What's in a Distribution?

A Comparison of Stormwater Ordinances

IAFSM Annual Conference, March 2023

Henry Schmitz, PE, CFM

CMT
Engineers and Consultants

Agenda

01

Background

- What is a rainfall distribution?
- Huff and SCS

02

Local Stormwater Ordinance Review

03

Analysis – Hypothetical Detention Ponds

CMT
Engineers and Consultants

How Design Storms are Defined

CMT
Engineers and Consultants

Common Rainfall Distributions

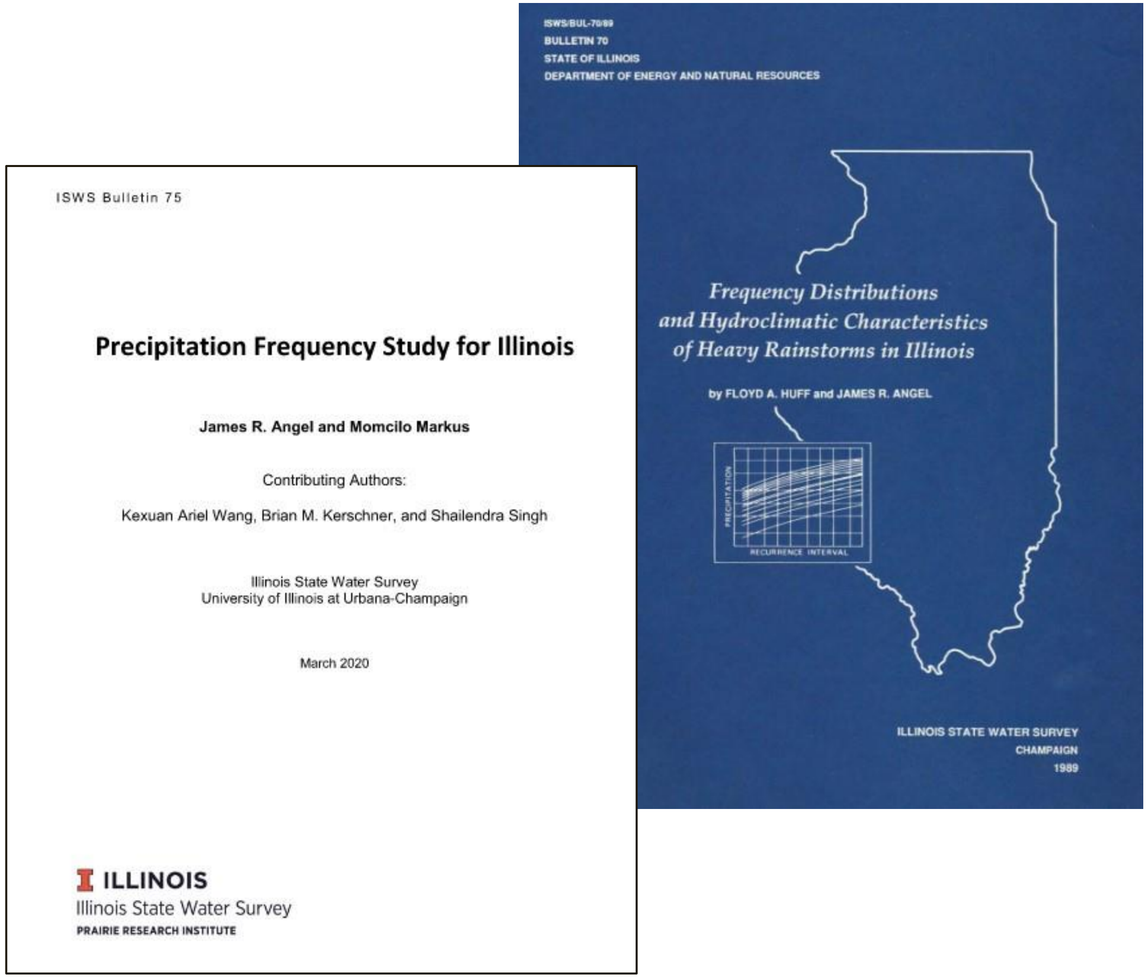
Huff Distributions (Floyd A. Huff)

- 1959 – Bulletin 46 / Comparison of several methods for rainfall frequency analysis (Huff & Neill)

- 1989-1992 – Bulletin 70 & 71 (Huff & Angel)

similar precipitation. The Illinois study was undertaken because earlier time distribution models, developed by the Soil Conservation Service (1972) and others, were not considered satisfactory for use in the Midwest's heavy rainstorms.

- 2020 – Bulletin 75 (Angel & Markus)



CMT
Engineers and Consultants

Huff Distributions

- Broken into quartiles
- Based on rainfall data from over 200 gauges across Illinois

