NOAA Atlas 15: National Precipitation Frequency Standard Update

Janel Hanrahan

RTI International, Center for Water Resources

OFFICE OF WATER PREDICTION

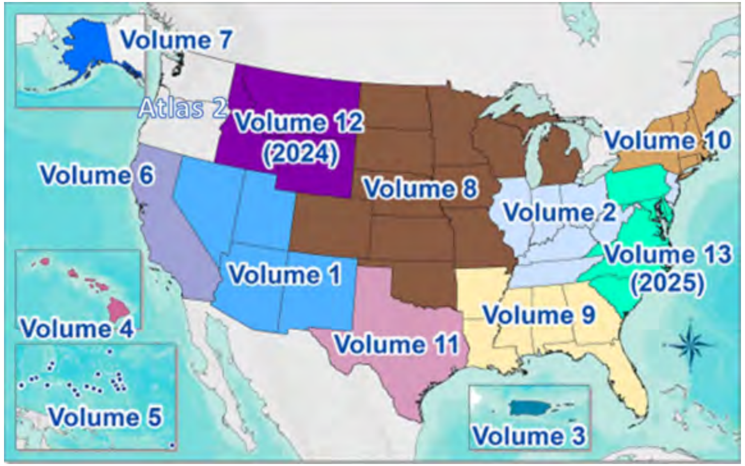
Overview

1. What is NOAA Atlas 15?
2. Extreme precipitation time series database
3. Volume 1 framework
4. Volume 2 framework

Towards Updated Precipitation Frequency Estimates

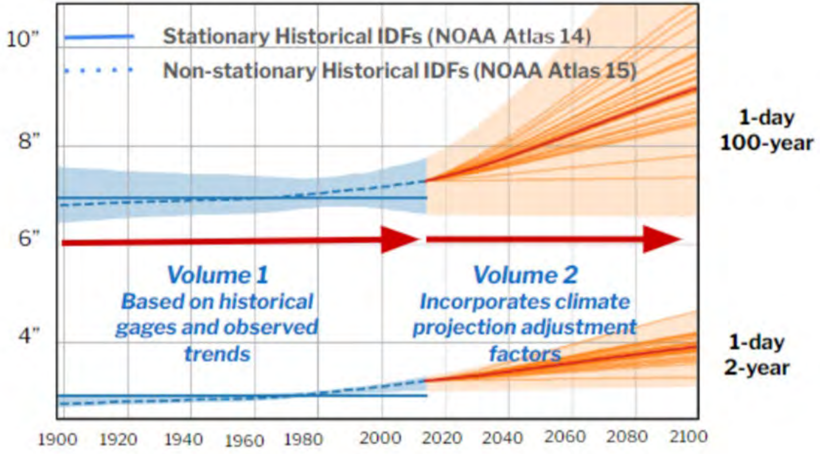
NOAA Atlas 14

- Authoritative precipitation frequency (PF) estimates
- Published in regional volumes
- Assumes climate stationarity
- Present-day PF estimates
- Estimates currently available at hdsc.nws.noaa.gov/pfds/



NOAA Atlas 15

- Updated national precipitation frequency standard
- Seamless estimates across CONUS
- Accounts for climate nonstationarity
- Present-day (Vol 1) and future (Vol 2) PF estimates
- Preliminary CONUS-wide estimates will be available soon



NOAA Atlas 15 Road Map: CONUS & OCONUS

2022/2023

- **Jan 2023** - Hosted technical workshop with federal partners.
- **July 2023** - Initiated dataset development.

2024

- **Development** - Evolve framework. Create quality controlled national precipitation database. Evaluate climate model projections
- **Aug 2024** - Hosted technical workshop with federal partners.
- **Sept 2024 Pilot** - Deliver Atlas 15 Vol. 1 and Vol. 2 pilot over Montana.

2025

- **CONUS** - Publish preliminary data

Initiate 60-day peer review for Atlas 15 Vol. 1 and Vol. 2 for CONUS (lower 48 states).

Collect feedback and adjudicate comments on product.

2026

- **CONUS** - Complete Atlas 15 Vol. 1 and Vol. 2 and publish final estimates, documentation and supplementary products to stakeholders.

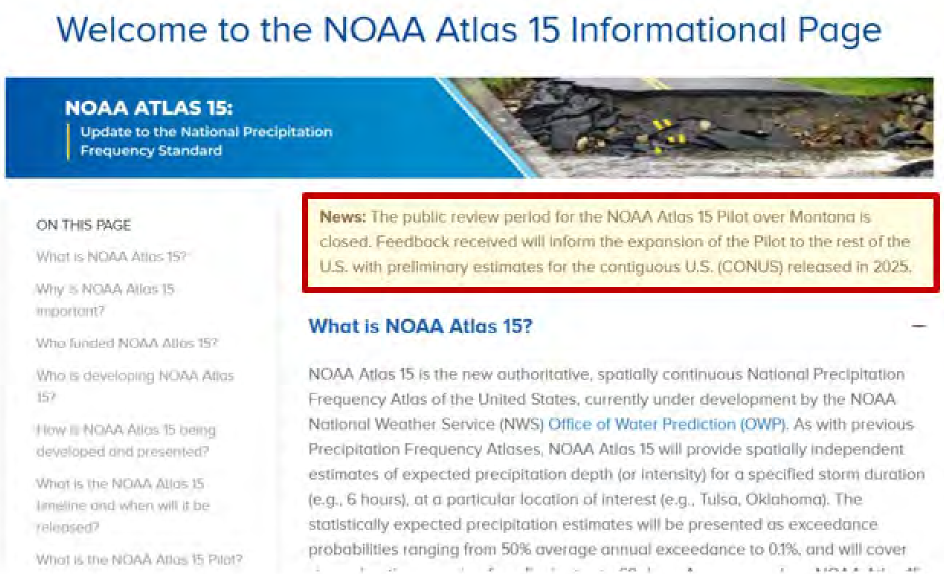
- **oCONUS** - Publish preliminary estimates.

Initiate peer review for oCONUS (e.g. Hawaii, Alaska, Puerto Rico, U.S. Virgin Islands, Guam).

2027

- **oCONUS** - Complete Atlas 15 Vol. 1 and Vol. 2 and publish final estimates, documentation and supplementary products to stakeholders.

NOAA Atlas 15 - Pilot released in 2024


Welcome to the NOAA Atlas 15 Informational Page

NOAA ATLAS 15:
Update to the National Precipitation Frequency Standard

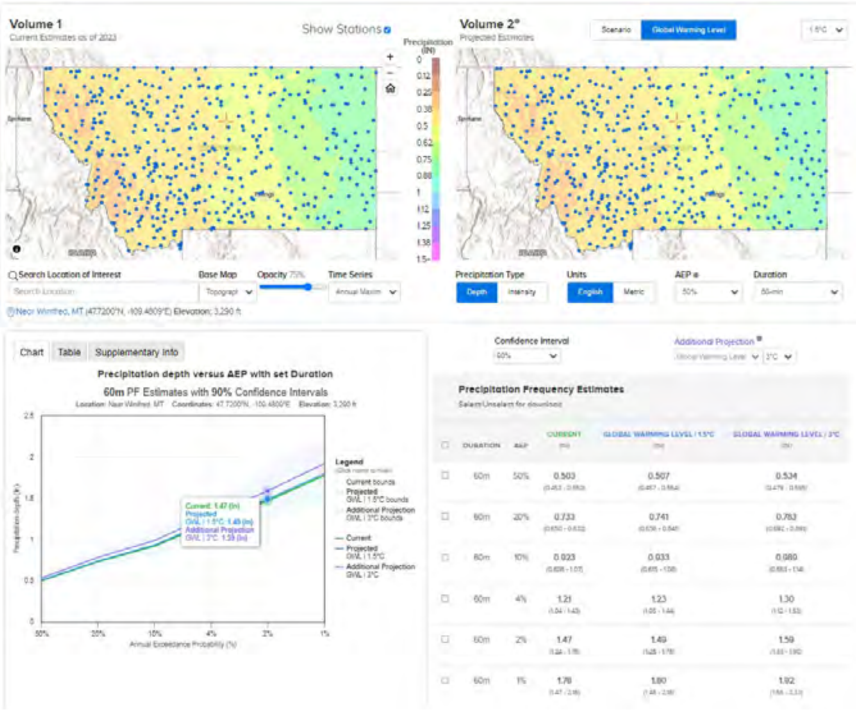
ON THIS PAGE

What is NOAA Atlas 15?
Why is NOAA Atlas 15 important?
Who funded NOAA Atlas 15?
Who is developing NOAA Atlas 15?
How is NOAA Atlas 15 being developed and presented?
What is the NOAA Atlas 15 timeline and when will it be released?
What is the NOAA Atlas 15 Pilot?

News: The public review period for the NOAA Atlas 15 Pilot over Montana is closed. Feedback received will inform the expansion of the Pilot to the rest of the U.S. with preliminary estimates for the contiguous U.S. (CONUS) released in 2025.

What is NOAA Atlas 15?

NOAA Atlas 15 is the new authoritative, spatially continuous National Precipitation Frequency Atlas of the United States, currently under development by the NOAA National Weather Service (NWS) Office of Water Prediction (OWP). As with previous Precipitation Frequency Atlases, NOAA Atlas 15 will provide spatially independent estimates of expected precipitation depth (or intensity) for a specified storm duration (e.g., 6 hours), at a particular location of interest (e.g., Tulsa, Oklahoma). The statistically expected precipitation estimates will be presented as exceedance probabilities ranging from 50% average annual exceedance to 0.1%, and will cover



Montana Pilot public review included:

- Visualization Page
- Quick Start Video
- Pilot Technical Report
- Feedback Google Form

The public-review period for the pilot is now closed.

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Atlas 15 preliminary estimates for CONUS (2025)

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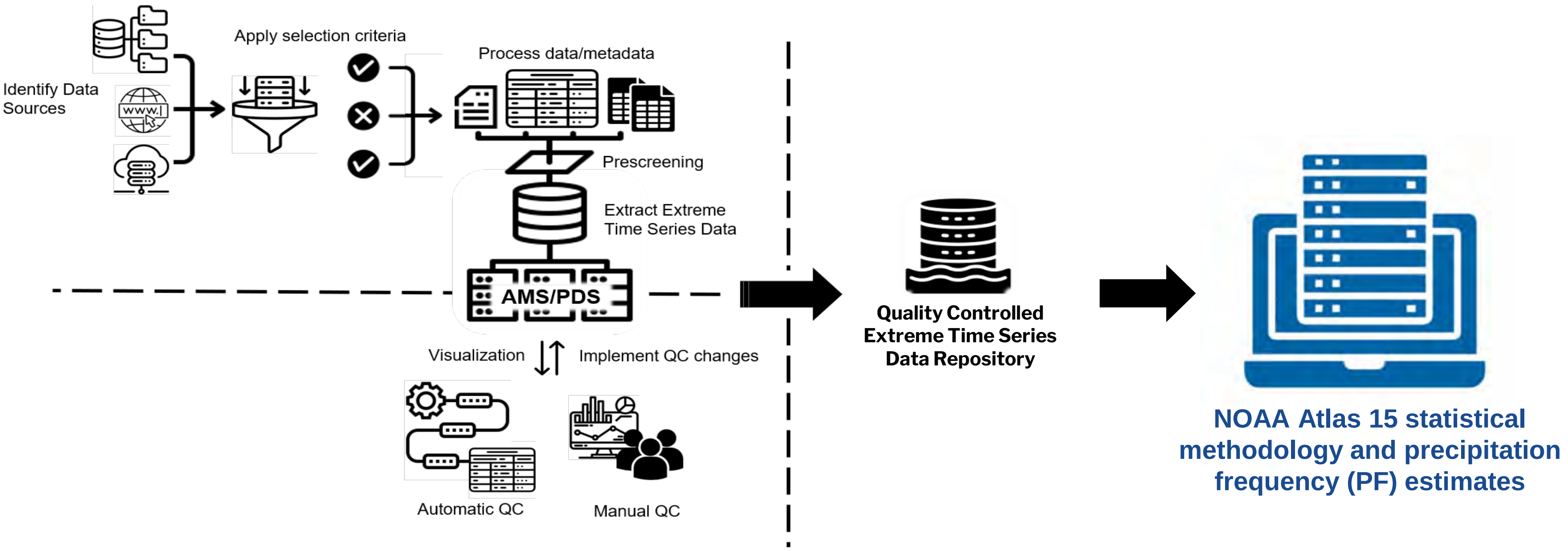
A15 Volume 1 - Extreme precipitation time series data repository



A15 Volume 1 - Data repository

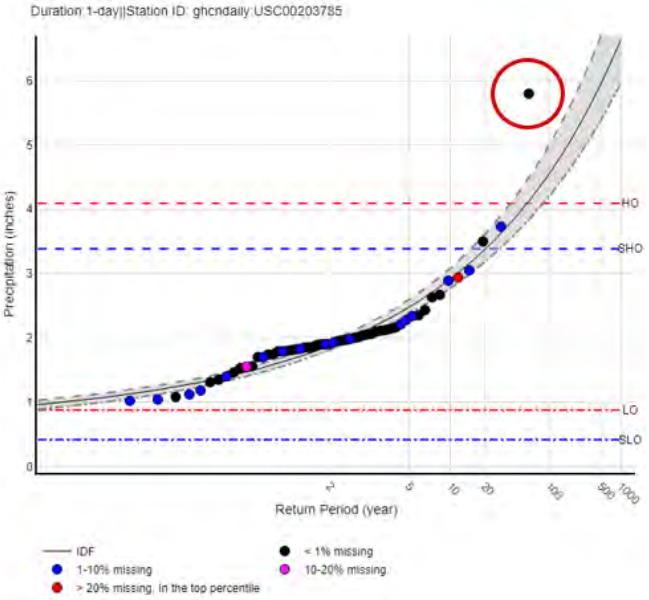
- 78 total datasets collected and formatted (~120K stations)
- Review of additional CONUS datasets will be informed by public feedback
- Data discovery and collection is underway for oCONUS

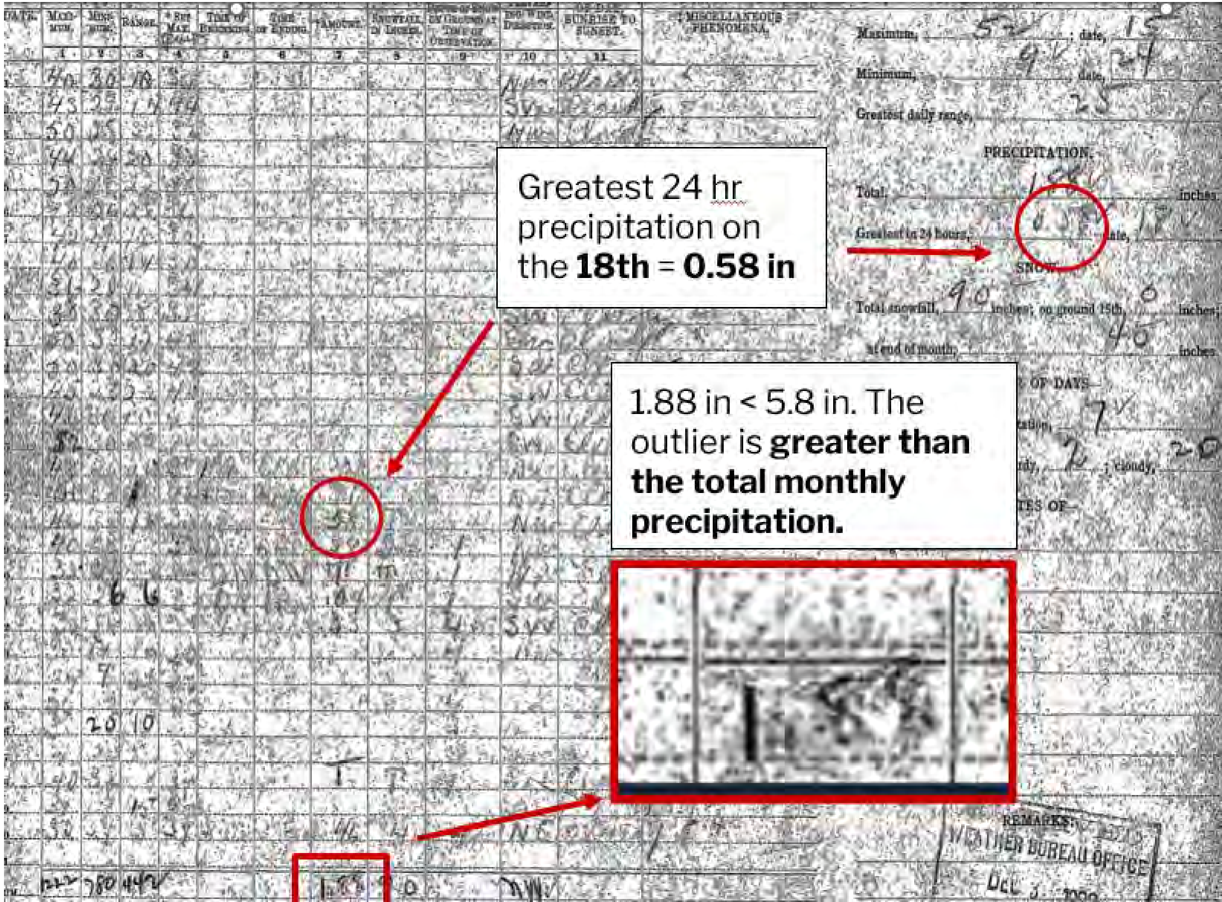
	DAILY		HOURLY		SUBHOURLY	
	dset	Status	dset	Status	dset	Status
PRIORITY LEVEL I	eccc_daily		eccc_hourly		ncei_asos_1min	
	forts		ncei_coop_hourly		ncei_coop_15min	
	ghcndaily		ncei_dsi3240		ncei_dsi3260	
	ntn		ncei_lcd		ncei_uscrn_subhourly	
	scan_daily		ncei_uscrn_hourly		swmp	UPDATED
	smn		raws			
	snotel		scan_hourly			
			snotel_hourly			
PRIORITY LEVEL II	agrimet_daily	UNDER REVIEW	agrimet_hourly	UNDER REVIEW	chili	
	awdn	UNDER REVIEW	azmet_hourly		coa_15min	
	azmet_daily		cimis_hourly		coagmet_5min	UNDER REVIEW
	cdec_daily	UNDER REVIEW	coa_hourly		fawn_15min	
	cemp_daily		coagmet_hourly		kstate_5min	UNDER REVIEW
	cimis_daily		kstate_hourly	UNDER REVIEW	lcra_15min	
	coagmet_daily		lcra_hourly		njwxnet_5min	
	kstate_daily	UNDER REVIEW	ndawn		okmesonet_5min	
	mngage		nevcan	UPDATED	sfwmd_15min	UPDATED
	ndswc		njwxnet_hourly			
	okmesonet		tva_hourly	UPDATED		
	sfwmd_daily	UPDATED				
	tva	UPDATED				
PRIORITY LEVEL III	ca_alameda_daily	UPDATED	agwxnet_hourly		arl_sord	
	ca_la_daily		nc_econet_hourly	UPDATED	az_alert	
	ca_santa_barbara_daily	UPDATED	nycdep_hourly		ca_marin_1min	
	ca_santa_clara_daily		rcew		ca_san_diego_1min	
	ca_ventura_daily				deos	
	catskill				dugway	
	madcr				hcfcd_5min	
	nycdep_daily				inl	
	ca_san_luis_obispo	NEW			nc_econet	
					nwfwmd_5min	
					ug_aemn	

Submit data questions to *atlas15.info@noaa.gov*
attn: Lynne Trabachino

A15 Volume 1 - AMS QC

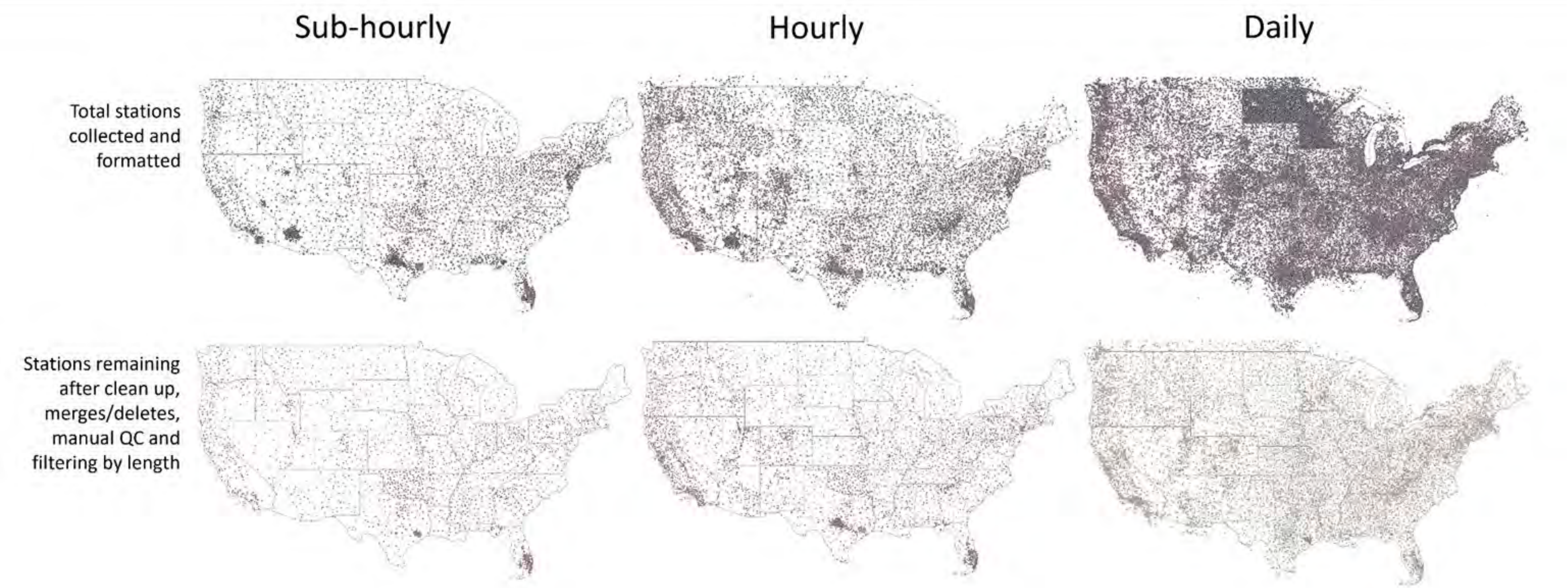
GHCN-Daily Station: Higgins Lake, MI
AMS High Outlier: 5.8 in
Date of Outlier: 11-18-1928





