



# Sub Regional RTEP Committee Mid-Atlantic

December 01, 2016



# Reliability Analysis Update

## N-1 First Energy Planning Criteria (FERC Form 715):

- The Traynor - Whippany 34.5 kV (N14) circuit is overloaded for the loss of the Madison – Traynor 34.5 kV (R96) circuit .

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, JCPL (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

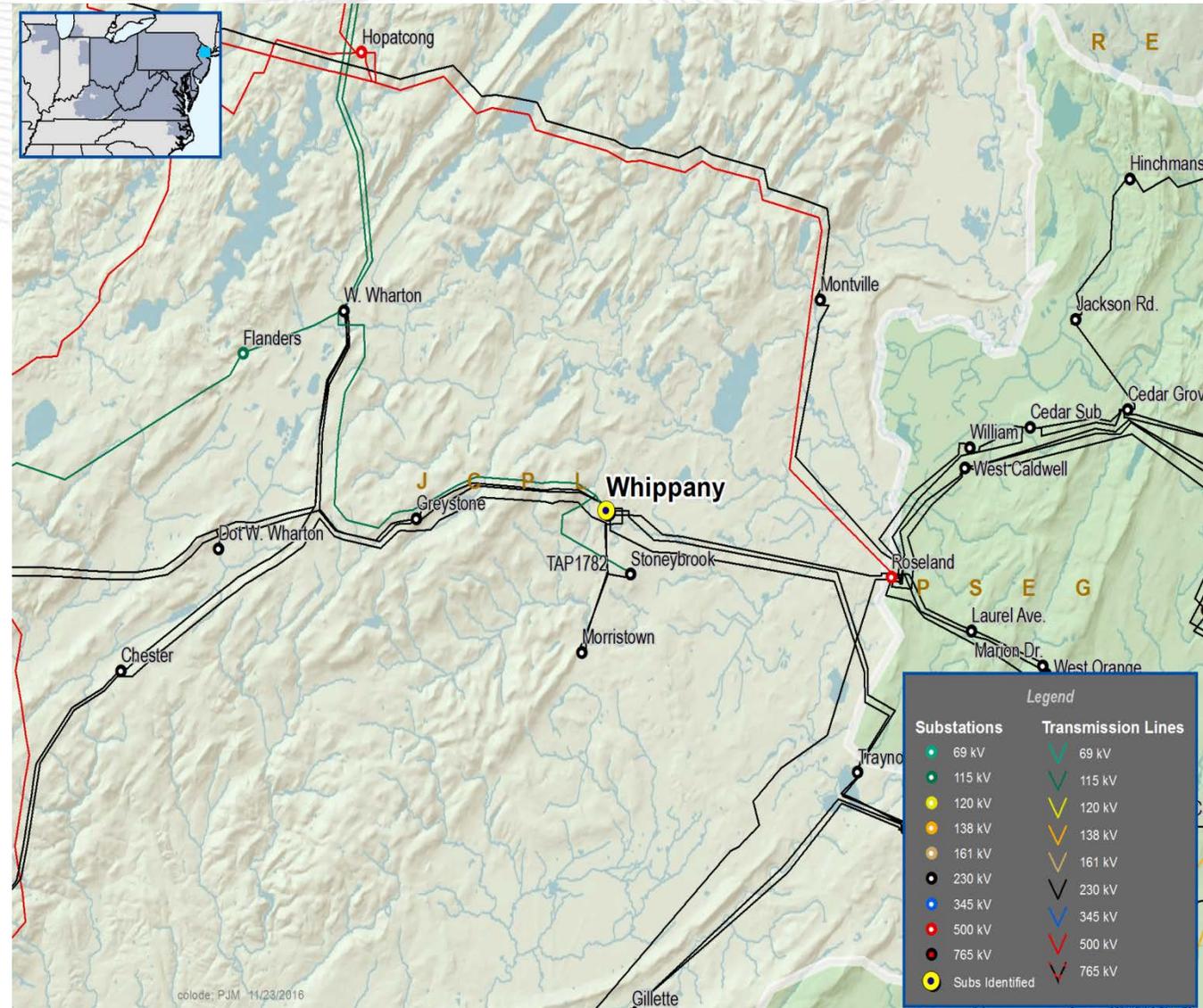
## Proposed Solution:

- Install a bypass switch at Mount Pleasant 34.5 kV substation to allow the Mount Pleasant substation load to be removed from the N14 line and transfer to O769 line. (B2809)

**Estimated Project Cost:** \$ 0.01 M

**Required IS Date:** 6/1/2017

**Expected IS Date:** 6/1/2018



## N-1 First Energy Planning Criteria (FERC Form 715):

- East Penn Manufacturing customer will be increasing their load incrementally starting from 2018 -2023. The load is radially served from Lyons 230/69 kV substation. In 2019 the Lyons 230/69 kV transformer #3 is overloaded for the loss of the #5 transformer.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, Met-Ed (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

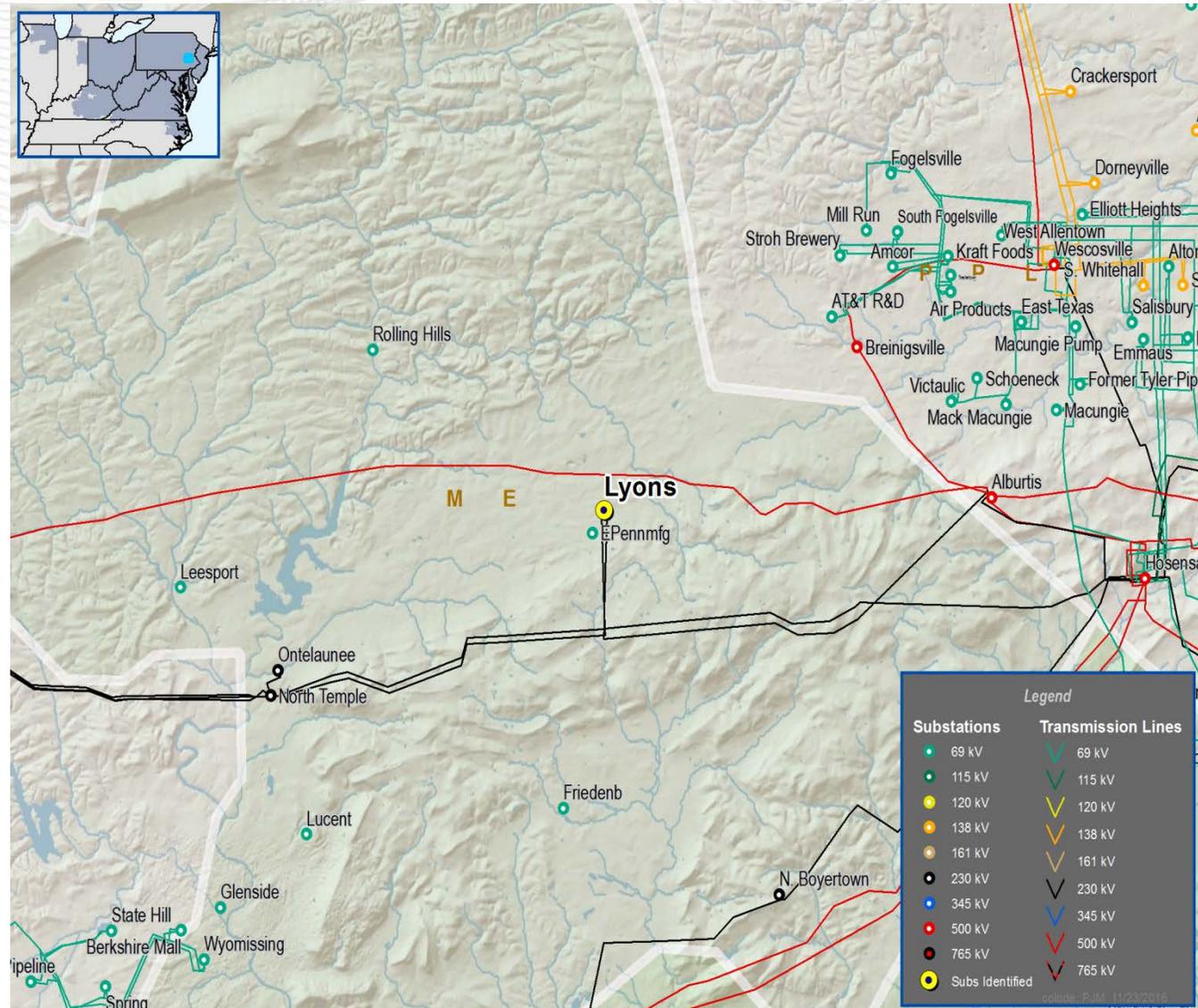
## Proposed Solution:

- Install a 3rd 230/69 kV 224 MVA Transformer at Lyons and install new terminal equipment for existing Lyons - East Penn(865) 69 kV Line. (B2814)

**Estimated Project Cost:** \$ 5.5 M

**Required IS Date:** 6/1/2019

**Expected IS Date:** 6/1/2019



## N-1 First Energy Planning Criteria (FERC Form 715):

- The Bethlehem to Leretto 46 kV circuit is overloaded for a single contingency loss of the Summit 115/46 kV transformer and the Summit – Claysburg, Summit – C. Slope 115 kV circuits.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PenElec (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

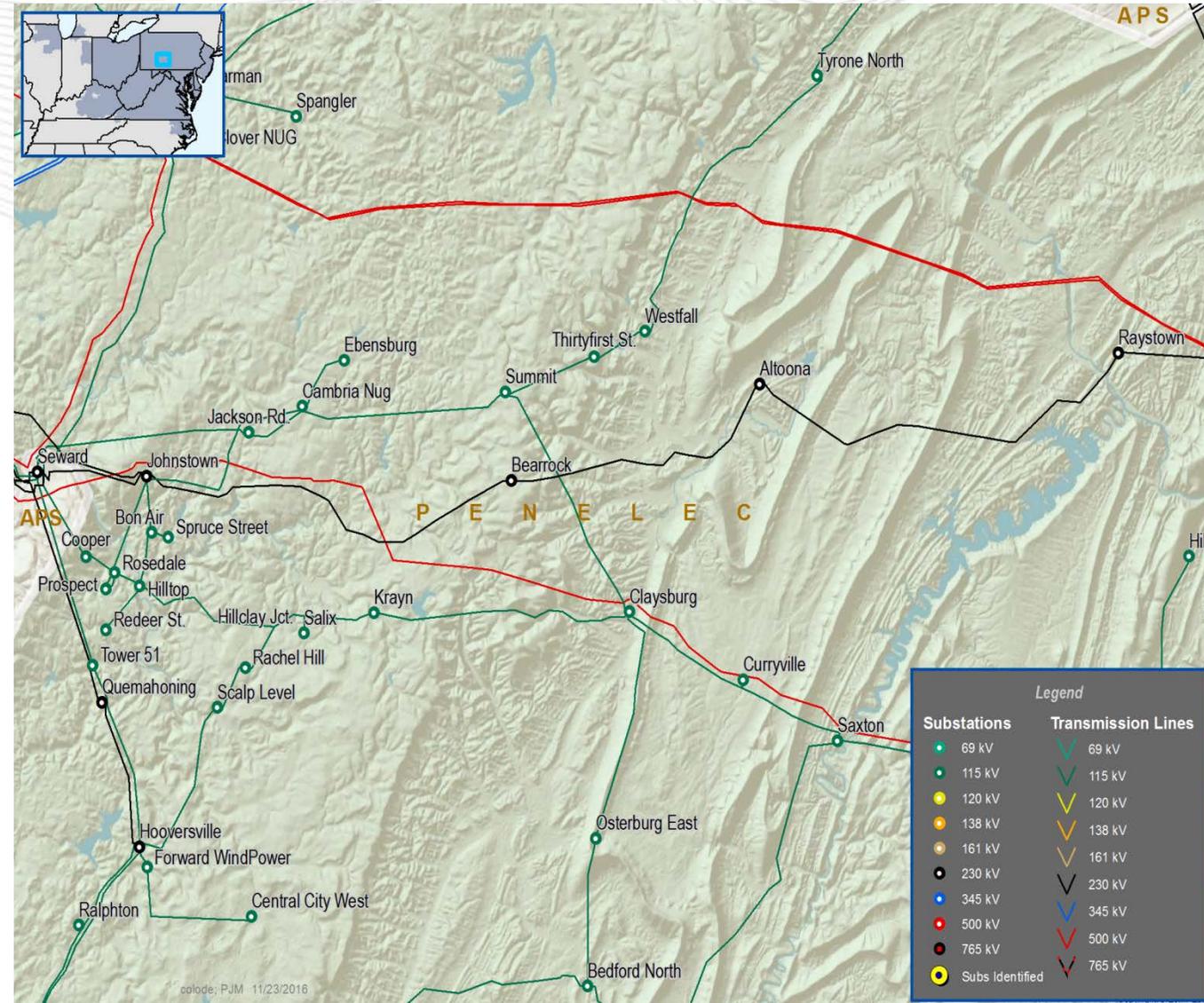
## Proposed Solution:

- Reconductor 3.7 miles of the Bethlehem to Leretto 46 kV circuit and replace terminal equipment at Summit 46 kV. (B2803)

**Estimated Project Cost:** \$ 4.0 M

**Required IS Date:** 6/1/2017

**Expected IS Date:** 12/1/2017



## N-1 First Energy Planning Criteria (FERC Form 715):

- The Huntingdon to C Tap 46 kV circuit is overloaded for single contingency loss of the Huntingdon – Raystown 46 kV circuit.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PenElec (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

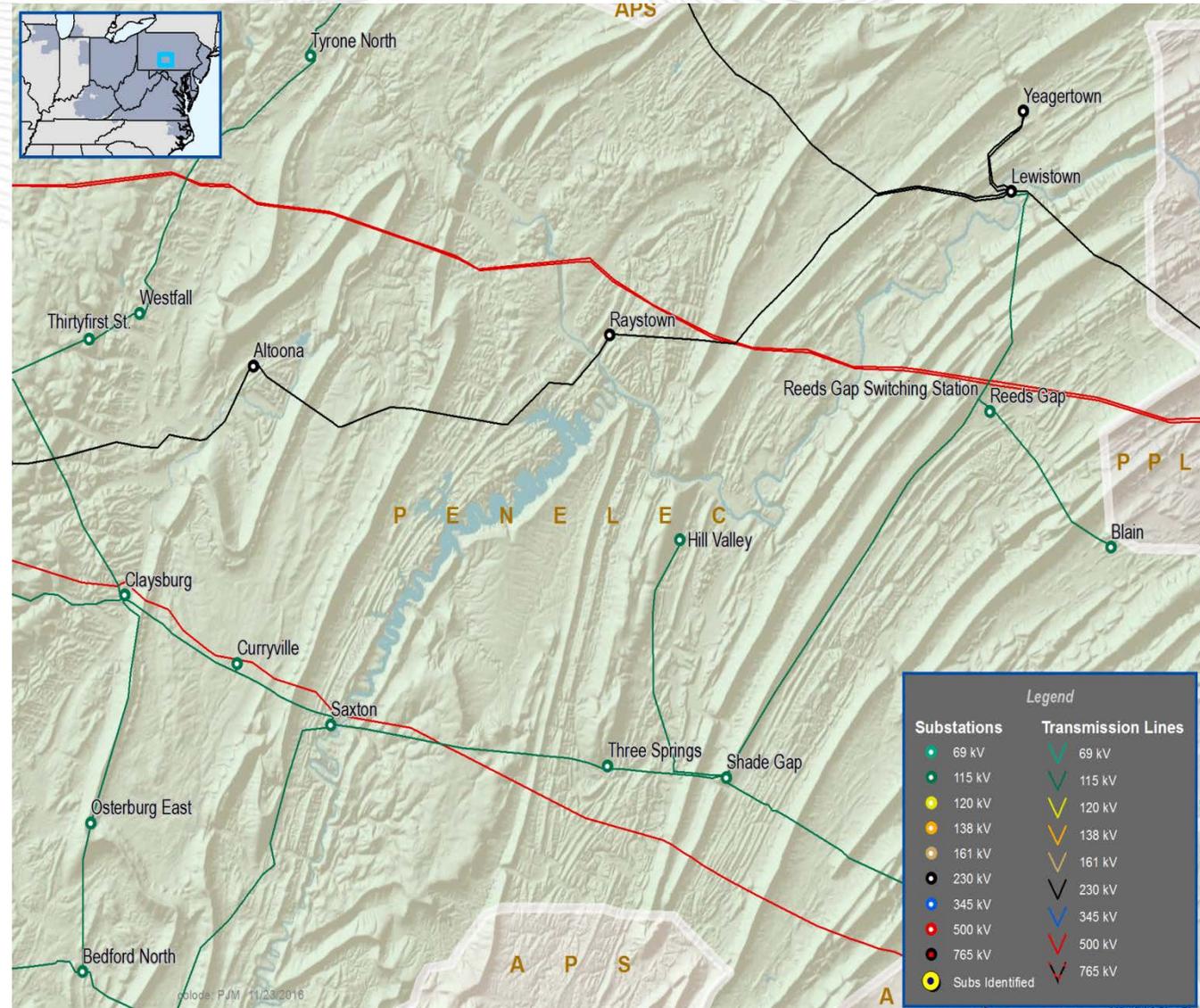
## Proposed Solution:

- Install a new relay and replace 4/0 CU bus conductor at Huntingdon 46 kV station: on the Huntingdon - C tap 46 kV circuit . (B2804)

**Estimated Project Cost:** \$ 0.5 M

**Required IS Date:** 6/1/2017

**Expected IS Date:** 12/1/2017



## N-1 First Energy Planning Criteria (FERC Form 715):

- The Hollidaysburg - HCR Tap 46 kV circuit is overloaded for single contingency loss of the Bear Rock – Johnstown 230 kV circuit.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PenElec (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

## Proposed Solution:

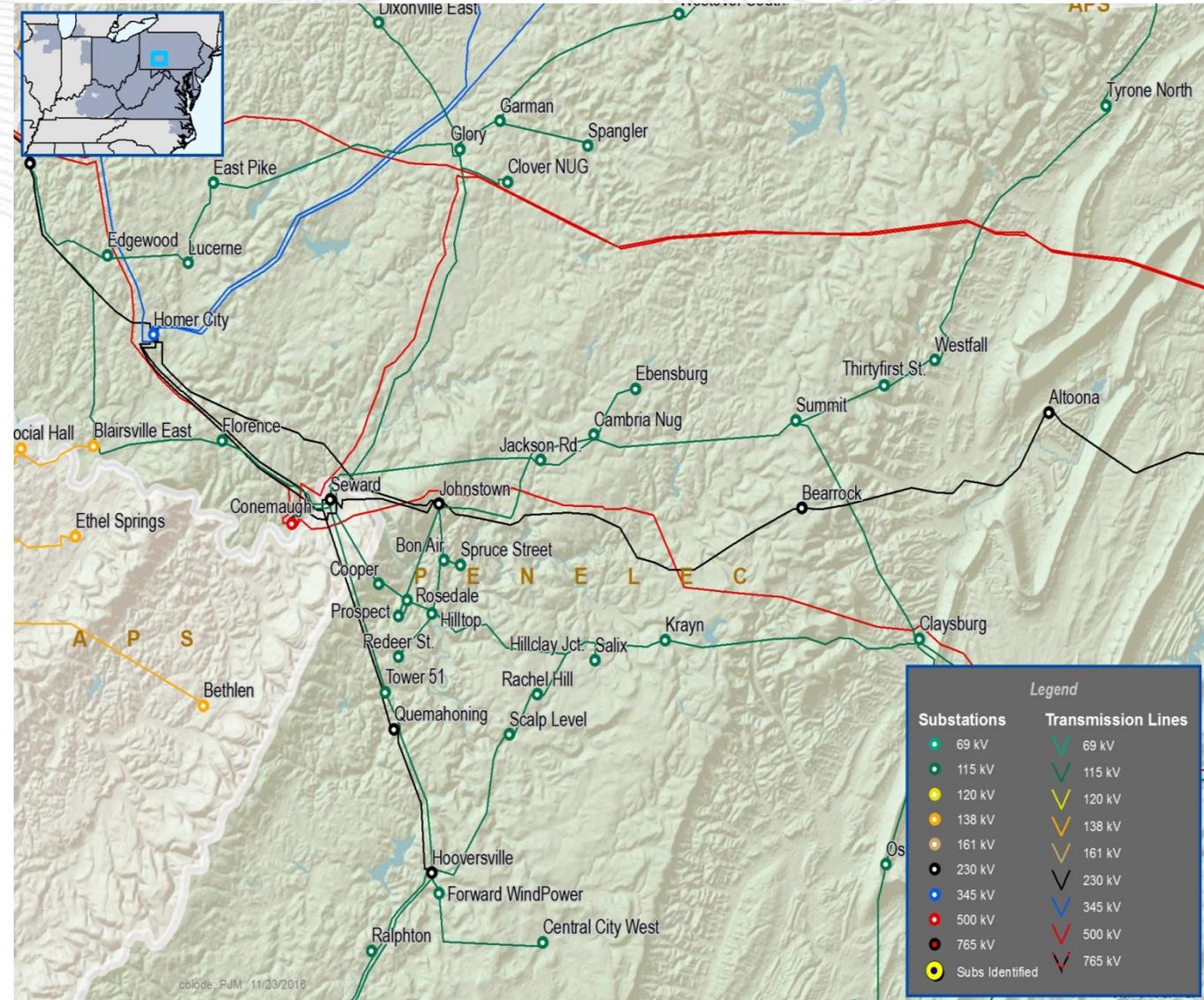
- Install a new relay and replace 4/0 CU & 250 CU substation conductor at Hollidaysburg 46 kV station: on the Hollidaysburg - HCR Tap 46 kV circuit. (B2805)

