

HURRICANE IDA IMPACT & LESSONS LEARNED

PSE&G Gas Response and Restoration

Paul Pirro – PSE&G Gas T&D Engineering
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2022 NGA Spring
Operations Conference



PSEG

We make things work for you.

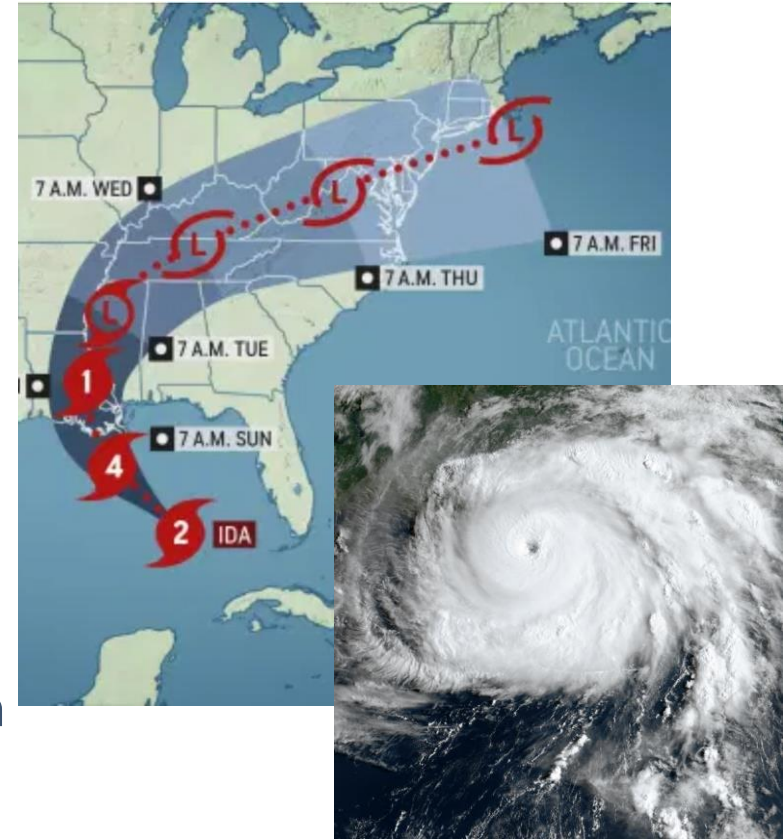
PSE&G Gas Utility Facts



- Largest Utility in NJ, serving Gas & Electric Customers
- 18,173 miles of Gas Distribution Main
- 54 miles of Gas Transmission Main
- 1.9M Gas Customers
- 15 Counties
- 269 Municipalities

Hurricane Ida – A Powerful Storm (2021)

- Ida intensified into a hurricane on August 27 before crossing Cuba
- At peak intensity near the Gulf Coast, Ida became a Category 4 hurricane
- Maximum sustained winds of 150 mph
- Made landfall in the US on August 29
- Second most destructive storm in Louisiana since Hurricane Katrina (2005)
- Ida transitioned into a post-tropical cyclone as it approached the northeast on September 1st
- Ida broke many rainfall records in the US
- Total estimated damage at \$75.25 billion



Hurricane Ida – Impact on New Jersey

- Ida was the 3rd tropical system in a matter of weeks. Prior storms Fred and Henri left the soil saturated with a greater risk of flooding
- Approximately 35 municipalities were impacted by flooding
- Newark airport grounded all flights
- Multiple tornadoes were confirmed
- According to the CDC, Ida resulted in 34 deaths in New Jersey, making it one of the deadliest storms in its history



Tornado in Mullica Hill, NJ



Hurricane Ida – The Aftermath

- Approximately 51,000 gas customers statewide experienced a gas service interruption or had an inspection due to flooding
- Approximately 35 municipalities were impacted by flooding associated with Ida:
 - Over 52 miles of gas mains were replaced and upgraded in these communities as part of PSE&G’s Gas System Modernization Program and Energy Strong. Under the program, areas of low pressure were upgraded to high pressure to eliminate the possibility of water infiltration into the mains
 - As a result, gas service to approximately 8,000 customers was maintained or restored on a significantly expedited basis

