APPENDIX A – SCORING TABLES
Vulnerability Assessment Scoring Data
Extreme Heat 🌞
# Extreme Heat – Track

## Background
- 95 degrees Amtrak is under an alert
- >98 degrees F – slow to 100 MPH
- >102 degrees F – slow to 80 MPH

## Assumptions
- Exposure – Using 100 F as the threshold – 130 F track temp
- Sensitivity – incorporate tree assumption which mitigates heat impacts

## Score | Exposure | Sensitivity | Adaptive Capacity
--- | --- | --- | ---
0 | 0 | 0 – area with trees (New England Division; Lancaster to Harrisburg) | 0 |
1 | >0-3 Days/year increase over 100 | 1 – all other areas | 1 |
2 | >3-6 Days/year increase over 100 | | 1 |
3 | >6 to 10 Days/year increase over 100 | | 1 |
4 | >10 to 15 Days/year increase over 100 | | 1 |
5 | 15+ or more Days/year increase over 100 | | 1 |
### Extreme Heat – Catenary

**Assumptions:**
- Sensitivity – tension systems in place/not impacted by heat (1 for North of NY)

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0 – if Exposure is 0</td>
<td>0 – if Exposure is 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 – North of NY</td>
<td>1 (Washington to NY)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 – South of NY</td>
<td>5 (North of NY)</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-3 Days/year increase over 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>&gt;3-6 Days/year increase over 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>&gt;6 to 10 Days/year increase over 100</td>
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<tr>
<td>4</td>
<td>&gt;10 to 15 Days/year increase over 100</td>
<td></td>
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<tr>
<td>5</td>
<td>15+ or more Days/year increase over 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Extreme Heat – Signals (Instrument House)

Assumptions:
- Most do not have A/C; New England Division has more issues
- Data includes cases and instruments

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity (same grid as track)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Follows exposure score unless in New England Division; New England Division follows exposure score plus 1, to a maximum score of a 5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-3 Days/year increase over 100</td>
<td></td>
<td>1</td>
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<tr>
<td>2</td>
<td>&lt;3-6 Days/year increase over 100</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&lt;6 to 10 Days/year increase over 100</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>&lt;10 to 15 Days/year increase over 100</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>15+ or more Days/year increase over 100</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
Extreme Precipitation 🌧️
**Extreme Precipitation – Track**

**Assumptions**
- Data threshold - Increase of days with 2 inches of rain
- Some drainage, starting at 2 inches operations restricted.
- No runoff to be conservative (without full drainage study)
- Designing to 100 year in general. Daily max precip (NYC is 8.2 inches)

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 days per year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-0.5 Days/year increase days with 2 inches</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>&gt;0.5 – 1 Days/year increase days with 2 inches</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&gt;1 – 1.5 Days/year increase days with 2 inches</td>
<td>Aligns with exposure score</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>&gt;1.5-2 Days/year increase days with 2 inches</td>
<td>Aligns with exposure score</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>&gt;2+ Days/year increase days with 2 inches</td>
<td>Aligns with exposure score</td>
<td>1</td>
</tr>
</tbody>
</table>
## Extreme Precipitation – Tunnels

### Assumptions
- Aligns with track but higher sensitive

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 days per year</td>
<td>0</td>
<td>0</td>
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<tr>
<td>1</td>
<td>&gt;0-0.5 Days/year increase days with 2 inches</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>&gt;0.5 – 1 Days/year increase days with 2 inches</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&gt;1 – 1.5 Days/year increase days with 2 inches</td>
<td>Aligns with exposure score +1, to a max score of 5</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>&gt;1.5-2 Days/year increase days with 2 inches</td>
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<td>1</td>
</tr>
<tr>
<td>5</td>
<td>&gt;2+ Days/year increase days with 2 inches</td>
<td></td>
<td>1</td>
</tr>
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</table>
## Extreme Precipitation – Buildings