## Estimated Project Cost:

\$ 0.5 M

Required IS Date: 6/1/2017

Expected IS Date: 12/1/2017



## N-1 First Energy Planning Criteria (FERC Form 715):

- The Raystown - Smithfield 46 kV circuit is overloaded for single contingency loss of the Huntingdon – Raystown 46 kV circuit.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PenElec (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

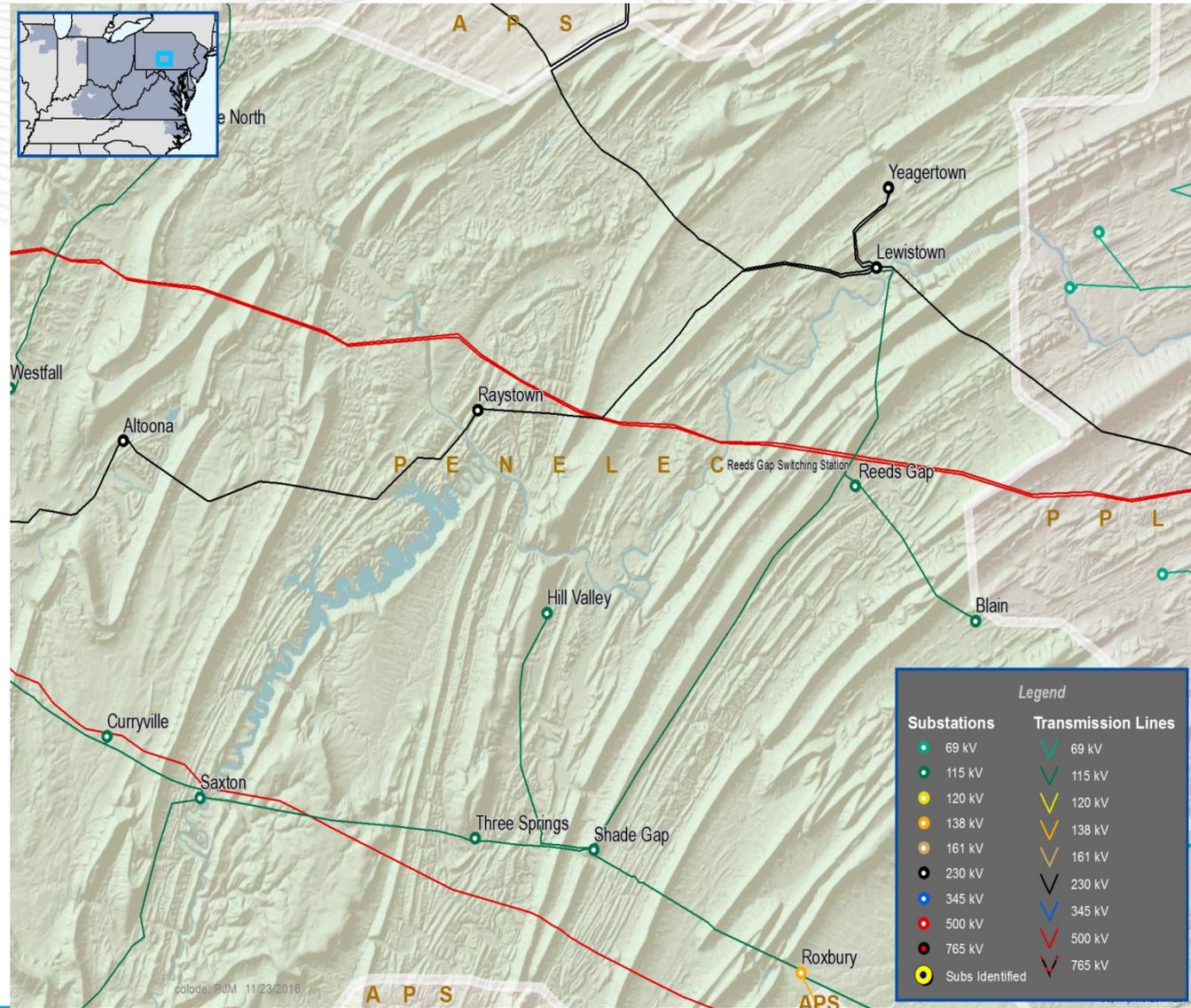
## Proposed Solution:

- Install a new relay and replace meter at the Raystown 46 kV substation: on the Raystown - Smithfield 46 kV circuit. (B2806)

**Estimated Project Cost:** \$ 0.5 M

**Required IS Date:** 6/1/2017

**Expected IS Date:** 12/1/2017



## N-1 First Energy Planning Criteria (FERC Form 715):

- The Eldorado - Gallitzin 46 kV circuit. is overloaded for single contingency loss of the Bear Rock – Johnstown 230 kV circuit.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PenElec (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

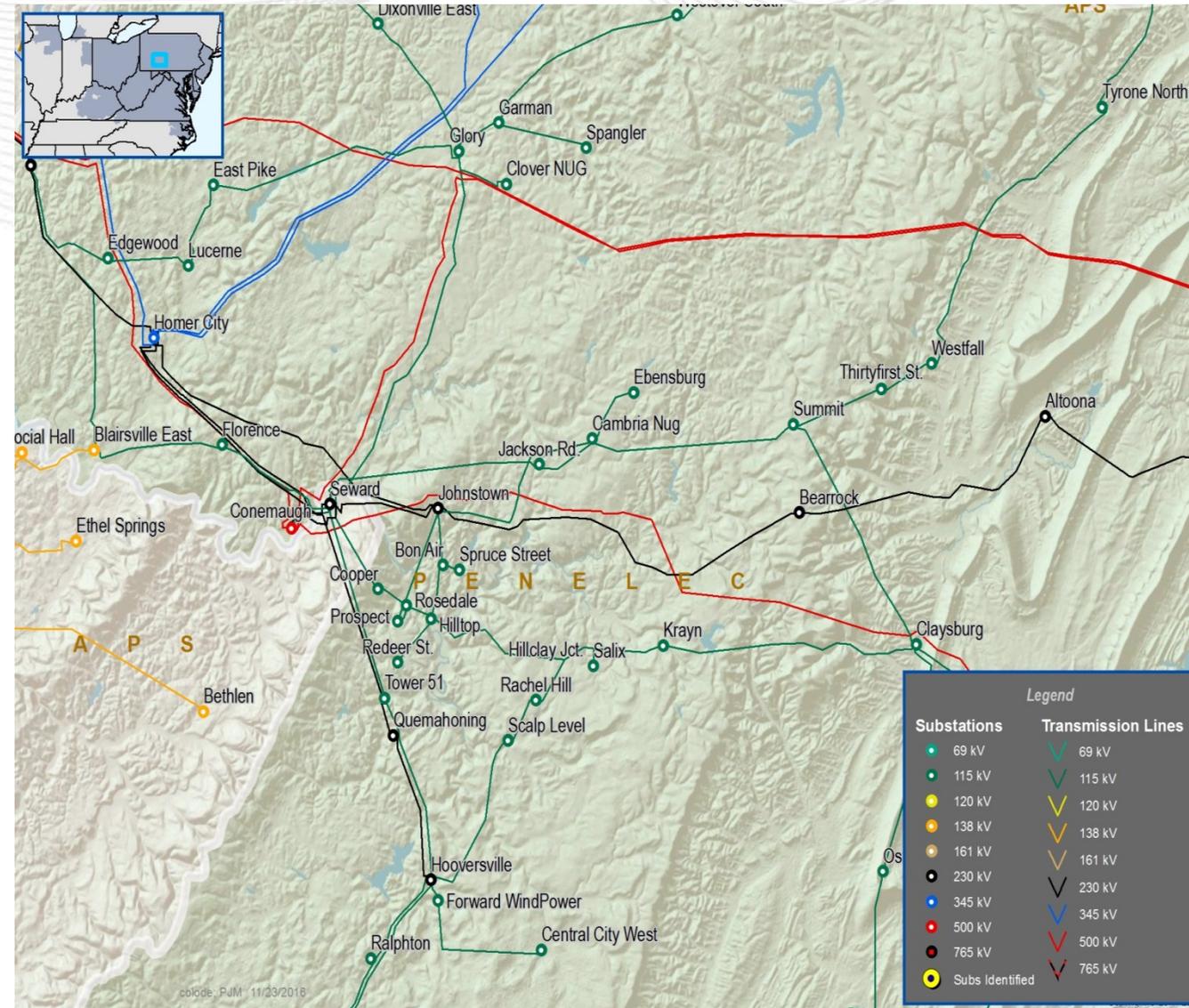
## Proposed Solution:

- Replace the CHPV and CRS relay, and adjust the IAC overcurrent relay trip setting; or replace the relay at Eldorado 46 kV substation: on the Eldorado - Gallitzin 46 kV circuit. (B2807)

**Estimated Project Cost:** \$ 0.3 M

**Required IS Date:** 6/1/2017

**Expected IS Date:** 12/1/2017



## N-1 First Energy Planning Criteria (FERC Form 715):

- The Raystown - Huntingdon 46 kV circuit is overloaded for single contingency loss of the Hill Valley - Huntingdon - Raystown 46kV circuit.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PenElec (Local TO) will be the Designated Entity

## Alternatives Considered:

- Do to the immediate need of the project, no alternative solution was considered.

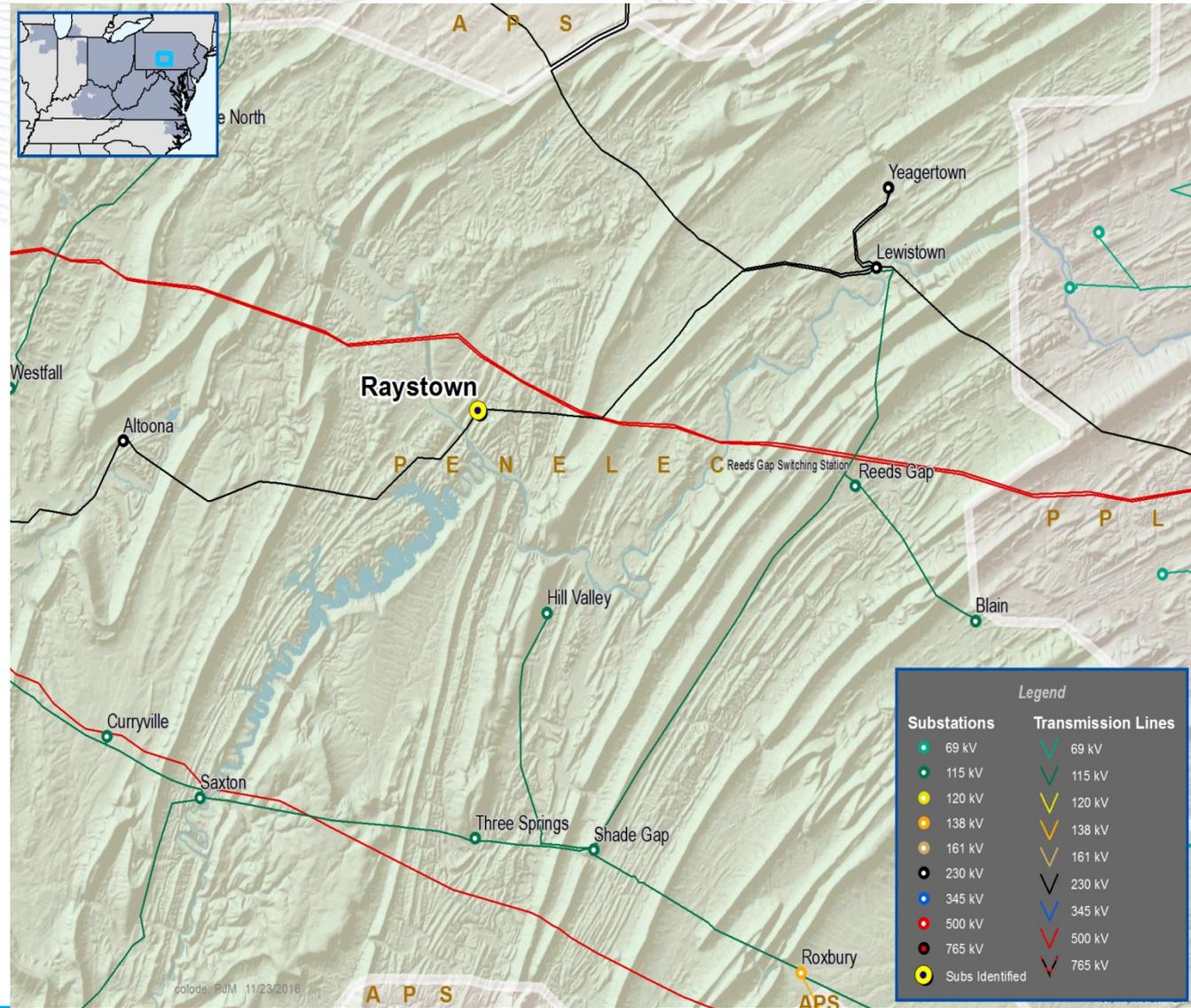
## Proposed Solution:

- Adjust the JBC overcurrent relay trip setting at Raystown, and replace relay and 4/0 CU bus conductor at Huntingdon 46 kV substations: on the Raystown - Huntingdon 46 kV circuit. (B2808)

**Estimated Project Cost:** \$ 0.3 M

**Required IS Date:** 6/1/2017

**Expected IS Date:** 12/1/2017



## PPL Planning Criteria (FERC Form 715):

- A stuck 69 kV bus section Circuit Breaker in the Lycoming 69 kV yard or a bus section failure in the Lycoming 69kV yard leads to more than acceptable (5 %) voltage drop and creates less than acceptable minimum voltage (0.90 pu).
- PPL TO Criteria for 69 kV System- No more than 5% voltage drop and not less than 0.90 pu voltage for P2-2 (bus section fault) or P4-6 contingency (stuck bus section Circuit Breaker)

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PPL (Local TO) will be the Designated Entity

## Alternatives Considered:

- Building a new 230-69 kV regional substation and more than 50 miles of double circuit 230 kV line is the other possible alternatives to resolve this problem. However this alternative is not considered due to higher cost

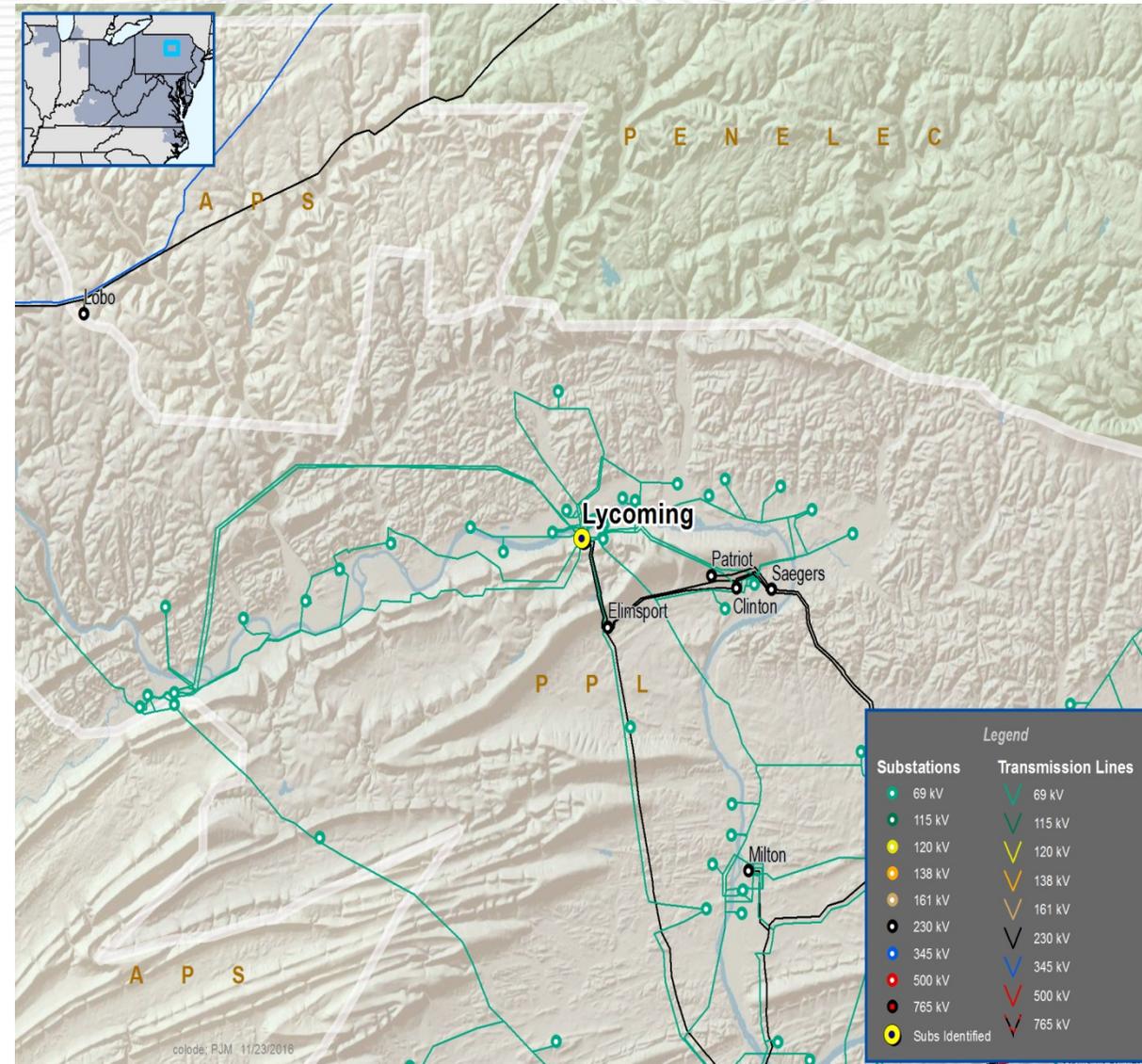
## Proposed Solution:

- Expand existing Lycoming 69kV yard to double bus double breaker arrangement. This will convert the substation from single operating bus to double bus configuration and will eliminate the risk of losing Lycoming source under a Stuck Circuit Breaker Contingency. **(B2813)**

**Estimated Project Cost: \$ 22 M**

**Required IS Date: 6/1/2018**

**Expected IS Date: 11/30/2019**





# PSEG Transmission Zone

## N-1-1 PSEG Planning Criteria (FERC Form 715):

- Great Notch currently has two 69kV circuits as its supply.
- During an N-1-1 contingency event, Great Notch 69kV substation loses its electric supply, which is a violation of PSEG's FERC 715 Planning Criteria.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PSEG (Local TO) will be the Designated Entity

## Alternatives:

- Connect Great Notch to an alternative 69kV station which would also require station expansion as there are no stations in the vicinity that have an open 69kV line position.
- The chosen option is the most cost effective solution.