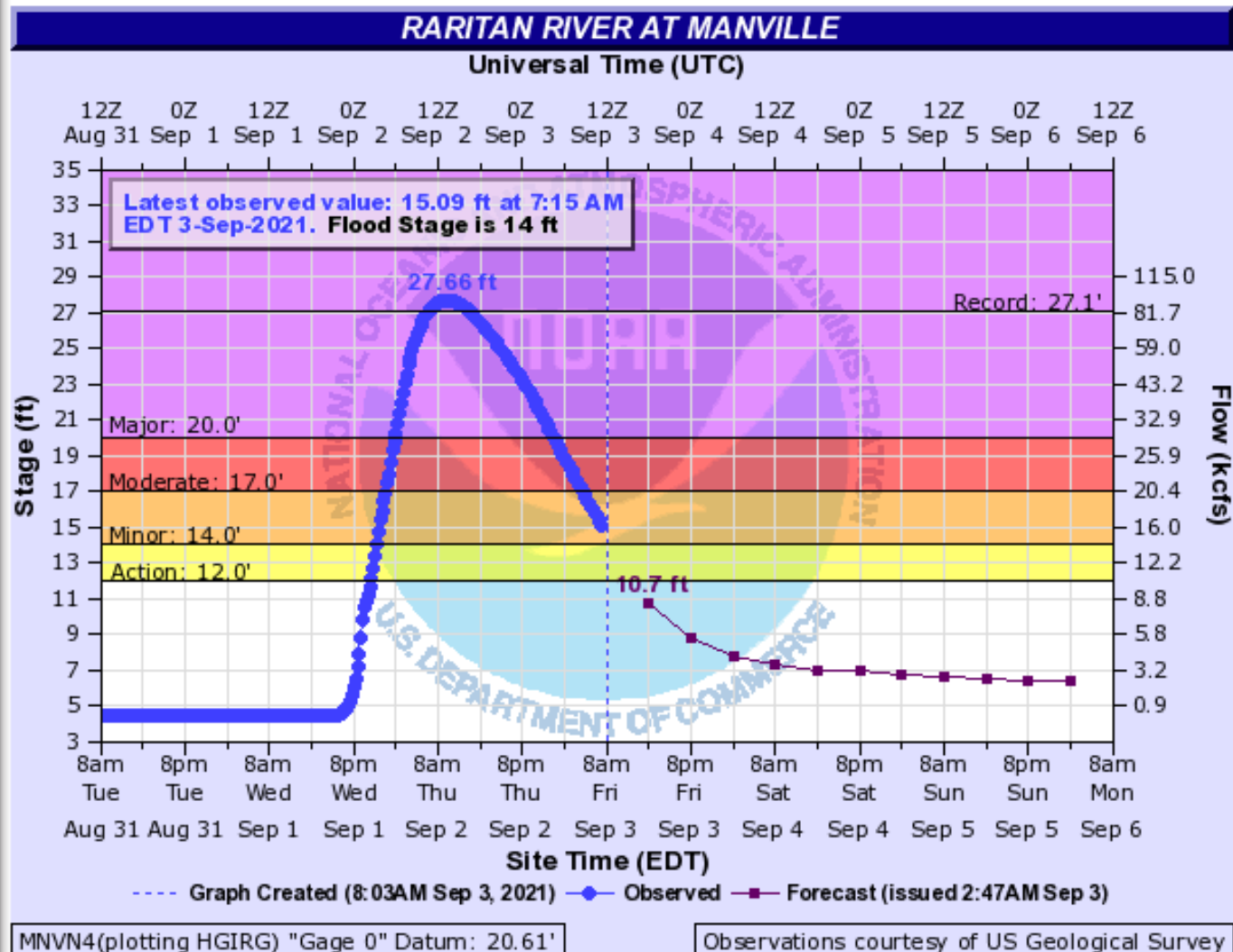
Bayonne City	Green Brook Twp	Lyndhurst Twp	Paterson City	Somerville Boro
Bloomfield Twp	Hackensack City	Middlesex Boro	Plainfield City	South Bound Brook Boro
Bound Brook Boro	Hamilton Twp Mer	Millburn Twp	Ridgefield Boro	South Hackensack Twp
Cliffside Park Boro	Hillsdale Boro	New Milford Boro	River Edge Boro	Springfield Twp
Clifton City	Hoboken City	Newark City	River Vale Twp	Wallington Boro
East Orange City	Little Falls Twp	North Plainfield Boro	Rochelle Park Twp	Wayne Twp
Garfield City	Lodi Boro	Nutley Town	Secaucus Town	Westwood Boro

Hurricane Ida – Manville

- Manville Borough experienced extreme flash floods due to heavy rainfall as well as the surging of nearby rivers
- PSE&G has approximately 3,700 gas customers and 45 miles of 35 psig MAOP gas main in Manville
- Approximately 2,380 gas customers in Manville experienced a gas service interruption or had an inspection due to flooding



Hurricane Ida - Manville



Hurricane Ida – Manville

- There were five building fires and explosions in Manville overnight Sept 2nd into Sept 3rd
- Assistance from local Fire Departments was hindered by the flood waters

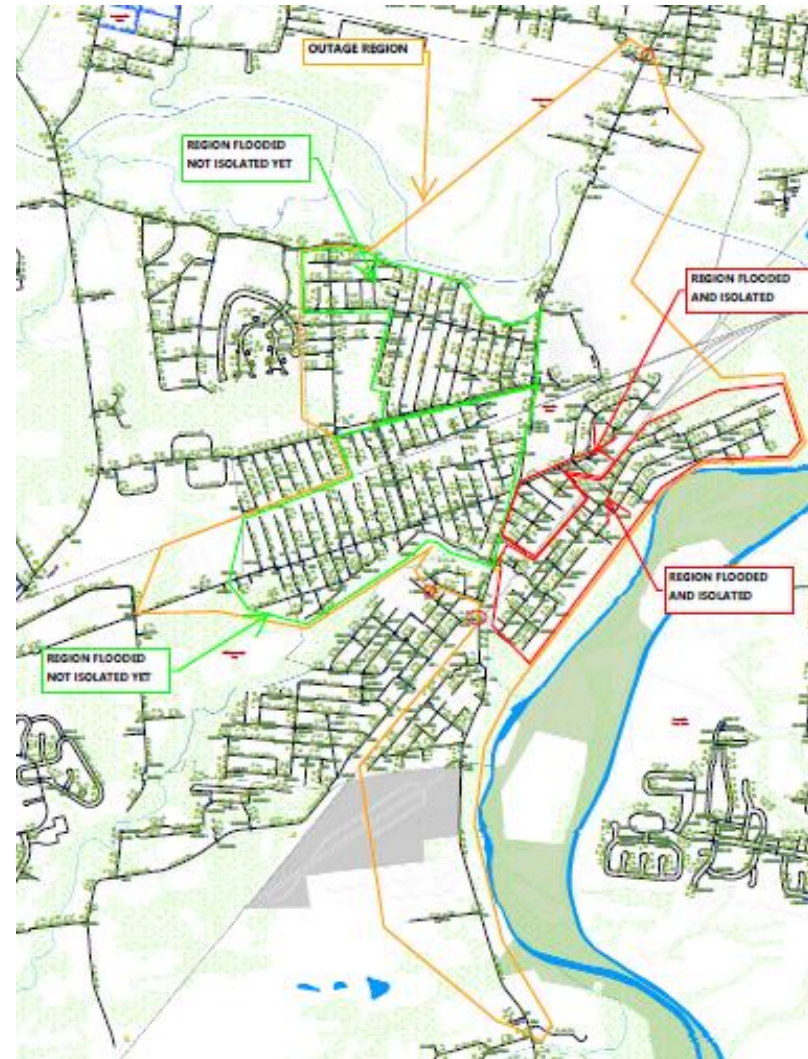


Hurricane Ida – Manville



Hurricane Ida – Shut Down Efforts

- With initial reports of explosions and fires, Engineering worked with Gas Operations to identify valves to isolate the area and reduce pressure
- Issues occurred due to flood waters still rising and valves becoming inaccessible
- Multiple iterations were required to locate accessible valves to isolate area (orange)
- After the final explosion on Sept 3rd, decision was made to attempt a full shutdown of area
- Larger valves may have had blow by as full shut down to 0 psig could not be achieved within the full area
- As water receded, personnel could reach valves to do a full shut down of Lost Valley area (red) and fully assess other flood impacted areas (green)



