CITY OF DEWITT
CITY COUNCIL

RESOLUTION

A RESOLUTION BY THE CITY COUNCIL OF THE CITY OF DEWITT ADOPTING A WATERSHED MAP FOR THE CITY AND ESTABLISHING STORM WATER MANAGEMENT STANDARDS AS DIRECTED BY ARTICLE XIV, CHAPTER 78 OF THE CITY CODE OF ORDINANCES

WHEREAS, the Storm Water Management Article of the City Code requires the City Council to adopt by Resolution a Watershed Map for the City and Storm Water Management Standards which establish the minimum design standards for calculating runoff, storm water discharge release rates, and requirements for dischargers to implement on-site detention, detention, infiltration, or other methods necessary to control the rate and volume of surface water runoff discharged into the storm water drainage system; and,

WHEREAS, after research and discussion, the Storm Water Management Ordinance Working Group has developed and recommended that the City Council adopt the Watershed Map (Attachment A) and Storm Water Management Standards.

NOW, THEREFORE, BE IT RESOLVED that the City Council, based on the recommendation of the Storm Water Management Ordinance Working Group, hereby adopts the Watershed Map and Storm Water Management Standards.

Upon a motion by Councilmember Flood, seconded by Councilmember Rundborg, the above and forgoing Resolution was unanimously approved by the City Council at their meeting held on January 13, 2003. Councilmember Lancaster was excused.

Attachment B

City Of DeWitt, Michigan
Storm Water Management Standards

Adopted by the City Council on _____January 13, 2003_____ in accordance with Article XIV, Chapter 78 of the City of DeWitt Code of Ordinances.

The City of DeWitt requires that both the volume and rate of storm water runoff resulting from development be controlled. Specific requirements and the methodology to be followed for each requirement are described below. Sample calculations for a hypothetical site entitled **"Sample Site Acres"** are also provided for the applicant's benefit.

Volume Control

The increase in storm water runoff volume resulting from development from the 10-year, 24-hour storm shall be controlled in an approved manner such that it does not leave the site boundaries by surface water discharge.

Volume = (Post-development runoff volume) – (Pre-development runoff volume)

The volume of storage required shall be calculated by using the methodology contained in Table 4. The calculated volume is the minimum amount that must be controlled. The applicant may, subject to City approval, control additional volume.

Pre-development runoff volume shall be calculated as follows:

$Volume_{pre}$ (acre-feet) = C_{pre} * rainfall (inches) / 12 (inches/foot) * site area (acres)

C_{pre} = Pre-development runoff coefficient calculated by using the values provided in Table 1, calculated as a weighted average of all surface conditions as per Table 2.

rainfall = 3.43 inches (equal to 10-year, 24-hour total rainfall as per MDEQ)

Post-development runoff volume shall be calculated as follows:

$Volume_{post}$ (acre-feet) = C_{post} * rainfall (inches) / 12 (inches/foot) * site area (acres)

C_{post} = Post-development runoff coefficient calculated by using the values provided in Table 1, calculated as a weighted average of all surface conditions as per Table 3.

rainfall = 3.43 inches (equal to 10-year, 24-hour total rainfall as per MDEQ)

Any one or combination of the following methods may be used to meet this requirement:

        a. Infiltration (e.g. basin or trench)
        b. Retention (e.g. non-regulated wetland or permanent pool)
        c. Evapo-transpiration
        d. Bio-retention
        e. Other proposed BMP(s) or means subject to City approval

The applicant is required to provide evidence that soil and other site conditions are suitable for the proposed method. All storm water facilities intended to meet this requirement shall be located within City rights-of-way, parcel outlots, or other common areas accessible by the City by easement or other methods.

Rate Control

The storm water runoff not otherwise controlled in accordance with the volume control requirements above shall be released off-site at a controlled rate. Runoff from storm events up to, and including, the 100-year, 24-hour storm shall be released at or below the rate of 0.15 cubic feet per second (cfs) per acre of site area.

Maximum allowable release rate = 0.15 (cfs/acre) * site area (acres)

The volume of storage required to meet the design release rate shall be calculated by using the methodology contained in Table 5. Note that the storm water runoff volume utilized in this calculation excludes that which is subject to volume control as calculated in Table 4 above.

