

REGIONAL EXTREME HEAT ANALYSIS

Draft Results and Toolkit Resources for Transportation Planning in the Face of Extreme Heat

Pierre Gaunard
TPB Transportation Planner

Transportation Planning Board
September 16, 2026



Major Studies to Date

NATIONAL CAPITAL REGION TRANSPORTATION SYSTEM CLIMATE VULNERABILITY ASSESSMENT

May 2024



National Capital Region Transportation Resilience Improvement Plan

June 2024

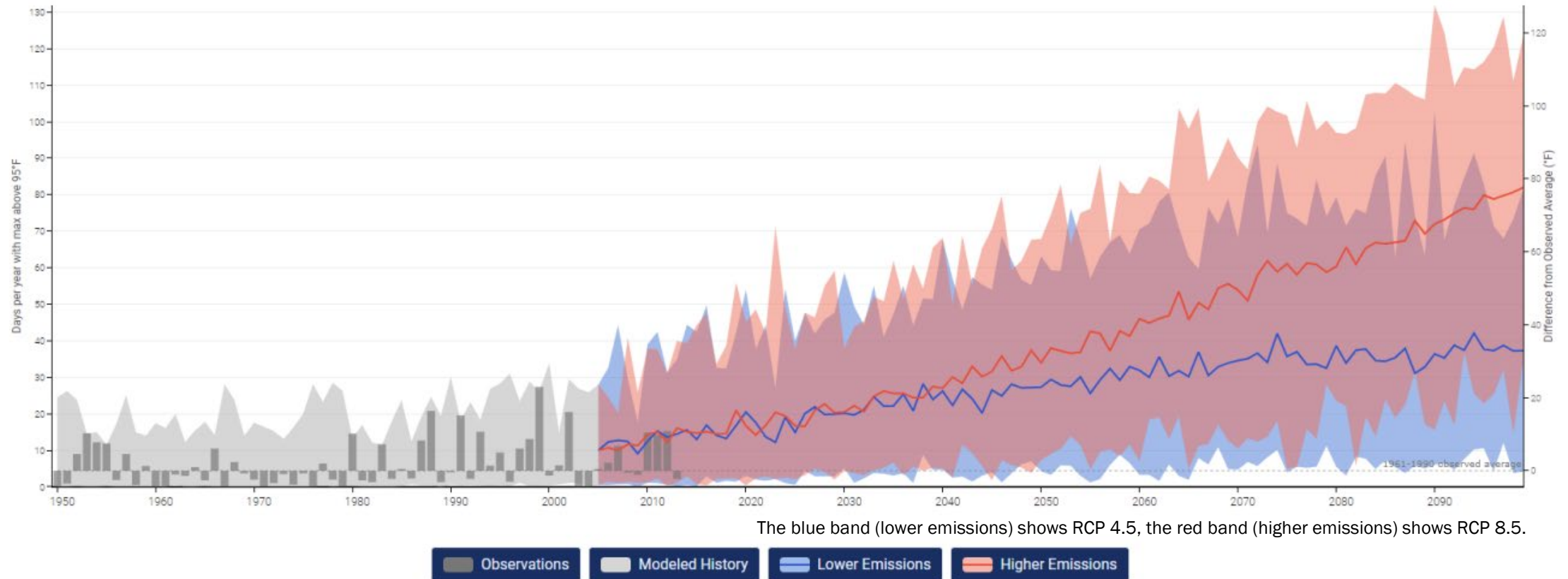


NATIONAL CAPITAL REGION TRANSPORTATION SYSTEM FLOOD ANALYSIS ADDENDUM



Extreme Heat in the National Capital Region

Days with extreme heat as identified by days with maximum temperatures above 95°F for Washington DC. Projections through 2100 given both low and high emissions are shown.



Source: NOAA Climate Explorer



Extreme Heat Project Objectives



WHAT?

Understand potential impacts of extreme heat on transportation systems and users



WHERE?

Identify where transit systems and users might be the most exposed to extreme heat



HOW?

