

**STORMWATER
DESIGN STANDARDS
& GUIDELINES FOR
SITE DEVELOPMENT
In
Imlay City**

Review Procedures

Imlay City shall review all plans for development of subdivisions, multiple family projects, commercial, and industrial sites for compliance with Imlay City's design standards for storm water management.

The Planning Commission shall designate a review Engineer who will provide the services required to assure the City that all the requirements of the plan and the design standards are being met. The Engineer shall review the Developer's plan and submit a report to Imlay City showing the acceptance or rejection of the proposed site drainage plans, calculations and best management practices for discharge of clean storm water.

A site will be considered in compliance with the Storm Water Regulations and guidelines when an approval of the site's Storm Water Management Plan has been completed. The City will not accept runoff into the drainage systems located within Imlay City from newly developed or redeveloped sites without compliance with these design standards and guidelines.

To comply with the Storm Water Design Standards and Guidelines a developer or owner must complete the following process and deliver or mail all submittals to Imlay City's Planning Commission,

A complete submittal package for a storm water review consists of:

- A completed Drainage Checklist
- 2 sets of Site Plans
- 2 sets of calculations
- Storm System Operation & Maintenance plan
- NOTE this information for storm water review can be submitted digitally.

Pre-design Meeting/ Conceptual Review

This meeting, at a minimum, shall consist of the Developer's Engineer and the Imlay City's Planner and DPW. The purpose of the meeting is to address the various storm water management proposals of the developer. Conceptual storm water management alternatives can be discussed, and potential problems addressed prior to the design phase of the project. The goal of the meeting is to eliminate potential problems up front and reduce the time and costs needed for the design and review of the project.

The Developer's Engineer and/or Imlay City's Planner / DPW staff should have in his/her possession or have an understanding of the following information prior to attending the pre-design meeting.

- a. The drainage area in which the proposed development is located and the outlet conditions for the proposed development. This information can be obtained from Imlay City's public works staff.
- b. Small location map showing where the site is situated.
- c. Location and description of activities that may impact or be impacted by the proposed development or redevelopment both on and off the site.
- d. Acreage of the total site and an estimate of the area tributary to the proposed storm drainage system, including offsite runoff.
- e. The size and location of the proposed storm drainage outlet and information on contributing area.

- f. If known, a conceptual layout of the proposed storm drainage system for the development or redevelopment.

Formal Review

- a. The Owner/Developer or representative shall submit two sets of plans, two sets of calculations, a copy of the completed checklist (Appendix), and any other supporting information for the site to Imlay City's Engineer. The plans and calculations shall comply with the requirements of this Storm Water Design Guidelines. The checklist, design calculations, and design standards that will be used during the formal review process are established by this Storm Water Design document.
- b. Submit deposit/fee for storm water management plan review and inspection to the Planning Commission in accordance with the current fee schedule established by Imlay City.
- c. Formal review and approval will not begin until all items required for application have been received. The proposed drainage system will be either approved or rejected with reason and returned to the owner/ developer.
- d. Imlay City's Engineer will review all plans, calculations, and other information for compliance with Imlay City's design standards and guidelines. All materials will be reviewed for completeness. Calculations will be checked. The minimum design calculations and design standards outlined in this document will be used for review. The drainage plan checklist will be reviewed.
- e. A typical review will take approximately two (2) weeks to complete from the date the plan is submitted in a complete submittal.
- f. If the proposed drainage system is rejected, two (2) sets of plans and calculations will need to be resubmitted with the appropriate revisions. A completed checklist will also have to be resubmitted. This can also be submitted via email.

Plan Approval

Once the proposed sites storm water management plan has been recommended for approval by Imlay City's Engineer, they will send Imlay City a "recommendation for approval" letter.

Changes to Plan after Approval

- 1. Any changes made to the approved plan after issuance of the storm water permit shall require two sets of plans are submitted to Imlay City for review and approval.
- 2. Upon receipt of this information, it will be determined if additional information, such as calculations, revised checklist, etc. will be required.
- 3. The fee for review of any changes to the plan after approval will be billed on an hourly basis. An occupancy permit will not be issued until all changes have been approved and Imlay City has received all review fees.

