Critical Watershed Groups

RAMP Overview and Discussion

June 2024

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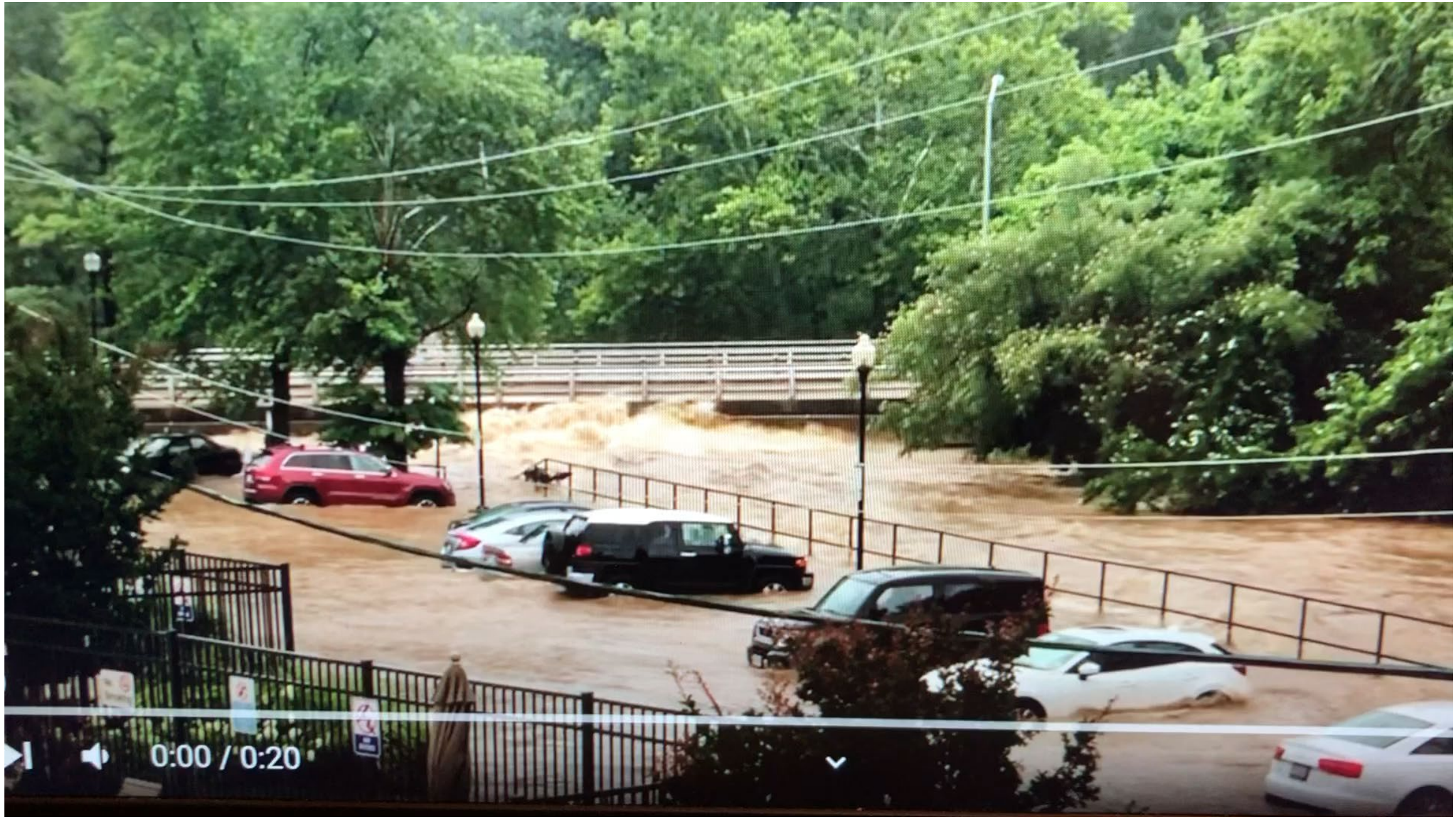
Agenda

- The Legacy, the Challenge and the Response
  - Pivot to Flood Resilient Arlington
  - Deploy Risk-Management Strategy
- RAMP-ing Up for Storms
  - Executive Summary - Scope & Deliverables
  - Analytics – Vulnerability and Risk
- Conveyance / Detention Projects
  - Including Cost-Benefit Analyses
- Program / Policy Recommendations
- Wide Use and Application of the RAMP
- Internal/Public Engagement
- What Follows the RAMP

The Legacy, the Challenge, the Response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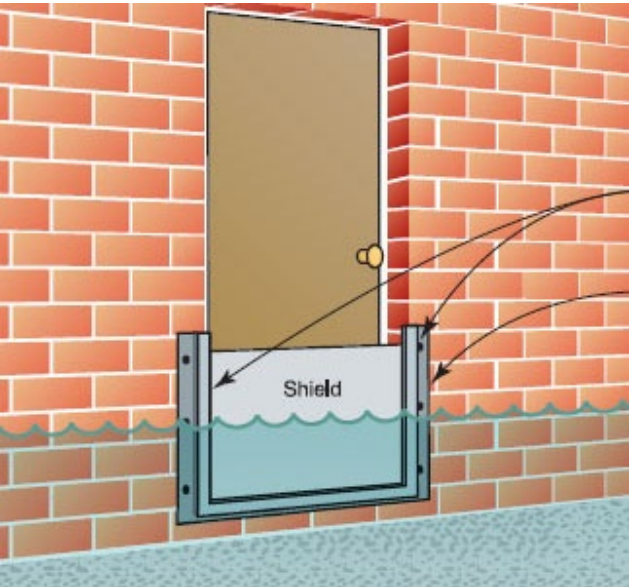
This is what it looks like when the stormwater system overflows

Environmental Risks and Cascading Impacts

- Economic disruption
  - Property loss, supply chain disruption, economic activity interruption
  - Re/insurance markets
  - Bonding / Cost-of-Debt
- Physical damage
  - Damage to roads, utilities, assets, communications, buildings, facilities
- Health and public safety
  - Loss of life, interruption in critical emergency services
- Population displacement
  - Short term displacement, long term relocation