Provide resources that guide how the region might adapt to these impacts



Overview of Products



ITEM A – Transit Infrastructure Resilience Analysis



ITEM B – Best Practice Design Guidance



ITEM C – Grant Application Support



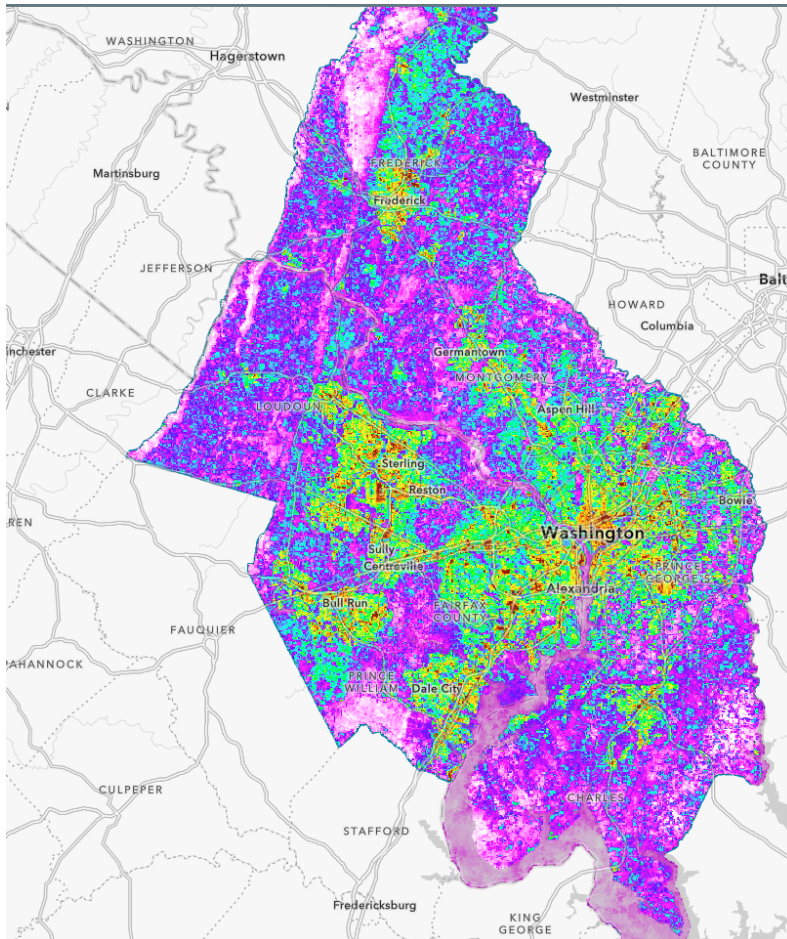
ITEM D – Policy, Planning, Guidance Use Cases



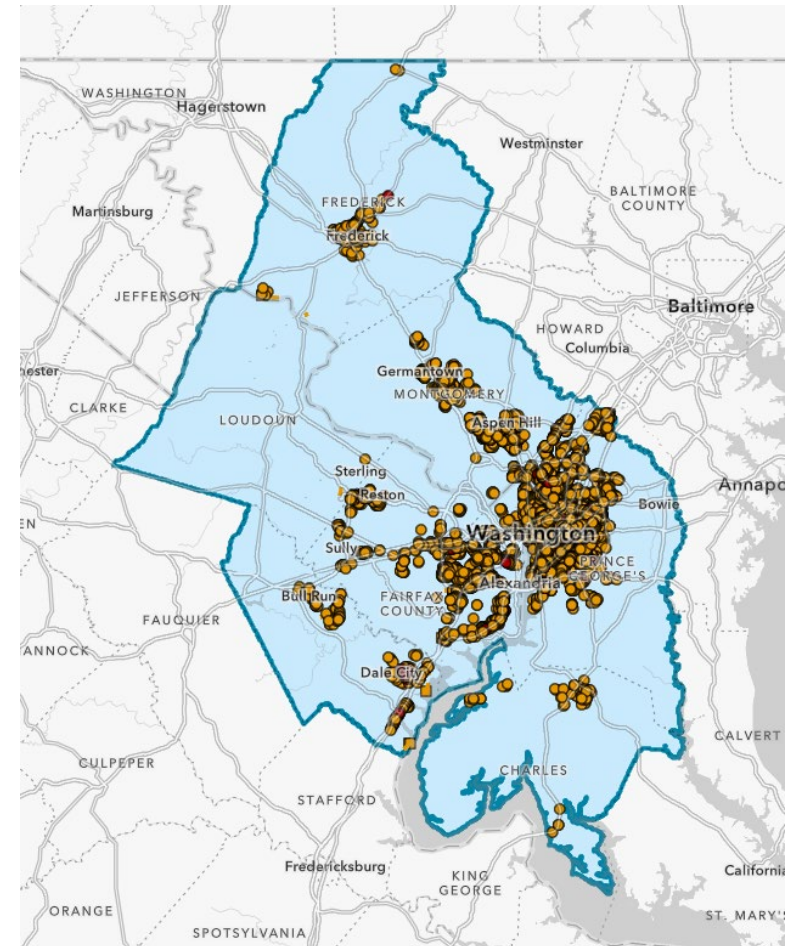
Photo Source: Pierre Gaunaud



Extreme Heat in the National Capital Region



Median historical land surface temperature data for National Capital Region, Landsat 2018-2022 average



Bus stops, rail stops and rail lines scored as medium and high-risk to the impacts of extreme heat in TPB's Vulnerability Assessment, 2024



Transit Infrastructure Resilience Analysis



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

- **A retrospective analysis** using historical high heat days and transit ridership data to understand how heat thresholds may impact ridership
- **A future analysis** using climate projections to anticipate high heat trends and the potential future impacts on ridership
- **A qualitative impacts analysis** of downstream consequences

We gotta drop it when it's hot.

