6	37.1	46.0	54.9
3.0	19.8	28.8	33.4	37.9	46.9	56.0
3.1	20.3	29.5	34.0	38.6	47.8	57.0
3.2	20.7	30.1	34.7	39.4	48.7	58.0
3.3	21.2	30.6	35.4	40.1	49.6	59.0
3.4	21.6	31.2	36.0	40.8	50.5	60.0
3.5	22.0	31.8	36.7	41.6	51.3	61.0
3.6	22.5	32.4	37.3	42.3	52.2	62.0
3.7	22.9	32.9	37.9	42.9	53.0	63.0
3.8	23.3	33.4	38.5	43.6	53.8	63.9
3.9	23.7	34.0	39.1	44.3	54.6	64.8
4.0	24.1	34.5	39.7	44.9	55.4	65.7

**EXHIBIT NO. 19**  
Capacity of Catch Basins With No Clogging

<b>CB2-5 OR CB2-6</b>							
H measured vertically from window sill in feet; Top of Grate is 12" above window sill							
H (Ft.)	Q (cfs)						
	Total Width of Window Openings						
	0	4'	5'	6'	8'	10'	12'
	Flow thru grate only, assuming no window/s	Sum of flow thru one-4' window opening and grate	Sum of flow thru one-5' window opening and grate	Sum of flow thru one-6' window opening and grate	Sum of flow thru two-4' window opening and grate	Sum of flow thru two-5' window openings and grate	Sum of flow thru two-6' or three-4' window opening and grate
.0	.0	0.0	0.0	0.0	0.0	0.0	0.0
.1	.0	3.2	4.1	4.9	6.4	8.2	9.8
.2	.0	4.6	5.8	6.9	9.2	11.6	13.8
.3	.0	5.7	7.1	8.5	11.4	14.2	17.0
.4	.0	6.5	8.2	9.8	13.0	16.4	19.6
.5	.0	7.3	9.2	11.0	14.6	18.4	22.0
.6	.0	8.0	10.1	12.1	16.0	20.2	24.2
.7	.0	8.7	10.9	13.0	17.4	21.8	26.1
.8	.0	9.3	11.6	13.9	18.6	23.2	27.9
.9	.0	9.8	12.3	14.8	19.6	24.6	29.6
1.0	.0	10.4	13.0	15.6	20.8	26.0	31.2
1.1	.7	11.6	14.4	17.1	22.5	28.1	33.5
1.2	2.0	13.4	16.3	19.2	24.8	30.6	36.4
1.3	3.7	15.6	18.6	21.6	27.5	33.5	39.5
1.4	5.8	18.1	21.2	24.3	30.5	36.6	42.8
1.5	8.1	20.9	24.1	27.3	33.7	40.1	46.5
1.6	10.6	23.8	27.1	30.4	37.0	43.6	50.1
1.7	11.4	25.0	28.4	31.8	38.6	45.4	52.2
1.8	12.2	26.2	29.7	33.2	40.2	47.2	54.2
1.9	12.9	27.3	30.9	34.5	41.7	48.9	56.1
2.0	13.7	28.4	32.1	35.8	43.1	50.5	57.9
2.1	14.3	29.4	33.2	37.0	44.5	52.1	59.7
2.2	15.0	30.4	34.3	38.2	45.8	53.6	61.4
2.3	15.6	31.4	35.3	39.3	47.1	55.0	63.0
2.4	16.2	32.3	36.4	40.4	48.4	56.5	64.6
2.5	16.7	33.2	37.3	41.5	49.7	57.9	66.2
2.6	17.3	34.1	38.3	42.5	51.0	59.3	----
2.7	17.8	35.0	39.2	43.5	52.2	60.7	----
2.8	18.3	35.8	40.2	44.5	53.3	62.1	----
2.9	18.8	36.6	41.0	45.5	54.4	63.3	----
3.0	19.3	37.4	41.9	46.4	55.5	64.5	----
3.1	19.8	38.2	42.8	47.4	56.6	65.7	----
3.2	20.3	38.9	43.6	48.3	57.6	66.9	----
3.3	20.7	39.7	44.4	49.2	58.7	----	----
3.4	21.2	40.4	45.2	50.0	59.6	-----	----
3.5	21.6	41.1	46.0	50.9	60.6	-----	----
3.6	22.0	41.8	46.8	51.7	61.6	-----	----
3.7	22.5	42.5	47.5	52.6	62.5	-----	----
3.8	22.9	43.2	48.3	53.4	63.5	-----	----
3.9	23.3	43.9	49.0	54.2	64.4	-----	----
4.0	23.7	44.5	49.8	55.0	65.4	-----	----

**EXHIBIT NO. 20**  
Bulletin 45 Computation Sheet (Sheet 1 of 4)

Project: \_\_\_\_\_ Date: \_\_\_\_\_ By: \_\_\_\_\_

Located: \_\_\_\_\_ feet \_\_\_\_\_ of \_\_\_\_\_ Road

Existing structure is:

(1) Drainage Area (A) = \_\_\_\_\_ sq. miles or \_\_\_\_\_ Acres.

(2) Length or Major Stream (L) = \_\_\_\_\_ Mi. or \_\_\_\_\_ Ft.

(3) 0.85 (L) = \_\_\_\_\_ Mi. or \_\_\_\_\_ Ft. Elevation at 0.85 (L) = \_\_\_\_\_ Ft.,  
as measured along the existing watercourse from the downstream end

(4) 0.10 (L) = \_\_\_\_\_ Mi. or \_\_\_\_\_ Ft. Elevation at 0.10 (L) = \_\_\_\_\_ Ft.,  
as measured along the existing watercourse from the downstream end

(5) 0.75 (L) = \_\_\_\_\_ Mi. or \_\_\_\_\_ Ft.

(6) Elevation 0.85 (L) - Elevation 0.10 (L) = \_\_\_\_\_ Ft.

(7) Slope (S) = Step (6) ÷ Step (5) \_\_\_\_\_ Ft./Mi.

(8) Soil Factor (C) \_\_\_\_\_ (See EXHIBIT 20, Sheet 2 of 4)

(9) Mean Annual Flood (Qa) = \_\_\_\_\_ cfs (See EXHIBIT 20, Sheet 3 of 4)

Urban correction factor (UCF) =  $\frac{\% \text{ Rural} + f}{100} + f \frac{\% \text{ Urban}}{100}$

Bulletin 45

Flood Recurrence Interval	2	5	10	25	50	100
Urban Factor (f)	2.9	2.2	1.9	1.7	1.6	1.5
(UCF)						

Caution should be exercised when using the above factor, especially for small drainage areas and recurrence intervals of 10 years and less.

Q 10 Yr. = Qa \_\_\_\_\_ X FF \_\_\_\_\_ X UCF \_\_\_\_\_ = \_\_\_\_\_ cfs

Q 25 Yr. = Qa \_\_\_\_\_ X FF \_\_\_\_\_ X UCF \_\_\_\_\_ = \_\_\_\_\_ cfs

Q 50 Yr. = Qa \_\_\_\_\_ X FF \_\_\_\_\_ X UCF \_\_\_\_\_ = \_\_\_\_\_ cfs

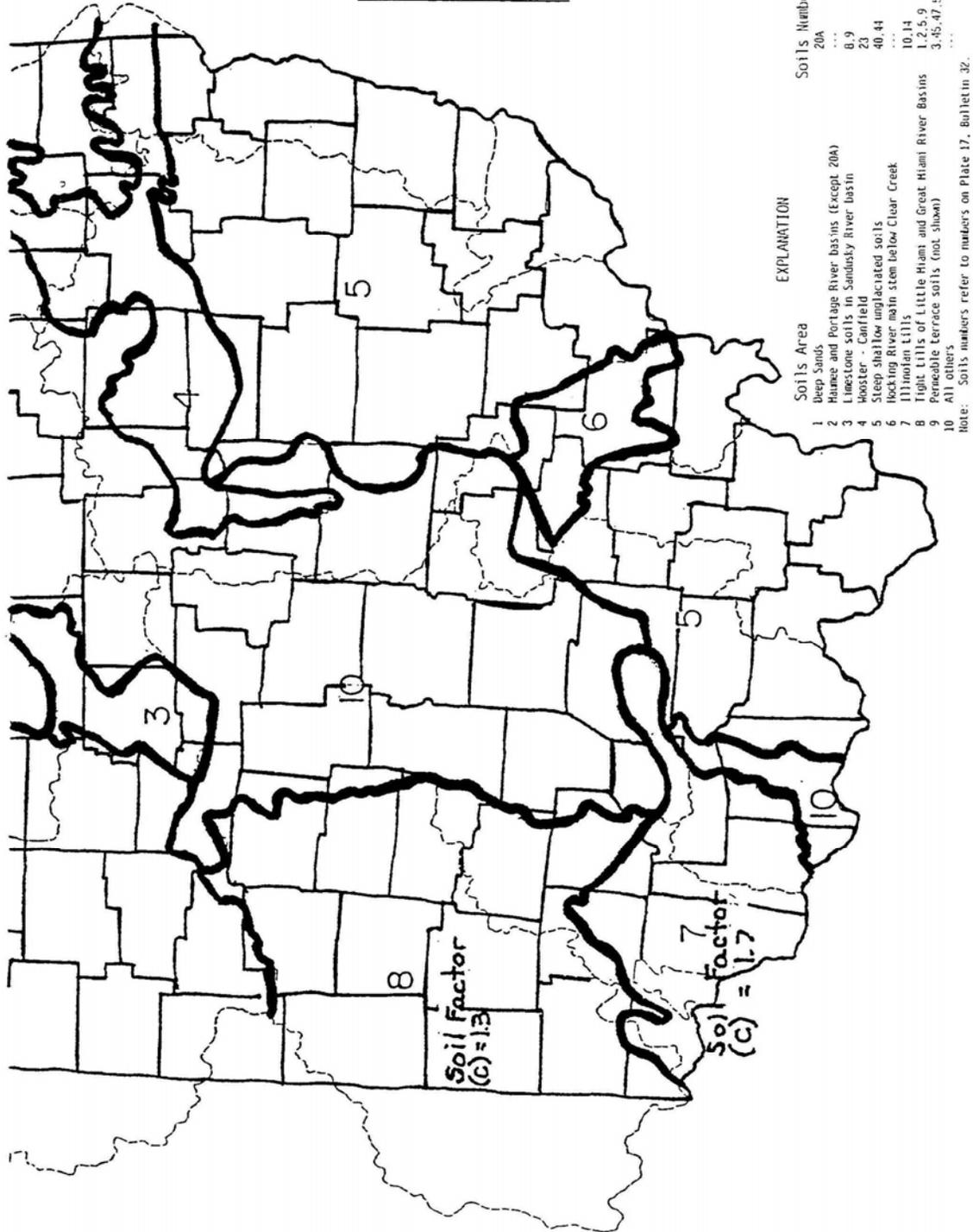
Q 100 Yr. = Qa \_\_\_\_\_ X FF \_\_\_\_\_ X UCF \_\_\_\_\_ = \_\_\_\_\_ cfs

FF (Frequency Factor)  
See EXHIBIT 20 (Sheet 4 of 4)

EXHIBIT NO. 20

Bulletin 45 Computation Sheet (Sheet 2 of 4)

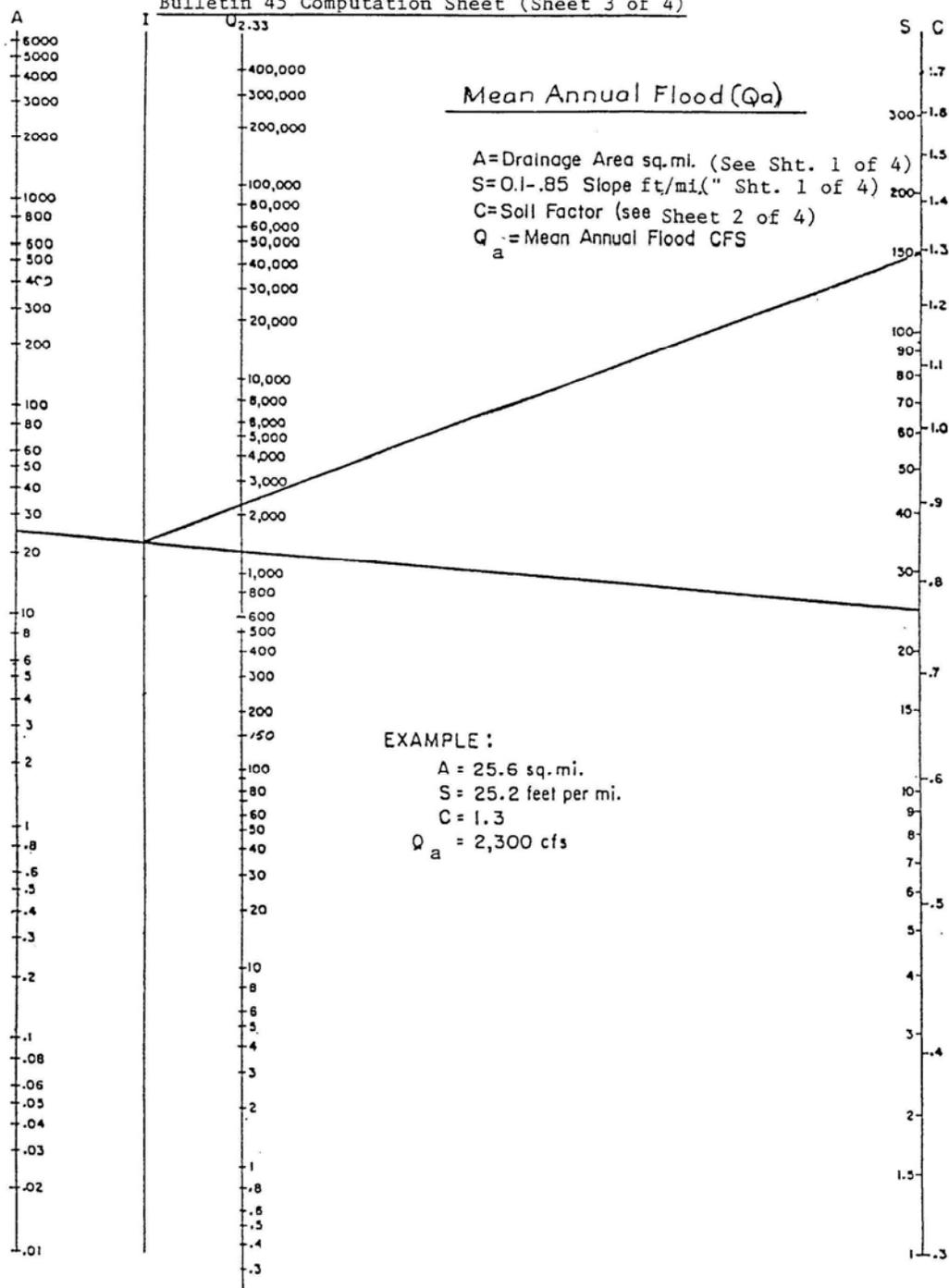
Soil Factor (c)