## Proposed Solution:

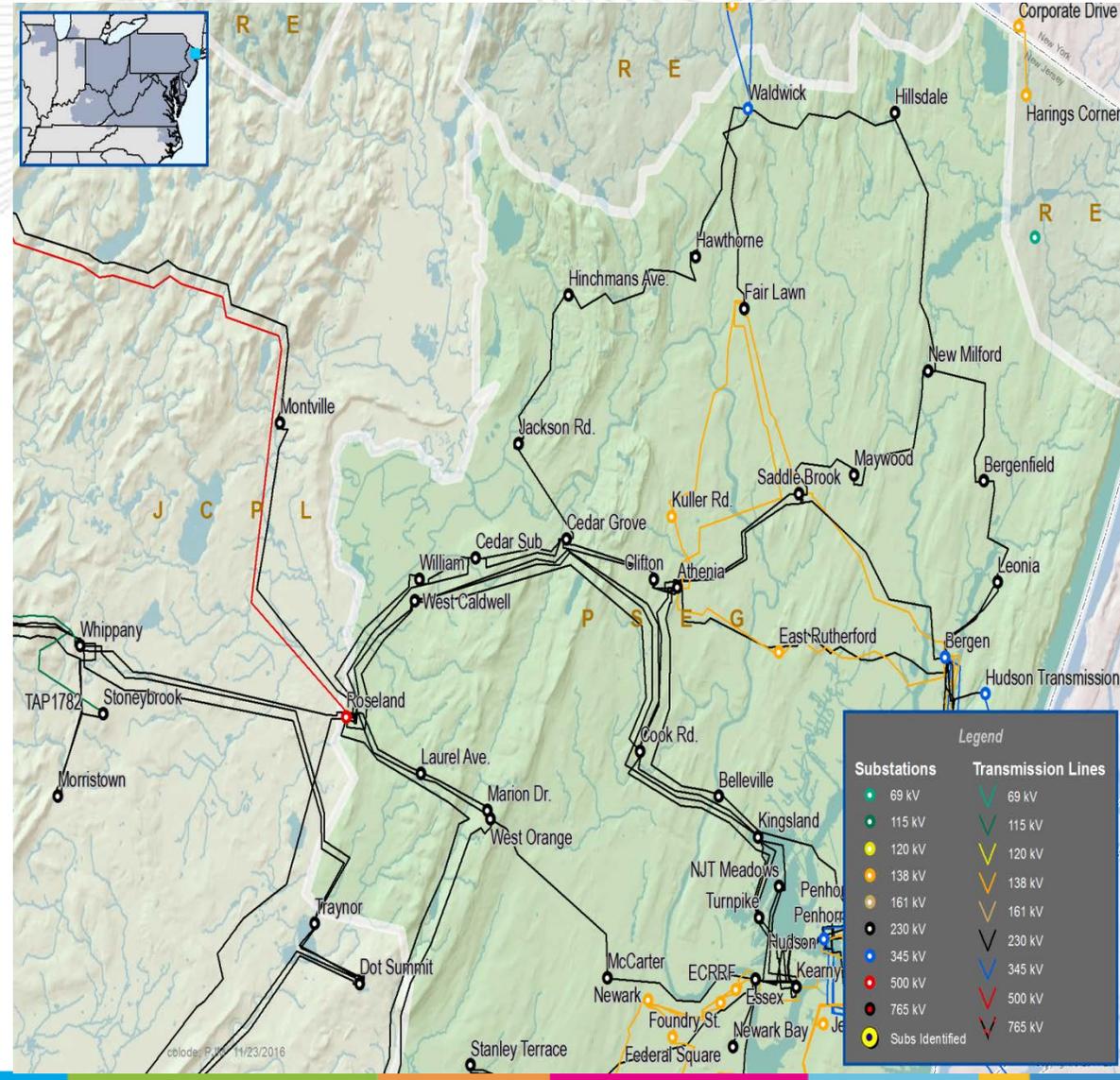
- Install second 230/69kV Transformer at Cedar Grove. (B2810.1)
- Build a new line between Cedar Grove 69kV and Great Notch 69kV. (B2810.2)

**Estimated Project Cost:** \$44M

**Required IS Date:** 6/1/2019

**Expected IS Date:** 4/1/2019

**Project Status:** Project Development and Engineering





# PSEG Transmission Zone

## N-1-1 PSEG Planning Criteria (FERC Form 715):

- Tonnelle Avenue and River Road currently have two 69kV circuits as its supply.
- During an N-1-1 contingency event, Tonnelle Avenue and River Road 69kV substations lose their electric supply, which is a violation of PSEG's FERC 715 Planning Criteria.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PSEG (Local TO) will be the Designated Entity

## Alternatives:

- Connect Tonnelle Avenue and River Road to two alternative 69kV substations, which would result it needing to build two new 69kV circuits instead of one.

## Proposed Solution:

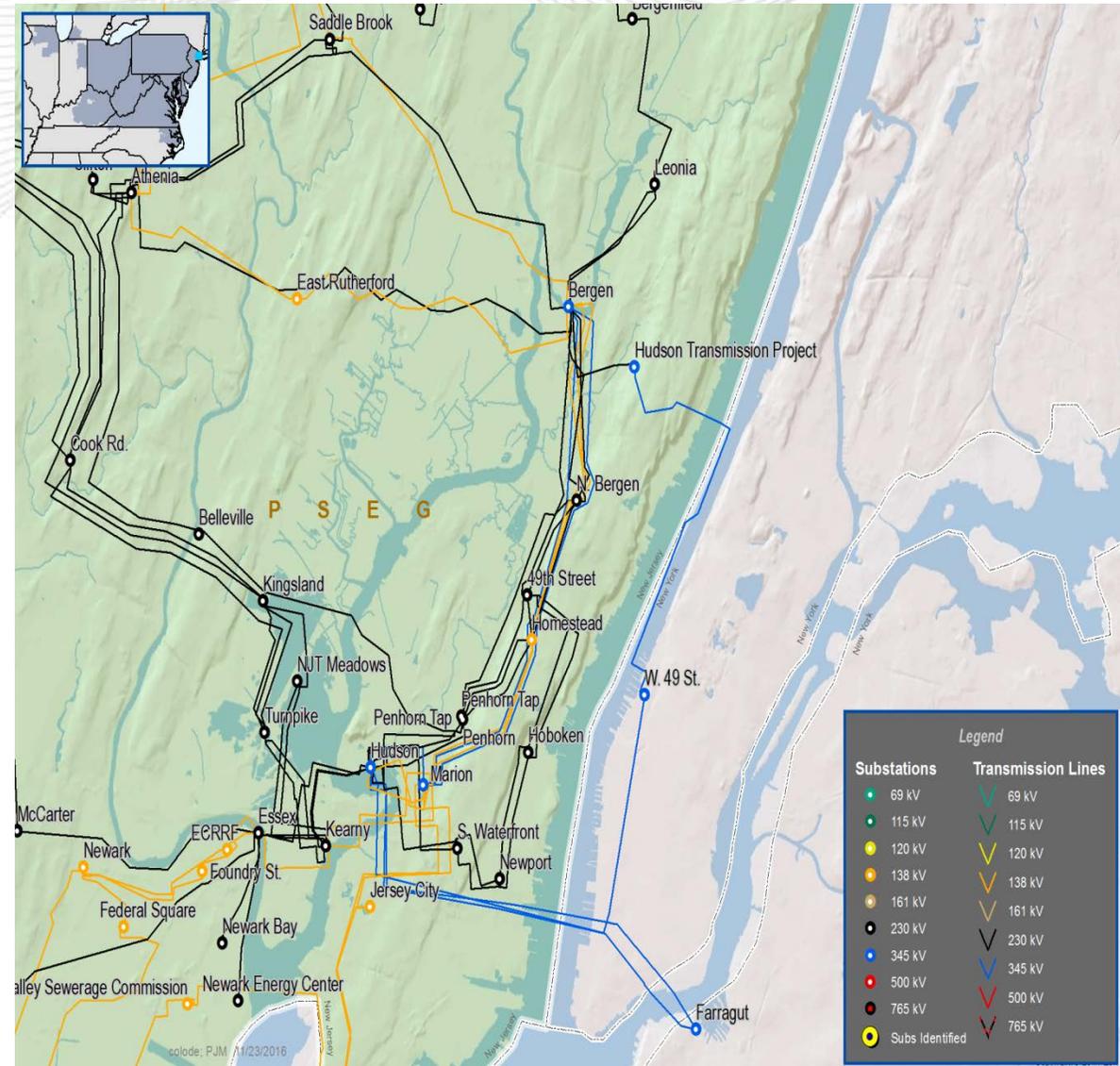
- Build a new line between Tonnelle Avenue and River Road . (B2812)

**Estimated Project Cost:** \$31M

**Required IS Date:** 6/1/2017

**Scheduled IS Date:** 4/1/2019

**Project Status:** Project Development and Engineering





# PSEG Transmission Zone

## N-1-1 PSEG Planning Criteria (FERC Form 715):

- Delair and Locust Street currently have two 69kV circuits as its supply.
- Locust street is the main supply for load growth occurring in the Camden area.
- During an N-1-1 contingency event, Delair and Locust Street 69kV substations lose their electric supply, which is a violation of PSEG's FERC 715 Planning Criteria.

## Immediate Need:

- Due to the time – sensitive nature and current issue this problem presents, PSEG (Local TO) will be the Designated Entity

## Alternatives:

- Connect Delair and Locust Street to two alternative 69kV substations, which would result it needing to build two new 69kV circuits instead of one.

## Proposed Solution:

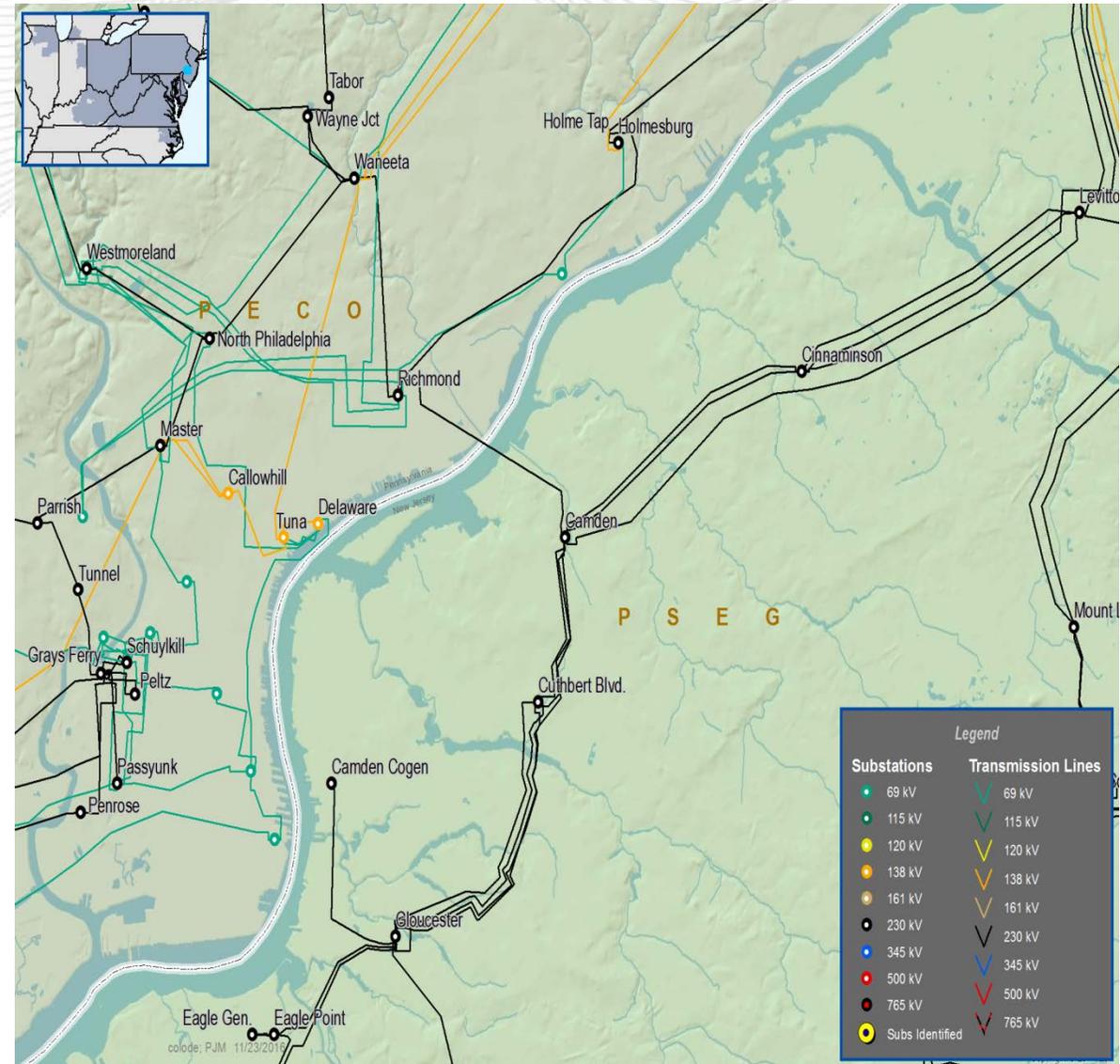
- Build a new line between Delair and Locust Street. (B2811)

**Estimated Project Cost:** \$13.5 M

**Required IS Date:** 6/1/2017

**Scheduled IS Date:** 6/1/2018

**Project Status:** Project Development and Engineering





# Supplemental Projects

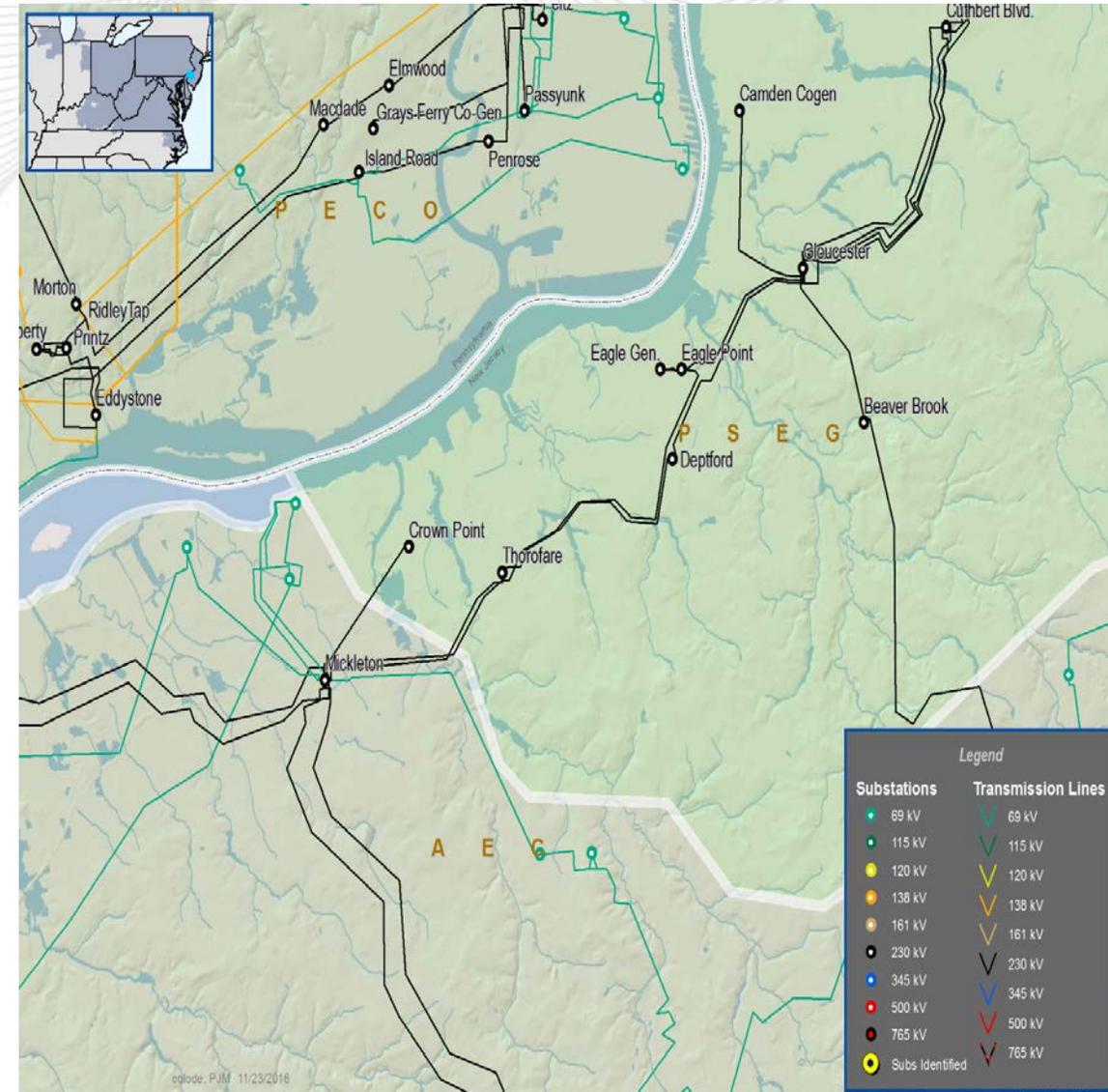
## Supplemental Upgrade: Distribution Overloads and Aging Infrastructure in Beckett Area

### Problem Statement:

- Distribution overload issues and aging infrastructure have been identified at Beckett substation. Upgrades are needed to relieve local area distribution overloading, replace aging and retiring equipment, and convert to a more standard operating voltage.

### Potential Solutions:

- 18.7 mile rebuild and upgrade of the existing Woodstown-Paulsboro 34.5 kV distribution line to create two (2) 69 kV sources to a new High Street Substation. The Paulsboro-High Street 69 kV line would be approximately 9.1 miles long. The Woodstown-High Street 69 kV line would be approximately 9.6 miles long. The new High Street substation configuration includes a six breaker 69 kV ring bus and one 69/12 kV 42 MVA distribution transformer with a position available for a future second 69/12 kV transformer. The project includes a new 69 kV terminal at Woodstown substation and a new 69 kV terminal at Paulsboro substation.
- Replace both Mullica Hill substation transformers. Rebuilding Mullica Hill substation with a new 40 MVA transformer within the existing fence line is not feasible. Purchasing adjacent land is not possible because Mullica Hill is bordered by a road and backed by wetlands.
- Transfer all Mullica Hill substation load to tie substations. Not possible with current configuration. Neighboring substations would eventually be overloaded.
- Expand nearby Beckett substation. Expansion of Beckett substation along with the required distribution feeders would result in degraded reliability, limited operational flexibility, and would not allow for long term area load growth associated with retail business expansion. Additional land would also be required around Beckett substation, which is surrounded by wetlands, making permitting complicated and expensive.



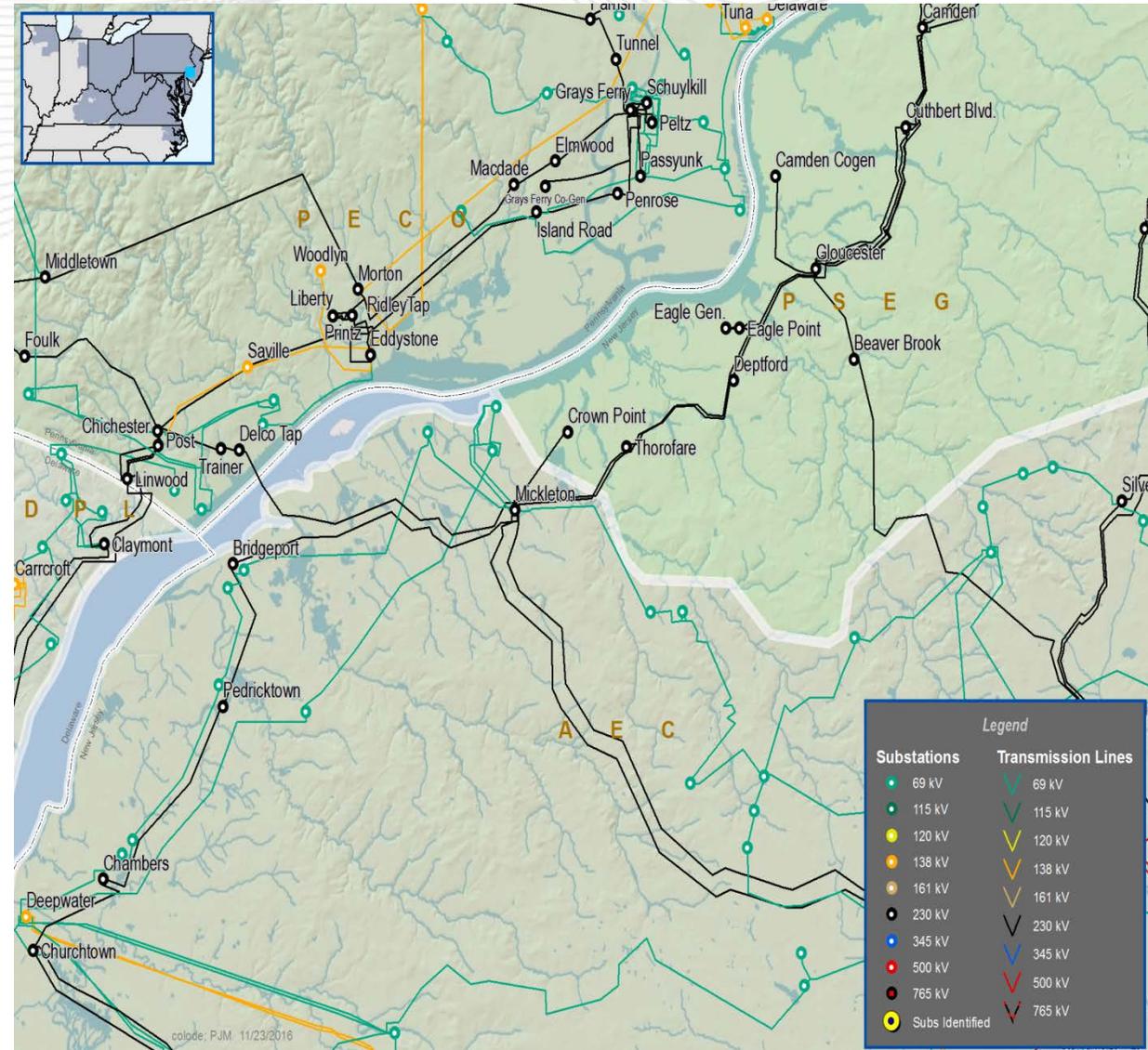
## Supplemental Upgrade: Line Overload Conditions During Churchtown Transformer Outage

### Problem Statement:

- Anticipated line overload conditions exist during an outage of the Churchtown 230/69 kV transformer with the Carlls Corner #2 CT offline.

### Potential Solutions:

- Reconductor 0.27 mile section 'J' of the Beckett-Paulsboro 69 kV line with 1200 amp minimum conductor.
- Do nothing – allow overload (not acceptable).