Extreme heat can expand the rails our trains run on.

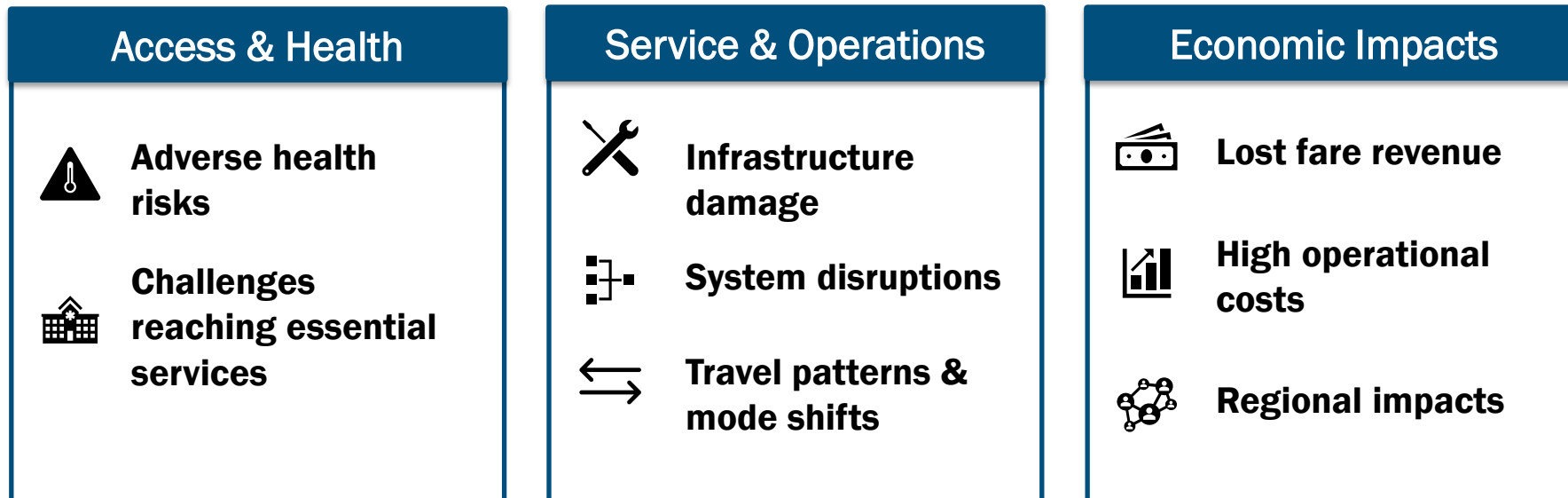
For safety, trains will run at slower speeds during very hot weather.



Transit Infrastructure Resilience Analysis



Beyond just ridership loss, extreme heat impacts transit users and owners in other ways:



Transit Infrastructure Resilience Analysis: WMATA



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1

Identify case studies

June 20-23, 2024:

- 3 days > 95F, heat emergency activated
- Record-breaking temperatures, hottest since Aug 2016
- Climatologically abnormal for time of year

July 13-17, 2024:

- Daily highs of 95 to 103F, high nighttime lows
- Excessive heat warning
- Record-breaking high temperatures

June 23-26, 2025:

- 4 days > 95F, heat index > 105F
- Climatologically abnormal for time of year



Transit Infrastructure Resilience Analysis: WMATA



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1

Identify case studies

2

Determine impact to ridership

June 20-23, 2024:

- Baseline daily ridership: 334k
- High heat daily ridership: 308k
- Percent change: **8% ↓**

July 13-17, 2024:

- Baseline daily ridership: 336k
- High heat daily ridership: 329k
- Percent change: **2% ↓**

June 23-26, 2025:

- Baseline daily ridership: 506k
- High heat daily ridership: 504k
- Percent change: **0.4% ↓**



Transit Infrastructure Resilience Analysis: WMATA



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1

Identify case studies

2

Determine impact to ridership

3

Determine fare revenue lost

June 20-23, 2024:

- Daily fare revenue lost: \$82k

July 13-17, 2024:

- Daily fare revenue lost: \$22k

June 23-26, 2025:

- Daily fare revenue lost: \$6k



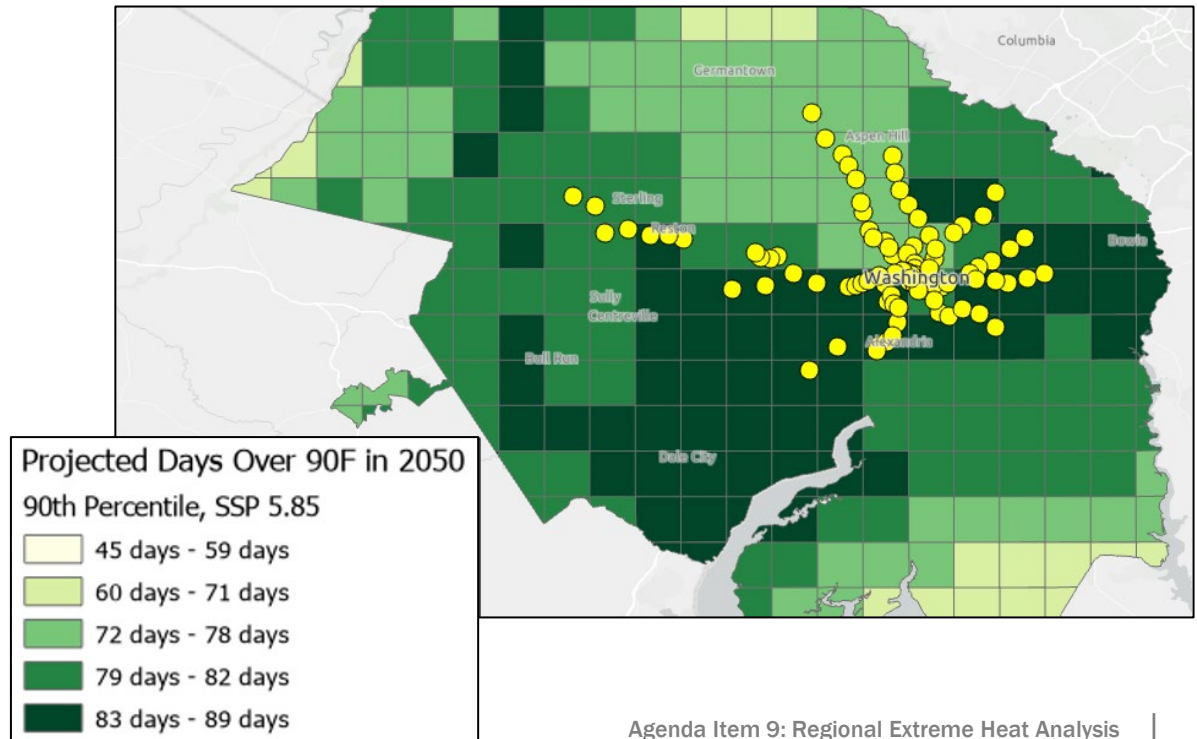
Transit Infrastructure Resilience Analysis: WMATA



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

- 1 Identify case studies
- 2 Determine impact to ridership
- 3 Determine fare revenue lost
- 4 Project future loss

- 2030 65 high heat days/year → \$2.8M annual fare revenue lost
- 2050 87 high heat days/year → \$4.6M annual fare revenue lost



Transit Infrastructure Resilience Analysis: VRE



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

- 1 Identify case studies
- 2 Determine impact to ridership
- 3 Determine fare revenue lost
- 4 Project future loss

- **2030** 65 high heat days/year → **\$67k annual fare revenue lost**
- **2050** 87 high heat days/year → **\$167k annual fare revenue lost**

VRE is a commuter line and only runs on weekdays, so we completed an additional analysis focused on determining the **operating and time savings cost associated with delays from heat-related slow orders and warnings.**



Transit Infrastructure Resilience Analysis: VRE



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

- 1 Quantify riders impacted
- 2 Determine frequency of delays
- 3 Calculate user (rider) and owner (operator) costs
- 4 Project future loss

	Delay Duration (min)	Riders Impacted	Commuter Train Operating Costs (\$/delay)	Value of Person Time for Personal Travel (\$/p-hr)
<i>Low</i>	1	4	\$ 11	\$ 13
<i>Avg</i>	10	431	\$ 109	\$ 1,486
<i>High</i>	47	1229	\$ 503	\$ 11,461



Transit Infrastructure Resilience Analysis: VRE



Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1

Quantify riders impacted

2

Determine frequency of delays

3

Calculate user (rider) and owner (operator) costs

4

Project future loss

2030 65 high heat days/year →

Owner Cost

- Low: \$700
- Avg: \$7k
- High: \$33k

User Cost

- Low: \$800
- Avg: \$97k
- High: \$745k

2050 87 high heat days/year →

Owner Cost

- Low: \$900
- Avg: \$9k
- High: \$44k

User Cost

- Low: \$1k
- Avg: \$129k
- High: \$997k



*These values reflect the average **cost per delay for one train** and will be multiplicative when more than one train is impacted.*



Toolkit of Resources for Addressing the Impacts of Extreme Heat on Transportation System



Best Practice Design Guidance



Best practices and design guidelines for cooling solutions, with region-specific examples.