Any one or combination of the following methods may be used to meet this requirement:

        a. Detention (e.g. basin or pond)
        b. Subsurface storage (e.g. restricted storm drainage pipe system)
        c. Other proposed BMP(s) or means subject to City approval

City of DeWitt, Michigan
Storm Water Management Standards
Table 1 - Runoff Coefficients

Surface Condition	Runoff Coefficient
Water Surfaces	
Wetlands - Marsh - Swamp	
Roofs	
Asphalt and Concrete Pavement	
Gravel	
Brick	
Agricultural - Cultivated Fields	
Meadow - Pasture	
Dense Weeds and Brush	
Dense Woods	
Lawns, Parks, Playgrounds (<4% slope)	
Hydrologic Soil Group A	
Hydrologic Soil Group B	
Hydrologic Soil Group C	
Hydrologic Soil Group D	
Lawns, Parks, Playgrounds (>4% slope)	
Hydrologic Soil Group A	
Hydrologic Soil Group B	
Hydrologic Soil Group C	
Hydrologic Soil Group D	

City of DeWitt, Michigan
Storm Water Management Standards
Table 2 - Pre-Development Runoff Coefficient

Surface Condition	"C"	Area (acres)	C*Area
Total			
Average (Weighted) Runoff Coefficient "C"			

Procedure:

1. Surface Condition - Identify the condition from the list included in Table 1.
2. "C" - Note the runoff coefficient "C" from Table 1 that matches the noted surface condition.
3. Area (acres) - Note the size, in acres, of the portion of the site containing the noted surface condition.
4. C*Area - Multiply the runoff coefficient "C" by its corresponding area.
5. Total - Add the individual surface condition areas and C*Area values.
6. Average (Weighted) Runoff Coefficient "C" - Divide the sum of C*Area values by the total site area.

City of DeWitt, Michigan
Storm Water Management Standards
Table 3 - Post-Development Runoff Coefficient

Surface Condition	"C"	Area (acres)	C*Area
Total			
Average "C"			

Procedure:

1. Surface Condition - Identify the condition from the list included in Table 1.
2. "C" - Note the runoff coefficient "C" from Table 1 that matches the noted surface condition.
3. Area (acres) - Note the size, in acres, of the portion of the site containing the noted surface condition.
4. C*Area - Multiply the runoff coefficient "C" by its corresponding area.
5. Total - Add the individual surface condition areas and C*Area values.
6. Average (Weighted) Runoff Coefficient "C" - Divide the sum of C*Area values by the total site area.

City of DeWitt, Michigan
Storm Water Management Standards
Table 4 - Volume Control Storage Calculation

Site Information

Site Location:	_____	
Site Area:	_____	(acres)
Pre-development runoff coefficient ("C")	_____	
Post-development runoff coefficient ("C"):	_____	
Required Storage for Volume Control: (Copy value from below)	_____	(acre-feet)

Volume Control Storage Calculation

$Volume_{post}$ $(C_{post})*(3.43/12)*$(site area) (acre-feet)	$Volume_{pre}$ $(C_{pre})*(3.43/12)*$(site area) (acre-feet)	Required Volume (acre-feet)

Procedure:

1. $Volume_{post}$ - Multiply post-development runoff coefficient C_{post} calculated in Table 3 by 3.43 inches, divide by 12 to convert to feet, and multiply by the site area in acres.
2. $Volume_{pre}$ - Multiply pre-development runoff coefficient C_{pre} calculated in Table 2 by 3.43 inches, divide by 12 to convert to feet, and multiply by the site area in acres.
3. Required Volume - Subtract $Volume_{pre}$ from $Volume_{post}$ to determine the required volume to be controlled on-site.

City of DeWitt, Michigan
Storm Water Management Standards
Table 5 - Rate Control Storage Calculation

Site Information

Site Location:	_____	
Site Area:	_____	(acres)
Pre-development runoff coefficient ("C")	_____	
Post-development runoff coefficient ("C"):	_____	
Maximum allowable release rate: (Site Area * 0.15)	_____	(cfs)
Required Storage for Rate Control: (Copy peak value from below)	_____	(acre-feet)

Rate Control Storage Calculation

Storm Duration (hours)	Rainfall Amount (inches)	100% Runoff (acre-feet)	Runoff Coefficient ("C")	Effective Runoff$_{post}$ (acre-feet)	Adjusted Runoff (acre-feet)	Controlled Outflow (acre-feet)	Required Storage (acre-feet)
0.17	1.19						
0.33	1.65						
0.50	1.90						
0.67	2.13						
1	2.30						
2	2.80						
3	3.00						
4	3.20						
5	3.25						
6	3.30						
7	3.36						
8	3.44						
9	3.51						
10	3.60						
12	3.72						
18	3.96						
24	4.32						