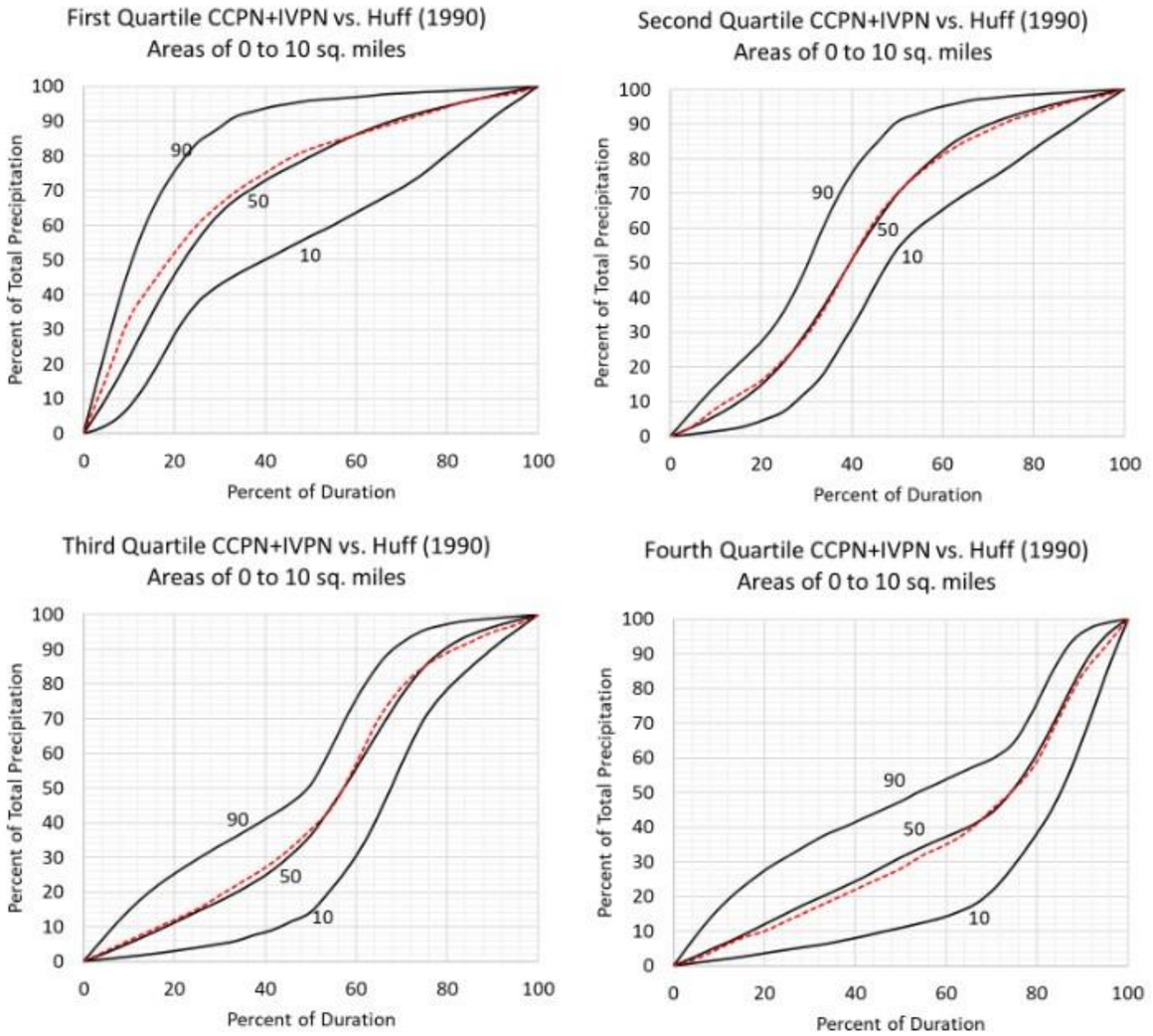


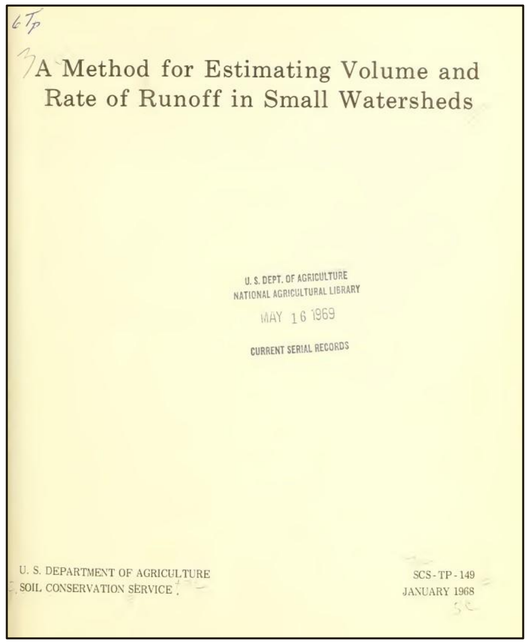
Figure 42. Curves for point (0 to 10 square miles) time distributions from all gages within the CCPN and IVPN compared to the median time distribution from Huff (1990), (red dashed line)

CMT Engineers and Consultants

Common Rainfall Distributions

SCS Type II Distribution

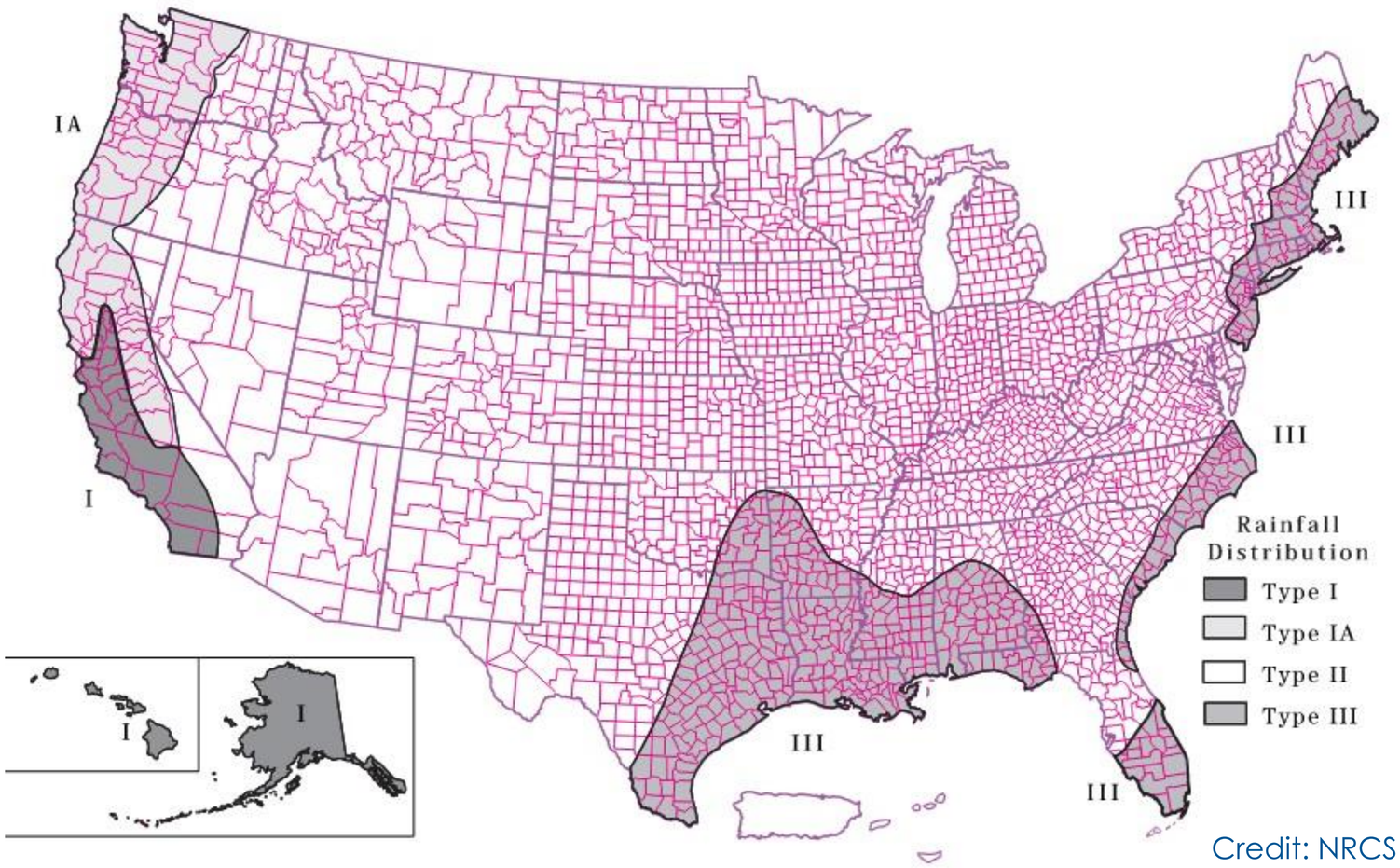
- 1968/1973
- 24-hour duration
- Nested Rainfall Intensities