Pivot to Flood Resilient Arlington

Analytics and Data Assessment

New Types and Locations for Capacity Projects

Increased Stormwater Requirements

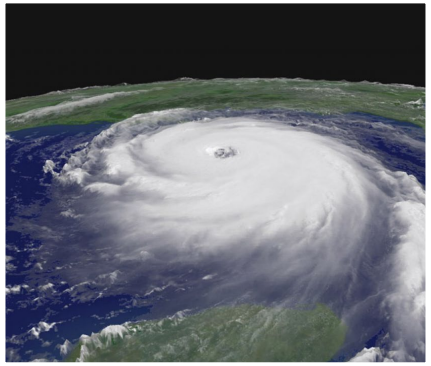
Increased Funding

Voluntary Property Acquisition

Floodproofing Outreach

RAMP Resilience Planning Approach

Develop Framework

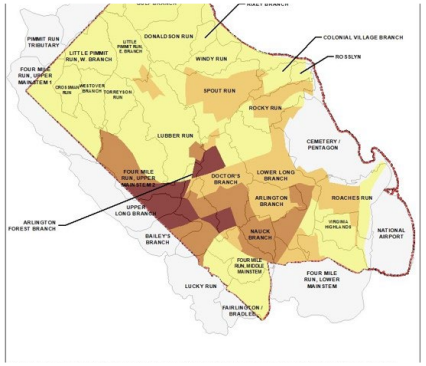


Goals

Climate Scenarios

Tools

Identify Vulnerabilities

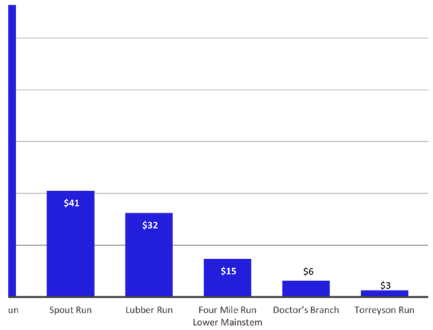


Facility inventory
Flood modeling

Vulnerability Assessments

Risk Analysis

Adaptation Strategies

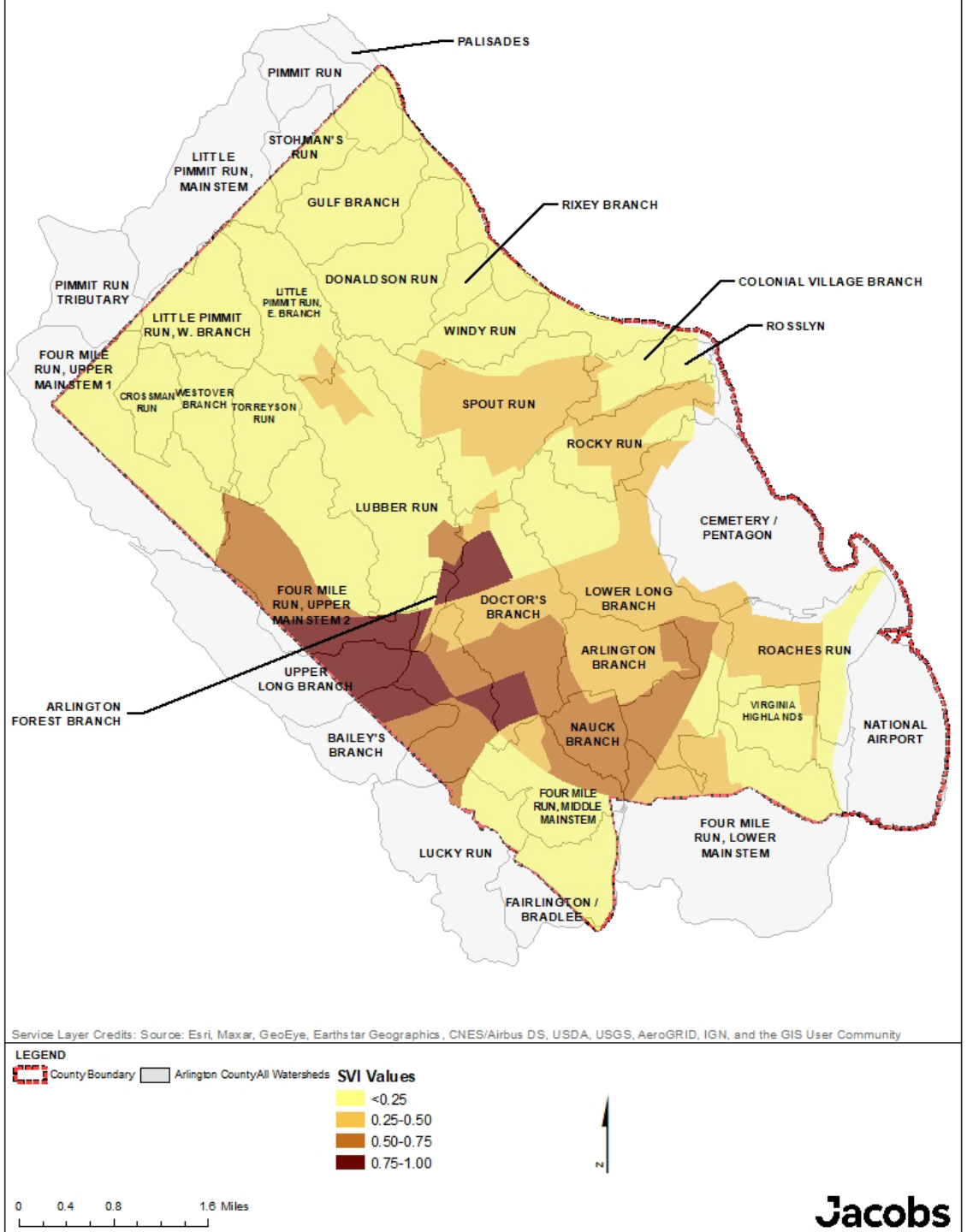


Cost benefit analysis

Programmatic strategies

Vulnerability Assessments

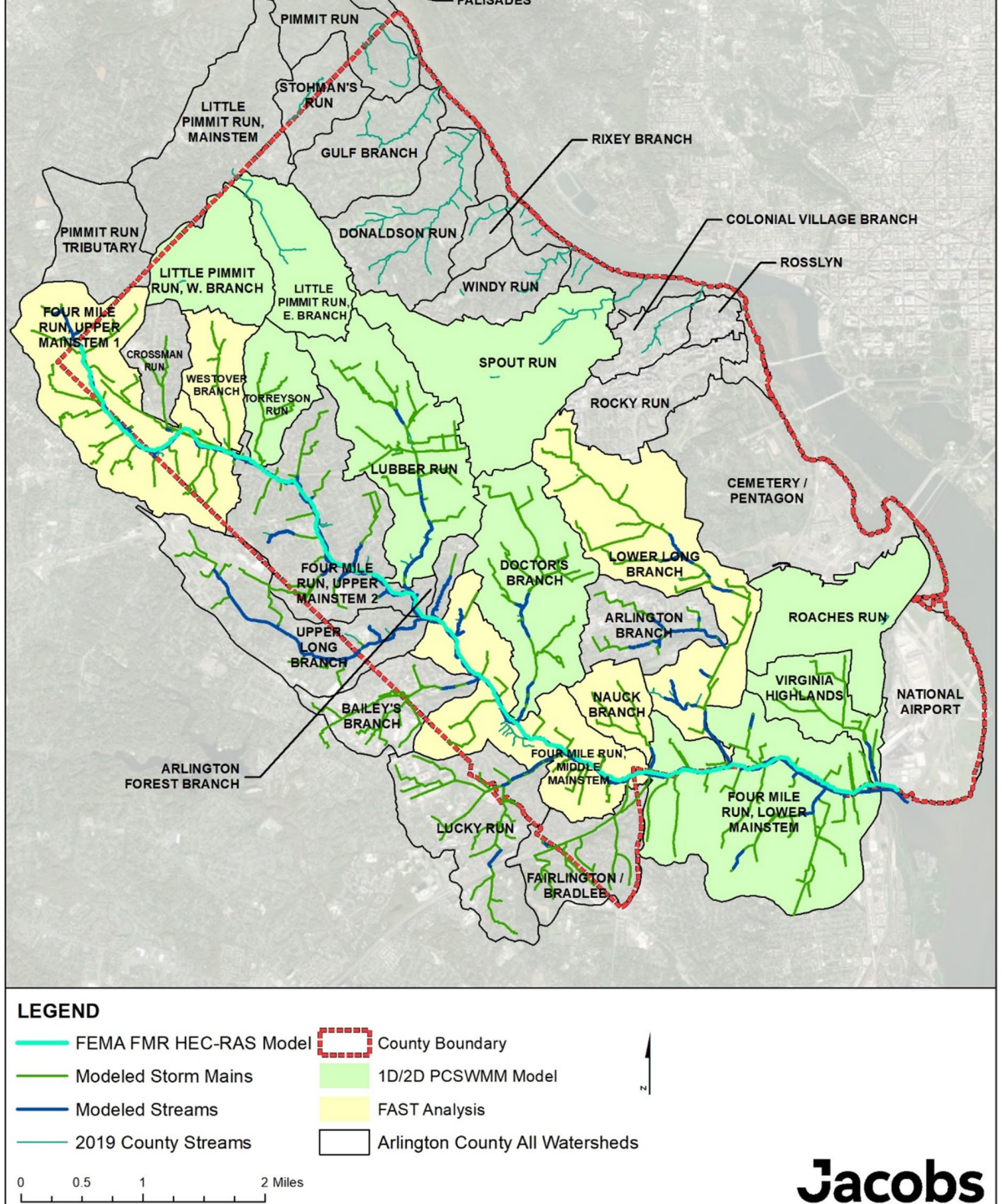
Vulnerability assessments include social vulnerability, environmental and critical facilities



RAMP (Risk Assessment and Management Plan)

- Prior to the RAMP, flood mitigation planning used ATLAS 14, a common and widely-used NOAA Tool
- ATLAS 14 lags in updates but, critically, uses past and present storm/flood data only (temporal stationarity)
- The RAMP expands upon past and present data, with climate projections and modeling for 2040, 2070, and 2100
  - RCP 8.5 with moderate forcing
  - Inland flooding, sea level rise, and storm surge
  - Present and future 2-D flood mapping within the key watersheds identified as flood-vulnerable

Watersheds Analyzed in the RAMP



Climate Scenarios for Modeling are Based on Climate Change Threats: Rainfall, Sea Level Rise and Storm Surge

Precipitation

2- to 10-year storms

100-year storms

Stormwater/ Drainage Management

- Localized flooding
- Increased SSOs/CSOs

Riverine Floodplain Management

- Regional flooding

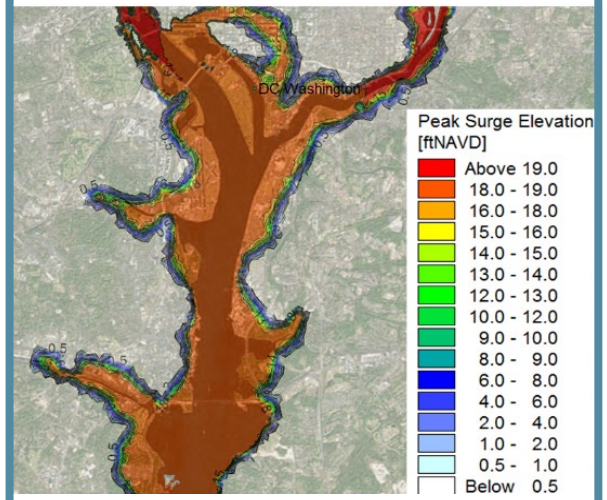
Sea Level Rise

Tidal flooding

Recurrent flooding from increased tide levels

Storm Surge

Tropical storms



- Coastal flooding

RAMP at a Glance

Final Document Suite

- Executive Summary
- Full Report
- Appendices Report – Technical Memoranda

Technical Memoranda

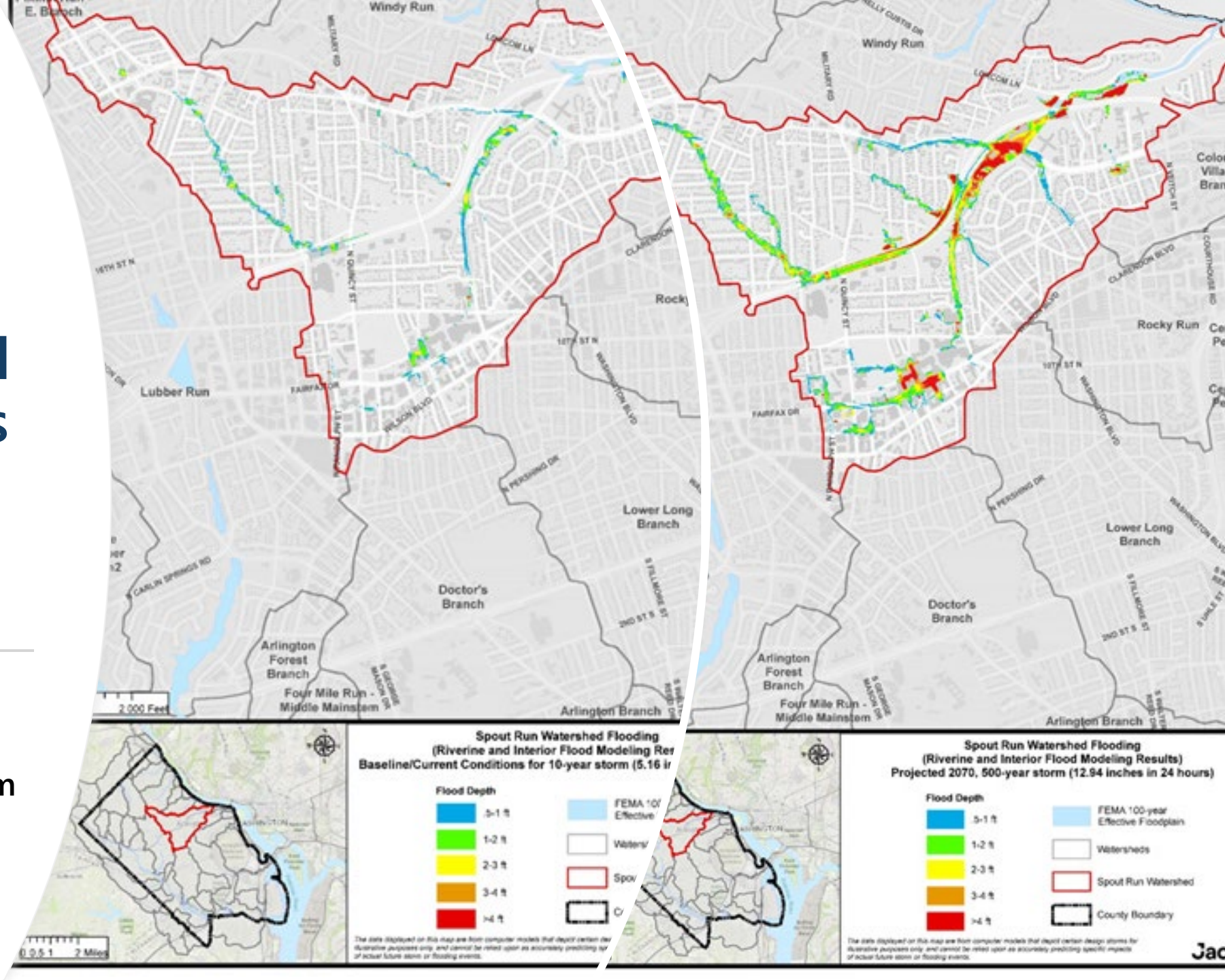
- Climate Projections and Scenarios
- Arlington Interior and Riverine Flooding
- Coastal Surge Modeling
- Arlington Flood Vulnerability Assessment
- Arlington Flood Risk Assessment
- Arlington Flood Mitigation and Adaptation Strategy
- Programmatic Strategies for Flood Management
- Market Analysis