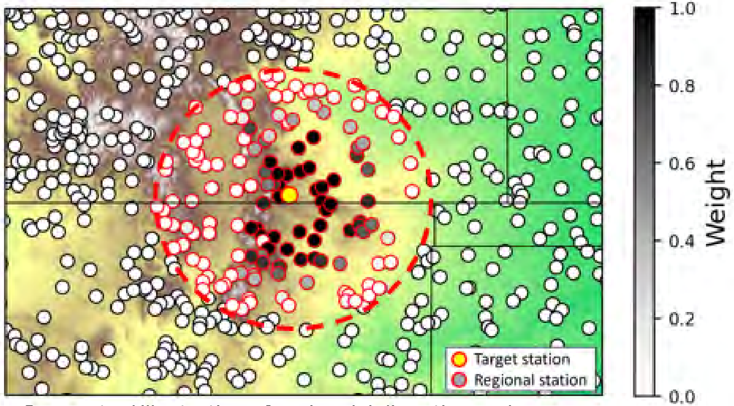
A15 Volume 1 - Data repository

- Extreme time series repository is under development for Atlas 15
- Station data are screened, aggregated temporally, grouped spatially, and merged
- 8,800+ hourly stations and 23,200+ daily stations included in latest repository

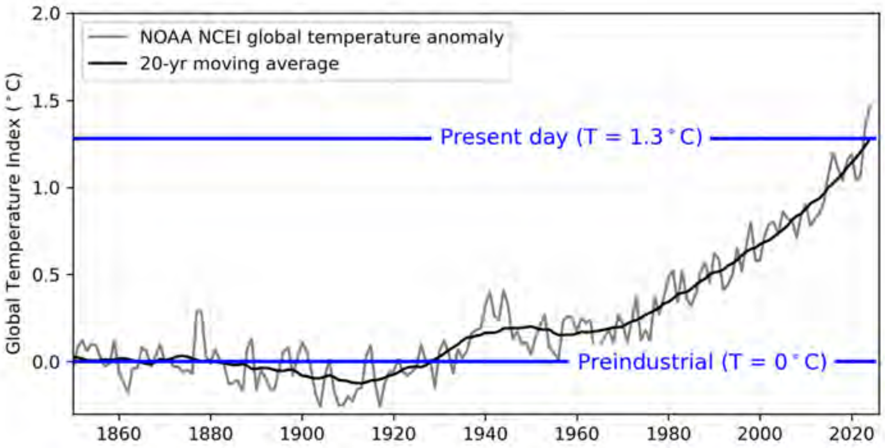


A15 Volume 1 - Framework

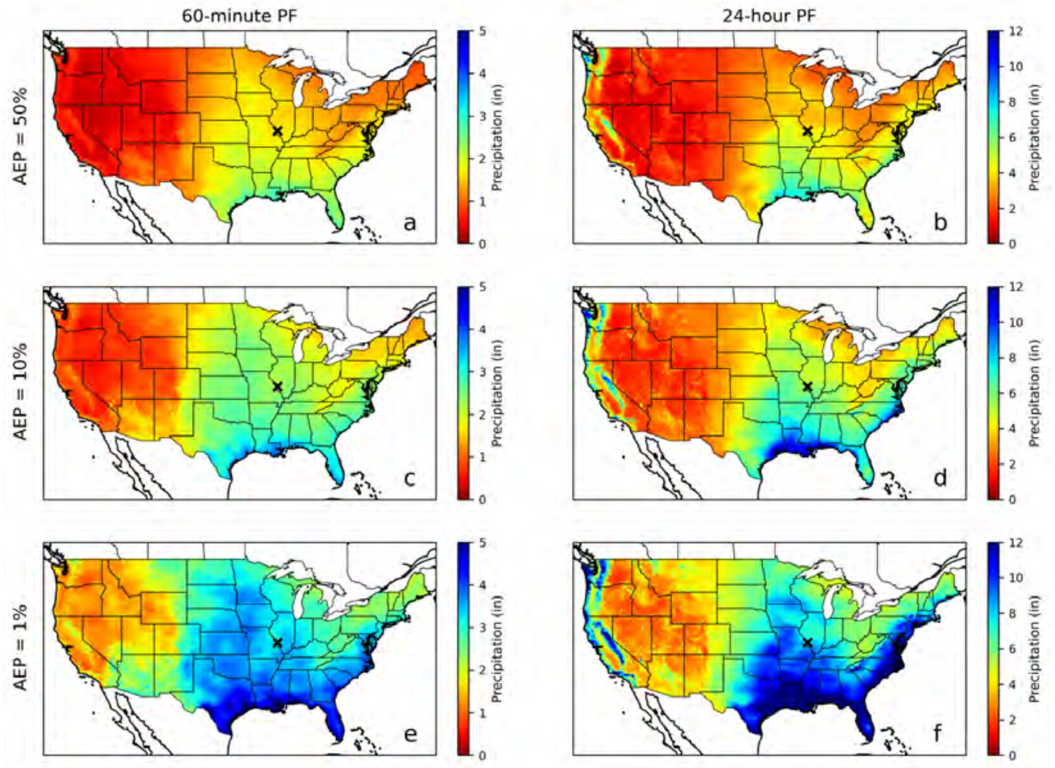
- Regional station data weighted based on geographical and meteorological characteristics
- GEV parameters determined via MLE, with location and scale parameters dependent on:
  - Spatial covariate: Mean annual maximum precipitation (MAM)
  - Temporal covariate: Global temperature index (GTI)
- Precipitation frequency (PF) estimates generated at each station location from the GEV, then spatially interpolated



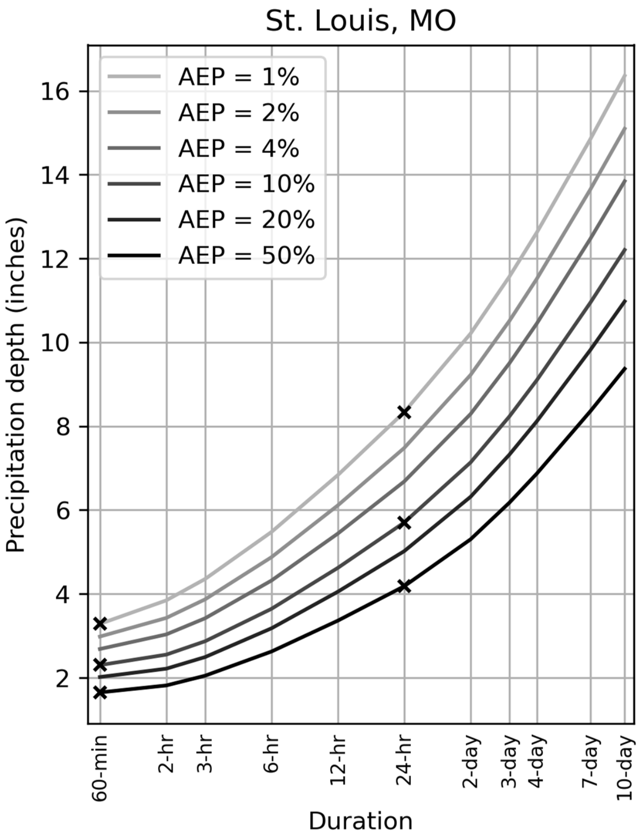
Conceptual illustration of regional delineation and weighting at daily duration for a station in Colorado



A15 Volume 1 - Preliminary CONUS estimates

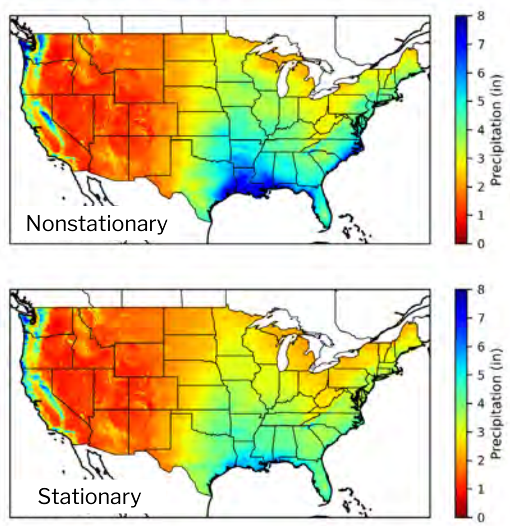


60-min and 24-hr PF estimates

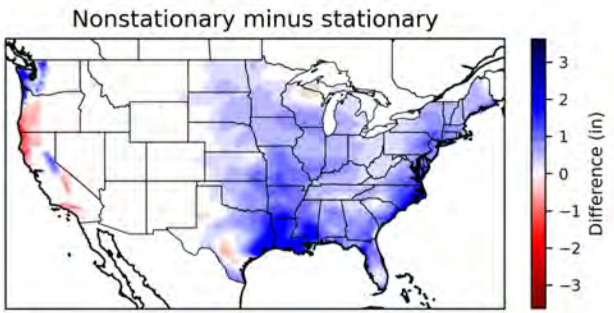


A15 Volume 1 - Nonstationary vs stationary estimates

- Stationary estimates can be obtained by omitting temporal covariate terms
- Nonstationary estimates are generally higher than stationary estimates



24-hr PF estimates (inches) for AEP = 50%.



Differences (inches) in 24-hr estimates for AEP = 50%.

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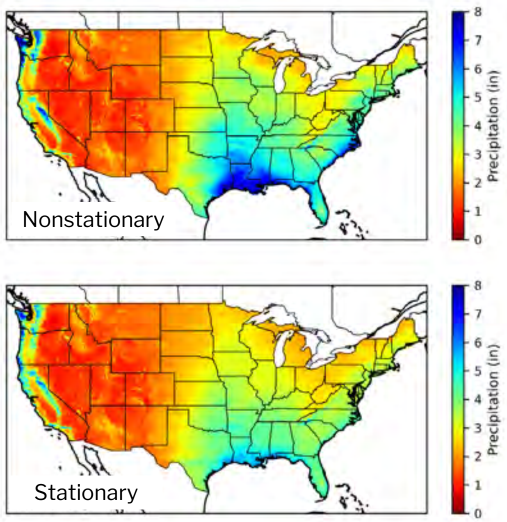

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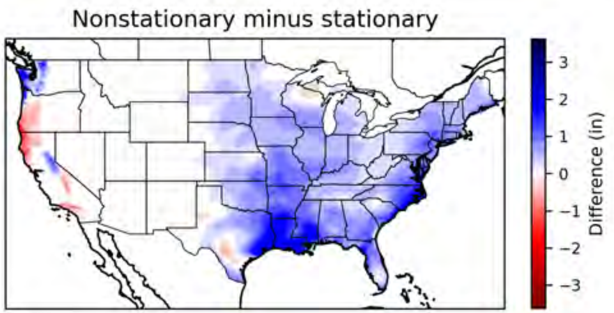
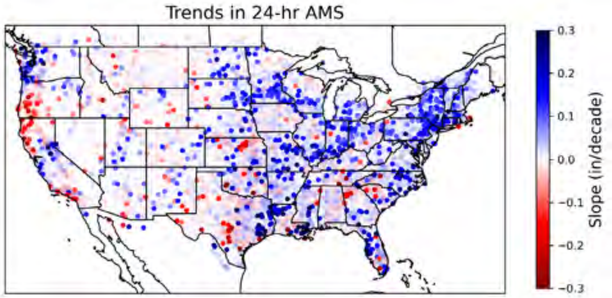


Differences (inches) in 24-hr estimates for AEP = 50%.

- Differences reflect trends in gauge data



Observed changes in AMS since 1960. Dark colors indicate significance based on the Mann-Kendall test ($p < 0.05$).

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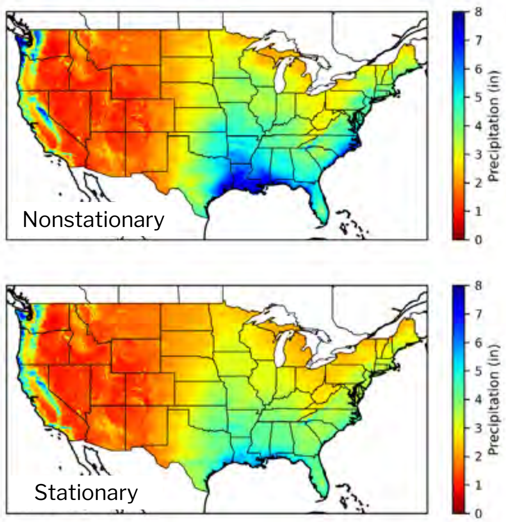

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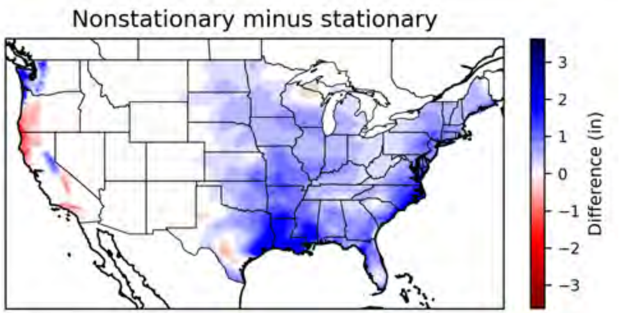

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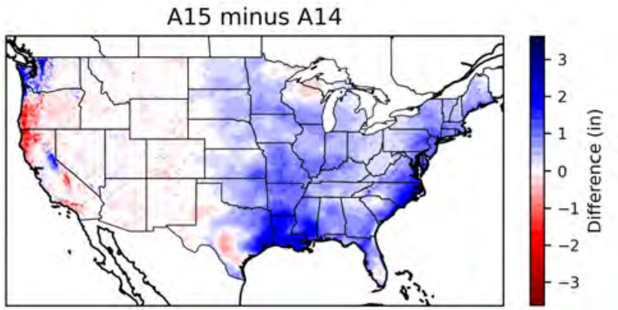
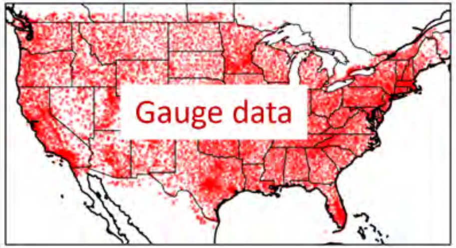
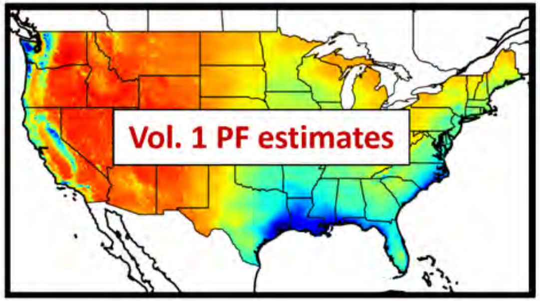


Differences (inches) in 24-hr estimates for AEP = 50%.

- Differences reflect trends in gauge data
- Large-scale differences between A15 and A14 are partly due to the implementation of a nonstationary framework

Developing precipitation frequency (PF) estimates





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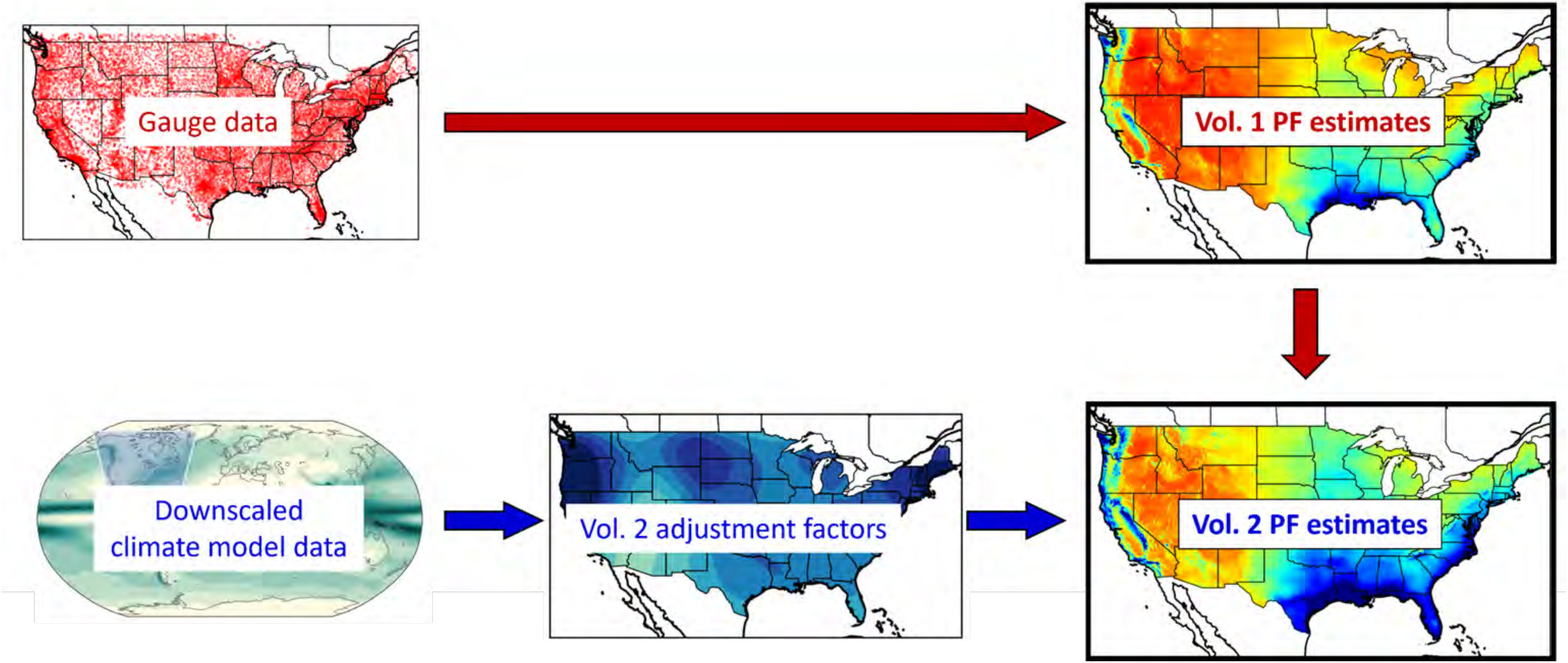
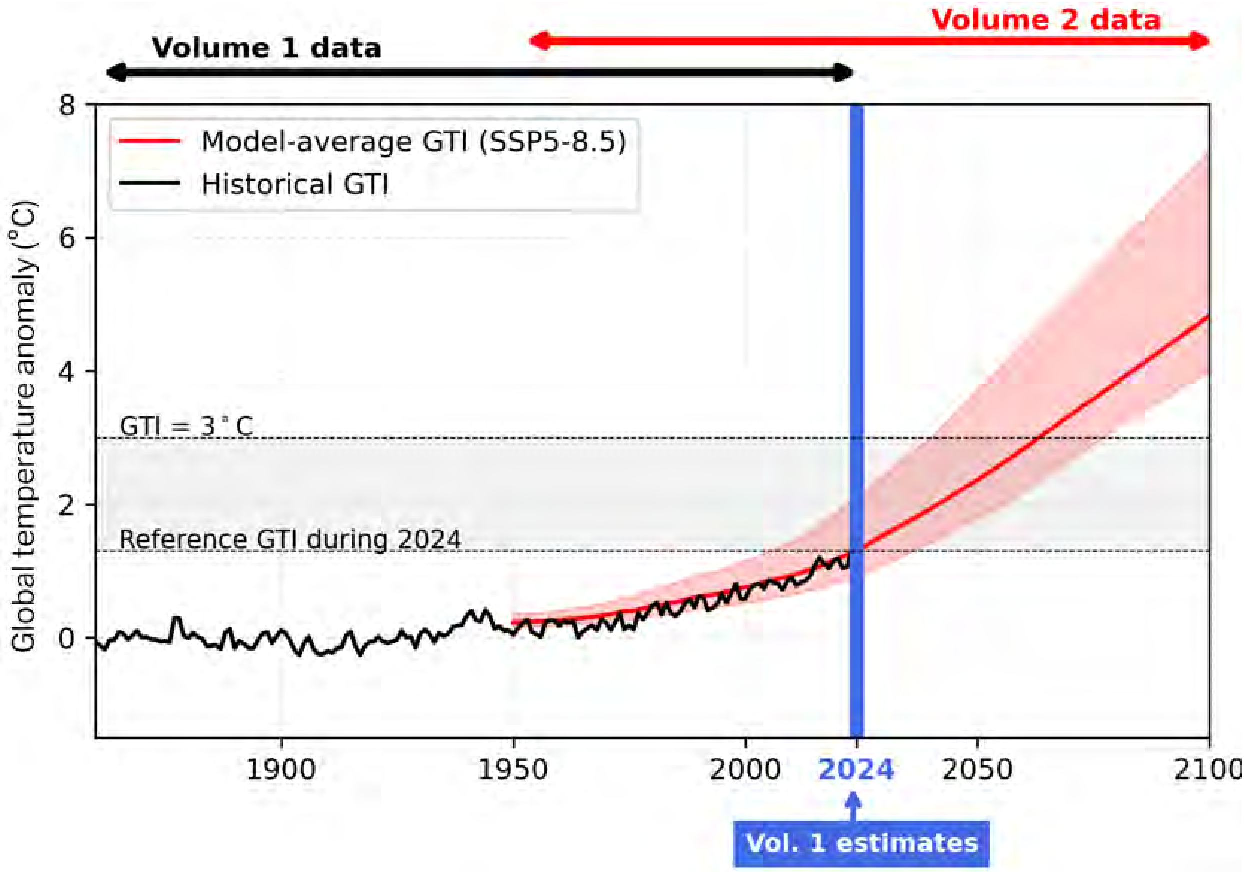


