

Resilient Stormwater Design For Northern Virginia

Regional Transportation Resilience
Subcommittee

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Nora Jackson, NVRC



ADVANCING RESILIENT DESIGN GUIDELINES FOR NORTHERN VIRGINIA

Task 5: Stormwater Guidelines Document

SEPTEMBER 1, 2026

WORKING DRAFT DOCUMENT

NOTE: This is a working draft document, intended for reviewing draft text, structure, messaging, etc., and gathering feedback on proposed graphics. The draft formal document will pivot from this to a document in desktop publishing software with aesthetic layout/formatting, etc., created by a professional designer. At that time, figure text sizes will be further reviewed for readability in the final layout.



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Project funded by DCR's Community
Flood Preparedness Fund.

Executive Summary

The primary goal of these guidelines is to establish a consistent approach for incorporating forward-looking rainfall amounts into the planning and design of stormwater drainage infrastructure.

Why now?

- Aging infrastructure, increasing development, undersized systems and outdated guidance. Intermediate approach while we wait for federal updates and multi-year DEQ rulemaking process

What are the benefits of increased standards?

- Reduced long term flood risk, damage and disruption of services

Key considerations

- Land use planning and context, design standards for engineering and development, capital improvement planning, outreach and education

Recommended Approach

- Single regional value: 18%

Introduction and Overview

Purpose, need, and stakeholder engagement process

More pavement.
Faster flooding.



Here's why NoVA
floods the way it does.

Flood Ready
NOVA

Development Process



The Case for Resilient Design Guidelines

Aging infrastructure, observed flooding and impacts,
historical rainfall trends and future projections,
regional vulnerability to increased rainfall flooding,
and benefits of increased standards