Hurricane Ida – Restoration Overview

PSE&G Gas Restoration Manville



Lost Valley – An Overview

- Lost Valley in Manville is located on the natural flood plain between the Raritan and Millstone Rivers, which makes it prone to flooding
- Several major flooding events occurred during Hurricane Floyd, April 2007 Nor'easter, Hurricane Irene, as well as Ida
- The nearby Raritan River was flooded to a record 27.66 feet during Ida, breaking its previous record set by Hurricane Floyd (1999)
- Previous Army Corps studies were conducted to assess the feasibility of building a seawall along the Millstone and Raritan River Basin to combat future flooding



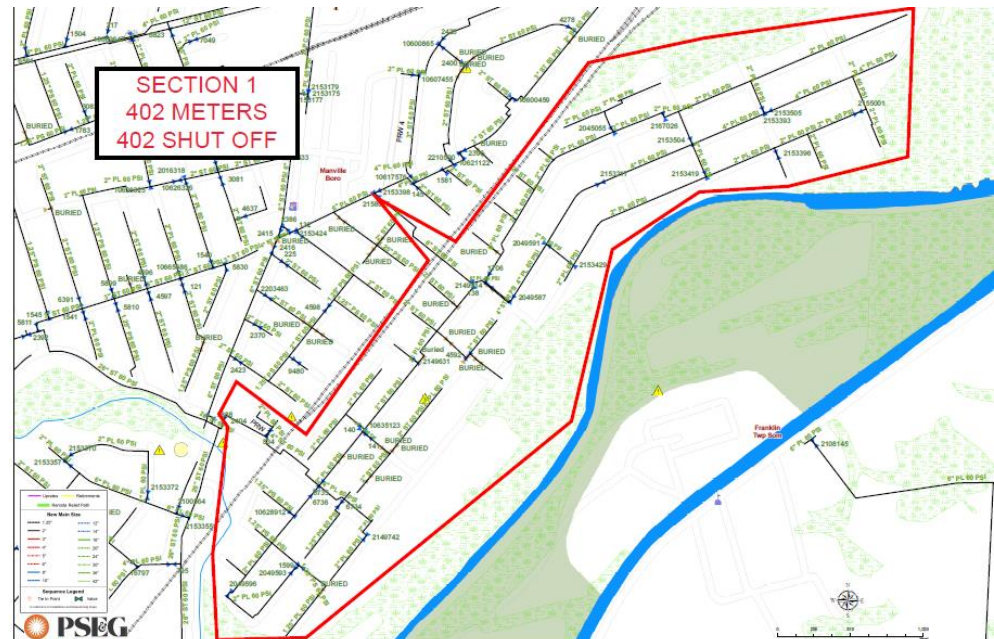
Lost Valley – Recovery Strategy

- Isolate – The Area
- Separate – The Customers
- Verify – The Separation
- Sequence – Natural Gas Introduction
- Introduce – The Natural Gas

Lost Valley – Preliminary Work

Achieving Shut Down:

- With flood waters receding, the Lost Valley area (i.e. Zone 1) was able to be sectionalized from the rest of the impacted areas and fully shut down to 0 psig utilizing 2 valves
- The remainder of the impacted area outside of Lost Valley remained at a reduced pressure between 3.5 and 10 psig due to valve blow by and/or a feed not found in records search
- 402 meters off with shut down in Zone 1



Lost Valley – Preliminary Work

Camera Work:

- Two locations excavated for camera inspection of the main prior to restoring gas pressure in Zone 1
- Concern over water/debris infiltration from compromised facilities (including damaged homes)
- Two locations at opposite ends of the isolation zone were chosen for excavation and plastic saddle installation on the main (would later be reused for gas re-introduction)
- All locations determined to be gas tight without infiltration