Map of Ohio showing soils regions used in determining Mean Annual Flood ( $Q_p$ ), Sheet 3 of 4

EXHIBIT NO. 20

Bulletin 45 Computation Sheet (Sheet 3 of 4)



Nomograph for solving equation  $Q_a = 50 CS^{0.298} A^{0.8}$

EXHIBIT NO. 20

Bulletin 45 Computation Sheet (Sheet 4 of 4)

Drainage Area (Acres)	Frequency				Ratio of Various Floods to Mean Annual Flood in Ohio (Sq. Mi.)	Frequency				Drainage Area (Sq. Mi.)	Frequency			
	10	25	50	100		10	25	50	100		10	25	50	100
	Year	Year	Year	Year		Year	Year	Year	Year		Year	Year	Year	Year
6	2.29	3.03	3.57	4.11	0.01	2.29	3.02	3.56	4.10	10	1.83	2.29	2.62	2.95
7	2.28	3.01	3.55	4.08	0.02	2.24	2.94	3.45	3.97	20	1.79	2.23	2.54	2.86
8	2.27	2.99	3.53	4.05	0.03	2.21	2.89	3.39	3.89	30	1.77	2.19	2.50	2.80
9	2.26	2.98	3.51	4.03	0.04	2.19	2.86	3.35	3.84	40	1.75	2.16	2.47	2.76
10	2.26	2.97	3.49	4.01	0.05	2.17	2.83	3.32	3.80	50	1.74	2.14	2.44	2.73
20	2.21	2.88	3.38	3.88	0.06	2.16	2.81	3.29	3.77	60	1.73	2.13	2.42	2.71
30	2.18	2.84	3.32	3.81	0.07	2.15	2.79	3.27	3.74	70	1.72	2.12	2.40	2.69
40	2.16	2.81	3.28	3.76	0.08	2.14	2.78	3.25	3.72	80	1.71	2.11	2.39	2.67
50	2.14	2.78	3.25	3.72	0.09	2.13	2.77	3.23	3.70	90	1.71	2.10	2.38	2.66
60	2.13	2.76	3.22	3.69	0.10	2.13	2.76	3.21	3.68	100	1.70	2.09	2.37	2.65
70	2.12	2.74	3.20	3.66	0.20	2.08	2.68	3.12	3.56	200	1.67	2.03	2.30	2.56
80	2.11	2.73	3.18	3.64	0.30	2.05	2.63	3.06	3.49	300	1.64	2.00	2.26	2.51
90	2.10	2.72	3.16	3.62	0.40	2.03	2.60	3.02	3.44	400	1.63	1.97	2.23	2.48
100	2.10	2.71	3.15	3.60	0.50	2.02	2.58	2.99	3.40	500	1.62	1.95	2.21	2.45
200	2.05	2.63	3.06	3.48	0.60	2.01	2.56	2.97	3.37	600	1.61	1.94	2.19	2.43
300	2.02	2.59	3.00	3.42	0.70	2.00	2.55	2.95	3.35	700	1.60	1.93	2.17	2.41
400	2.00	2.56	2.96	3.37	0.80	1.99	2.53	2.93	3.33	800	1.59	1.92	2.16	2.39
500	1.99	2.54	2.93	3.33	0.90	1.98	2.52	2.91	3.31	900	1.58	1.91	2.15	2.38
600	1.98	2.52	2.91	3.30	1.00	1.98	2.51	2.90	3.29	1000	1.58	1.90	2.14	2.37
700	1.97	2.50	2.89	3.28	2.00	1.93	2.44	2.82	3.19	2000	1.55	1.85	2.07	2.30
800	1.96	2.49	2.87	3.26	3.00	1.91	2.40	2.77	3.13	3000	1.53	1.82	2.04	2.25
900	1.95	2.48	2.86	3.24	4.00	1.89	2.37	2.73	3.08	4000	1.51	1.80	2.01	2.22
1000	1.95	2.47	2.85	3.23	5.00	1.88	2.35	2.70	3.05	5000	1.50	1.78	1.99	2.20
2000	1.90	2.40	2.76	3.12	6.00	1.87	2.33	2.68	3.02	6000	1.49	1.77	1.97	2.18
3000	1.88	2.36	2.71	3.06	7.00	1.86	2.32	2.66	3.00	7000	1.48	1.76	1.96	2.16
4000	1.86	2.33	2.68	3.02	8.00	1.85	2.31	2.64	2.98	8000	1.48	1.75	1.95	2.15
5000	1.85	2.31	2.65	2.99	9.00	1.84	2.30	2.63	2.96					

## EXHIBIT NO. 21

Entrance Loss Coefficients, Outlet Control Full or Partly Full Entrance Head Loss

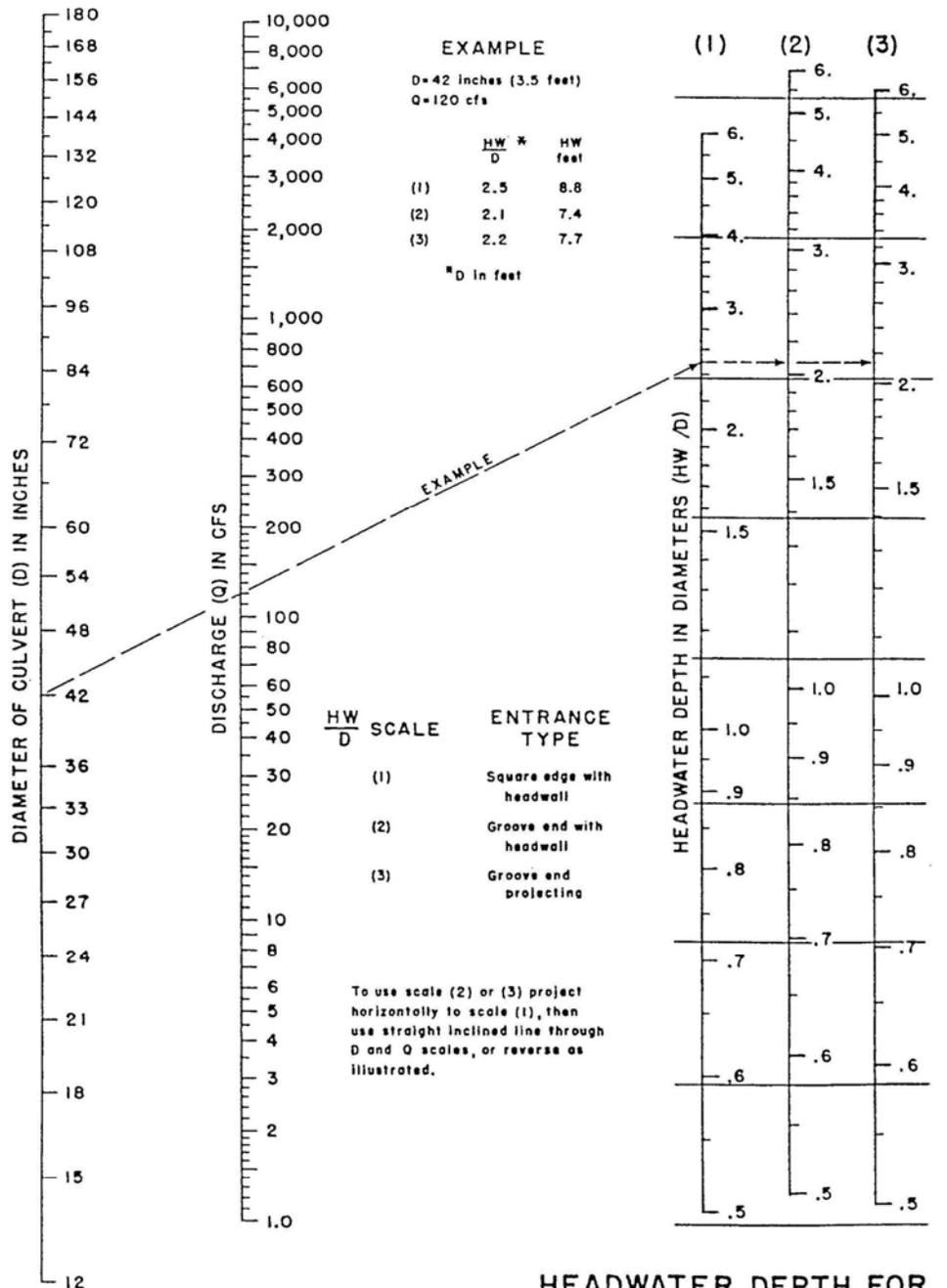
TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance Head Loss      $H_e = K_e (v^2 / 2g)$

Type of Structure and Design of Entrance	Coefficient k
<b>Pipe, Concrete</b>	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, square cut end	0.5
Headwall or headwall and wing walls, socket end of pipe (groove-end)	0.2
Headwall or headwall and wing walls, square-edge	0.5
Headwall or headwall and wing walls, rounded (radius=1/12 D)	0.2
Mitered to conform to fill slope	0.7
* End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side or slope tapered inlet	0.2
<b>Pipe, or Pipe-Arch, Corrugated Metal</b>	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wing walls square-edge	0.5
Mitered to conform to fill slope paved or unpaved slope	0.7
* End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side or slope tapered inlet	0.2
<b>Box, Reinforced Concrete</b>	
Headwall parallel to embankment (no wing walls) square edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wing walls at 30° to 75° to barrel squared edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wing wall at 10° to 25° to barrel squared edged at crown	0.5
Wing walls parallel (extension of sides) square edged at crown	0.7
Side or sloped tapered inlet	0.2
<p>* "End section conforming to fill slope." made of either metal or concrete, are the sections commonly available from manufactures. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design has a superior hydraulic performance.</p>	