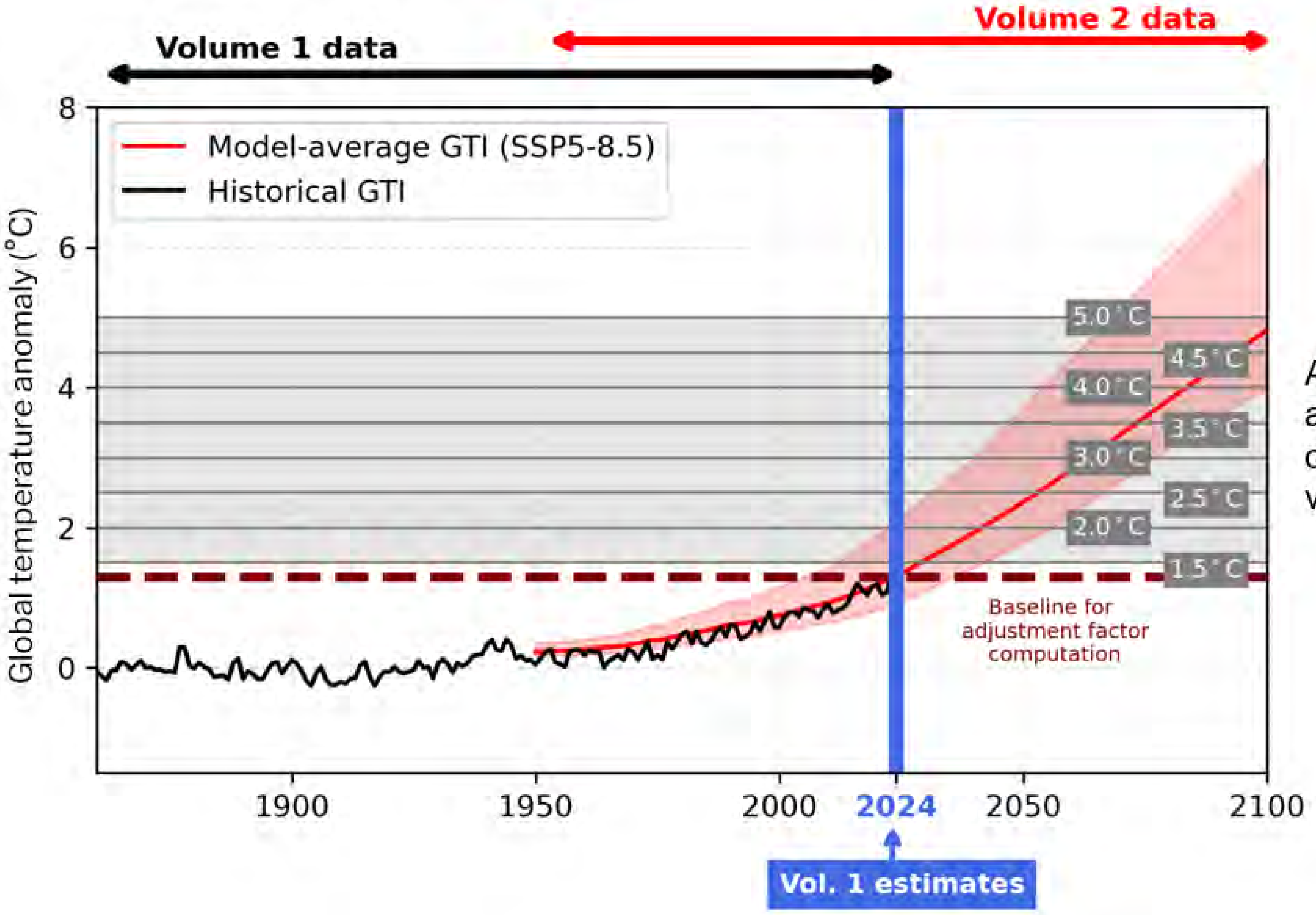
A15 Volume 2 - Applying adjustment factors to Volume 1



Downscaled data from CMIP5 and CMIP6 provide information at a range of global temperature indices (GTIs)

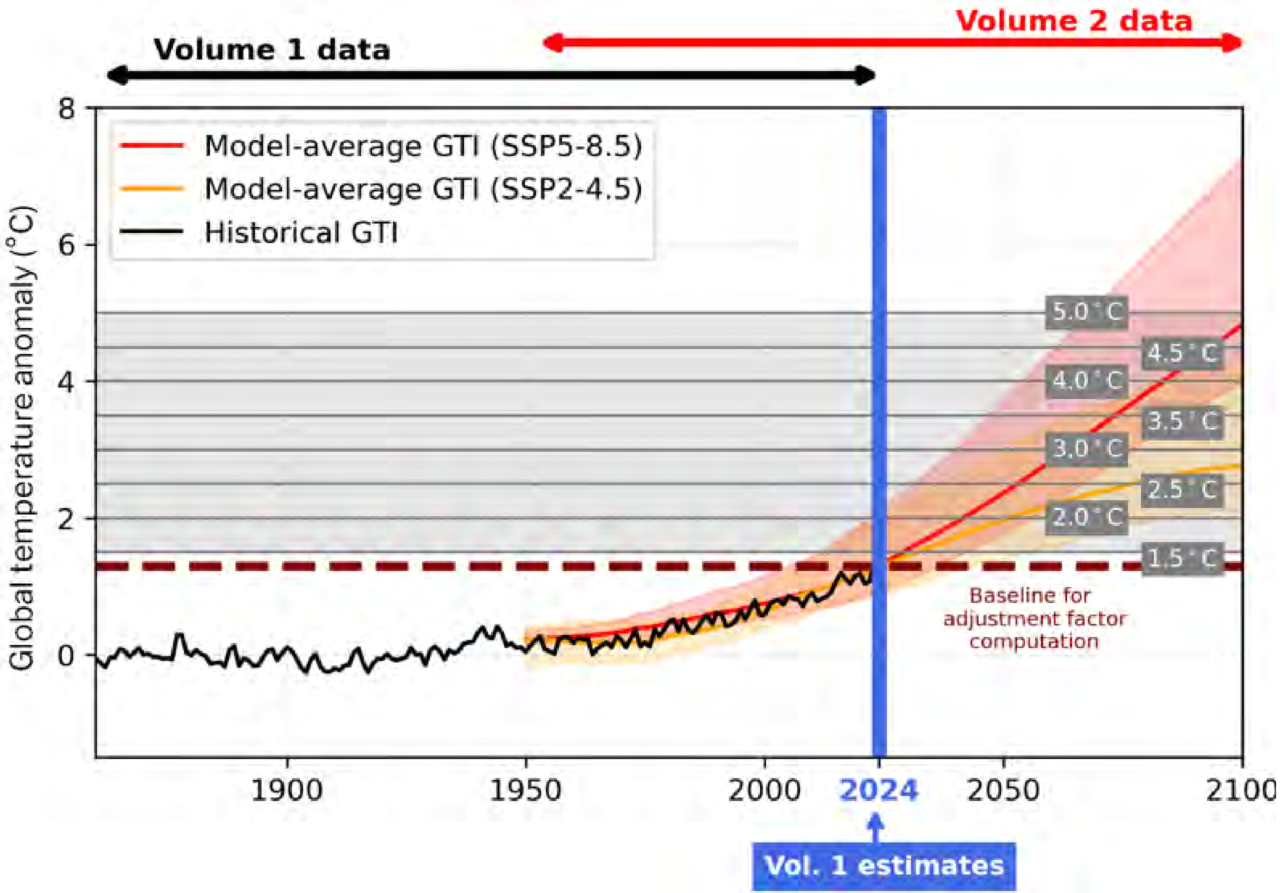
Adjustment factors measure precipitation differences between GTIs

A15 Volume 2 - Applying adjustment factors to Volume 1



Adjustment factors are applied to Vol 1 values to obtain estimates for various GTIs

A15 Volume 2 - Applying adjustment factors to Volume 1

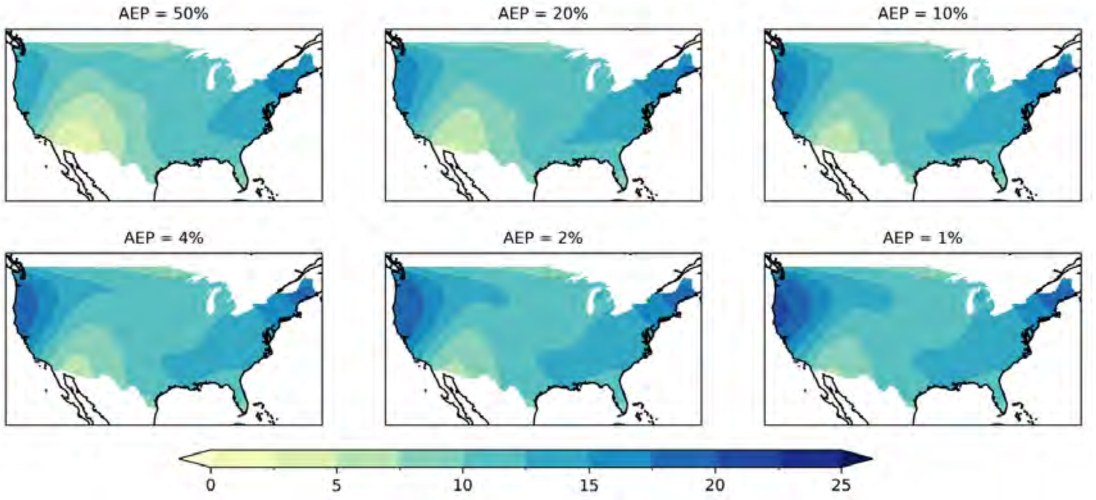


Estimates for various GTIs can be mapped back to any scenario

A15 Volume 2 - Preliminary CONUS adjustment factors

- CONUS AFs developed from a combination of products downscaled from CMIP5 and CMIP6
- Statistical models inform daily AFs: LOCA2[1], STAR[2], UWPD[3]
- Dynamical models inform daily and subdaily AFs: CONUS404[4], NIU[5], NA-CORDEX[6], GFDL-SPEAR[7]
- Model spread used to produce confidence intervals

Estimated 1-hr AFs (%) at 3°C GTI



[1] LOCA2 - Localized Constructed Analog v2
[2] STAR-ESDM - Seasonal Trends and Analysis of Residuals Empirical-Statistical Downscaling Model
[3] UWPD - University of Wisconsin Probabilistic Downscaling
[4] CONUS404 - USGS CONterminous U.S. 404 high-resolution hydro-climate dataset
[5] NIU - Northern Illinois University Convection-Permitting
[6] NA-CORDEX - North American Coordinated Regional Downscaling Experiment
[7] GFDL-SPEAR - Geophysical Fluid Dynamics Laboratory-Seamless System for Prediction and EArth System Research

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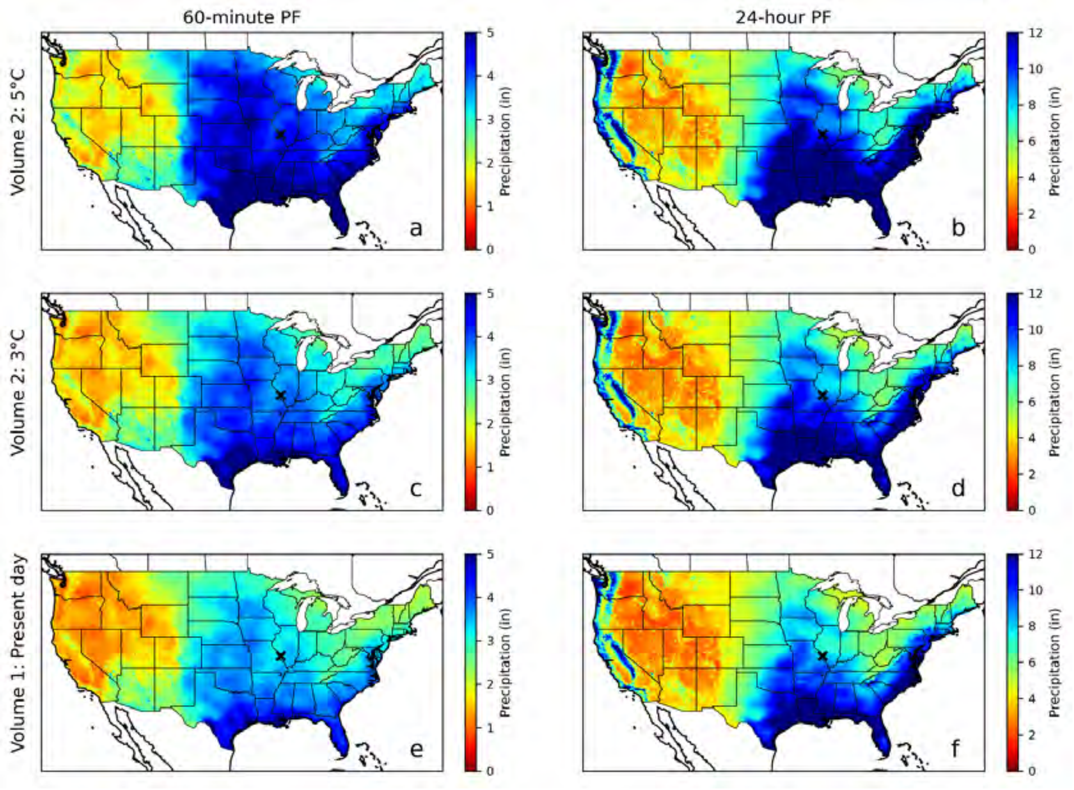
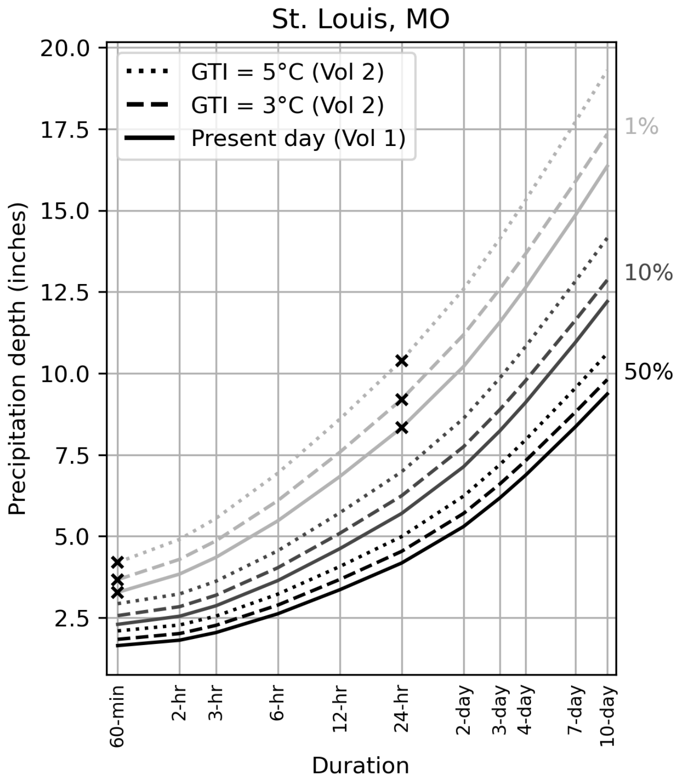
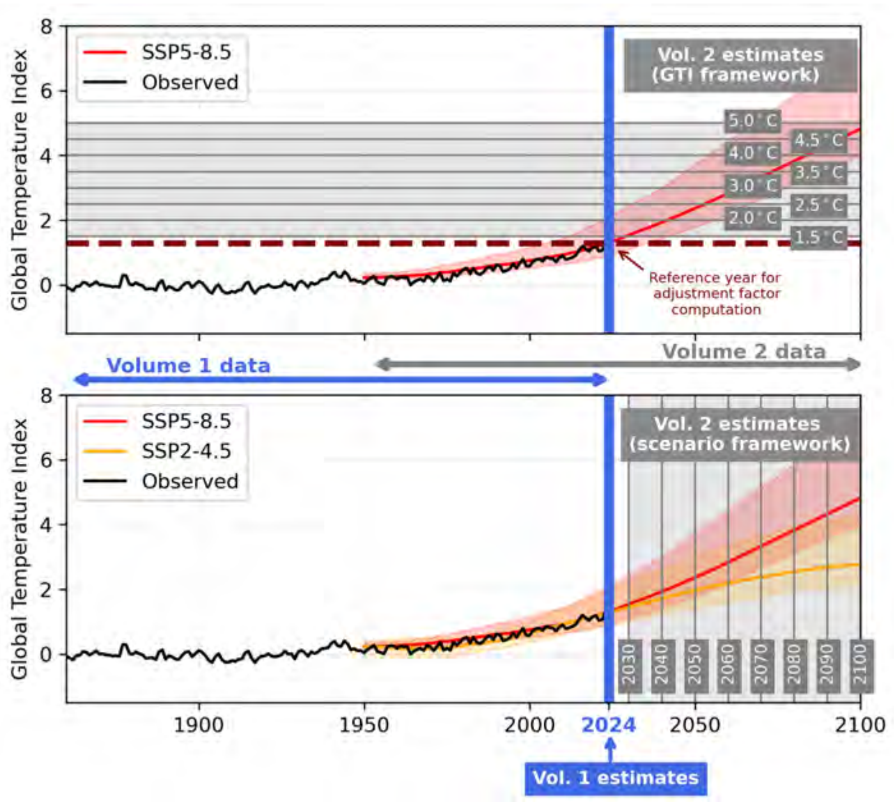




60-min and 24-hr PF estimates for AEP = 1%

A15 precipitation frequency estimates for Volumes 1 and 2



Durations	60-min, 2-hr, 3-hr, 6-hr, 12-hr, 24-hr, 2-day, 3-day, 4-day, 7-day, 10-day
AEPs	50%, 20%, 10%, 4%, 2%, 1%
Confidence bounds	5% and 95%
Spatial resolution	30-arc second grid
Temporal range	Vol 1: 2024 Vol 2: GTI 1.5 - 5°C Vol 2: 2030 - 2100 (SSP2-4.5 and SSP5-8.5)

Acknowledgements

IBSS
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Thank You!

Atlas 15 Info Page

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OWP OFFICE OF WATER PREDICTION

ASCE 24-24 and the NFIP: Better Together for Flood Resilience

Manny A. Perotin,
PE, PMP, CFM

MN DNR Monthly Local Government Units (LGU) Virtual Forum - October 8, 2025

Association of State Floodplain Managers

www.floods.org

ASCE 24-24 and the NFIP: Better Together for Flood Resilience

1. Background – why a new standard was needed?
2. Brief History of ASCE 24
3. ASCE 24 compared to the NFIP
4. Key Changes in 24-24 compared to the NFIP
5. Resources
6. Questions

What percent chance of flooding should newly constructed buildings have over the next 50 years (what is your acceptable risk threshold)?

- A) 5%
- B) 10%
- C) 20%
- D) 30%
- E) 40%

Should it vary based on the structure occupancy/use?

