RESILIENCE:
THE NEW REALITY

JEFFREY D. KNUEPPEL
DEPUTY GENERAL MANAGER
MARCH 17, 2015
EXTREME WEATHER = EXTREME COST

EIGHT SEPARATE BILLION DOLLAR EXTREME WEATHER EVENTS ACROSS U.S. IN 2014

U.S. 2014 Billion-Dollar Weather and Climate Disasters

Western Drought Historic in California Entire Year

Rockies/Plains Severe Weather September 29–October 2

Plains Severe Weather June 3–5

South/Plains Severe Weather April 2–3

Michigan and Northeast Flooding August 11–13

Midwest/Southeast/Northeast Winter Storm January 5–8

Midwest/Southeast/Northeast Tornadoes and Flooding April 27–May 1

This map denotes the approximate location for each of the eight billion-dollar weather and climate disasters that impacted the United States during 2014.
EXTREME WEATHER IN PHILADELPHIA

2010  SNOWIEST EVER (78.7”)

2011  WETTEST EVER (64.3”)

2012  WARMEST EVER (58.9°)

2013  WETTEST SUMMER EVER (29.7”)

2014  2ND SNOWIEST EVER (67.4”)
EXTREME COLD

JANUARY 2014
POLAR VORTEX → ICE JAM ON DELAWARE RIVER
EXTREME ICE

FEBRUARY 2014
LANSDALE DOYLESTOWN LINE
EXTREME SNOW

FEBRUARY 2012
ROUTE 15 DERAILMENT
EXTREME HEAT

CHESTNUT HILL WEST LINE
HEAT KINK
SUMMER 2011

NORRISTOWN HIGH SPEED LINE
BUCKLED RAIL
SUMMER 2011
EXTREME FLOODING

- 21 SCHUYLKILL RIVER FLOODS @ NORRISTOWN IN RECORDED HISTORY
- 13 (62%) OF THE FLOODS HAVE OCCURRED SINCE 2003

SPRING MILL STATION MAY 1, 2014 (UNNAMED EVENT)

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EXTREME STORMS

MEDIA-SHARON HILL LINE
HURRICANE IRENE, 2011

118,000 without power after storms roar through region
T’STORM?

YES, T’STORM.
ELSEWHERE IN THE INDUSTRY:
NEW JERSEY TRANSIT

OCTOBER 2012 (SUPERSTORM SANDY)
ELSEWHERE IN THE INDUSTRY: NEW YORK MTA

OCTOBER 2012 (SUPERSTORM SANDY)
ELSEWHERE IN THE INDUSTRY:
MBTA BOSTON

WINTER 2015 (105.7 INCHES)
ELSEWHERE IN THE INDUSTRY:
WINTER 2015 – ICE, SNOW & COLD

D.C.               CHICAGO

ATLANTA            NASHVILLE
PLANNING FOR RESILIENCE:
FTA PILOT PROGRAM

OBJECTIVES:

• Better Understand Climate Projections
• Assess Key Vulnerabilities
• Develop Forward-Looking Resiliency Strategies

ONE OF SEVEN PROJECT TEAMS ACROSS U.S.
WETTER, HOTTER & MORE EXTREME

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<th>CLIMATE VARIABLE</th>
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<td>1,107%</td>
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<td>AVERAGE RAINFALL</td>
<td>-6%</td>
<td>17%</td>
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<td>“SNOW CHANCE” DAYS</td>
<td>-12%</td>
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RESILIENCE STRATEGIES UNDERWAY:
CAPITAL