Core RAMP Elements

- Updated Climate Projections
  - Multiple climate vulnerabilities and climate “horizons” or timeframes
- Inundation Maps / Updated IDF Curves
  - modeled on a Watershed-Scale over multiple climate horizons (2040, 2070, and 2100)
- Vulnerability Assessments
  - Calculations factoring critical civil/civic assets, environmental impacts, and social vulnerability
- Risk Assessments
  - Direct, indirect and cascading impacts based on 1) total loss or replacement, lost revenue, increased costs of O&M, loss of economic activity
- Capital Projects, Programs and Policies to Mitigate and Manage Flooding in Arlington County
  - By type and cost-benefit calculations
- Market Impacts and Analysis
  - Impacts on bonding/cost of debt, re/insurance, land use

Climate Adjusted Inundation Maps for Varying Size Storms

Spout Run 10 year storm, baseline vs. 2070 500 year storm



Updated IDF Curves Allow for Future Ready Design

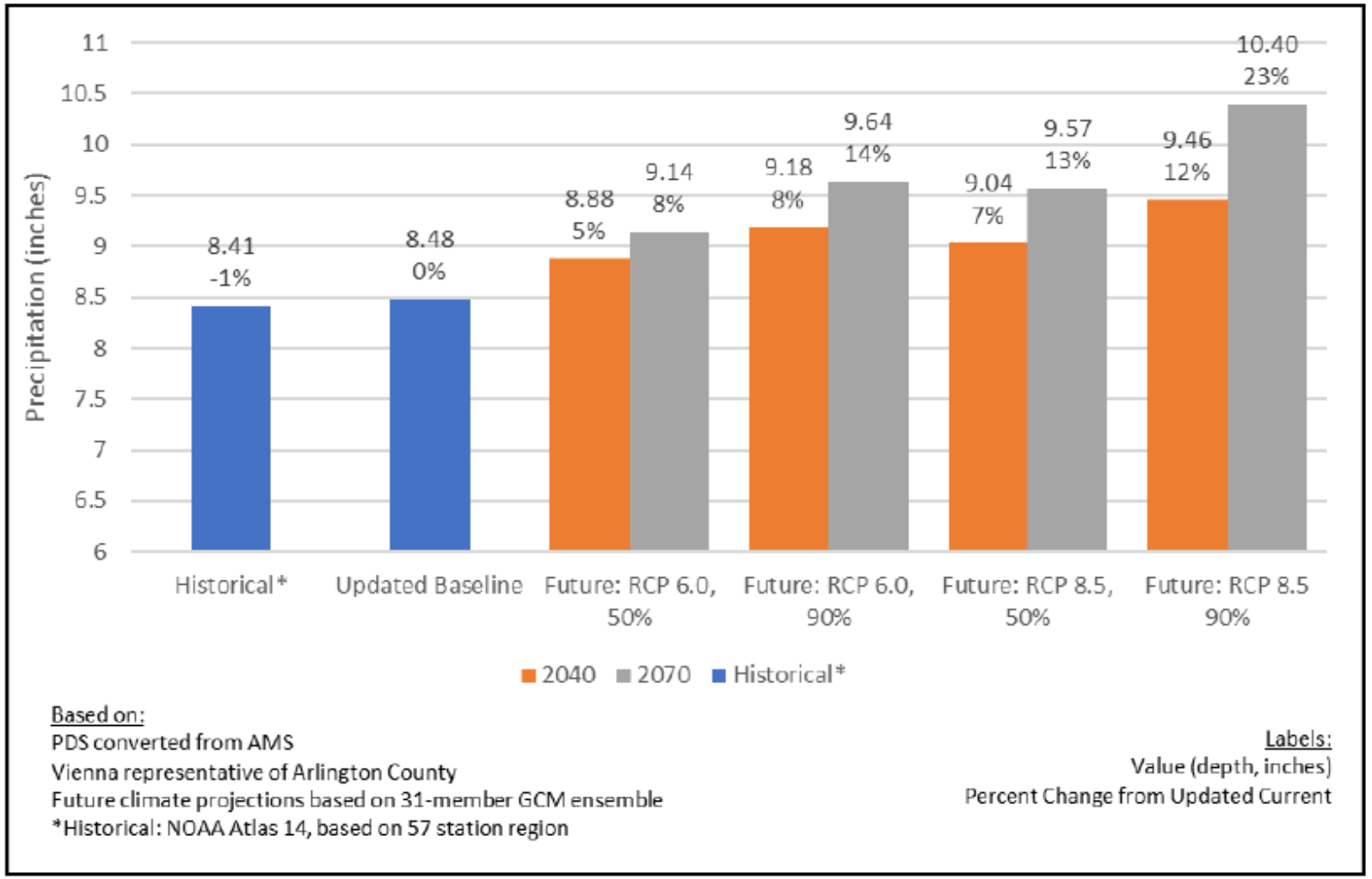


Figure 10. Baseline and Future 100-year 24-Hour Precipitation Depths for Vienna

Engineers use precipitation records, known as intensity, duration, frequency curves (IDF curves) in designing stormwater infrastructure. Arlington's previous IDF curves were developed by NOAA and had not been updated since 2000. The RAMP provides updated rainfall depths for Arlington County based on different climate scenarios

RCP stands for representative concentration pathway and is a prediction of future greenhouse levels/impacts.

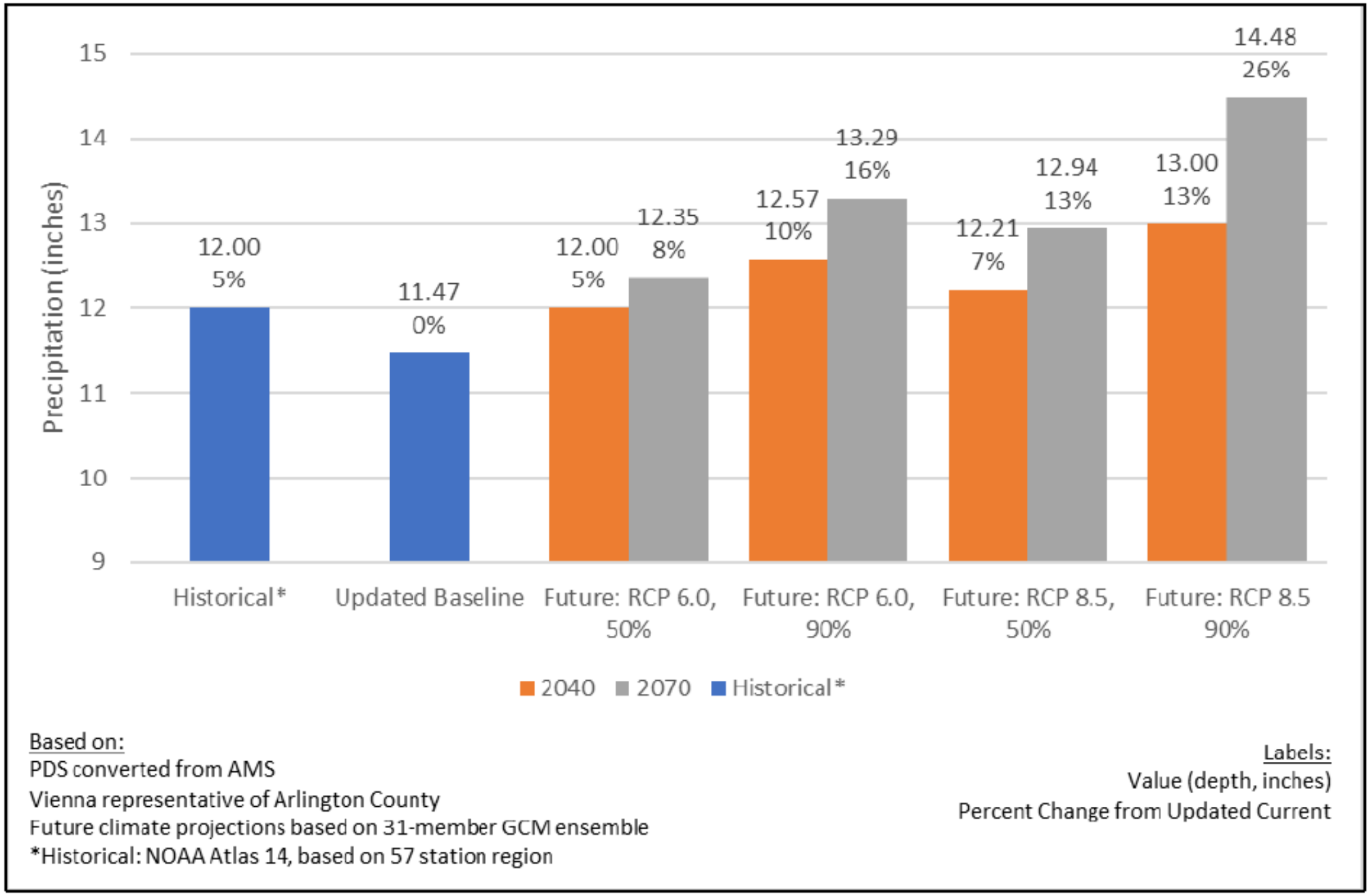


Figure ES-2. Baseline and Future 500-year 24-Hour Precipitation Depths for Arlington County