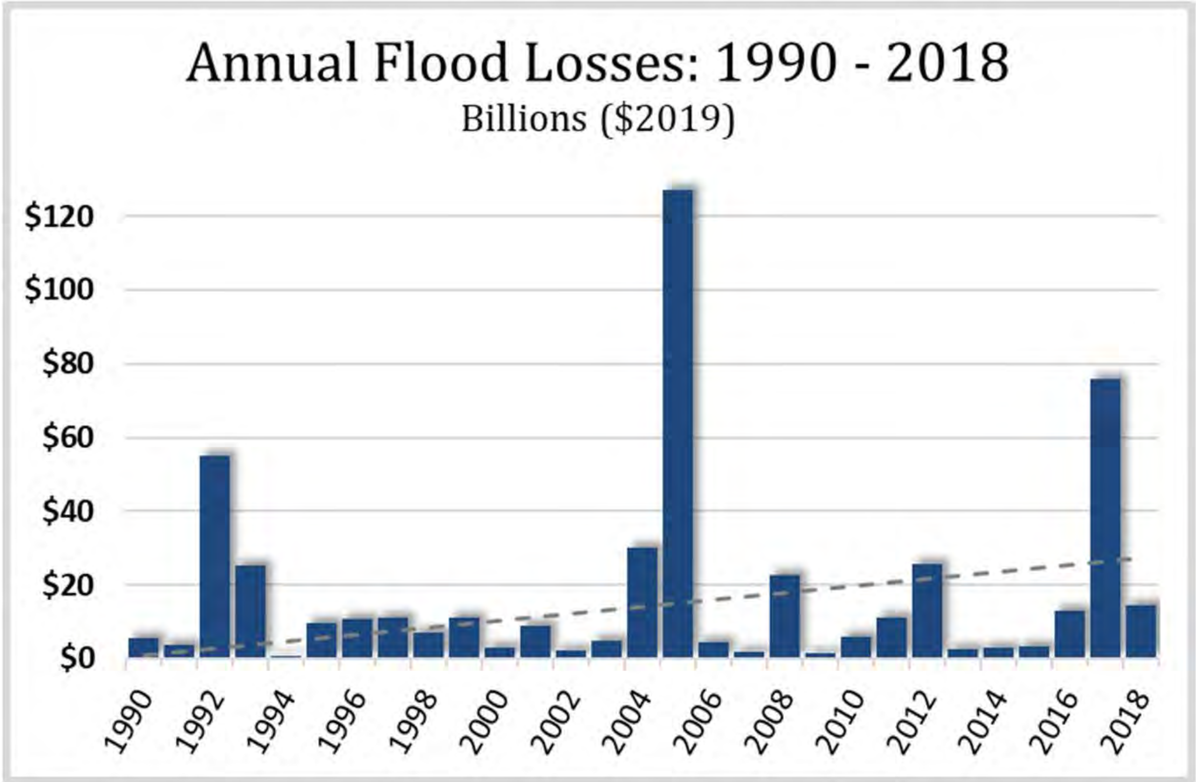
- A) 5%
- B) 10%
- C) 20%
- D) 30%
- E) 40%

Over a period of 50 years...

- A) 5% ≈ 1,000-year annual chance
- B) 10% ≈ 500-year annual chance
- C) 20% ≈ 225-year annual chance
- D) 30% ≈ 140-year annual chance
- E) 40% ≈ 100-year annual chance

Is flooding getting worse? YES!!!

- Flooding is the number one natural disaster in the United States
- Annual flood losses roughly doubling per decade - now $40+ billion/yr. $200 billion in 2021 and 2022.
- 17.7 million properties are at risk of flooding (SFHA + nonmapped + pluvial areas) according to First Street
- New precipitation model shows 1 in 100-year flooding can now be expected every 8 years in some areas



Nationwide historical NFIP Claims for single-family policies

Location of Claim	Quantity	Average Claim	Percent of Quantity
Within SFHA	940,550	$57,250	74%
Outside SFHA	329,450	$57,090	26%
Total	1,270,000	≈$57,200	

**Historical NFIP claims payment were adjusted for inflation using Consumer Price Index (CPI) data sourced from the U.S. Bureau of Labor Statistics. All claim amounts were converted into constant dollars based on the most recent available year of CPI data, which is 2024. This adjustment allows for equitable comparison across claims spanning multiple years.*

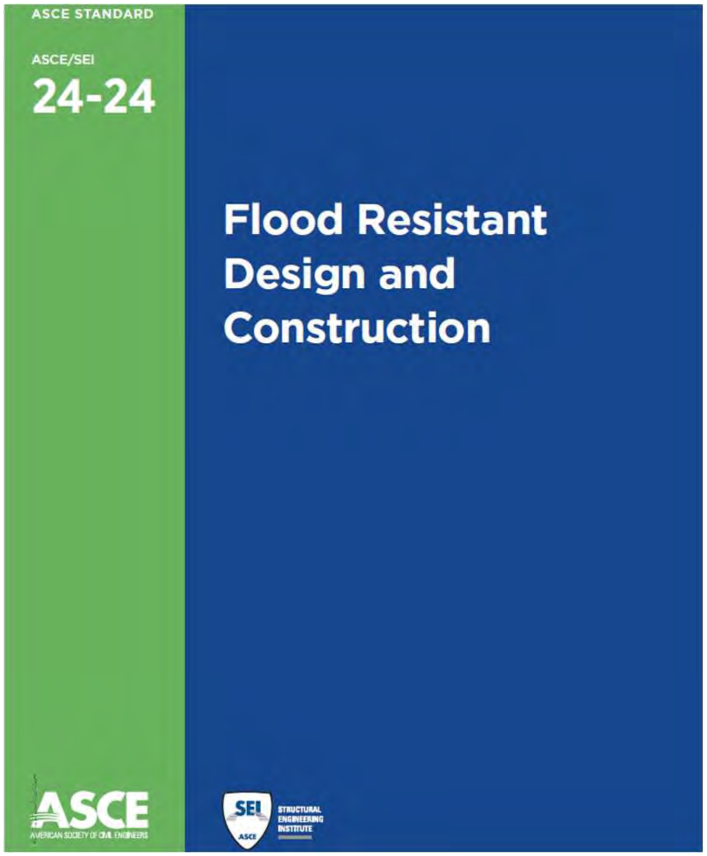
Source: *https://www.fema.gov/openfema-data-page/fima-nfip-redacted-claims-v2 (through December 2024)*

Nationwide historical NFIP Claims for *post 2000* single-family policies

Location of Claim	Quantity	Average Claim	Percent of Quantity
Within SFHA	40,985	$90,250	70%
Outside SFHA	17,515	$99,100	30%
Total	58,500	≈$92,900	

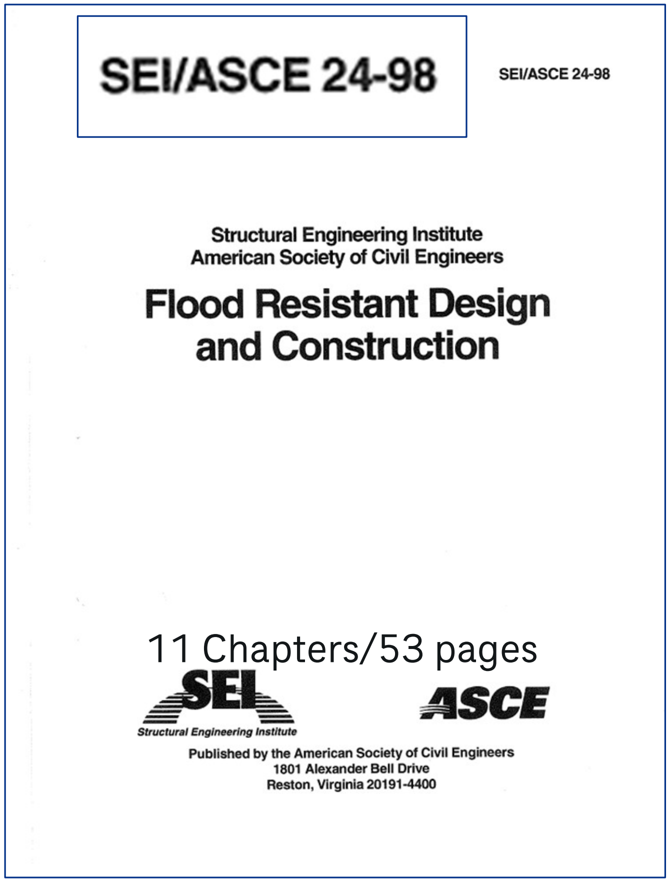
- Newer construction generally has less damage than older, especially compared to pre-1980
- Newer buildings are larger, so higher damages
- Hazard is not binary; flooding in/out of SFHA
- **Damage in newer (post 2000) construction within the 500-year floodplain can exceed that of newer (post 2000) buildings within the SFHA; newer within the SFHA incorporate flood resistant design and construction requirements whereas newer construction outside the SFHA does not**

What is ASCE 24?

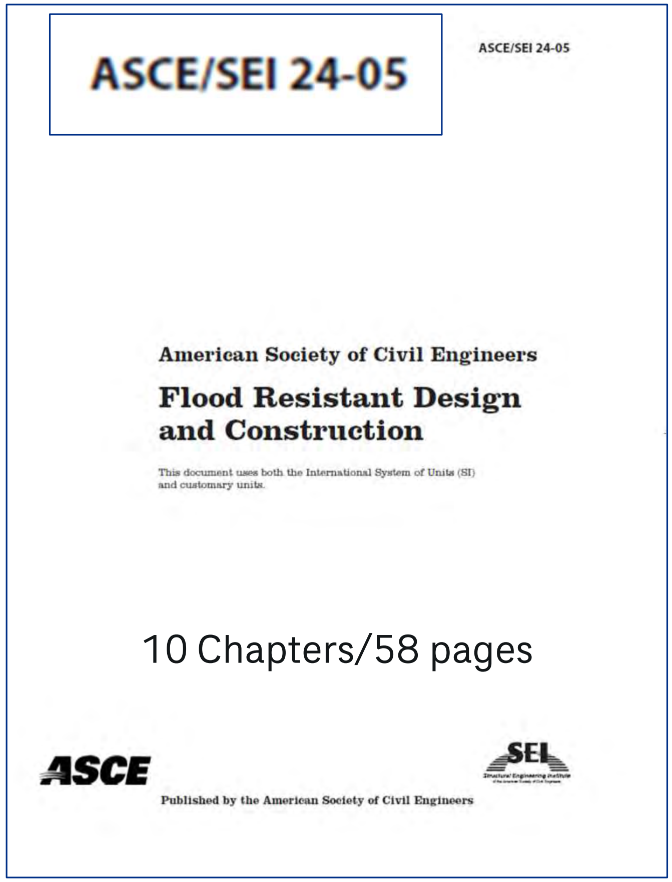


- This standard provides the **minimum requirements for flood resistant** design and construction of structures that are subject to building code requirements and that are located, in whole or in part, in **Flood Hazard Areas**.
- A new national flood resilience standard!

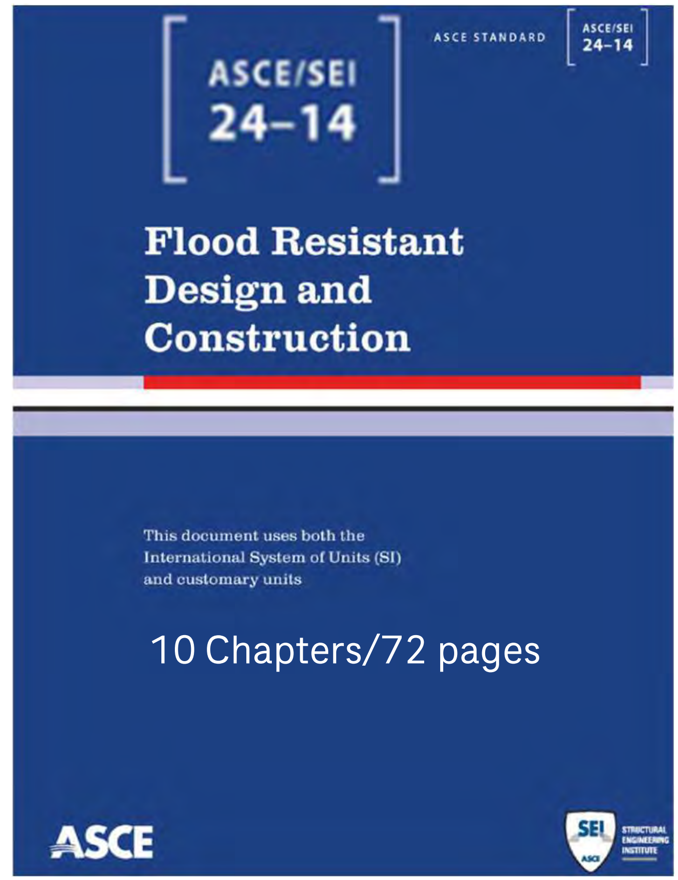
Brief History of ASCE 24 (1993 to 2014)



11 Chapters/53 pages



10 Chapters/58 pages



10 Chapters/72 pages

National Flood Insurance Program (NFIP) Minimum Standards

- 44 CFR part 60
- Originated in the Flood Disaster Protection Act of 1973 which introduced two key requirements:
  1. Mandatory Purchase of flood insurance in SFHA
  2. Community participation in the NFIP inc. Adoption, administration and enforcement of NFIP minimum standards
- NFIP minimum standards largely unchanged in 52 years since

Question: What have we learned in 52 years about effective floodplain management?

ASCE 24 and the National Flood Insurance Program (NFIP)

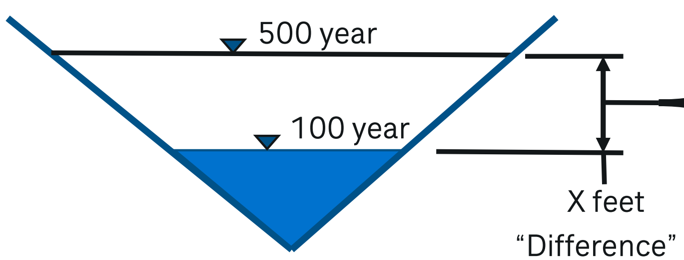
- The provisions of ASCE 24 are consistent with NFIP building performance requirements
  - *Commentary C1.1 Scope – "Any conflicts or differences between this standard and other applicable regulations should be resolved such that compliance with the NFIP requirements is equaled or exceeded."*
- ASCE 24 provisions generally meet or exceed NFIP minimum standards.
- In comparison with minimum NFIP minimum standards, ASCE 24:

1. Provides more specific requirements
2. Requires new construction to meet higher standards
3. Requires Substantial Improvement/Substantial Damage construction to meet higher standards

Key Change: Required Minimum Elevation & Risk Based Freeboard

Evaluating the protection provided by traditional freeboard

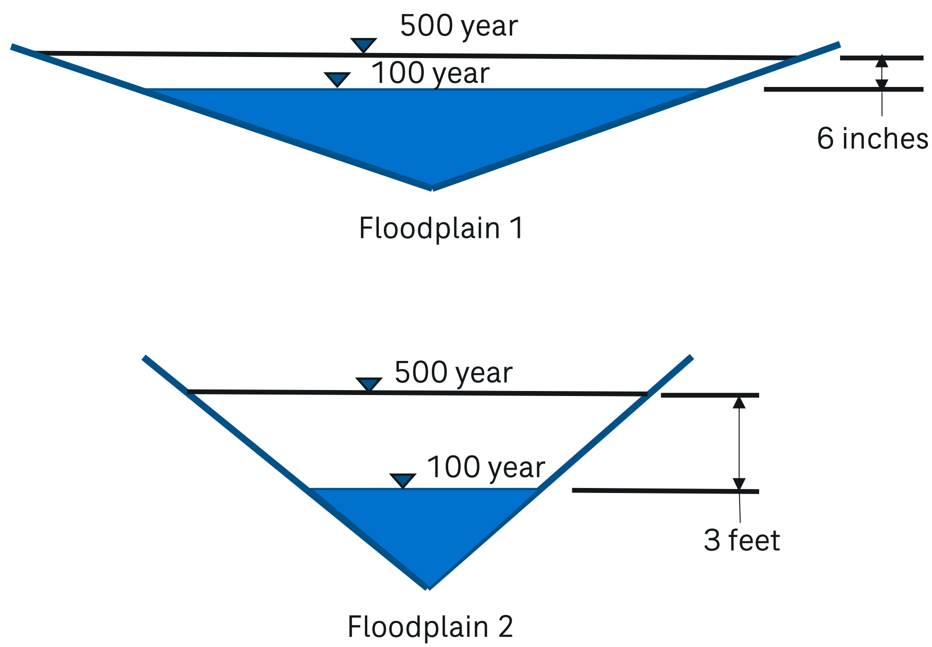
The protection provided by ASCE 24-14 **varies greatly depending** on the floodplain



Difference between 500-year and 100-year flood elevations in feet	Approx. MRI (year) Provided by Freeboard in a Representative Floodplain	
	BFE + 1	BFE + 2
1	500	2500
2	225	500
3	170	290
4	150	225
5	140	190
6	130	170
7	125	160
8	120	150

Why move to Risk-Based Elevation?

- We have used **Freeboard** which is a value above the Base Flood Elevation (BFE or 100-year flood event)
- Traditional freeboard (BFE + 1ft) provides **varying levels of protection** across floodplains and communities
- When considering risk, elevation should be calculated on an MRI basis – this provides **consistent levels of protection** across floodplains
- Allows regulation of the same risk across:
  - The entire community regardless of floodplain characteristics
  - Within Flood Design Classes



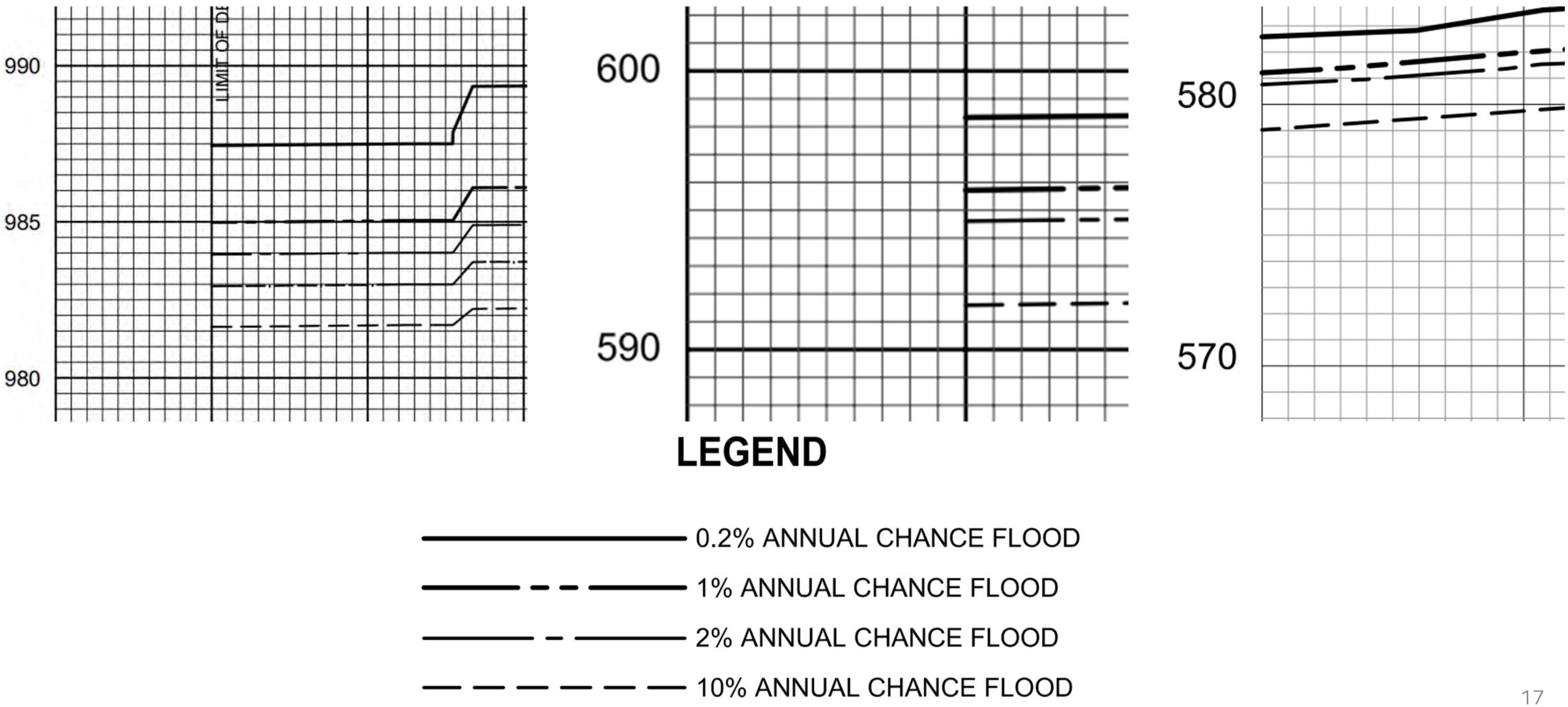
Risk Based Freeboard

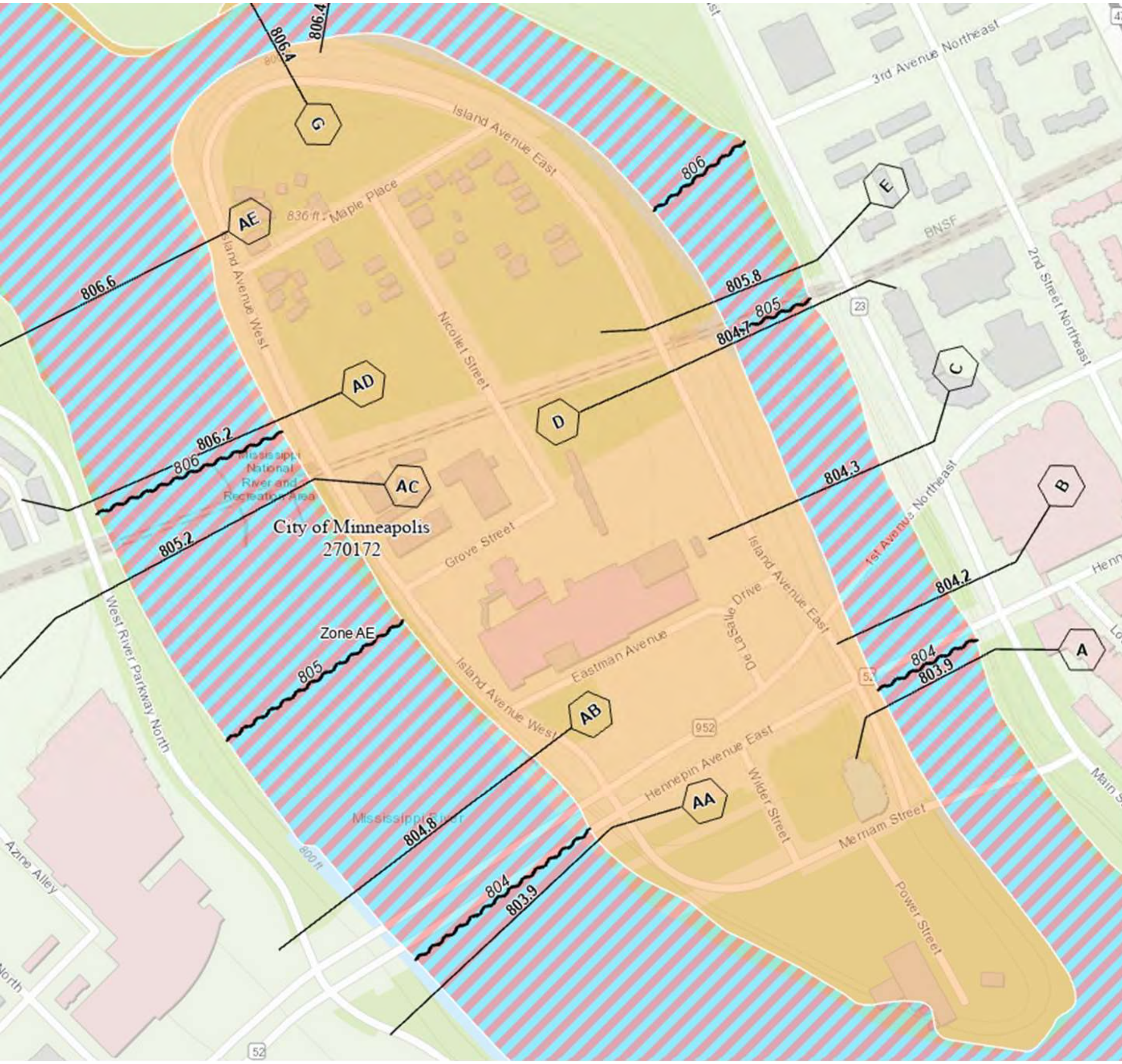
- **Adjusts flood parameters** based on **Risk Category** and associated **Mean Recurrence Interval (MRI)** aligning it with ASCE 7-22-S2
- Risk Category I: Agricultural, temporary, storage structures
- Risk Category II: Most residential, commercial, industrial structures
- Risk Category III: Nursing homes, schools and similar structures that could pose risk of harm/loss of life
- Risk Category IV: Critical or essential facilities (fire stations, EOCs, power plants)

