Rural Climate Dialogue

Public Infrastructure and a Changing Climate

Julie Kennedy
Grand Rapids City Engineer

May 15, 2015

GRAND RAPIDS
IT'S IN MINNESOTA'S NATURE

Challenges Associated with Public Infrastructure and a Changing Climate

Challenges Associated with Public Infrastructure and a Changing Climate

Challenges Associated with Public Infrastructure and a Changing Climate

Challenges Associated with Public Infrastructure and a Changing Climate

Challenges Associated with Public Infrastructure and a Changing Climate

The Big Challenge for Rural Infrastructure Engineers…

Designing projects that are resilient to a changing climate and also fiscally responsible.

It's a careful balance.

Challenge #1: Stormwater Design

MINNESOTA DEPARTMENT OF TRANSPORTATION
Engineering Services Division
Technical Memorandum No. 13-08-B-04
May 28, 2013

To: Electronic Distribution Recipients

From: Jon M. Chiglo, P.E.
Division Director, Engineering Services

Subject: Use of Atlas 14 Volume 8 Precipitation Frequency Estimates

Expiration
This is a new Technical Memorandum and shall remain in effect until May 28, 2018 unless superseded or included in the MnDOT Drainage Manual prior to that date.

Implementation
The guidelines contained in this Memorandum are effective immediately for trunk highway projects where feasible. Use the Atlas 14 precipitation data for hydraulic design on all trunk highway projects let after June 30, 2014.

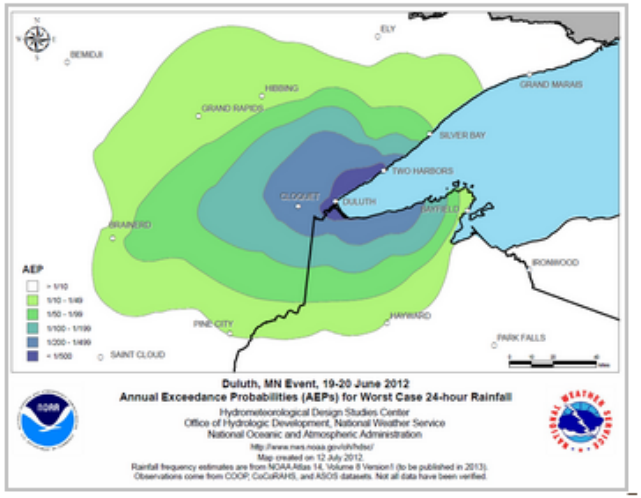
Local road authorities are encouraged to adopt these or similar guidelines.

Challenge #1: Stormwater Design

NOAA Atlas 14 - Precipitation Frequency Estimates

The National Weather Service Hydrometeorological Design Studies Center has released **NOAA Atlas 14, Volume 8**. The Atlas provides **precipitation frequency estimates** for many of the Midwestern states, including Minnesota. Analyses of the historical frequency of heavy rainfall events are of importance to engineers and others involved in designing and operating infrastructure such as culverts and stormwater runoff ponds.

NOAA Atlas 14 Precipitation Frequency Estimates for Minnesota



Click to enlarge

The information in NOAA Atlas 14, Volume 8 **supersedes** precipitation frequency estimates contained in these documents:

- **Technical Paper No. 40** (1961)
- **NWS HYDRO-35** (1977)
- **Technical Paper No. 49** (1964)

The new estimates are based on improvements in three primary areas: denser data networks with a greater period of record, the application of regional frequency analysis using L-moments for selecting and parameterizing probability distributions, and new techniques for spatial interpolation and mapping. See the **documentation** describing the station metadata, data, and project methodology used. Also, many questions are answered in the **Frequently Asked Questions about NOAA Atlas 14** section of the National Weather Service **Hydrometeorological Design Studies Center** web site.

NOAA Atlas 14, Volume 8 was funded in part by the State of Minnesota, including funds provided from the **Environment & Natural Resources Trust Fund**.