Current Conditions



Damage along Kirby Road from the July 8, 2019 Flooding Event.
Fairfax County PD

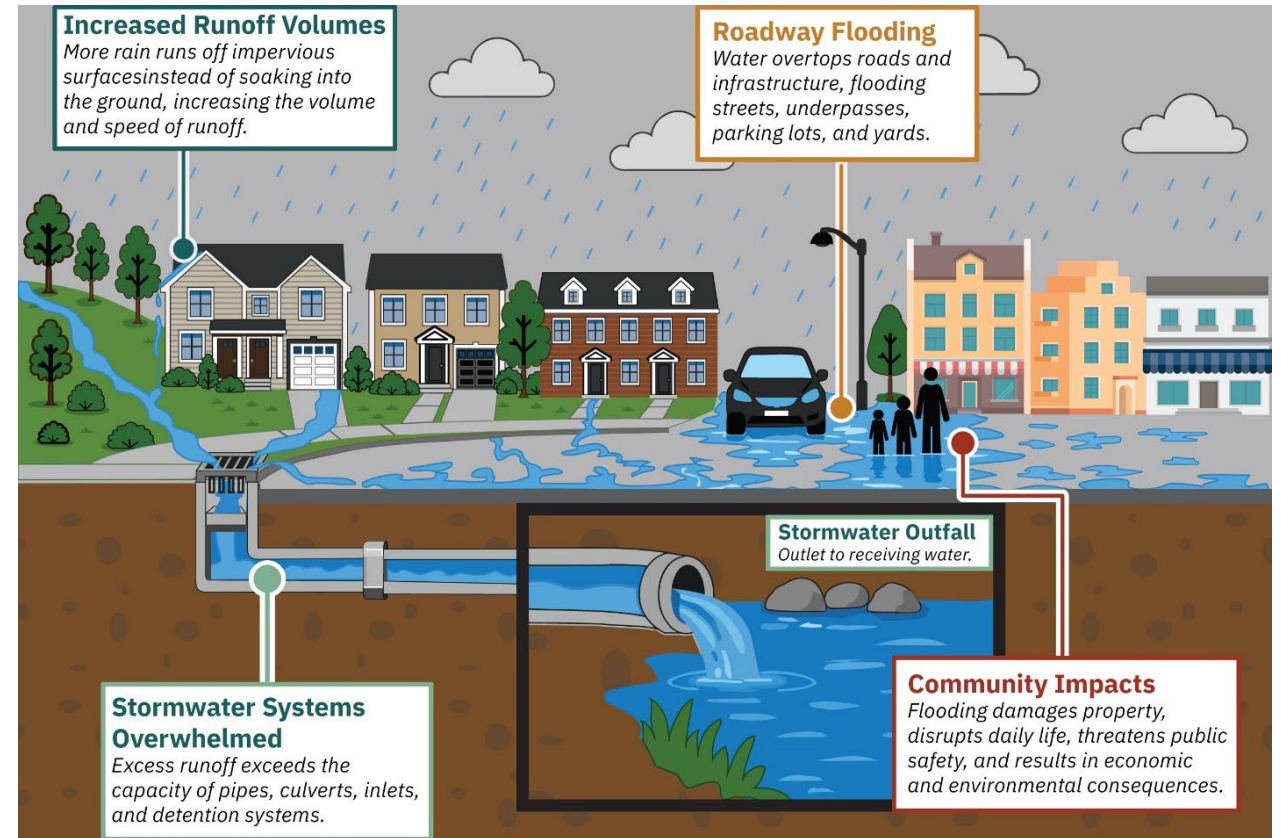
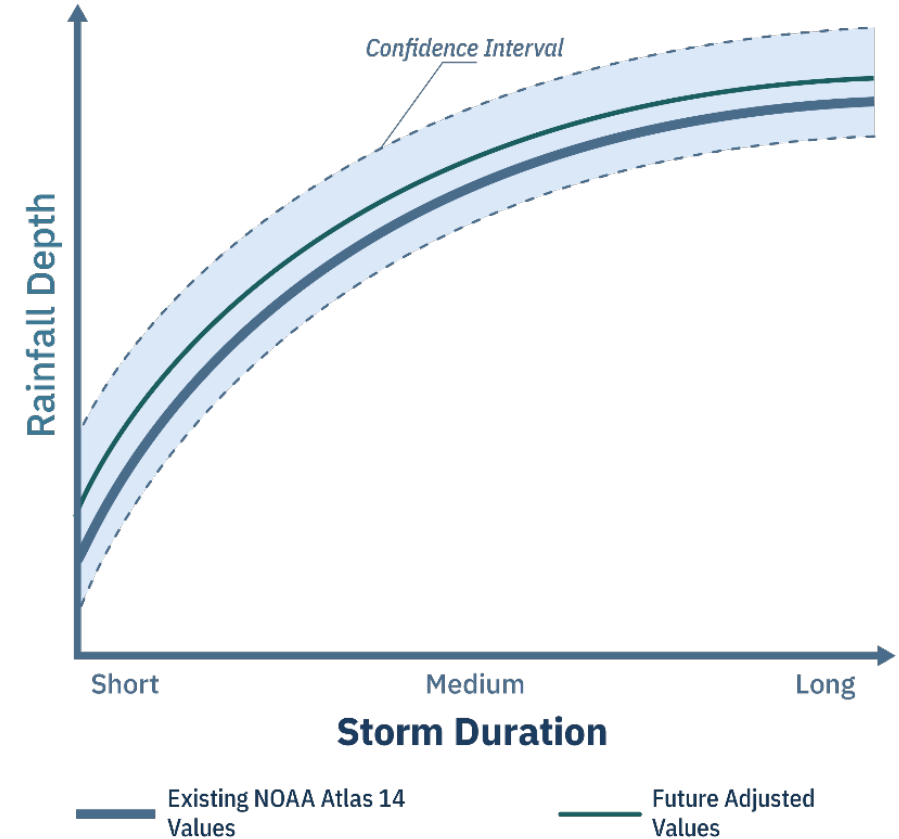
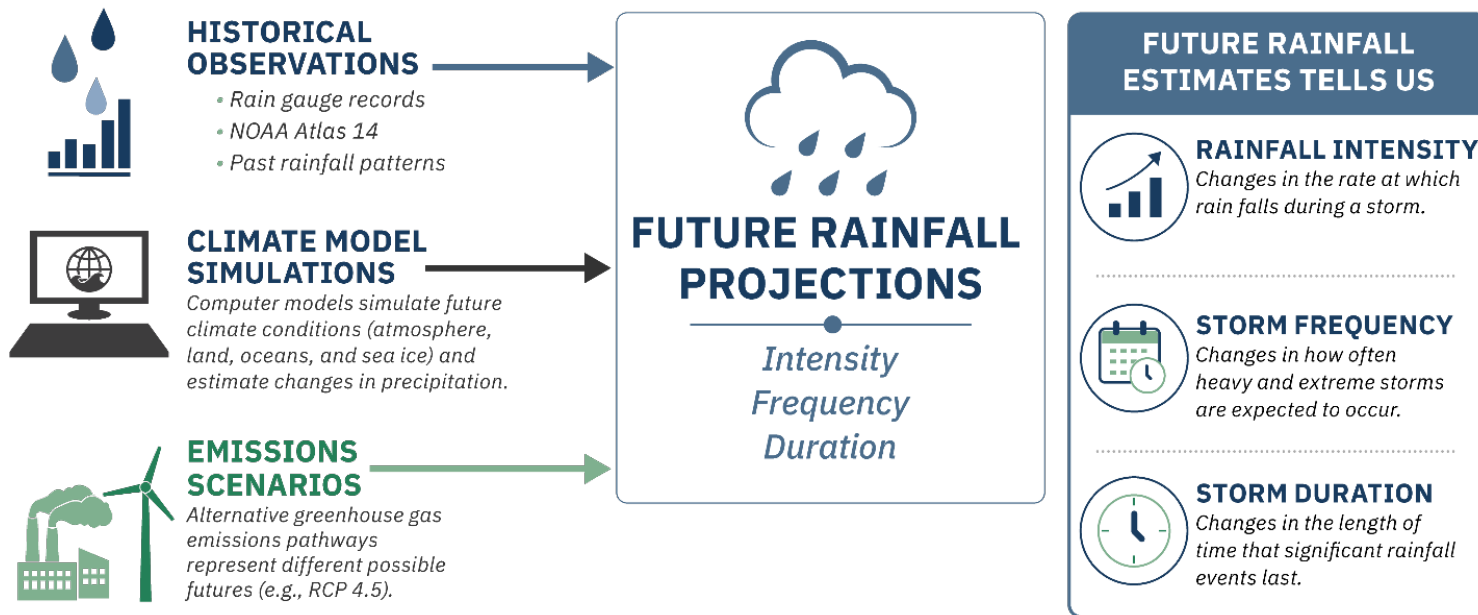