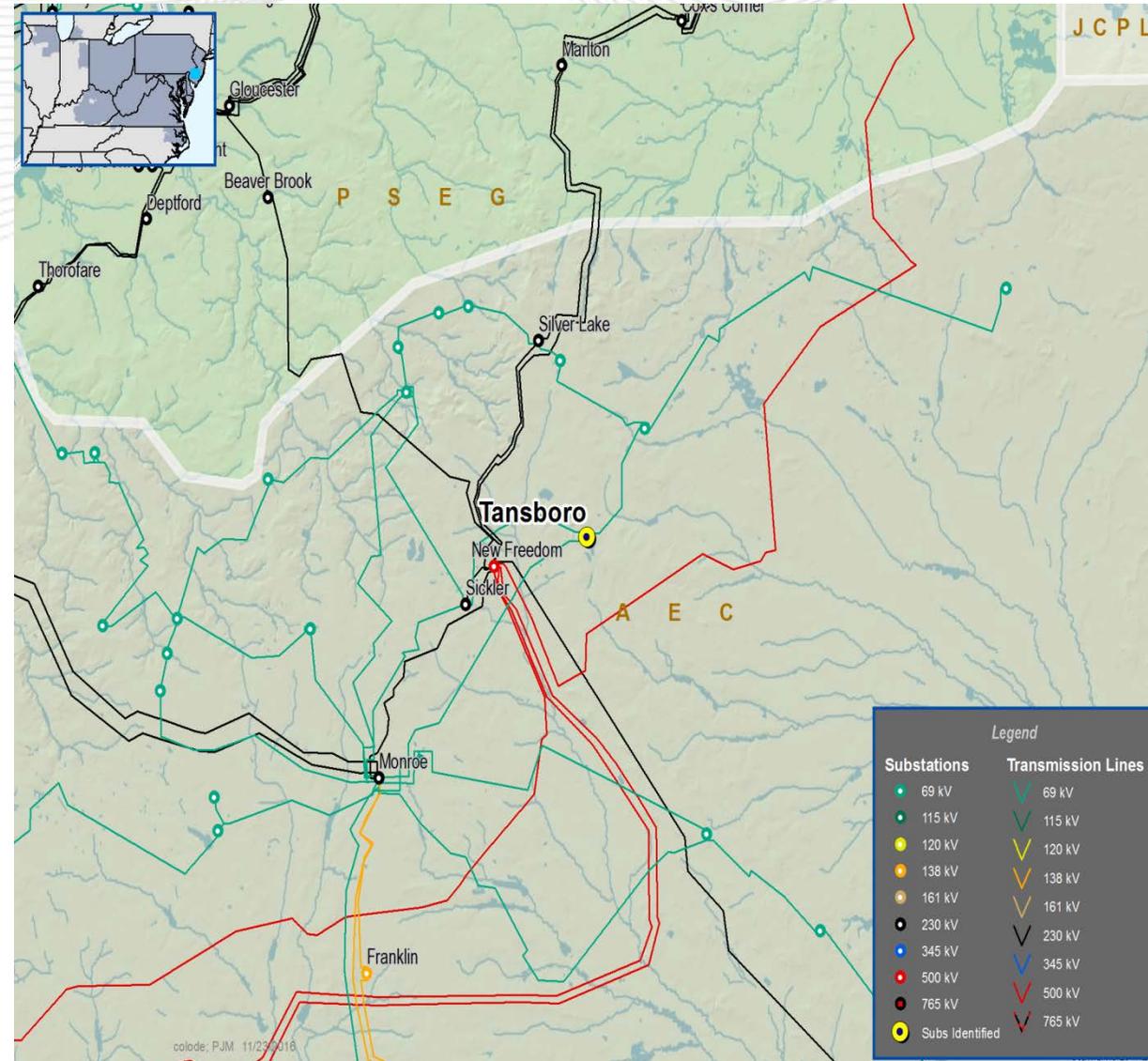
## Supplemental Upgrade: Tansboro Transformer Overload Forecast

### Problem Statement:

- Tansboro Substation 12 kV load is forecasted to be over the existing transformer normal rating capacity in the next several years.

### Potential Solutions:

- Upgrade 69 kV bus to a ring bus. Replace control building and upgrade all relays to microprocessor type. Replace T1 with a new 69/12 kV 40 MVA transformer.
- Temporary solution would be to install a new 12 kV 1200A circuit breaker in the open position between CB-H and CB-J, and transfer Cedarbrook 12 kV feeder on the new circuit breaker. A bus sectionalizing switch would be placed between CB-H and the new CB. This temporary solution would not tackle the load growth concerns



## Supplemental Upgrade: Cape May Substation Reliability Improvements

### Problem Statement:

- For any outage to the existing Cape May T2 transformer, 20 MVA (~50%) of the carried load cannot be restored via external feeder ties. A 40 MVA mobile transformer must be transported to the substation to serve customers if T2 cannot be restored. For a forced outage this may cost approximately \$100,000 and a mobile transformer takes 36-48 hours to place in service in addition to permitting. Cape May Substation has no existing 69 kV circuit breakers and the existing switches have maintenance issues.

### Potential Solutions:

- Installation of an in-line four position 69 kV ring bus, two 69 kV lines and two transformer terminals. Installation of four 69 kV circuit breakers and associated disconnect switches, two motor operated disconnects for #1 and #2 Rio Grande 69 kV lines. Primary and backup line relaying for both 69 kV lines will be required.
- Load Transfer to Adjacent Substations. Not feasible because it would overload neighboring substations.
- Two Mobile Units for back-up. This alternative is not feasible due to limited space in the substation.



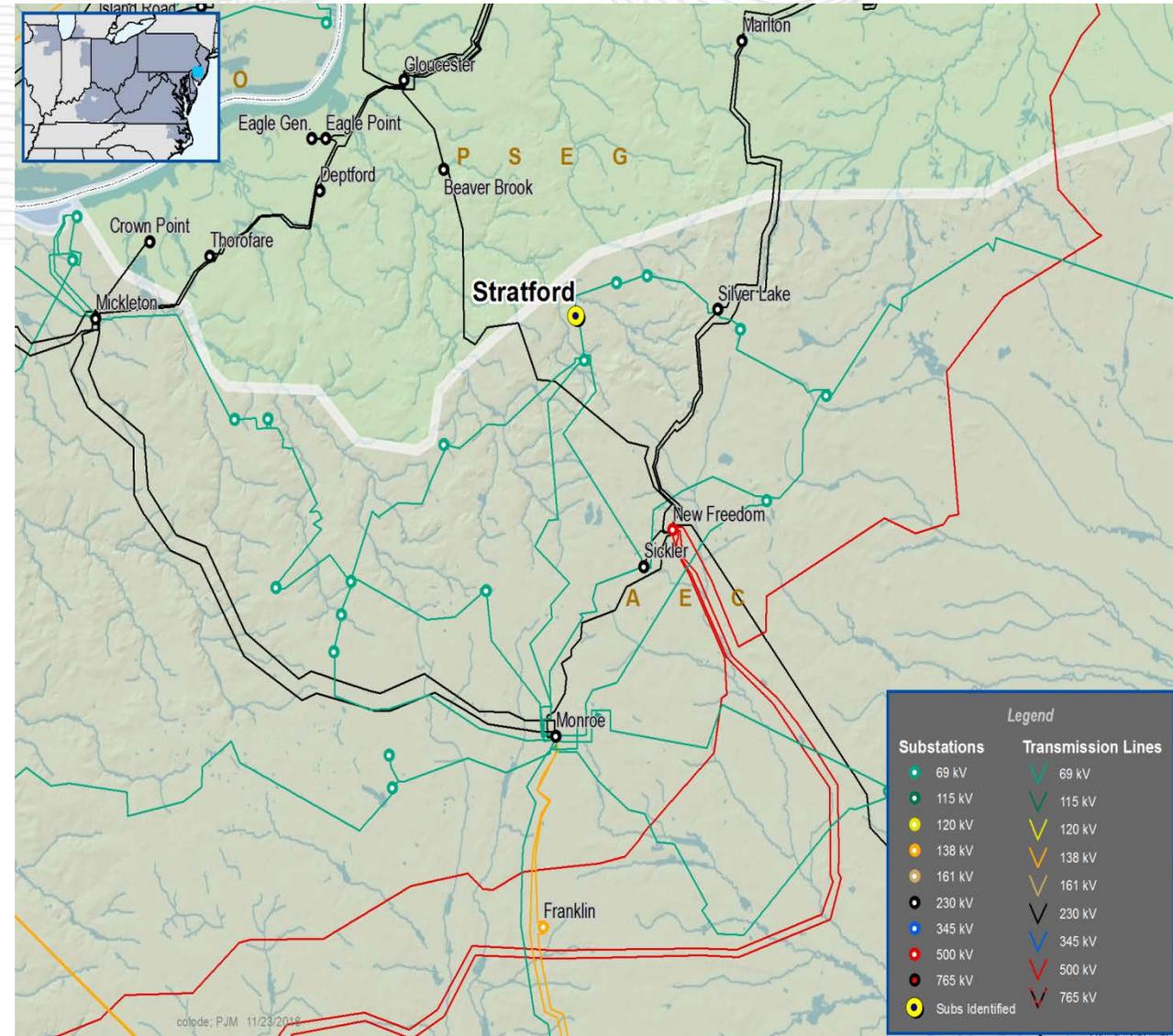
## Supplemental Upgrade: Stratford Substation Reliability Improvements

### Problem Statement:

- There are no existing 69 kV breakers at Stratford Substation to isolate 69 kV line faults. Stratford Substation serves approximately 8500 customers, including a hospital.

### Potential Solutions:

- At Stratford Sub, install three 69 kV circuit breakers in a line bus configuration. Install associated breaker controls/relays and bus differential relays. Install new control house.
- Install a 69 kV ring bus. (Space constraints).



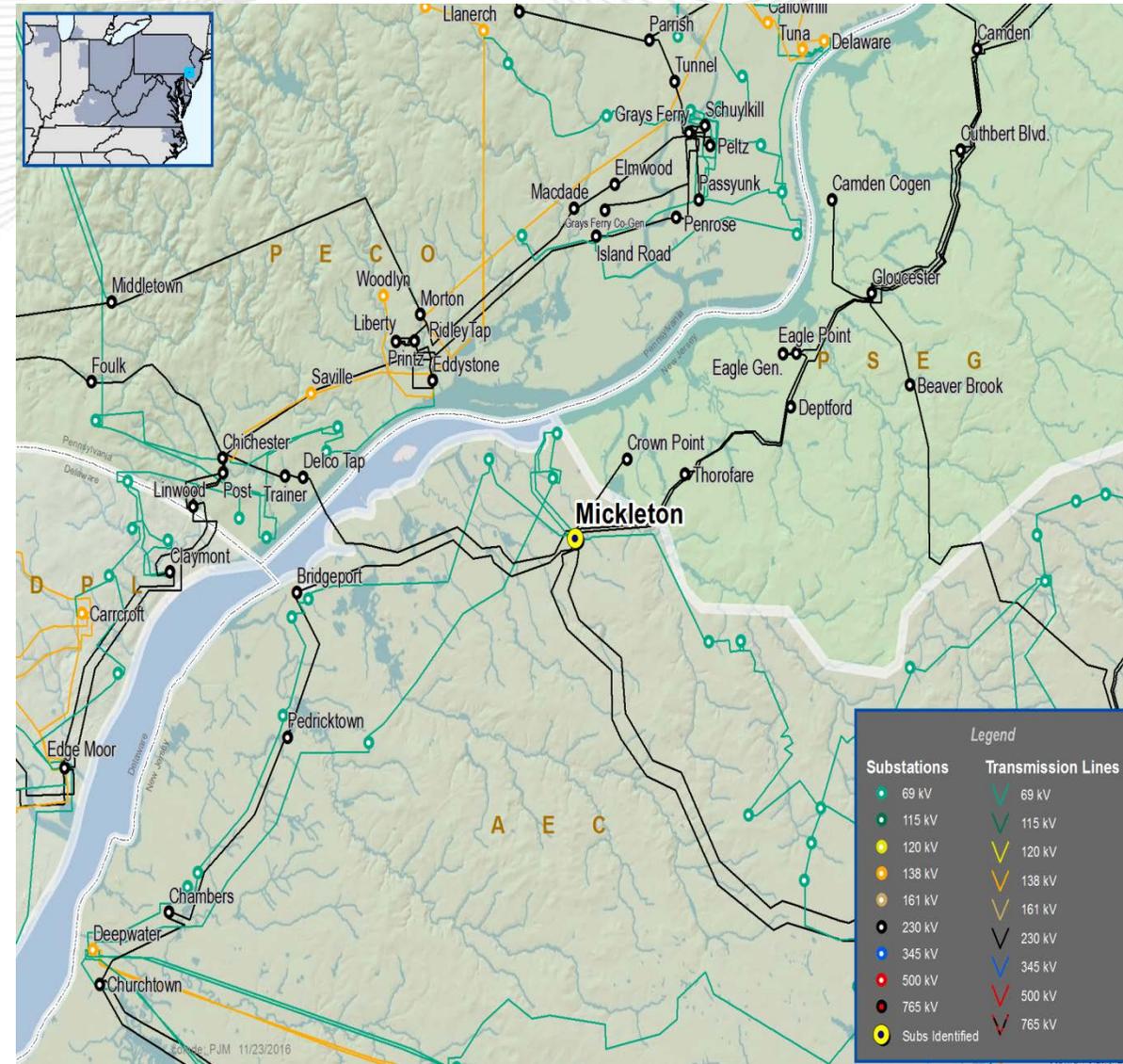
## Supplemental Upgrade: Mickleton Substation Reliability Improvements

### Problem Statement:

- Critical industrial and distribution customers in the area are served from the 69/12 kV transformers at this site. Existing transformers are in poor condition and are beyond the end of their useful life.

### Potential Solutions:

- Replace existing 69 kV line bus with a 69 kV ring bus. A ring bus will improve reliability and allow for operational flexibility in the area.
- Rebuild the deteriorated Gibbstown substation, which has reached its end of life. This alternative is not a long-term solution since additional capacity in the area will eventually be needed.
- Replace existing Paulsboro T5 (69/4 kV) with a 40 MVA 69/12 kV transformer. This alternative will leave Gibbstown substation (4 kV) with no alternatives to transfer load.
- Leave the existing line bus in place (does not address reliability concerns).
- Upgrade the line bus (does not address reliability concerns).
- Breaker and a half 69 kV configuration (space constraints).



## Supplemental Upgrade: 230 kV Harbor Cables

### Background:

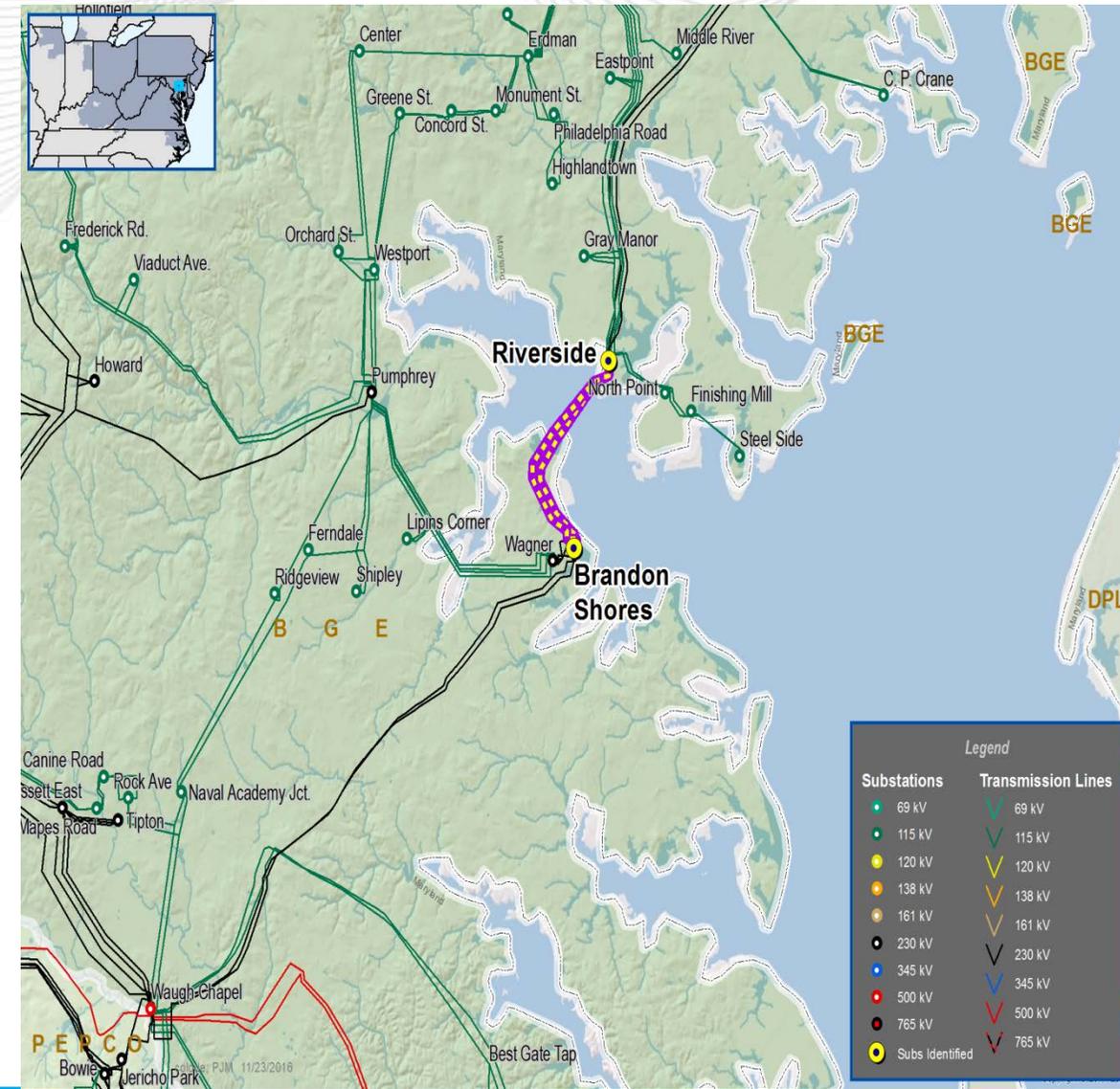
- BGE circuits #2344 and #2345 connect Brandon Shores to Riverside substations and are an important part of the 230 kV transmission ring enabling power transfer from southern generation (Brandon Shores, Wagner) to the northern portion of the BGE zone.
- A third of these circuits is under the Patapsco River near the Francis Scott Key bridge (~2 ¼ mile section of the total ~6 mile circuit length).
- This section is comprised of five identical 230kV oil filled pipe type transmission cables, two per circuit and an in service spare.
- Hawkins Point and Sollers Point Terminal Stations connect the cables to overhead lines.

### Problem Statement:

- The oil filled pipe type transmission cables are nearing end of life and have an increased risk of failure as indicated by elevated levels of dissolved gasses within oil (2 to 3 times the action level for acetylene and hydrogen gases).
- All cables show the same symptoms. The gas levels continue to grow.
- Terminations have already been replaced. The cable oil has been degassed and gas generation continues.
- Pipe integrity is unknown. Pipe failure could result in contamination of remaining cables.

### Potential Solutions:

- Run to failure and repair
- Replace the water crossing section of the 230 kV circuits with:
  - New underground cables
  - New overhead circuits



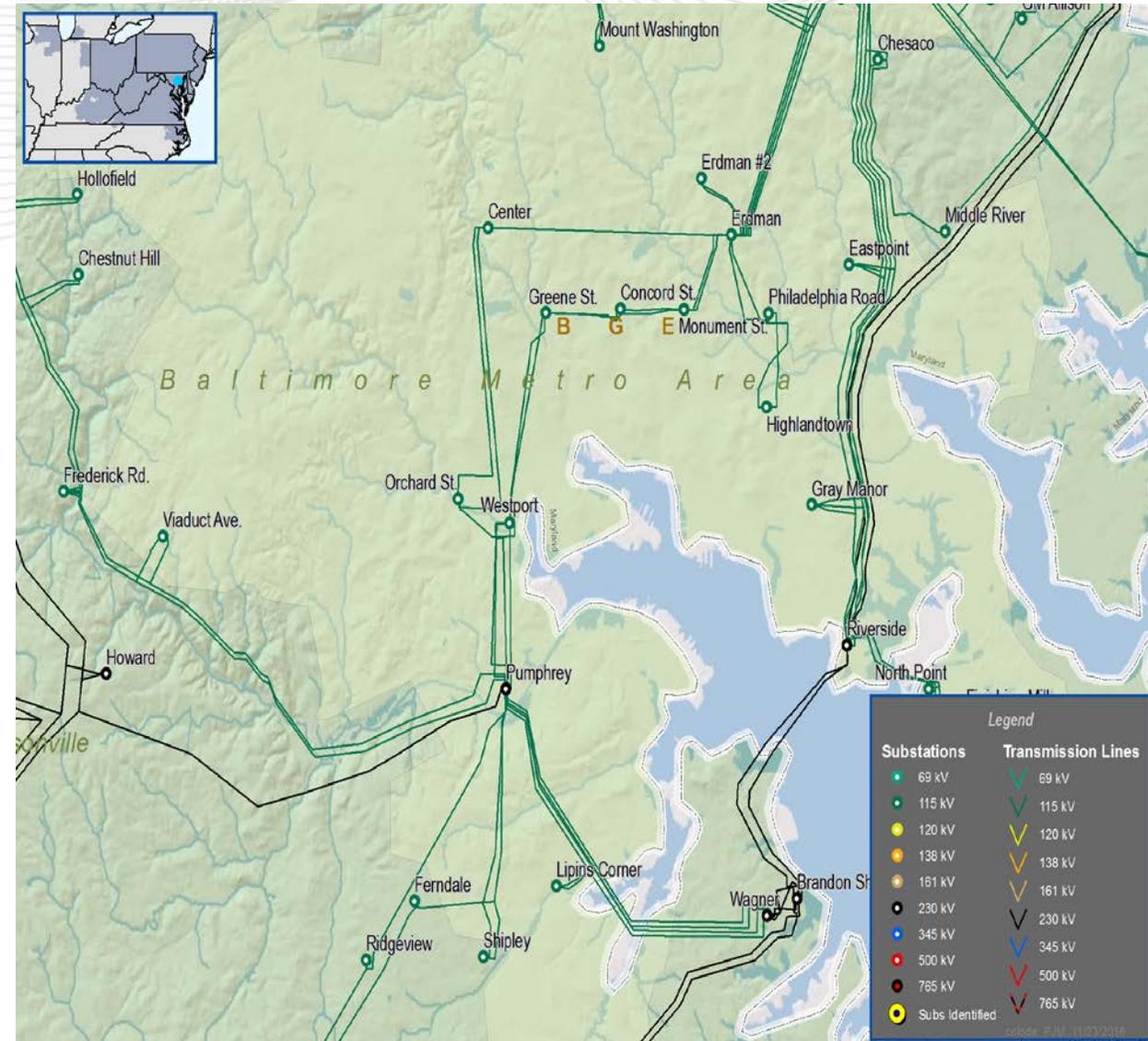
## Supplemental Upgrade: Port Covington Area Peninsula Redevelopment

### Problem Statement:

- Sagamore Development Company LLC, plans to redevelop the Port Covington peninsula in southern Baltimore City, resulting in new distribution customer demand of over 200 MVA.
- Distribution load on the Peninsula is presently supplied by the Gould St. 34.5/13.8kV substation, which also provides 34.5kV interconnect facilities for the Gould St. generator. Gould St. substation is supplied by four 34.5kV submarine cable circuits.
- The capability of the existing distribution substation (35MVA) and the four submarine supply circuits (160MVA combined) is far below the needed capability.
- The Gould St. substation and submarine cables are old, and the submarine cables fail frequently with poor reliability.
- Due to the peninsula geography, the ability to use distribution feeder ties and additional 34.5kV circuits is limited.