EXHIBIT NO. 22

Headwater Depth For Concrete Pipe Culverts With Inlet Control



**HEADWATER DEPTH FOR  
 CONCRETE PIPE CULVERTS  
 WITH INLET CONTROL**

EXHIBIT NO. 23

Headwater Depth For Box Culverts With Inlet Control

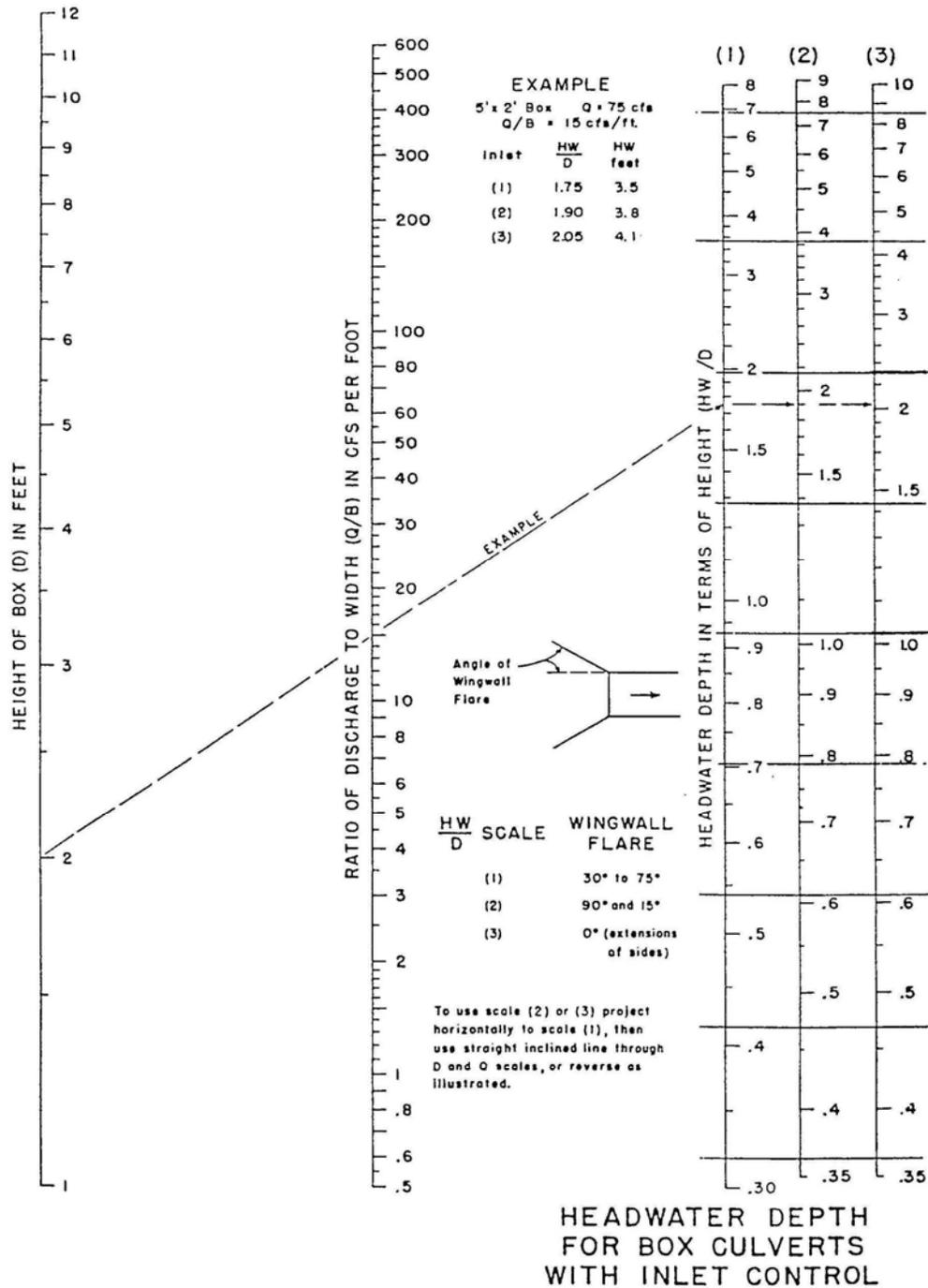
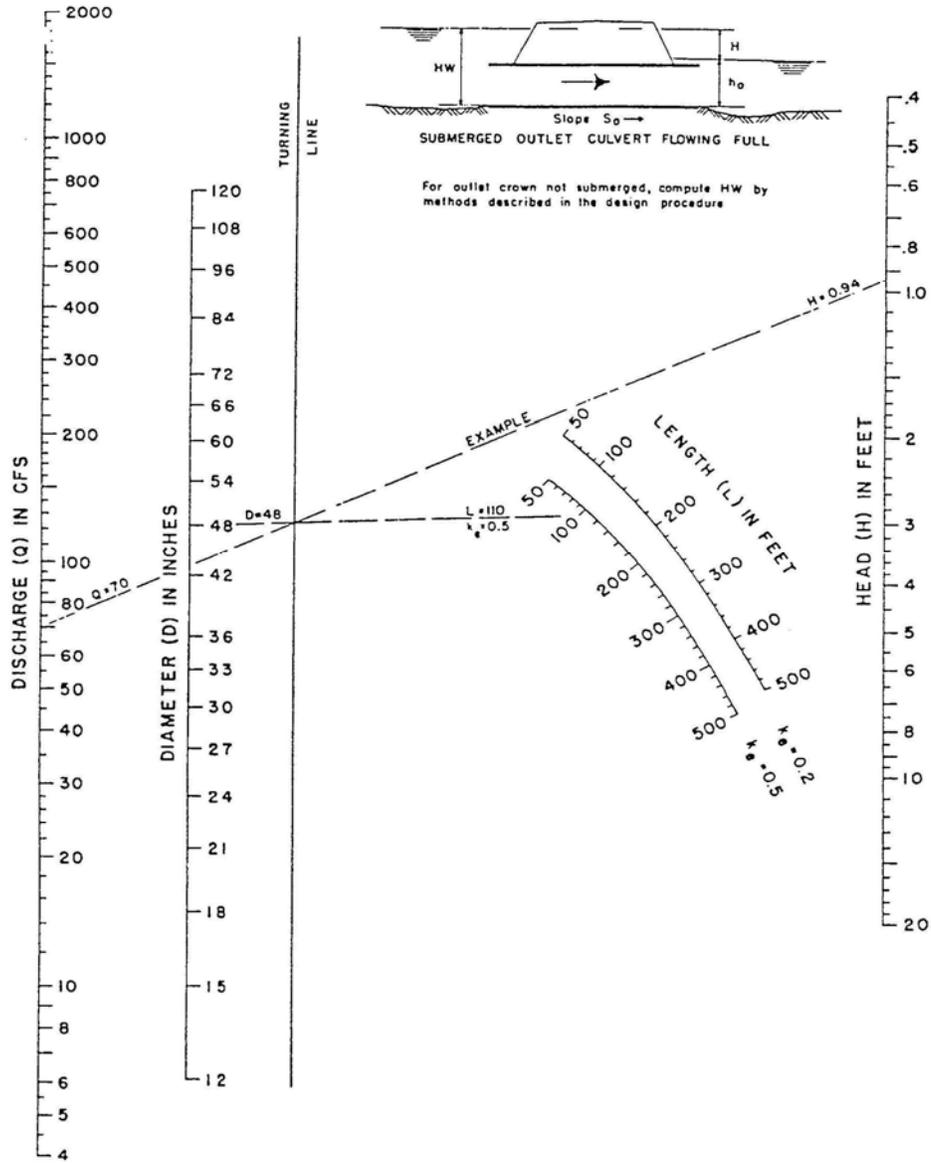


EXHIBIT NO. 24

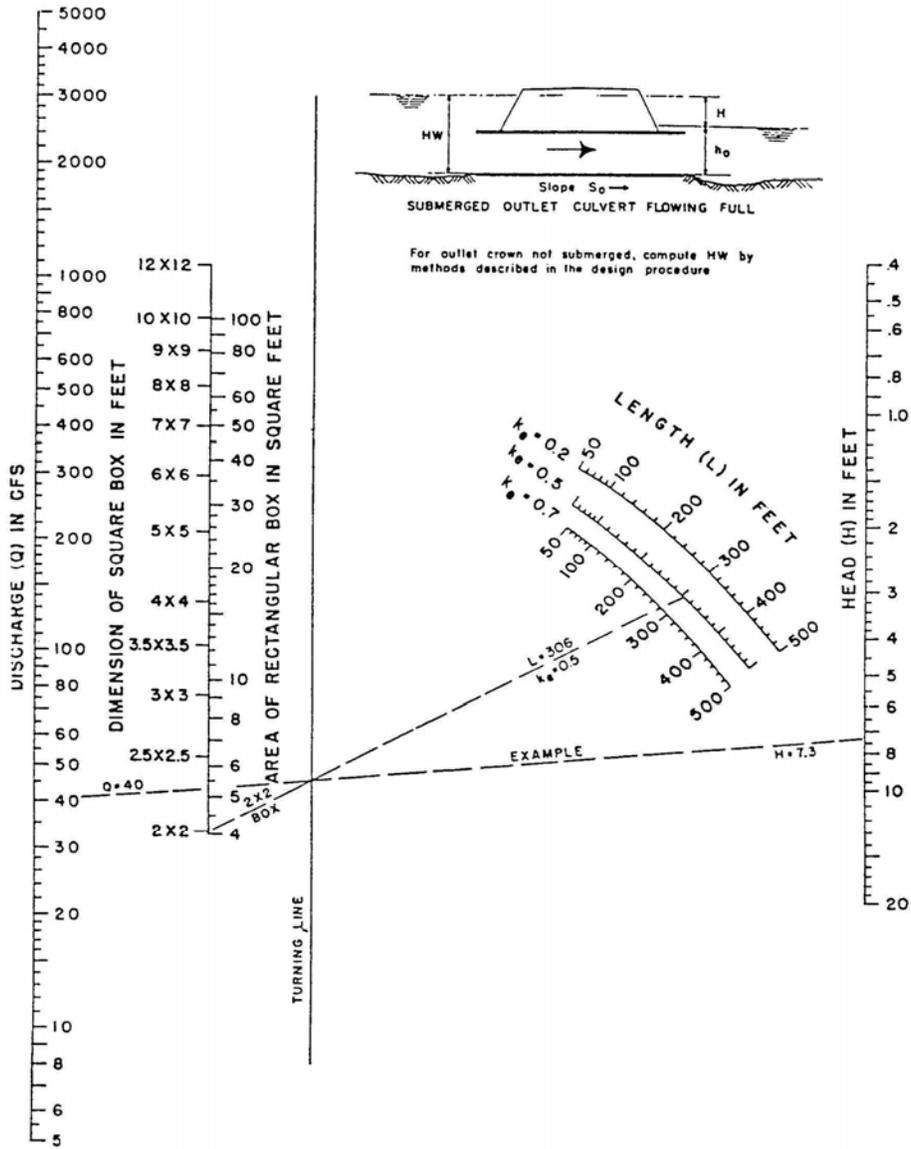
Head For Concrete Pipe Culverts Flowing Full  $n = .012$



HEAD FOR  
CONCRETE PIPE CULVERTS  
FLOWING FULL  
 $n = 0.012$

EXHIBIT NO. 25

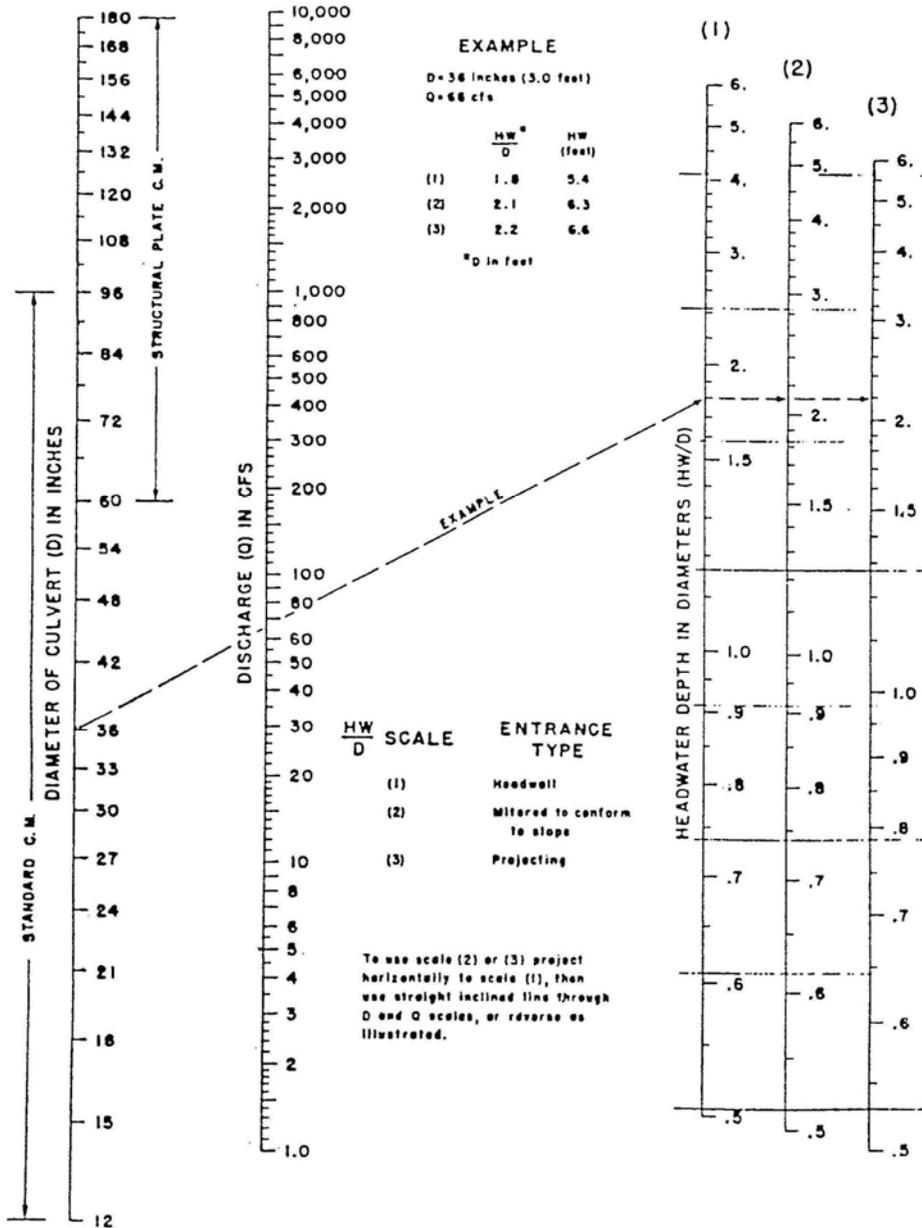
Head For Concrete Box Culverts Flowing Full  $n = .012$