Procedure:

1. 100% Runoff - Multiply site area in acres times rainfall amount in inches, divide by 12 to convert to acre-feet.
2. Runoff coefficient "C" - Note the post-development runoff coefficient developed in Table 3.
3. Effective Runoff$_{post}$ - Multiply the value calculated for 100% runoff by the post-development runoff coefficient "C$_{post}$".
4. Adjusted Runoff - The total amount of post-development runoff volume less that stored elsewhere for volume control.
   equation is (Effective Runoff$_{post}$) - (Effective Runoff$_{post}$)*(Required Storage for Volume Control from Table 4)/(Total Effective Runoff$_{post}$)
5. Controlled Outflow - The volume of runoff that has been discharged off-site through the rate control structure; multiply the allowable discharge rate (cfs) times the storm duration (hours) times 3,600 seconds per hour divided by 43,560 to convert to acre-feet.
6. Required Storage - The difference between adjusted runoff and controlled outflow requiring storage.

City of DeWitt, Michigan
Storm Water Management Standards
Table 1 - Runoff Coefficients

Surface Condition	Runoff Coefficient
Water Surfaces	1.00
Wetlands - Marsh - Swamp	0.15
Roofs	0.90
Asphalt and Concrete Pavement	0.98
Gravel	0.85
Brick	0.85
Agricultural - Cultivated Fields	0.40
Meadow - Pasture	0.25
Dense Weeds and Brush	0.20
Dense Woods	0.15
Lawns, Parks, Playgrounds (<4% slope)	
Hydrologic Soil Group A	0.20
Hydrologic Soil Group B	0.30
Hydrologic Soil Group C	0.35
Hydrologic Soil Group D	0.50
Lawns, Parks, Playgrounds (>4% slope)	
Hydrologic Soil Group A	0.25
Hydrologic Soil Group B	0.35
Hydrologic Soil Group C	0.40
Hydrologic Soil Group D	0.55

City of DeWitt, Michigan
Storm Water Management Standards
Table 2 - Pre-Development Runoff Coefficient

Site Location: | **Sample Site Acres**

Surface Condition	"C"	Area (acres)	C*Area
Meadow	**0.25**	**36.00**	**9.00**
Wetlands/swamp	**0.20**	**4.00**	**0.80**
Total		**40.00**	**9.80**
Average (Weighted) Runoff Coefficient "C"			**0.25**

Procedure:

1. Surface Condition - Identify the condition from the list included in Table 1.
2. "C" - Note the runoff coefficient "C" from Table 1 that matches the noted surface condition.
3. Area (acres) - Note the size, in acres, of the portion of the site containing the noted surface condition.
4. C*Area - Multiply the runoff coefficient "C" by its corresponding area.
5. Total - Add the individual surface condition areas and C*Area values.
6. Average (Weighted) Runoff Coefficient "C" - Divide the sum of C*Area values by the total site area.

City of DeWitt, Michigan
Storm Water Management Standards
Table 3 - Post-Development Runoff Coefficient

Site Location: **Sample Site Acres**

Surface Condition	"C"	Area (acres)	C*Area
Wetlands/swamp	0.20	4.00	0.80
Open space (undisturbed meadow)	0.25	1.00	0.25
Grass right-of-way ("B" soil lawn >4% slope)	0.30	1.45	0.44
Grass right-of-way ("B" soil lawn ≥4% slope)	0.35	1.45	0.51
Roadway (asphalt pavement)	0.98	2.10	2.06
Roofs	0.90	2.10	1.89
Driveways/sidewalk (concrete)	0.98	1.60	1.57
Lawns ("B" soil <4% slope)	0.30	13.15	3.95
Lawns ("B" soil ≥4% slope)	0.35	13.15	4.60
Total		40.00	16.06
Average "C"			0.40

Procedure:

1. Surface Condition - Identify the condition from the list included in Table 1.
2. "C" - Note the runoff coefficient "C" from Table 1 that matches the noted surface condition.
3. Area (acres) - Note the size, in acres, of the portion of the site containing the noted surface condition.
4. C*Area - Multiply the runoff coefficient "C" by its corresponding area.
5. Total - Add the individual surface condition areas and C*Area values.
6. Average (Weighted) Runoff Coefficient "C" - Divide the sum of C*Area values by the total site area.

