



# Transmission Expansion Advisory Committee

August 11, 2010



# Issues Tracking



# Issues Tracking

## Closed Issues:

Owner	Requestor	Issue ID	Issue Title	Issue Description	Issue Status	Stakeholder Body	Date Created
PJM	Patty Esposito / NRG	Raised at May 12 TEAC	MAAC and EMAAC Reactive Analysis Details	Request for more detail for MAAC and EMAAC reactive issues. Suggestion to order the list of issues by severity.	Open	TEAC	5/12/2010

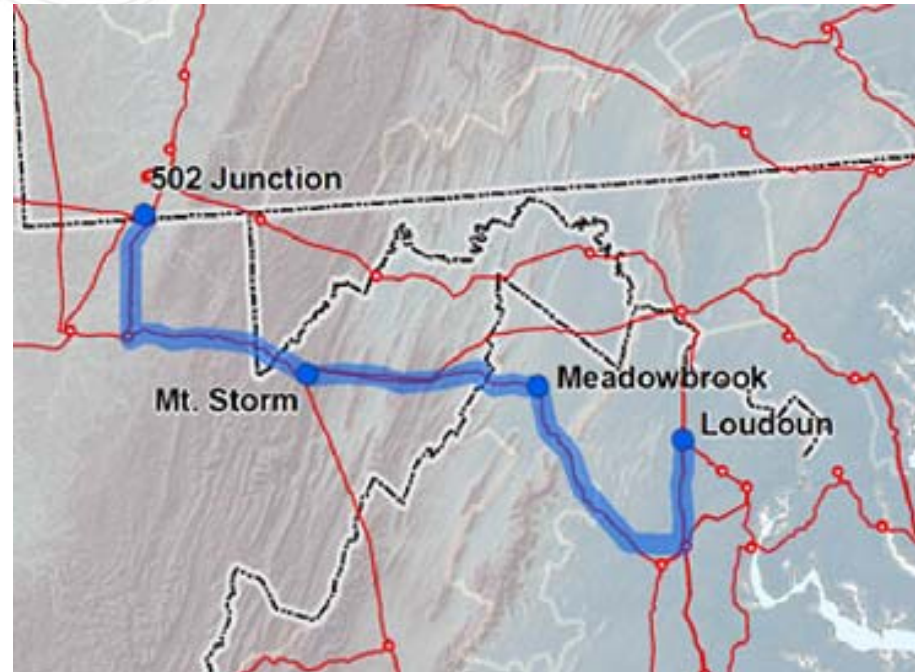
## Open Issues:

## New Issues:



# MAAC Analysis Update

- 2015 RTEP case had an incorrect impedance for the Meadow Brook – Loudoun section of TrAIL. The incorrect impedance was similar to the original as-planned impedance of TrAIL
- Retool in progress





# 15 Year MAAC Thermal Analysis TrAIL Correction Result

- Comparison of 15 year thermal analysis
- Complete retool in progress
  - Thermal
  - Voltage
  - PV
- Evaluation of base system & alternatives

From Bus	To Bus	100% Year	100% Year
		Incorrect TrAIL Impedance	Corrected TrAIL Impedance
Lexington	Dooms	2017	2017
Mt. Storm	T157 Tap	2017	2015
T157 Tap	Doubs	2017	2015
Pruntytown	Mt. Storm	2019	2020
Jacks Mountain	Juniata #1	2019	2018
Jacks Mountain	Juniata #2	2020	2020
Greenland Gap	Meadow Brook	2021	2025
Mt. Storm	Greenland Gap	2022	>2025
Bath County	Valley	2022	2022
Keystone	Jacks Mountain	2023	2022
Harrison	Pruntytown	2024	>2025
Keystone	Conemaugh	>2025	2025