ASCE 7-22-S2 Design Flood MRIs

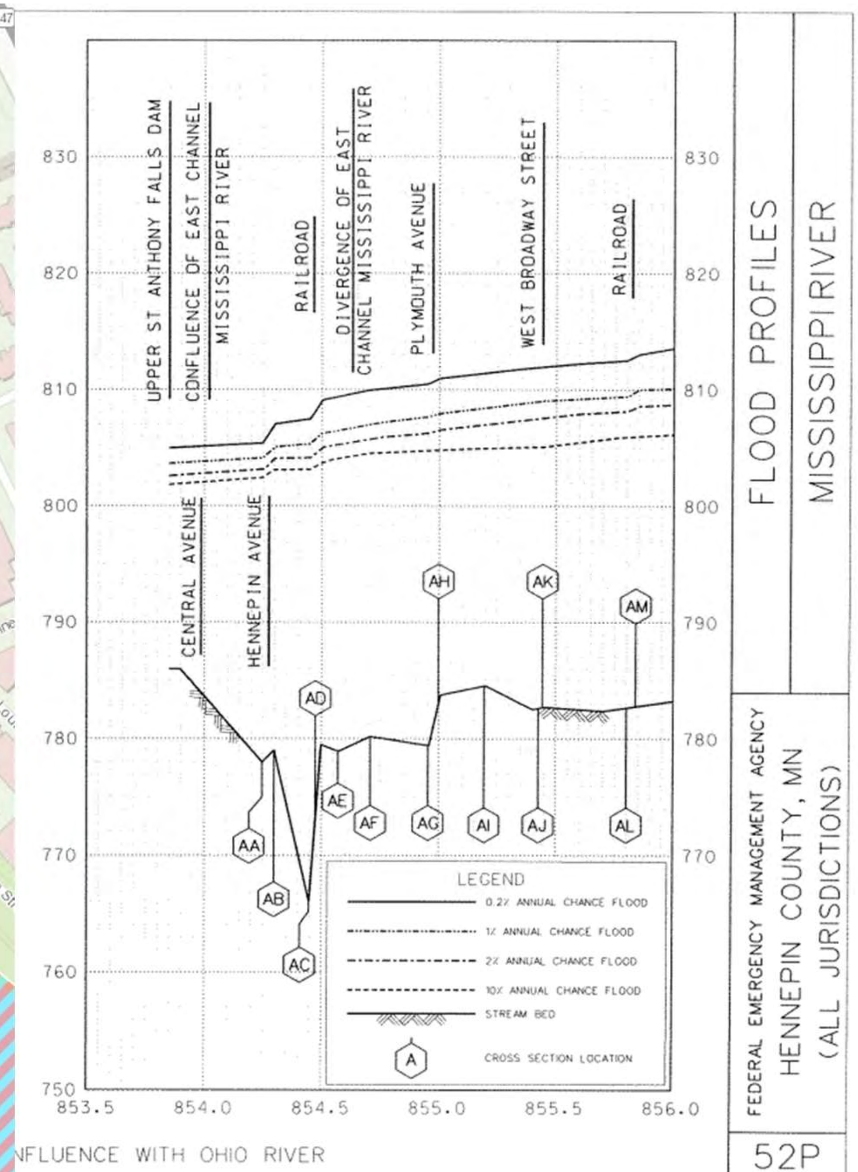
Risk Category/ Flood Design Class	Mean Recurrence Interval (MRI) [years]
I	100
II	500
III	750
IV	1,000

Traditional freeboard (BFE + 1ft) provides varying levels of protection

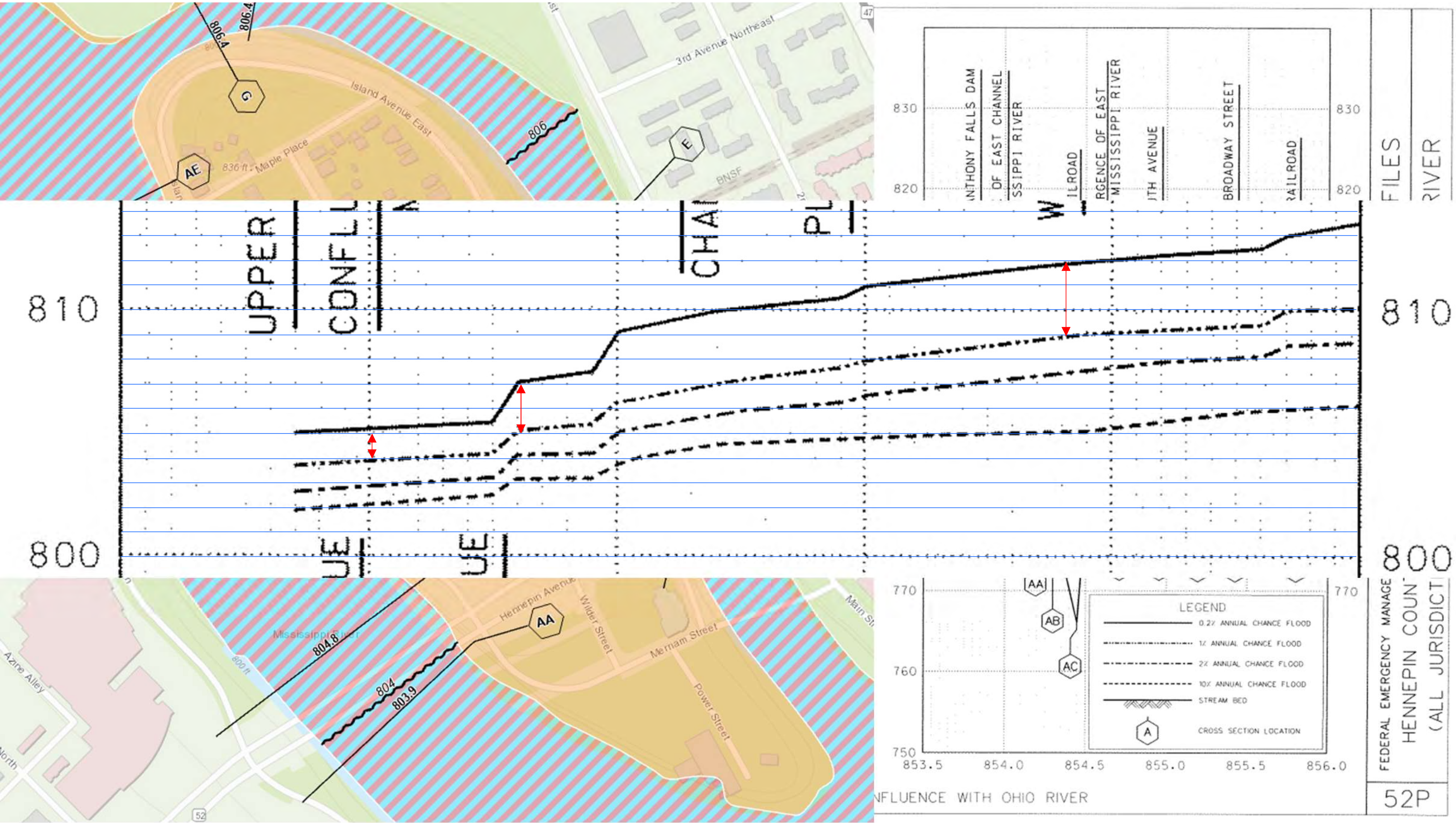




806.4
806.4
G
Island Avenue East
806
3rd Avenue Northeast
E
AE
836 ft
Maple Place
BNSF
806.6
Island Avenue West
Nicollet Street
805.8
805
804.7
2nd Street Northeast
AD
D
C
806.2
806
Mississippi National River and Recreation Area
804.3
AC
City of Minneapolis
270172
Grove Street
1st Avenue Northeast
B
805.2
Island Avenue East
De La Salle Drive
804.2
West River Parkway North
Zone AE
Eastman Avenue
804
803.9
A
805
Island Avenue West
AB
952
Hennepin Avenue East
AA
Wilder Street
Mississippi River
804.8
Merriam Street
804
803.9
Power Street
Azine Alley
52



UPPER ST ANTHONY FALLS DAM
CONFLUENCE OF EAST CHANNEL MISSISSIPPI RIVER
RAILROAD
DIVERGENCE OF EAST CHANNEL MISSISSIPPI RIVER
PLYMOUTH AVENUE
WEST BROADWAY STREET
RAILROAD
CENTRAL AVENUE
HENNEPIN AVENUE
830
820
810
800
790
780
770
760
750
AA
AB
AC
AD
AE
AF
AG
AH
AI
AJ
AK
AL
AM
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
A
CROSS SECTION LOCATION
853.5
854.0
854.5
855.0
855.5
856.0
NFLUENCE WITH OHIO RIVER
FLOOD PROFILES
MISSISSIPPI RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
HENNEPIN COUNTY, MN
(ALL JURISDICTIONS)
52P



806.4
806.4
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Island Avenue East
806
AE
836 ft
Maple Place
3rd Avenue Northeast
E
BNSF
830
820
ANTHONY FALLS DAM
OF EAST CHANNEL
SSIPPI RIVER
ILROAD
RGENCE OF EAST
MISSISSIPPI RIVER
TH AVENUE
BROADWAY STREET
RAILROAD
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LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
A
CROSS SECTION LOCATION
853.5
854.0
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NFLUENCE WITH OHIO RIVER
FEDERAL EMERGENCY MANAGE
HENNEPIN COUN
(ALL JURISDICT
52P
Hennepin Avenue
AA
Wilder Street
Merriam Street
Mississippi River
804.8
804
803.9
800 ft
Azine Alley
Power Street
Main St
52

Key Change: Floodplain Extent

ASCE 24-24 – floodplain extent

Design Flood: Flood corresponding to the elevations specified in Section 1.5.2 and acting over the flood hazard area specified in Section 1.3 of this standard or otherwise legally designated. In no case shall the design flood be taken as less restrictive than the base flood.

1.3 IDENTIFICATION OF FLOOD HAZARD AREAS

For Flood Design Classes 2, 3, and 4 structures, the flood hazard area shall be the larger of (1) the lands within the mapped 500-year floodplain (0.2% or greater chance of flooding in any year, including the 1% floodplain) on a FIRM, and (2) those lands designated as a flood hazard area on the community's flood hazard map, or otherwise legally designated (this includes the 1% floodplain).

For Flood Design Class 1 structures, the flood hazard area shall be the larger of (1) the lands within the mapped 100-year floodplain (1% or greater chance of flooding in any year) on a FIRM, and (2) those lands designated as a flood hazard area on the community's flood hazard map, or otherwise legally designated.

Floodplain extent

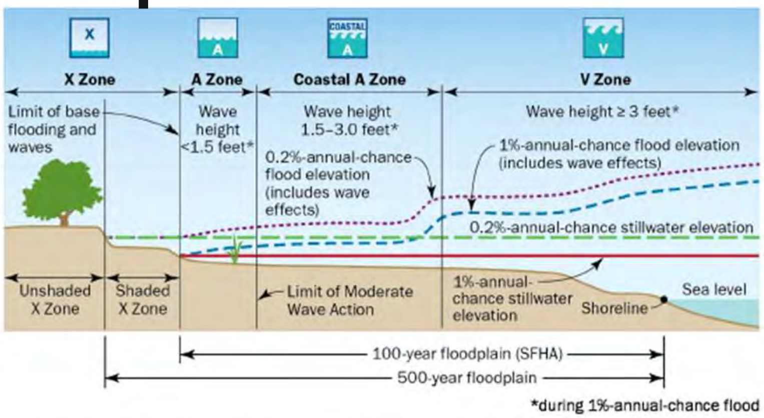


Figure 1. Typical flood zones from coastal flood sources

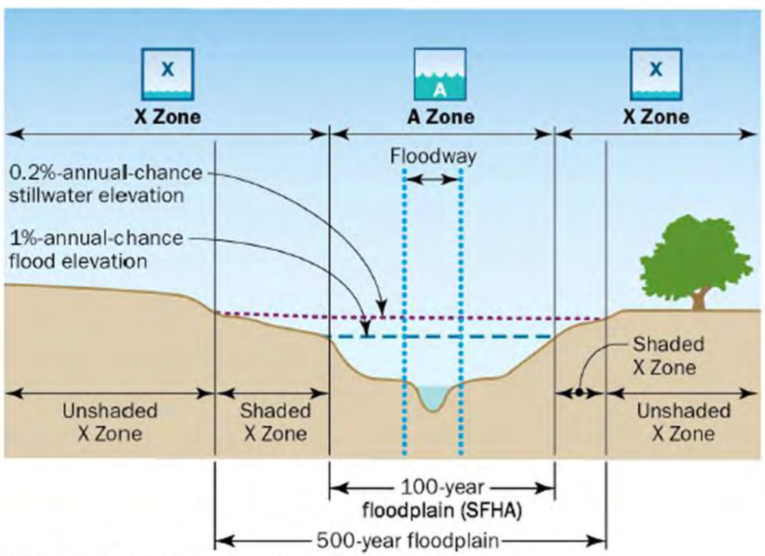
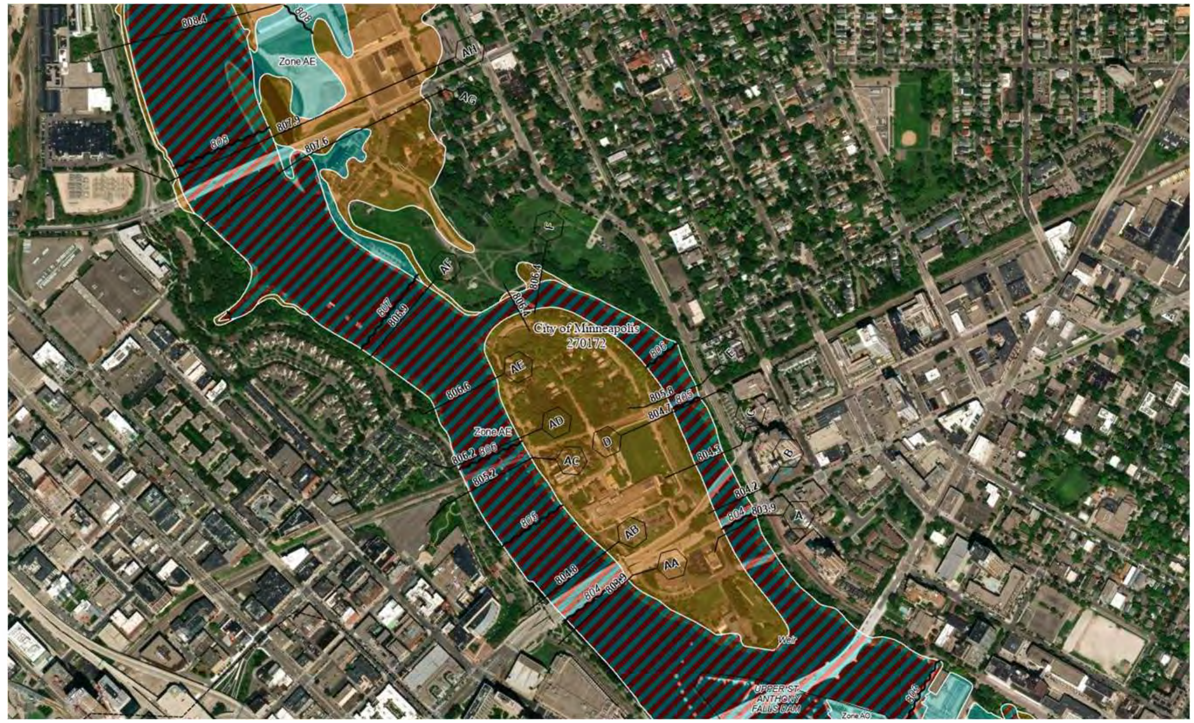
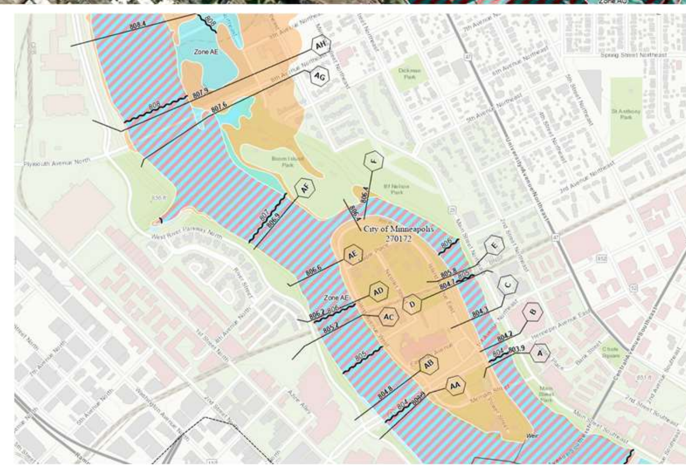