<table>
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<th>Exposure</th>
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<th>Adaptive Capacity</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>0 days per year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-0.5 Days/year increase</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>days with 2 inches</td>
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</tr>
<tr>
<td>2</td>
<td>&gt;0.5 – 1 Days/year increase</td>
<td>1</td>
<td>3</td>
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<tr>
<td></td>
<td>days with 2 inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>&gt;1 – 1.5 Days/year increase</td>
<td>Aligns with exposure score</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>days with 2 inches</td>
<td></td>
<td></td>
</tr>
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<tr>
<td></td>
<td>days with 2 inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>&gt;2+ Days/year increase</td>
<td>Aligns with exposure score</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>days with 2 inches</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Extreme Precipitation – Substations

**Assumptions:**
- All components are 1 foot above ground

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure (Daily max precip in inches)</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 days per year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-0.5 Days/year increase days with 2 inches</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>&gt;0.5 – 1 Days/year increase days with 2 inches</td>
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<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&gt;1 – 1.5 Days/year increase days with 2 inches</td>
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<tr>
<td>5</td>
<td>&gt;2+ Days/year increase days with 2 inches</td>
<td>Aligns with exposure score</td>
<td>1</td>
</tr>
</tbody>
</table>
## Extreme Precipitation  
**Signals/Switch Machines & Interlocking**

**Assumption:**
- Follows track

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 days per year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-0.5 Days/year increase days with 2 inches</td>
<td>1 (if critical add 2 to exposure score)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>&gt;0.5 – 1 Days/year increase days with 2 inches</td>
<td>1 (if critical add 2 to exposure score)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&gt;1 – 1.5 Days/year increase days with 2 inches</td>
<td>Aligns with exposure (if critical add 2 to a max score of 5)</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>&gt;1.5-2 Days/year increase days with 2 inches</td>
<td>Aligns with exposure (if critical add 2 to a max score of 5)</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>&gt;2+ Days/year increase days with 2 inches</td>
<td>Aligns with exposure (if critical add 2 to a max score of 5)</td>
<td>1</td>
</tr>
</tbody>
</table>
Wind
Wind – Track

Assumptions:
• 56 MPH sustained winds (72.8 MPH gust) – limited operations
• 74 MPH sustained (96.2 MPH gust) – operations stops
• Conversion to gust is 1.3 times sustained wind

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure (MPH gust)</th>
<th>Sensitivity (inverse of extreme heat)</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1 – area with trees (New England Division, Lancaster to Harrisburg)</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-49.4</td>
<td>0 – all other areas</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>&gt;49.4-58.5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&gt;58.5-71.5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>&gt;71.5-78</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>(78+ gust)</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
## Wind – Buildings

Assumptions:
- 39 MPH is start of the Tropical Storm
- Modified from Beaufort Scale (aligns with other scales)

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure (MPH gust)</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-49.4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>&gt;49.4-58.5</td>
<td>Follow exposure score + 1 to a max score of 5</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>&gt;58.5-71.5</td>
<td>Follow exposure score + 1 to a max score of 5</td>
<td>3</td>
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<td>Follow exposure score + 1 to a max score of 5</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>(78+ gust)</td>
<td>Follow exposure score + 1 to a max score of 5</td>
<td>3</td>
</tr>
</tbody>
</table>
# Wind – Catenary

## Assumptions:
- 20 MPH sustained noted as when impacts start
- 60 is a threshold for when you’re definitely seeming impacts

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure (MPH gust)</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1 – area with trees (New England Division; Lancaster to Harrisburg)</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>&gt;0-49.4</td>
<td>0 – all other areas</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>&gt;49.4-58.5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&gt;58.5-71.5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>&gt;71.5-78</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>(78+ gust)</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
Sea Level Rise
Assumptions
• Assumes SLR is there to stay
• Sensitivity is 5 because any salt is ultimately a problem
• 4 inches of water is when operations are halted

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0.1 - 1 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1.1 - 2 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2.1 - 3 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3.1 - 4 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>&gt;4 inches of inundation</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
## Sea Level Rise – Tunnels

### Assumptions
- Same as track;
- Not a drainage study-level analysis

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0.1 - 1 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1.1 - 2 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2.1 - 3 inches</td>
<td>5</td>
<td>1</td>
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<td>1</td>
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</table>
## Sea Level Rise – Catenary

<table>
<thead>
<tr>
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<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0.1 - 1 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1.1 - 2 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2.1 - 3 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3.1 - 4 inches</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>&gt;4 inches of inundation</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
# Sea Level Rise – Buildings