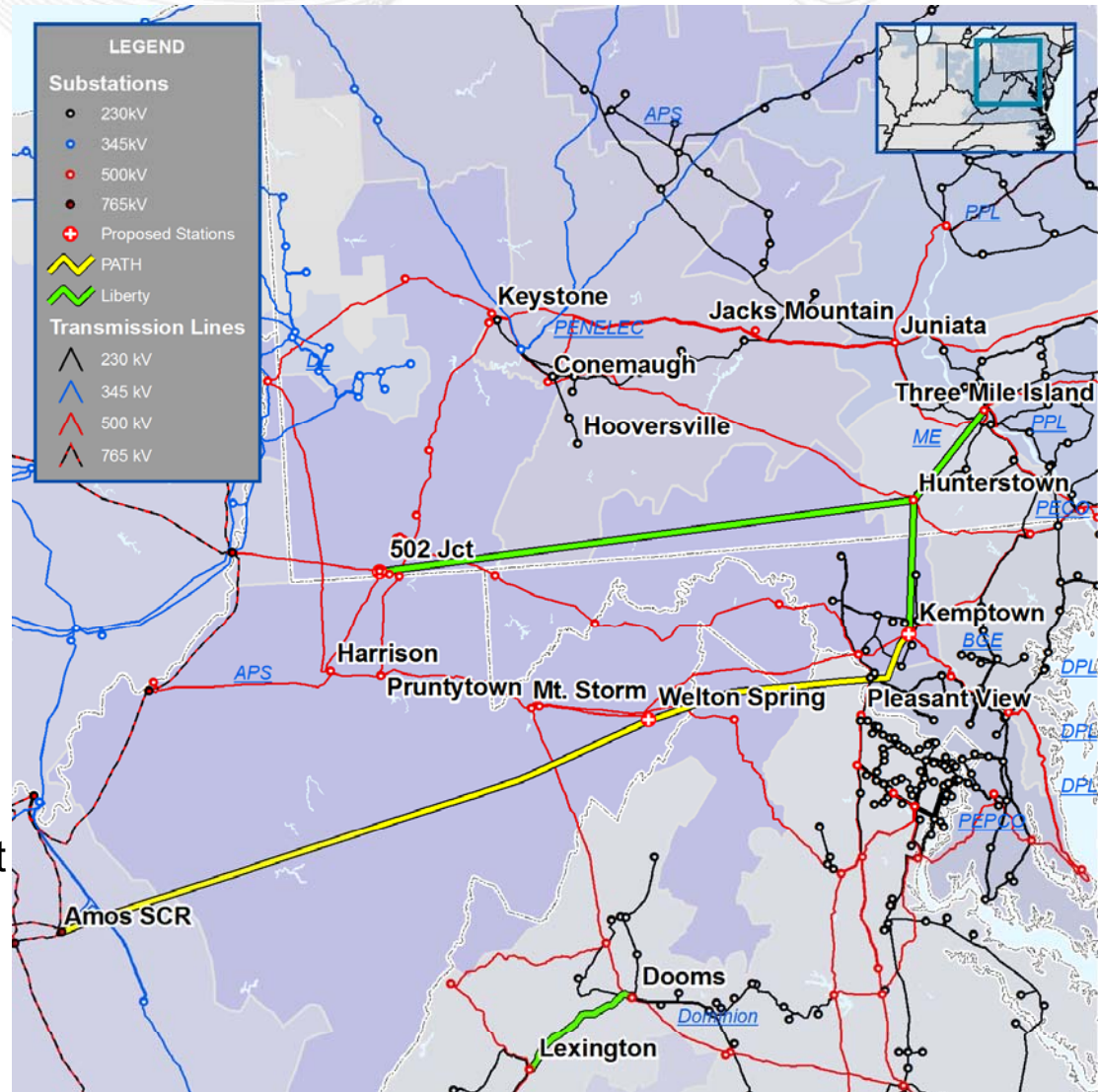
# MAAC Alternative Analysis Update

## Revised Liberty / LS Power

- 502J – Hunterstown 500 kV (includes 50% series compensation)
- Hunterstown – TMI 500 kV
- Hunterstown – Kemptown 500 kV
- Lexington – Doods 500 kV