### Potential Solution:

- Build a 115kV transmission supplied substation on the peninsula to supply new distribution customer demand, facilitate the retirement of aging and poor performing infrastructure, and provide connectivity for the Gould Street Generating plant.



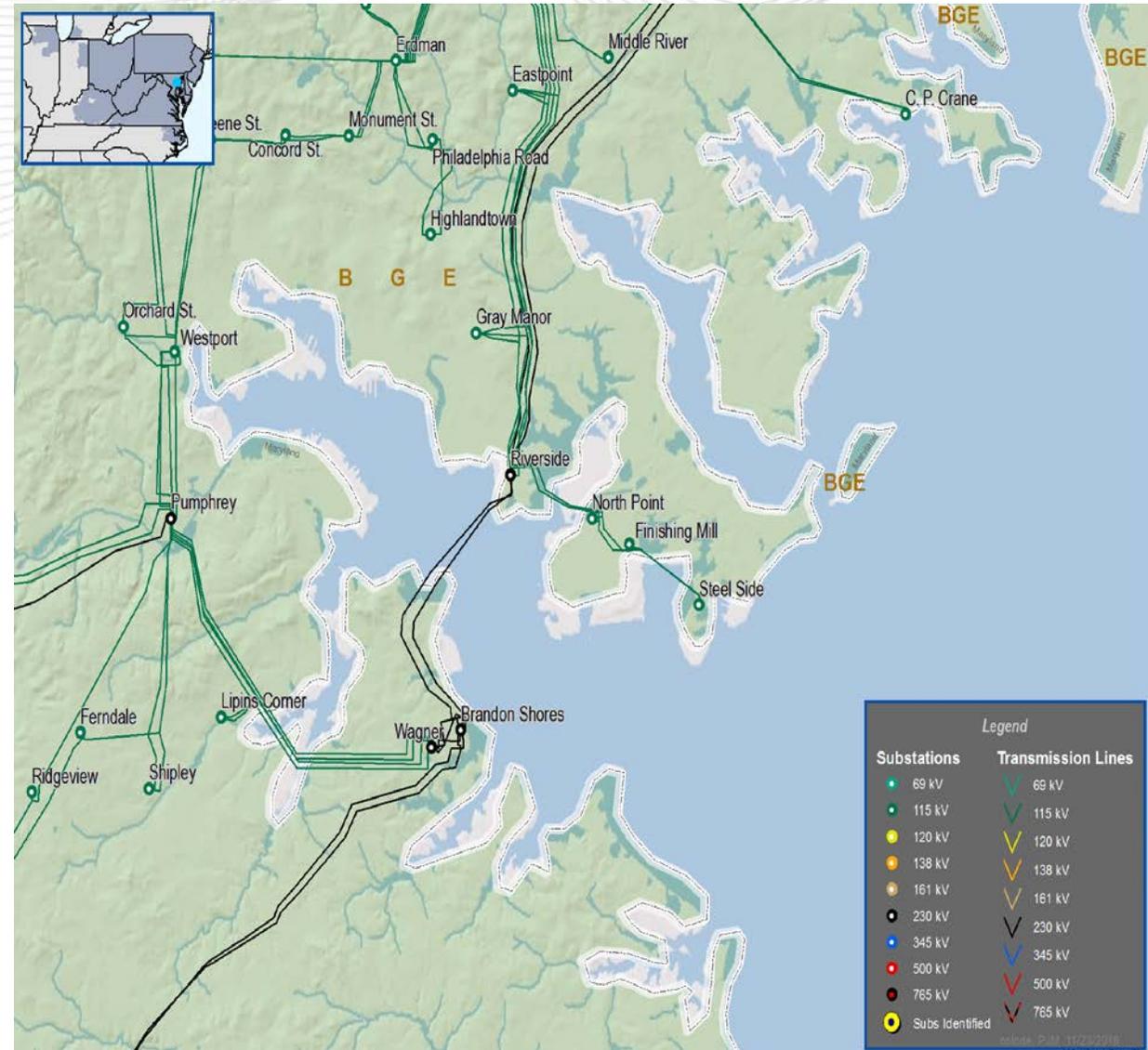
## Supplemental Upgrade: Sparrows Point Redevelopment

### Problem Statement:

- Tradepoint Atlantic has proposed a plan to redevelop the Sparrows Point peninsula including approximately 15 million sq. ft. of new space under roof plus small commercial.
- The entire peninsula is currently supplied by both BGE owned 115kV supplied substations (Northpoint, Shipyard, Sparrows Point) and Tradepoint Atlantic customer-owned 115 kV supplied substations (Finishing Mill, Steel Side).
- Customer has indicated plans to retire its own substations.
- BGE will need to supply ~95 MVA of new distribution customer demand which is greater than the capability of the BGE substations on the peninsula.

### Potential Solution:

- Build a 115 kV transmission supplied substation on the peninsula to provide diverse supplies to expected new distribution customer demand and facilitate the retirement of aging infrastructure



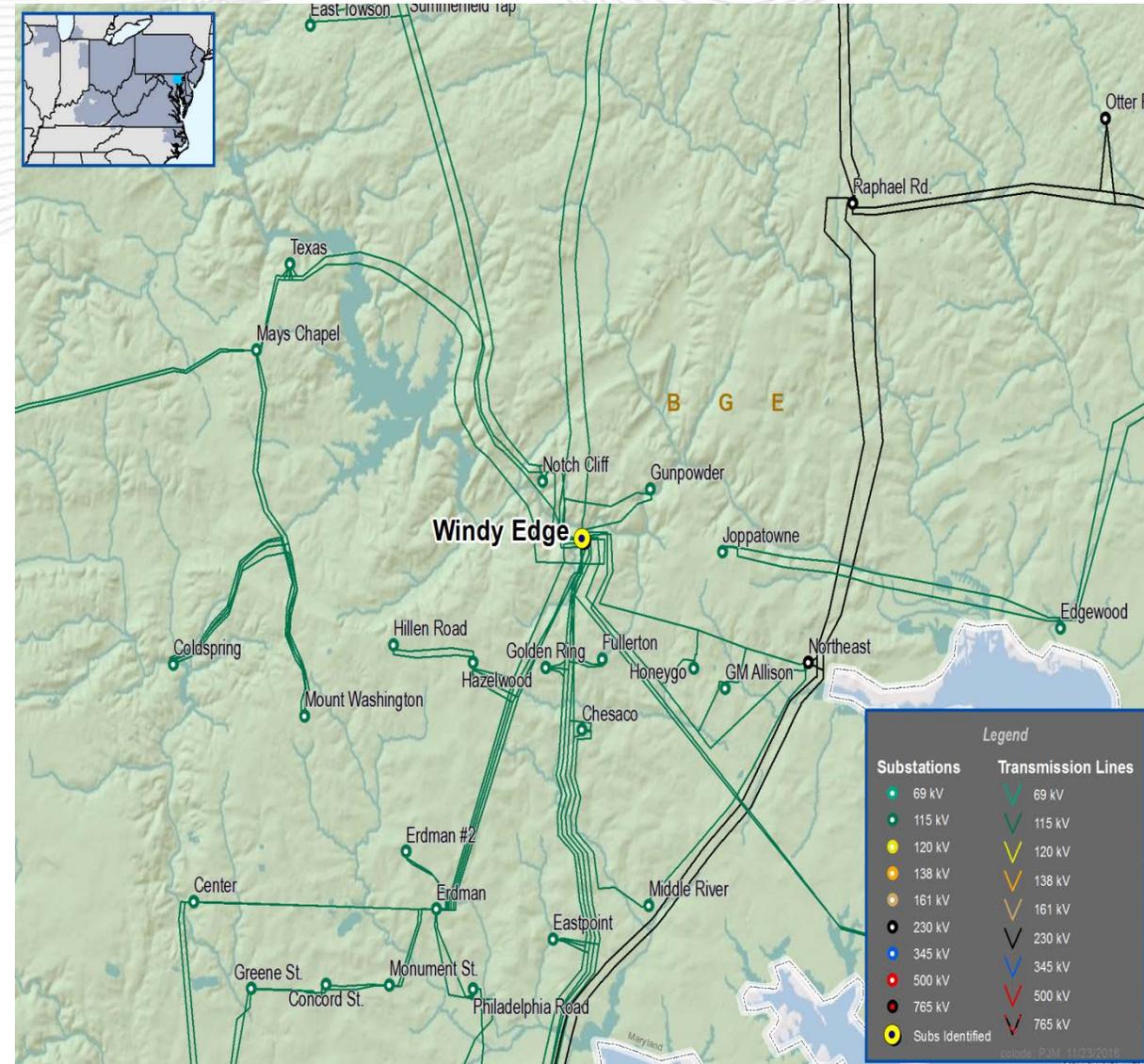
## Supplemental Upgrade: Transmission Relay Replacement

### Problem Statement:

–Relay configurations/schemes require replacement due to reasons such as inability to support system event recording, technologies prone to mis-operations, obsolete equipment or equipment for which spares are difficult to procure, enhanced ability to comply with NERC PRC-005, etc.

### Solution

- Replacing the following relay configurations/schemes in 2017 (will result in ratings changes).
  - Erdman to Windy Edge 110507 115kV Circuit
  - Erdman to Windy Edge 110508 115kV Circuit



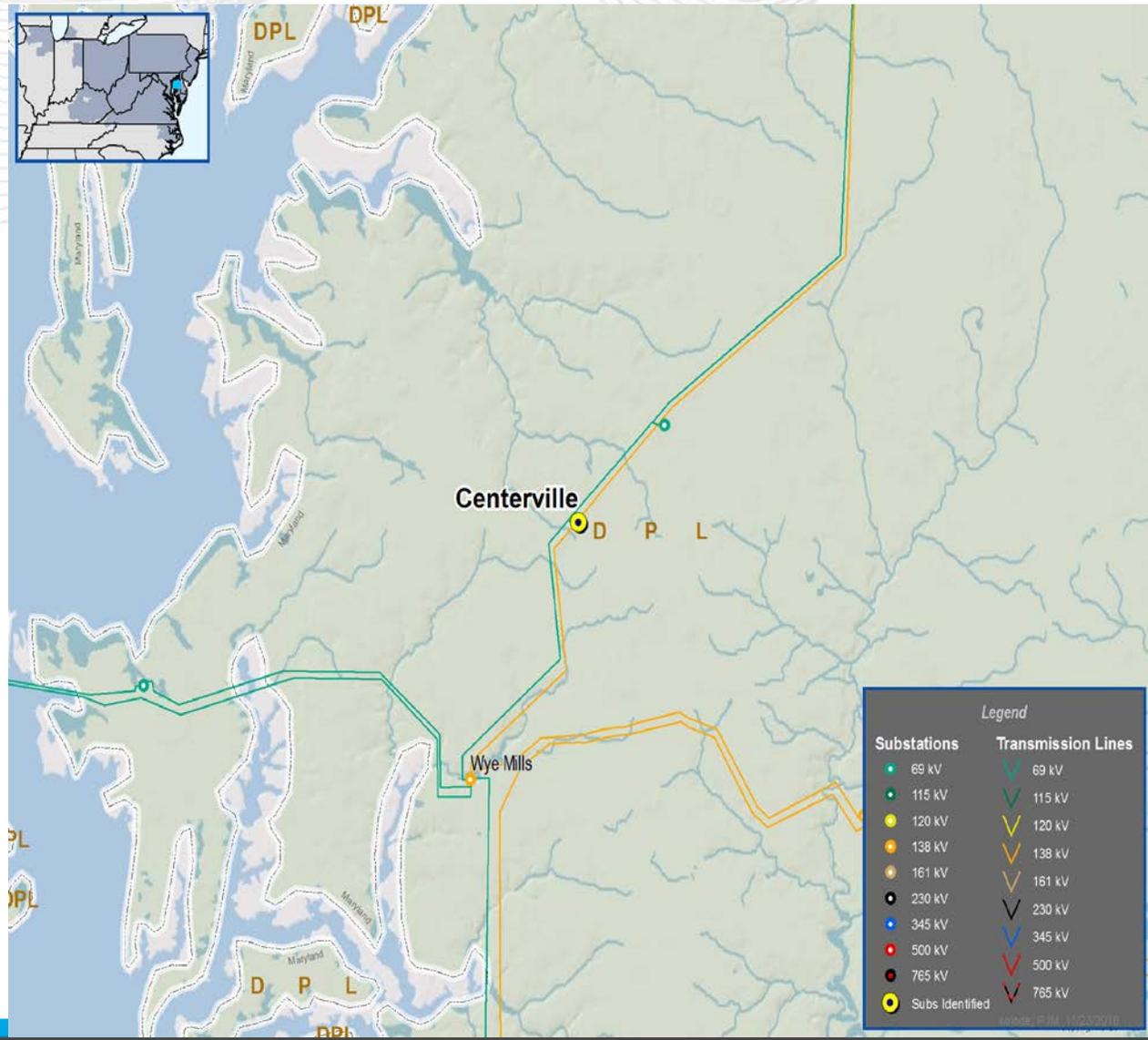
**Supplemental Upgrade:  
Centreville Area Reliability Improvements**

Problem Statement:

- MD PSC reliability requirements for improved COMAR SAIFI and SAIDI performance in the Centreville area.

Potential Solutions:

- Construct a new 138/25 kV Substation with one new 138/25 kV 37.6 MVA transformer and room for an additional 138/25 kV transformer in the future. Install a four position 138 kV ring bus at the new 25 kV substation with room for ultimate six (6) position 138 kV ring bus configuration in the future for capacitor bank installation. New substation would be on circuit 13723, approximately 1.4 miles north of Centreville substation.
- Continue to conduct reactive reliability improvements on the system, basing the work locations on past outages.
- Underground the entire backbone of local feeders.



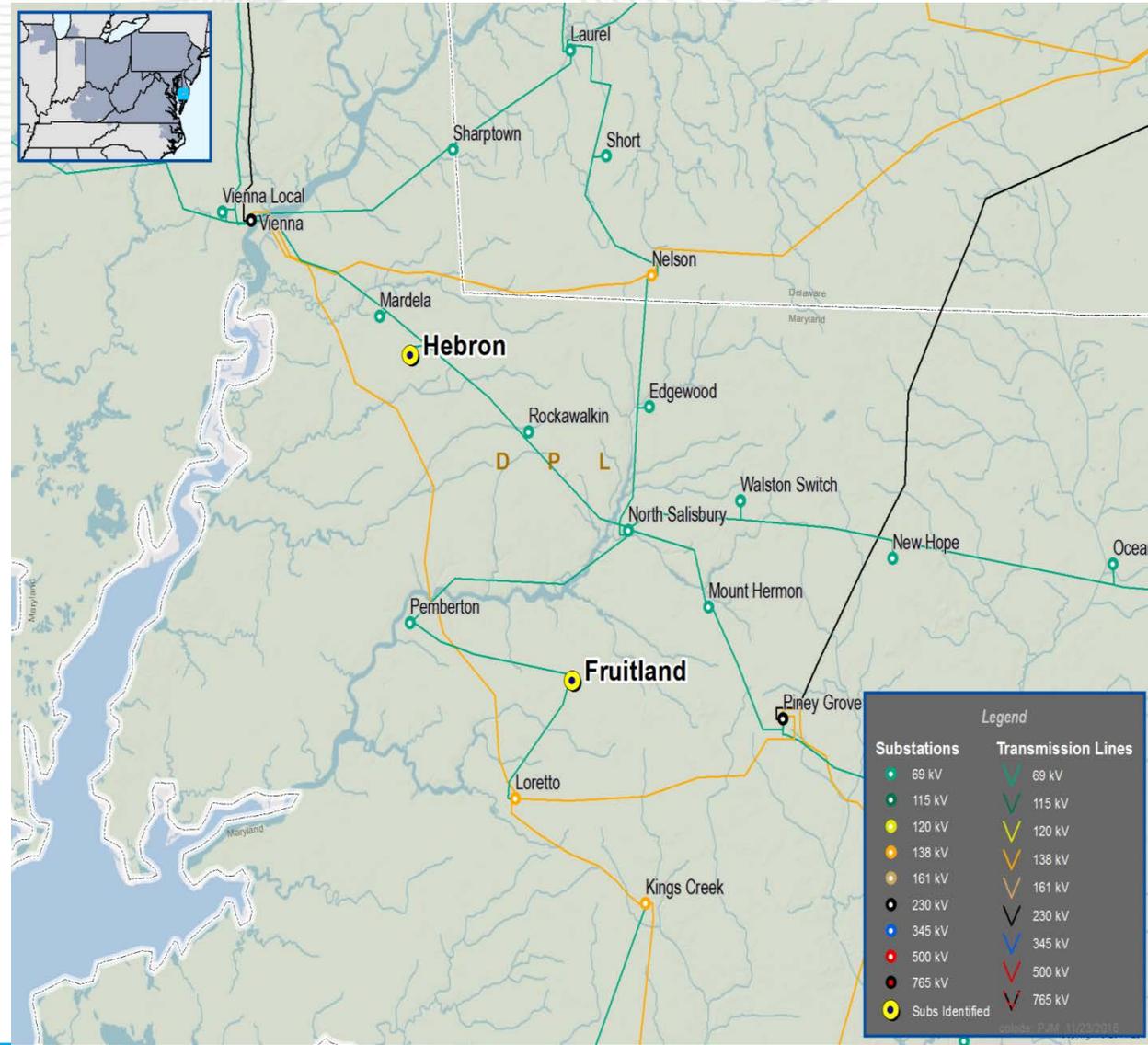
**Supplemental Upgrade:  
Salisbury Area Reliability Improvements**

Problem Statement:

- MD PSC reliability requirements for COMAR SAIFI and SAIDI performance in the Salisbury area.

Potential Solutions:

- Combined solution:
  - Hebron Substation 69 kV Upgrade
    - Rebuild the Hebron Substation as a 69/25 kV substation that can accommodate one new 69/25 kV 28 MVA transformer and two new 69 kV high-side breakers, with ultimate three breaker configuration. Hebron substation is on circuit 6708.
  - Beaglin 69/25 kV New Substation
    - New substation tied into circuit 6726 (North Salisbury – Mt. Hermon)
  - Fruitland Substation
    - Replace a 1969 vintage 38MVA 69/25 kV transformer with a 56MVA transformer due to age and poor condition.
- Continue to conduct reactive reliability improvements on the system, basing the work locations on past outages.
- Underground the entire backbone of local feeders.