Critical Facilities

Vulnerability to flooding

Facility need for public health, safety, and emergency response

Service impacts if the facility operations were interrupted

- Arlington Transit (ART) Operations and Maintenance (O&M) Facility, located in Four Mile Run Lower Mainstem
- Cardinal Elementary School, located in Torreyson Run
- Cherrydale Health and Rehabilitation Center (Cherrydale Center), located in Spout Run
- Gunston Middle School and Community Center, located in Four Mile Run Lower Mainstem
- Little Falls Booster Station, located in Little Pimmit Run East Branch
- Thomas Jefferson Middle School and Community Center, located in Doctor's Branch
- Trades Center Department of Parks and Recreation (DPR) Building and Network Operations Hub, located in Four Mile Run Middle Mainstem Trades Center Equipment Bureau, located in Four Mile Run Middle Mainstem
- Virginia Hospital Center, located in Lubber Run
- Water Pollution Control Plant (WPCP), located in Four Mile Run Lower Mainstem

Critical Facilities Cost-Benefit Analyses

Table 5-3. Critical Facility Cumulative Monetized Risk and Benefits with Mitigation Strategies, Based on Direct Equipment Damage

Facility	Sum of Cumulative Monetized Risk Without Strategy (2022-2042) (thousands $)	Alternative 1 Benefit (thousands $)	Alternative 2 Benefit (thousands $)
Cherrydale Center	1	1	1
Gunston Middle School	60	58	58
Little Falls Booster Station	100	52	52
Thomas Jefferson Middle School	1,798	1,764	1,770
Virginia Hospital Center [a]	5,659	5,586	5,586
WPCP (North)	10,137	9,401	Not computed[b]
WPCP (South)	32,270	27,368	Not computed[b]

[a] This does not reflect the mitigation provided by the Virginia Hospital Center stormwater improvements, as described in Section 3.4.

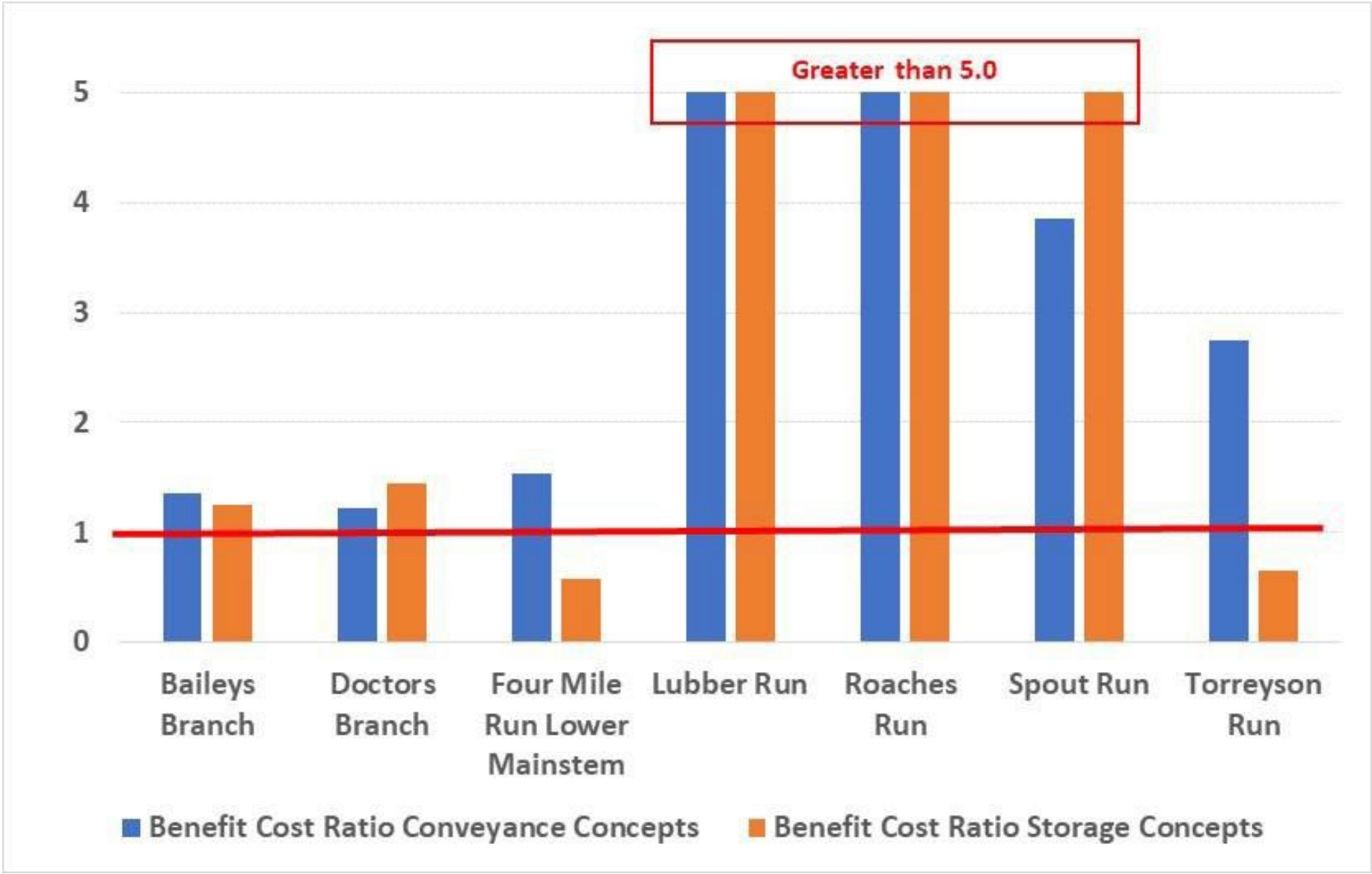
[b] The Alternative 2 strategy for the WPCP North and South uses the USACE floodwall. Cumulative monetized risk cannot be accurately calculated with the Task 6 critical facilities model; however, the floodwall would provide significant protection to both North and South facilities.

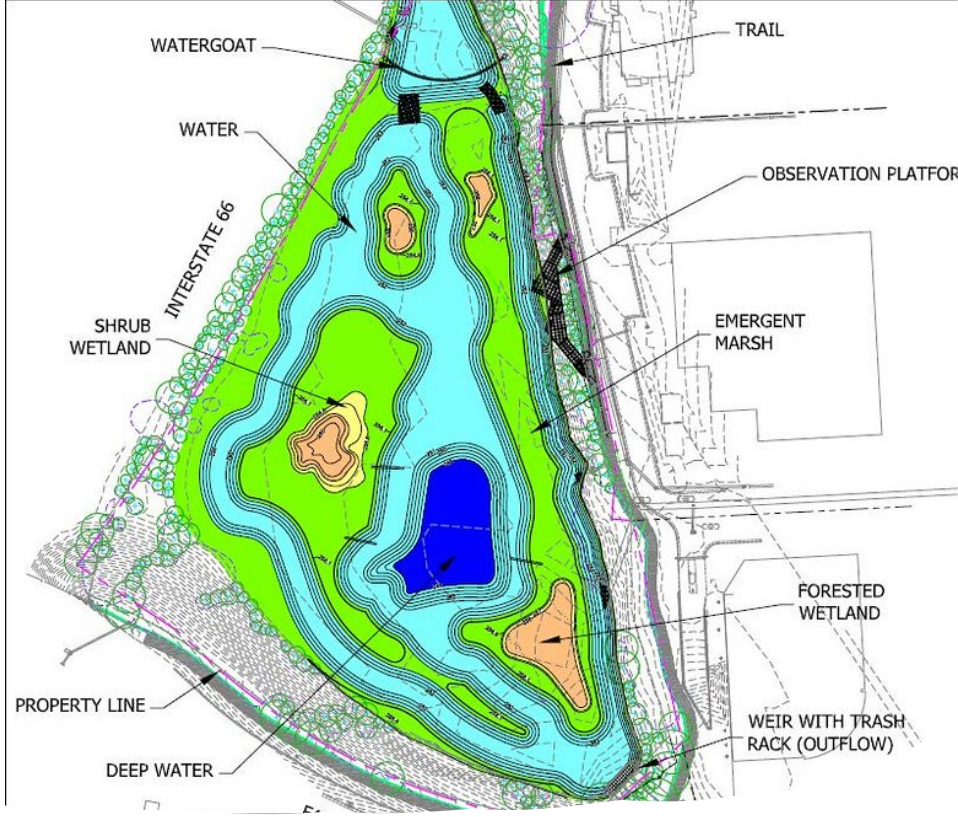
Economic Risk by Watershed - "Cost of Inaction"