A Method for Estimating Volume and Rate of Runoff in Small Watersheds

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY
MAY 16 1969
CURRENT SERIAL RECORDS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-TP-149
JANUARY 1968

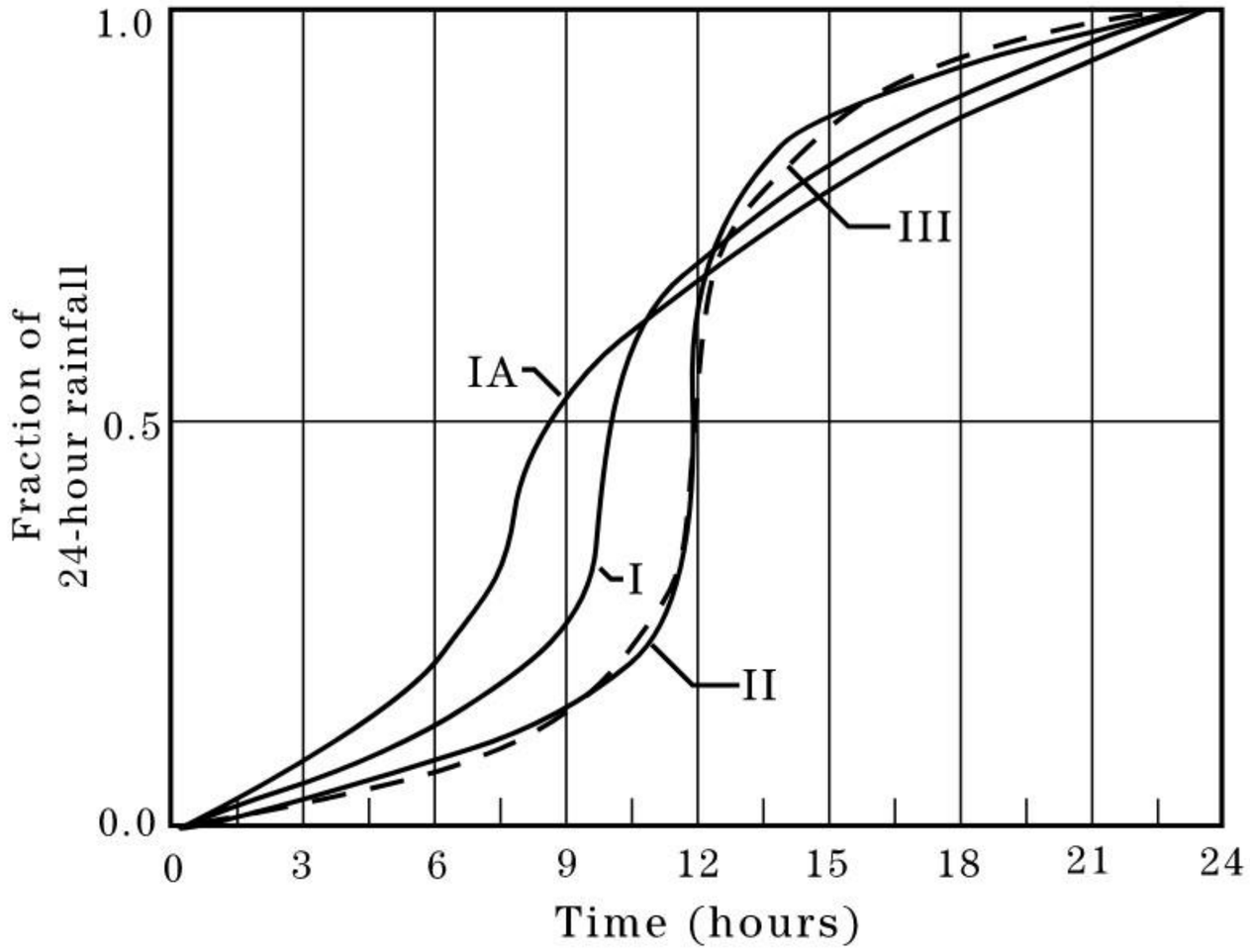


Credit: NRCS

CMT
Engineers and Consultants

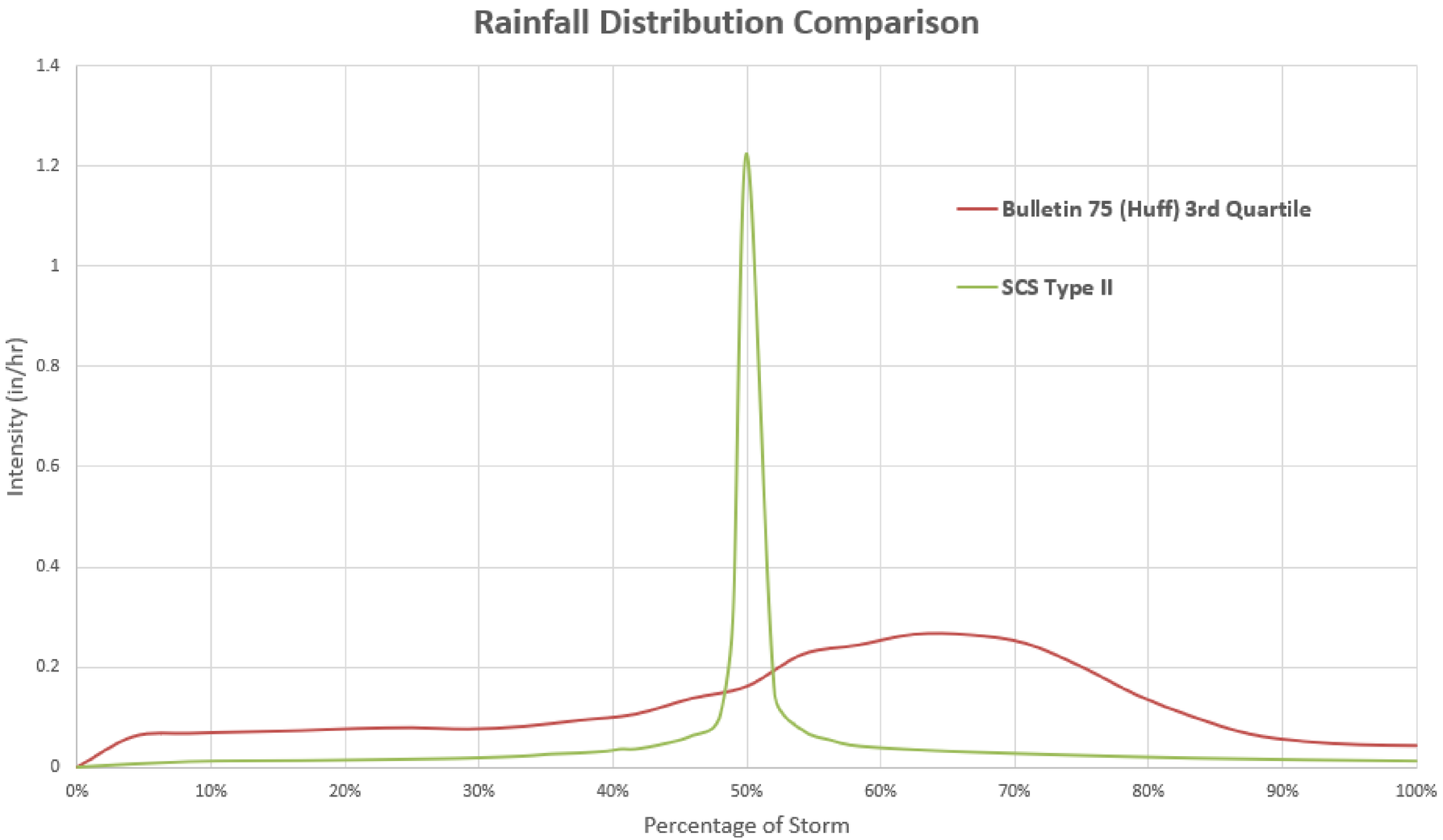
SCS Distribution

- Synthetic distribution to create peak discharge
- Not specific to Illinois



CMT
Engineers and Consultants

Comparing the Two

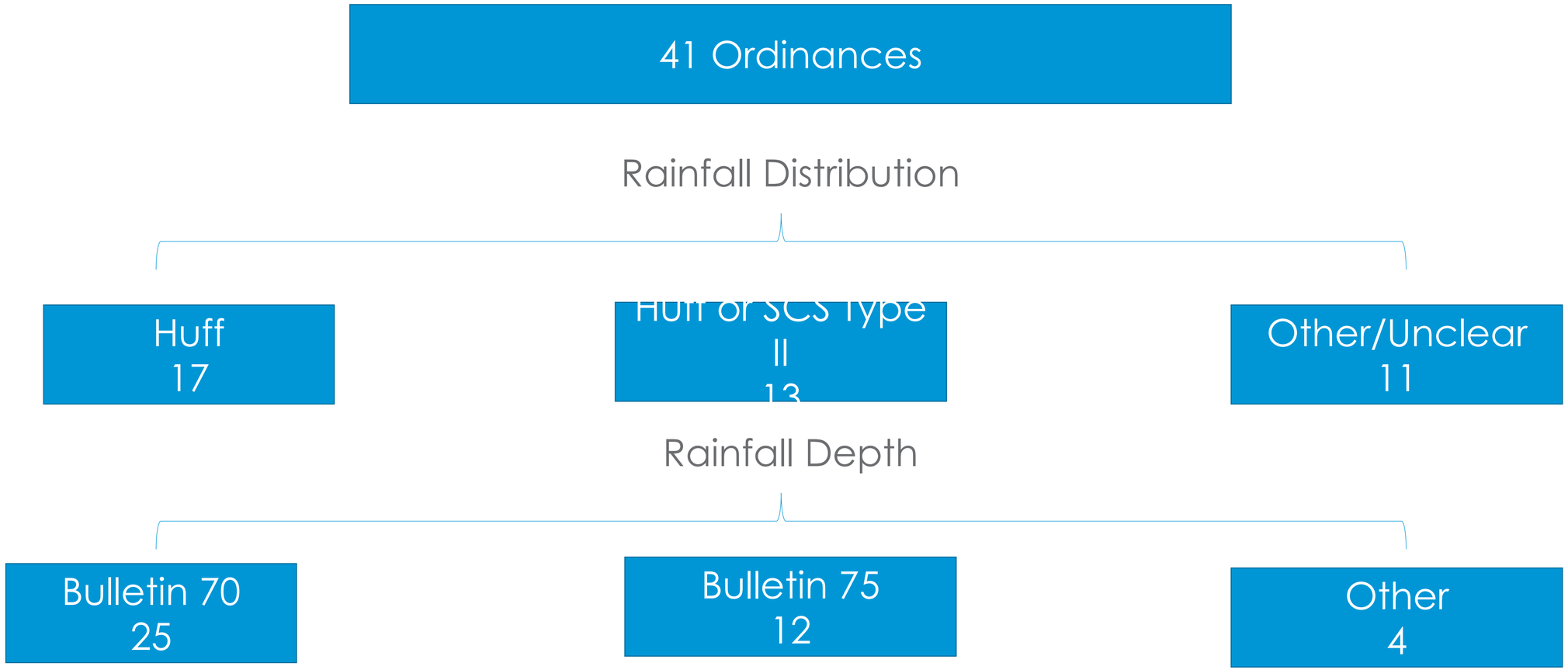


CMT
Engineers and Consultants

Walter, what’s the point?

CMT
Engineers and Consultants

Stormwater Ordinance Review



CMT
Engineers and Consultants

The Process

Existing Conditions

Proposed Conditions

- Two Different Ordinances

Compare Resulting Detention

CMT
Engineers and Consultants

Existing Conditions