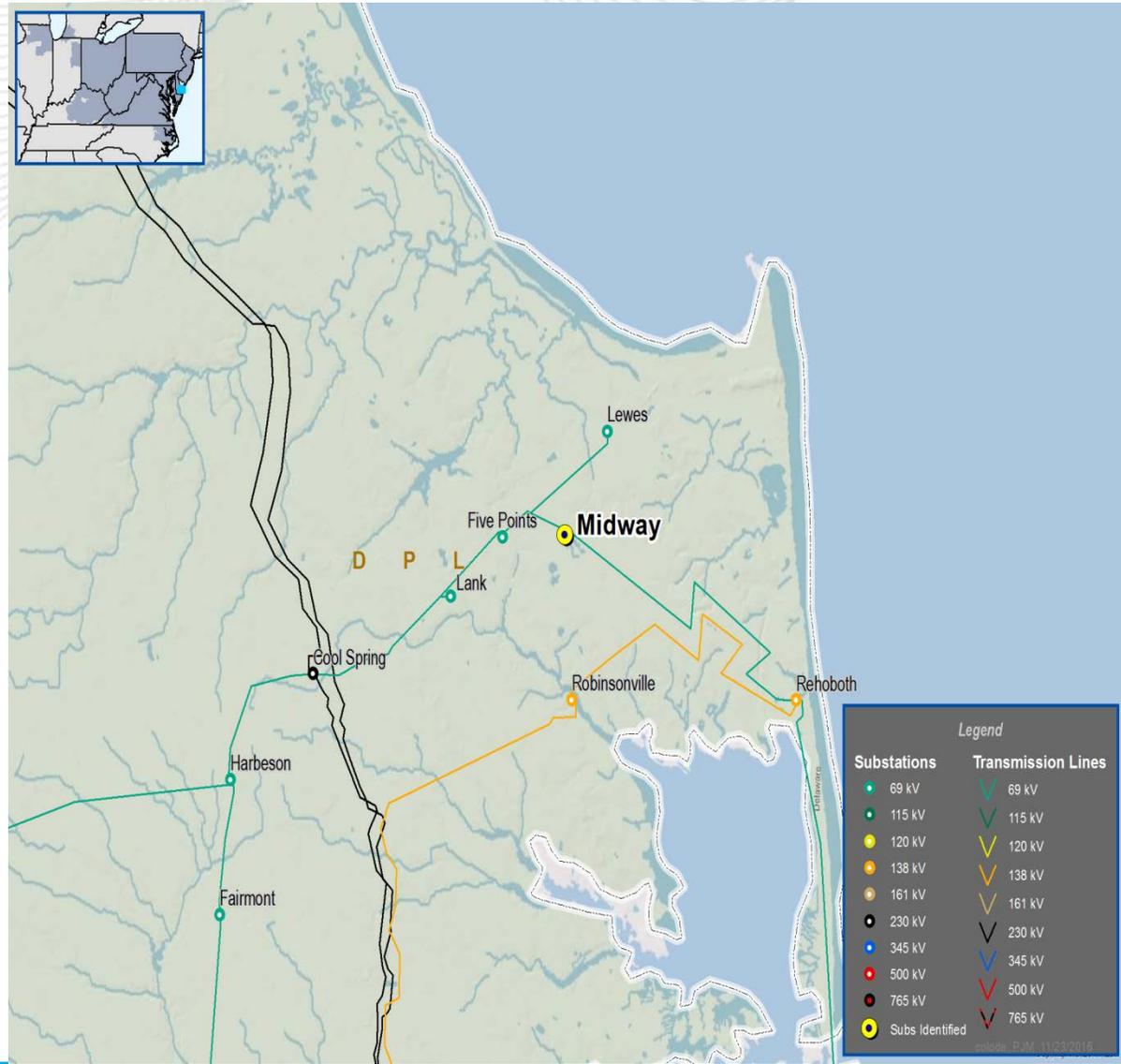
## Supplemental Upgrade: Midway Substation Reliability Improvements

### Problem Statement:

- Currently, the station is tapped off of Line 6751, and any fault on the line will result in the loss of the station. Additionally, anticipated feeder overloads exist on the distribution system.

### Potential Solutions:

- Add a second transformer, which requires a new line position and line bus configuration. Reconfigure the present 69 kV tap at Midway Substation to be a three-breaker line bus. Split the 6751 transmission line into two lines: from Rehoboth to Midway and from Midway to Five Points.
- Leave the substation as a tap off of Line 6751, which would not improve the reliability and service to Midway Substation. A forced outage on Line 6751 would result in a loss of both transformers at Midway substation with no ability to sectionalize and restore service without restoring all of Circuit 6751.
- A ring bus would further improve the sectionalizing capability along the existing Line 6751 (space constraints associated with this option).



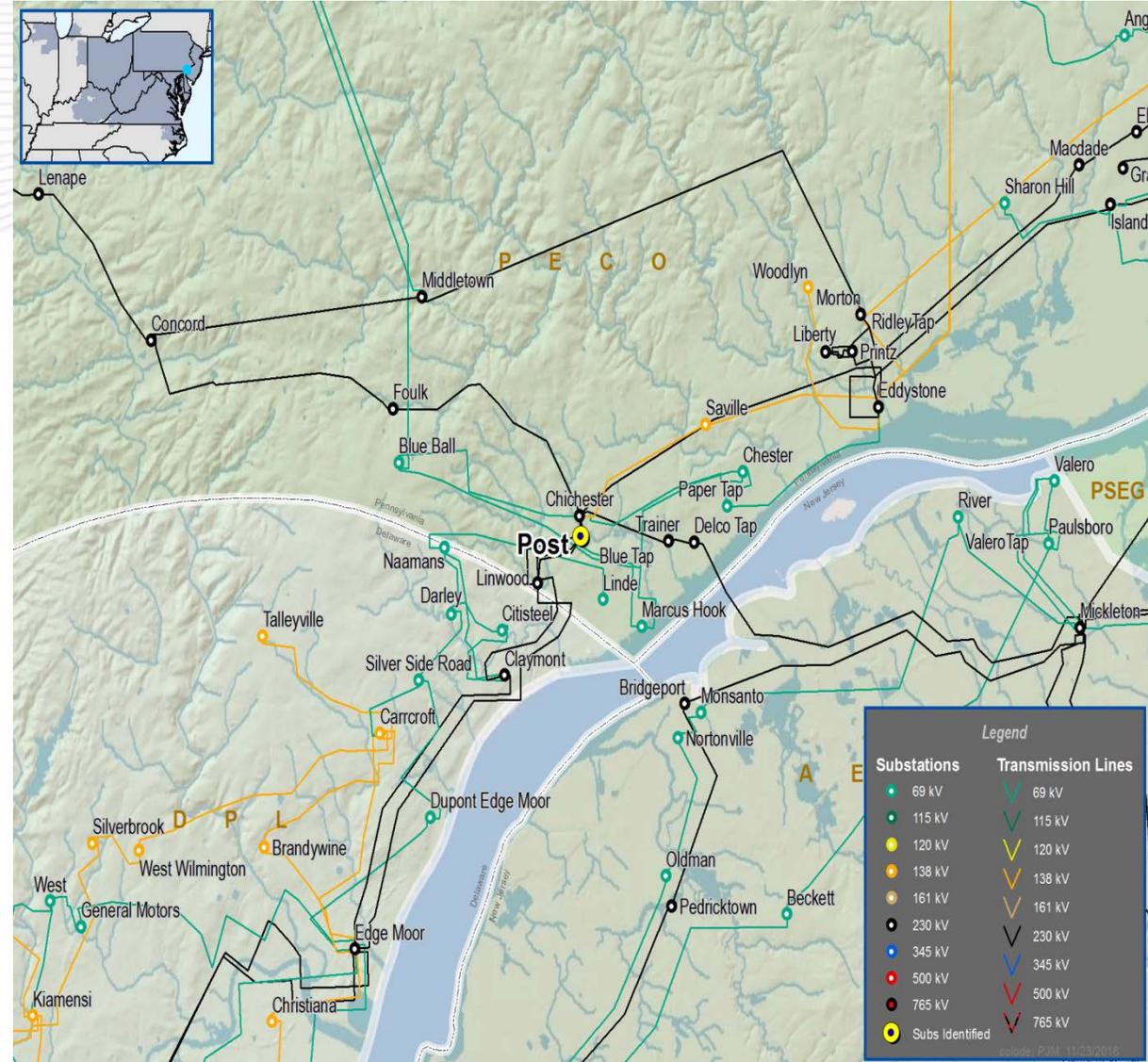
## Supplemental Upgrade:

### Problem Statement:

- Maintenance of Eddystone 138 kV bus section #2 followed by the outage of Chichester 230-138 kV #9A/B transformer may overload the Eddystone 138-69 kV transformer and Eddystone-Paper Tap 69 kV line
- Blueball 69-13 kV distribution substation will need major repair/maintenance work in near future

### Potential Solution:

- Install 3<sup>rd</sup> 230-13 kV transformer at Post Substation and move load from Blueball substation to Post substation and retire Blueball substation



## Supplemental Upgrade:

- **Construct Trade City 115 kV Ring Bus**

### Problem Statement:

- **Reliability:** Reduce customer exposure and load loss due to outages; To provide continuity of supply by eliminating simultaneous outages to two or more network elements.
- **Operational Performance:** Improve operational switching capabilities

### Potential Solution:

- Trade City 115 kV Substation: Construct a 115 kV ring bus.

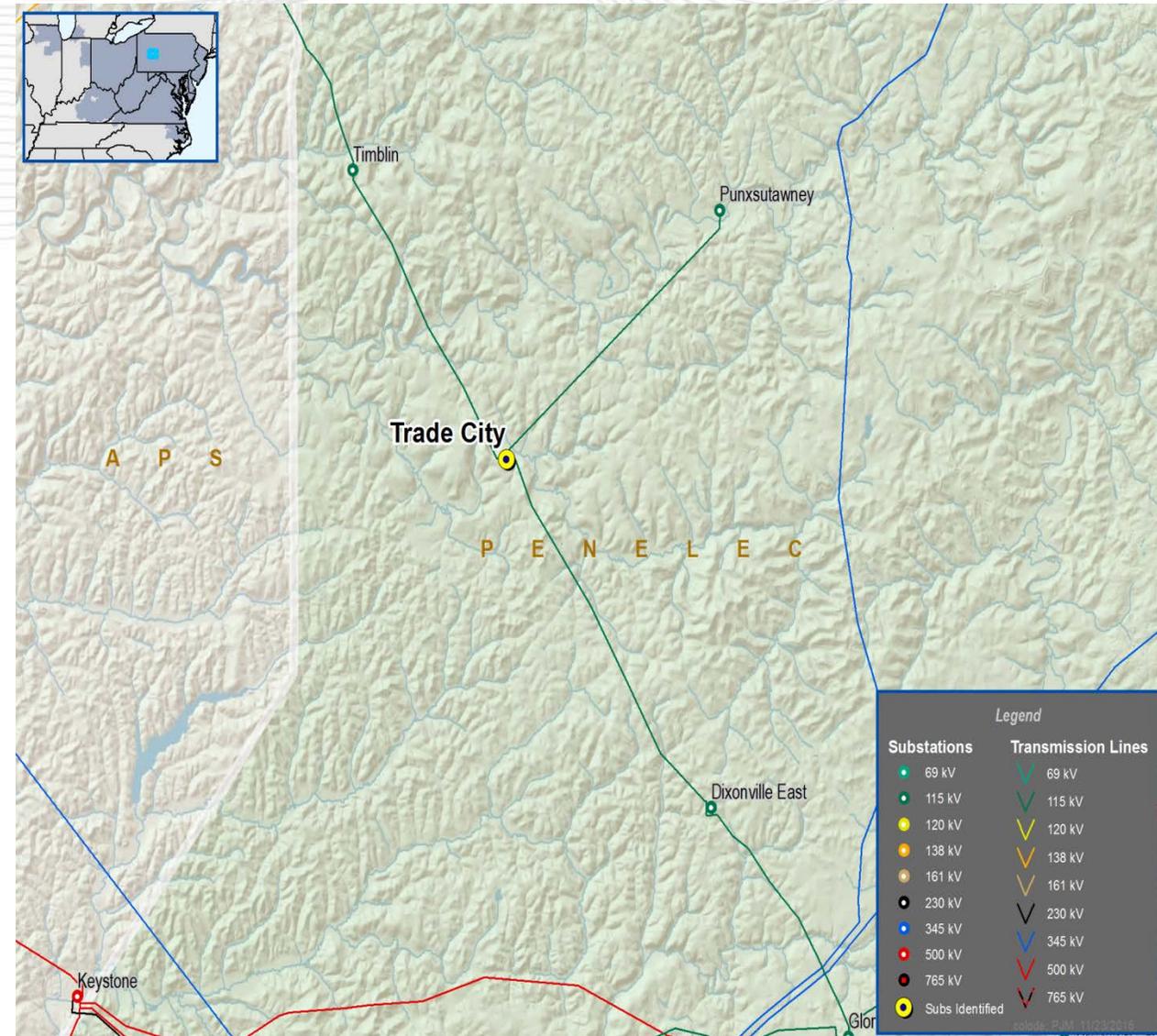
### Potential Alternatives:

- Construct 8 miles of new 115 kV line to Punxsutawney

Estimated Project Cost: \$ 7 M

Potential IS Date: 12/31/2017

Project Status: Engineering and Planning



## Supplemental Upgrade:

- **Rebuild Hauto-Frackville #3 69kV line to double circuit**

### Problem Statement:

- To address asset health issue due to 80+years old lattice towers and 60+years old wood poles that are well beyond intended service life.
- To improve resiliency for the area by providing two line supply
- To address lacking of backbone fiber path between Siegfried Substation and Frackville Substation
- To provide better flow balance for Type B distribution substation

### Potential Solution:

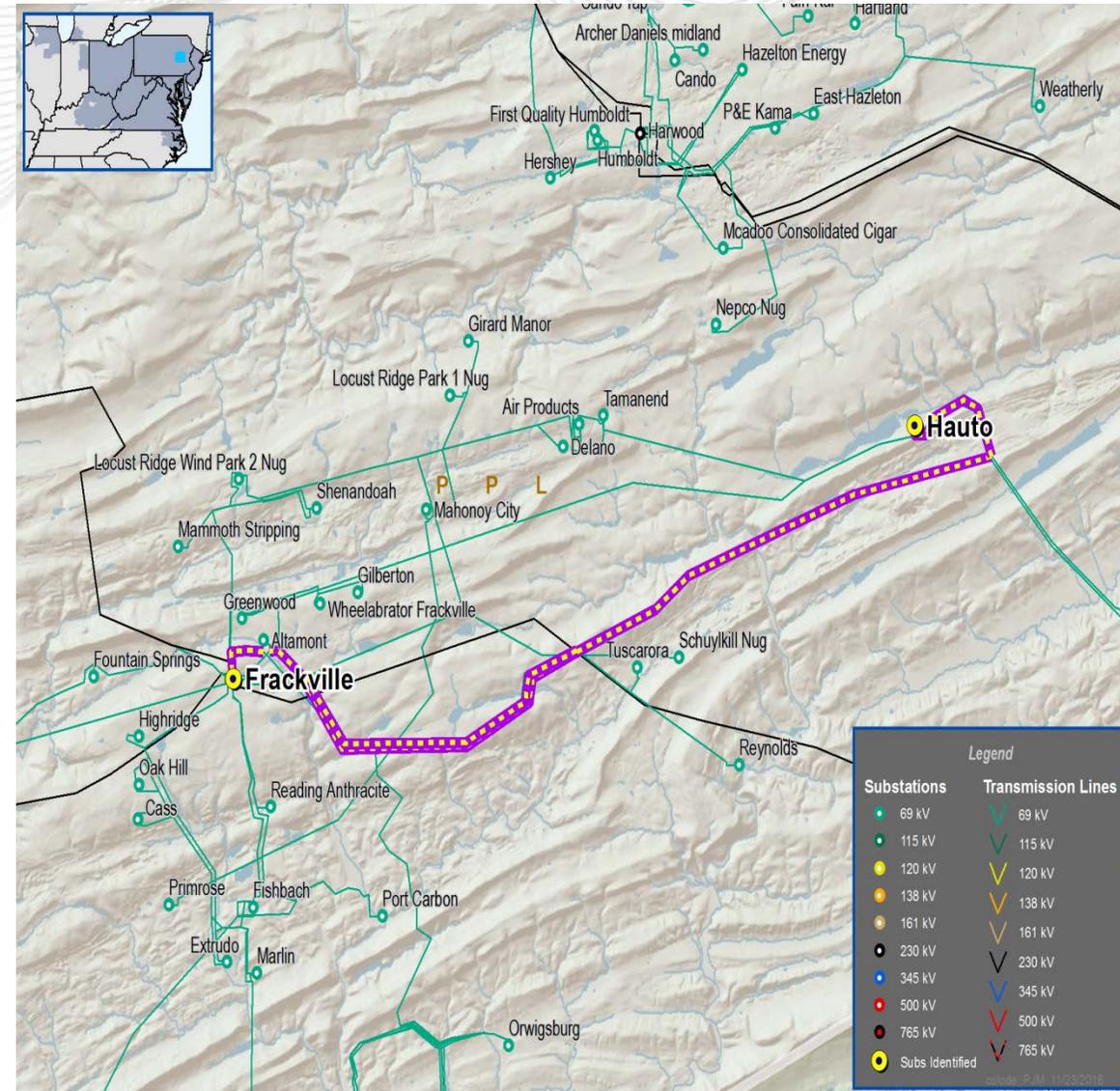
- Rebuild 26.3 miles of Hauto-Frackville #3 69kV line, including most of main line and tap lines. Install 5.1 miles of fiber on the section of Hauto-Frackville #3 Line that is not scheduled for rebuild.
- Retire 0.9 mile of Hauto-Frackville #1 69kV Line that is aged and becomes functionally obsolete.
- Replace existing switches with MOLBABs, install new MOLBABs to enhance sectionalizing capability. (S1242)

### Potential Alternatives:

- Rebuild a 4.8 miles section of Frackville-Shenandoah 69kV Line in lieu of a 3.2 miles section of Hauto-Frackville #3 Line. This alternative provides better flow balance for Type B distribution substation, but requires rebuilding line that was newly rebuilt in 2011 and longer in length.

Estimated Project Cost: \$57.8 M

Potential IS Date: 12/31/2020





# PSEG Transmission Zone

## Supplemental Upgrade:

### • Replace Lawrence 220-3 Transformer

#### Problem Statement:

- This unit have been identified as in poor condition based on our health scoring algorithm. And based on our transformer replacement strategy and economic analysis, we recommend pro-actively replacing this transformer to avoid failure.
- The existing 220-3 is not equipped with an on-load tap changer to regulate voltage on the 69kV side nor does it have TMP

#### Potential Solution:

- Replace Lawrence 230/69 kV 220-3 transformer. (S1095)

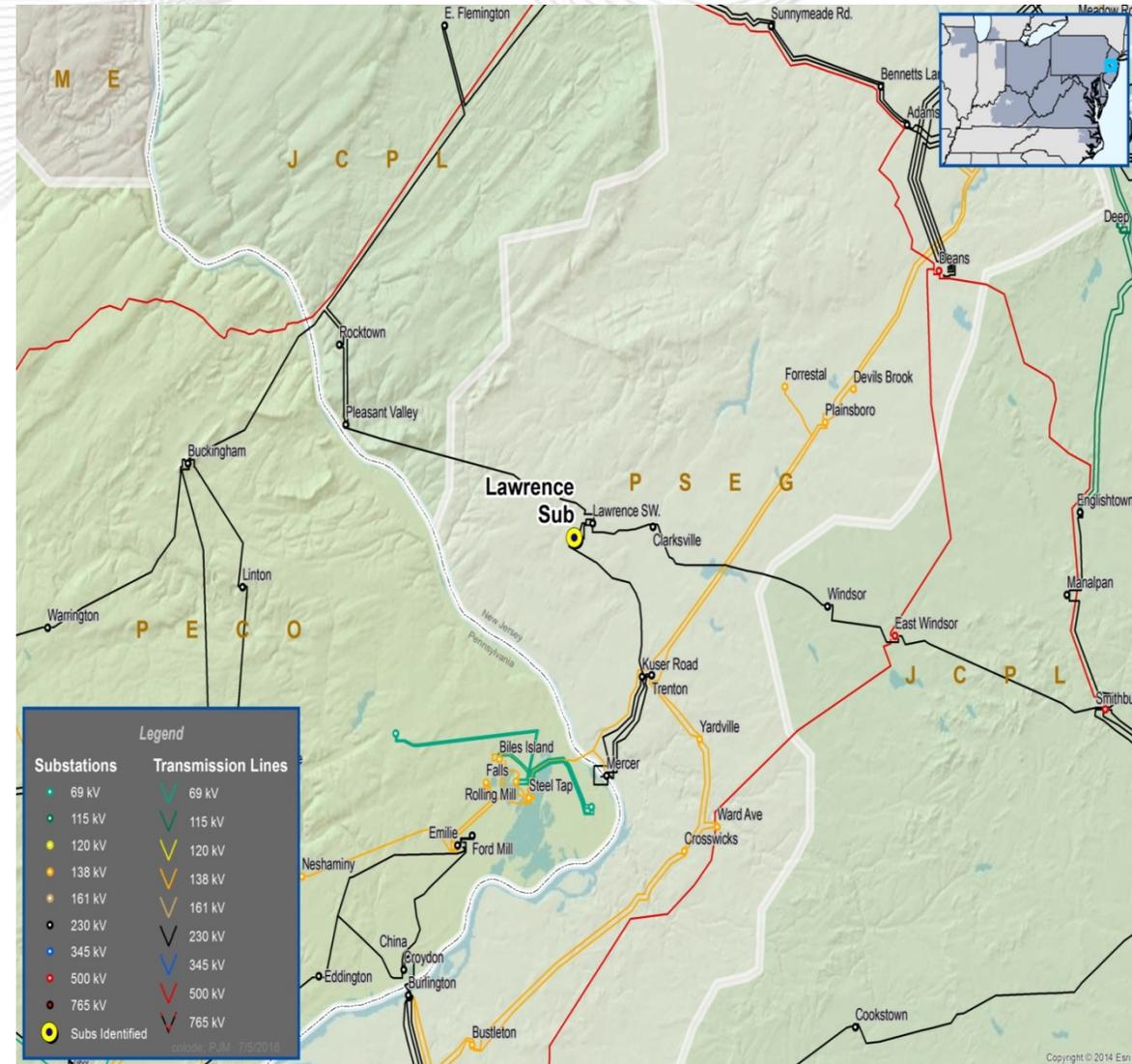
#### Potential Alternatives:

- Consideration was given to installing Transformer Monitoring at a cost of \$1.7 M.
- Life extension was considered. While this addresses the cooling system and dielectric condition of the oil, this does not address the electrical dielectric integrity and thermal performance of the transformer which progressively gets worse over time.