Diagram illustrating the relationships among increasing rainfall intensity, increased runoff volumes, overwhelmed stormwater systems, roadway flooding, and impacts on people and property.

Historical Trends and Future Projections

Developing Future Rainfall Estimates

Future rainfall estimates are derived from a combination of historical observations, climate models, and emissions scenarios.

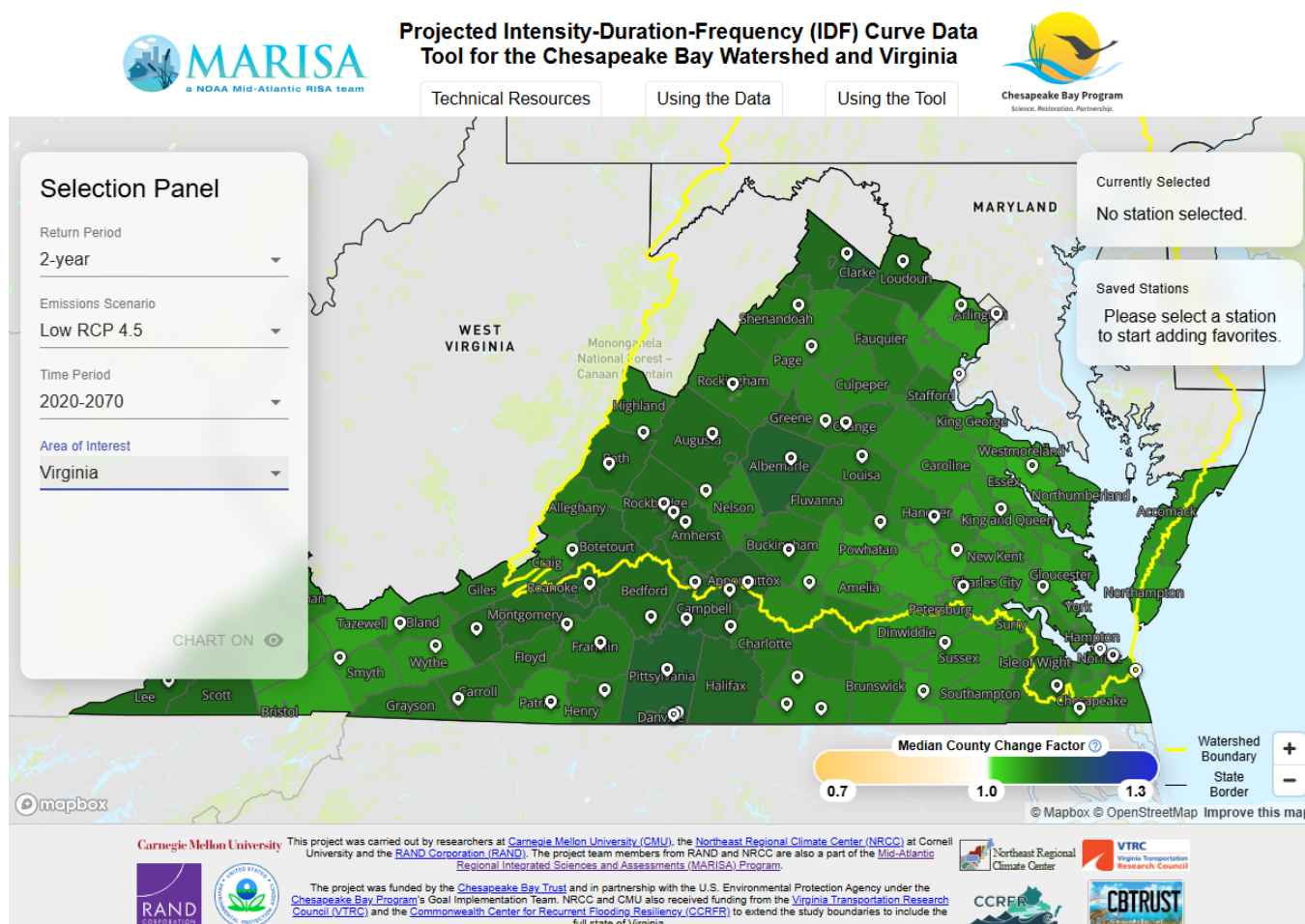


Conceptual representation of an IDF curve showing future adjusted rainfall depths and associated uncertainty relative to existing NOAA Atlas 14 values.