Design Standards & Guidelines

Minimum standards which must be met:

Design Storm event is the 10yr-24-hour storm – Use of NOAA Atlas 14 for this data set (attached)

Detention Volume – 10-yr design storm (minimum), will accept 25, 50 or 100-yr design storm events

Storm Sewer sizing criteria – 10-yr design storm event (standard engineering practice)

Emergency overflow – 10-yr flow rate from the sites contributing area. Sites which cannot put in an emergency overflow may be required to retain the runoff volume of back to back 100-yr 24-hour design storms.

Allowable Discharge rate from a site – 0.4 cfs/acre (this may be lowered if there are constricting or restrictive conditions in an existing outlet or storm pipe system servicing the site in development.

Calculations for Hydrology can be based on TR-55, SCS method, Oakland County Method, or Rational Method.

Hydraulics for pipe sizing or restrictors should be based on the Manning's Equation or other standard hydraulic engineering equations.

1. DETENTION / RETENTION FACILITIES

- 1.1 The City of Imlay City will follow these Storm Water Design guidelines for drainage structures, best management practices, allowable discharge rates, and Detention/Retention Design Standards except where modified below.
- 1.2 Commercial and industrial developments using an underground detention system as their means of storm water detention must provide a storm water pre-treatment unit to minimize the potential of contaminants entering the detention system. These pre-treatment units will be reviewed on a site by site basis. These units must have sufficient maintenance access ports for long term care of the structure.
- 1.3 If underground storage is to be used on a site, due diligence must include research of previous land use to assure there is no condition present that may indicate groundwater contamination. Underground storage must be designed with a forebay or isolation chamber structure to trap sediment and must be accessible for cleanout.
- 1.4 A Stormwater Structure Operation & Maintenance Plan is required for all types of storm water structures, best management practices and detention / retention systems. This document is required at the time of as-built plan review. An editable version of the plan is provided with these standards.

Maintenance Agreements, per the Michigan Department of Environment, Great Lakes and Energy (EGLE), is recommended for ALL vegetative and structural BMPs (i.e. catch basins, detention/retention basins, oil/water separators and stormceptors, bioswales, green roofs, etc.). Imlay City is requiring this document be developed for site developments in the City to assure the constructed storm sewer system operates as intended and protects the water quality of the Belle River which is an important water resource in our community.

Additional Water Quality Requirements:

Stormwater Management Criteria	Description
A. Water Quality (WQ)	Treat the runoff volume generated from the proposed site equivalent to 1.0-inch depth of runoff from the contributing area. The WQ Volume is determined by the runoff from a 1.0-inch depth from the contributing area of a site development. Design for a minimum removal of 80% of TSS as compared to uncontrolled runoff or a discharge concentration not to exceed 80 mg/L Total Suspended Solids (TSS).
B. Channel Protection (CP)	The Channel Protection (CP) Criteria was developed to prevent or minimize the channel enlargement process in streams and rivers. The CP Volume for a 2-yr 24-hour design storm event must be stored and released over a period of at least 24 hours.

The Michigan Department of Environment, Great Lakes and Energy (EGLE) MS4 Permit & Post Construction Control Guidelines released in 2014 States:

Applicability: a) 1 acre or more of site development or re-development that discharges to an MS4 owned and operated by the City of Imlay City or Waters of the State, such as county drains, lake, wetland, river, or stream; b) less than 1 acre but is part of a larger common plan of development or sale.

Regulatory Mechanism or Ordinance must treat the following:

Water Quality - a) Treat the first one-inch of runoff from the contributing area of the site; or b) Treat runoff generated from 90% of all runoff-producing storms. c) BMPs must be designed on a site-specific basis to reduce post-development total suspended solids (TSS) by 80%; or d) Achieve a discharge concentration of TSS not to exceed 80 mg/L. NOTE: These requirements do not require monitoring of project sites to determine compliance with this TSS removal requirement. Instead, the expected reduction of suspended solids by BMPs is obtained from the literature and built into the design of the project.

Channel Protection – This criteria is to be used to meet water quality standards and provide protection when the MS4 discharges into waters of the state; a) The post-construction runoff rate and volume of discharges not to exceed the pre-development rate and runoff for all storms up to the 2 year, 24 hour storm at the entire site. At a minimum, pre-development is the last land use prior to the planned new development or re-development.

Infiltration BMPs; Redevelopment of previously degraded sites offers benefits for minimizing land disturbance and impervious cover, as well as economic benefits, these sites must be evaluated for designs that allow infiltration. If there is any questions regarding groundwater contamination refer to EGLE document on Post Construction Controls and the section on Soil and/or Groundwater Contamination.

