

## Storm Water Management Design and Performance Standards

### General Performance standards for storm water management

- A. Storm water management conveyance, storage, infiltration measures, and facilities shall be designed to prevent flood hazards and water pollution related to storm water runoff and soil erosion from the proposed project site/location.
- B. Alterations to natural drainage patterns shall not create flooding or water pollution for adjacent properties. Storm water from upstream and off-site locations shall be conveyed around or through the site or may be stored on site.
- C. When developing the storm water management plan for the project, do not assume that the site is exempt (grandfathered). The University, being a good steward of the environment shall require that the consultant review the NOAA data gathered from the NOAA weather station on campus and develop a design that accounts for the impact of the rain events on the system as well as how the proposed design will impact other flows at the outlet. (Refer to table at the end of the standard).
- D. A primary storage system that manages runoff from storms up to a 50-year frequency and 24-hour duration shall be provided. (System shall provide one foot of freeboard above the design storage elevation).
- E. Detention basins and conveyance systems shall be designed to safely control and accommodate a secondary drainage system to direct runoff. This shall be achieved through a means of bypassing the 10-year storm above the design storm event of 50 years, by the use of an emergency bypass or overflow.
- F. For the 50-year frequency and 24-hour duration storm event, the discharge runoff rate shall not exceed the peak rate of 0.15 cfs per acre for the entire site. Where these standards cannot realistically be achieved, the Engineer shall demonstrate that existing higher runoff rates meet the intent of this standard.
- G. Unless otherwise approved, storm water discharge shall be conveyed through swales and vegetated buffer strips so as to decrease runoff velocity, to allow for natural infiltration, to allow suspended sediment particles to settle, and to remove pollutants. The design shall treat the first ½ (or 1”) of runoff to remove up to 80% of Total Suspended Solids (TSS). Provide evidence that treatment method will remove the minimum TSS based on tests or published standards. SEMCOG publication for low impact development best management practices is an excellent resource which can be found at the following; <http://semcog.org/desktopmodules/SEMCOG.Publications/GetFile.ashx?filename=LowImpactDevelopmentManualforMichiganSeptember2008.pdf>
- H. Drainage systems shall be designed to protect public health and safety and to be visually attractive.
- I. Pipe sizing needs to account for the “tail-water effect” (sometimes called backwater effect). Typical industry standard designs use the rational method, but this method does

not fully account for this effect. The design shall demonstrate that the “backwater effect” has been taken into consideration.

- J. Storm sewer conveyance / piping shall be designed to convey a 10-year storm event. The minimum Manning’s n roughness coefficient for the pipes shall be 0.013.
- K. Minimum pipe grades must be such to produce minimum scouring velocity of two and one-half feet per second (2.5 ft/sec.) when pipe is flowing full without surcharging.
- L. Minimum pipe diameter for catch basin leads is 12 inches.
- M. Minimum pipe size for storm sewer main is 12 inches.
- N. Pipe should be sized for a ten-year design storm without surcharging.
- O. When two pipes or more of different sizes come into a structure, the 8/10<sup>th</sup> flow lines shall match when possible.
- P. Catch basins shall have a minimum sump of 24 inches.

#### Storm water storage and infiltration structure standards

- A. Storm water storage and/or infiltration structures that protect water quality and minimize flooding shall be required. Storage facilities may include but are not limited to rain gardens, detention/retention basins (either at ground surface or underground), and other facilities.
- B. All detention basins shall be designed to maximize the ability of the basin to hold and trap sediment. Side slopes shall not be greater than 1 on 4, with the preferred slope being 1 on 6.
- C. Detention and retention basins shall be safely and adequately designed to control runoff. Retention and detention basins shall have an overflow system designed to safely control a 100-year frequency storm event. Basins shall be permanently stabilized to minimize erosion.
- D. Detention basins and associated berms and landscaping shall be designed to protect public safety and to be visually attractive.
- E. Detention basins shall be constructed with the top of banks a minimum of 10 feet from any pedestrian walkway or bike path.

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PLEASANT UNIV

Station ID: 20-5662

Location name: Mt Pleasant, Michigan, USA\*

Latitude: 43.5858°, Longitude: -84.7697°

Elevation:

Elevation (station metadata): 796 ft\*\*

\* source: ESRI Maps

\*\* source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.282 (0.219-0.367)	0.333 (0.259-0.434)	0.423 (0.327-0.553)	0.503 (0.386-0.661)	0.620 (0.464-0.859)	0.717 (0.523-1.01)	0.819 (0.578-1.19)	0.928 (0.629-1.39)	1.08 (0.704-1.68)	1.20 (0.762-1.90)
10-min	0.413 (0.320-0.537)	0.488 (0.379-0.635)	0.619 (0.479-0.809)	0.736 (0.566-0.967)	0.908 (0.680-1.26)	1.05 (0.767-1.48)	1.20 (0.846-1.74)	1.36 (0.921-2.04)	1.58 (1.03-2.46)	1.76 (1.12-2.78)
15-min	0.503 (0.391-0.655)	0.595 (0.462-0.775)	0.755 (0.584-0.987)	0.898 (0.690-1.18)	1.11 (0.829-1.53)	1.28 (0.935-1.80)	1.46 (1.03-2.12)	1.66 (1.12-2.49)	1.93 (1.26-3.00)	2.15 (1.36-3.39)
30-min	0.733 (0.569-0.954)	0.867 (0.673-1.13)	1.10 (0.851-1.44)	1.31 (1.01-1.72)	1.62 (1.21-2.24)	1.87 (1.37-2.63)	2.14 (1.51-3.11)	2.43 (1.64-3.65)	2.83 (1.84-4.40)	3.15 (2.00-4.97)
60-min	0.949 (0.737-1.23)	1.13 (0.875-1.47)	1.44 (1.11-1.88)	1.71 (1.31-2.25)	2.11 (1.58-2.92)	2.44 (1.78-3.42)	2.78 (1.96-4.03)	3.14 (2.13-4.72)	3.65 (2.38-5.67)	4.06 (2.57-6.39)
2-hr	1.17 (0.916-1.49)	1.39 (1.09-1.78)	1.77 (1.39-2.28)	2.11 (1.64-2.74)	2.60 (1.97-3.55)	3.00 (2.21-4.16)	3.42 (2.44-4.89)	3.86 (2.64-5.72)	4.47 (2.94-6.87)	4.96 (3.17-7.74)
3-hr	1.29 (1.02-1.64)	1.54 (1.21-1.95)	1.96 (1.55-2.50)	2.33 (1.83-3.00)	2.88 (2.19-3.89)	3.32 (2.47-4.57)	3.78 (2.72-5.38)	4.27 (2.94-6.29)	4.95 (3.28-7.56)	5.49 (3.53-8.51)
6-hr	1.52 (1.22-1.90)	1.79 (1.44-2.25)	2.28 (1.82-2.86)	2.71 (2.15-3.43)	3.36 (2.60-4.50)	3.90 (2.94-5.31)	4.47 (3.25-6.30)	5.09 (3.55-7.42)	5.95 (3.99-9.01)	6.65 (4.32-10.2)
12-hr	1.79 (1.45-2.20)	2.07 (1.68-2.55)	2.59 (2.10-3.21)	3.09 (2.48-3.85)	3.86 (3.05-5.15)	4.53 (3.47-6.14)	5.26 (3.89-7.37)	6.07 (4.30-8.81)	7.24 (4.92-10.9)	8.20 (5.39-12.5)
24-hr	2.08 (1.71-2.52)	2.36 (1.94-2.87)	2.92 (2.40-3.57)	3.48 (2.84-4.28)	4.38 (3.52-5.80)	5.18 (4.03-6.96)	6.08 (4.56-8.44)	7.08 (5.08-10.2)	8.56 (5.89-12.8)	9.78 (6.50-14.7)
2-day	2.39 (2.00-2.86)	2.69 (2.24-3.22)	3.29 (2.74-3.96)	3.90 (3.22-4.72)	4.89 (3.98-6.40)	5.78 (4.56-7.68)	6.79 (5.15-9.31)	7.91 (5.75-11.3)	9.58 (6.67-14.1)	11.0 (7.36-16.3)
3-day	2.63 (2.21-3.12)	2.93 (2.46-3.48)	3.54 (2.97-4.22)	4.16 (3.46-4.99)	5.17 (4.25-6.71)	6.09 (4.84-8.01)	7.11 (5.44-9.69)	8.27 (6.05-11.7)	9.98 (6.99-14.6)	11.4 (7.71-16.9)
4-day	2.83 (2.39-3.33)	3.13 (2.65-3.70)	3.75 (3.16-4.45)	4.37 (3.67-5.22)	5.40 (4.45-6.95)	6.31 (5.04-8.25)	7.35 (5.65-9.94)	8.51 (6.25-12.0)	10.2 (7.19-14.9)	11.7 (7.90-17.1)
7-day	3.32 (2.84-3.87)	3.66 (3.13-4.27)	4.33 (3.69-5.07)	4.98 (4.22-5.87)	6.03 (5.00-7.62)	6.95 (5.60-8.94)	7.97 (6.18-10.6)	9.12 (6.75-12.6)	10.8 (7.65-15.6)	12.2 (8.34-17.8)
10-day	3.76 (3.24-4.34)	4.15 (3.58-4.80)	4.89 (4.20-5.67)	5.59 (4.77-6.53)	6.69 (5.58-8.35)	7.65 (6.19-9.73)	8.69 (6.77-11.5)	9.85 (7.33-13.5)	11.5 (8.21-16.5)	12.9 (8.88-18.7)
20-day	5.04 (4.41-5.73)	5.60 (4.90-6.38)	6.60 (5.75-7.55)	7.50 (6.49-8.63)	8.84 (7.43-10.8)	9.96 (8.14-12.4)	11.1 (8.76-14.4)	12.4 (9.32-16.8)	14.2 (10.2-20.0)	15.7 (10.9-22.5)
30-day	6.16 (5.43-6.93)	6.86 (6.05-7.73)	8.06 (7.08-9.12)	9.10 (7.94-10.4)	10.6 (8.95-12.7)	11.8 (9.72-14.5)	13.1 (10.3-16.7)	14.4 (10.9-19.3)	16.3 (11.8-22.7)	17.7 (12.4-25.2)
45-day	7.63 (6.79-8.50)	8.48 (7.54-9.47)	9.90 (8.76-11.1)	11.1 (9.75-12.5)	12.7 (10.8-15.1)	14.0 (11.6-17.0)	15.3 (12.1-19.3)	16.6 (12.6-21.9)	18.3 (13.3-25.3)	19.7 (13.9-27.8)
60-day	8.92 (7.98-9.87)	9.89 (8.84-11.0)	11.5 (10.2-12.8)	12.7 (11.3-14.3)	14.4 (12.3-16.9)	15.7 (13.0-18.8)	16.9 (13.5-21.1)	18.1 (13.8-23.7)	19.7 (14.4-26.9)	20.9 (14.8-29.4)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.