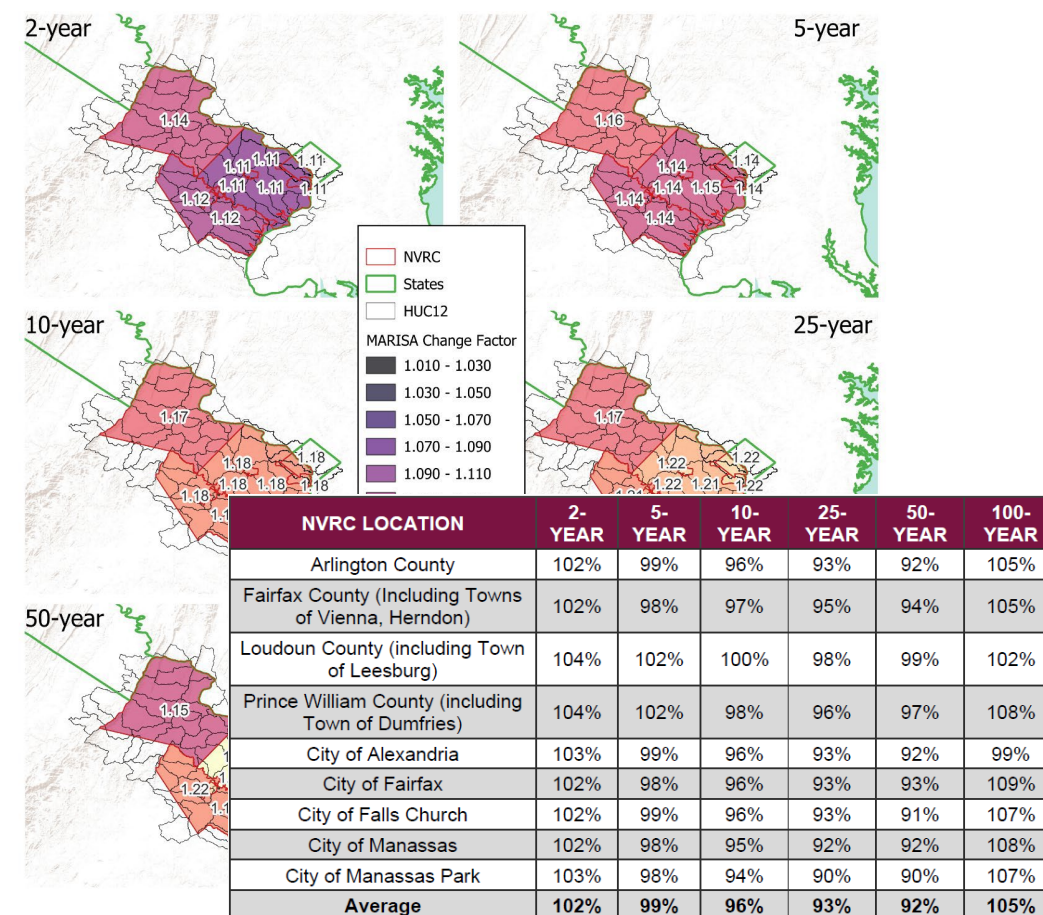
Proposed Regional Guideline for Increased Rainfall

Regional approach and factor, applying the guidelines, addressing
uncertainty and existing and pending guidelines

Rainfall Change Factor Development



MARISA RCP-4.5 2050-2100



NOVA Methodology

Selected time horizon and emissions scenario: RCP4.5, 2050-2100

- While RCP8.5 is often considered the “worst-case scenario” for emissions, change factors from **RCP4.5 produce the greatest change** across most return periods

Change factors **vary spatially** and **inconsistently** across the region depending on emission scenario and time periods.