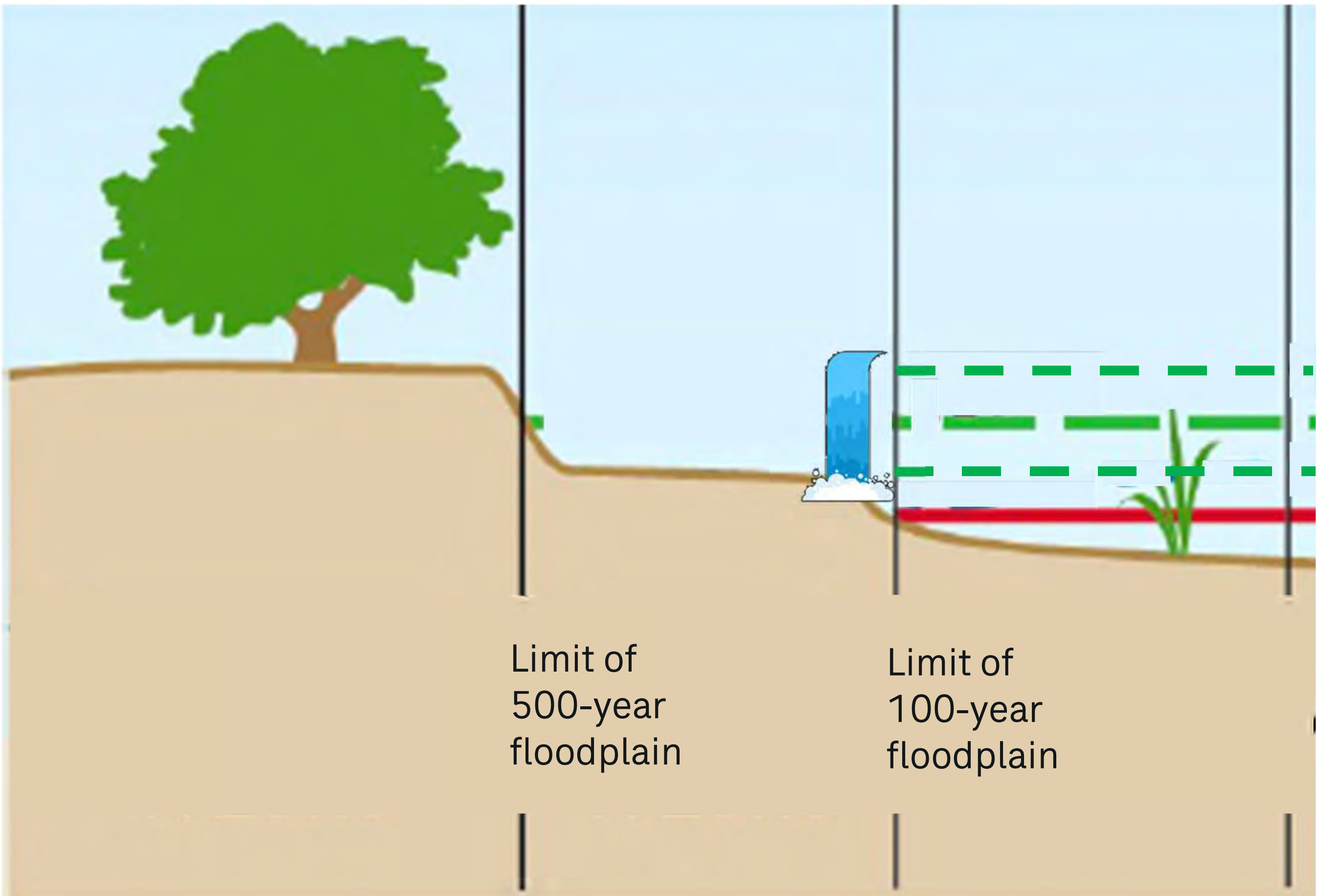
Figure 2. Typical flood zones from riverine flood sources

Source: *FEMA P-2345*



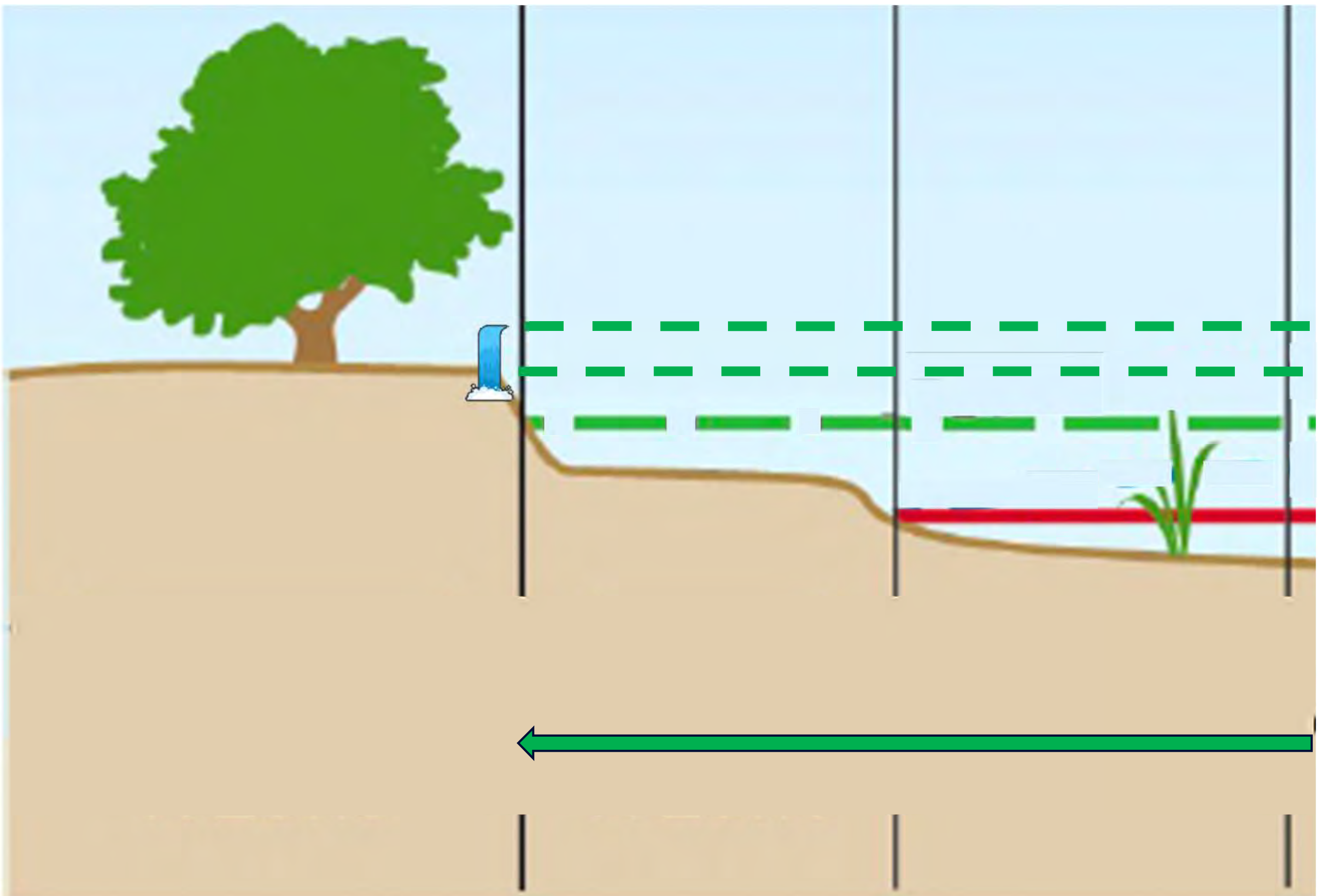


The Waterfall Effect



Source: *Dr. Dan Cox*

Risk-based Design

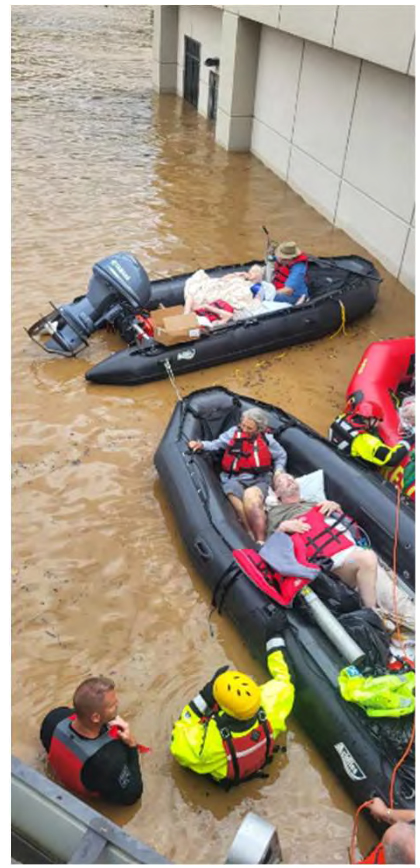


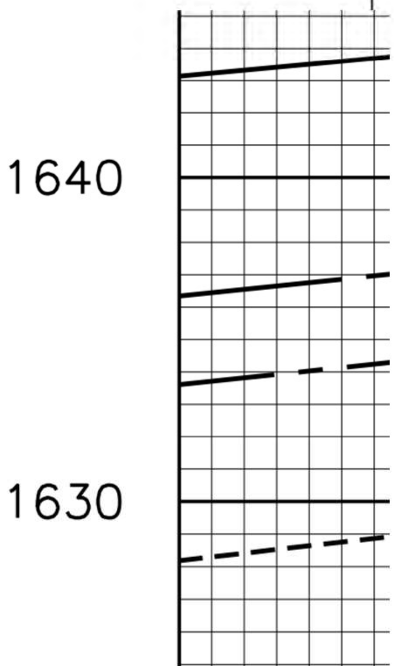
RC = Risk Category of structure

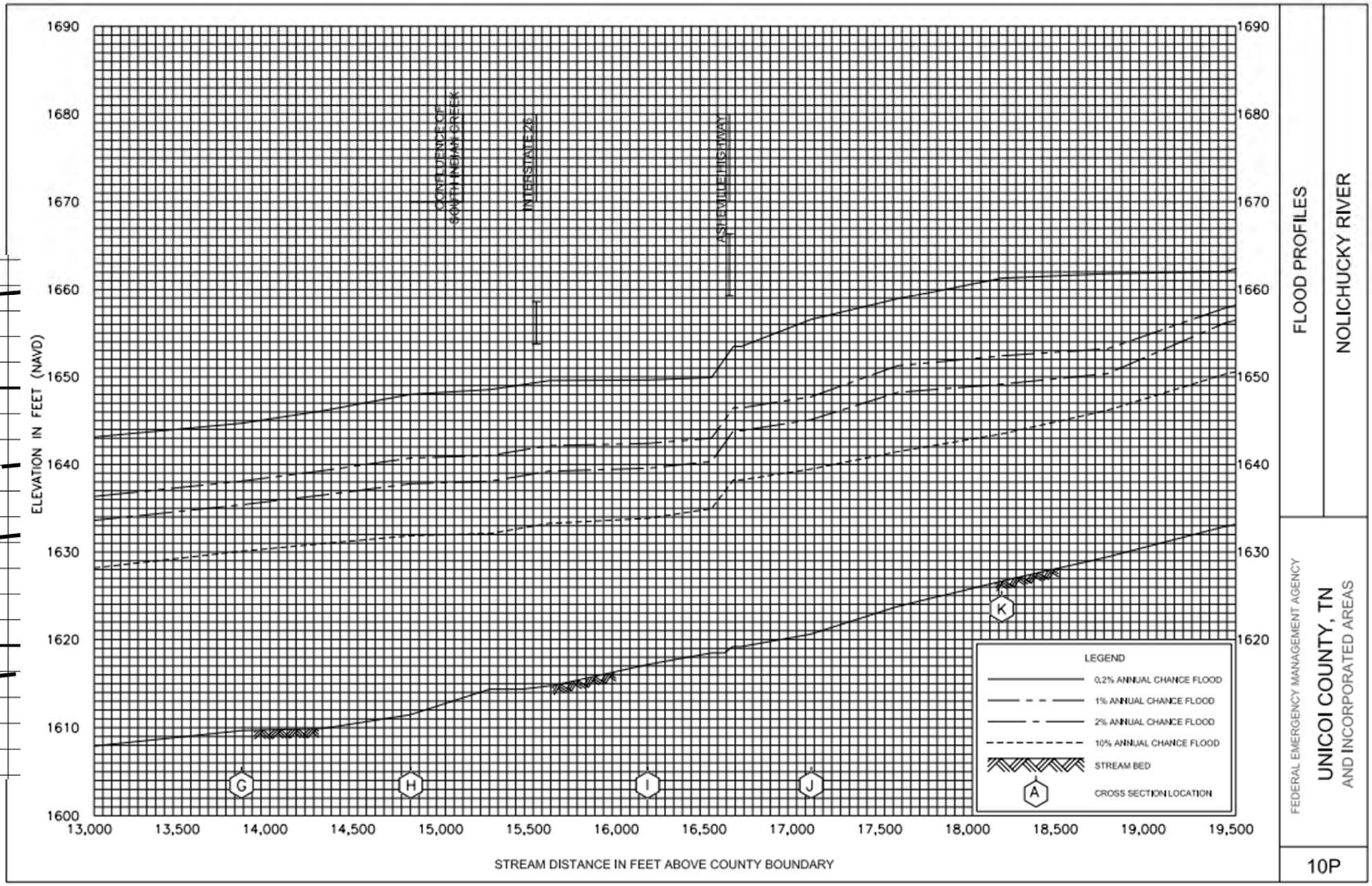
Source: *Dr. Dan Cox*

Unicoi County Hospital – Erwin, TN

Unicoi County Hospital – Erwin, TN




1640
1630


CONFLUENCE OF SOUTH INDIAN CREEK
INTERSTATE 26
ASHEVILLE HIGHWAY
ELEVATION IN FEET (NAVD)
STREAM DISTANCE IN FEET ABOVE COUNTY BOUNDARY
1600
1610
1620
1630
1640
1650
1660
1670
1680
1690
13,000
13,500
14,000
14,500
15,000
15,500
16,000
16,500
17,000
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18,000
18,500
19,000
19,500
G
H
I
J
K
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
A
CROSS SECTION LOCATION
FLOOD PROFILES
NOLICHUCKY RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
UNICOI COUNTY, TN
AND INCORPORATED AREAS
10P

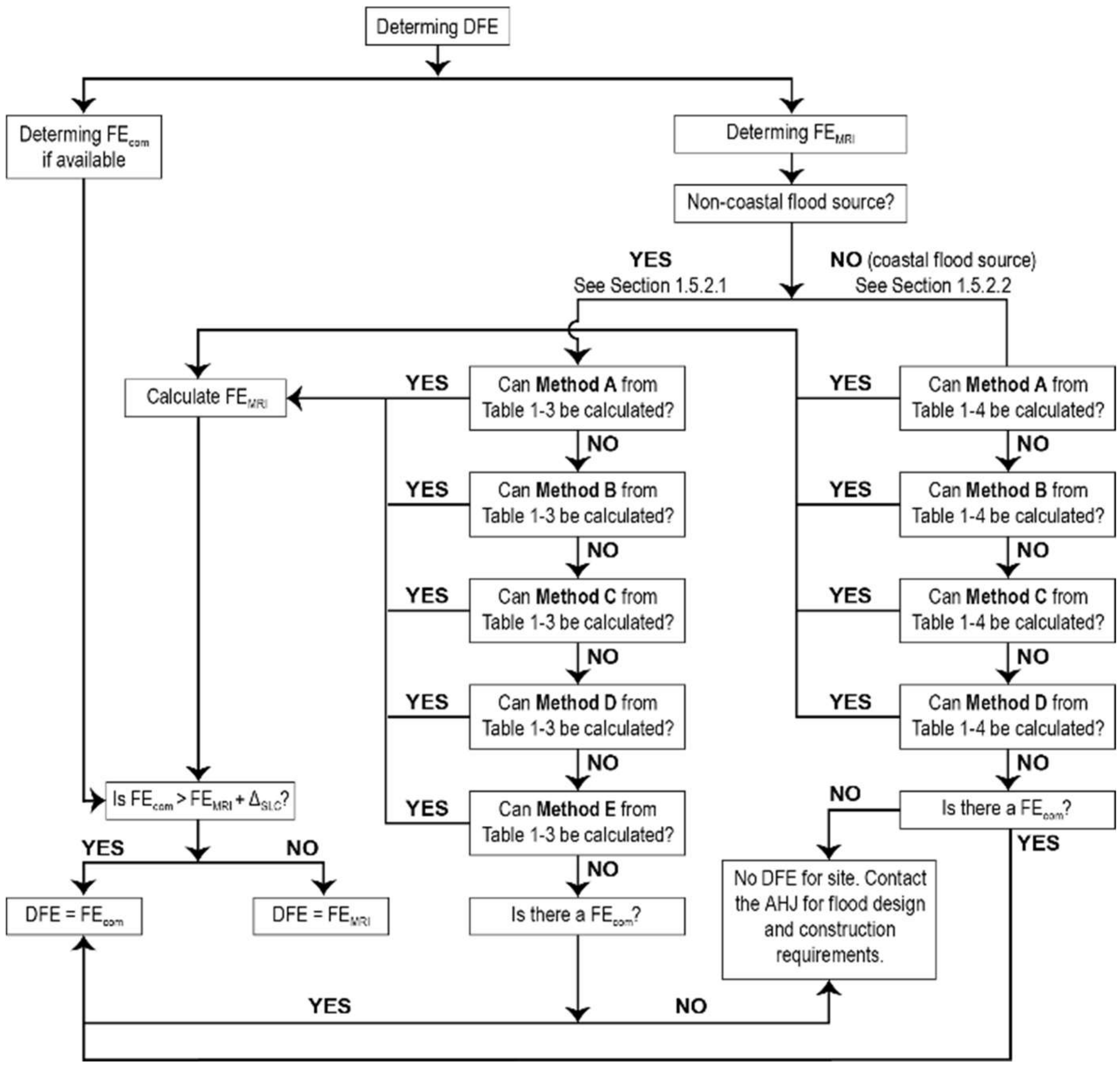
ASCE 24-24 & ASCE 7-22 Supplement 2 – align required minimum elevation

Table 1-3. FE_{MRI} for Flood Hazard Areas with Noncoastal Flood Sources.*

Flood Design Class	MRI	Method A: MRI Data are Available or Site-Specific/ Local Study is Prepared	Method B: 100-Year and 500-Year Flood Elevations are Available	Method C: Only 100-Year and 10-Year Flood Elevations are Available	Method D: Only 100-Year Flood Elevation is Available	Method E: 100-Year Flood Elevation is Not Available
1	100-Year	FE_{100}	FE_{100}	FE_{100}	FE_{100}	100_{com}
2	500-Year	FE_{500}	FE_{500}	$FE_{100} + 0.70(FE_{100} - FE_{10})$	FE_{100} + 2.1 ft (0.6 m)	100_{com} + 2.1 ft (0.6 m)
3	750-Year	FE_{750}	$FE_{100} + 1.25(FE_{500} - FE_{100})$	$FE_{100} + 0.90(FE_{100} - FE_{10})$	FE_{100} + 2.6 ft (0.7 m)	100_{com} + 2.6 ft (0.8 m)
4	1000-Year	FE_{1000}	$FE_{100} + 1.43(FE_{500} - FE_{100})$	$FE_{100} + (FE_{100} - FE_{10})$	FE_{100} + 3.0 ft (0.9 m)	100_{com} + 3.0 ft (0.9 m)

*FE_{100}, FE_{500}, FE_{750}, and FE_{1000} are the flood elevations for the indicated MRIs.