Long-Term O&M – Long-Term Operation & Maintenance plans/agreements are required for all structural and vegetative BMPs installed and implemented on a city site or commercial/industrial or residential projects meeting development criteria. These plans/agreements must meet the performance standards in perpetuity, or until land use changes in a manner that warrants changes in the BMP or its removal. The owner or developer must annually provide the City with documentation that they have completed their site

inspections as outlined in the O&M procedure for the site.

O&M should allow the City, if controls are neglected to: a) Enter the property and inspect all structural or vegetative BMPs; b) Provide written documentation to the owner to correct any deficiencies noted, or lacking action within 7 business days, or in the event of a health hazard or pending neighboring property damage; perform maintenance or corrective actions neglected by the BMP owner or operator. All funds expended in maintenance or corrective actions will be paid for by the BMP owner or operator; and c) Track the transfer of O&M responsibility of the BMP to new ownership.

2. STORM WATER QUALITY MANAGEMENT

General Guidelines for Stormwater Reviews:

- 2.1 The City of Imlay City will perform site planning review on all development and re-development projects within the defined urbanized area and within the jurisdictional boundaries of the City that exceed one acre or less than one acre but part of a larger common plan of development or sale that would disturb 1 acre or more.
- 2.2 The design standards and guidelines of Imlay City are to be used for calculations determining allowable discharge rates and detention/retention volumes for water quality on development and re-development projects within the City and will be referenced in the review process.
- 2.3 If a site will be discharging into a MS4 under jurisdiction of the Michigan Department of Transportation (MDOT), the site must provide the City of Imlay City with the MDOT permit and subsequent calculations and plans for their files.
- 2.4 A completed checklist and storm water discharge permit application will accompany each submittal for review.
- 2.5 The proposed design will consist of treatment train of best management practices that will meet the water quality standards outlined in Section 1 above.
- 2.6 The review will also include a review of the site's Operation & Maintenance plan and it's signing by the owner / developer, with a copy for the owner/developer for implementation and a copy left with the city for documentation and follow up as needed.
- 2.7 All storm water designs will be sealed by a professional civil engineer or architect licensed to practice in the state of Michigan.
- 2.8 A site will be inspected by the City of Imlay City or their designee for compliance with the approved plans for the site, a written copy of the inspection will be kept on file for that site.
- 2.9 The City of Imlay City will utilize water quality standards on its municipal projects including linear projects (e.g. roads and paths) with an area of one acre or more. The BMPs used will not put the City into a position that it must purchase property or easements to implement. The standards will be incorporated to the maximum extent practicable.
- 2.10 Roof drains may be connected to a storm sewer system on the site, if the flow through the outlet to the City of Imlay City's MS4 is properly restricted. Unrestricted runoff from a roof drain will not be accepted, there are no exemptions. Also, roof drains and footing drains cannot connect to the sanitary sewer.
- 2.11 The developer, City Engineer and/or City DPW staff shall make a determination as to whether any or all of the facilities proposed are to become private or part of the City's MS4 or part of any other regulating agencies MS4 (e.g. MDOT or Lapeer County Drain Commissioner).
- 2.12 The City Engineer shall, in the case of a proposed subdivision, make a determination as to those control elevations that shall be entered on the final plat or make a determination as to the necessity for deed restrictions on any particular lot in said subdivision requiring the preservation of mandatory drainage facilities. Where a non-subdivided parcel of land

is proposed for development, the City Engineer shall make a determination as to the need for covenants to maintain responsibility for mandatory drainage facilities. All the said facilities shall be located in easements dedicated to the public and shall be subject to continual inspection during the construction period.