City of DeWitt, Michigan
Storm Water Management Standards
Table 4 - Volume Control Storage Calculation

Site Information

Site Location:	**Sample Site Acres**	
Site Area:	**40.00**	(acres)
Pre-development runoff coefficient ("C")	**0.25**	
Post-development runoff coefficient ("C"):	**0.40**	
Required Storage for Volume Control: (Copy value from below)	**1.79**	(acre-feet)

Volume Control Storage Calculation

Volume$_{post}$ (C_{post})*(3.43/12)*(site area) (acre-feet)	Volume$_{pre}$ (C_{pre})*(3.43/12)*(site area) (acre-feet)	Required Volume (acre-feet)
4.59	2.80	1.79

Procedure:

1. Volume$_{post}$ - Multiply post-development runoff coefficient C_{post} calculated in Table 3 by 3.43 inches, divide by 12 to convert to feet, and multiply by the site area in acres.
2. Volume$_{pre}$ - Multiply pre-development runoff coefficient C_{pre} calculated in Table 2 by 3.43 inches, divide by 12 to convert to feet, and multiply by the site area in acres.
3. Required Volume - Subtract Volume$_{pre}$ from Volume$_{post}$ to determine the required volume to be controlled on-site.

City of DeWitt, Michigan
Storm Water Management Standards
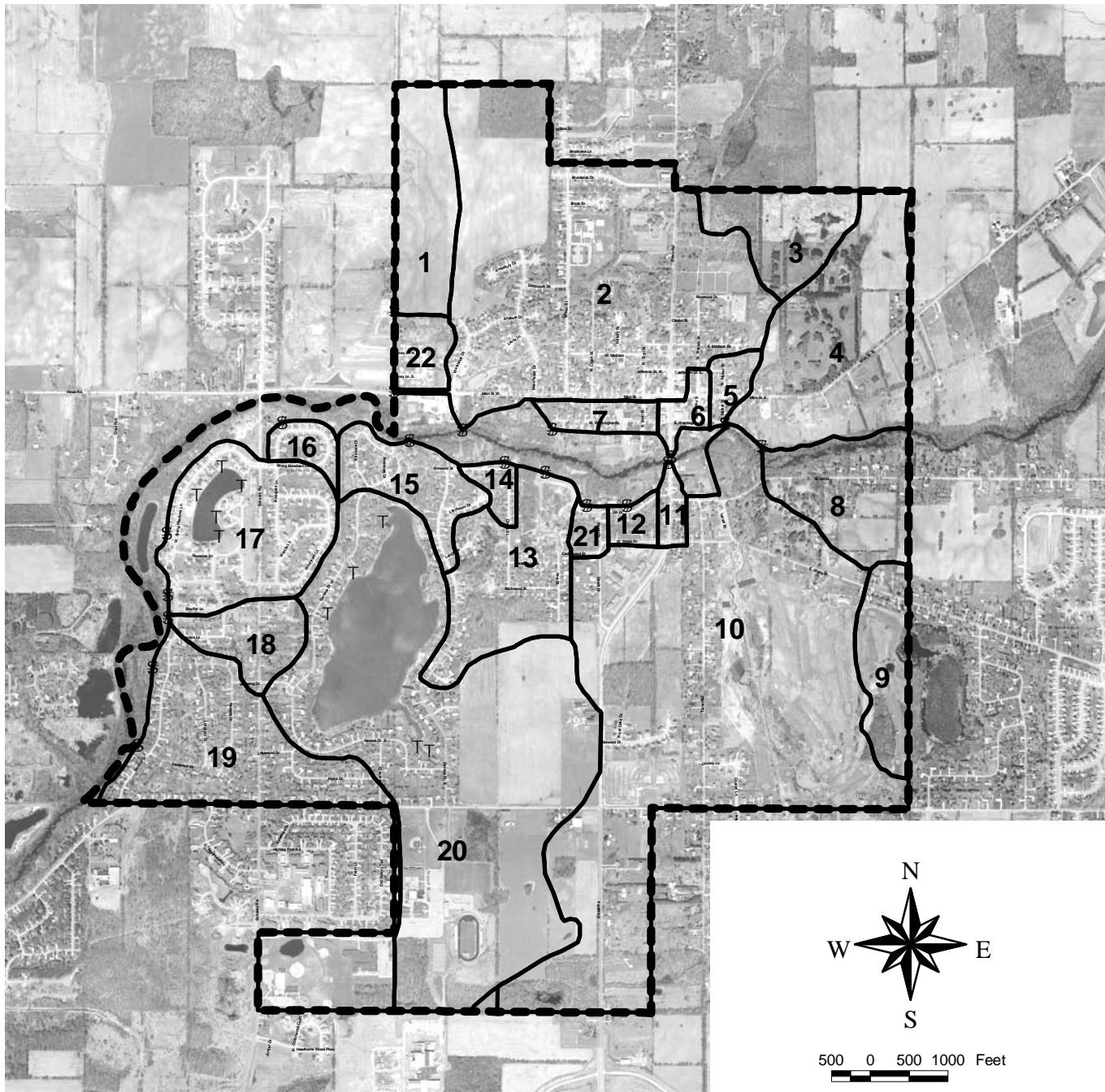### Table 5 - Rate Control Storage Calculation