HEAD FOR  
CONCRETE BOX CULVERTS  
FLOWING FULL  
 $n = 0.012$

EXHIBIT NO. 26

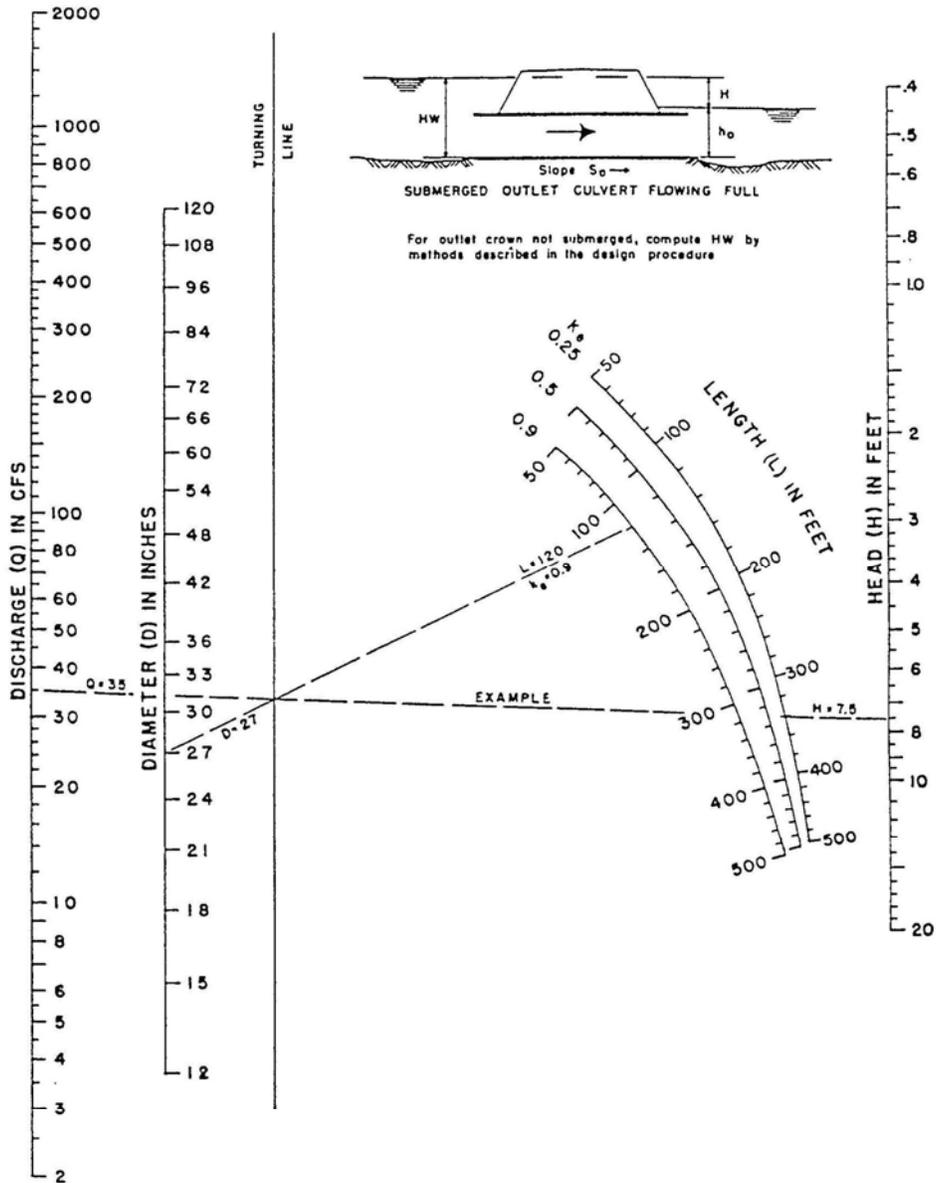
Headwater Depth For C.M. Pipe Culverts With Inlet Control



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

EXHIBIT NO. 27

Head For Standard C.M. Pipe Culverts Flowing Full  $n = .024$



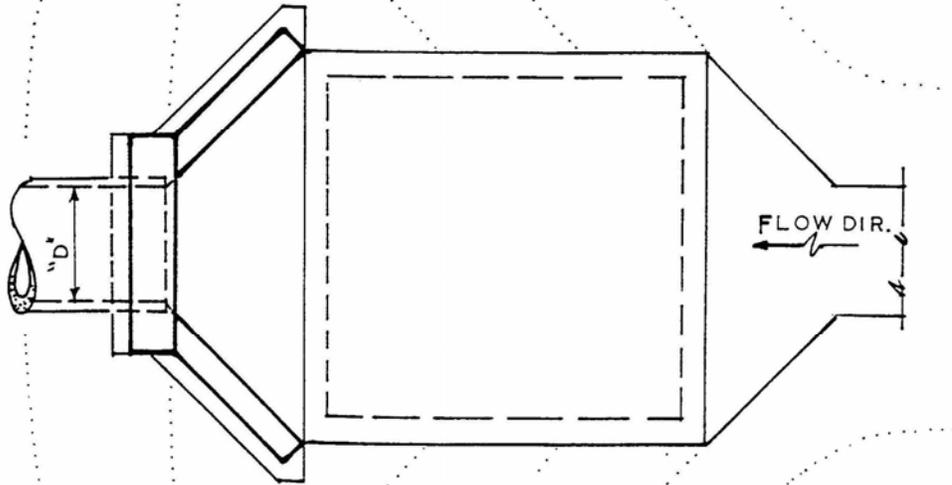
HEAD FOR  
STANDARD  
C. M. PIPE CULVERTS  
FLOWING FULL  
 $n = 0.024$

EXHIBIT NO. 28  
Culvert Design Form

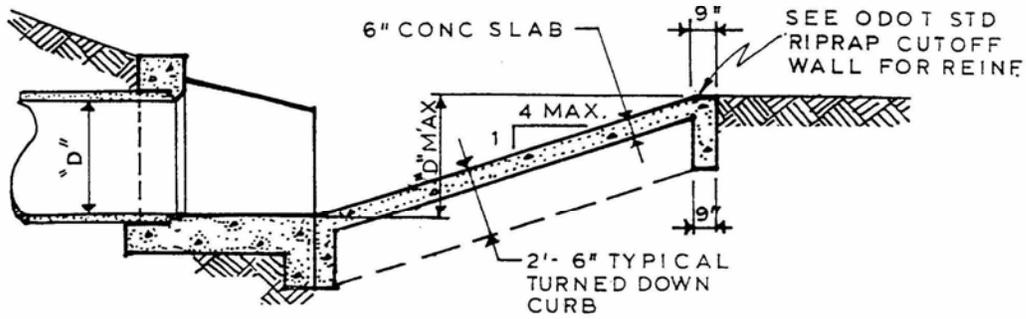
PROJECT : _____ STATION : _____ OF _____ SHEET _____ OF _____	CULVERT DESIGN FORM DESIGNER / DATE : _____ / _____ REVIEWER / DATE : _____ / _____	ROADWAY ELEVATION : _____ (ft) 	
HYDROLOGICAL DATA <input type="checkbox"/> METHOD : _____ <input type="checkbox"/> DRAINAGE AREA : _____ <input type="checkbox"/> STREAM SLOPE : _____ <input type="checkbox"/> CHANNEL SHAPE : _____ <input type="checkbox"/> ROUTING : _____ <input type="checkbox"/> OTHER : _____ SEE ADD'L SHTS.		DESIGN FLOWS/TAIWATER R. I. (YEARS) : _____ FLOW (cfs) : _____ TW (ft) : _____	
CULVERT DESCRIPTION : MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW PER BARREL Q (cfs) : (1) _____	HEADWATER CALCULATIONS	
	INLET CONTROL HWj/D (2) _____ TW (5) _____ FALL (3) _____ EL hi (4) _____	OUTLET CONTROL d <sub>c</sub> (6) _____ H (7) _____ $\frac{d_c + D}{2}$ (6) _____ EL ho (8) _____	COMMENTS
TECHNICAL FOOTNOTES : (1) USE Q/NB FOR BOX CULVERTS (2) HWj/D * HW /D OR HWj/D FROM DESIGN CHARTS (3) FALL * HWj - (EL <sub>hd</sub> - EL <sub>sf</sub> ) ; FALL IS ZERO FOR CULVERTS ON GRADE (4) EL <sub>hi</sub> * HWj + ELj (INVERT OF INLET CONTROL SECTION) (5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL. (6) h <sub>o</sub> * TW or (d <sub>c</sub> + D/2) (WHICHEVER IS GREATER) (7) H = $\left[ 1 + \frac{1}{2} + \frac{(29n^2 L)}{R L^{3.3}} \right] V^2 / 2g$ (8) EL <sub>ho</sub> * EL <sub>o</sub> + H + h <sub>o</sub>			
SUBSCRIPT DEFINITIONS : g. APPROXIMATE f. CULVERT FACE h. DESIGN HEADWATER hi. HEADWATER IN INLET CONTROL ho. HEADWATER IN OUTLET CONTROL l. INLET CONTROL SECTION o. OUTLET CONTROL SECTION s. STREAM BED AT CULVERT FACE tw. TAILWATER	COMMENTS / DISCUSSION : _____ CULVERT BARREL SELECTED : _____ SIZE : _____ SHAPE : _____ MATERIAL : _____ ENTRANCE : _____		

EXHIBIT NO. 29  
TYPICAL ALTERNATE CULVERT DESIGN

INLET-DROP CHANNEL



PLAN

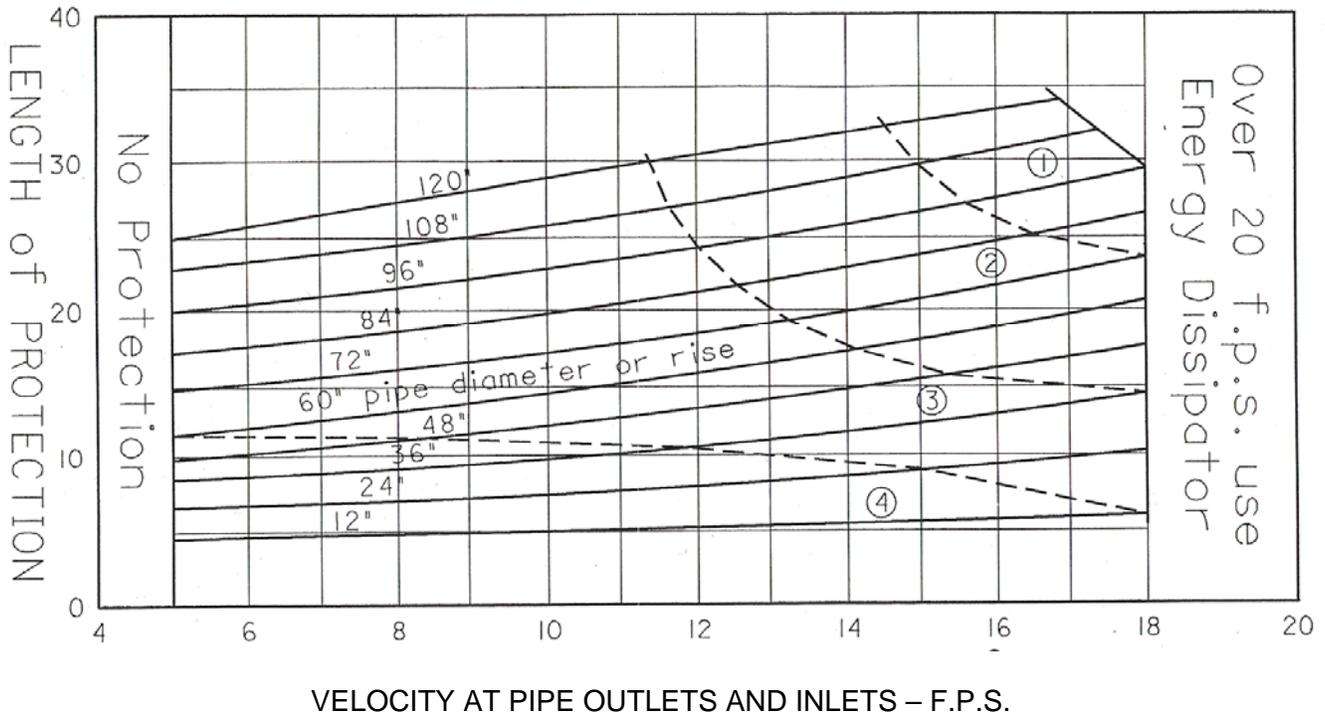


PROFILE

TYPICAL ALTERNATE  
CULVERT DESIGN

EXHIBIT NO. 30

ITEM 601, ROCK CHANNEL PROTECTION AT CULVERTS, STORM SEWER OUTLETS AND INLETS \*\*\*



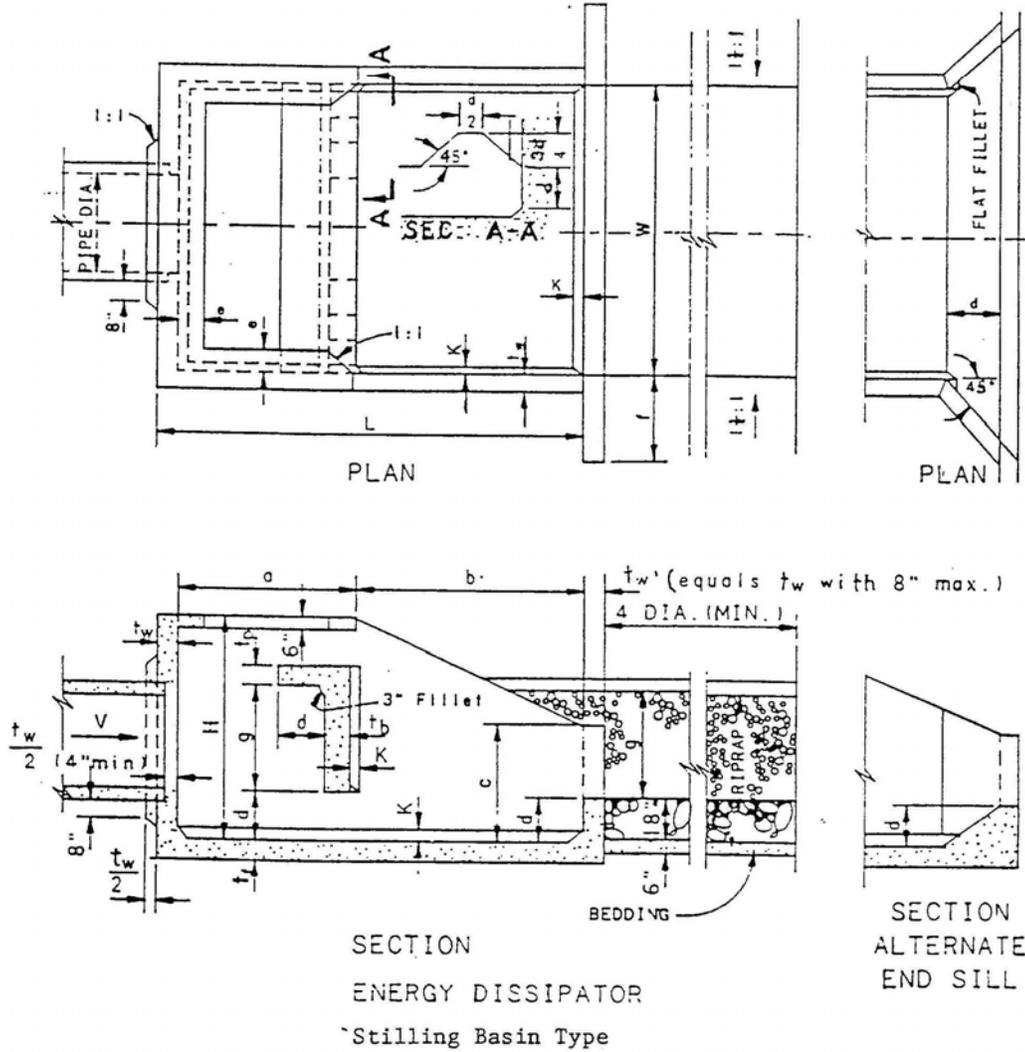
LEGEND	ROCK TYPE
(1) 48" of 18" rock	A
(2) 36" of 18" rock	A
(3) 30" of 12" rock	B
* (4) 18" of 6" rock	C
** (4) 18" of 9" rock	C