2.14 OTHER CONSIDERATIONS:

Requirements for all Detention/ Retention Areas

- a. Proposed storm water detention facilities shall be designed to detain the 10-year design storm runoff volume from the entire contributing area in excess of the allowable discharge from the site.
- b. The maximum design storage elevation in a detention area must be a minimum of one (1) foot below the lowest ground elevation adjacent to the detention area.
- c. The design maximum storage elevation in a detention area must not exceed a depth of nine (9) inches above any paved surfaced in non-residential developments. In residential developments the maximum ponding elevation in the detention pond shall not exceed the lowest rim elevation in the development.
- d. If parking lot detention is used the owner or lessee must be aware of this detention and sign a letter of understanding that the parking lot will flood during design storms and be flooded for periods of time. The area where detention will be in the parking lot must be marked as to let people using the parking lot understand it will flood during rain events. Also, parking lot detention cannot be for storage of first flush volume.
- e. The design maximum storage elevation in a detention area must not be closer than one (1) foot below the minimum finish floor elevation of the proposed structure(s) or existing facilities.
- f. An emergency overflow shall be provided at the detention basin to ensure the maximum ponding elevation does not exceed the depths outlined in items “d” and “e” above. This overflow shall be able to allow drainage from the site in the event the 10-year storm is exceeded, or the restricted outlet is obstructed.
- g. Designs of detention facilities shall incorporate safety features, particularly at inlets, outlets, on steep slopes, and at any attractive nuisances. These features may include, but not be limited to, landscaping, fencing, handrails, lighting, steps, grills, signs, and other protective or warning devices so as to restrict access as required by the City.
- h. Side slopes and the bottom of detention basins shall be top soiled, to a minimum of 3 inches, and seeded. Flow through detention basins must be sodded when constructed to decrease sediment transport and provide filtration capacity quickly for the basin.
- i. The side slopes and bottom of the basins shall be shaped with maximum slopes of 1 vertical to 4 horizontal to allow mowing of these surfaces. It will be preferred if side slopes are 1 vertical to 6 horizontal.

- j. Detention basins with bottom slopes less than 1% shall be underdrained.
- k. Detention basins shall be constructed with the top of banks a minimum of 5 feet from any pedestrian walkway (i.e. public and private sidewalks/ bike paths).
- l. If a “Wet” detention pond is proposed the bottom of the pond shall be a minimum of 5 feet below the proposed pond’s outlet elevation. Item “j” shall not apply to “Wet” detention facilities.
- m. Wet Detention basins must incorporate BMPs to insure they do not start harboring algae blooms, for example, a fountain to aerate the pond.

Rear Lot Drainage Requirements

- a. Rear lot drainage systems are not part of an MS4, they are not owned by the City of Imlay City, they are to be owned by the homeowners or condo association and must be entered into the covenant for a subdivision or condominium development.
- b. Minimum rear lot tile drain sizes and slopes have been determined assuming ponding will occur in rear yards for a duration 4 times the duration of a given 10-year design storm event. This time may range from 4 to 24 hours depending on drainage conditions. The following minimum pipe sizes and slopes apply:
 - i. Rear lot tile drains with contributing drainage areas up to 2 acres will have a minimum diameter of 6 inches and a minimum slope of 0.5 %.
 - ii. Rear lot tile drains with contributing drainage areas greater than 2 and less than 3 acres shall have a minimum diameter of 8 inches and a minimum slope of 0.4%.
- c. Rear lot tile drains with contributing drainage areas greater than 3 and less than 4 acres shall have a minimum diameter of 10 inches and a minimum slope of 0.32%.
- d. Rear lot tile drains with a contributing area greater than 4 acres shall be considered main line storm sewer and shall be designed according to corresponding storm sewer requirements (See design calculations section of this report). Calculations shall be submitted to verify that rear lot drains have the capacity to pass the 10-year design storm event. Plastic pipe is acceptable for rear lot drainage systems draining more than 4 acres provided it is installed in landscaped/ lawn areas.
- e. Rear lot tile drains cannot connect to road underdrains.
- f. Rear lot drainage tiles shall have a minimum cover of 2 feet. A minimum of four inches of sand bedding is required beneath the pipe and a minimum of 6 inches of sand backfill is required above the pipe.
- g. Rear lot catch basins shall have a minimum diameter of 2 feet. Plastic structures may be used for rear lot drainage systems. Concrete structures are required for storm sewer systems. The catch basins shall not be placed at spacing greater than 300 feet. Any bends, turns, or dead ends shall require a structure.
- h. If pipe is perforated, a manufacturer’s “Sock” may be used over the pipe but is not required.