- Examination of **3 typologies** with **4 cooling interventions** for each
- Three-dimensional simple block diagrams of each typology
- **Region-specific design and implementation considerations** and backing references for each cooling element

Goals:

- Identify **strategies to reduce heat exposure and impact** on people navigating the public realm
- Focus on **first-last mile connections to transit and active transportation**

Streetscapes



Bus Station Areas



Trailhead Plazas



Trees



Paving



Groundcover and Bioretention Areas



Shade Structures



Water Features



Seating



Drinking Fountains and Refreshments

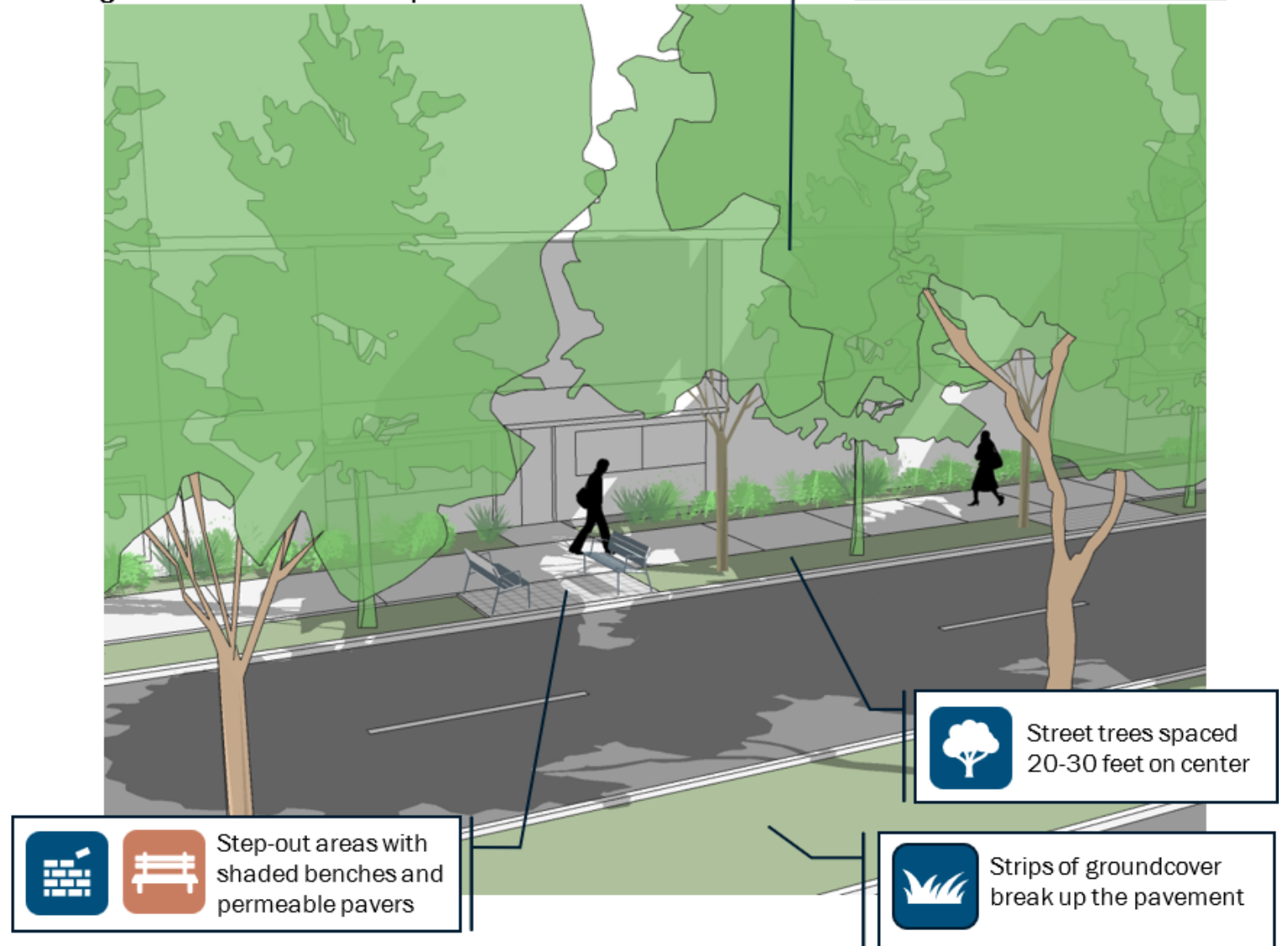


Best Practice Design Guidance

Streetscapes:

- Trees
- Paving
- Groundcover
- Seating

Figure 5: Model Cool Streetscape

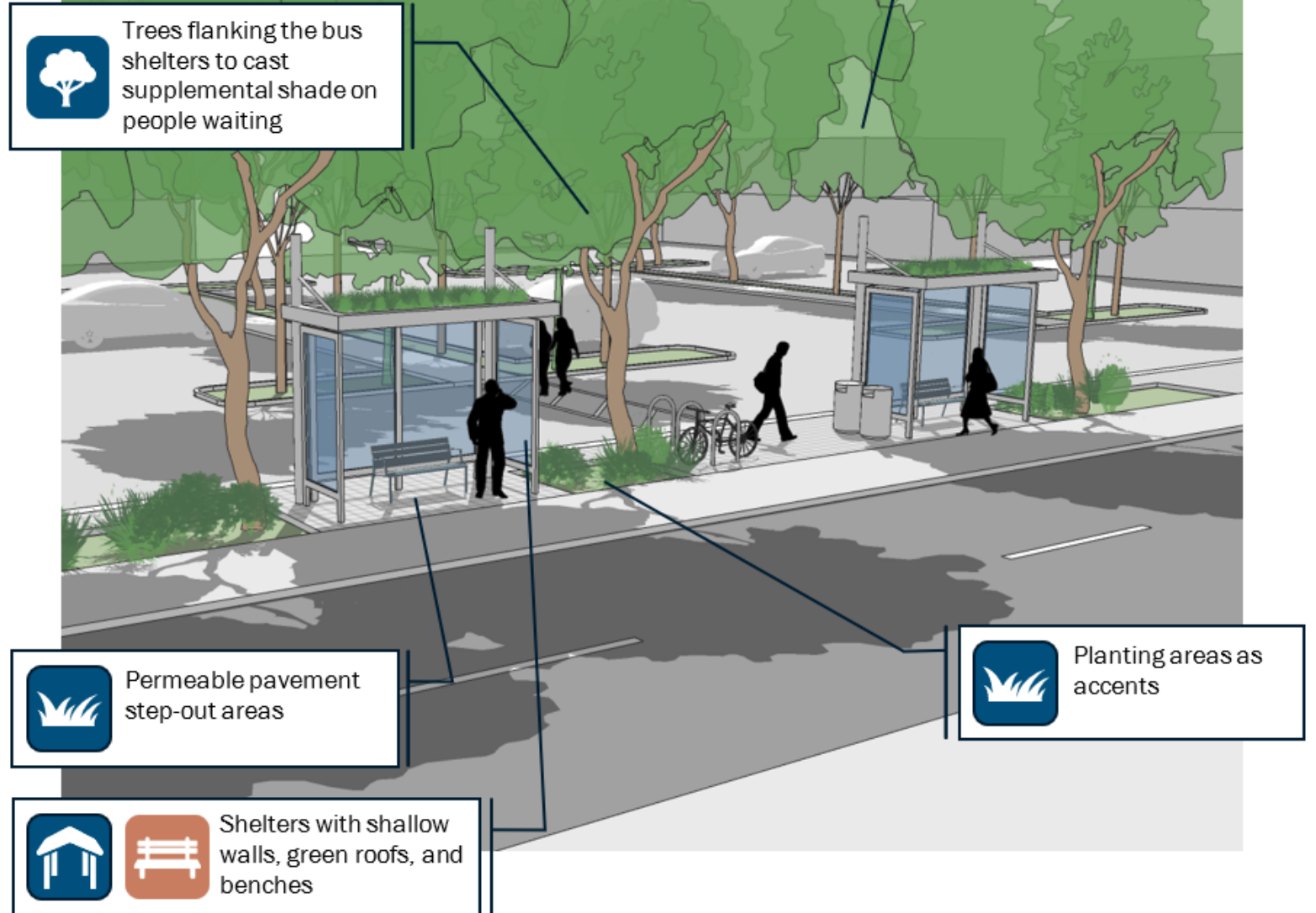


Best Practice Design Guidance

Bus Station Areas:

- Trees
- Groundcover
- Shade Structures
- Seating

Figure 6: Model Cool Bus Station Area

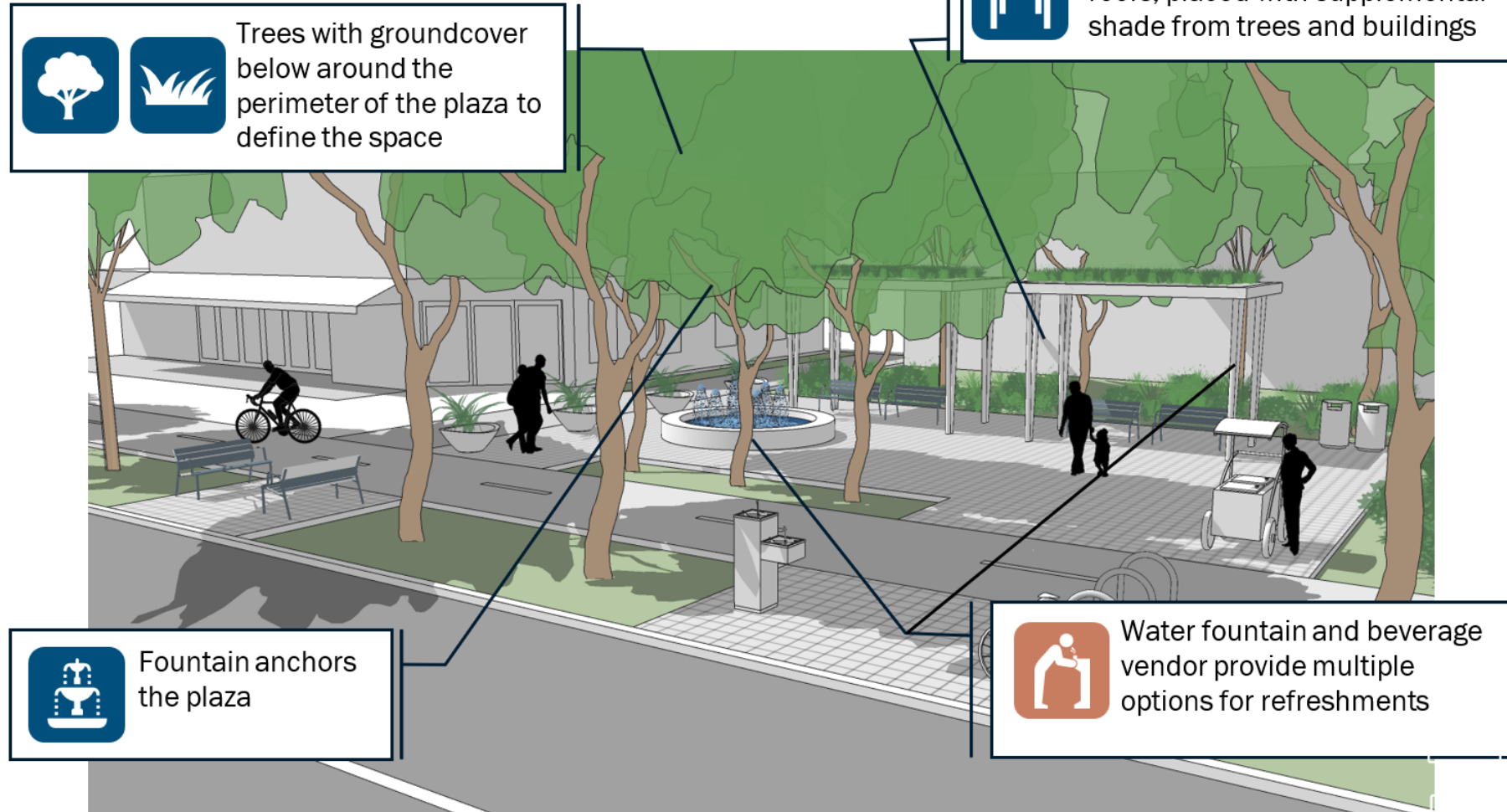


Best Practice Design Guidance

Trailhead Plaza:

- Trees
- Shade Structures
- Water Features
- Drinking Fountains and Refreshments

Figure 7: Model Cool Trailhead Plaza



Grant Application Support



Grant matrix to help agencies identify and develop strong applications for funding opportunities.