## PATH

- Amos – Welton Spring – Kemptown
- Includes baseline reactive upgrades of 1000 MVAR shunt and 500 MVAR SVC at Welton Spring and a 250 MVAR shunt at Kemptown 500kV







# MAAC Alternative Analysis

## Dominion Alternative #1

- Rebuild Mt. Storm – Doubs
- 50% series compensation on Meadow Brook end of Trail
- Rebuild Mt. Storm – Pruntytown

## Dominion Alternative #2

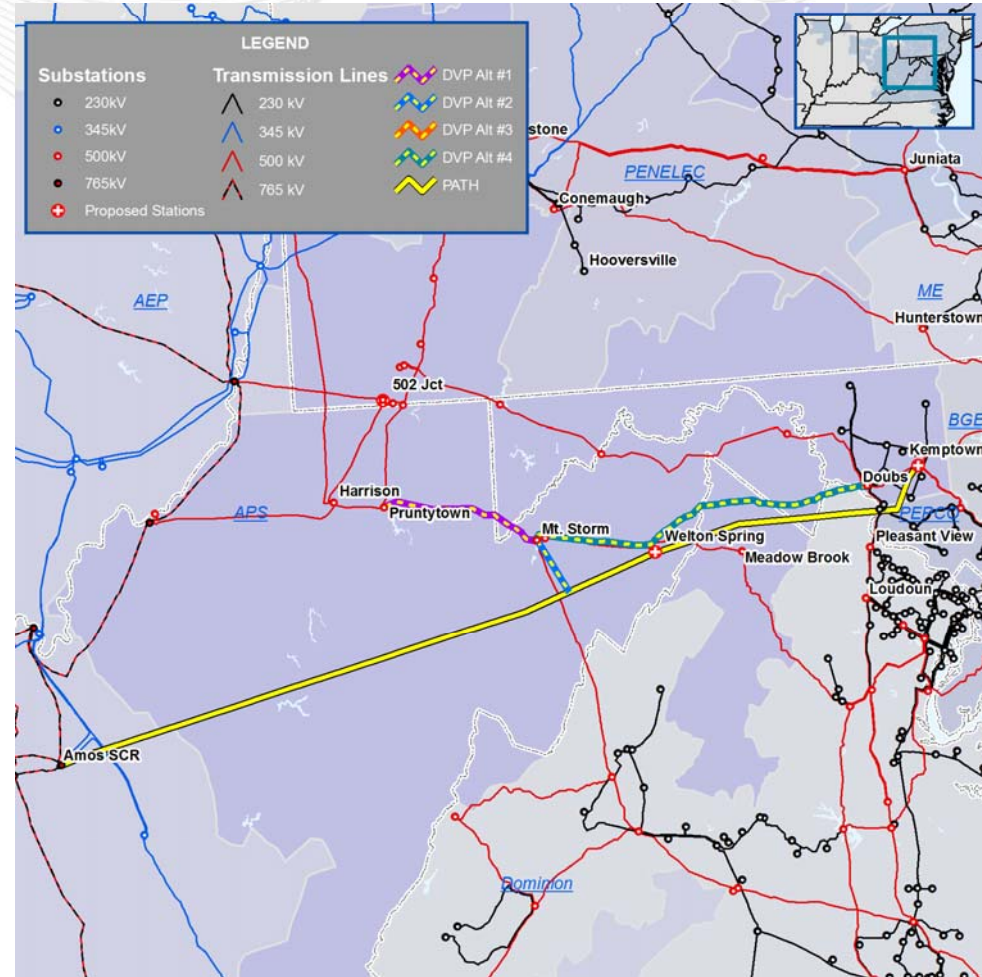
- Rebuild Mt. Storm – Doubs
- 50% series compensation on Meadow Brook end of Trail
- Build a portion of PATH stopping at Mt. Storm (requires a new 765/500 kV transformer)

## Dominion Alternative #3

- Rebuild Mt. Storm – Doubs
- 50% series compensation on Meadow Brook end of Trail
- Build a portion of PATH stopping at Welton Spring (requires new 765/500 kV transformer)