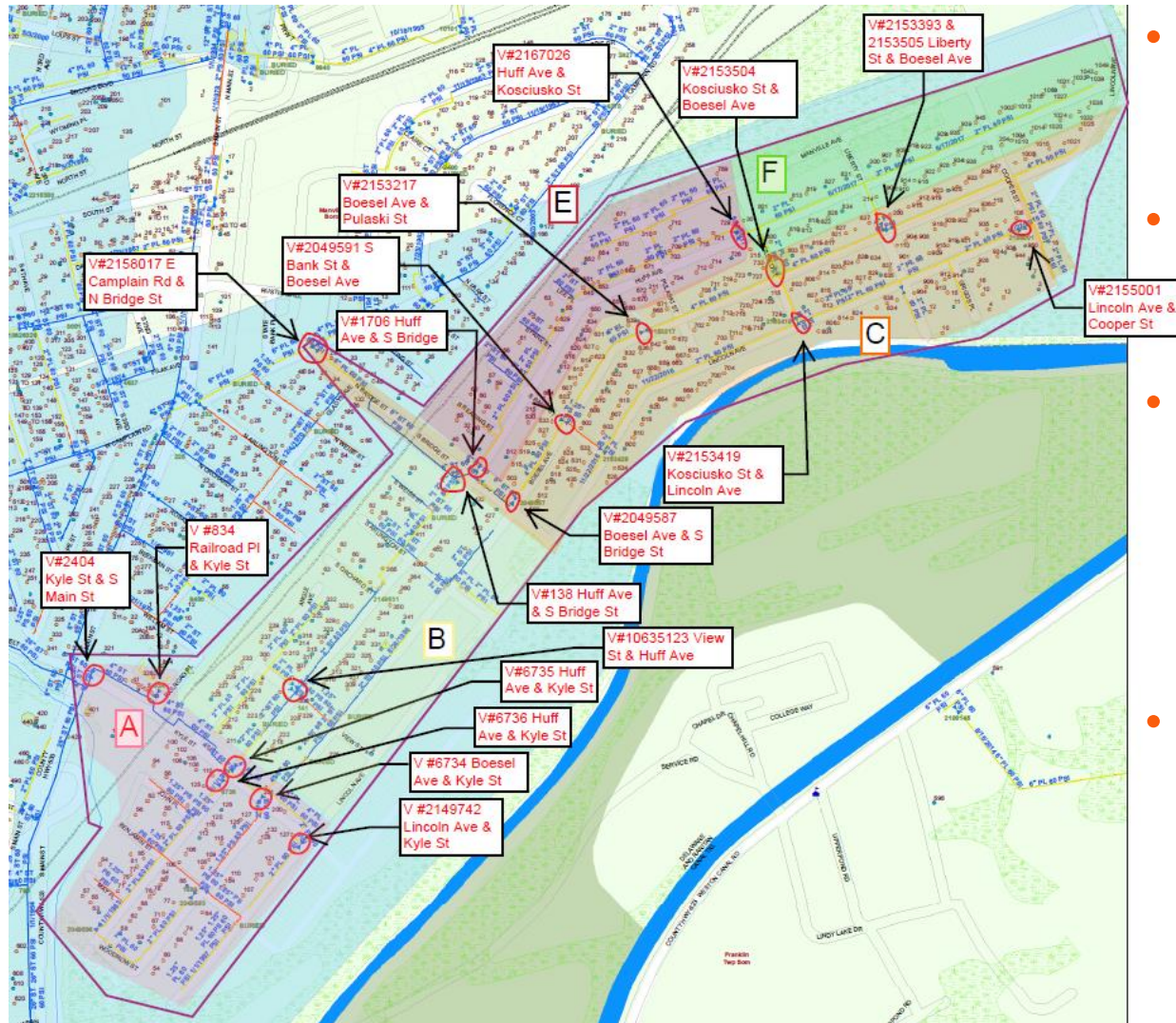


Lost Valley – Preliminary Work

Area Preparation:

- A comprehensive gas out plan for the Lost Valley area was developed to reintroduce gas to the entire area safely. These plans provided a sequence on clearing mains and introducing gas street by street
- Procedures were created, reviewed, and approved to ensure that all work would be performed in compliance with the Safety Standards and the Gas Distribution Standards
- Two sections were required to be inerted with nitrogen due to length and size while the remaining sections could be cleared prior to introducing gas
- Procedures, sketches, and clear in-service checklists were prepared to identify vent locations, valves to open, etc. They included details on restoration sequence for specific sections, final valve positions for boundary valves

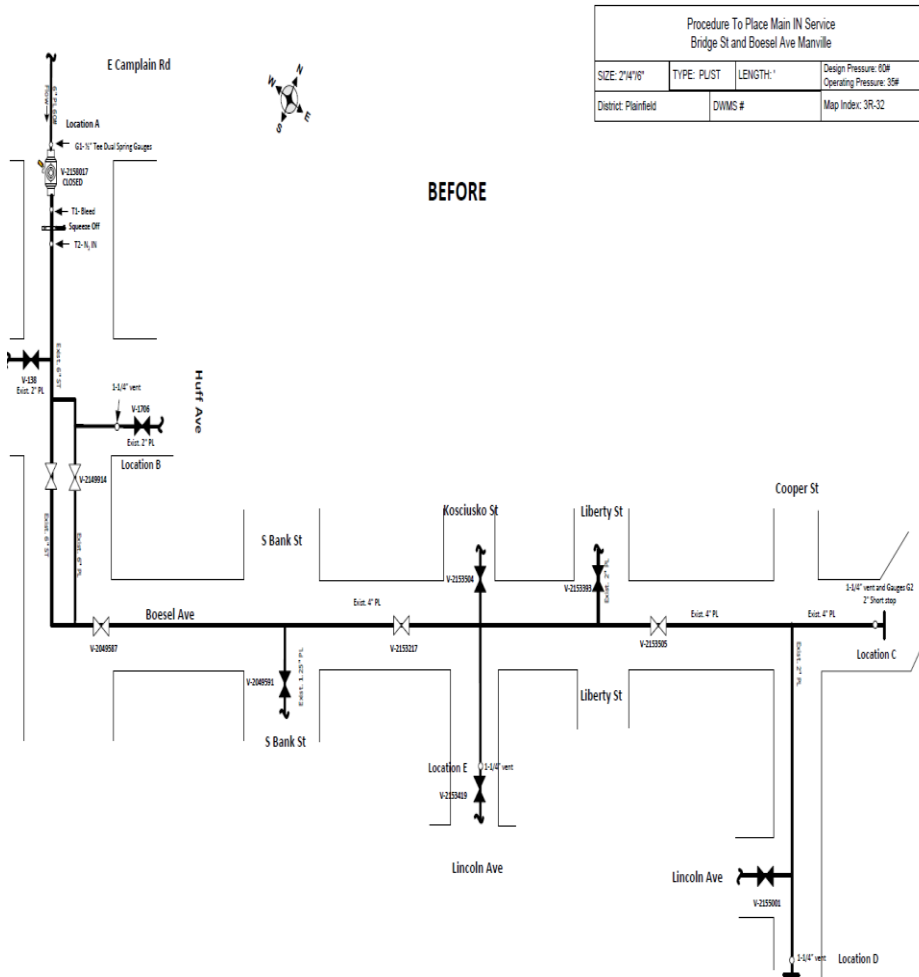
Lost Valley – Preliminary Work



- All valves identified that would be operated as gas is restored
- Lost Valley was divided into five sections A-F for restoration.
- There is a dependency of restoration
 - Section A then B
 - Section C then E then F
- Gas re-introduced from the 26" main and valve at Kyle St and Main St.