NOTES

1. Rock size (6", 9", 12", 18") indicates the square opening on which 85% of the material by weight will be retained.
2. Minimum width of protection shall be the width of the wing wall headwall tapered 10' to twice the pipe diameter, with 4' being the very minimum past the 10' taper.
3. \* Use at inlet ends only for velocities < 3-1 fps
4. \*\* Use at inlet or outlet ends for velocities > 3-1 fps
5. \*\*\* R.C.P. required at inlet end of storm systems only when fill material has been placed at inlet end, or erodable soils exists.
6. A rock check dam is required downstream of all outfall headwalls.
7. The minimum distance between an outfall headwall and the downstream offsite property line is 40 feet. Modification of the minimum distance may be granted by the Director of Public Works for extenuating circumstances.

EXHIBIT NO. 31

Energy Dissipator - Stilling Basin Type



Suggested pipe size		Max. discharge	Feet and Inches										Inches					Suggested riprap size
Dia. in.	Area sq. ft.		W	H	L	a	b	c	d	e	f	g	t <sub>w</sub>	t <sub>f</sub>	t <sub>b</sub>	t <sub>p</sub>	K	
18	1.77	21	5-6	4-3	7-4	3-3	4-1	2-4	0-11	0-6	1-6	2-1	6	6½	6	6	3	See EXHIBIT 30
24	3.14	38	6-9	5-3	9-0	3-11	5-1	2-10	1-2	0-6	2-0	2-6	6	6½	6	6	3	
30	4.91	59	8-0	6-3	10-8	4-7	6-1	3-4	1-4	0-8	2-6	3-0	6	6½	7	7	3	
36	7.07	85	9-3	7-3	12-4	5-3	7-1	3-10	1-7	0-8	3-0	3-6	7	7½	8	8	3	
42	9.62	115	10-6	8-0	14-0	6-0	8-0	4-6	1-9	0-10	3-0	3-11	8	8½	9	8	4	See EXHIBIT 30
48	12.57	151	11-9	9-0	15-8	6-9	9-11	4-11	2-0	0-10	3-0	4-5	9	9½	10	8	4	
54	15.90	191	13-0	9-9	17-4	7-4	10-0	5-5	2-2	1-0	3-0	4-11	10	10½	10	8	4	
60	19.63	236	14-3	10-9	19-0	8-0	11-0	5-11	2-5	1-0	3-0	5-4	11	11½	11	8	6	
72	28.27	339	16-6	12-3	22-0	9-3	12-9	6-11	2-9	1-3	3-0	6-2	12	12½	12	8	6	

EXHIBIT NO. 32

Open Channel Symbols, Equations, and Geometric Formulas

SYMBOLS

<u>Symbol</u>	<u>Units</u>	<u>Description</u>
A	sq. ft.	Area of cross section of flow
b	ft.	Bottom width of trapezoidal channel
c		Side slope of channel, c:l
d <sub>c</sub>	ft.	Critical depth
d <sub>f</sub>	ft.	Depth of flow
g	ft./sec <sup>2</sup>	Acceleration of gravity = 32.2
n		Manning roughness coefficient
Q	cfs	Rate of discharge
r	ft.	Hydraulic radius = A/wp
s	ft./ft.	Slope of channel
s <sub>c</sub>	ft./ft.	Critical slope
T	ft.	Top width of water surface in a channel
V	fps	Mean velocity of flow
V <sub>c</sub>	fps	Critical velocity
wp	ft.	Wetted perimeter - length of line of contact between the flowing water and the channel
Z		Section factor for critical flow

Equations

$$V = \frac{1.49}{n} r^{2/3} s^{1/2}$$

$$Q = AV$$

$$Q = \frac{1.49}{n} Ar^{2/3} s^{1/2}$$

$$Z = Q/q^{1/2}$$

Geometric Formula

Trapezoidal

$$A = (b + cd_f) d_f$$

$$wp = b + 2d_f (1 + c^2)^{1/2}$$

$$T = b + 2cd_f$$

$$r = \frac{(b+cd_f) d_f}{b+2d_f (1 + c^2)^{1/2}}$$

Rectangle

$$A = bd_f$$

$$wp = b + 2d_f$$

$$T = b$$

$$r = \frac{bd_f}{b + 2d_f}$$

Triangle

$$A = cd_f^2$$

$$wp = 2d_f (1 + c^2)^{1/2}$$

$$T = 2cd_f$$

$$r = \frac{cd_f}{2(1 + c^2)^{1/2}}$$

OPEN CHANNEL

SYMBOLS, EQUATION, AND GEOMETRIC FORMULA

**EXHIBIT NO. 33**

Sheet 1 of 3

Detention/Retention Basin Computation Sheet

Project: \_\_\_\_\_ By: \_\_\_\_\_ Date: \_\_\_\_\_

Storm Water Detention/Retention Basin Design

Refer to Sections ST 701, 702, 711 and/or 712 for design criteria. This computation sheet may be used for drainage areas, off-site and on-site, totaling not more than 200 acres. Design criteria for all detention and retention basins that have contributing drainage areas totaling more than 200 acres must be established on a case-by-case basis.

Required Storage

The required storage is the volume of runoff obtained by using the formulas in this EXHIBIT. It shall be the difference between the post-development  $Q_{100}$ , based on an adjusted post-development runoff coefficient  $C_6$  as indicated below, and the pre-development  $Q_{10}$ , based on an adjusted pre-development runoff coefficient  $C_3$  as indicated below.

The detention of storm water shall occur in two (2) stages. Stage One (1) shall provide for a pre-development one (1) year storm and Stage Two (2) shall provide for a pre-development ten (10) year storm. Refer to Section ST 711(i) and Section ST 711(l).

**EXHIBIT NO. 33**

Sheet 2 of 3

$a_1$ = On-site pre-development drainage area (acres), See Section ST 711(d)(1)	=	
$a_2$ = Off-site drainage area (acres) See Section ST711(d)(1)	=	
$a_3$ = Total pre-development drainage area (acres) = $a_1 + a_2$	=	
$a_4$ = On-site post development drainage area to release structure	=	
$a_5$ = Total post development drainage area to release structure $a_2 + a_4$	=	
$c_1$ = On-site pre-development runoff coefficient, See Section ST 711(f)	=	
$c_2$ = Off-site pre-development runoff coefficient, See Section ST 711(f)	=	
$c_3$ = Adjusted pre-development runoff coefficient = $\frac{c_1 a_1 + c_2 a_2}{a_1 + a_2}$	=	
$c_4$ = On-site post-development runoff coefficient, See Section ST 702(c) & ST 711(g)	=	
$c_5$ = Off-site post-development runoff coefficient See Section ST 711(g)	=	
$c_6$ = Adjusted post-development runoff coefficient = $\frac{c_4 a_4 + c_5 a_2}{a_4 + a_2}$	=	
$tc_{10}$ = Time of concentration to release structure (pre-development condition) using the adjusted pre-development runoff coefficient ( $c_3$ ) and EXHIBIT NO. 5	=	
$tc_{100}$ = Time of concentration to release structure (post-development condition) using the adjusted post-development runoff coefficient ( $c_6$ ) and EXHIBIT NO. 5 =	=	

**EXHIBIT NO. 33**

Sheet 3 of 3

Pre-Development Ten (10) Year Storm

$$I_{10} = \frac{170}{tc_{10} + 23} = \frac{170}{( ) + 23} = ( ) \text{ in/hr}$$

$$\text{Pre } Q_{10} = c_3 a_3 I_{10} = ( ) ( ) ( ) = ( ) \text{ c.f.s.}$$

NOTE:  $c_3 = c_1$  and  $a_3 = a_1$  when off-site runoff does not exist

$$q_0 = \text{Pre } Q_{10} = \text{Maximum Release Rate} = ( ) \text{ c.f.s.}$$

Orifice Controlled Outflow Condition:

Storm Duration Producing Maximum Detention Storage

$$T_c = [ 290 \times 31 c_6 a_5 \div (2q_0 \div 3 - q_0^2 tc_{100} \div 290 \div 6 \div c_6 \div a_5) ]^{1/2} - 31$$

$$T_c = [ \text{_____} \div ( \text{_____} - \text{_____} \div \text{_____} \div \text{_____} \div \text{_____} \div \text{_____} ) ]^{1/2} - 31$$

$$T_c = \text{_____} \text{ minutes}$$

Rainfall Intensity

$$I_{100} = \frac{290}{T_c + 31} = \frac{290}{( ) + 31} = ( ) \text{ in/hr}$$

Peak Rate of Flow Post-Development  $Q_{100}$

$$Q_0 = c_6 a_5 I_{100} = ( ) ( ) ( ) = ( ) \text{ c.f.s.}$$

Detention Storage Volume

$$V = 60 Q_0 T_c - \frac{2 q_0 (T_c + tc_{100}) (60)}{3} + \frac{(q_0)^2 (tc_{100}) (60)}{6 Q_0}$$

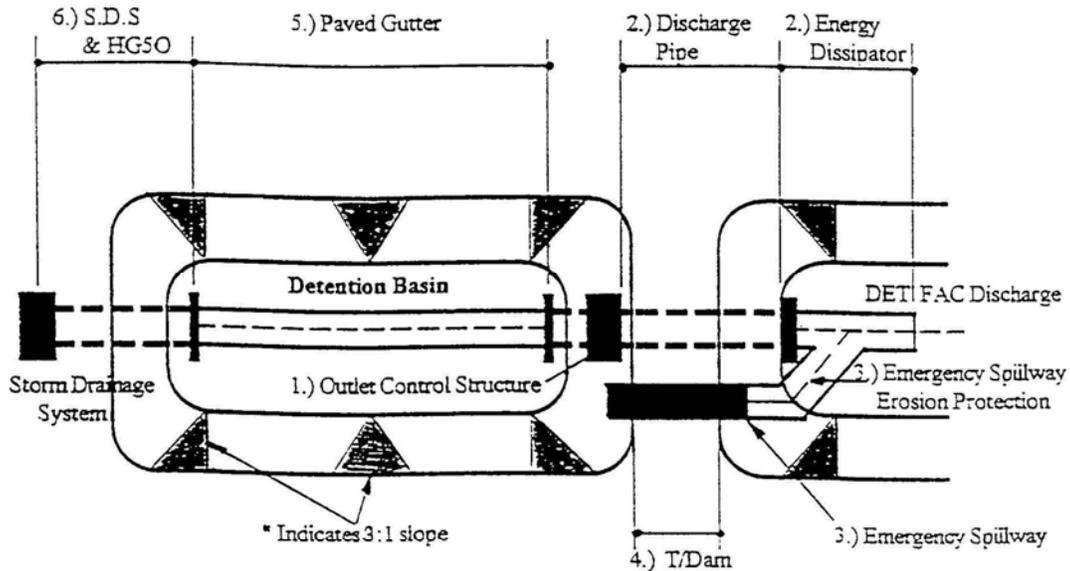
$$V = 60 ( ) ( ) - \frac{2 ( ) [ ( ) + ( ) ] (60)}{3} + \frac{( )^2 ( ) (60)}{6 ( )}$$

$$V = ( ) - ( ) + ( ) = ( ) \text{ cu. ft.}$$

$$V = ( ) , 43560 = ( ) \text{ Acre-Ft}$$

NOTE:  $c_6 = c_4$  and  $a_3 = a_1$  when off-site runoff does not exist.