## Dominion Alternative #4

- Rebuild Mt. Storm – Doubs
- Build PATH proposal



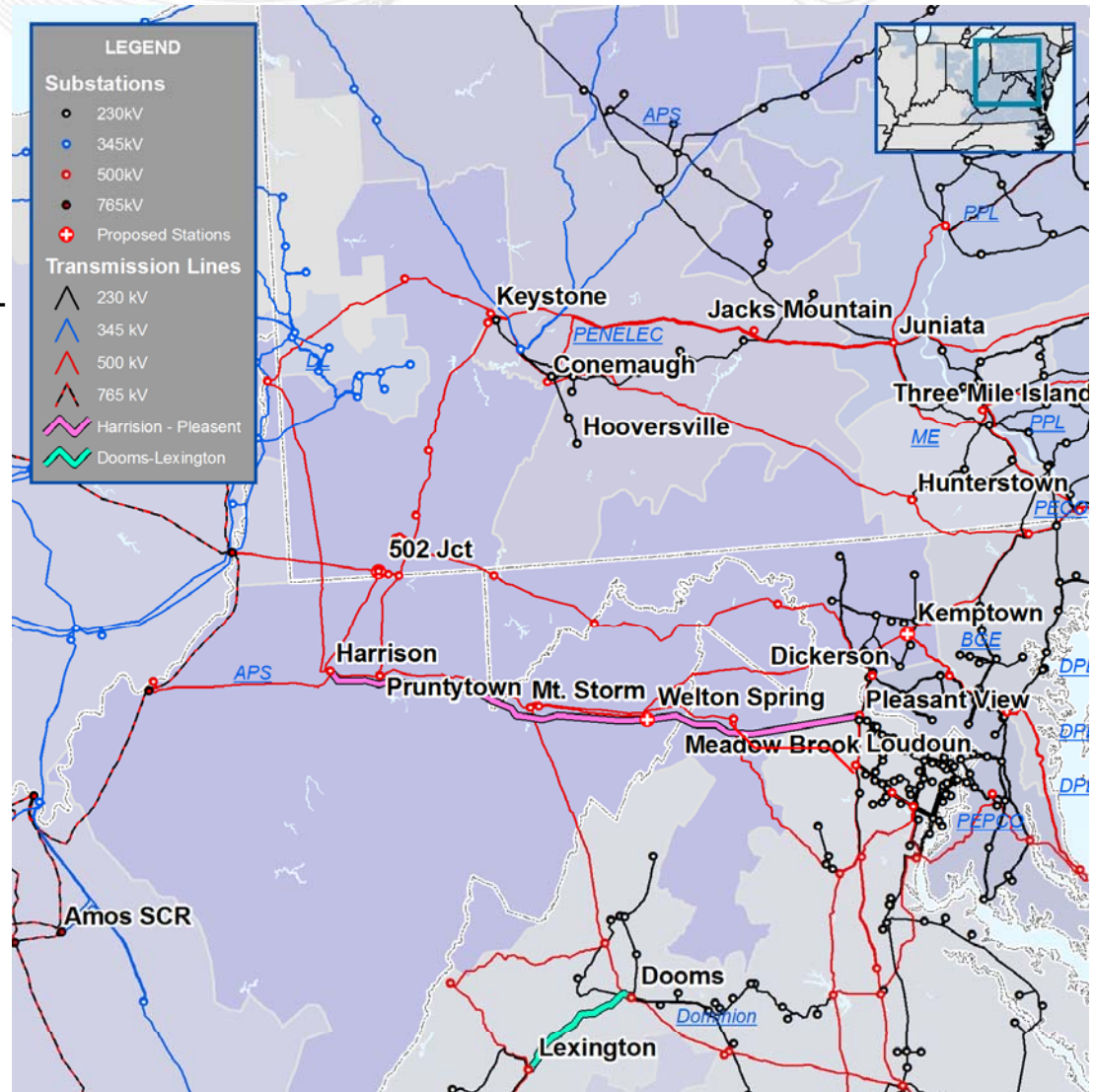
\* All Dominion alternatives include 900 MVAR SVC's at Loudoun 230 kV and T157 Tap 500 kV and 900 MVAR of static capacitors at other locations