Site Information

Site Location:	**Sample Site Acres**	
Site Area:	**40.00**	(acres)
Pre-development runoff coefficient ("C")	**0.25**	
Post-development runoff coefficient ("C"):	**0.40**	
Maximum allowable release rate: (Site Area * 0.15)	**6.00**	(cfs)
Required Storage: (Copy peak value from below)	**1.64**	(acre-feet)

Rate Control Storage Calculation

Storm Duration (hours)	Rainfall Amount (inches)	100% Runoff (acre-feet)	Runoff Coefficient ("C")	Effective Runoff$_{post}$ (acre-feet)	Adjusted Runoff (acre-feet)	Controlled Outflow (acre-feet)	Required Storage (acre-feet)
0.17	1.19	**3.97**	**0.40**	**1.59**	**1.10**	**0.08**	**1.02**
0.33	1.65	**5.50**	**0.40**	**2.21**	**1.52**	**0.16**	**1.36**
0.50	1.90	**6.33**	**0.40**	**2.54**	**1.76**	**0.25**	**1.51**
0.67	2.13	**7.10**	**0.40**	**2.85**	**1.97**	**0.33**	**1.64**
1	2.30	**7.67**	**0.40**	**3.08**	**2.13**	**0.50**	**1.63**
2	2.80	**9.33**	**0.40**	**3.75**	**2.59**	**0.99**	**1.60**
3	3.00	**10.00**	**0.40**	**4.01**	**2.77**	**1.49**	**1.28**
4	3.20	**10.67**	**0.40**	**4.28**	**2.96**	**1.98**	**0.97**
5	3.25	**10.83**	**0.40**	**4.35**	**3.00**	**2.48**	**0.52**
6	3.30	**11.00**	**0.40**	**4.42**	**3.05**	**2.98**	**0.07**
7	3.36	**11.20**	**0.40**	**4.50**	**3.10**	**3.47**	**-0.37**
8	3.44	**11.47**	**0.40**	**4.60**	**3.18**	**3.97**	**-0.79**
9	3.51	**11.70**	**0.40**	**4.70**	**3.24**	**4.46**	**-1.22**
10	3.60	**12.00**	**0.40**	**4.82**	**3.33**	**4.96**	**-1.63**
12	3.72	**12.40**	**0.40**	**4.98**	**3.44**	**5.95**	**-2.51**
18	3.96	**13.20**	**0.40**	**5.30**	**3.66**	**8.93**	**-5.27**
24	4.32	**14.40**	**0.40**	**5.78**	**3.99**	**11.90**	**-7.91**

Procedure:

1. 100% Runoff - Multiply site area in acres times rainfall amount in inches, divide by 12 to convert to acre-feet.

2. Runoff coefficient "C" - Note the post-development runoff coefficient developed in Table 3.

3. Effective Runoff$_{post}$ - Multiply the value calculated for 100% runoff by the post-development runoff coefficient "C$_{post}$".

4. Adjusted Runoff - The total amount of post-development runoff volume less that stored elsewhere for volume control.
   equation is (Effective Runoff$_{post}$) - (Effective Runoff$_{post}$)*(Required Storage for Volume Control from Table 4)/(Total Effective Runoff$_{post}$)

5. Controlled Outflow - The volume of runoff that has been discharged off-site through the rate control structure;
   multiply the allowable discharge rate (cfs) times the storm duration (hours) times 3,600 seconds per hour divided by
   43,560 to convert to acre-feet.

6. Required Storage - The difference between adjusted runoff and controlled outflow requiring storage.

N
W E
S

500 0 500 1000 Feet

This map has been developed based upon information provided by:
The Clinton County, Michigan GIS Department

*CITY OF DEWITT STORM WATER
MANAGEMENT PLAN*

*ATTACHMENT A
WATERSHED MAP*

CAPITAL CONSULTANTS

Project # 01284