Watershed	Annualized Risk of Losses (millions $)	Potential Losses for 100-year Storm (millions $)	
		100-year Storm in 2020: 8.5 Inches in 24 Hours	100-year Storm in 2070: 9.6 Inches in 24 Hours
Roaches Run	112.8	718.9	803.5
Spout Run	41.0	234.4	263.4
Lubber Run	32.4	297.1	344.2
Four Mile Run Lower Mainstem	14.7	109.2	136.8
Doctor's Branch	6.4	39.0	46.1
Torreyson Run	2.6	17.9	19.7
Bailey's Branch	1.0	7.5	n/a

Capital Projects Cost Benefit Analysis

Allows for prioritization of projects and community understanding of investments





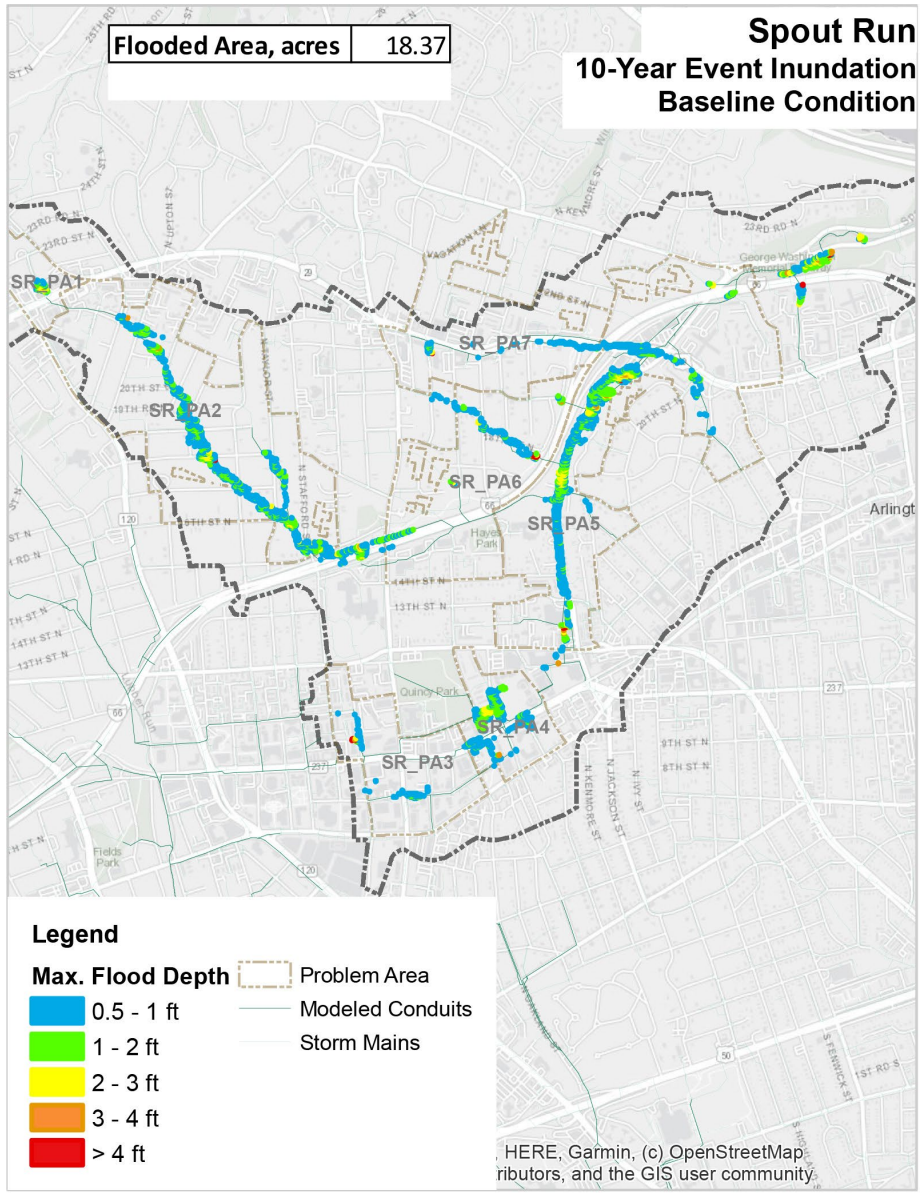
RAMP-Informed Projects – Conveyance, Detention and Overland Relief

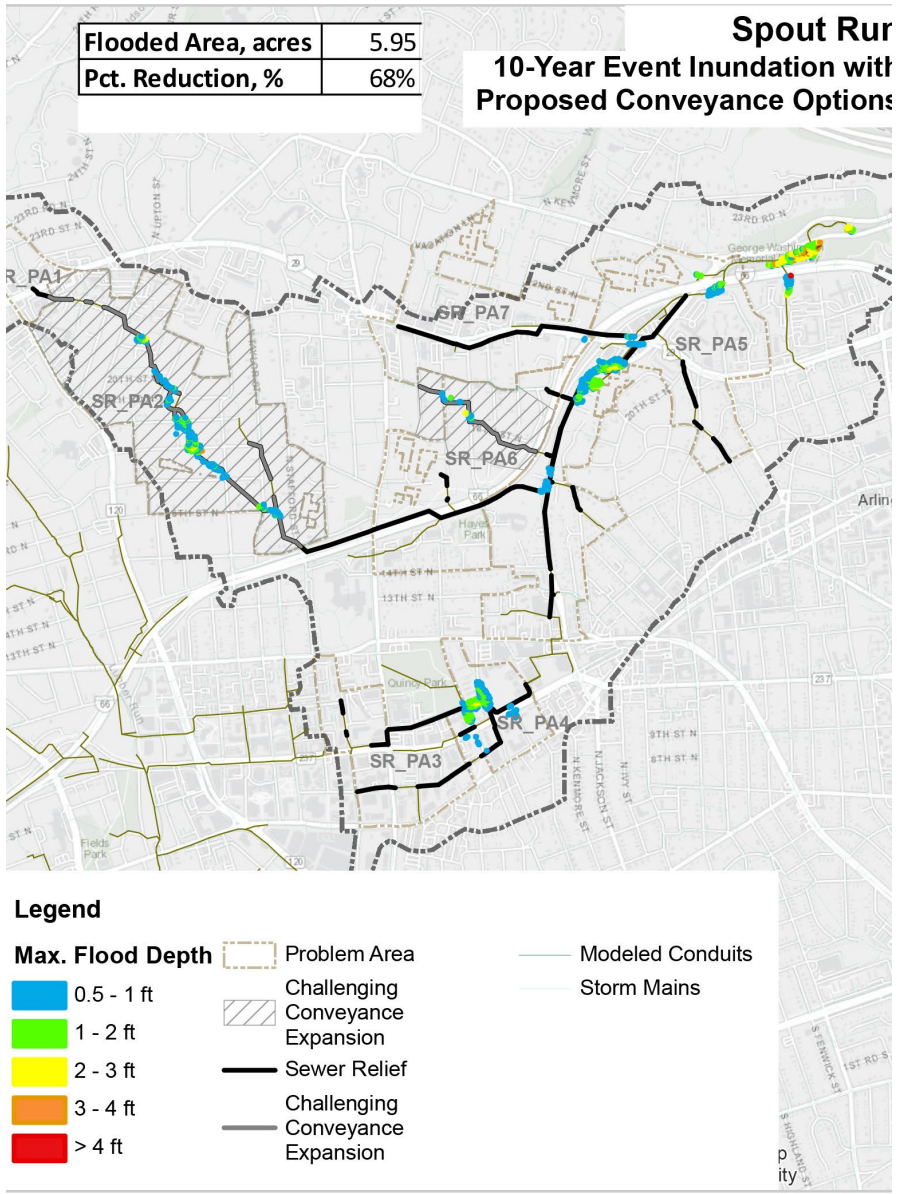
Ballston Wetlands Park

March 2022

September 2023

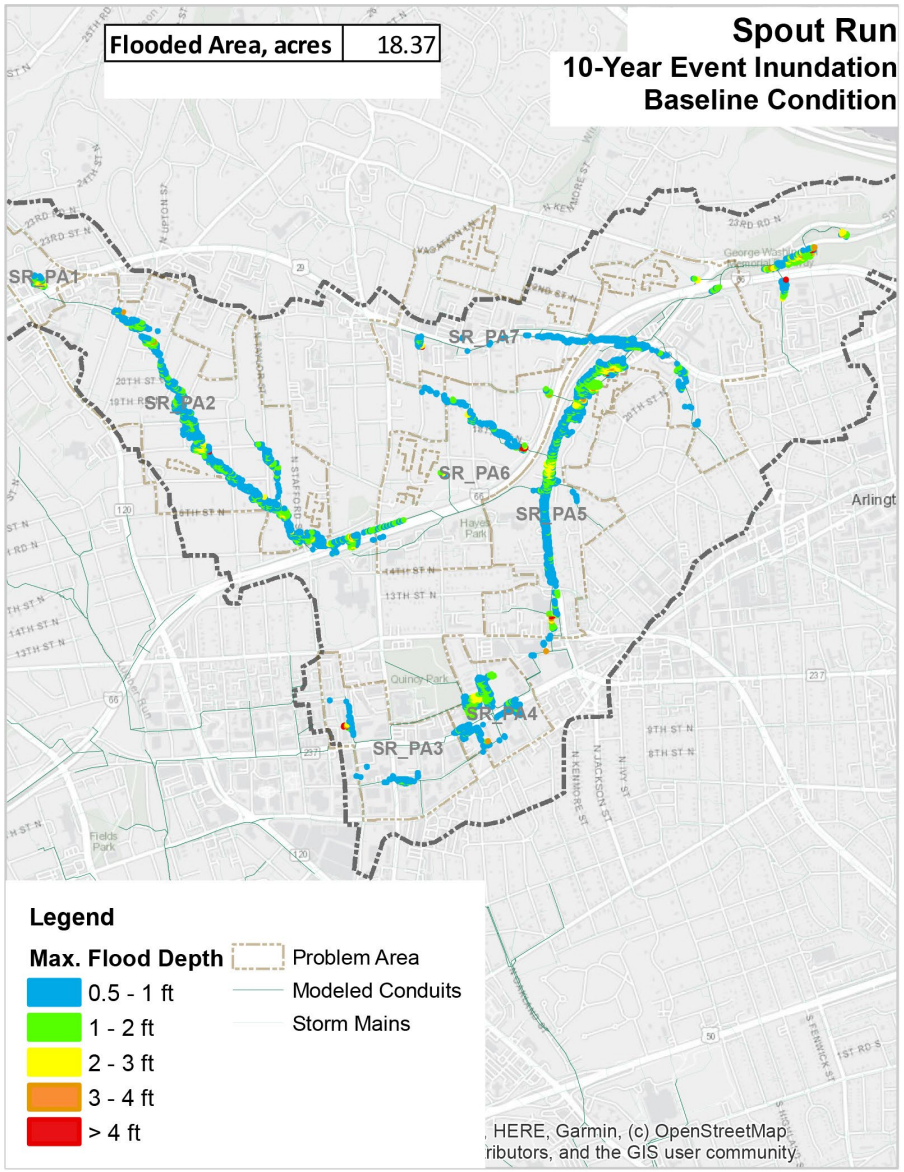
Spout Run 10-year storm at Baseline and with proposed **Conveyance** Upgrades