# EXHIBIT NO. 34 (sheet 1 of 5) DETENTION BASIN CONTROLS

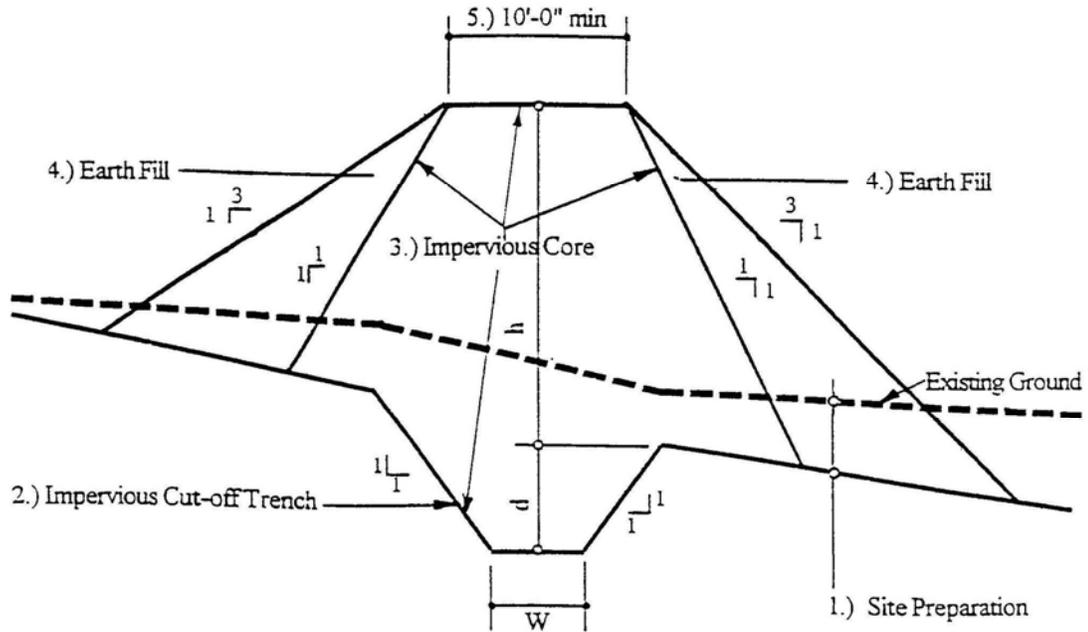


## TYPICAL DETENTION PLAN

Detention Basin Design Criteria  
Refer to Section ST 711

- 1) Outlet Control Structure: ST 711(J), ST 711(O)5 and ST 711(I)4
- 2) Discharge Pipe and Energy Dissipator: ST 711(J)4  
(Pipe Bedding Plate 1, Class "C" Concrete Cradle, 6" min. thickness with #3 Bars at 12" on centers eachway, 3" clear bottom).
- 3) Emergency Spillway: ST 711(O)1.02  
Erosion Protection: ST 711(O)3
- 4) Top of Dam: ST 711(O)1.06
- 5) Paved Gutter, for Low Flow and House Keeping Purposes: ST 805(d)1;  
Use ODOT MC-5 Width to Equal Diameter of S.D.S. Outlet Pipe
- 6) Storm Drainage System: Pipe Capacity Design Section ST 703 and  
Hydraulic Gradient Section ST 707

**EXHIBIT NO. 34 (SHT 2 of 5).  
DETENTION BASIN CONTROLS**



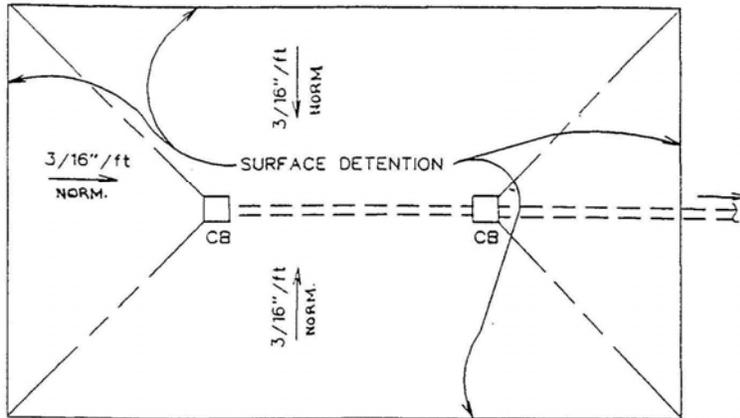
d = 3'-0"                  Detention Basin  
d = 6'-0"                  Retention Basin  
w = 8'-0" or h - d        whichever is greater

**TYPICAL UPLAND EARTHEN DAM SECTION**

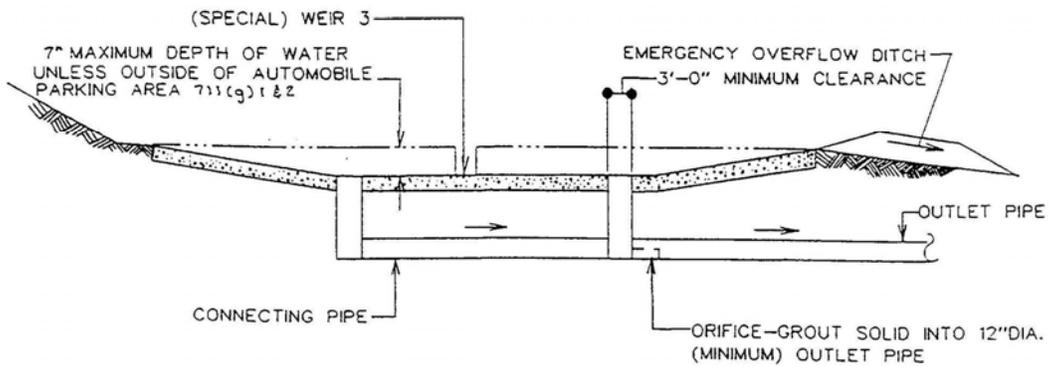
- 1.) Site Preparation, Foundation Area Stripped 6" min: ST 711 (P) 2
- 2.) Impervious Cut-off Trench: ST 711 (P) 3
- 3.) Impervious Core: ST 711 (P) 4
- 4.) Earth Fill: ST 711 (P) 5
- 5.) Top of Dam 10'-0" min: ST 711 (O) 1.06

## PARKING LOT SURFACE DETENTION REQUIRED STORAGE CONTROL

Refer to exhibit 34 sheet 1 of 5 (apply similar design criteria for outlet control devices for this structure).



PLAN



PROFILE

### NOTES:

1. CB (catch basin) frame and grate to be heavy duty and use bicycle safe grate.
2. Emergency overflow ditch may be omitted if there is no danger of erosion or flooding occurring in the event of plugging to the orifice.
3. In special cases, usually where the adjacent off site geography is almost flat and a minor size detention facility is required, a weir opening instead of the catch basin and outlet pipe may be used for outlet control.

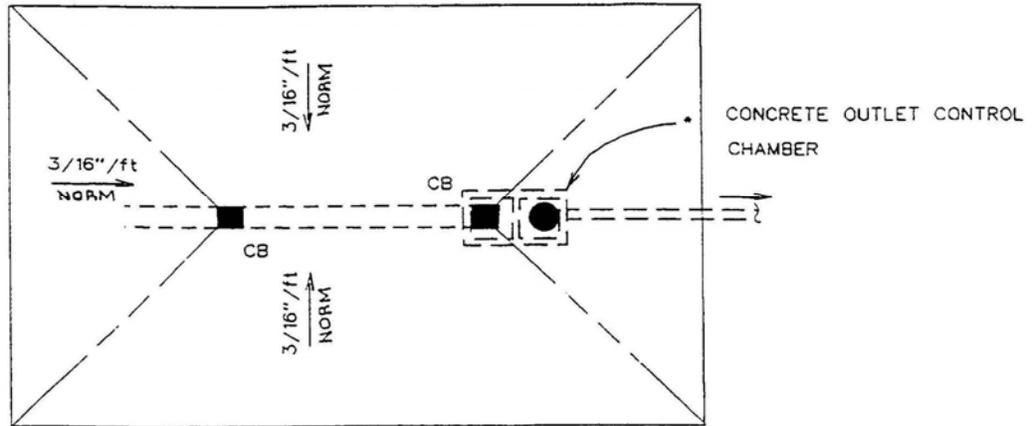
## DETENTION BASIN CONTROLS

EXHIBIT NO. 34

Detention Basin Controls (Sheet 4 of 5)

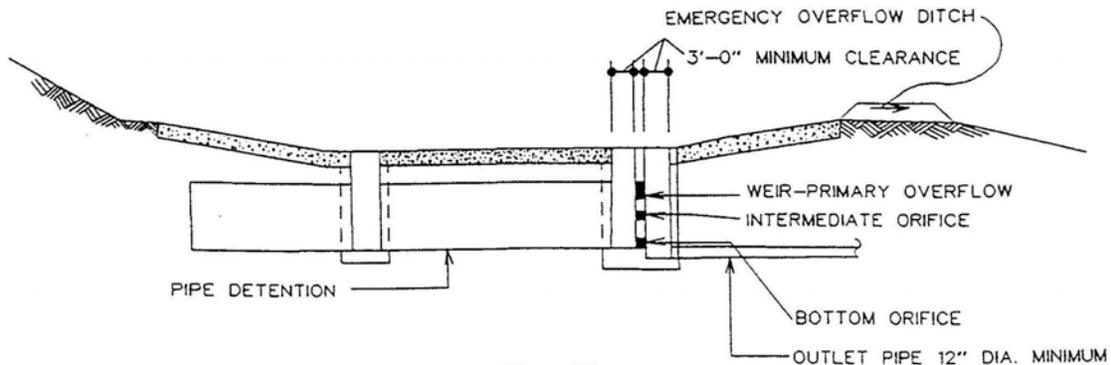
UNDERGROUND/PIPE DETENTION  
REQUIRED STORAGE CONTROL

Refer to exhibit 34 sheet 1 of 5 (apply similar design criteria for outlet control devices for this case).



PLAN

\*A manhole instead of a concrete chamber may be used where the primary overflow doesn't require a weir. In that case the bottom and intermediate orifice is to be extended from the storage pipe to the manhole.



PROFILE

NOTES:

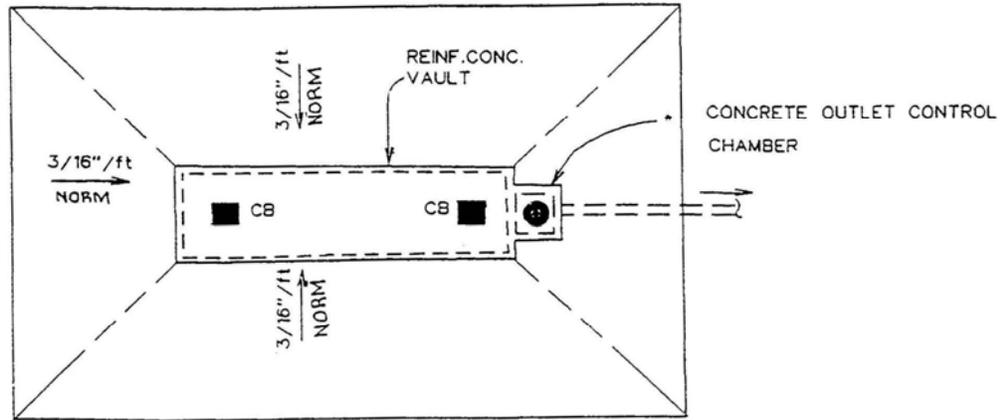
1. CB (catch basin) frame and grate to be heavy duty and use bicycle safe grate.
2. Pipes, catch basin and storage pipe end closures are to be constructed with watertight joints, where below water level.
3. Emergency overflow ditch may be omitted if there is no danger of erosion or flooding occurring in the event of plugging to the orifice.

DETENTION BASIN  
CONTROLS

# REINFORCED CONCRETE VAULT DETENTION

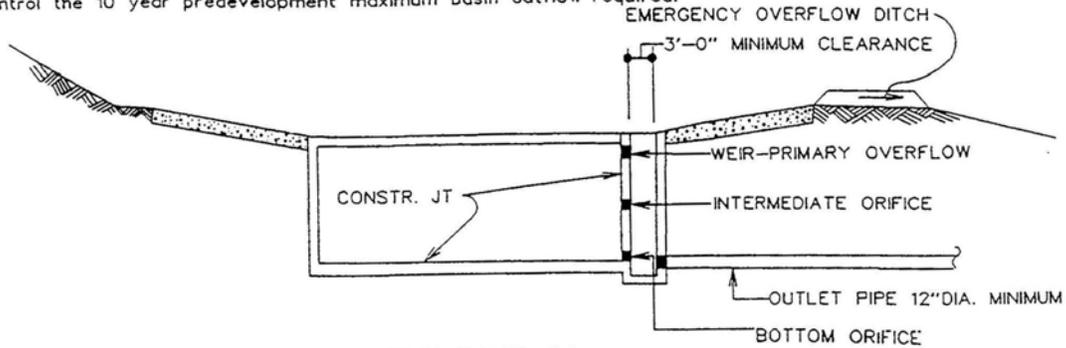
## REQUIRED STORAGE CONTROL

Refer to exhibit 34 sheet 1 of 5 (apply similar design criteria for outlet control devices for this structure).



PLAN

\*A manhole instead of a concrete chamber may be used where the primary overflow doesn't require a weir. The outlet control structure may be omitted when a 3" to 6" diameter bottom orifice is sufficient size to control the 10 year predevelopment maximum basin outflow required.



PROFILE

### NOTES:

1. CB (catch basin) frame and grate to be heavy duty and use bicycle safe grate.
2. Building permit required for reinforced conc. vault.
3. All construction joints below water level shall be made watertight with continuous pvc dumb bell water stops.
4. Emergency overflow ditch may be omitted if there is no danger of erosion or flooding occurring in the event of plugging to the orifice.