Key features:

- Critical deadlines, evaluation criteria, applicant requirements, project requirements
- Win themes for each funding source to support a strong application

General Program Information						
Funding Type	Funding Agency	Program Overview	Max Award Amount	Submission Deadlines	Funding Cycle Frequency	Contact Information
Federal	Federal Emergency Management	HMGP provides post-disaster funding for mitigation projects that	The HMGP program does not have a maximum award amount.	Dependent upon disaster declarations and varies by state.	Dependent on disaster declarations by FEMA. Typically annually.	Vermecia Alsop, DC Hazard Mitigation Officer: vermecia.alsop@dc.gov
Federal	Federal Railroad Administration	The FSP Grant Program supports planning and capital projects that	Not specified.	The 2024-2025 opportunity for projects outside of the Northeast Corridor is due on	2023 was first and last program year.	Sergio Coronado: Sergio.Coronado@dot.gov Remi Work:

Applicable Natural Hazards				
Extreme Heat	Temporary Flooding	Permanent Flooding	Extreme Winter	Extreme Wind
☒	☒	☒	☒	☒
☒	☒	☒	☒	☒
☒	☒	☒	☒	☒

Applicant Resources		
Criteria	Past Awards	Win Theme
evaluation criteria are for the State/Territory Grantee unt for alignment with state n review and selection sts of an eligibility review, review, steering committee re evaluated on seven	Not publicly available For FY 2022 - 2023, 25 projects in the northeast corridor were awarded over \$16.4 billion, and 10 projects outside of All past award recipients are posted on	Applications should address climate hazard vulnerability regional hazard mitigation Applications should include railroad data and quality accessibility improvement Applications should address

Eligibility												
Agency Type				Asset Type								
MPO	Transit Authority	City or County	Agency Department	Roads	Bridges	Culverts	Rail	Bus	Transit Station	Green Infrastructure	Asset Data	Cost
☒	☐	☒	Eligible states, territories,	☒	☒	☒	☒	☒	☒	☒	There are no specified restrictions	Yes
☒	☒	☒	Eligible agencies include states	☐	☐	☐	☒	☐	☒	☐	Funding may only be used for	Yes
☒	☐	☒	CSCI grants require a team of three	☒	☒	☒	☒	☒	☒	☒	There are no specified restrictions	No



Policy, Planning, and Design Considerations



Policy, planning, and design guidance considerations to promote the use of cooling strategies.

Five use cases for extreme heat policy, planning, and guidance updates, including examples from other jurisdictions:

- Integrating extreme heat preparedness language into **goals and vision statements**
- Developing language for **land use and zoning policies** that encourage preserving or expanding the tree canopy
- Updating **design standards and manuals** to help mainstream the use of cooling strategies
- Updating **worker safety policies and protocols** to include extreme heat safety measures.
- Developing **contracting and procurement language** to encourage use of cooling strategies in project design and implementation



Moving from Analysis to Implementation

Review the analysis and resources through a local lens – what TPB members can do:

- Explore applicable design guidelines and policy recommendations
- Identify projects that could benefit from resilience funding, work towards pursuing those funding opportunities
- Incorporate heat resilience into ongoing planning and capital programs by referencing guidance use cases and local examples
- Share successes and challenges with regional partners
- Help identify where a regional approach could provide additional value
 - TPB can help facilitate coordination, information sharing, regional initiatives or workshops



How to Use this Toolkit of Resources



ITEM A – Transit Infrastructure Resilience Analysis



ITEM B – Best Practice Design Guidance



ITEM C – Grant Application Support



ITEM D – Policy, Planning, And Guidance Use Cases

Use the results to determine that it is worth constructing shade structures at unsheltered transit stops, given the increasing heat-related burden on riders at those stops.



How to Use this Toolkit of Resources



ITEM A – Transit Infrastructure Resilience Analysis



ITEM B – Best Practice Design Guidance



Refer to the design guidelines to scope out and design your project.



ITEM C – Grant Application Support



ITEM D – Policy, Planning, And Guidance Use Cases



How to Use this Toolkit of Resources



ITEM A – Transit Infrastructure Resilience Analysis



ITEM B – Best Practice Design Guidance



ITEM C – Grant Application Support



Use the database to determine what funding opportunities might be available to support the type of project you have in mind.



ITEM D – Policy, Planning, And Guidance Use Cases



How to Use this Toolkit of Resources



ITEM A – Transit Infrastructure Resilience Analysis



ITEM B – Best Practice Design Guidance



ITEM C – Grant Application Support



ITEM D – Policy, Planning, And Guidance Use Cases



Refer to this guidance for use cases and sample language to support your efforts to mainstream your heat resilience projects and priorities.



Pierre Gaunard

Transportation Planner
(202) 962-3761
pgaunard@mwkog.org

mwkog.org/tpb

Metropolitan Washington Council of Governments
777 North Capitol Street NE, Suite 300
Washington, DC 20002



National Capital Region
Transportation Planning Board