

IMPLICATIONS OF PRECIPITATION CHANGES IN SOUTHEAST MICHIGAN AND OPTIONS FOR RESPONSE: A GUIDE FOR MUNICIPALITIES

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This fact sheet is part of a guide supporting decision makers and water resource managers as they adapt policies and practices in stormwater management in response to a changing climate.
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CHANGES TO KEY STORM DEFINITIONS AND IMPLICATIONS FOR DECISION MAKING

Across the region, patterns in precipitation have been changing. Historical records and projected trends indicate that these changes require modifications to the practice of stormwater management. Below is a review of what design storms are used to inform stormwater management and the degree to which these design storm definitions have changed in the new NOAA Atlas 14 analysis of precipitation data.

Bulletin 71 vs. NOAA Atlas 14

Design storm events are mathematical/statistical representation of precipitation events based on historical records. They are often described by the probability of occurring once within a given number of months or years. Technical Paper 40¹ and Bulletin 71² are two rainfall frequency data resources often used in the Midwest region of the US. Both resources utilized data published by the National Oceanic and Atmospheric Administration (NOAA) in 1992. The new Atlas 14 Volume 8³ was released by NOAA in April 2013 based on the most recent 30 years of precipitation data. Atlas 14 provides precipitation estimates for duration of 5-minutes through 60-days over recurrence intervals of 1-year through 1000 years. Compared to Bulletin 71, **Atlas 14 estimates are 3% to 35% higher across all recurrence intervals and durations, for the Ann Arbor area.** The increase is notably higher for shorter-duration less frequent storms.

Common Storm Definitions: How much has changed?

Certain storm event sizes are used for stormwater management regulations and infrastructure design. The following design storms are used to describe the level of service required for the stormwater drainage system (all figures are for the Ann Arbor area):

References

- 1. Hershfield, D.M., Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years, Technical Paper 40, U.S. Dept. of Commerce, Weather Bureau, Washington, D.C., May 1961.*
- 2. Huff and Angel, 1992. Rainfall Frequency Atlas of the Midwest (Bulletin 71). Illinois State Water Survey, Champaign, Illinois.*
- 3. Perica, et al. 2013. NOAA Atlas 14 Volume 8 Version 2, Precipitation-Frequency Atlas of the United States, Midwestern States. NOAA National Weather Service. Silver Spring, Maryland.*

First Flush (first 1" of runoff)	The delivery of a highly concentrated pollutant loading during the early stages of a storm, due to the washing effect of runoff on pollutants that have accumulated on the land. The EPA, MDEQ, and WCWRC now all define the first flush as the runoff from the first inch of precipitation. 85% of stormwater water quality pollutant loading occurs during the 1" and smaller rains, therefore infiltration of the first 1" of runoff can address pollutant loading. Storms with 1" or more rainfall are more frequent.
2-Year 24-Hour or "bankfull" (2.35" in Atlas 14, 2.26" in Bulletin 71, a 4% increase)	A condition where flow completely fills the stream channel to the top of the bank. In undisturbed watersheds, this occurs on average every 2 years and controls the shape and form of natural channels, more than any other event size over time. The bankfull storm is used to help design outlet restrictions for detention ponds in an effort to avoid having the increased runoff from development cause an increase in the frequency of the bankfull condition.
10 year (10%), 12-hr (2.91" in Atlas 14, 2.72" in Bulletin 71, a 7% increase)	This storm represents the typical level of service currently being provided by many communities for their storm drain designs. In other words most communities size new storm conveyance systems to carry the 10% 12-hour event without reaching full capacity. Storm conveyance systems are typically expected to be over capacity in storms larger or more intense than this.
100-Year 24-Hour (5.11" in Atlas 14, 4.36" in Bulletin 71, a 17% increase)	This storm significantly exceeds what is typically designed for in a stormwater drainage system, but it is used for FEMA flood insurance studies and it defines the floodplain boundary. Flood insurance is required when structures are located within the inundation zone of this storm event. This event is also used to size stormwater detention basins and outlet structures by Water Resource and Drain Commissioners.
500-Year 24-Hour (6.74" in Atlas 14)	This storm significantly exceeds what is typically designed for in a stormwater drainage system, but it is used for evaluation of stormwater systems as part of this analysis for FEMA flood insurance study. Critical Facilities typically may not be constructed in the inundation zone of this storm event.

Better Preparing Our Communities

Local, County, and State governments should adopt the 2013 NOAA Atlas 14, Volume 8 precipitation frequency estimates for stormwater management regulation, infrastructure design, and floodplain mapping. The estimates that most agencies are currently using is over 30 years old and is resulting in stormwater infrastructure being undersized. This increases property damage and cost when flooding occurs and means our floodplain areas may be underestimated. **Please note:** Adopting the new NOAA precipitation frequency estimates will only bring municipalities and counties up-to-date with weather observations, it will not take into account the increases due to climate change. Where possible, local governments should consider adding an additional margin of safety to infrastructure projects in anticipation of increasing annual rainfall and larger extreme events.

Examples

Washtenaw County Water Resources Commissioners Office has adopted new Stormwater Rules regulating stormwater management on new and redevelopment projects using NOAA Atlas 14 storm definitions. The City of Ann Arbor is reevaluating its floodplain map using a model that predicts inundation areas for the 100 year (17% increase) and 500 year (new event definition) events from Atlas 14 to identify new vulnerabilities.

Access to the data

NOAA has created a point-and-click website providing access to reports, data, and GIS and cartographic maps (<http://hdsc.nws.noaa.gov/hdsc/pfds>).