## DETENTION BASIN

## CONTROLS

**EXHIBIT NO. 35**

**RESOLUTION ADOPTING FLOOD DAMAGE PREVENTION REGULATIONS**

**FOR**

**UNINCORPORATED HAMILTON COUNTY, OHIO**

BY THE BOARD:

WHEREAS, the Board of County Commissioners of Hamilton County, Ohio did, on April 1, 1987, adopt the Flood Damage Prevention Regulations for Unincorporated Hamilton County, Ohio (Vol. 226, Image 111, et seq.), effective April 1, 1987; and

WHEREAS, the Board of County Commissioners of Hamilton County, Ohio, found it necessary and advisable to amend the aforesaid Regulations; and

WHEREAS, the Board of County Commissioners of Hamilton County, Ohio, found that the most appropriate method of amending the aforesaid Regulations, was to rescind it and adopt a replacement resolution which incorporates the necessary amendments; and

WHEREAS, on October 26, 1988, the Board of County Commissioners of Hamilton County, Ohio rescinded the aforesaid Regulations and adopted a replacement resolution which incorporated the necessary amendments (Vol. 232, Image 481, et seq.), effective October 26, 1988; and

WHEREAS, on September 5, 2001, the Board of County Commissioners of Hamilton County, Ohio rescinded the aforesaid Regulations and adopted a replacement resolution which incorporated the necessary amendments (Vol. 283, Image 3249, et seq.), effective September 5, 2001; and

WHEREAS, the Board of County Commissioners of Hamilton County, Ohio, again finds it necessary and advisable to rescind the aforesaid Regulations and adopt a replacement resolution which will incorporate the necessary amendments; and

WHEREAS, the Board of County Commissioners of Hamilton County, Ohio, had previously adopted and is now enforcing various flood plain management rules, regulations, resolutions, codes, etc., including, but not limited by enumeration to:

- 1) Zoning Resolution for the Unincorporated Hamilton County, Ohio; and
- 2) Rules and Regulations of the Regional Planning Commission of Hamilton County, Ohio, for the Subdivision of Land; and
- 3) Building Code of Hamilton County, Ohio; and

- 4) Rules and Regulations of Hamilton County Public Works Governing the Construction, Operation, and Maintenance, in the County of Hamilton Storm Drainage System; and
- 5) Rules and Regulations Governing the Surface Physical Improvements for Private Developments Within the Unincorporated Areas of Hamilton County, Ohio; and
- 6) Rules and Regulations Governing the Design, Construction, Maintenance, Operation, and Use of the Sanitary and Combined Sewers in the Metropolitan Sewer District of Greater Cincinnati, Hamilton County, Ohio.

NOW, THEREFORE, BE IT RESOLVED by the Board of County Commissioners of Hamilton County, Ohio, that this Resolution shall be known as, and is, the Flood Damage Prevention Regulations for Unincorporated Hamilton County, Ohio, and that it shall apply to all new construction, substantial improvements, and other development within all Special Flood Hazard Areas in the Unincorporated Territory of Hamilton County, Ohio, after June 1, 1982, and that it shall be as follows:

## **Section 1.0 EXISTING FLOOD PLAIN MANAGEMENT SYSTEM**

**Section 1.1** All applicable flood plain management rules, regulations, codes, and resolutions, shall be adjusted, revised, modified, amended, or augmented by the various administrative agencies of the Board of County Commissioners, independent regulatory agencies, and by the Board of County Commissioners, as required by the Ohio Revised Code, (Section 307.37) to properly reflect at least the minimum requirements of these Regulations, and the National Flood Insurance Program, as specified in 44 CFR Section 59.1, and 60.3 et seq., which are hereby adopted by reference and declared to be a part of these Regulations.

## **Section 2.0 DEFINITIONS**

**Section 2.1** Terms used in these Regulations are defined as in 44 CFR Section 59.1, and as follows:

**Section 2.2** "Area of special flood hazard" means the land in the floodplain subject to a one percent or greater chance of flooding in any given year. Areas of special flood hazard are designated by the Federal Emergency Management Agency as Zone A, AE, AH, AO, A1-30, and A99, and/or by the Storm Drainage and Open Space Master Plan for Hamilton County, Ohio.

**Section 2.3** "Base flood" means the flood having a one percent chance of being equaled or exceeded in any given year. The base flood may also be referred to as the one-hundred (100) year flood.

**Section 2.4** "Basement" means any area of the building having its floor sub grade (below ground level) on all sides.

**Section 2.5** “Development” means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

Development” Comment:

The NFIP Regulations require that all proposed developments within the special flood hazard area, or 100 year floodplain, must be reviewed to determine if the activity falls within the scope of the local flood damage prevention regulations. In addition to “structural” development proposals (e.g. new construction and improvements to existing structures), “nonstructural” developments (e.g. filling, grade alterations, excavations, and mining or drilling activities) must be reviewed through the local permit process to ensure that the developments will not be affected by floodwaters and not adversely affect the flow of the floodgate. Other examples of development activities include storage of materials and equipment, dredging operations, and paving.

**Section 2.6** “Encroachment” means any development (as defined) within the regulatory floodway of any special flood hazard area, as defined in Section 3.3 of these Regulations, which will result in any increase in base (100 year) flood level, as determined by reference to Section 3.1 of these Regulations, during the occurrence of the base flood discharge. Encroachment is determined by application of the equal degree of encroachment principle to the proposed development.

**Section 2.7** “Equal Degree of Encroachment” means a standard applied in determining the location of floodway limits so that both sides of a stream are capable of conveying a proportionate share of flood flows. This is determined by considering the hydraulic conveyance of the flood plain along both sides of a stream for a significant reach.

**Section 2.8** “Federal Emergency Management Agency” (FEMA) means the agency with the overall responsibility for administering the National Flood Insurance Program.

**Section 2.9** “Floodway” means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than 1.0 foot.

**Section 2.10** “Historic Structure” means any structure that is:

(1) Listed individually in the National Register of Historic Places (a listing maintained by the U.S. Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listings on the National Register;

(2) Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily

determined by the Secretary to qualify as a registered historic district;

(3) Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or

(4) Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either;

(i) By an approved state program as determined by the Secretary of the Interior  
or

(ii) Directly by the Secretary of the Interior in states without approved programs.

“Historic Structure” Comment:

For more information about a structure’s historic designation contact the Ohio Historical Society, 1985 Velma Avenue, Columbus, Ohio 43211 (614) 297-2300.

**Section 2.11** “Manufactured Home” means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term “Manufactured Home” does not include a “Recreational Vehicle”.

**Section 2.12** “Recreational Vehicle” means a vehicle which is built on a single chassis; 400 square feet or less when measured at the largest horizontal projection; designed to be self-propelled or permanently tow able by a light duty truck and designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel or seasonal use.

**Section 2.13** “Substantial damage” means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. Substantial damage also means flood related damage sustained by a structure on two separate occasions during a 10year period for which the cost of repairs at the time of each such flood event, on the average, equals or exceeds 25 percent of the market value of the structure before the damage occurred.

**Section 2.14** “Substantial Improvement” means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure either (1) before improvement or repair is started, or (2) if the structure has been damaged and is being restored, before the damage occurred. For the purposes of this definition “substantial improvement” is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure. The term does not, however, include either (1) any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions, or (2) any alteration of a structure individually listed on the National Register of Historic Places or State Inventory of Historic Places, provided that the alteration will not preclude the

structure's continued designation as a "Historic Structure".

**Section 2.15** "Watercourse" means any river, stream, or tributary having defined banks and a defined flood hazard area identified by the special flood hazard areas of Section 3.0 of these regulations

### **Section 3.0 SPECIAL FLOOD HAZARD AREAS**

**Section 3.1** The following scientific and engineering reports, accompanying maps and profiles, identify, in

whole or in part, Special Flood Hazard Areas within the Unincorporated territory of Hamilton County, Ohio, and are hereby declared to be a part of these Regulations:

- a) Storm Drainage and Open Space Master Plan for Hamilton County, Ohio, (Consoer, Townsend and Associates, December, 1966) (Criteria for revisions and amendments must be followed within Zones A, AE, A1-30 etc. on the FIRM); and
- b) Flood Insurance Study For Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004); and
- c) Flood Insurance Rate Map for Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004).

**Section 3.2** The Special Flood Hazard Areas of Unincorporated Hamilton County, Ohio, include:

- a) All that area within Zones AE, A1-30, AO, AH, and the unnumbered A Zones on the Flood Insurance Rate Map for Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004); and
- b) All that area within the unincorporated territory of Hamilton County, Ohio, not identified in Section 3.2 (a), above, but designated as being within the 50 year flood plain of various streams as identified in Appendix A of the Storm Drainage and Open Space Master Plan for Hamilton County, Ohio.

**Section 3.3** The Regulatory Floodway of Unincorporated Hamilton County, Ohio, is all that area designated as "Floodway" on the Flood Insurance Rate Map for Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004); and, for unnumbered A Zones, as identified in Appendix A of the Storm Drainage and Open Space Master Plan for Hamilton County, Ohio.

**Section 3.4** Flood Protection Elevation (FPE)

a) For all Zones AE or A1-30 identified as Special Flood Hazard Areas (SFHA's) in Section 3.2(a), the FPE is one (1) foot above the base flood elevation as established in the Flood Insurance Study referenced in Section 3.1(b), above, or as described in 3.4(c) whichever is more restrictive.

b) For all unnumbered A Zones identified as SFHA's in Section 3.2(a), above, the

FPE is one (1) foot above the base flood elevation as established in the Storm Drainage and Open Space Master Plan for Hamilton County, Ohio referenced in Section 3.1(a), above.

c) For all other Special Flood Hazard Areas identified in Section 3.2(b), the FPE is one (1) foot above the base flood elevation as established in the Storm Drainage and Open Space Master Plan for Hamilton County, Ohio referenced in Section 3.1(a), above.

## **Section 4.0 STANDARDS**

### **Section 4.1 General Standards**

**Section 4.1.1** Encroachments, as herein defined, are prohibited within the Regulatory Floodway of Unincorporated Hamilton County, Ohio.

**Section 4.1.2** The lowest floor of the manufactured home to be one foot above the flood protection elevation. The manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than 36 inches in height above grade and be securely anchored to an adequately anchored foundation system to resist floatation, collapse and lateral movement.

**Section 4.1.3** All new construction and substantial improvements shall:

- a) Be designed and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
- b) Be constructed with materials resistant to flood damage;
- c) Be constructed by methods and practices that minimize flood damages; and
- d) Be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within such components during conditions of flooding.

**Section 4.1.4** All subdivision proposals governed by Rules and Regulations of the Regional Planning

Commission of Hamilton County, Ohio, for the Subdivision of Land, shall:

- a) Be consistent with the need to minimize flood damage;
  - b) Shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage;
  - c) Shall have adequate drainage provided to reduce exposure to flood damage;
- and
- d) Provide base flood elevation data for subdivision proposals, and other proposed developments which contain at least 50 lots or 5 acres (whichever is less).

**Section 4.1.5** All public and private utilities and facilities, including, but not limited by enumeration to, sewer, on site waste disposal systems, gas, electrical, storm drainage,

and potable water systems, shall be located and constructed in such a manner as to minimize or eliminate the flow or infiltration of flood waters into or out of such systems during and after a base (100 year) flood discharge, and to eliminate flood damage to them.

**Section 4.1.6** Storm drainage shall be designed to minimize or eliminate exposure to surface flooding of any kind or from any source, for on and off site existing and new construction, substantial improvements, and other development.

## **Section 4.2** Specific Standards

**Section 4.2.1** Accessory structures (e.g., sheds, detached garages) containing 576 square feet or less, which are designed to have low flood damage potential, are placed on the building site so as to offer minimum resistance to the flow of flood waters, have service facilities such as electric and heating equipment elevated above the base flood elevation, are properly anchored to prevent flotation, and which are not used or designed not to be used for human habitation, are exempted from further flood proofing standards, This Section shall not apply to accessory structures located within any regulatory floodway as defined in Section 3.3, above.

**Section 4.2.2** Within any designated Special Flood Hazard Area in the unincorporated territory of Hamilton County, Ohio, only that new construction, substantial improvement, or other development shall be allowed which:

a) Has, for residential structures, the lowest floor, including any basement(s), elevated to or above the Flood Protection Elevation (FPE) as determined by reference to Section 3.4, above.

b) Has, for nonresidential structures, the lowest floor, including any basement(s) elevated to or above the Flood Protection Elevation (FPE) as determined by reference to Section 3.4, above; or together with attendant utility and sanitary facilities,

1) is designed so that below the FPE any structure(s) is (are) watertight, with walls substantially impermeable to the passage of waters; and

2) has structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; and

3) which is certified by a registered professional engineer or architect prior to issuance of any required building permit and/or certificate of occupancy by the office of the Building Commissioner, that the design and methods of construction are in accordance with the accepted standards of practice for meeting the requirements of this Resolution.

**Section 4.2.3** The following standards apply to all new and substantially improved

residential and nonresidential non-basement structures which are elevated one foot above the base flood elevation using pilings, columns, posts or solid foundation perimeter walls with openings sufficient to allow unimpeded movement of flood water. Fully enclosed areas below the lowest floor that are useable solely for the parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing of the entry and exit of flood waters. Designs for meeting this requirement must be certified by a registered professional engineer or architect and meet or exceed the following criteria: A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves, or other covering or devices provided that they permit the automatic entry and exit of flood waters.

**Section 4.2.4** All subdivision proposals governed by the Rules and Regulations of the Regional Planning Commission of Hamilton County, Ohio, for the Subdivision of Land, and other proposed developments containing greater than fifty (50) lots or greater than five (5) acres (whichever is less), shall include, on the surface of any required improvement plan, record plat, preliminary development plan, zone change petition plat, or other graphic or written materials, accurate written and graphic information about the base (100 year) flood elevation, where such areas are within Zones A1-30 and the unnumbered A Zones on the Flood Insurance Rate Map for Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004), or the 50 year flood elevation, for all other Special Flood Hazard Areas, as it pertains to the proposed development.