Our Site

- 40 acres (1320’ x 1320’)
- SCS Curve Number = 70
- ToC = 18 minutes (1.2 ft/s)

CMT
Engineers and Consultants

Proposed Conditions

The Details

- 40 acres (1320’ x 1320’)
- SCS Curve Number = ~~70~~ 85
- ToC = ~~18 minutes (1.2 ft/s)~~

  = 15 minutes (1.5 ft/s)

CMT
Engineers and Consultants

Example Ordinance #1

“The drainage system for new developments or redevelopments shall be designed to control the peak rate of discharge from the total property under development for the two year, 24-hour, ten year, 24-hour, and one hundred year, 24-hour events to pre-project levels…”

”Huff or SCS Type 2 distribution”

“Bulletin 70 rainfall data must be used”

CMT
Engineers and Consultants

These Are Not Equal

Option 1:

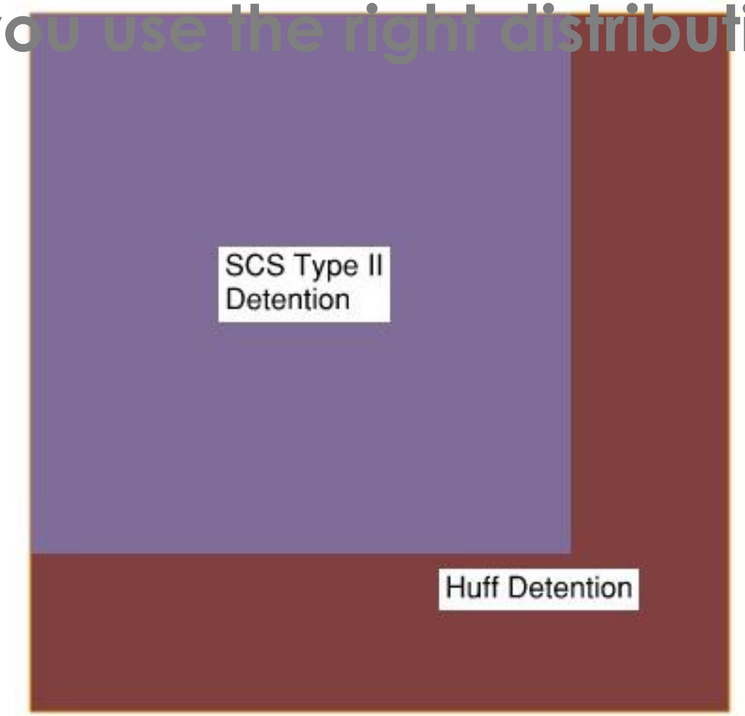
- Detention: 1.5 acres x 4-feet deep
- Outlet: Four 24" diameter orifices

Option 2:

- Detention: 2.5 acres x 4-feet deep
- Outlet: One 18" diameter orifice

But Both Meet Ordinance #1

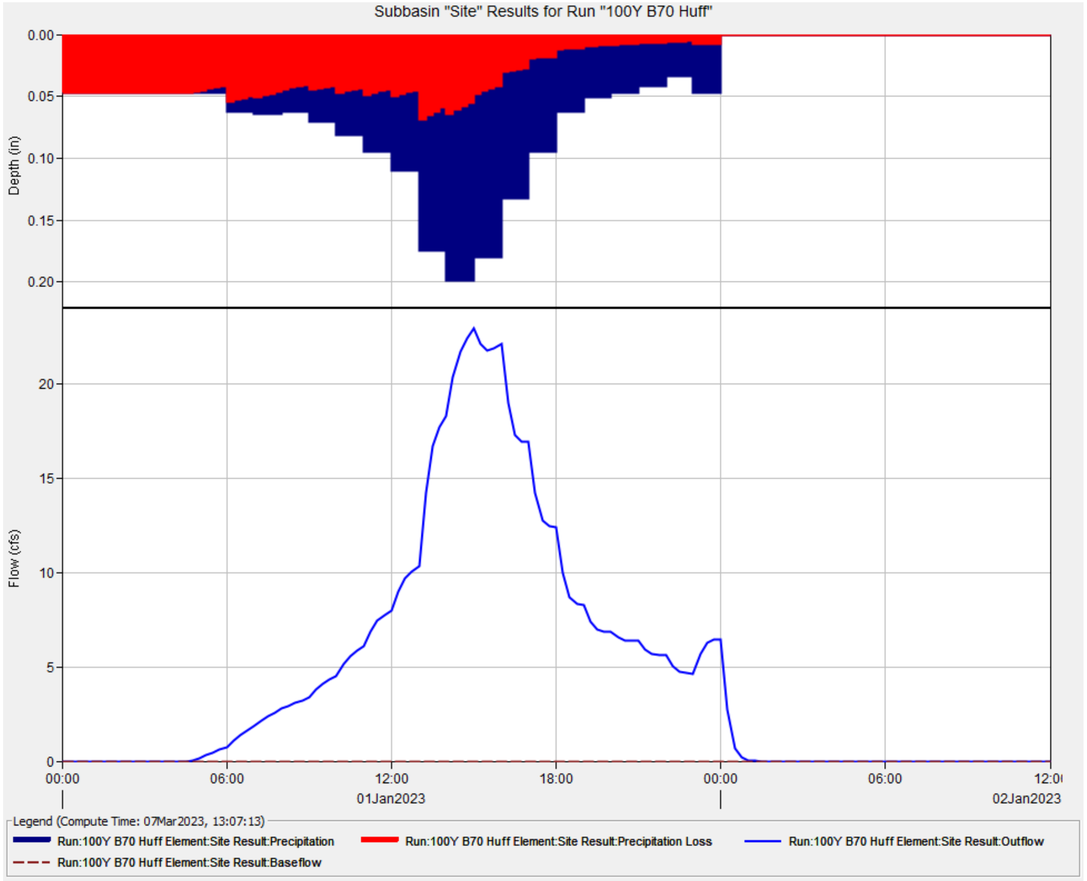
(If you use the right distribution)