## Assumptions
- Estimated FFE
- ~12 inches is where impacts are; electrical system
- AC – simple measures to employ to manage (e.g., sand bags)

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Follow exposure score</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>0.1 - 3 inches</td>
<td>Follow exposure score</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3.1 - 6 inches</td>
<td>Follow exposure score</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>6.1 - 9 inches</td>
<td>Follow exposure score</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>9.1 - 12 inches</td>
<td>Follow exposure score</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>&gt;12 inches of inundation</td>
<td>Follow exposure score</td>
<td>3</td>
</tr>
</tbody>
</table>
Sea Level Rise – Substations

Assumptions
• Assume everything is 1 foot above ground
• Sensitivity – CCV stations are critical; access is also an issue (thus went all 5’s for converters substations)
• AC – CCV stations are critical (lose one, many impacts. Can lose one and be ok but hard/expensive to move

<table>
<thead>
<tr>
<th>Score</th>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive Capacity</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Converter substation = 5</td>
<td>Converter substation = 1</td>
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<tr>
<td>1</td>
<td>0.1 - 3 inches</td>
<td>All others = 0</td>
<td>All others = 3</td>
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<tr>
<td>2</td>
<td>3.1 - 6 inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6.1 - 9 inches</td>
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<td>5</td>
<td>&gt;12 inches of inundation</td>
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</table>
## Sea Level Rise – Signals – Switch Machines and Interlockings

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0.1 - 3 inches</td>
<td>Follows exposure (if critical interlocking add 2)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3.1 - 6 inches</td>
<td>Follows exposure (if critical interlocking add 2)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>6.1 - 9 inches</td>
<td>Follows exposure (if critical interlocking add 2)</td>
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</tr>
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<td>9.1 - 12 inches</td>
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<td>5</td>
<td>&gt;12 inches of inundation</td>
<td>Follows exposure (if critical interlocking add 2)</td>
<td>1</td>
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</tbody>
</table>
Heat Maps
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
Moderate Emissions (RCP 4.5)
Year 2050

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Above 100° F from Present
- 0 days
- 18.2 days

Stations
- NYP - New York - Penn Station, NY
- BAL - Baltimore - Penn Station, MD
- WAS - Washington - Union Station, DC
- BOS - Boston - South Station, MA
- NHV - New Haven, CT

Maximum Number of Days: 4.1
### Amtrak Climate Change Vulnerability Assessment

#### Northeast Corridor (NEC) Study

**Extreme Heat Event**

**Year 2050**

**Moderate Emissions (RCP 4.5)**

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Below is a map of the Northeast Corridor (NEC) showing stations and increase in days above 100°F from present. The stations are as follows:

- **NYP** - New York - Penn Station, NY
- **BAL** - Baltimore - Penn Station, MD
- **BOS** - Boston - South Station, MA
- **WAS** - Washington - Union Station, DC
- **NHV** - New Haven, CT

#### Instrument Houses Vulnerability Score

<table>
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<th>Increase in Days Above 100°F from Present</th>
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<tr>
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<td>0 days</td>
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<tr>
<td>1</td>
<td>18.2 days</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
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**Maximum Number of Days: 4.1**
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study

Extreme Heat Event

Moderate Emissions (RCP 4.5)

Year 2050

Amtrak Line

Track Vulnerability Score

0

1

2

3

4

NYP - New York - Penn Station, NY

BAL - Baltimore - Penn Station, MD

BOS - Boston - South Station, MA

NHV - New Haven, CT

NYP - New York - Penn Station, NY

WAS - Washington - Union Station, DC

Maximum Number of Days: 4.1

Increase in Days Above 100° F from Present

0 days

18.2 days

Stations

Miles

N

0 20 40 60 80 100 Miles

18.2 days

0 days

Maximum Number of Days: 4.1

Stations

Amtrak Line
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
Moderate Emissions (RCP 4.5)
Year 2100

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Above 100° F from Present

- 0 days
- 18.2 days

NYP - New York - Penn Station, NY
BAL - Baltimore - Penn Station, MD
BOS - Boston - South Station, MA
NHV - New Haven, CT
WAS - Washington - Union Station, DC
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
Moderate Emissions (RCP 4.5)
Year 2100