## **Section 5.0 NOTIFICATION OF INCREASED FLOOD RISK**

**Section 5.1** In the case of any permitted accessory structures, or any development permitted under Section 6.0 of these Regulations, the following language shall be affixed to all plans, plats and other written or graphic materials which may be construed as constituting authorization, in whole or in part, for such construction:  
“A lowest floor elevation less than one (1) foot above the base flood elevation (100 year) of \_\_\_\_\_ feet NGVD, or the absence of flood proofing to one (1) foot above the base flood level, will increase the risk of flooding and flood damage, and the cost of flood insurance will be commensurate with the increased risk.”

## **Section 6.0 APPEALS AND VARIANCES (See Section 9.3)**

**Section 6.1** Any person aggrieved of any decision of an administrative officer of Hamilton County, Ohio, which is based on the provisions of these Regulations, may appeal such decision or seek a variance from the provisions of these Regulations or any other rules, regulations, codes, or resolutions affected by these Regulations, as follows:

- a) From the Zoning Resolution for the Unincorporated Territory of Hamilton

County, Ohio, to the Hamilton County Board of Zoning Appeals; and

b) From the Hamilton County Board of Storm Drainage Variance and Appeals (Adopted May 8, 1985); and

c) From the Building Code of Hamilton County, Ohio and the Ohio Basic Building Code to the Hamilton County Board of Building Appeals; and

d) From the Rules and Regulations of the Sanitary Engineering Department Governing the Construction, Operation, and Maintenance, in the County of Hamilton Storm Drainage System; to the Hamilton County Board of Storm Drainage Variances and Appeals; and

e) From the Rules and Regulations of the Regional Planning Commission of Hamilton County, Ohio, for the Subdivision of Land to the Hamilton County Regional Planning Commission; and

f) From all other rules regulations, codes, or resolutions of the County so affected, to the Court of Common Pleas of Hamilton County, Ohio, as provided for in Chapter 2c06 of the Ohio Revised Code.

**Section 6.2** Any request for a variance from the requirements of these Regulations (which were based upon the standards of 44 CFR 60.3) shall be reviewed by the appropriate body identified in Section 6.1, above, using the guidance and procedures contained in 44 CFR 60.6(a).

## **Section 7.0 ENFORCEMENT**

**Section 7.1** No structure or land shall hereafter be located, erected, constructed, repaired, extended, converted, enlarged, or altered without full compliance with the terms of these Regulations and all other applicable regulations which apply to uses with the jurisdiction of these Regulations.

**Section 7.2** Violation of the provisions of these Regulations or failure to comply with any of its requirements shall constitute a misdemeanor. Any person who violates these Regulations or fails to comply with any of its requirements (including violations of, conditions of, and safeguards established in connection with conditions) shall upon conviction thereof be fined or imprisoned as provided by the laws of the State of Ohio. Each day such violation continues shall be considered a separate offense. Nothing herein contained shall prevent Hamilton County from taking such other lawful action as is necessary to prevent or remedy any violations.

## **Section 8.0 WARNING AND DISCLAIMER OF LIABILITY**

**Section 8.1** The degree of flood protection required by these Regulations is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur. Flood heights may be increased by man-made or natural causes. These Regulations do not imply that land outside the

designated Special Flood Hazard Areas, or uses permitted within such Areas, will be free from flooding or flood damages. These Regulations shall not create liability on the part of the Board of County Commissioners of Hamilton County, Ohio, any officer or employee thereof, or of any other independent regulatory agency or board with jurisdiction within the unincorporated territory of Hamilton County, Ohio, or the Federal Emergency Management Agency, for any flood damages that result from reliance on these Regulations or any administrative decision lawfully made hereunder.

## **Section 9.0 TECHNICAL LIMITATIONS AND AMENDMENTS**

**Section 9.1** The adoption of these Regulations does not imply that the Board of County Commissioners of Hamilton County, Ohio, accepts that the Flood Insurance Study for Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004), the Flood Insurance Rate Map for Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004), are free from technical or graphic error(s) in the whole or in part.

**Section 9.2** The Board of County Commissioners of Hamilton County, Ohio, reserves the right at any time to challenge the technical or graphic accuracy of any or all of the scientific and engineering reports and accompanying maps and profiles made a part of these Regulations by reference, and to pursue whatever course necessary to insure that they accurately reflect the existing conditions within unincorporated Hamilton County, Ohio.

**Section 9.3** Any person who believes that the Flood Insurance Study For The County of Hamilton, Ohio (Federal Emergency Management Agency, May 17, 2004), the Flood Insurance Rate Map for Hamilton County, Ohio (and Incorporated Areas) (Federal Emergency Management Agency, May 17, 2004) are technically or graphically and/or corrections that have been made (this includes L.O.M.R. letter of map provisions, and L.O.M.A letter of map amendments) due to development and that may be in error may request that the Board of County Commissioners of Hamilton County, Ohio, petition the Federal Emergency Management Agency to correct these documents so that they accurately reflect the existing conditions within unincorporated Hamilton County, Ohio, in the following manner:

a) Property owners or others who wish to make such a request should contact the Federal Emergency Management Agency in Chicago, Illinois, to receive instructions on its information requirements for reviewing such a request.

b) Property owners or others who wish to make such a request should then submit five

(5) copies of all required technical, graphic, and other material to the Hamilton County Department of Public Works.

c) The Department of Public Works shall review and comment upon and shall

likewise submit all such requests to the Hamilton County Engineer, the Hamilton County Rural Zoning Commission, the Hamilton County Regional Planning Commission, and others for review and comment.

d) Upon receipt of these reviews and comments on such requests, the Department of Public Works shall submit the same, together with all required technical, graphic, and other material, to the Board of County Commissioners of Hamilton County, Ohio, for its transmittal of same to the Federal Emergency Management Agency in Chicago, Illinois, for its review and determination. The Board of County Commissioners of Hamilton County, Ohio, reserves the right to transmit such documents with its own comments or recommendations after reviewing the submitted documents and comments of other County Agencies.

e) Upon a determination by the Federal Emergency Management Agency that the above referenced scientific and engineering reports are in error, and its transmittal to the Board of County Commissioners of Hamilton County, Ohio, of appropriate corrections to said documents, all county agencies involved shall proceed to amend, modify, revise, adjust, or augment their rules, regulations, codes, resolutions, maps, and other regulatory materials, as necessary, to reflect such corrections at the earliest date.

## **Section 10.0 DEVELOPMENT PERMITS**

**Section 10.1** Prior to the start of any construction or other development within any Special Flood Hazard Area of Unincorporated Hamilton County, Ohio, as defined in Section 3.2, Hamilton County shall issue a “special flood hazard area development permit”. A permit shall not be issued unless the development proposal meets all the requirements of this regulation. Applications for special flood hazard area development permits shall be initiated in the office of the Hamilton County Department of Public Works.

a) Buildings. All permits involving construction, repair, improvement or addition to buildings shall be issued by the Department of the Building Commissioner. If a permit application involves both building and non-structural development activities, the permit application shall be reviewed and receive preliminary approval by the Department of Public Works before being transmitted to the Building Department for review and approval of structural plans.

b) Nonstructural. All permits which include filling, grading, paving, dredging, mining, excavation, drilling, or storage of equipment or materials, operations or any non-building type nonstructural activity shall be issued by the Department of Public Works.

**Section 10.2** Application for a special flood hazard area development permit shall be made on forms furnished by the Department of Public Works and may include, but not

be limited to plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing and proposed structures, fill, storage of materials, drainage facilities, and the location of the foregoing. Specifically, the following information is required:

a) Elevation in relation to mean sea level of the lowest floor, including basement, of all proposed structures;

b) Elevation in relation to mean sea level to which any proposed structures will be flood proofed;

c) Certification by a registered professional engineer or architect that the flood proofing methods for any proposed nonresidential structures meet all applicable flood proofing criteria in Section 4.22(b);

d) Description of the extent to which any watercourse will be altered or relocated as a result of proposed development; and

e) Description of the extent of all filling, grading and other non-building activities.

### **Section 10.3 Permit Review**

a) The Department of Public Works shall review all nonstructural development permits to determine that the permit requirements of these Regulations have been satisfied. The Department of Public Works and the Building Commissioner shall review all building permits to determine that the permit requirements of these Regulations have been satisfied.

b) Review all development permits to assure that all necessary permits have been received from those federal, state or local governmental agencies from which prior approval is required. The applicant shall be responsible for obtaining such permits as required including permits issued by the Department of the Army under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

c) Review all development permits to determine if the proposed development is located within a designated floodway. Floodways are delineated in the Flood Insurance Rate Map and the Flood Insurance Study. Floodways may also be delineated in other sources of flood information. If the proposed development is located within a designated floodway, assure that the encroachment provision of Section 4.1.1 is met.

### **Section 10.4 Exemption from filing a development permit**

An application for a Development Permit shall not be required for maintenance work such as roofing, painting, and basement sealing, or for small nonstructural development activities (except for filling and grading) valued at less than \$1,000.00. Any proposed

action exempt from filing for Development Permit is also exempt from the standards of these Regulations.

### **Section 10.5** Information to be obtained and maintained

a) The Zone in which the development activity is located as determined by reference to Section 3.1(d).

b) The FPE as established in Section 3.4.

c) Actual elevation (NGVD) of the lowest floor, including basement of all new or substantially improved structures, and whether or not the structures contain a basement (as defined herein per definition “basement”) as certified by a registered professional engineer, architect, or land surveyor.

d) For all new or substantially improved nonresidential dry-flood proofed structures:

1) Actual lowest floor elevation, the elevation to which the structure is flood proofed and certification that the flood proofing requirements of Section 4.22(b)(3), the Hamilton County Building Code and the Ohio Basic Building Code have been met.

e) For all development activities to be located within a floodway identified in Section 3.3, hydrologic and hydraulic analysis performed in accordance with standard engineering practices, and certification by a registered professional engineer that the requirements of Section 4.1.1 have been met.

### **Section 10.6** Alteration of Watercourses

1) Applicant must notify adjacent communities and the Ohio Department of Natural Resources, Division of Water, prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Emergency Management Agency. A watercourse is considered to be altered if any change occurs within its banks.

2) Maintain engineering documentation required in Section 4.1(4) that the flood carrying capacity of the altered or relocated portion of said watercourse will not be diminished.

3) Require that necessary maintenance will be provided for the altered or relocated portion of said watercourse so that the flood carrying capacity will not be diminished.

Alteration of Watercourses Comment:

Prior to any alteration or relocation of a watercourse for which flood hazard areas have

been identified on a community's Flood Insurance Rate Map, adjacent communities and the Ohio Department of Natural Resources, Division of Water must be notified in writing by the community in which the alteration or relocation is being proposed. FEMA must receive evidence of the notification. The main purpose of the notification is to invite comment by communities which may be affected by the stream alteration or relocation. Additionally, the appropriate district office of the U.S. Army Corps of Engineers should be contacted since such activity may be subject to federal permit requirements under Section 404 of the Clean Water Act. Proper notification of a watercourse alteration or relocation should include a map and supplemental information.

ADOPTED at a regularly adjourned meeting of the Board of County Commissioners of Hamilton County, Ohio,

this 12th day of April, 2004.

Mr. Dowlin, \_\_\_\_\_ Mr. Heimlich \_\_\_\_\_ Mr. Portune, \_\_\_\_\_

#### CERTIFICATE OF CLERK

IT IS HEREBY CERTIFIED, that the foregoing is a true and correct transcript of a resolution adopted by the Board of County Commissioners in session this 12th day of April, 2004.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the office of County

Commissioners of Hamilton County, Ohio, this 12th day of April, 2004.  
Jacqueline Panioto, Clerk  
Board of County Commissioners  
Hamilton County, Ohio



# County of Hamilton

BOARD OF COUNTY  
COMMISSIONERS  
PAT DEWINE  
DAVID PEPPER  
TODD PORTUNE

DEPARTMENT OF PUBLIC WORKS  
138 E COURT STREET – ROOM 800  
CINCINNATI, OHIO 45202  
PHONE: (513) 946-4750  
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JEFFREY A. LEEDY  
DEPUTY DIRECTOR

JOHN J. MICHEL  
DEPUTY DIRECTOR

GARY R. VAN HART  
DIRECTOR

## EXHIBIT NO. 36

### CERTIFICATION FOR THE DEVELOPMENT IN A FLOOD HAZARD AREA

This form should be completed by a professional surveyor and returned to the local flood plain administrator. The form can be used to serve two purposes. First, it can be used by the property owner to certify that the completed construction meets the flood elevation standards of the community. Secondly, this form can be used by insurance agents to complete the Elevation Certificate which they need to complete for insuring new construction in the flood plain. The community should keep the completed original on file and provide the property owner with a copy that he or she can furnish to the insurance agent.

In this manner the agent will not have to call upon community officials for assistance in determining the elevation data they require.

I, the undersigned, do hereby certify to the following elevation at the referenced property in compliance with the permit requirements of the Flood Damage Prevention Regulations for Unincorporated Hamilton County, Ohio (Volume 259, Image 5569-5584) effective September 27, 1995.

Location of property \_\_\_\_\_

Owner of property \_\_\_\_\_

Lowest floor elevation,  
including basement \_\_\_\_\_ feet above msl.  
(mean seal level)

Signature of Surveyor \_\_\_\_\_

Professional Seal

Date \_\_\_\_\_