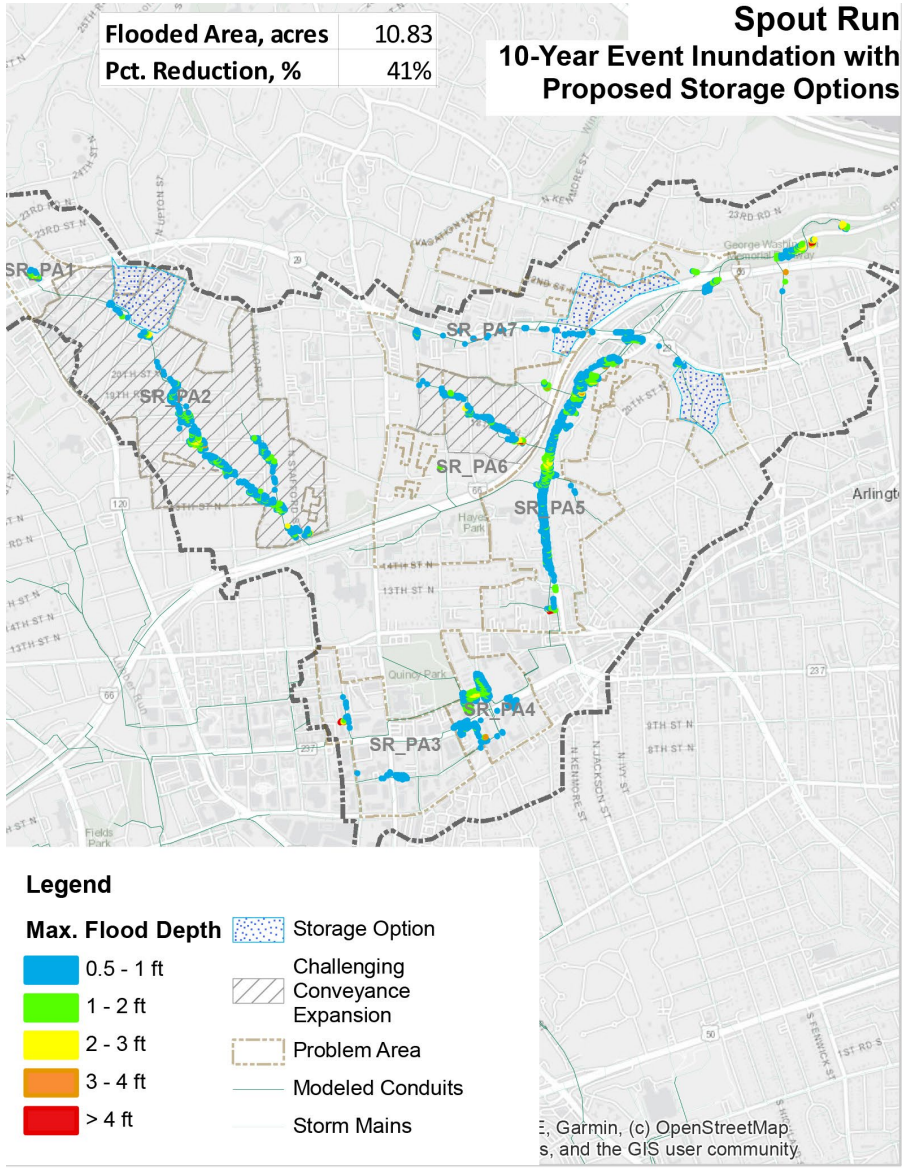




Percent reduction in flooded area 68%

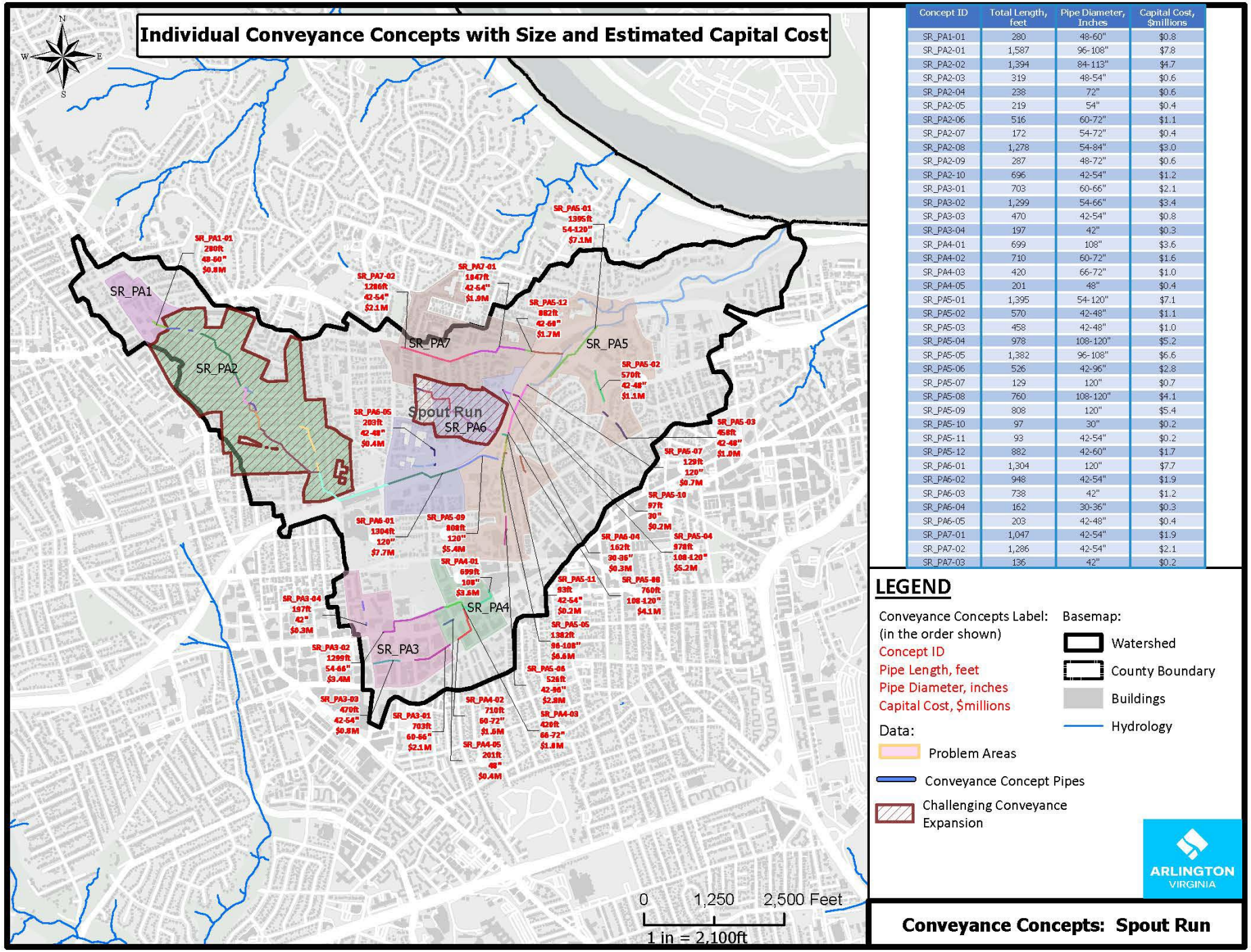
Spout Run 10-year storm at Baseline and with proposed **Storage** Upgrades





Percent reduction in flooded area 41%

Spout Run individual conveyance projects with size and estimated cost



Concept ID	Total Length, feet	Pipe Diameter, Inches	Capital Cost, $millions
SR_PA1-01	280	48-60"	$0.8
SR_PA2-01	1,587	96-108"	$7.8
SR_PA2-02	1,394	84-113"	$4.7
SR_PA2-03	319	48-54"	$0.6
SR_PA2-04	238	72"	$0.6
SR_PA2-05	219	54"	$0.4
SR_PA2-06	516	60-72"	$1.1
SR_PA2-07	172	54-72"	$0.4
SR_PA2-08	1,278	54-84"	$3.0
SR_PA2-09	287	48-72"	$0.6
SR_PA2-10	696	42-54"	$1.2
SR_PA3-01	703	60-66"	$2.1
SR_PA3-02	1,299	54-66"	$3.4
SR_PA3-03	470	42-54"	$0.8
SR_PA3-04	197	42"	$0.3
SR_PA4-01	699	108"	$3.6
SR_PA4-02	710	60-72"	$1.6
SR_PA4-03	420	66-72"	$1.0
SR_PA4-05	201	48"	$0.4
SR_PA5-01	1,395	54-120"	$7.1
SR_PA5-02	570	42-48"	$1.1
SR_PA5-03	458	42-48"	$1.0
SR_PA5-04	978	108-120"	$5.2
SR_PA5-05	1,382	96-108"	$6.6
SR_PA5-06	526	42-96"	$2.8
SR_PA5-07	129	120"	$0.7
SR_PA5-08	760	108-120"	$4.1
SR_PA5-09	808	120"	$5.4
SR_PA5-10	97	30"	$0.2
SR_PA5-11	93	42-54"	$0.2
SR_PA5-12	882	42-60"	$1.7
SR_PA6-01	1,304	120"	$7.7
SR_PA6-02	948	42-54"	$1.9
SR_PA6-03	738	42"	$1.2
SR_PA6-04	162	30-36"	$0.3
SR_PA6-05	203	42-48"	$0.4
SR_PA7-01	1,047	42-54"	$1.9
SR_PA7-02	1,286	42-54"	$2.1
SR_PA7-03	136	42"	$0.2