Estimated Project Cost: \$ 15 M

Potential IS Date: 12/31/2019

Project Status: Project Development and Engineering



## Supplemental Upgrade:

- **Replace Brunswick 220-4 Transformer**

### Problem Statement:

- Brunswick Switching Station has moved and the existing 220-4 transformer position must be relocated.
- The existing 220-4 is not equipped with an on-load tap changer to regulate voltage on the 69kV side nor does it have TMP

### Potential Solution:

- Replace Brunswick 220-4 with a new TMP equipped 230-69kV Auto-transformer with LTC. (\$1096)

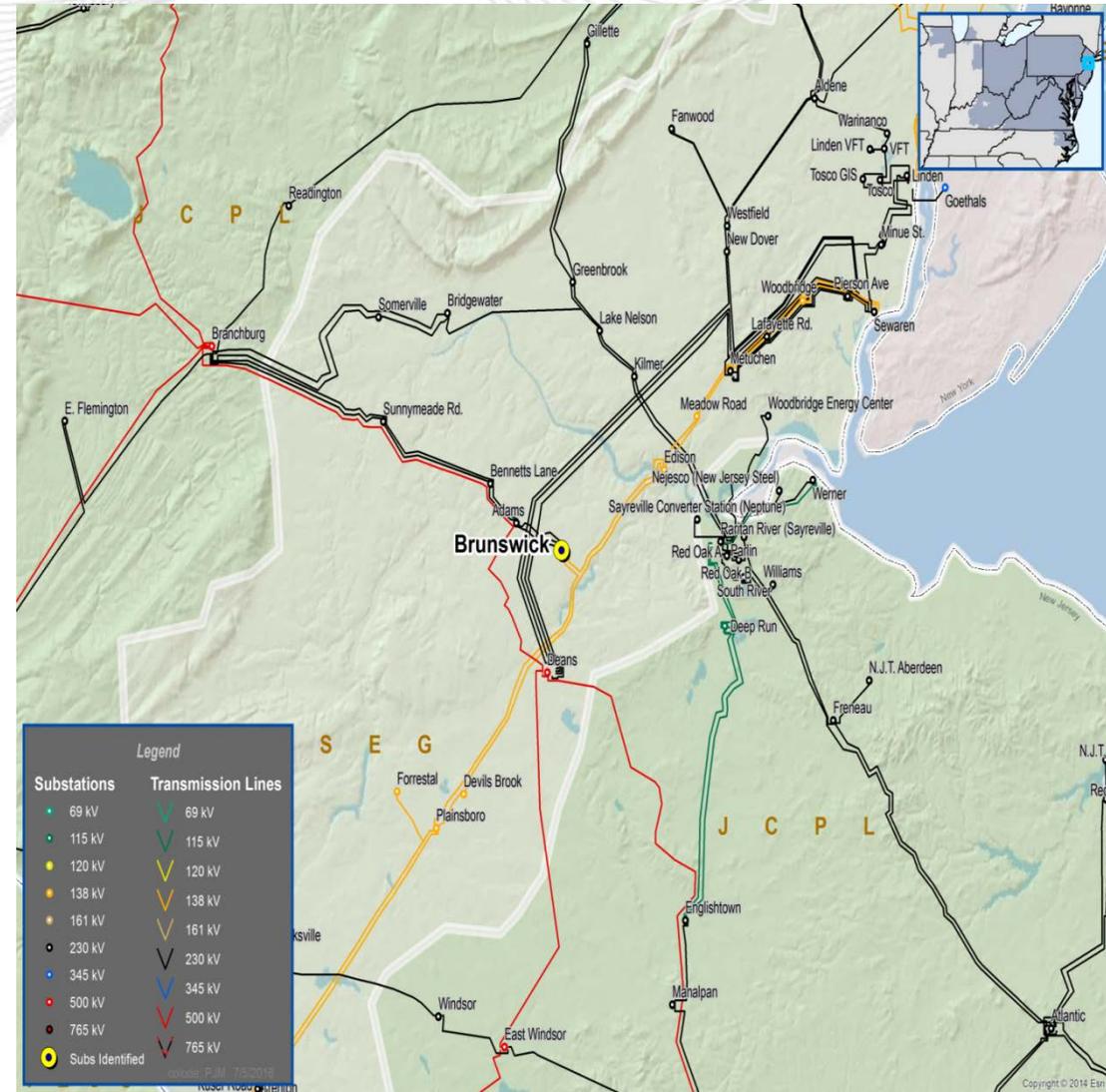
### Potential Alternatives:

- Relocate (disassembly and reassembly) the existing Transformer with \$1.2M (O&M)
- The project cost for both options which consists of Project Management, Engineering & Design, Construction, Licensing & Permitting, and Testing is estimated at \$5 M (Capital).

Estimated Project Cost: \$ 8M

Potential IS Date: 12/31/2016

Project Status: Project Development and Engineering





# PSEG Transmission Zone

## Supplemental Upgrade:

- **Replace Bustleton 230-13 kV transformers**

### Problem Statement:

- Transformer 1 and Transformer 2 have been identified to be in an unhealthy state. They have a history of frequent LTC operation and overloading.
- To maintain system reliability, it should be replaced.
- Transformer monitoring is not present on either existing transformer and should be installed to maintain high reliability and reduce O&M costs.

### Potential Solution:

- Replace Bustleton 230/13 kV T-10 and T-20 transformers and install transformer monitoring. (S1178)

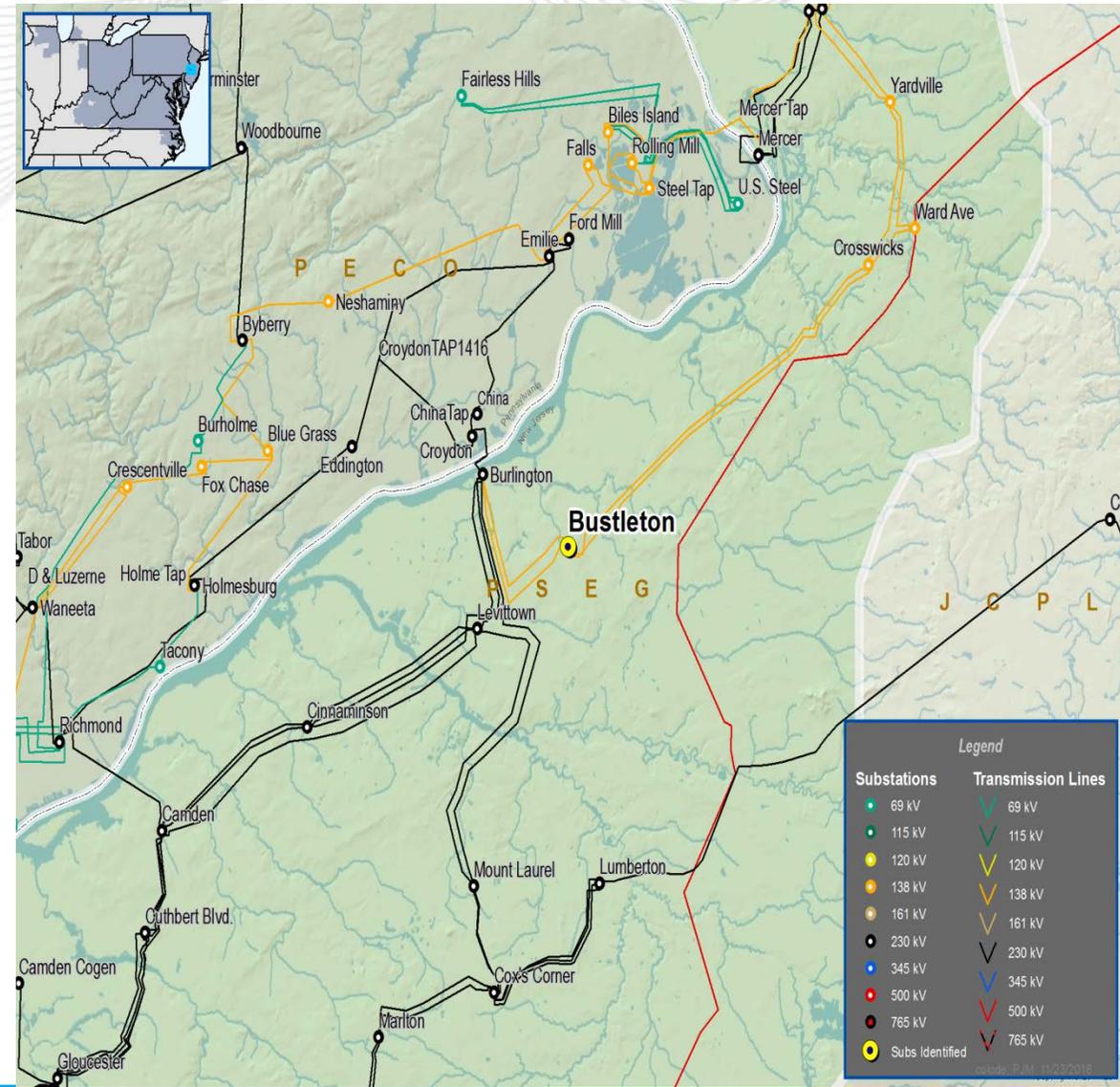
### Potential Alternatives:

- No alternatives were considered because of the nature of the work. The work is required in the existing substation.

**Estimated Project Cost:** \$ 9.8 M

**Potential IS Date:** 12/31/2019

**Project Status:** Project Development and Engineering



## Supplemental Upgrade:

- **Replace Trenton 138-26-11 kV transformers**

### Problem Statement:

- Transformer 132-1, Transformer 132-2 and Transformer 132-3 has been identified to be in an unhealthy state. They have a history of high water content and high Hydran gas.
- To maintain system reliability, it should be replaced.
- Transformer monitoring is not present on Transformer 132-2 and should be installed to maintain high reliability and reduce O&M costs.

### Potential Solution:

- Replace Trenton 138/26/11 kV 132-1, 132-2 and 132-3 transformers and install Monitoring on Transformer 132-2. (S1179)

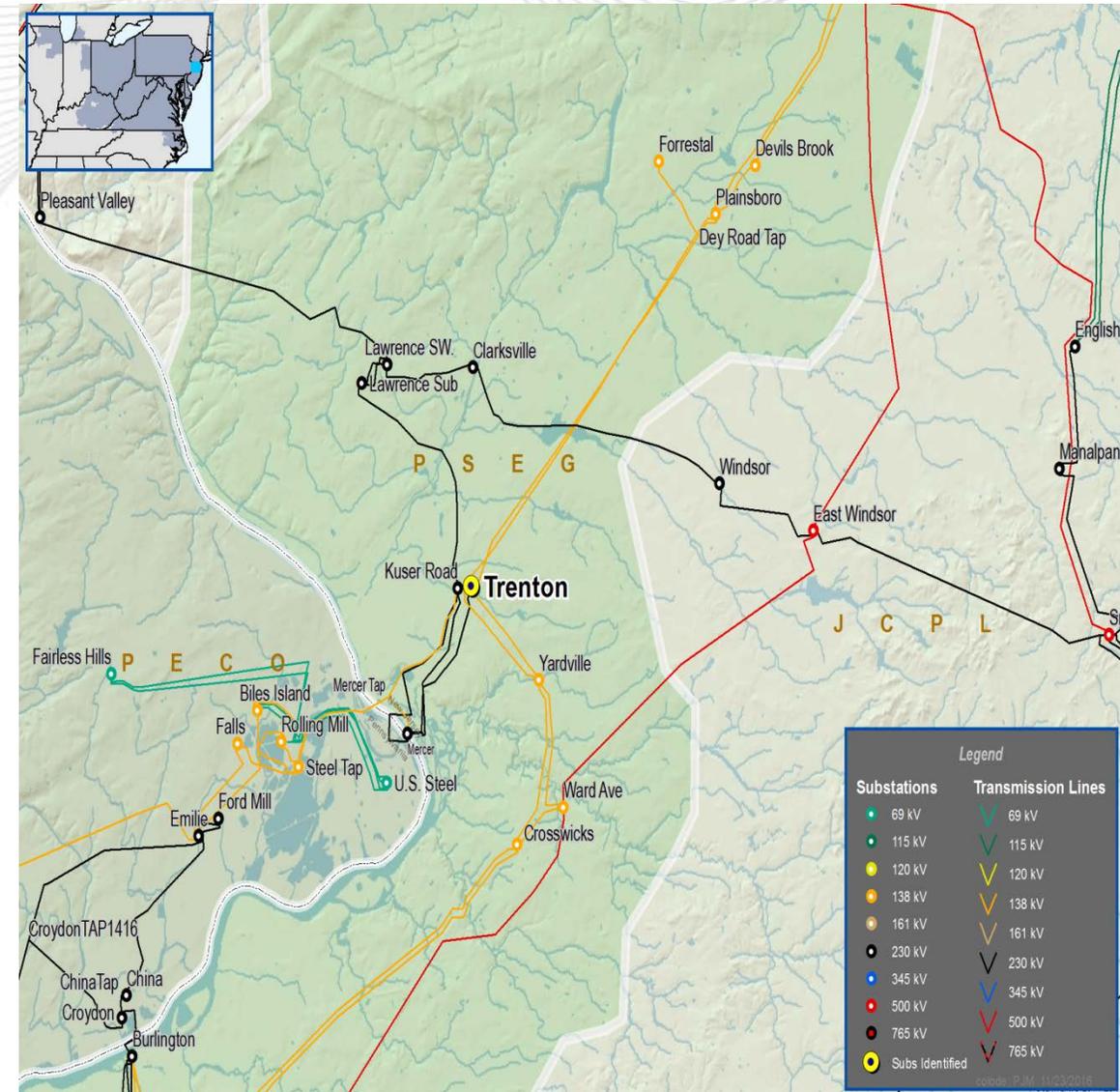
### Potential Alternatives:

- No alternatives were considered because of the nature of the work. The work is required in the existing substation.

Estimated Project Cost: \$ 36 M

Potential IS Date: 12/31/2020

Project Status: Project Development and Engineering





# PSEG Transmission Zone

## Supplemental Upgrade:

- **Replace Trenton 230-138 kV transformers**

### Problem Statement:

- Transformer 220-1 has been identified to be in an unhealthy state and transformer 220-2 has been identified to be nearing or at end of life. They have a history of frequent LTC operation
- To maintain system reliability, it should be replaced.
- Transformer monitoring is not present on transformer 220-2 and should be installed to maintain high reliability and reduce O&M costs.

### Potential Solution:

- Replace Trenton 230/138 kV 220-1, 220-2 transformers and install transformer monitoring. (S1183)

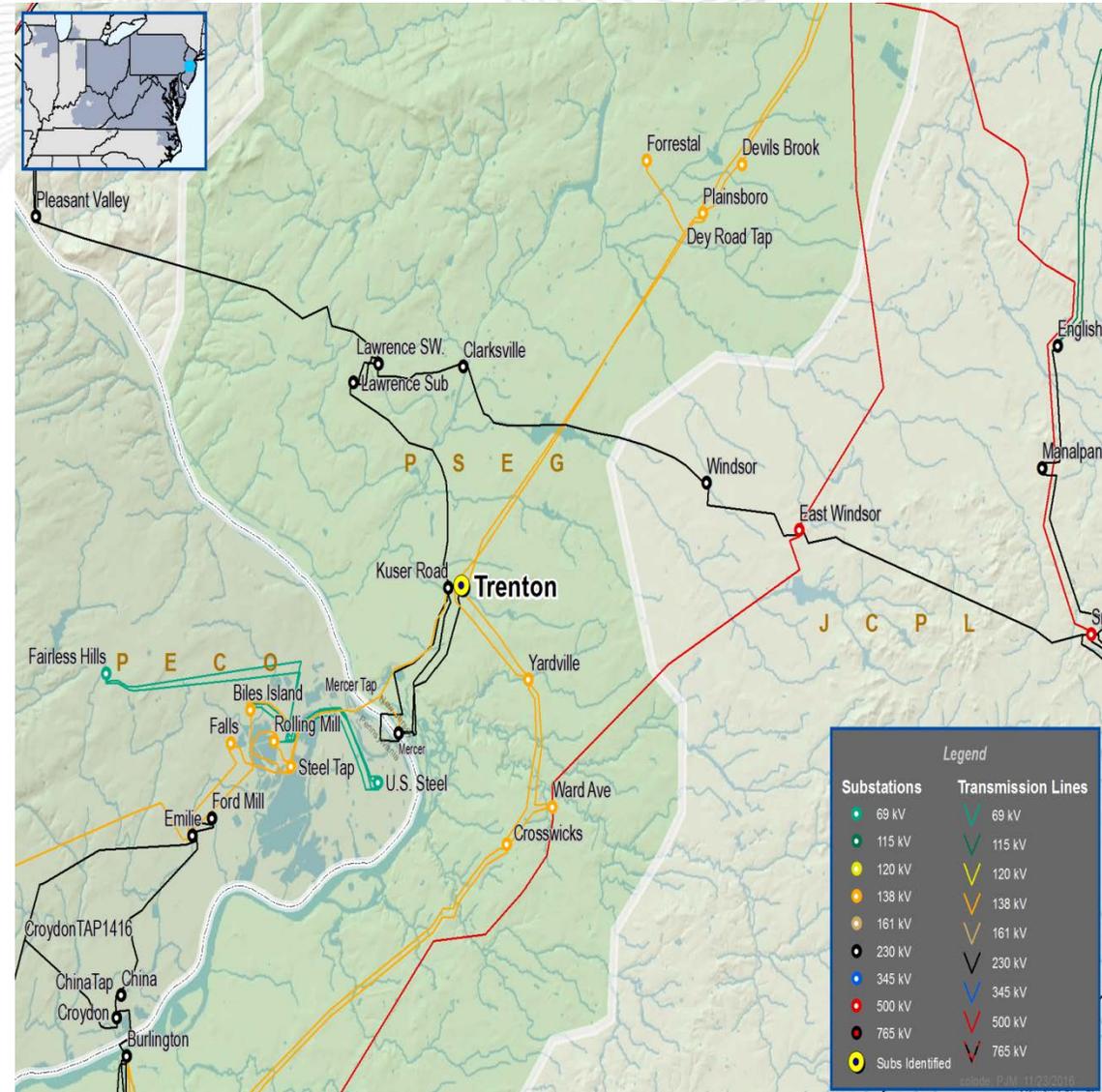
### Potential Alternatives:

- No alternatives were considered because of the nature of the work. The work is required in the existing substation.

Estimated Project Cost: \$ 24 M

Potential IS Date: 12/31/2019

Project Status: Project Development and Engineering



## Supplemental Upgrade:

- **Purchase Spare 138-69kV Transformer at Federal Square**

### Problem Statement:

- This will serve as a dedicated spare for Federal Square due to a small footprint and if needed, serve as a spare for East Rutherford and Fairlawn
- Federal Square cannot accept a re-connectable due space constraints.
- The minimum requirement is to maintain one (1) spare in stock as the in-service population

### Potential Solution:

- Purchase 180/340/300MVA, 138/69kV spare Transformer for Federal Square station. (S1180)

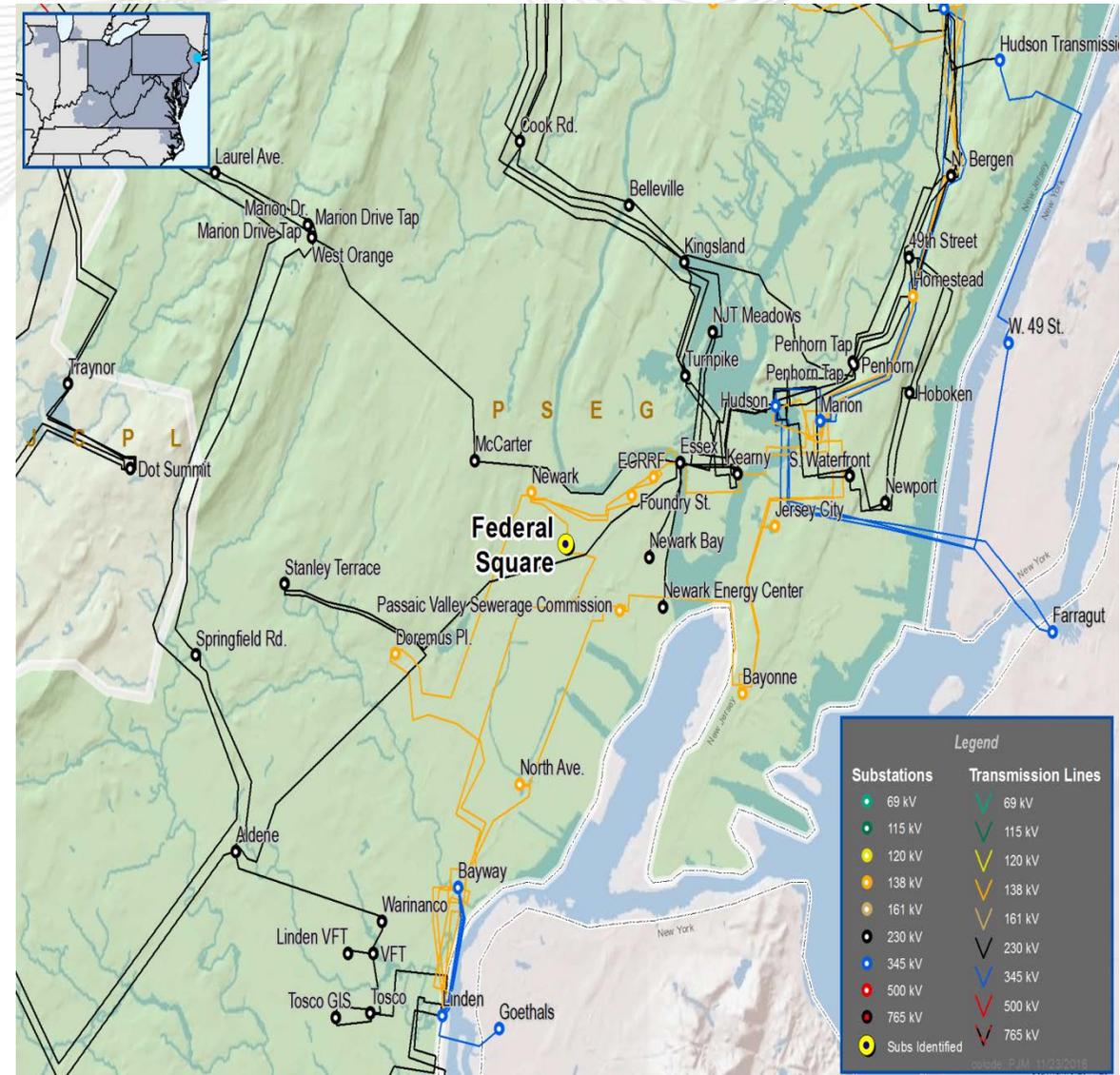
### Potential Alternatives:

- None: Accept the risk associated with operating with limited replacement options that potentially compromises PSE&G's reliability and ability to adhere to prevailing requirements and industry standards. Lead times associated with securing and replacing a similar unit in the event of a failure is or could be extensive.