Lost Valley – Preliminary Work

Inert Main Procedure for and Clear In Service Check List



Procedure To Place Main In Service Bridge St and Boesel Ave Manville			
SIZE: 2" x 1/8"	TYPE: PLUST	LENGTH: 1"	Design Pressure: 60# Operating Pressure: 35#
District: Plainfield	DWMS #	Map Index: 3R-32	

Manville Restoration Sequence	
Zone Area: Zone 1 Section B	Design Pressure: 60 psi Operating Pressure: 35 psi

Stage 1:

Huff Ave between Kyle St and S Bridge St, Angle Ave, View St between Angle Ave and Boesel Ave, Boesel Ave between Kyle Ave and S Bridge St, S Orchard St, S Arlington St, S Weiss St 5,230' of 2" PL and ST, 70' of 4" ST

Inert or Clear	Clear
Procedure Required?	No
Volume of N2 Required	n/a
Vent Size Required	3/4" and 1-1/4"
Vent Locations	B, C, D, E, F, G, H, I

Sequence:

Step	Operation
	FOLLOW CLEAR INTO SERVICE CHECKLIST
1.	Ensure the following valves are open, if not open the valves 6735, 138, 140, 10635123, 2149631, 4592
2.	Install 3/4" vents at A, B, C, D, E, F, G, H, J, K Install 1 1/4" vent at I
3.	Slowly open valve 6735 to clear main into service venting at A, B, C and D until a reading of 95-100% gas is obtained
4.	Open valve 4592 to clear and vent at E and F until a reading of 95-100% gas is obtained.
5.	Open valve 141 to clear and vent at H and I until a reading of 95-100% gas is obtained.
6.	Open valve 10635123 to clear and vent at J and K until a reading of 95-100% gas is obtained.
7.	Close and remove vents
8.	Using Valve 6735, Bring pressure up in four equal increments (1 psig, 11 psig, 21 psig, full line pressure 35 psig), leak checking at each step. Fully open Valve 6735
9.	Valve 138, remains closed. Red tag.

Lost Valley – Preliminary Work

How do you guarantee a safe gas in?

Outside Meter Sets		
	Accessible Set	Inaccessible Set
Accessible Shutoff Valve	Off at shutoff with meter dropped and plugged	Cut and cap service
Inaccessible/Damaged Shutoff Valve	Cut and cap service	Cut and cap service

Inside Meter Sets		
	Accessible Set	Inaccessible Set
Accessible Curb Valve	Off at curb and off at meter	Cut and cap service
Inaccessible Curb Valve	Off at meter with meter dropped and plugged	Cut and cap service

Lost Valley – Preliminary Work

Meters and Services:

- Each procedure had a checklist attached to capture the status at each physical structure. All physical structures on the property were checked for gas
- Service Inspection Checklist was completed ahead of procedure to ensure all structures made safe

Service Inspection Checklist - Gas Distribution									
House #	Street	Double Block (DB) / Physical Separation (PS)?		Service Off At? Double Block or Physical Separation Required				Date	Confirmed By?
		<input type="checkbox"/> DB	<input type="checkbox"/> PS	<input type="checkbox"/> Meter Shutoff	<input type="checkbox"/> Curb Valve	<input type="checkbox"/> Meter Dropped /Plugged	<input type="checkbox"/> Cut and Cap		
		<input type="checkbox"/> DB	<input type="checkbox"/> PS	<input type="checkbox"/> Meter Shutoff	<input type="checkbox"/> Curb Valve	<input type="checkbox"/> Meter Dropped /Plugged	<input type="checkbox"/> Cut and Cap		
		<input type="checkbox"/> DB	<input type="checkbox"/> PS	<input type="checkbox"/> Meter Shutoff	<input type="checkbox"/> Curb Valve	<input type="checkbox"/> Meter Dropped /Plugged	<input type="checkbox"/> Cut and Cap		
		<input type="checkbox"/> DB	<input type="checkbox"/> PS	<input type="checkbox"/> Meter Shutoff	<input type="checkbox"/> Curb Valve	<input type="checkbox"/> Meter Dropped /Plugged	<input type="checkbox"/> Cut and Cap		

Lost Valley – Preliminary Work

Mains:

- Use a buffer beyond the scope of the procedure to verify adjacent homes/structures are not within the scope of the gas main procedures or are included and properly isolated
- Prepare vents and equipment needed and review procedures
- Calculate and obtain sufficient nitrogen tanks for the sections requiring inerts
- Set up rally points and communication structure to Incident Command ahead of procedure execution



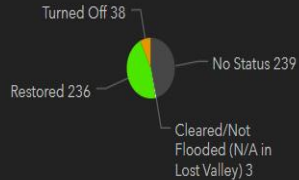
Use of New Technology

- A new GIS Web App and dashboard was developed to aid in accurate data reporting and to allow tracking of all the mains, services and meters in the affected areas
- For internal use to facilitate real-time gas outage updates in Lost Valley, statuses were updated as facilities were being shutoff, turned off, and restored
- Several groups were involved with the updates: Planning and Design, ASB Technicians, and Field Operations, Dispatch
- The meter points were automatically updated every 30 minutes as meter reports were submitted
- Services were updated by Field Operations and Mains and Valves were completed by Engineering as the procedures were executed sequentially