Source: *ASCE 24-24, With permission from ASCE*

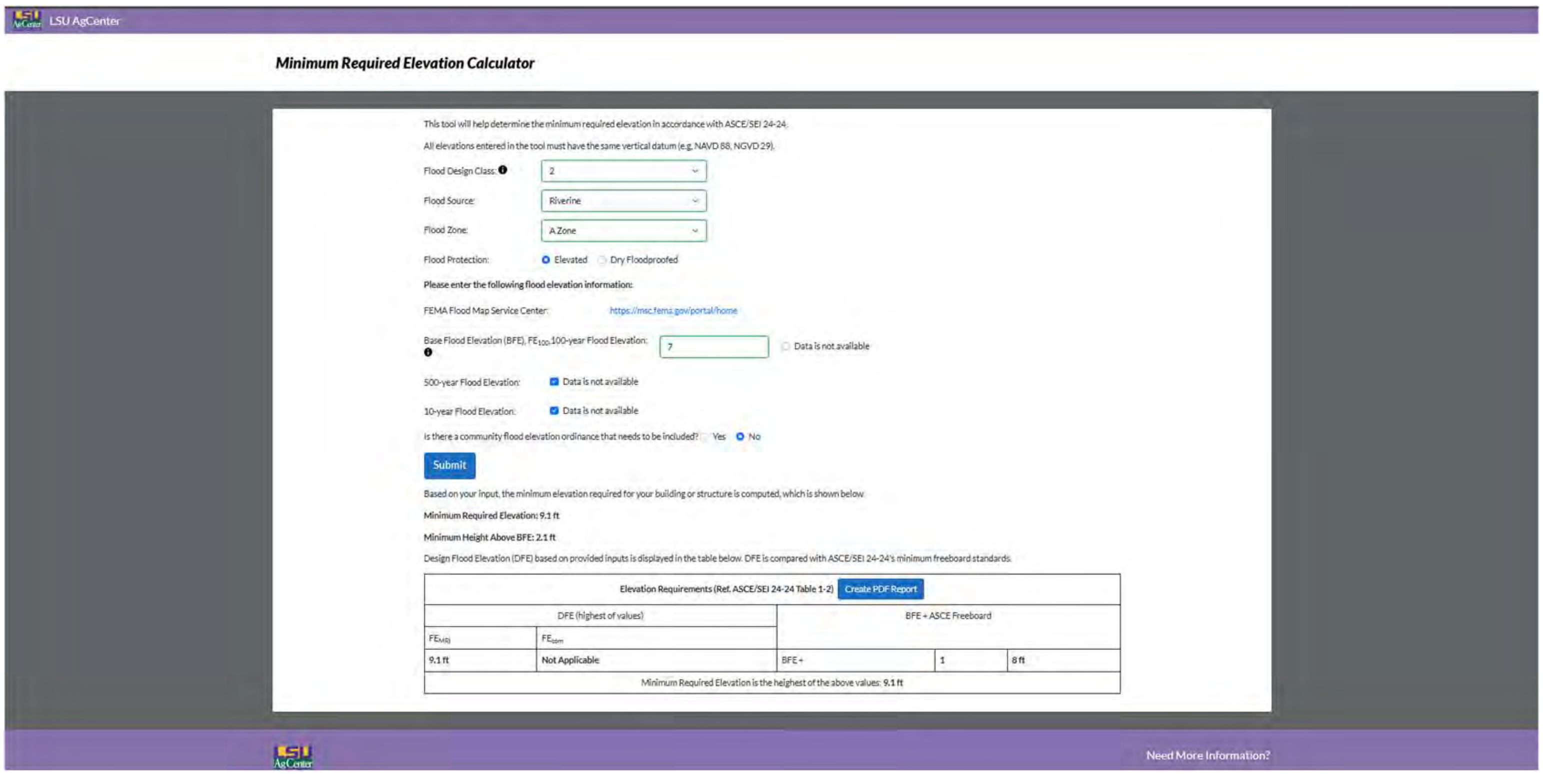


Source: *ASCE 24-24, Figure 1-3, With permission from ASCE*

Job Aid: Web Based Elevation Calculator

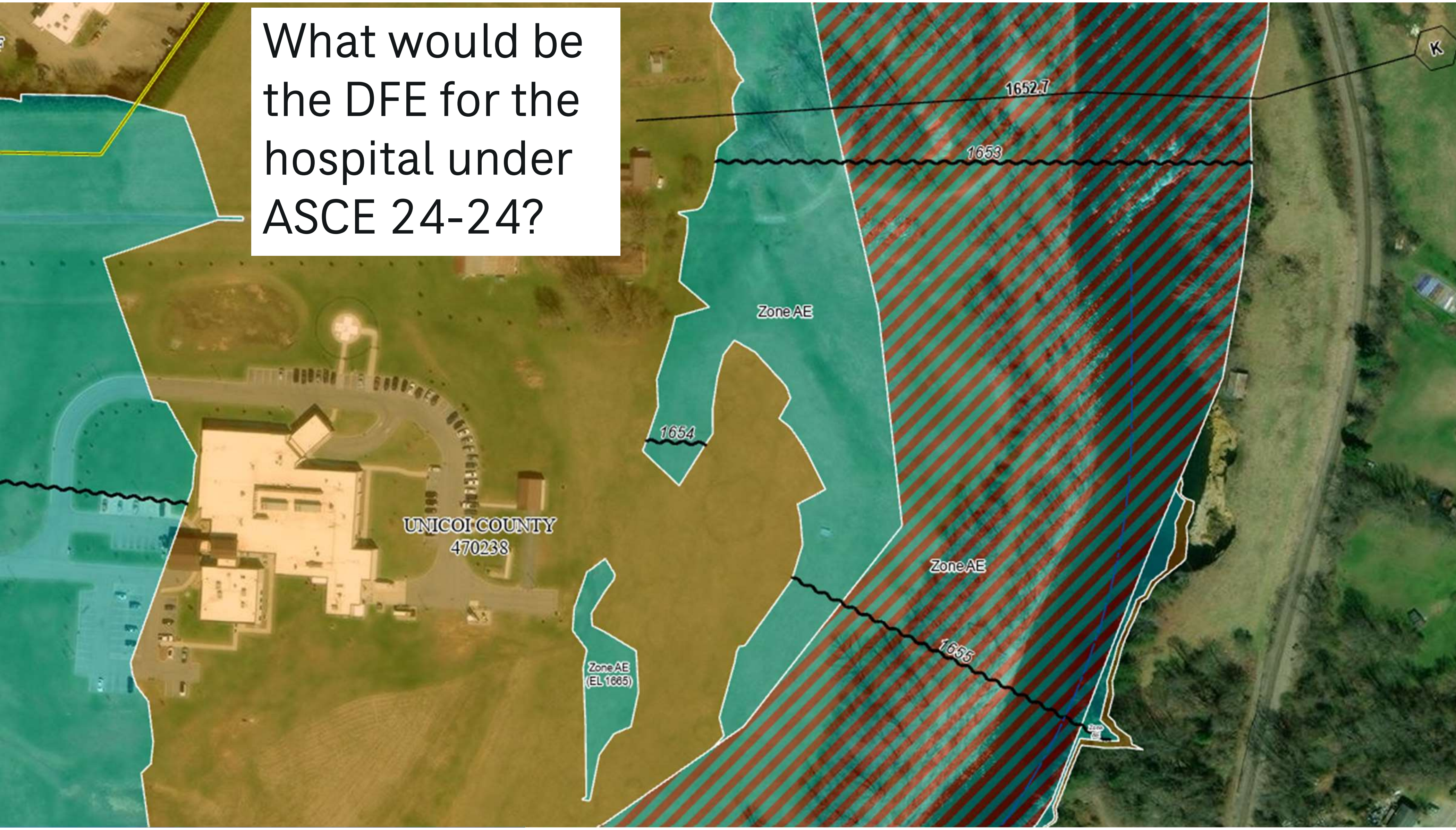
Pilot tool - ASCE 24-24 Minimum Required Elevation Calculator

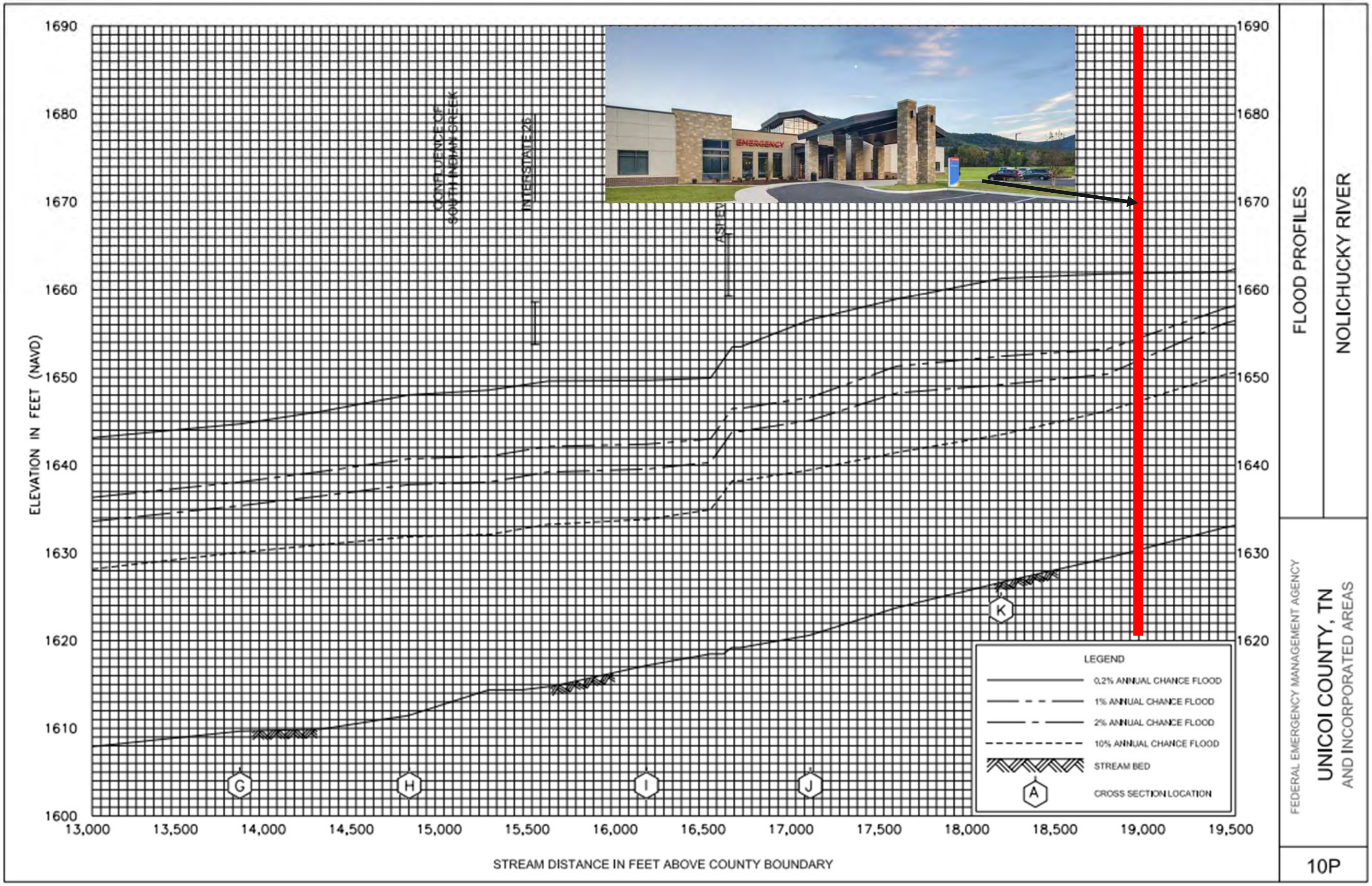
- This product was developed by the LSU Ag Center, not ASCE
- This ***may*** eventually be incorporated into the ASCE Hazard Tool



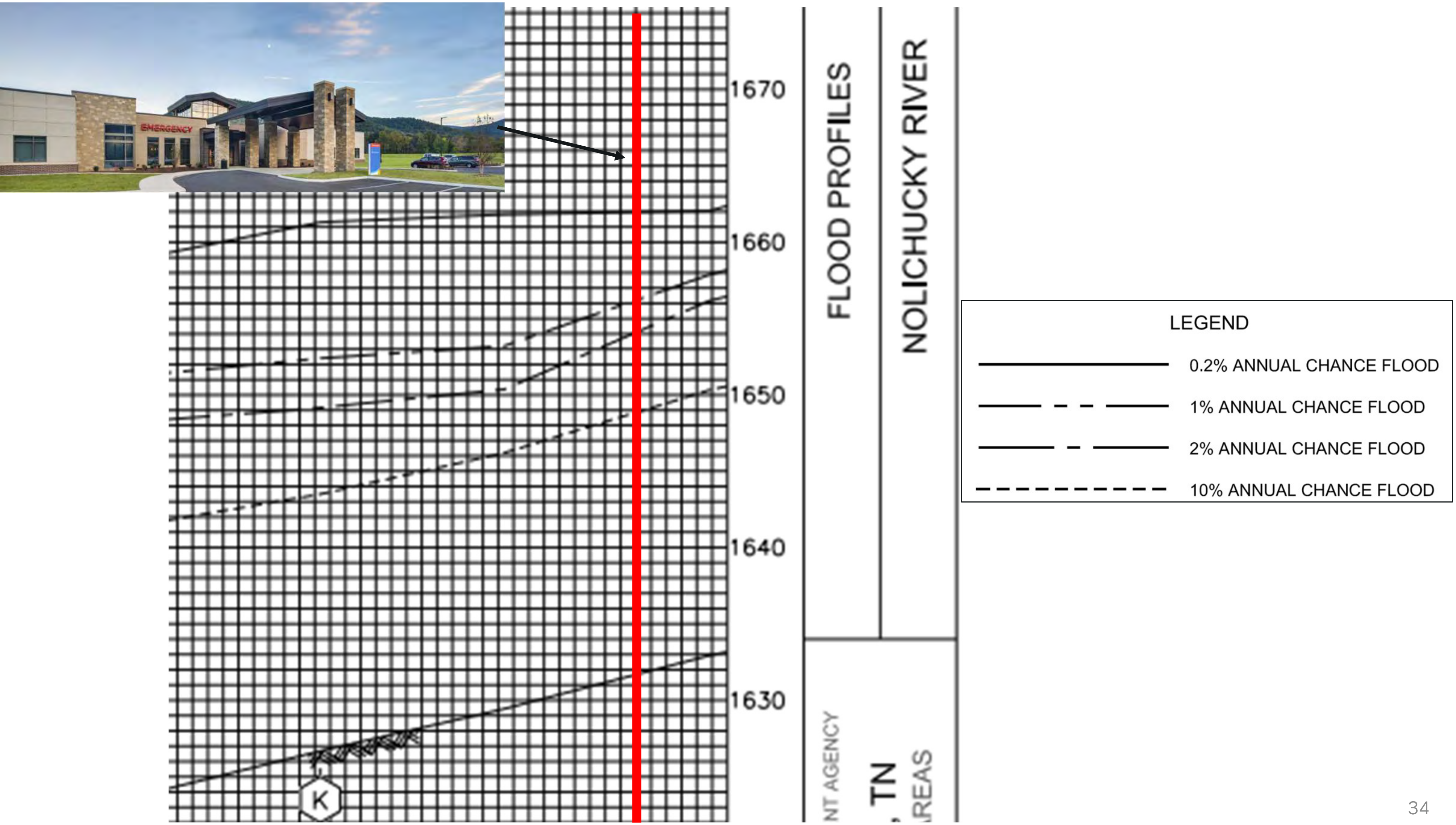
https://www.lsuagcenter.com/floodelev

What would be the DFE for the hospital under ASCE 24-24?





ELEVATION IN FEET (NAVD)
STREAM DISTANCE IN FEET ABOVE COUNTY BOUNDARY
1600
1610
1620
1630
1640
1650
1660
1670
1680
1690
13,000
13,500
14,000
14,500
15,000
15,500
16,000
16,500
17,000
17,500
18,000
18,500
19,000
19,500
CONFLUENCE OF SOUTH INDIAN CREEK
INTERSTATE 26
EMERGENCY
G
H
I
J
K
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
A
CROSS SECTION LOCATION
FLOOD PROFILES
NOLICHUCKY RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
UNICOI COUNTY, TN
AND INCORPORATED AREAS
10P


EMERGENCY
1670
1660
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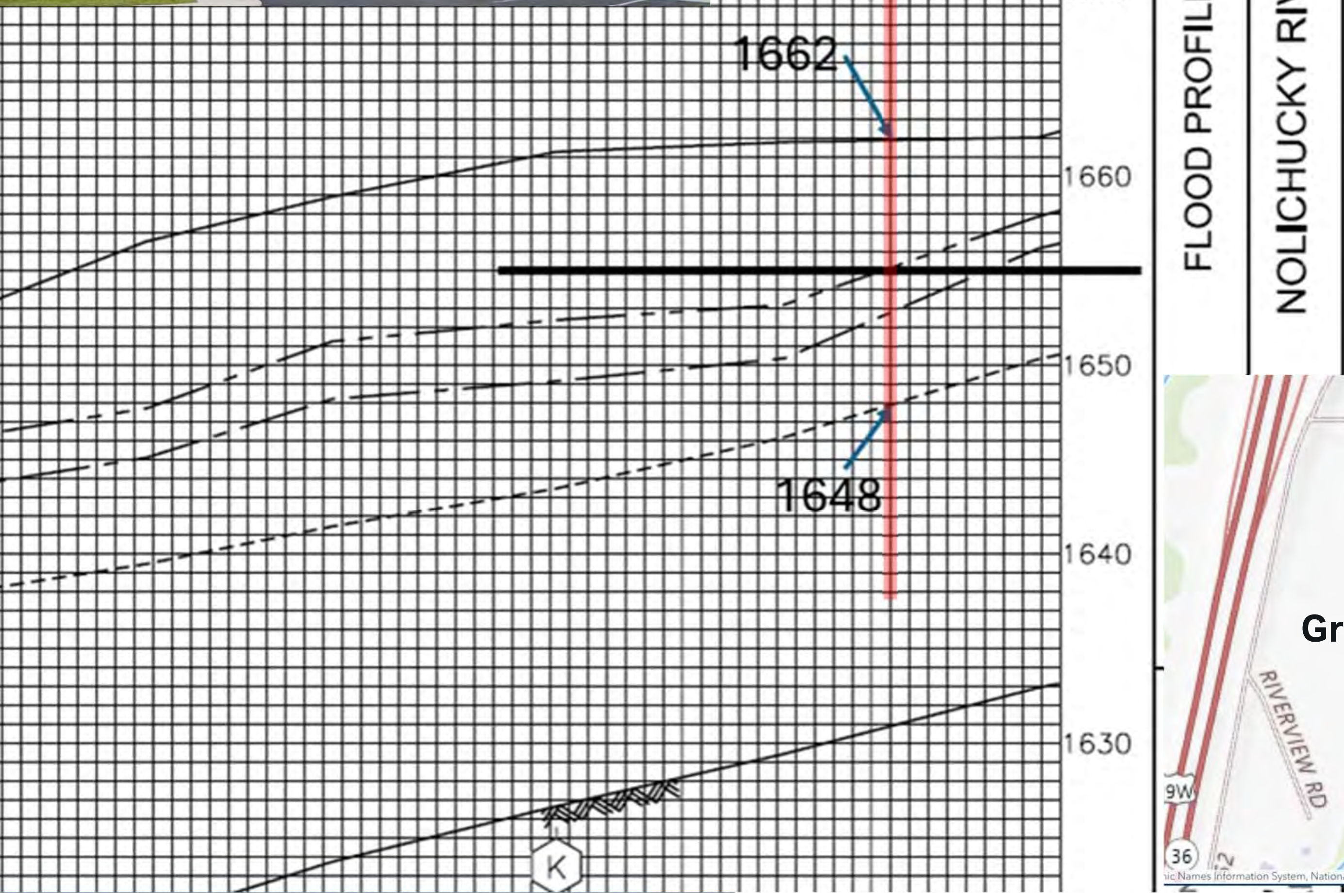
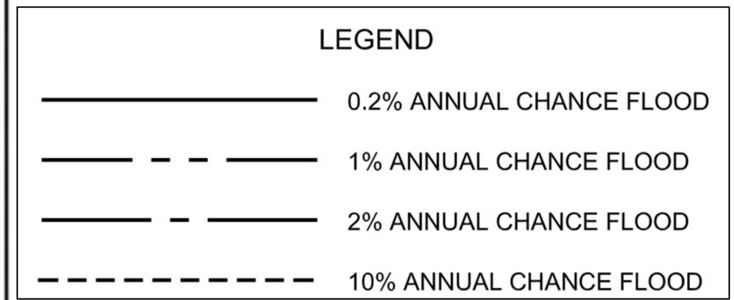
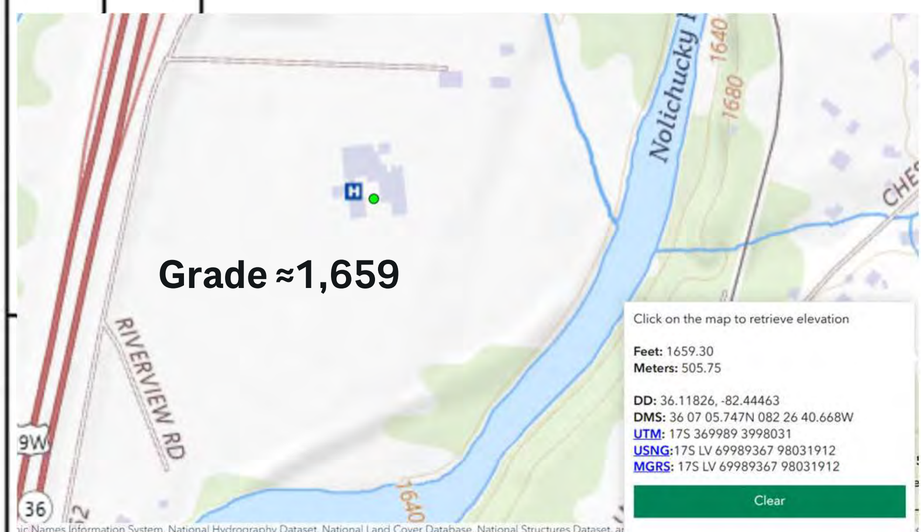
1640
1630
K
FLOOD PROFILES
NOLICHUCKY RIVER
NT AGENCY
, TN
REAS
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD





0.2% annual chance (500-year) is 1,662
1% annual chance (100-year) is 1,655
10% annual chance (10-year) is 1,648




Zone AE
1654
1655
UNICOI COUNTY
470238
Zone AE
Zone AE
Zone AE
(EL 1665)
1655


McDavid Ln
McDavid Ln
Nolichucky River
Ground: 1,658.9 ft
1,650 ft
1,640 ft
500 ft
832 ft
1,000 ft
1,500 ft
Ground
New profile
Chestoa Pike

This tool will help determine the minimum required elevation in accordance with ASCE/SEI 24-24.

All elevations entered in the tool must have the same vertical datum (e.g. NAVD 88, NGVD 29).

Flood Design Class: 4

Flood Source: Riverine

Flood Zone: Shaded X

Flood Protection: Elevated ◉ Dry Floodproofed ○

Please enter the following flood elevation information:

FEMA Flood Map Service Center: https://msc.fema.gov/portal/home

Base Flood Elevation (BFE), FE_{100}, 100-year Flood Elevation: 1655 ☐ Data is not available

1000-year Flood Elevation: ☑ Data is not available

500-year Flood Elevation: 1662 ☐ Data is not available

Is there a community flood elevation ordinance that needs to be included? ○ Yes ◉ No

Submit

0.2% annual chance (500-year) is 1,662
1% annual chance (100-year) is 1,655
10% annual chance (10-year) is 1,648

Based on your input, the minimum elevation required for your building or structure is computed, which is shown below.

Minimum Required Elevation: 1665 ft

Minimum Height Above BFE: 10 ft

Design Flood Elevation (DFE) based on provided inputs is displayed in the table below. DFE is compared with ASCE/SEI 24-24's minimum freeboard standards.

Elevation Requirements (Ref. ASCE/SEI 24-24 Table 1-2) Create PDF Report				
DFE (highest of values)		BFE + ASCE Freeboard		
FE_{MRI}	FE_{com}			
1665 ft	**Not Applicable**	BFE +	2	**1657 ft**
Minimum Required Elevation is the heighest of the above values: **1665 ft**				


Zone AE
1655
1654
UNICOI COUNTY
470238
Zone AE
Zone AE
(EL 1665)
1655
Zone AE
SCHOOL BUS
McDavid Ln
McDavid Ln
Nolichucky River
Ground: 1,653.1 ft
1,650 ft
1,640 ft
228 ft
500 ft
1,000 ft
1,500 ft
Ground
New profile
Chestoa Pike

Flood Design Class: 3

Flood Source: Riverine

Flood Zone: A Zone

Flood Protection: ◉ Elevated ○ Dry Floodproofed

Please enter the following flood elevation information:

FEMA Flood Map Service Center: https://msc.fema.gov/portal/home

Base Flood Elevation (BFE), FE_{100}, 100-year Flood Elevation: 1655 ☐ Data is not available

750-year Flood Elevation: ☑ Data is not available

500-year Flood Elevation: 1662 ☐ Data is not available

Is there a community flood elevation ordinance that needs to be included? ○ Yes ◉ No

Submit

0.2% annual chance (500-year) is 1,662
1% annual chance (100-year) is 1,655
10% annual chance (10-year) is 1,648

Based on your input, the minimum elevation required for your building or structure is computed, which is shown below.