Estimated Cost: \$ 3.3 M

Potential IS Date: 3/31/2018

Project Status: Project Development and Engineering



## Supplemental Upgrade:

- **Purchase Spare Power 230-26kV Transformer**

### Problem Statement:

- Presently, there is only one (1) system spare
- If a failure occurs, the system would be at risk for 13 months while awaiting the spare transformer

### Potential Solution:

- Purchase 72/96/120MVA, 230/26 kV Spare Power Transformer for spare inventory to support the forty-two (42) In-Service 230-26kV transformers in the system. (S1182)

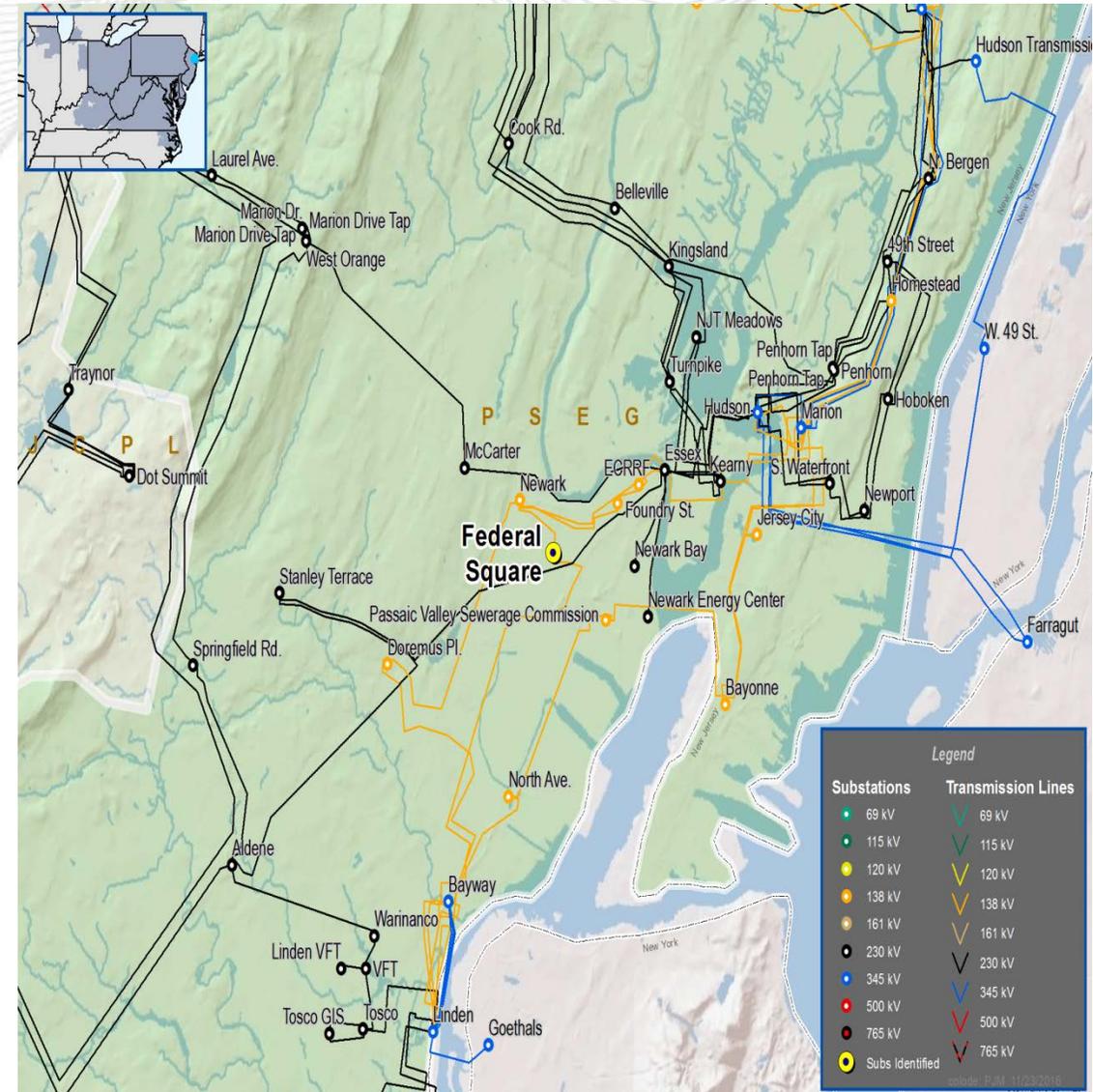
### Potential Alternatives:

- None: Accept the risk associated with operating with limited replacement options that potentially compromises PSE&G's reliability and ability to adhere to prevailing requirements and industry standards. Lead times associated with securing and replacing a similar unit in the event of a failure is or could be extensive.

Estimated Cost: \$ 2.6 M

Potential IS Date: 4/30/2018

Project Status: Project Development and Engineering





# PSEG Transmission Zone

## Supplemental Upgrade:

- **Replace Linden 138 KV Breakers**

### Problem Statement:

- In response to recent natural disasters like Sandy, PSE&G is implementing several resilient initiatives (s0644) including raising and rebuilding Linden 138 kV switchyard (s0644.1) .
- Existing Linden 138 kV breakers 1APA and 2BPB are overstressed based on a PJM short circuit study.

### Potential Solution:

- Increase the MVA rating of the generator lead by paralleling two circuits (V-1348 and U-1347). This involves re-conductoring and rerouting of existing circuits.
- Upgrade 2BPM breaker to 80 kA ratings.
- PSEG Power design includes series reactor near generators.

Note: This design will save the cost of replacing a GSU transformer and upgrading three additional breakers on low voltage side.

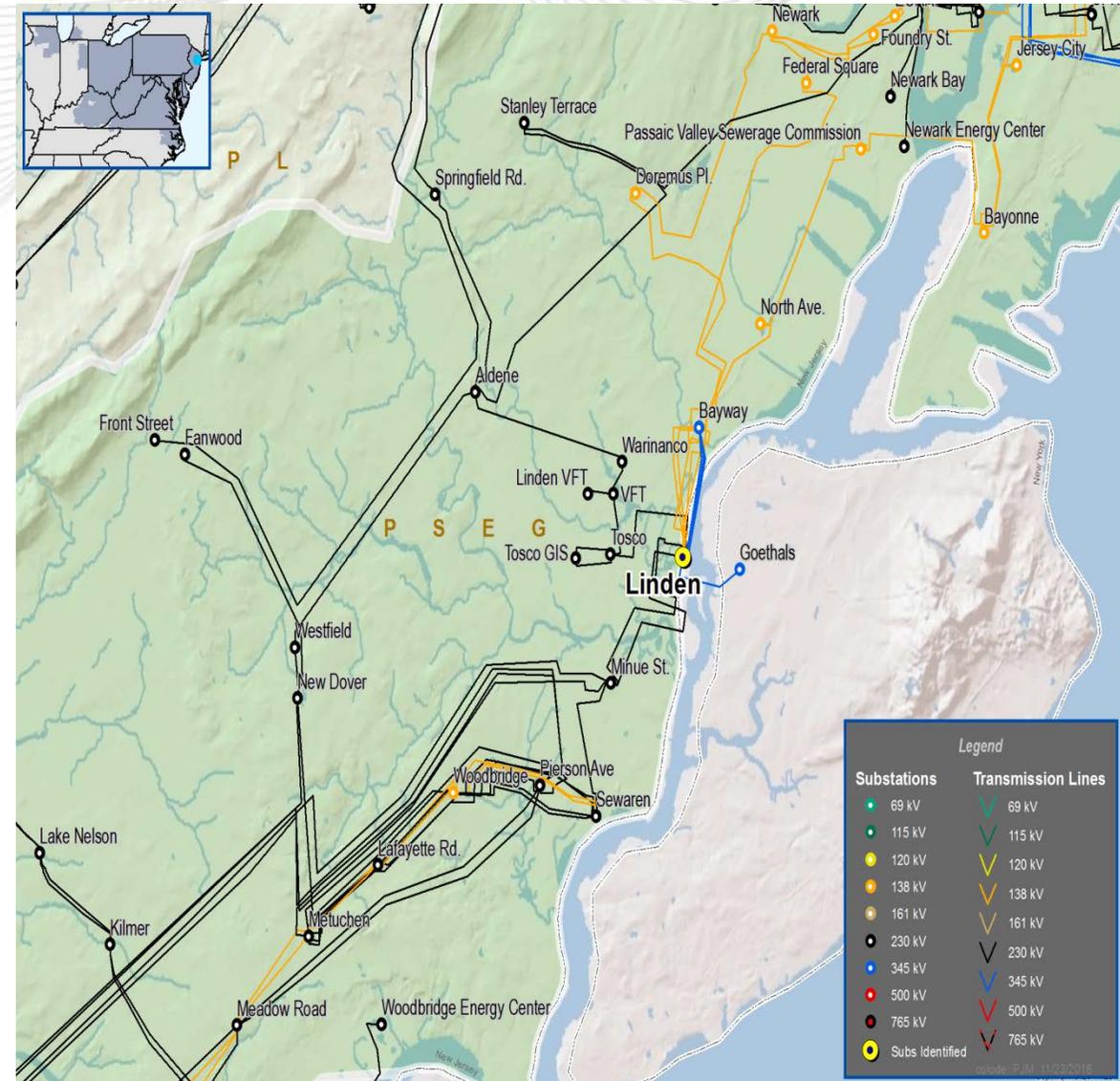
### Potential Alternatives:

- To avoid stuck breaker scenario, causing both generator power flows into one line causing overstressing the line, various alternatives were evaluated. The best option with respect to reliability and economics was selected.

**Estimated Cost:** \$ 9.3M (Cost Responsibility of PSEG Power)

**Potential IS Date:** 12/31/2018

**Project Status:** Project Development and Engineering



## Supplemental Upgrade:

- **Build 13 kV Stanley Terrace Class H substation with two 230/13kV Transformers**

### Problem Statement:

- Stanley Terrace Station is in the ideal location for load relief of many surrounding stations, i.e. some of these stations are islanded such as Vauxhall, and Hillside. Vauxhall and Hillside substations went in service in 1948, and 1937, respectively.
- Need to improve reliability for customers supplied from Vauxhall and Hillside substations as they have no backup electric supply.

### Potential Solution:

- Eliminate and convert Vauxhall 4kV and Hillside 4kV substation loads to 13kV and supply them via Stanley Terrace Class H Station.
- Build Stanley Terrace class H station to alleviate heavily loaded substations and also help increase reliability, and provide self-healing loops to areas which are presently electrically isolated from other station supplies.
- Install two new 230/13kV transformer at Stanley Terrace. (S1241)

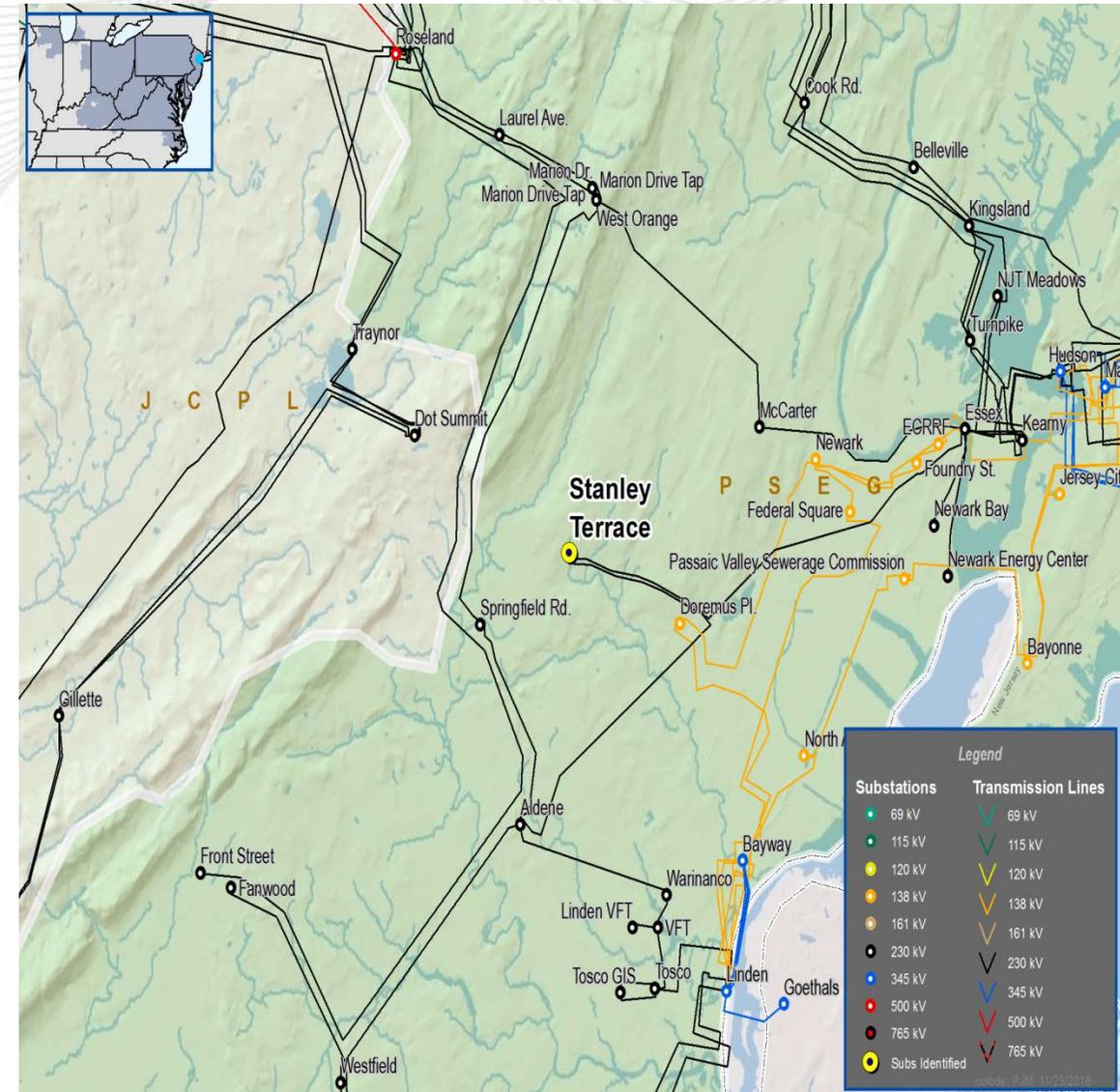
### Potential Alternatives:

- Completely rebuild Vauxhall and Hillside substations, which would result in no future expansion being available in the two areas for any future load growth.

**Estimated Cost:** \$20.7M

**Potential IS Date:** 5/1/2018

**Project Status:** Project Development and Engineering





# UGI Transmission Zone

## Supplemental Upgrade:

### • **Huntsville 66/13.8kV Substation Expansion**

#### Problem Statement:

- Need to accommodate a second 66/13.8kV distribution transformer planned to support load growth, enhance 13.8kV tie-line/sectionalizing options and to guard against single transformer outages.

#### Potential Solution:

- Install two additional 66kV breakers (1- line terminal breaker and 1-bus tie breaker) and rearrange the current 66kV configuration to accommodate the addition/connection of the new transformer.

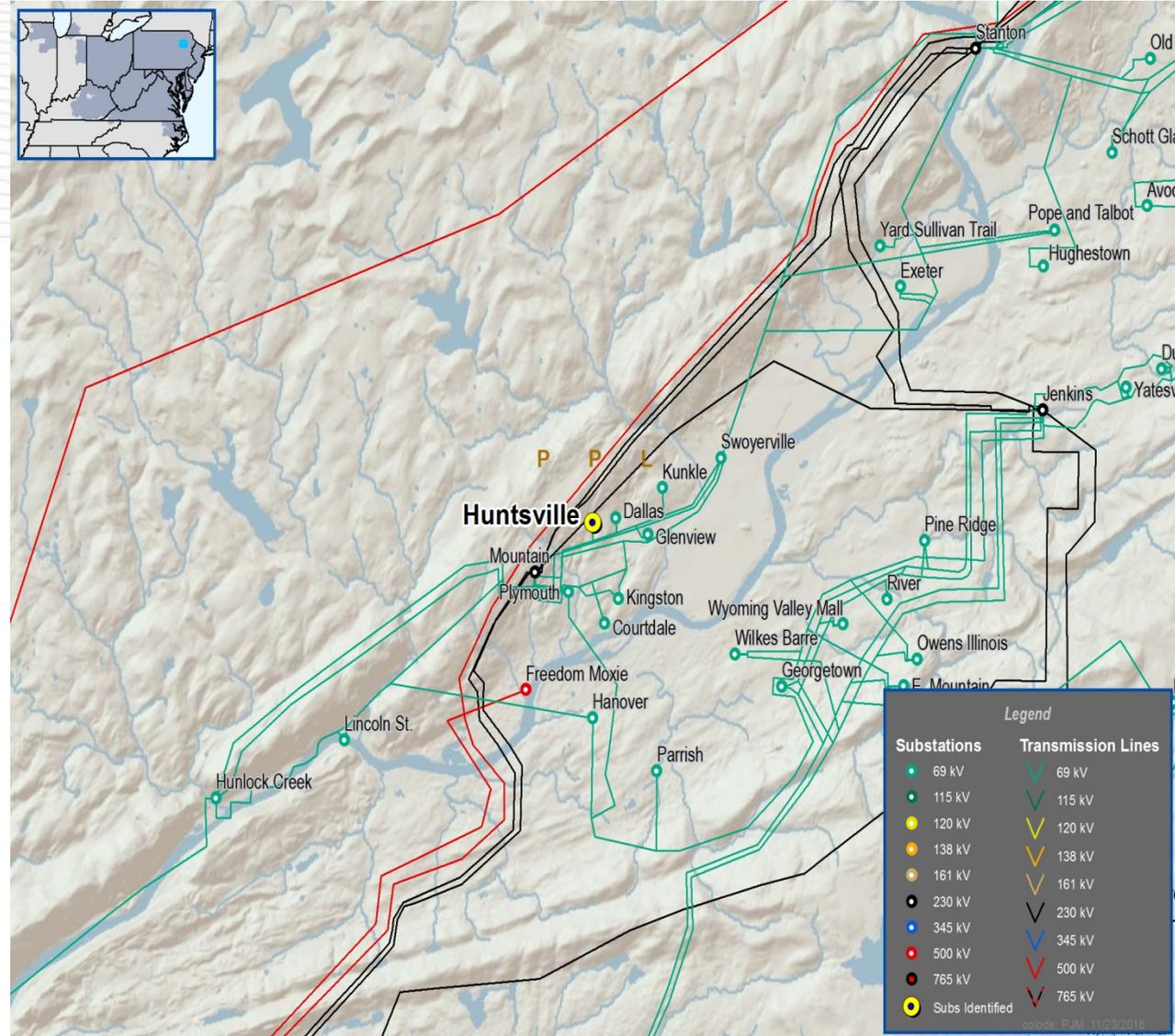
#### Potential Alternatives:

- Tap transformer off existing line without breaker additions.

Estimated Cost: \$0.20M

Potential IS Date: 06/01/2017

Project Status: Under Construction



# Questions?

Email: [RTEP@pjm.com](mailto:RTEP@pjm.com)



## Revision History

11/23/2016 – Original version posted to PJM.com

11/28/2016 – V1 – added three PSEG slides (12, 13 and 14) and made minor changes to some slides.