Use of New Technology

Gas Restoration - Lost Valley

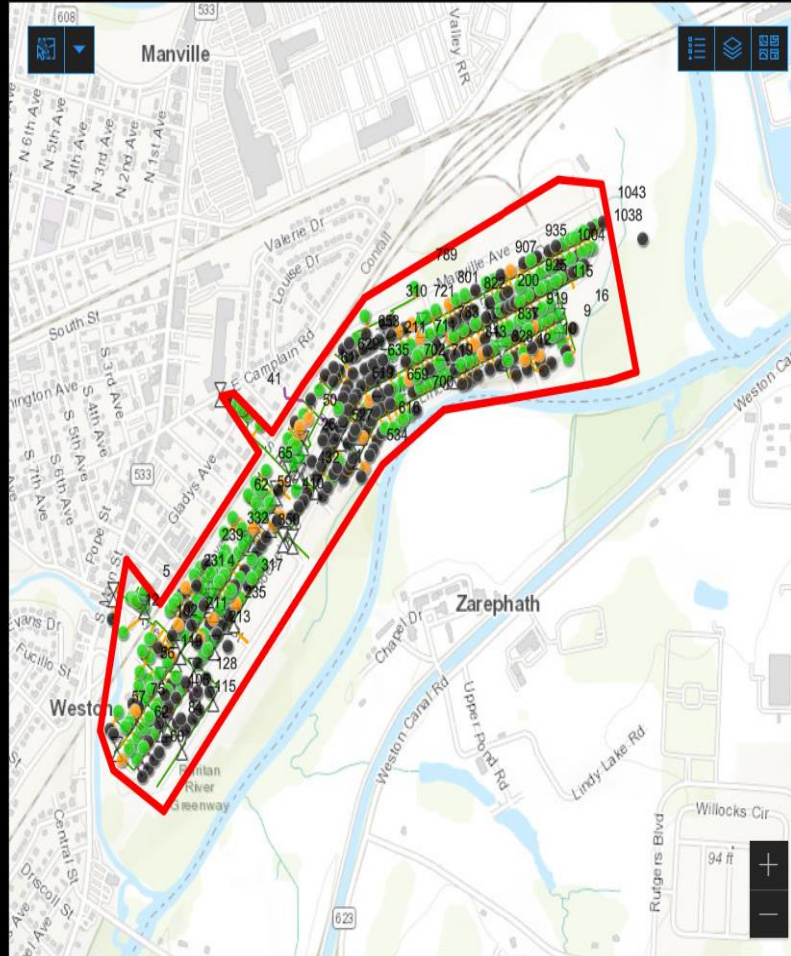
Gas Service Point Restoration Status



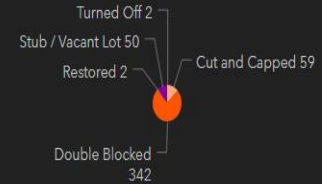
Restored or Cleared Meters

239
of
523

Last update: 2 minutes



Services Restoration Status



Services Restored, Capped or Blocked

453
of
455

Last update: 2 minutes

Restored Mains

158
of
158

Last update: 2 minutes

Restored Mains



Restored Mains 158

Open Valves

43
of
43

Last update: 2 minutes

Gas Valve Status



Open 43

Use of New Technology

Gas Restoration – Mains

- **Off-** Main shutdown (no gas)
- **Restored-** Main is live with full line pressure
- **Water in Main-** Water infiltration

Gas Restoration – Valves

- **Closed-** Valves are fully closed
- **Inaccessible-** Unable to be accessed
- **Open-** Valves are fully open
- **No status-** No updates available yet

Gas Restoration – Gas Service Point (Meters)

- **Restored-** Operational and customer is receiving gas
 - Gas meter turned on, equipment replaced, inspections completed, etc.
- **Cleared-** Not flooded (not applicable to the Lost Valley Area)
- **Turned Off-** Shut off meter valve or curb valve
- **No Status-** No updates available yet