Instrument Houses Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Above 100° F from Present
- 18.2 days
- 0 days

Maximum Number of Days: 5.8

NYP - New York - Penn Station, NY
BAL - Baltimore - Penn Station, MD
BOS - Boston - South Station, MA
NHV - New Haven, CT
WAS - Washington - Union Station, DC
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
Moderate Emissions (RCP 4.5)
Year 2100

Track Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Above 100° F from Present
- 0 days
- 18.2 days

Maximum Number of Days: 5.8
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
High Emissions (RCP 8.5)
Year 2050

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Above 100° F from Present

Maximum Number of Days: 6.4
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study

Extreme Heat Event

High Emissions (RCP 8.5)

Year 2050

Instrument Houses
Vulnerability Score

- 0
- 1
- 2
- 3
- 4

Increase in Days Above 100° F from Present

0 days

18.2 days

Maximum Number of Days: 6.4

Stations

Amtrak Line
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Heat Event
High Emissions (RCP 8.5)
Year 2050

Track Vulnerability Score

<table>
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<tr>
<th>Station</th>
<th>Vulnerability Score</th>
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</tr>
<tr>
<td>BAL - Baltimore - Penn Station, MD</td>
<td>3</td>
</tr>
<tr>
<td>NHV - New Haven, CT</td>
<td>4</td>
</tr>
<tr>
<td>BOS - Boston - South Station, MA</td>
<td>0</td>
</tr>
<tr>
<td>WAS - Washington - Union Station, DC</td>
<td>1</td>
</tr>
<tr>
<td>NHV - New Haven, CT</td>
<td>4</td>
</tr>
</tbody>
</table>

Increase in Days Above 100° F from Present

| Maximum Number of Days: 6.4 |

- 0 days
- 18.2 days
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
High Emissions (RCP 8.5)
Year 2100

Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
High Emissions (RCP 8.5)
Year 2100

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Above 100° F from Present
- 0 days
- 18.2 days

Maximum Number of Days: 18.2

NYP - New York - Penn Station, NY
BAL - Baltimore - Penn Station, MD
BOS - Boston - South Station, MA
NHV - New Haven, CT
WAS - Washington - Union Station, DC

Stantec
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Heat Event
High Emissions (RCP 8.5)
Year 2100

Increase in Days Above 100° F from Present

- Maximum Number of Days: 18.2
Precipitation Maps
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2050

Interlockings Vulnerability Score:
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present:
- 0 days
- 0.5 days
- 1 day
- 1.5 days
- 2 days
- 2.5 days
- 3 days
- 3.5 days

Maximum Number of Days: 3.5
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2050

Substations
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- Maximum Number of Days: 3.5
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2050

Switch Machines Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 3.5
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2050

Track Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Stations
Amtrak Line

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 3.5
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2050

Tunnels
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 3.5

Stations
- BAL - Baltimore - Penn Station, MD
- WAS - Washington - Union Station, DC
- NYP - New York - Penn Station, NY
- NHV - New Haven, CT
- BOS - Boston - South Station, MA

Map showing tunnels and stations along the Northeast Corridor with color-coded vulnerability scores and estimated increase in days receiving at least 2 inches of precipitation by the year 2050.
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2100

Maximum Number of Days: 3.1

Buildings Vulnerability Score:
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present:
- 0 days
- 3.5 days

Stations
Amtrak Line

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2100

Interlockings
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 3.1

Stations
Amtrak Line

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2100

Substations
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

 Maximum Number of Days: 3.1

Stations
Amtrak Line

0 25 50 100 Miles

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2100

Switch Machines Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 3.1

Stations
Amtrak Line

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2100
Stantec

Track Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present

Maximum Number of Days: 3.1

Stations
Amtrak Line

BOS - Boston - South Station, MA
NHV - New Haven, CT
NYP - New York - Penn Station, NY
WAS - Washington - Union Station, DC
BAL - Baltimore - Penn Station, MD
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
Moderate Emissions (RCP 4.5)
Year 2100

Tunnels Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 3.1
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2050

Buildings
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 3.5 days
- 0 days

Stations
Amtrak Line

Maximum Number of Days: 2.6
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2050