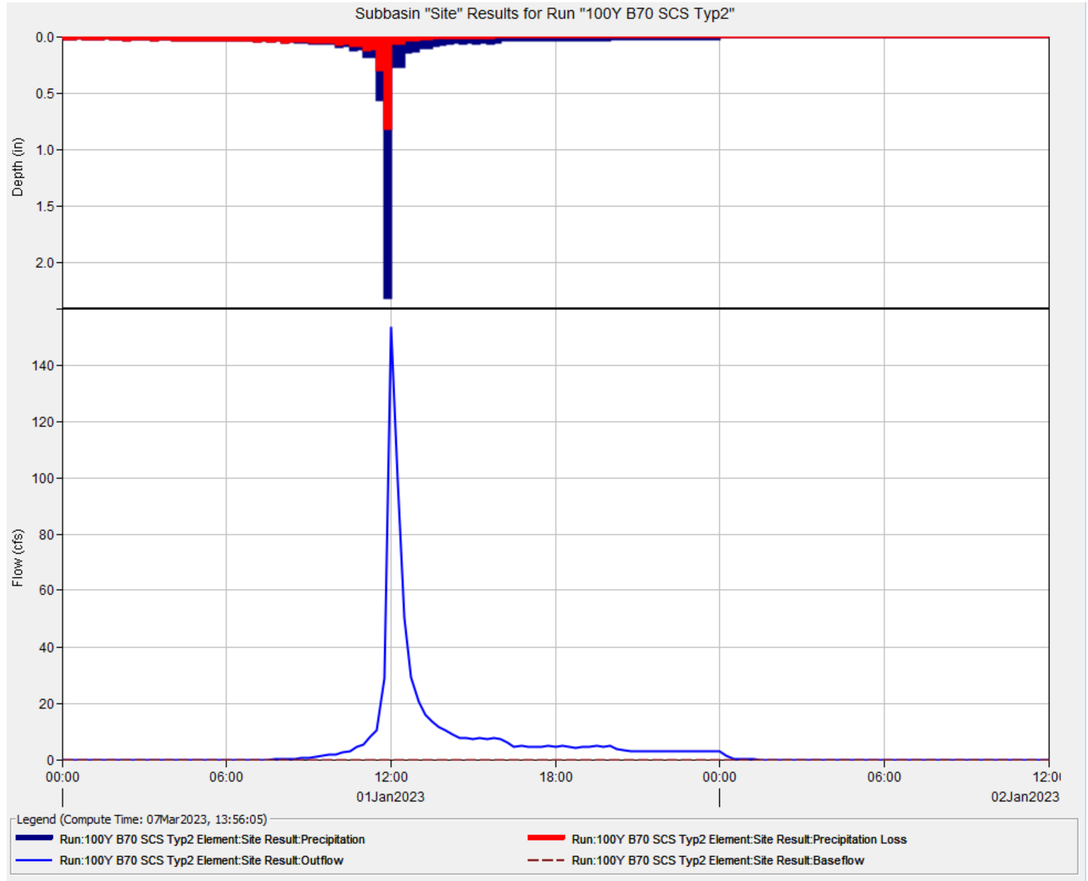
CMT
Engineers and Consultants

Setting the Bar

Existing Conditions



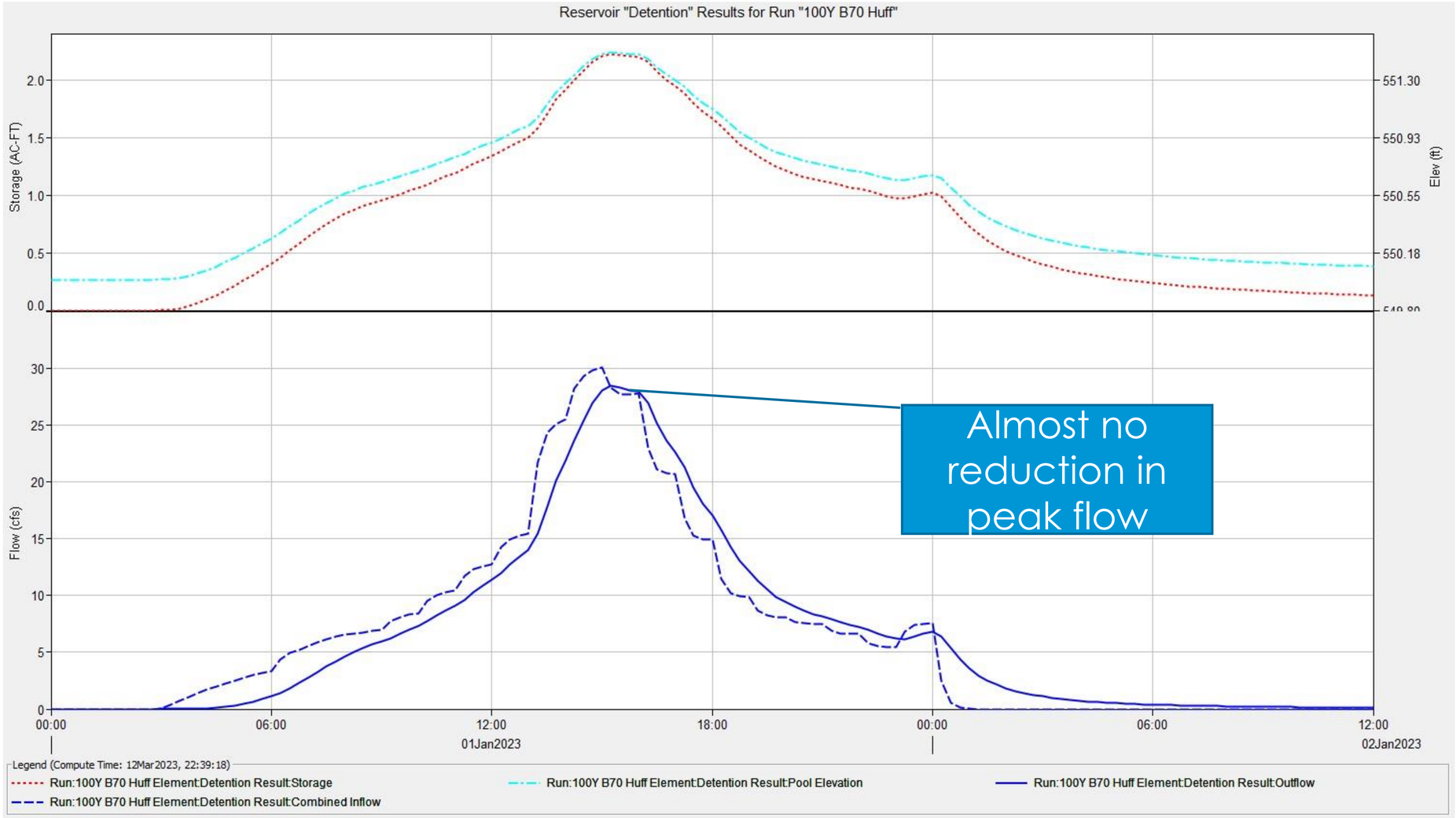
Allowable Release Rate = 22.9 cfs



Allowable Release Rate = 153.6 cfs

CMT Engineers and Consultants

SCS Pond, Huff Rain



CMT
Engineers and Consultants

Example Ordinance #2