- i. A 20-foot easement will be required for all rear lot drainage systems. This easement should be centered along lot lines to allow for a 10-foot easement along adjacent lots and to provide access to the rear lot drainage system from either adjacent property owners. Said easements shall be written as to permit neighboring property and/or condominium owners to maintain the rear lot drainage system as it may affect their property.
- j. Rear lot drainage shall be large enough to convey all contributing area to the rear lot system, including off site drainage if it is not diverted around the development.
- k. Existing rear lot drainage systems abutting a proposed development may be used for the new development provided:
 - i. The existing rear lot drainage system has the capacity to convey storm water runoff from the proposed rear lot drainage areas.
 - ii. A signed agreement is obtained from property owners located within the existing subdivision allowing the proposed subdivision's rear lot storm water runoff to pass through their existing system.
- l. Phased developments owned by the same proprietor may utilize proposed rear lot drainage for a current development phase on future phases of the development provided:
 - i. Covenants shall be recorded into the deeds of the property owners affected in the current phase allowing for future phases of the development to drain into the current phase's rear lot drainage system.
 - ii. If covenants are not made as outlined above, future phases will require separate rear lot drainage systems or agreements from the current landowners allowing for the use of their rear lot drainage system.
 - iii. The rear lot drainage system shall be constructed to convey rear lot drainage from both the existing and proposed rear lot drainage areas.
 - iv. Easements shall be provided allowing for maintenance by both abutting landowners in current and proposed phases of development.
- m. Rear lot drainage shall be shown on the preliminary plat (subdivisions) or site plan (condominiums).
- n. All rear lot drains shall connect to an approved storm water drainage system.

NOAA Atlas 14 Data



NOAA Atlas 14, Volume 8, Version 2
Location name: Imlay City, Michigan, USA*
Latitude: 43.03°, Longitude: -83.072°
Elevation: 823.58 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