GasRestoration - Mains

- Off
- Restored
- Water in Main

GasRestoration - Valves

- ⌘ Closed
- ⌘ Inaccessible
- ⌘ Open
- ⌘ No Status

GasRestoration - Gas Service Point

- Turned Off
- Restored
- Cleared/Not Flooded (N/A Lost Valley)
- No Status

Use of New Technology

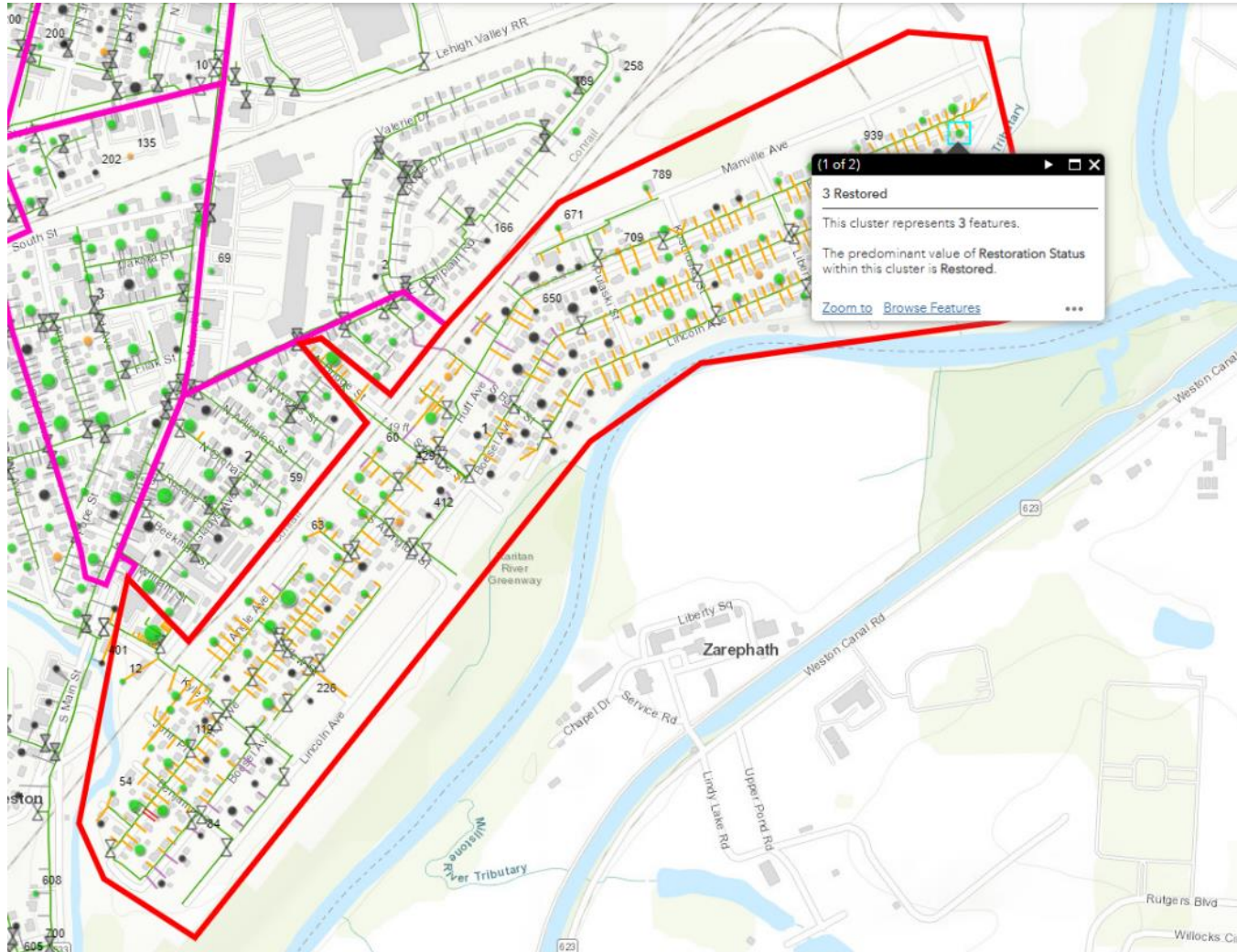
Gas Restoration – Services

- **Cut and Capped-** (yellow)
- **Double Blocked-** (yellow)
 - Meter Physically removed and plugged
 - Off at curb and off at meter
 - Needs to be verified address by address and manually updated in Web App
- **Restored-** Operational with live gas (green)
- **Stub/ Vacant Lot-** Service stubs or do not exist (purple)
- **Turned Off-** Shut off meter valve or curb valve (red)
- **No Status-** No status available yet (grey)

GasRestoration - Services

- Restored
- Double Blocked
- Cut and Capped
- Turned Off
- Stub / Vacant Lot
- No Status

Lost Valley – Restoration of Service



Lost Valley – Service Restoration Cont'd

- To reintroduce natural gas into mains, each section was treated as an in-service procedure and uprate
- Procedures were developed for each section of main
- The main was purged with N₂ or cleared before gas was introduced
- Pressure was increased in specified increments
 - Leak mobile and walking surveys conducted with each increase in pressure
- All results are documented in the procedure table for each physical structure

Leak Surveys and Leaks Detected during Pressure Increase.

All subsequent pressure increments shall not exceed 10 Psig or one fourth of the total increase, whichever requires fewer increments.

The entire main system and services must be surveyed for leaks using a leak mobile and walking survey after each increment and when the final pressure has been reached.

Each leak detected before and during the increase in pressure shall be repaired before a further pressure increase is made.

Survey Results for Incremental Pressure Increase.

Pressure	#s of leak detected	#s of Leak Repaired	#s of Leak monitored/Readings	Supervisor:
				Date:
				Time:

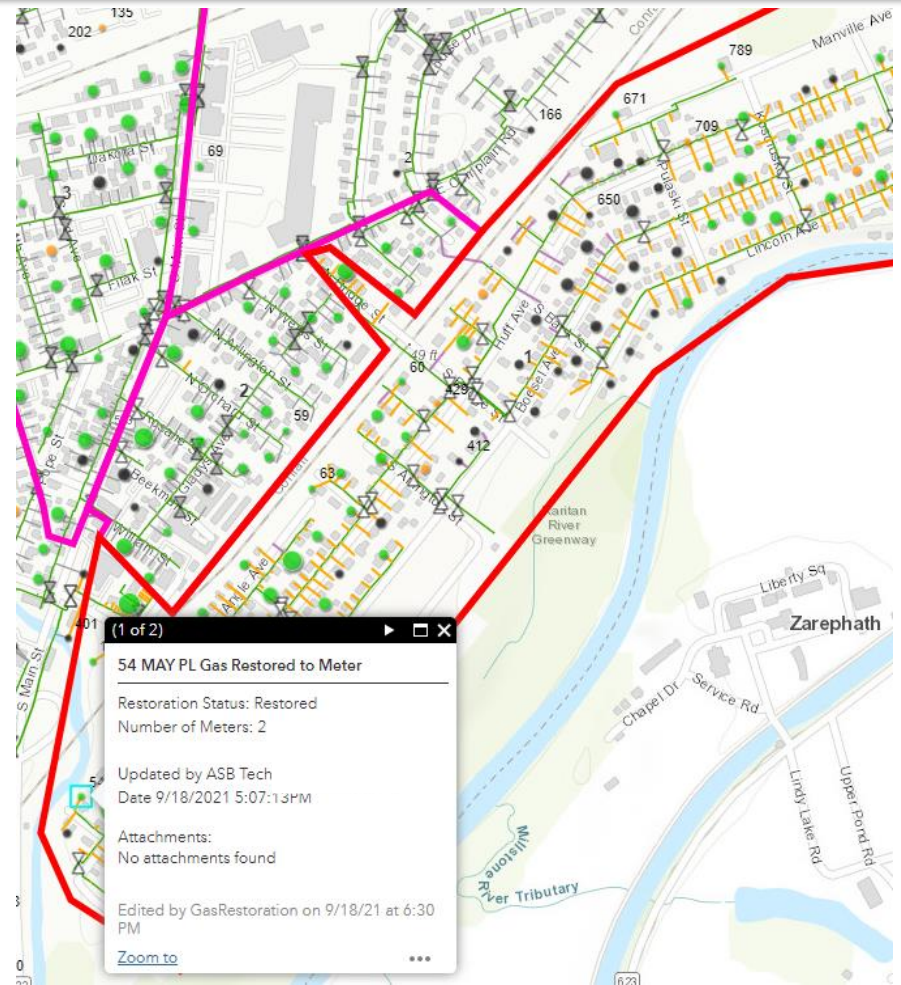
Leak Survey after Pressure Increase

When the system operating pressure is reached, the following surveys shall be started immediately and completed as soon as possible.

1. Each service shall be checked for leaks with a portable flame ionization unit or leak detection device of equivalent sensitivity.
2. All the exposed pipe joints of the meters, regulators and service entrances are to be inspected for gas tightness, tested with a Combustible Gas Indicator (CGI), and the atmosphere in the building near the gas service tested with a Combustible Gas Indicator (CGI). If access cannot be gained to the building to perform these checks on the day of the restoration, the service shall be kept isolated per preliminary step #4.
3. An additional leak mobile survey shall be conducted over the area approximately one week later.