Stations

Substations
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 0.5 days
- 1 day
- 1.5 days
- 2 days
- 2.5 days
- 3 days
- 3.5 days
- 4 days

Maximum Number of Days: 2.6
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2050

Switch Machines Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- Maximum Number of Days: 2.6

Stations
Amtrak Line

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA

2050 Year

0 days
3.5 days
-
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2050

Track Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 0.5 days
- 1 day
- 2 days
- 3.5 days

Maximum Number of Days: 2.6
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2050

Tunnels
Vulnerability Score

- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 2.6
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2100

Buildings
Vulnerability Score

- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present

- 0 days
- 0.5 days
- 1 day
- 1.5 days
- 2 days
- 2.5 days
- 3 days
- 3.5 days

Maximum Number of Days: 2.9

Stations

Amtrak Line

Year 2100

Amtrak Climate Change
Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2100

Buildings
Vulnerability Score

- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present

- 0 days
- 0.5 days
- 1 day
- 1.5 days
- 2 days
- 2.5 days
- 3 days
- 3.5 days

Maximum Number of Days: 2.9

Stations

Amtrak Line
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2100

Interlockings
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 1.5 days
- 3.5 days

Maximum Number of Days: 2.9
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2100

Stantec

<table>
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<tr>
<th>Substations</th>
<th>Vulnerability Score</th>
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Maximum Number of Days: 2.9
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2100

Switch Machines Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 2.9
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2100

Track Vulnerability Score
0
1
2
3
4

Increase in Days Receiving at Least 2 inches from Present
- 0 days
- 3.5 days

Maximum Number of Days: 2.9
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Extreme Precipitation Event
High Emissions (RCP 8.5)
Year 2100

Tunnels
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Increase in Days Receiving at Least 2 inches from Present

- 3.5 days
- 0 days

Maximum Number of Days: 2.9
Sea Level Rise Maps
Amtrak Climate Change
Vulnerability Assessment

Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2050

Stantec

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Sea Level Rise with Surge Depth
- 19 feet
- 7 feet
- 0.1 feet

Maximum Depth: 15.3 feet
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge High Emissions (RCP 8.5)
Year 2050

Sea Level Rise with Surge Depth
- 0.1 feet
- 0.1 feet
- 7 feet
- 19 feet

Maximum Depth: 15.3 feet
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge High Emissions (RCP 8.5)
Year 2050

Stantec

Sea Level Rise with Surge Depth
19 feet
7 feet
0.1 feet

Maximum Depth: 15.3 feet
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge High Emissions (RCP 8.5)
Year 2050

Switch Machines Vulnerability Score

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<th>Sea Level Rise with Surge Depth</th>
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<td>0.1 feet</td>
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<tr>
<td>2</td>
<td>7 feet</td>
</tr>
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<td>3</td>
<td>19 feet</td>
</tr>
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<td>4</td>
<td>7 feet</td>
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Maximum Depth: 15.3 feet
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge High Emissions (RCP 8.5)
Year 2050

Stantec

Track Vulnerability Score
0
1
2
3
4

Sea Level Rise with Surge Depth
0.1 feet
7 feet
19 feet

Maximum Depth 15.3 feet
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2050

Tunnels Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Sea Level Rise with Surge Depth
- 0.1 feet
- 7 feet
- 19 feet

Maximum Depth: 15.3 feet
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2100

Stantec
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2100

Stantec

Interlockings
Vulnerability Score

- 0
- 1
- 2
- 3
- 4

Sea Level Rise with Surge Depth

- 19 feet
- 7 feet
- 0.1 feet

Maximum Depth: 19 feet
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2100

Substations Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Sea Level Rise with Surge Depth
- 0.1 feet
- 7 feet
- 19 feet

Maximum Depth: 19 feet
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2100

Stantec

Switch Machines
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Sea Level Rise with Surge Depth
- 19 feet
- 7 feet
- 0.1 feet

Maximum Depth: 19 feet
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2100

Sea Level Rise with Surge Depth

- 19 feet
- 7 feet
- 0.1 feet

Maximum Depth: 19 feet

Stations
Amtrak Line
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
Projected Sea Level Rise with Surge
High Emissions (RCP 8.5)
Year 2100

Stantec

Tunnels
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Stations
Amtrak Line