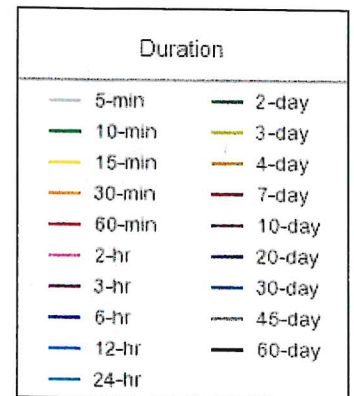
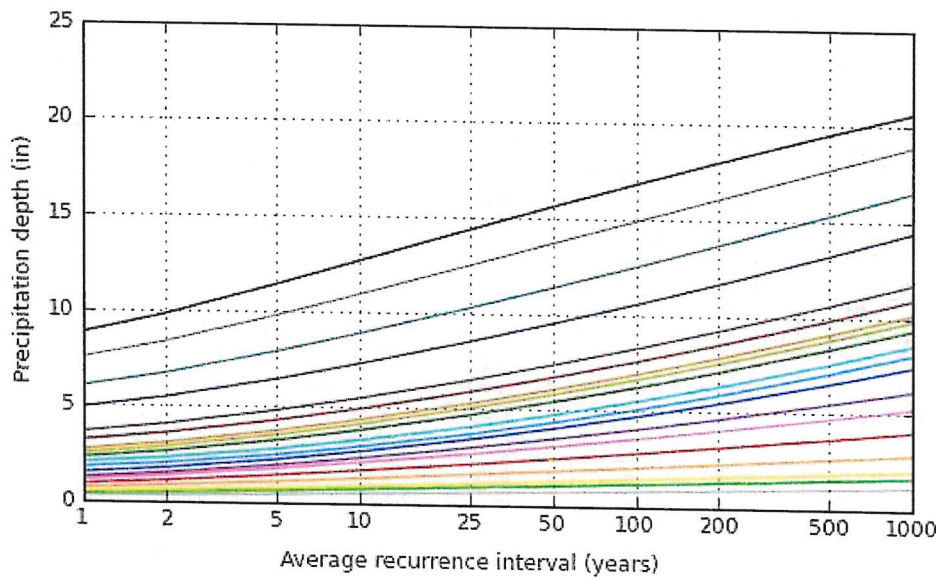
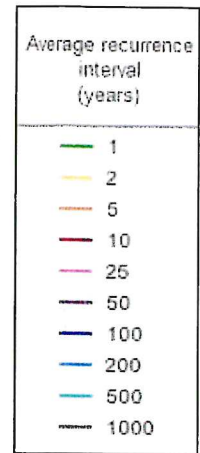
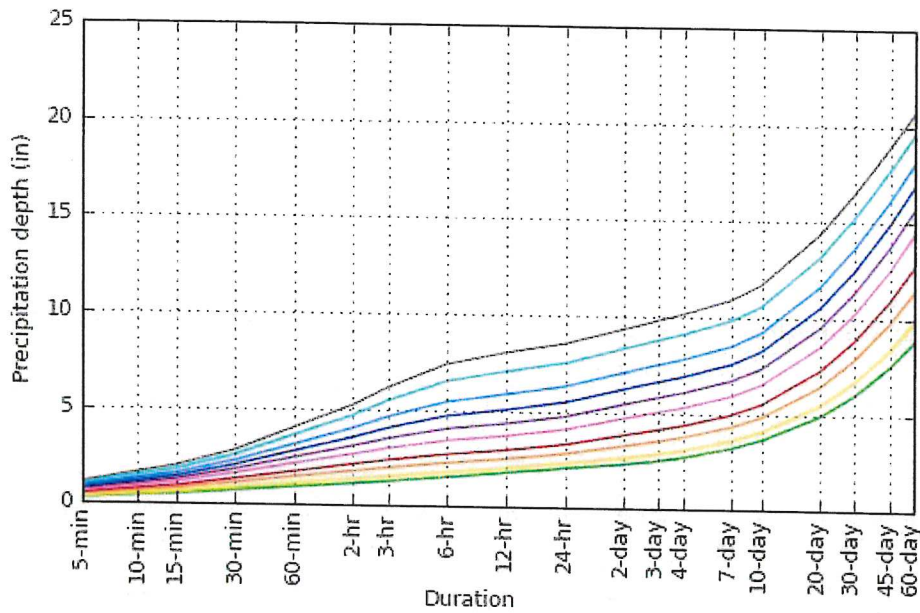
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.287 (0.226-0.373)	0.342 (0.268-0.444)	0.433 (0.339-0.564)	0.511 (0.398-0.667)	0.621 (0.468-0.831)	0.708 (0.520-0.955)	0.797 (0.565-1.09)	0.889 (0.604-1.24)	1.01 (0.662-1.44)	1.11 (0.706-1.59)
10-min	0.420 (0.330-0.546)	0.500 (0.393-0.650)	0.634 (0.497-0.826)	0.748 (0.583-0.977)	0.910 (0.685-1.22)	1.04 (0.762-1.40)	1.17 (0.828-1.60)	1.30 (0.885-1.82)	1.49 (0.970-2.11)	1.63 (1.03-2.33)
15-min	0.512 (0.403-0.666)	0.610 (0.479-0.793)	0.774 (0.606-1.01)	0.913 (0.710-1.19)	1.11 (0.835-1.48)	1.26 (0.929-1.71)	1.42 (1.01-1.95)	1.59 (1.08-2.22)	1.81 (1.18-2.57)	1.99 (1.26-2.84)
30-min	0.716 (0.563-0.930)	0.861 (0.676-1.12)	1.10 (0.862-1.43)	1.30 (1.01-1.70)	1.59 (1.19-2.12)	1.81 (1.33-2.43)	2.03 (1.44-2.78)	2.26 (1.54-3.15)	2.57 (1.68-3.65)	2.81 (1.79-4.03)
60-min	0.925 (0.728-1.20)	1.11 (0.875-1.45)	1.44 (1.12-1.87)	1.71 (1.33-2.24)	2.12 (1.60-2.85)	2.44 (1.80-3.31)	2.78 (1.98-3.82)	3.14 (2.13-4.39)	3.63 (2.37-5.17)	4.01 (2.55-5.75)
2-hr	1.13 (0.903-1.45)	1.37 (1.09-1.75)	1.77 (1.40-2.27)	2.13 (1.68-2.74)	2.65 (2.03-3.53)	3.08 (2.30-4.12)	3.53 (2.54-4.81)	4.01 (2.76-5.56)	4.68 (3.10-6.61)	5.22 (3.35-7.41)
3-hr	1.27 (1.02-1.61)	1.52 (1.22-1.93)	1.96 (1.56-2.50)	2.36 (1.88-3.02)	2.97 (2.30-3.95)	3.48 (2.62-4.65)	4.03 (2.92-5.46)	4.62 (3.21-6.38)	5.46 (3.64-7.68)	6.14 (3.96-8.66)
6-hr	1.52 (1.23-1.90)	1.77 (1.44-2.22)	2.25 (1.82-2.82)	2.70 (2.17-3.40)	3.41 (2.68-4.50)	4.02 (3.07-5.32)	4.69 (3.45-6.32)	5.44 (3.83-7.45)	6.51 (4.39-9.08)	7.39 (4.82-10.3)
12-hr	1.79 (1.47-2.21)	2.03 (1.67-2.51)	2.49 (2.04-3.09)	2.95 (2.40-3.66)	3.69 (2.95-4.81)	4.34 (3.36-5.68)	5.06 (3.77-6.74)	5.87 (4.18-7.96)	7.05 (4.81-9.75)	8.03 (5.29-11.1)