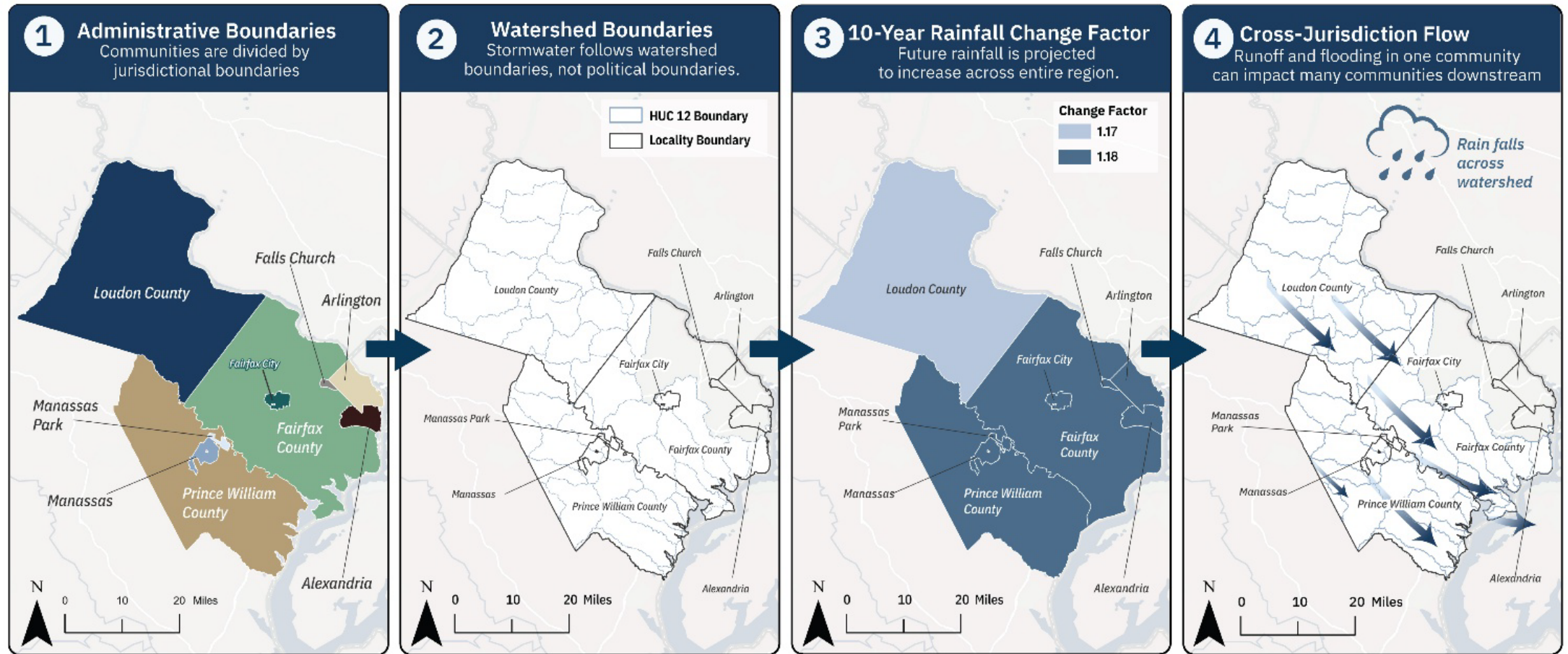
- **The maximum region-wide change factor** was selected for each locality within the NVRC communities for the **2050-2100 time period and RCP4.5 emission scenario** rather than average to prevent the potential for underestimation.

Final recommended change factor is 1.18, average of RCP4.5 maximum change factors

- The **1% difference in change factor value** between RCP4.5 and RCP8.5 results in minimal differences in actual precipitation values in adjusted IDF curves.

NOVA Methodology

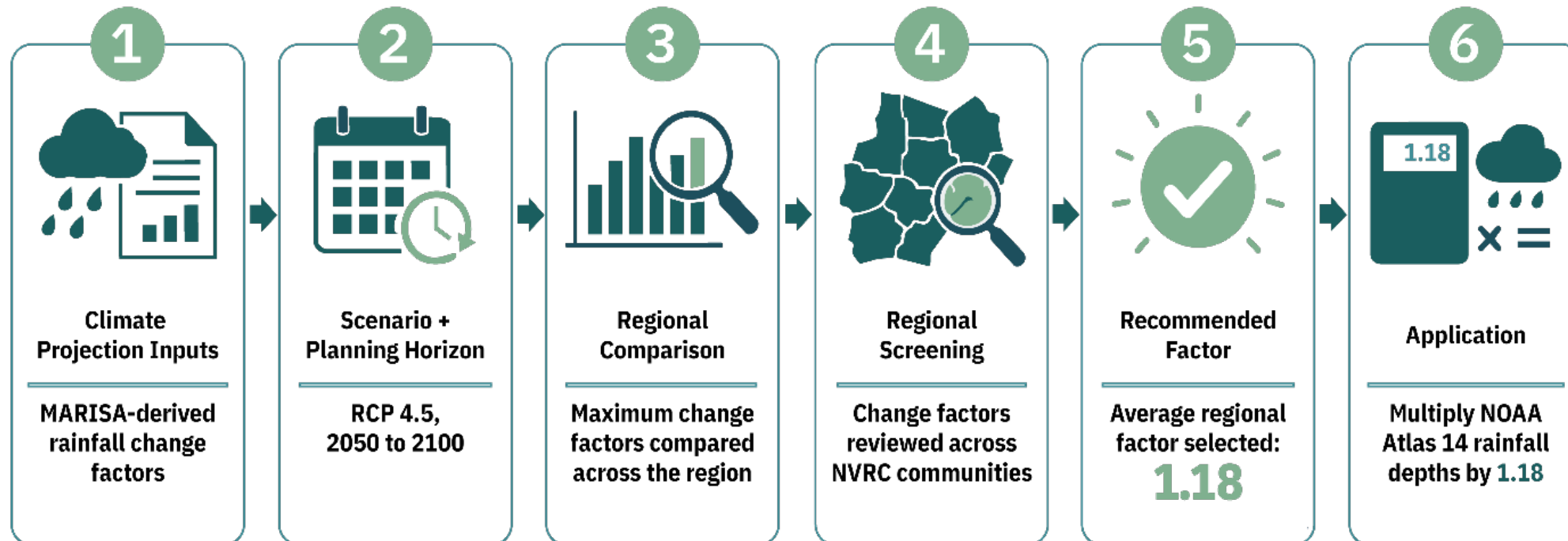
Regional Watersheds Cross Jurisdictional Boundaries and Support a Consistent 10-Year Rainfall Planning Approach