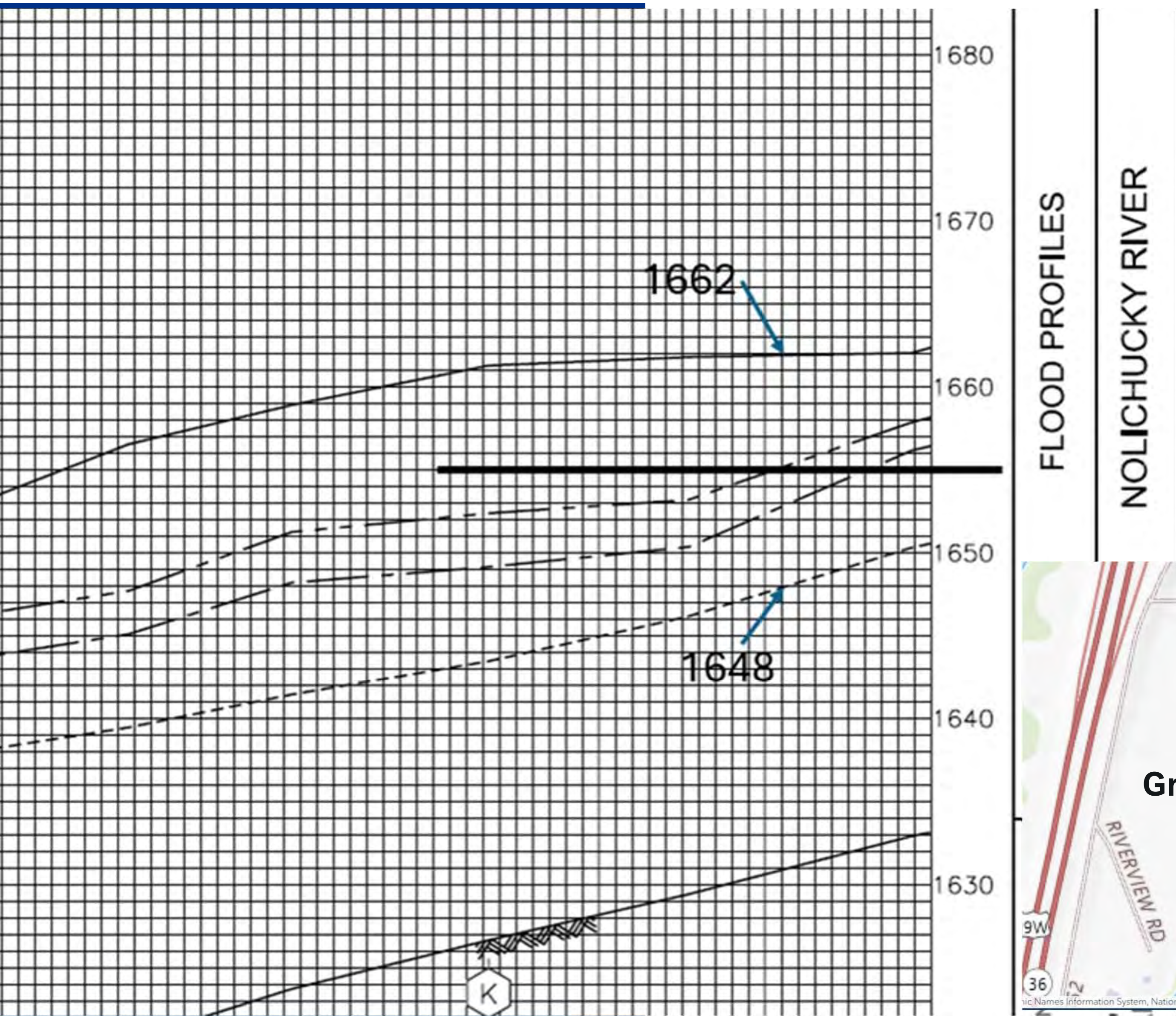
Minimum Required Elevation: 1663.8 ft

Minimum Height Above BFE: 8.8 ft

Design Flood Elevation (DFE) based on provided inputs is displayed in the table below. DFE is compared with ASCE/SEI 24-24's minimum freeboard standards.

Elevation Requirements (Ref. ASCE/SEI 24-24 Table 1-2) Create PDF Report				
DFE (highest of values)		BFE + ASCE Freeboard		
FE_{MRI}	FE_{com}			
1663.8 ft	**Not Applicable**	BFE +	2	**1657 ft**
Minimum Required Elevation is the heighest of the above values: **1663.8 ft**				


Zone AE
1654
1655
UNICOI COUNTY
470238
Zone AE
Zone AE
Zone AE
(EL 1665)
1655
McDavid Ln
McDavid Ln
McDavid Ln
Nolichucky River
Nolichucky River
Ground: 1,655.2 ft
1,650 ft
1,640 ft
500 ft
1,000 ft
1,465 ft
Ground
New profile
Chestoa Pike



LEGEND

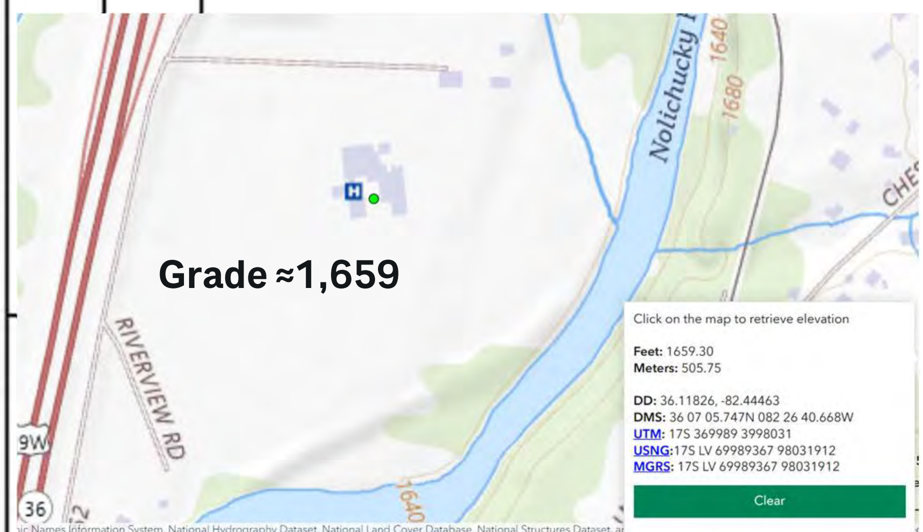
0.2% ANNUAL CHANCE FLOOD

1% ANNUAL CHANCE FLOOD

2% ANNUAL CHANCE FLOOD

10% ANNUAL CHANCE FLOOD

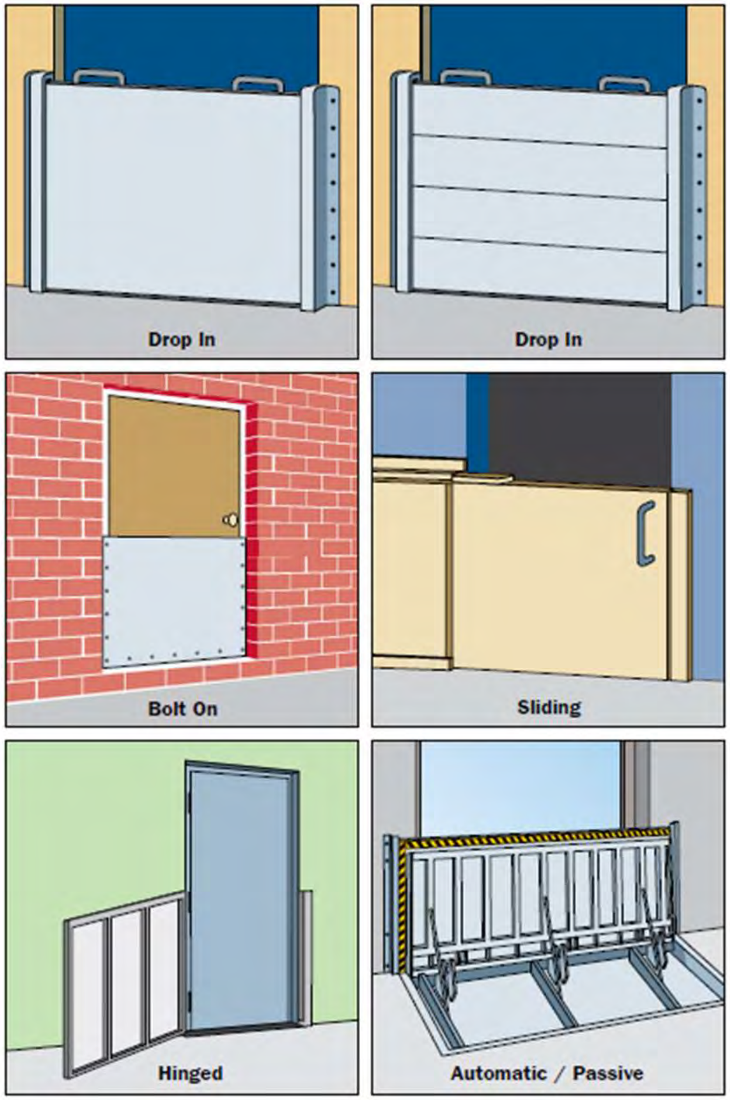
0.2% annual chance (500-year) is 1,662
1% annual chance (100-year) is 1,655
10% annual chance (10-year) is 1,648



Key Change: Dry Floodproofing Requirements

Dry Floodproofing requirements

- New/Modified Definitions
- **Allowable Shield Types**
- **ANSI/FM 2510**
- Opening barrier vs “temporary floodwall”
- Marking and identification
- **Planning and Inspection Requirements**



Dry Floodproofing – Allowable Shield Types

	Flood Design Class	- Permanent Fixed Passive - Permanent Automatic Passive - Permanent Active	Contingent Active (stored on site)	Contingent Active (stored on or off site)
New Construction	1	✓	✓	✓
	2	✓	✓	X
	3	✓	✓	X
	4	✓	X	X
Substantial Improvement	1	✓	✓	✓
	2	✓	✓	✓
	3	✓	✓	X
	4	✓	X	X

Source: *ASCE 24-24, Table 6-1, With permission from ASCE*

✓= Allowed
X = Not Allowed

Permanent
(barrier permanently next to opening)

- Slide/swing gate
- Passive gate

Contingent (removeable)

- Stop logs
- Removeable panels

Image Source: FEMA

Dry Floodproofing requirements - Shields must meet ANSI/FM 2510

- The shields and all necessary accessories for the shields shall be tested to and certified to meet the applicable requirements of the ***American National Standard for Flood Mitigation Equipment***, ANSI/FM 2510, including, but not limited to, the general component and water performance testing requirements for opening barrier applications.
- In an existing building where substantial improvement is triggered, when an available ANSI/FM 2510 tested and certified shield does not meet the required maximum width or water depth specifications for a particular installation, a licensed design professional shall evaluate on a case-by-case basis to determine the acceptability of increasing the size of an available ANSI/FM 2510 tested and certified shield. The design professional must have a minimum of 5 years' experience in flood resistant design, and such specifications are restricted to substantial improvements rather than new construction.

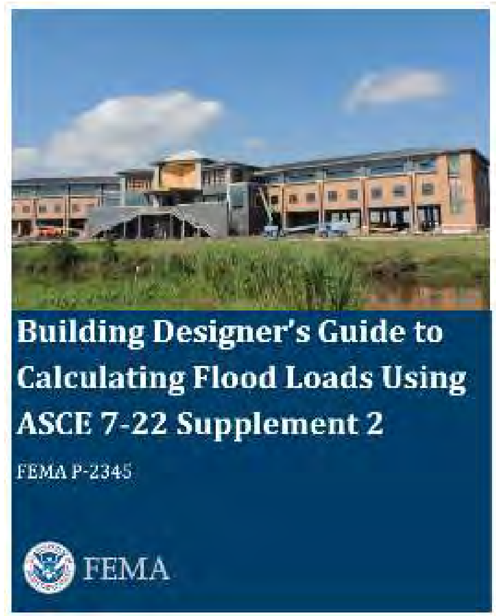
Dry Floodproofing requirements - Planning and Inspection Requirements

- Required plans – Inspection, Maintenance, and Operations
- Annual inspection and full-scale deployment
- Time required to implement the measures is less than
  - 12 hours for Flood Design Class 1 and Flood Design Class 2,
  - 8 hours for Flood Design Class 3, and
  - 4 hours for Flood Design Class 4
- For structures with permanent automatic passive measures the plan should include an audio or visual device to alert the building owner or designated representative as well as occupants that the measures have been implemented and additional steps in the operations plan may be triggered

Other Changes

ASCE 7-22 Supplement 2 – Flood Loads

- 1.6 LOADS IN FLOOD HAZARD AREAS
  - 1.6.1 General Design of structures within flood hazard areas shall be governed by the loading provisions of ASCE/SEI 7.
    - ASCE 7-22 Supplement 2



Other (some of the 29 items in the 24-24 Preface highlighting changes from 2014 to 2024 that we did not get to)...

- The **elevation requirements have been relocated** and modified to Chapter 1.
- Clarifications were made to the **FDC applicable to Hospitals, Health Care and Ambulatory Care Facilities**.
- Exceptions in the location of **flood openings for buildings on sloped sites** and **interior areas with a single exterior wall.**
- Criteria for **helical piles and anchors** have been added.
- **Door at DFE** above elevated buildings with enclosures.
- Criteria for the **distinction between columns and walls** have been added.
- New buildings and structure **shall not be supported by or bear on bulkheads**, seawalls, revetments, and other erosion control structures.
- **Glass Fiber Reinforced Polymer** (GFRP) reinforcement has been added to Chapter 5 Materials.
- Dry floodproofing limited to areas with velocity less than 5 feet per second, **removed**
- Attendant utilities and equipment serving residential buildings and residential portions of mixed-use buildings are not permitted in dry floodproofed enclosures.
- Automatic pressure control valves are required for flammable gas and fuel supply lines.
- Self-supporting decks and porches shall be located to avoid obstructing the free flow of floodwater under structures.
- **Tents and membrane structures** have been added to Chapter 9.

Summary and Resources

ASFPM members have access to ASCE 24-24

Exclusive Member Benefit: Free Access to ASCE 24-24

New flood standard is now free for ASFPM members ***(a $165 value)***

ASFPM is proud to offer members free digital access to the new **ASCE 24-24: Flood Resistant Design and Construction,** which establishes minimum requirements for building structures in flood hazard areas.

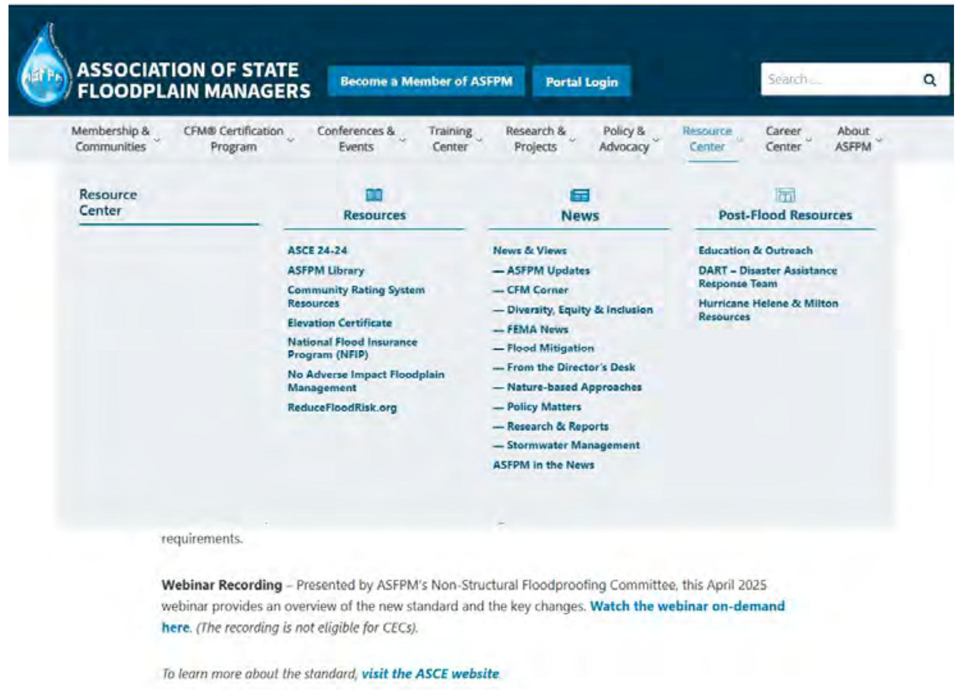
Published by the American Society of Civil Engineers, the new ASCE 24-24 redefines how we design and build in flood hazard areas — aligning with the latest data and practices to help communities reduce risk and future losses.

> *"This may be the most significant upgrade in the nation's flood loss reduction standards since the creation of the NFIP minimums in 1973."*
>
> Chad Berginnis, CFM, Executive Director, ASFPM

The 2024 edition provides new, recommended minimum standards for flood resistant design and construction of structures that are subject to building code requirements, floodplain management regulations, or other requirements that cite this standard. While not a requirement to be adopted under the NFIP at this time, the new standard nonetheless represents an opportunity for communities to adopt a new national standard that has been through a rigorous consensus process.

Model Floodplain Ordinance Language

- ASFPM is developing model ordinance language to incorporate key elements of ASCE 24-24 – it will be posted to our website and included in ASFPM's updated Higher Standards Guide
- ASFPM can assist on an as needed basis – contact our policy team



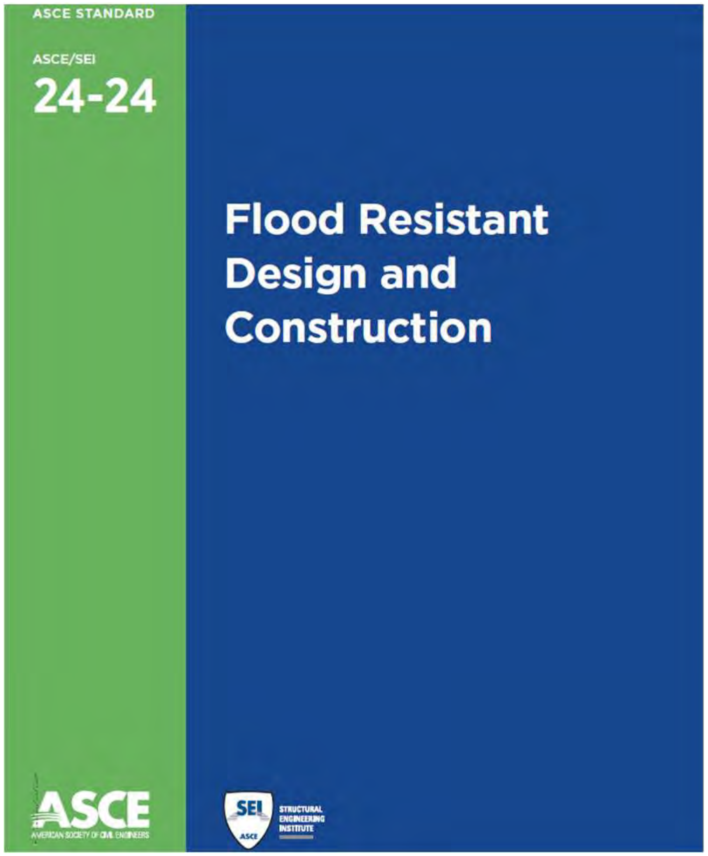
At Committee Action Hearing #1 in Orlando earlier this year, the ASCE Proposal to incorporate ASCE 7-22-Supplement 2 and ASCE 24-24 into the 2027 **International Building Code** (supported w/ 13 of 14 votes).

The ASCE Proposal to incorporate ASCE 7-22-Supplement 2 and ASCE 24-24 into the 2027 **International Residential Code** (w/ 7 of 10 votes disapproving of the proposal)

If today we are building to yesterday’s standards, we are building tomorrow’s problems

- Nationwide, average annual flood losses have doubled each decade since the 1990's. Annual losses now average **over $40 billion/year**. Yesterday's standard aren't good enough
- Every floodplain is **not created equal/the same**
  - MRI basis provides consistent levels of protection across floodplains
  - Extent, Depth, Velocity, etc.
- FEMA’s **Flood Maps/Products** only illustrate **historic flood risk**
- You however should be building for the **lifespan of the asset**
- **Code minimums** often **only** consider **structural** damage and **contents** damage
- Consider **downtime** and other factors like the impact of future flood conditions on **insurability** and your **credit rating**
- **Build right the first time**, because future retrofits can be prohibitively expensive

Questions



- Background – why change/upgrade the standard?
- Brief History of ASCE 24
- ASCE 24 compared to the NFIP
- Key Changes in 24-24 compared to the NFIP
- Resources

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