LEGEND

Conveyance Concepts Label:
(in the order shown)
Concept ID
Pipe Length, feet
Pipe Diameter, inches
Capital Cost, $millions

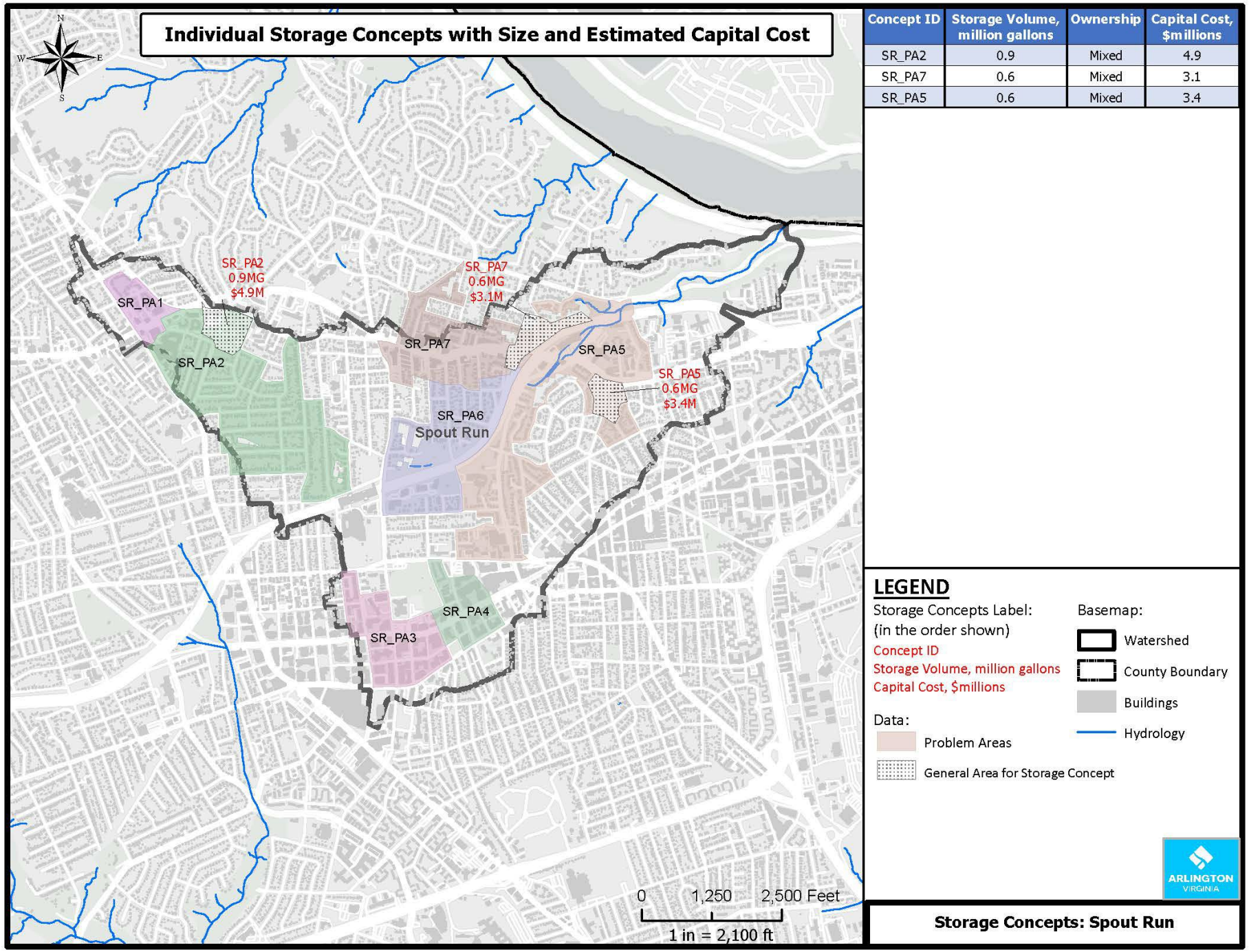
Data:
Problem Areas
Conveyance Concept Pipes
Challenging Conveyance Expansion

Basemap:
Watershed
County Boundary
Buildings
Hydrology

ARLINGTON VIRGINIA

Conveyance Concepts: Spout Run

Spout Run individual storage projects with size and estimated cost



Concept ID	Storage Volume, million gallons	Ownership	Capital Cost, $millions
SR_PA2	0.9	Mixed	4.9
SR_PA7	0.6	Mixed	3.1
SR_PA5	0.6	Mixed	3.4

LEGEND

Storage Concepts Label:
(in the order shown)
Concept ID
Storage Volume, million gallons
Capital Cost, $millions

Data:
Problem Areas
General Area for Storage Concept

Basemap:
Watershed
County Boundary
Buildings
Hydrology

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Storage Concepts: Spout Run

RAMP - Programmatic and Policy Recommendations

- Communications and data sharing among agencies
- Increasing access to flood risk information for the public
- Storm infrastructure asset management
- Real time rainfall or stream gauges
- Better flood insurance information tracking
- Flood proofing technical assistance
- Voluntary property acquisition
- Adding drainage focus to building permit reviews
- Integrate flood risk into land use planning
- Update regulations and design standards based on flood risk information
- Funding for flood management strategies

Internal / Public Engagement

Internal Working Group

- CPHD
- DPR
- DES-Transportation
- DES-Utilities
- DES-Facilities
- DPSCEM
- Arlington Public Schools
- DES-Engineering Bureau
- Water Pollution Control Plant
- Zoning
- DES-GIS
- DMF

Public Engagement (Communicate)

- Civic Federation
- Committee of 100
- Spout Run (Waverly Hills and Cherrydale Civic Associations)
- Westover/Torreyson Run Civic Associations
- Lubber Run (Waycroft-Woodlawn/Bluemont Civic Association)
- Crossman Run (East Falls Church Civic Association)
- West Columbia Pike Civic Associations
- Northern Virginia Regional Commission

Commissions

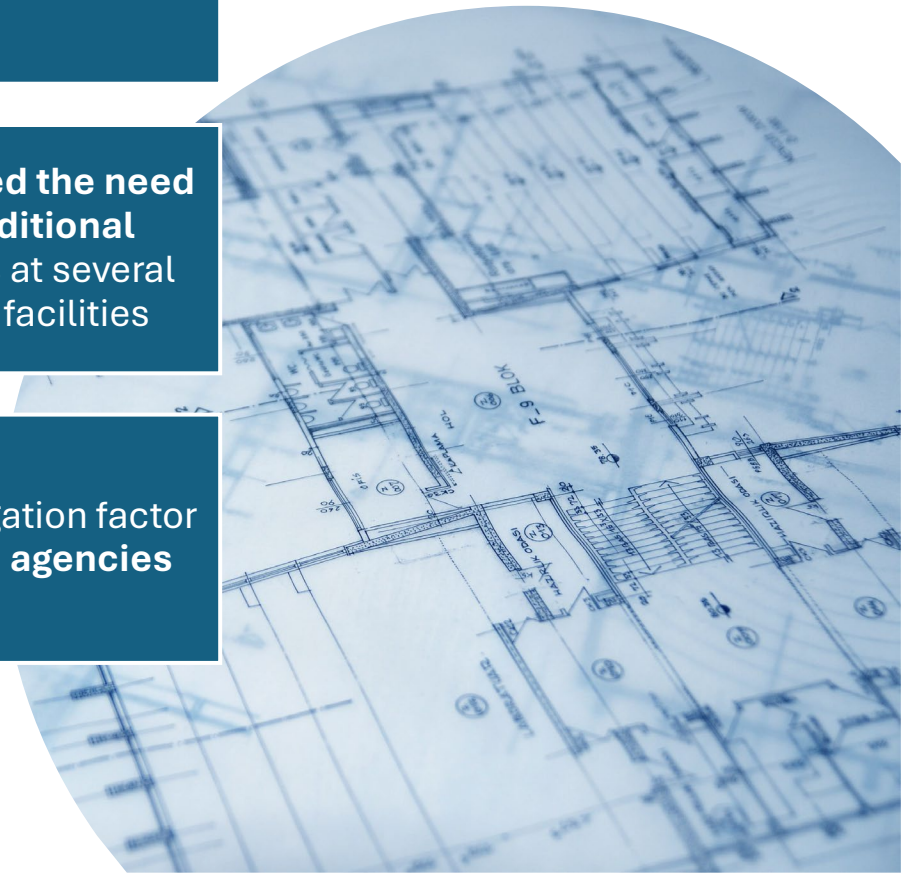
C2E2

Utilities

Dominion Energy Virginia
Washington Gas

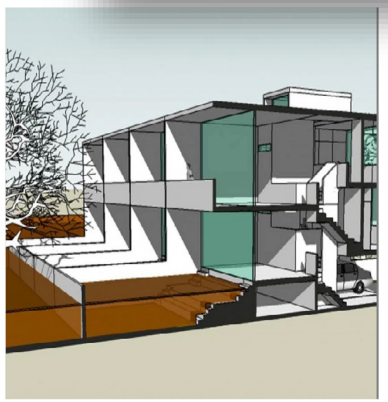
RAMP Present and Future Uses

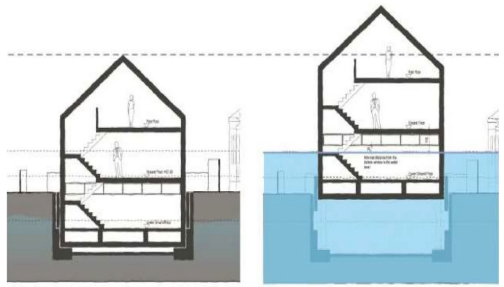
CIP Design and Budgeting	Compares **value of current investments** against **cost of inaction**	**Special Projects Planning**, e.g., Barcroft, PLB	**Resiliency planning** and measurement
Inform **flood resilient design** and construction standards	Use in **plan reviews** (private and public)	Provides **independent confirmation** of previous watershed analyses	**Eliminated the need for additional analysis** at several critical facilities
Provides guidance on **policies and programmatic measures** for implementation	**Certifications, rankings, and recognitions**, e.g., CDP, LEED® Platinum Cities	**Grant support**	Risk-mitigation factor for **bond agencies**