NOVA Methodology

Development of the Recommended NVRC Regional Rainfall Change Factor

MARISA-derived change factors were reviewed across NVRC communities to select a regional planning factor for adjusting NOAA Atlas 14 rainfall depths.



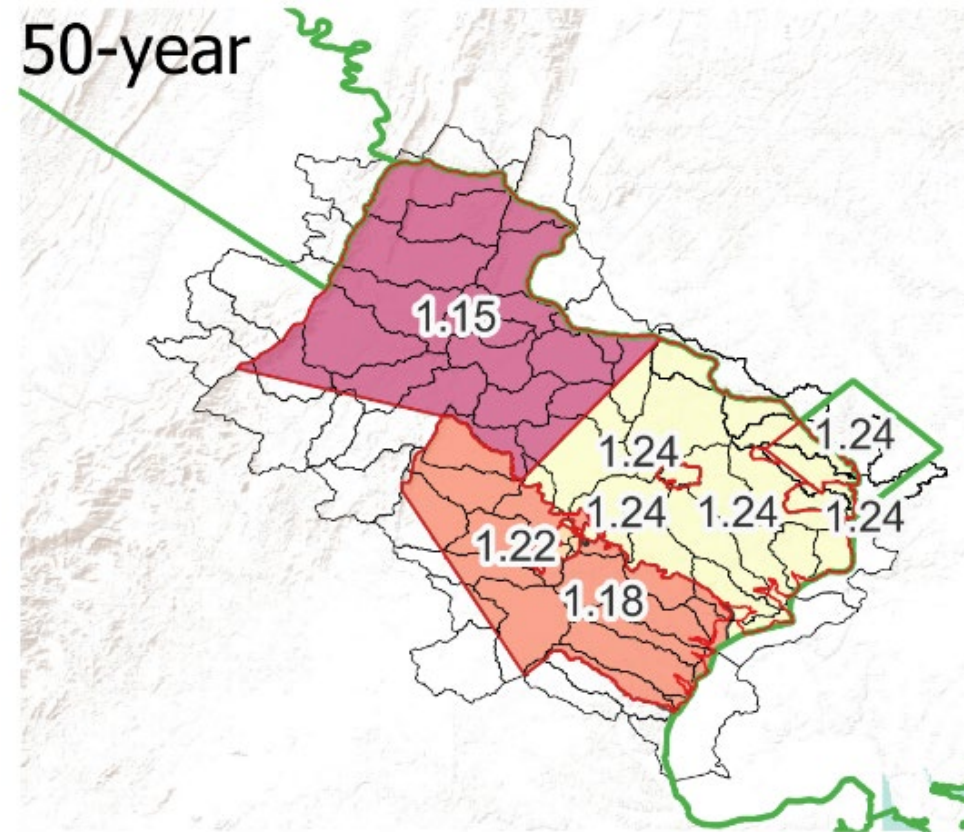
Promoting Regional Consistency

Watersheds are shared

Small communities should not be different from their neighbors

Variances exist and should be simplified

Single factors across regions can simplify implementation

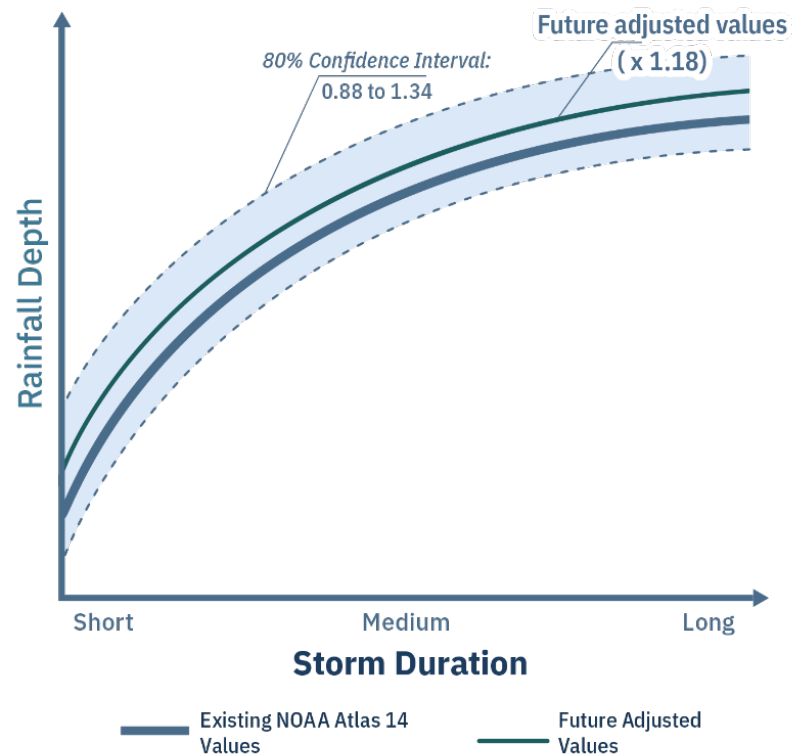


Benefits of regional approach

Call-Out Quote: “The more people understand the background to these decisions and why they were made, the easier they are for people to accept.” – Staff member from a Northern Virginia locality

Call-Out Quote: “It’s important that we’re all on the same page and that we don’t have to try to defend ourselves against somebody else’s lower standard.” – Staff member from a Northern Virginia locality

Applying the guidelines to existing rainfall



Conceptual illustration only. The 1.18 factor is intended for use across rainfall durations and frequencies available in NOAA Atlas 14, Volume 2.

HOW THE ADJUSTMENT IS APPLIED

Future rainfall = Existing Atlas 14 rainfall x Change factor

$$4.90 \text{ in} \times 1.18 = 5.78 \text{ in}$$

Example: 10-year, 24-hr rainfall



Scenario: RCP4.5 (2050 to 2100)



Recommended regional change factor: **1.18**



Represents an 18% increase above existing NOAA Atlas 14 rainfall depths

SHORT: Brief, high-intensity rainfall events
(Example duration: 5 minutes, 15 minutes, 1 hour)

MEDIUM: Moderate-duration storm events
(Example duration: 2 hours, 6 hours, 12 hours)

LONG: Longer-duration rainfall events
(Example duration: 24 hours, 2 days, 7 days)

WHY THIS MATTERS



Design based on only historical rainfall will underrepresent future conditions



Applying the regional change factor helps account for projected changes in rainfall