SLOPE STABILIZATION

RAISED SIGNAL HUTS

TURNBACK OUTSIDE FLOOD ZONE

EMERGENCY GENERATORS
RESILIENCE STRATEGIES UNDERWAY: CAPITAL

VENTWELLS – BEFORE

VENTWELLS – AFTER
RESILIENCE STRATEGIES UNDERWAY: OPERATING & MAINTENANCE

DILIGENT TREE-TRIMMING

SANDBAGGING VENTWELLS

STAGING FLEET IN HIGHER GROUNDS

EMERGENCY RESPONSE TRACKING
RESILIENCE STRATEGIES UNDERWAY: ADMINISTRATIVE

CORE FIRST, RESTORE OUTWARD

CUSTOMER COMMUNICATIONS

INTERAGENCY COOPERATION

PLANNED SERVICE SUSPENSIONS
Resolution of Commendation
September 2011

Whereas in August 2011, the Philadelphia region endured its heaviest month of rain ever recorded, and
Whereas Tropical Storm Irene struck the region with gale-force winds and flooding rains, and
Whereas more rain and flash floods followed on September 7 and 8, and
Whereas these extreme weather conditions caused considerable damage to our transportation infrastructure, including washed-out tracks, flooded stations and other facilities, and fallen trees knocking down power and communications lines, and
Whereas the Southeastern Pennsylvania Transportation Authority continued to operate rail and transit service as Irene approached, shut down in an orderly fashion, and resumed operations just 12 hours later, and
Whereas SEPTA personnel worked long hours to repair damage from each of these storms so rail service could operate normally, and
Whereas SEPTA used the internet and other communications resources to provide up-to-the-minute information to passengers about changes in service during and after the storms,

Therefore we, the Delaware Valley Association of Rail Passengers, hereby COMMEND the operating, maintenance, and management employees of SEPTA for their determined efforts to keep the region’s public transportation system serving passengers as much as possible during these challenging conditions, and for their ongoing work to recover from the storms.
FTA FUNDING OPPORTUNITY: $3B AVAILABLE FOR “SANDY ZONE”

• Prioritized Projects that:
  – **Harden** Assets Against Future Natural Disasters
  – **Reduce Risk** of Disruptions from Natural Disasters
  – **Cost-Effective** Projects From **Collaborative Planning** Efforts

• SEPTA’s Application included:
  – **Power Resiliency**    – **Flood Mitigation**
  – **Right of Way Hardening** – **Emergency Communications**
7 PROJECTS, $115.7M
$87M (75%) GRANT
SYSTEM-WIDE IN SCOPE
Manayunk/ Norristown Line Shoreline Stabilization ($4.5 M)

- $6 MILLION TOTAL PROJECT COST
- STABILIZE 2.45 MILES OF EMBANKMENTS ALONG SCHUYLKILL RIVER
- DECREASE LIKELIHOOD OF WASHOUTS
- INCREASE SPEED OF RECOVERY AFTER FLOOD EVENT
$25 MILLION TOTAL PROJECT COST
STABILIZE KEY EMBANKMENTS ALONG REGIONAL RAIL
GLENSIDE CUT ON SEPTA’S MAINLINE
MEDIA CUT ON MEDIA/ELWYN LINE
Sharon Hill Line Flood Mitigation ($3.8 M)

- $5 MILLION TOTAL PROJECT COST
- PUMPED DRAINAGE SYSTEM FOR FLOODING AT UNDERPASS
- UNDERPASS FLOODS MORE THAN A DOZEN TIMES EACH YEAR
Subway Pump Room Emergency Power
($3.7 M)

- $5 MILLION TOTAL PROJECT COST
- ON-SITE POWER GENERATION SYSTEMS FOR WATER PUMPS
- PROTECT AGAINST LOCALIZED OR REGIONAL POWER OUTAGES
$42 MILLION TOTAL PROJECT COST

- UPGRADES TO SIGNAL POWER CABLES & MOTOR GENERATORS
- INSTALLATION OF NEW SIGNAL SUBSTATION AT DOYLESTOWN
- PROTECT AGAINST FAILURES CAUSED BY DOWNED BRANCHES
Jenkintown Area Flood Mitigation
($15.0 M)

- $20 MILLION TOTAL PROJECT COST
- COMPREHENSIVE STUDY OF DRAINAGE PATTERNS
- NEW BOX CULVERT/RAINWATER DETENTION SYSTEMS
- REINFORCEMENTS TO BRIDGE 10.97
$12 MILLION TOTAL PROJECT COST
COMPREHENSIVE COMMUNICATIONS CAPABILITIES IN THE EVENT OF AN EMERGENCY
STRATEGICALLY SITED AT LOCATION OUTSIDE OF CENTER CITY
KEY ENGINEERING TAKEAWAYS: RESILIENCE IS THE NEW REALITY

INCORPORATE INTO PROJECT DEVELOPMENT:

- Severe weather events are happening with increasing frequency.
- Consider whether design codes are adequate for a given project.
- Evaluate need for back-up power.
- Think worst case and advise clients of vulnerabilities and the range of possible solutions.
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