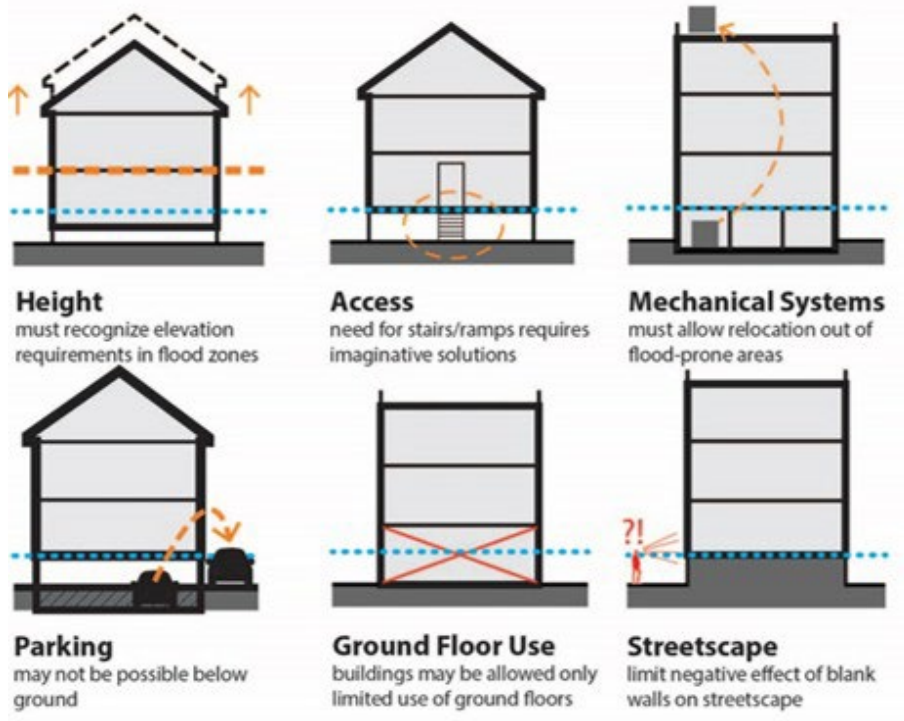


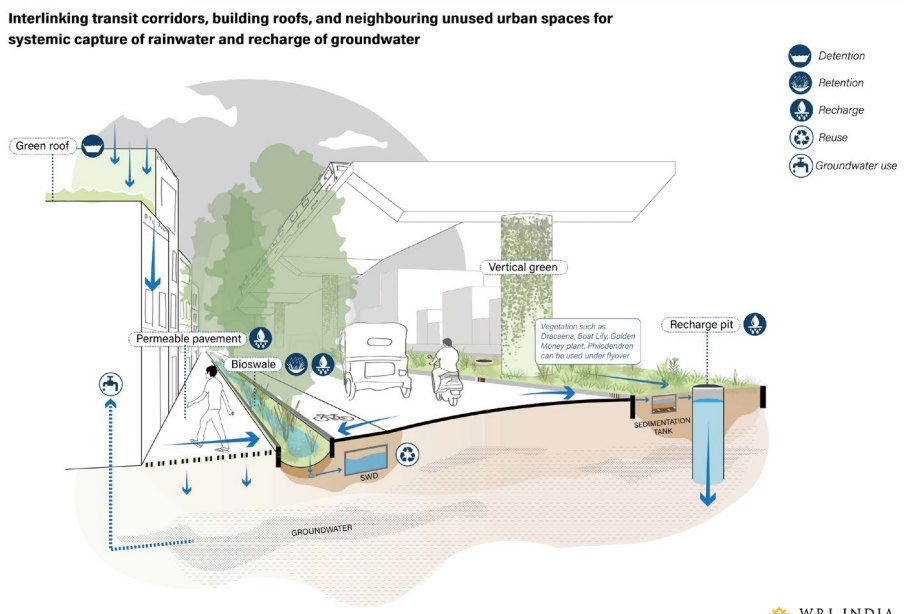
Coming Design/Construct Guidelines and Blended Infrastructure Survey

- Flood Resilient Design and Construction Guidelines Manual
- Future-Facing Natural Infrastructure Manual – *urban heat mitigation*









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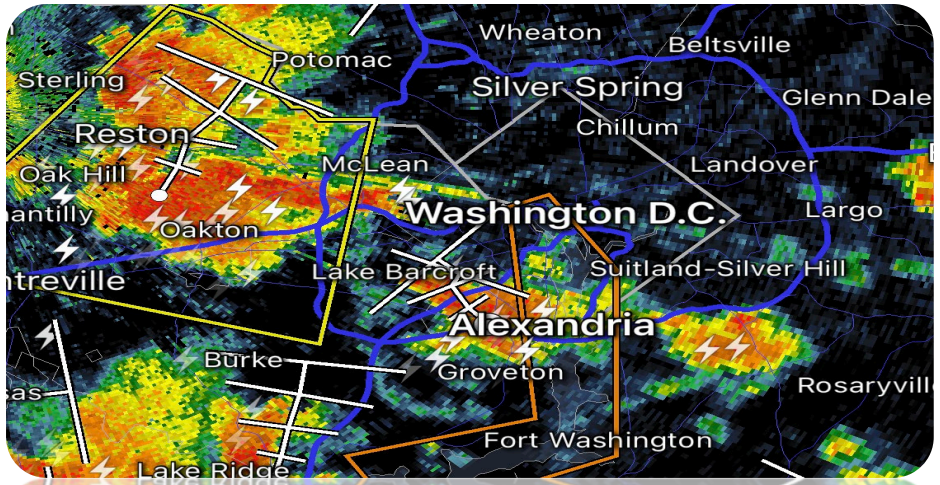
ROSS CENTER

Resiliency Planning - Active

RAMP



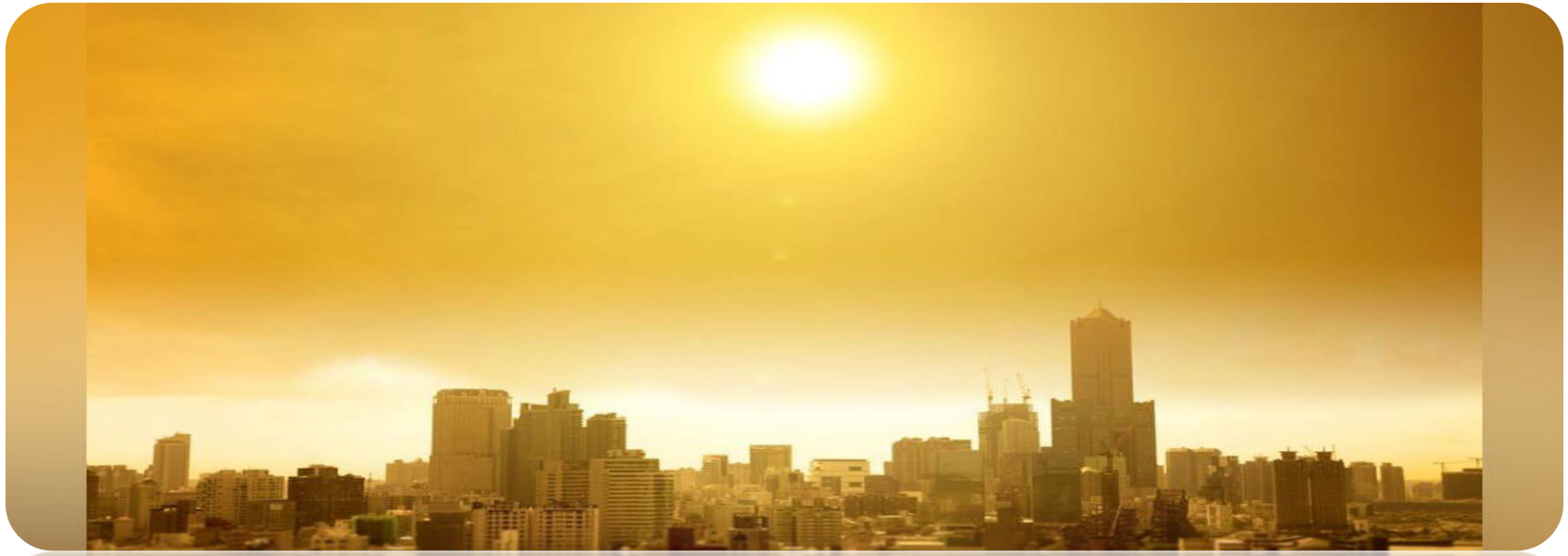
- Multiple applications/uses of projects
- Cost-Benefit Analysis to Measure Cost-Effectiveness
- Equity in Flood Mitigation
- Land-use and Building Design for Resiliency
- Supports competitive grant applications
- Mitigate the government and personal costs

Energy Assurance Plan

- Manage inoperability or interruption of grid
- Plan for continuity of key services and operations
- Equity-based planning – Resiliency Hubs
- Planned coordination across government departments, bureaus and offices
- Multi-sector policies, actions and programs
- Supports competitive grant applications

Resiliency Planning

Urban Metabolism and Heat Management



- Natural Resources & Forestry Plan
- RAMP / Stormwater Standards
- Re/Development, e.g., Plan Langston Boulevard
- Green Building Incentive Program
- Transportation / Green Streets
- Urban Metabolism/Urban Mechanics Guidelines
- Construction Recommendations - Materials
- Green Building Incentive Program (upgrade)
- Site Plan Review
- Enhanced green infrastructure options/uses

Questions?

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