24-hr	2.05 (1.71-2.50)	2.31 (1.92-2.81)	2.81 (2.33-3.42)	3.29 (2.71-4.02)	4.06 (3.28-5.21)	4.73 (3.70-6.10)	5.48 (4.13-7.19)	6.31 (4.54-8.45)	7.53 (5.19-10.3)	8.53 (5.68-11.7)
2-day	2.31 (1.95-2.76)	2.64 (2.23-3.17)	3.25 (2.73-3.91)	3.82 (3.19-4.60)	4.68 (3.81-5.89)	5.42 (4.28-6.86)	6.21 (4.72-8.02)	7.08 (5.14-9.33)	8.32 (5.78-11.2)	9.33 (6.27-12.6)
3-day	2.51 (2.14-2.98)	2.88 (2.44-3.41)	3.53 (2.99-4.20)	4.13 (3.47-4.93)	5.03 (4.12-6.26)	5.80 (4.61-7.27)	6.62 (5.06-8.46)	7.51 (5.48-9.82)	8.78 (6.14-11.7)	9.81 (6.64-13.2)
4-day	2.70 (2.31-3.19)	3.07 (2.63-3.63)	3.74 (3.18-4.43)	4.35 (3.68-5.17)	5.28 (4.34-6.52)	6.06 (4.84-7.55)	6.89 (5.30-8.77)	7.80 (5.72-10.1)	9.09 (6.39-12.1)	10.1 (6.89-13.6)
7-day	3.20 (2.77-3.73)	3.59 (3.10-4.19)	4.29 (3.69-5.01)	4.93 (4.21-5.78)	5.89 (4.89-7.18)	6.70 (5.40-8.24)	7.56 (5.87-9.50)	8.50 (6.29-10.9)	9.83 (6.96-12.9)	10.9 (7.47-14.5)
10-day	3.64 (3.17-4.21)	4.07 (3.54-4.70)	4.81 (4.17-5.58)	5.49 (4.72-6.39)	6.50 (5.43-7.86)	7.35 (5.96-8.97)	8.25 (6.44-10.3)	9.22 (6.87-11.8)	10.6 (7.55-13.9)	11.7 (8.07-15.4)
20-day	4.91 (4.34-5.59)	5.48 (4.83-6.23)	6.44 (5.65-7.35)	7.29 (6.35-8.34)	8.51 (7.18-10.1)	9.51 (7.80-11.4)	10.6 (8.32-12.9)	11.7 (8.76-14.7)	13.2 (9.49-17.0)	14.4 (10.0-18.8)
30-day	6.03 (5.36-6.79)	6.72 (5.97-7.57)	7.88 (6.97-8.90)	8.86 (7.79-10.1)	10.3 (8.70-12.0)	11.4 (9.38-13.5)	12.5 (9.91-15.2)	13.7 (10.3-17.0)	15.3 (11.0-19.5)	16.5 (11.6-21.4)
45-day	7.50 (6.73-8.37)	8.36 (7.49-9.33)	9.76 (8.70-10.9)	10.9 (9.66-12.3)	12.5 (10.6-14.4)	13.7 (11.4-16.0)	14.9 (11.9-17.8)	16.1 (12.2-19.8)	17.7 (12.8-22.4)	18.9 (13.3-24.3)
60-day	8.81 (7.95-9.77)	9.81 (8.83-10.9)	11.4 (10.2-12.7)	12.7 (11.3-14.1)	14.4 (12.3-16.4)	15.6 (13.0-18.1)	16.8 (13.5-20.0)	18.0 (13.7-22.0)	19.5 (14.2-24.5)	20.6 (14.6-26.4)

¹ 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.

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PF graphical

PDS-based depth-duration-frequency (DDF) curves
 Latitude: 43.0300°, Longitude: -83.0720°



Maps & aeriels

Small scale terrain