"The peak discharge from events less than or equal to the two-year event shall not be greater than 0.04 cfs per acre of property drained. The peak 100-year discharge shall not be greater than 0.15 cfs per acre of property drained"

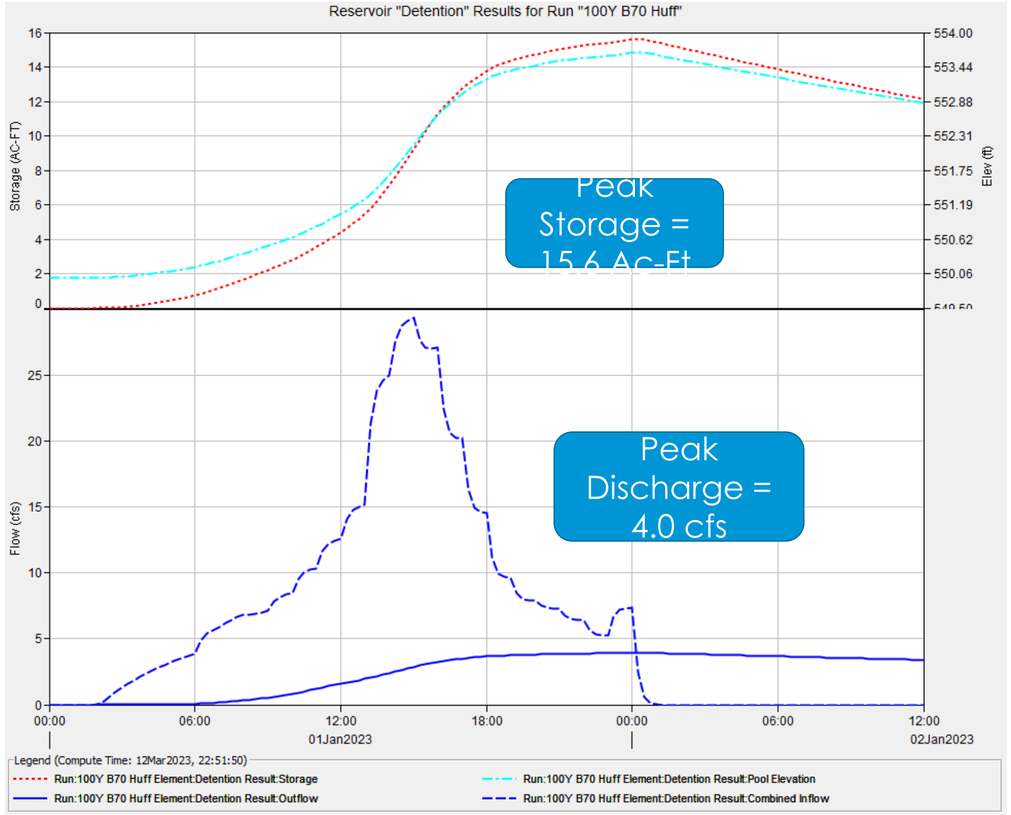
"…all design rainfall events shall be based on the Illinois State Water Survey's Bulletin 70."