Sea Level Rise with Surge Depth
- 0.1 feet
- 7 feet
- 19 feet

Maximum Depth: 19 feet
Wind Maps
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
Moderate Emissions (RCP 4.5)
Year 2050

Maximum Value: 109.6 mph

Climate Adjusted 100-year Return Period Peak Wind Gust

Buildings Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Amtrak Line

Stations

NY, MA, CT, PA, DE
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
Moderate Emissions (RCP 4.5)
Year 2050

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Climate Adjusted 100-year Return Period Peak Wind Gust

- 111.4 mph
- 56.8 mph

Maximum Value: 109.6 mph
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
Moderate Emissions (RCP 4.5)
Year 2050

Amtrak Line
Stations

Track Vulnerability Score
0
1
2
3
4

Climate Adjusted 100-year Return Period Peak Wind Gust

Maximum Value: 109.6 mph

111.4 mph
56.8 mph

NY
CT
MA
NJ
PA
RI
DE
MD
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
Moderate Emissions (RCP 4.5)
Year 2100

- BAL - Baltimore - Penn Station, MD
- WAS - Washington - Union Station, DC
- NYP - New York - Penn Station, NY
- NHV - New Haven, CT
- BOS - Boston - South Station, MA

Buildings with a 100-year Return Period Peak Wind Gust exceeding 56.8 mph are at risk.

Climate Adjusted Maximum Value: 110.5 mph
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
Moderate Emissions (RCP 4.5)
Year 2100

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Climate Adjusted 100-year Return Period Peak Wind Gust

- Maximum Value: 110.5 mph
- 111.4 mph
- 56.8 mph
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
Moderate Emissions (RCP 4.5)
Year 2100

Track
Vulnerability Score

Climate Adjusted
100-year Return
Period Peak Wind Gust

Maximum Value: 110.5 mph

111.4 mph
56.8 mph

Stations
Amtrak Line

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
High Emissions (RCP 8.5)
Year 2050

Climate Adjusted 100-Year Return Period Peak Wind Gust

- Maximum Value: 109.6 mph
- 111.4 mph
- 56.8 mph

Buildings Vulnerability Score:
- 0
- 1
- 2
- 3
- 4

Stations

Amtrak Line
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
High Emissions (RCP 8.5)
Year 2050

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Climate Adjusted 100-Year Return Period Peak Wind Gust

Stations
Amtrak Line

Maximum Value: 109.6 mph

111.4 mph
56.8 mph

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA

Stantec
Amtrak Climate Change Vulnerability Assessment
Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
High Emissions (RCP 8.5)
Year 2050

- BAL - Baltimore - Penn Station, MD
- WAS - Washington - Union Station, DC
- NYP - New York - Penn Station, NY
- NHV - New Haven, CT
- BOS - Boston - South Station, MA

Amtrak Line
Stations

Climate Adjusted 100-Year Return Period Peak Wind Gust

- Maximum Value: 109.6 mph
- Track Vulnerability Score
  - 0
  - 1
  - 2
  - 3
  - 4

- 111.4 mph
- 56.8 mph

Year 2050
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
High Emissions (RCP 8.5)
Year 2100

Buildings
Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Climate Adjusted 100-Year Return Period Peak Wind Gust

Maximum Value: 111.4 mph

Stations
Amtrak Line

111.4 mph
56.8 mph

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
NHV - New Haven, CT
BOS - Boston - South Station, MA
Amtrak Climate Change Vulnerability Assessment

Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
High Emissions (RCP 8.5)
Year 2100

Catenary Vulnerability Score
- 0
- 1
- 2
- 3
- 4

Climate Adjusted 100-Year Return Period Peak Wind Gust

- Maximum Value: 111.4 mph
- 111.4 mph
- 56.8 mph

Stations
Amtrak Line

BAL - Baltimore - Penn Station, MD
WAS - Washington - Union Station, DC
NYP - New York - Penn Station, NY
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Northeast Corridor (NEC) Study
100 Year Peak Gust Wind Event
High Emissions (RCP 8.5)
Year 2100

Climate Adjusted 100-Year Return Period Peak Wind Gust

- Maximum Value: 111.4 mph
- 111.4 mph
- 56.8 mph

Stations
Amtrak Line