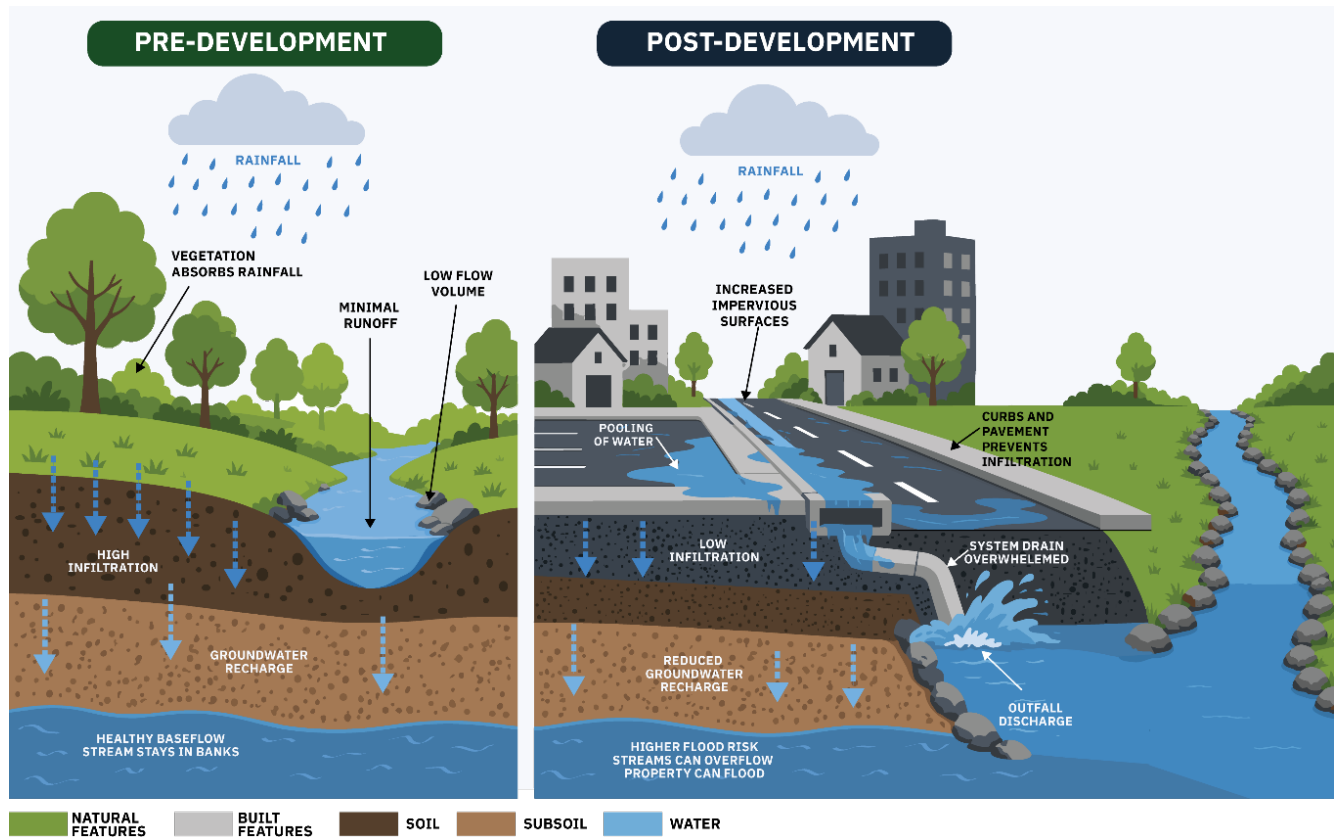


The confidence interval illustrates uncertainty in rainfall estimates

Considerations for Implementation

Existing increased rainfall standards, local considerations, land use planning and context, design standards for development, engineering criteria and alternatives, capital improvement planning, state regulatory considerations, outreach and education

Land use planning and context



Comparison of pre-development and post-development hydrologic conditions and their effects on stormwater runoff, infiltration, and streamflow.

A case study of potential different design specifications for pre- and post-development rainfall amounts was completed to illustrate how these differences can change site detention volumes. Four potential combinations of pre- and post-development conditions were evaluated, including:

- **Baseline Regulatory:** representing how Atlas 14 rainfall amounts are currently applied for site design, where the same existing Atlas 14 values are used for both pre- and post-development conditions.
- **Scenario 1A: Baseline with Resilience Guidelines Applied Post-Development:** representing application of the recommended change factor (1.18) to post-development conditions, as compared to the current regulatory Atlas 14 rainfall values as the pre-development condition.
- **Scenario 1B: Baseline with Resilience Guidelines Applied Pre- and Post-Development:** representing use of the future rainfall estimates with the recommended change factor (1.18) for both pre- and post-development conditions.
- **Scenario 2: Future Regulatory Baseline:** representing a potential updated Atlas 14, volume 13 pre-condition based on preliminary information (1.08 increase over existing Atlas 14), and the application of the recommended change factor (1.18) to post-development conditions.



Required detention increased **13–55%** across three hypothetical sites, ranging from 0.3 to 3 acres in size depending on site conditions and scenario.

State regulatory context

Authorization for more stringent ordinances is provided for in § 62.1-44.15:33 (A.): *“Localities that are serving as VESMP authorities are authorized to adopt more stringent soil erosion control or stormwater management ordinances than those necessary to ensure compliance with the Board's minimum regulations, provided that the more stringent ordinances are based upon factual findings of local or regional comprehensive watershed management studies or findings developed through the implementation of an MS4 permit or a locally adopted watershed management study and are determined by the locality to be necessary to prevent any further degradation to water resources...”*

The process for adoption is outlined in § 62.1-44.15:33 (B.): *“Localities that are serving as VESMP authorities shall submit a letter report to the Department when more stringent stormwater management ordinances or more stringent requirements authorized by such stormwater management ordinances, such as may be set forth in design manuals, policies, or guidance documents developed by the localities, are determined to be necessary pursuant to this section within 30 days after adoption thereof...”*

The Path Forward

Although it is up to each locality to consider adopting future rainfall amounts for stormwater design, the recommendations provided in these guidelines are intended to support localities with implementation and communicating the benefits of resilient design.

These guidelines are intended to be a living document that can be updated as the science evolves and communities share lessons learned.

Over the past two decades, rainfall has increased in frequency and intensity in the Northern Virginia region. This trend is expected to continue through the rest of the century. By incorporating considerations of changing rainfall patterns, infrastructure will continue to perform as it is intended for decades to come.

Although there are upfront costs associated with constructing and updating existing infrastructure to accommodate additional rainfall and runoff, doing so will mitigate future flood impacts, which are ultimately more costly.

Coming soon

Final publication

- ~December 2026

Appendices:

- Review of Member Community Stormwater Design Requirements and Guidelines
- Rainfall Change Factor Development
- Historical Heavy Rainfall Analysis
- Literature Review of Resilient Stormwater Practices and Summary of Stakeholder Interviews
- Sample form letter notifying DEQ of increased standards

Webinar and outreach toolkit

- January/February 2027



Thank you!

Questions?

njackson@novaregion.org