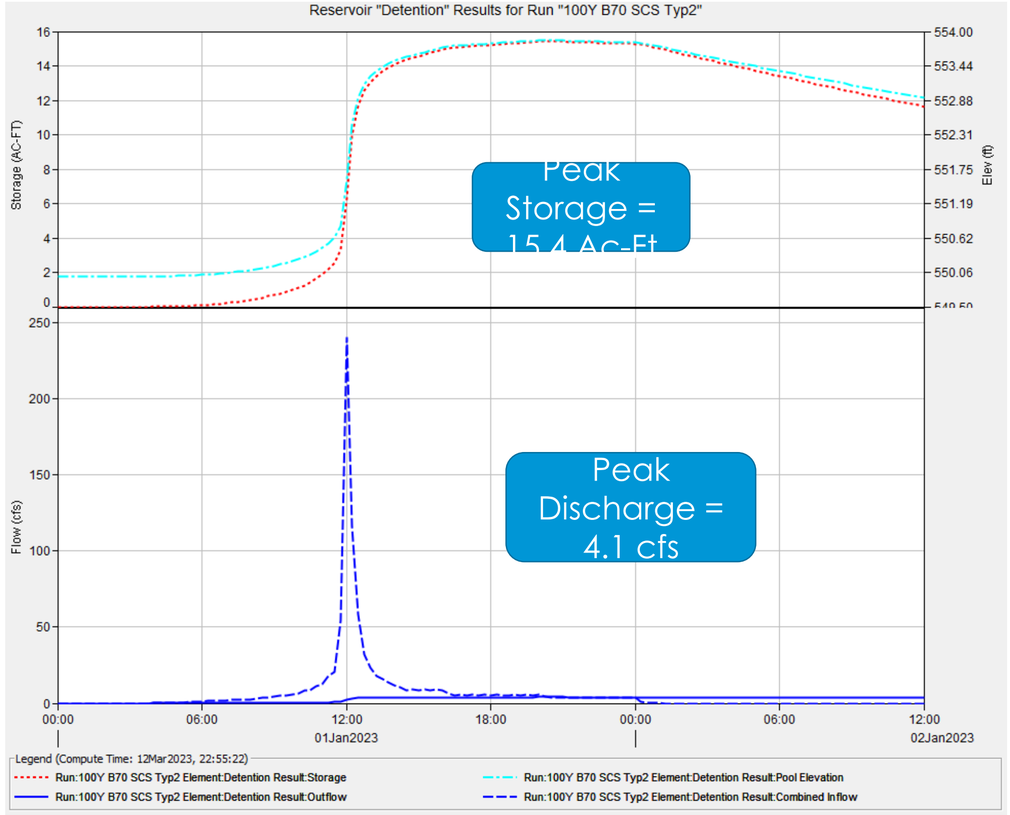
"The SCS Type II distribution may be used as an alternate to the Huff distributions."

Ordinance #2 results

Discharge limit brings consistency

- For 40 acres: 2-yr limit is 1.6 cfs, and the 100-yr limit is 6.0 cfs





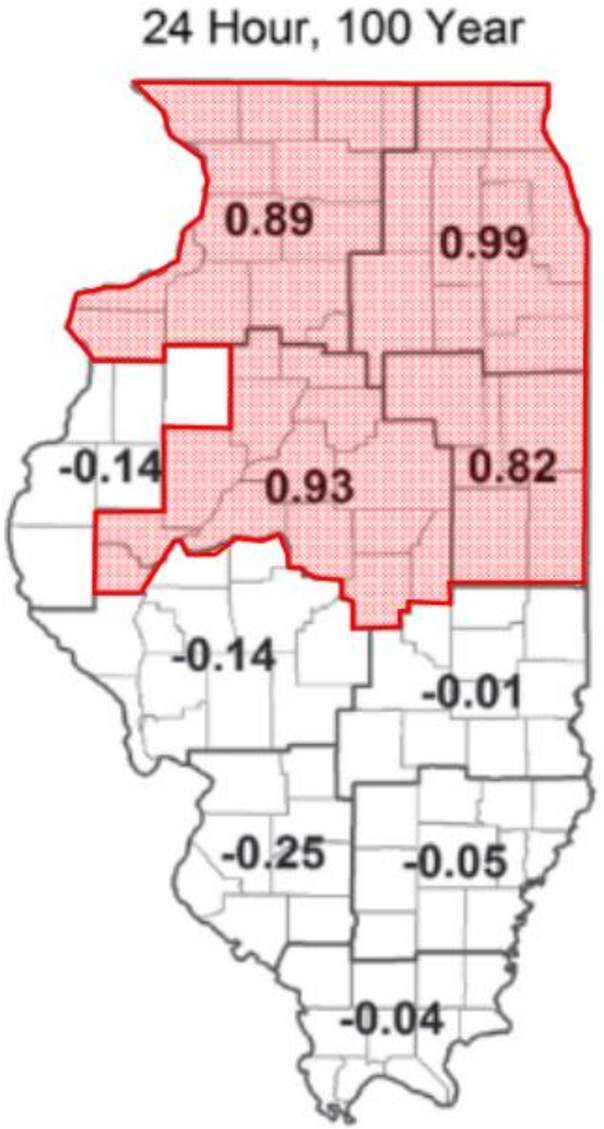
CMT Engineers and Consultants

Comparing the Results

Ordinance	Rain Distribution	Detention Volume, ac-ft	Outlet Size
Match Existing (#1)	Huff	10	One 18”
Match Existing (#1)	SCS Type II	6	Four 24”
Discharge Limit (#2)	Huff	17	One 9”
Discharge Limit (#2)	SCS Type II	16	One 9”

Parting Thoughts

- Consider adding cfs/acre limit
- If not, at least remove “or SCS Type II”
- Update to Bulletin 75



CMT
Engineers and Consultants

Thank you!

Questions?

CMT
Engineers and Consultants