Lost Valley – Restoration Cont'd

- Once gas has been reintroduced to a section, the GIS Dashboard is updated
- The crews then split up with majority moving on to the next section of main and a portion remaining behind to connect habitable services and test/check fittings
- As services were physically reconnected, updates were made in the Dashboard to track progress
- The process was repeated until the entire Lost Valley was brought back online, section by section, with all approved customers being re-lit one by one



GIS Dashboard with updated service

Lost Valley – Presidential Visit

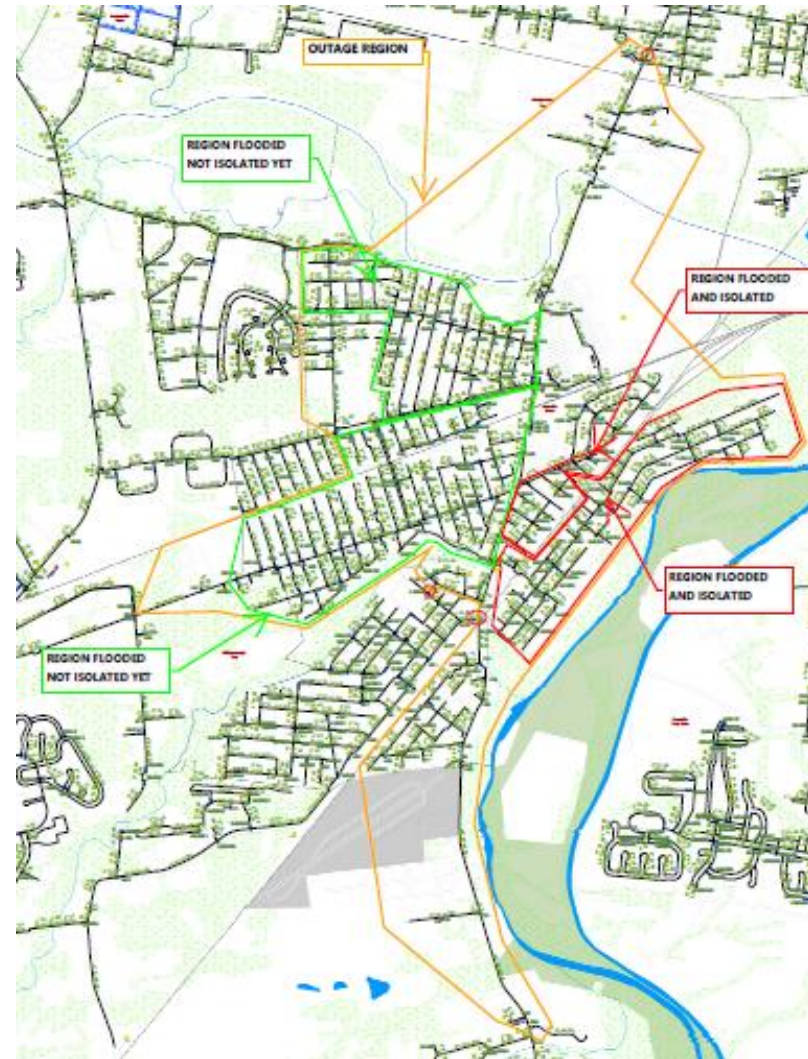
- President Biden visited Manville on Friday Sept. 7th to view the damage and assess the need for Federal aid.
- The president met with state and local leaders in Somerset County.



- Work was paused for multiple hours to allow Secret Service to sweep the area
- All employees had to vacate the area during the presidential tour

Outside of the Lost Valley

- While the most intensive work was required to reconnect customers in the Lost Valley, other areas of Manville were being inspected and returned to service simultaneously
- As flood waters receded, the exact extent of the impacted customers was determined
- Impacted customers services were shut off and had meters and regulators replaced
- Non-impacted areas and fully restored areas were brought back up to line pressure in areas
- All valves reducing area pressure were eventually returned to full open position



Materials, Logistics, and Supply Chain

- While PES&G's service regulators can withstand rain and snow, they must be replaced after being submerged
- Approximately 9,500 service regulators were obtained through:
 - Contacting manufacturers/service reps who provided over 7,000 service regulators
 - Worked with Mutual Aid partners (NGA and AGA) to obtain access to 2,500 regulators in surplus stock from other members

Safety Mechanisms:

- PSE&G reviewed manufacturer specs of all regulators prior to installation
- Affixed badges to each regulator stating the pressure system for which they were approved
- Shipped regulators to two different PSE&G sites depending on their designated PSE&G pressure system

Materials, Logistics, and Supply Chain

Thank you to all of the utilities and vendors who supported us:

Organizations:

- Northeast Gas Association (NGA) - José Costa
- American Gas Association (AGA) - Jackie Malatesta

Vendors:

- Control Associates
- Accumet
- Richards Mfg. (in liaison with PECO)
- MRC (in liaison with Citizens Energy Group)

Utilities:

- Orange & Rockland
- National Grid
- Central Hudson
- PGW
- Liberty Utilities NY
- Liberty Utilities MA
- LG&E
- Washington Gas
- New Mexico Gas
- Southern Cal Gas
- Duke Energy OH
- NW Natural
- Ameren

Preparing for the Future

- Post Storm Efforts: Lessons Learned teams were assembled to review current procedures, training materials, and technology for improvement
- PSE&G is exploring various solutions to mitigate the impact of future storm events:
 - Installing Remote Automatic Shutoff Valves at Flood Prone Customer Locations
 - Installing Excess Flow Valves in Flood Areas
 - Moving Meter Sets Outside
 - Performing Proactive Shutdowns in Gas Distribution System
 - Using Drones to Determine Flood Perimeter & Damage Assessment

FOR MORE INFORMATION

Paul Pirro

- Manager – Appliance Service Technical Support
- PSE&G Gas Asset Strategy
- 973-703-0614 ©
- paul.pirro@pseg.com