Challenge #1: Stormwater Design

Precipitation frequency analysis methods used in NOAA Atlas 14 volumes are based on the assumption of stationary climate. We test the assumption by applying various statistical tests to see if statistically significant trends are present in the annual maximum series (AMS) of observations used in our frequency analysis. So far, tests have shown very little observable or geographically consistent temporal change in these data and it is expected that traditional methods, assuming a stationary climate, will continue to be an important baseline for NOAA Atlas 14 precipitation frequency estimates. For more information see, for example, Appendix A.2 of Atlas 14 Volume 9 document.

There is considerable speculation as to whether these assumptions are appropriate. The published literature provides mixed results with authors from different disciplines examining different climatological aspects of precipitation. The FHWA has an interest in better understanding the potential impact of climate change on precipitation frequency estimates so that designers of future infrastructure will use appropriate design standards. As part of that effort, FHWA tasked HDSC with analyzing trends in depth-duration-frequency (DDF) precipitation magnitudes from NOAA Atlas 14 in a pilot project (as of this writing, still in progress) and to determine how HDSC findings compare to corresponding results obtained in the climate community. The pilot project will examine the viability of different approaches for use in a comprehensive analysis that can be performed for the entire U.S. to produce credible results which can be relied upon by Federal water agencies.

Recent local example of challenge: Stormwater Design

Stormwater treatment options for the north drainage area (8.01 acres) and middle drainage area (2.85 acres) are limited by site elevations and lack of right-of-way due to the linear nature of the project. Treatment of these two areas will be provided by overland flow through vegetated (grassed) swales prior to discharging to Prairie River (receiving water). The south drainage area (4.59 acres) will be completely retained onsite through the use of an infiltration basin. Project constraints do not allow for an outlet from

Infiltration Basin Design Requirement

Required Basin Volume = 4.25 af (to hold entire volume from 100 year back-to-back event)
Minimum Pond Elevation = 1267.0
Pre-treatment with sump manhole, grit chamber, saffle baffle, or other means, upstream of basin inlet.

Table 3: Basin Size (provided by project design staff)

Basin Elevation	Surface Area (acre)	Cumulative Storage (ac-ft)
1267	0.04	0.00
1270	0.08	0.18
1275	0.19	0.86
1280	0.34	2.18

Challenge…

…balancing the newly required 0.34 acre, 13’ deep pond at a cost of $25K for construction and the cost to acquire the additional land.

Opportunities to address the challenges and improve our quality of life

Increase the life of our capital investments – resulting in less money spent ☺

Reduce the operational disruptions – resulting in less daily headaches ☺

Actions to address the challenges or realize opportunities

What EPA Is Doing

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. The Green Infrastructure Initiative provides information on applications and approaches that can reduce, capture, and treat stormwater runoff at its source.

Low impact development is an approach to land development or redevelopment that works with nature to manage stormwater as close to its source as possible. Low impact development principles and practices allow water to be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed.

The NPDES Permit Writers Manual – Inclusion of Climate Change Considerations (PDF) (1 pp, 75K, About PDF) addresses the inclusion of climate change considerations as part of National Pollutant Discharge Eliminiation System (NPDES) permitting.

> DOT shall integrate consideration of climate impacts and adaptation into the planning, operations, policies, and programs of DOT in order to ensure that taxpayer resources are invested wisely and that transportation infrastructure, services and operations remain effective in current and future climate conditions.
>
> **Excerpt from DOT Policy Statement on Climate Adaptation**

- **Educate our public officials and our general public**
- **Continue watching the research / trends**

Community Member Actions

Get Educated

- local regulations
- latest research / trends
- consequences of policies

Get Creative

- green design ideas, new thermal pavements
- keep an open mind – different filters

Get Involved

- ask what you can do on your own property
- participate in decision making meetings

Thank you! ☺

Public Infrastructure and a Changing Climate

Julie Kennedy
Grand Rapids City Engineer

May 15, 2015

GRAND RAPIDS
IT'S IN MINNESOTA'S NATURE