# MAAC Alternative Analysis

## Harrison – Dickerson Alternative

- Harrison – Dickerson New 500kV AC Line
- New Dickerson 500/230 kV Station
- Series Comp on Meadow Brook – Loudoun
- Lexington – Doods 500 kV





# 15 Year MAAC Thermal Alternative Analysis

From Bus	To Bus	2015 Baseline Case – no alternatives	PATH	Revised Liberty	Dominion Alternative #1	Dominion Alternative #2	Dominion Alternative #3	Dominion Alternative #4	Harrison – Dickerson
Lexington	Dooms	2017	>2025						
Mt. Storm	T157 Tap	2015	2023						
T157 Tap	Doubs	2015	2023						
Pruntytown	Mt. Storm	2020	>2025						
Jacks Mountain	Juniata #1	2018	>2025						
Jacks Mountain	Juniata #2	2020	>2025						
Greenland Gap	Meadow Brook	2025	>2025						
Bath County	Valley	2022	>2025						
Keystone	Jacks Mountain	2022	>2025						
Keystone	Conemaugh	2025	>2025						

Analysis In-Progress

- All results include updated TrAIL impedance

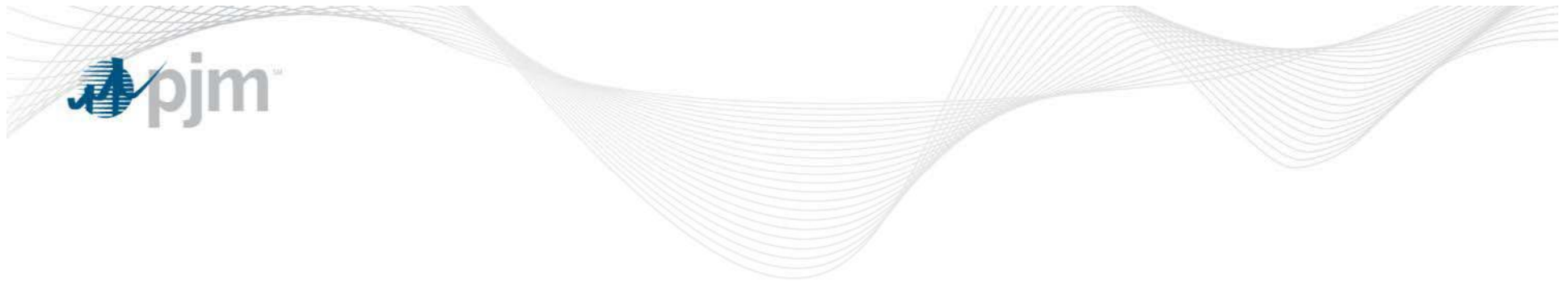


# MAAC Alternative Side by Side Comparison

	Mileage			Number of States	Cost (\$B)
	Existing ROW	New ROW	Total		
PATH	121.2 (adjacent to existing ROW)	156.1	277.3*	MD, VA, WV	\$2.10
Revised Liberty	Estimated 270 - 300 (40 - 50% estimated to be parallel to existing transmission ROW)			PA, MD, VA	\$1.34
Dominion Alt #1	99 - Rebuild of existing transmission	0	99	MD, VA, WV	\$0.62
Dominion Alt #2					\$1.32 (includes \$0.9 for portion of PATH)
Dominion Alt #3					\$1.32 (includes \$0.9 for portion of PATH)
Dominion Alt #4					\$2.52 (includes \$2.1 for entire PATH)

\* Data based on filed Line Route Evaluations (LRE)

- Updated alternative analysis
  - Thermal & Reactive
- More detailed side by side comparison
- Potential for additional siting analysis by consultant



# EMAAC Alternative Analysis Update

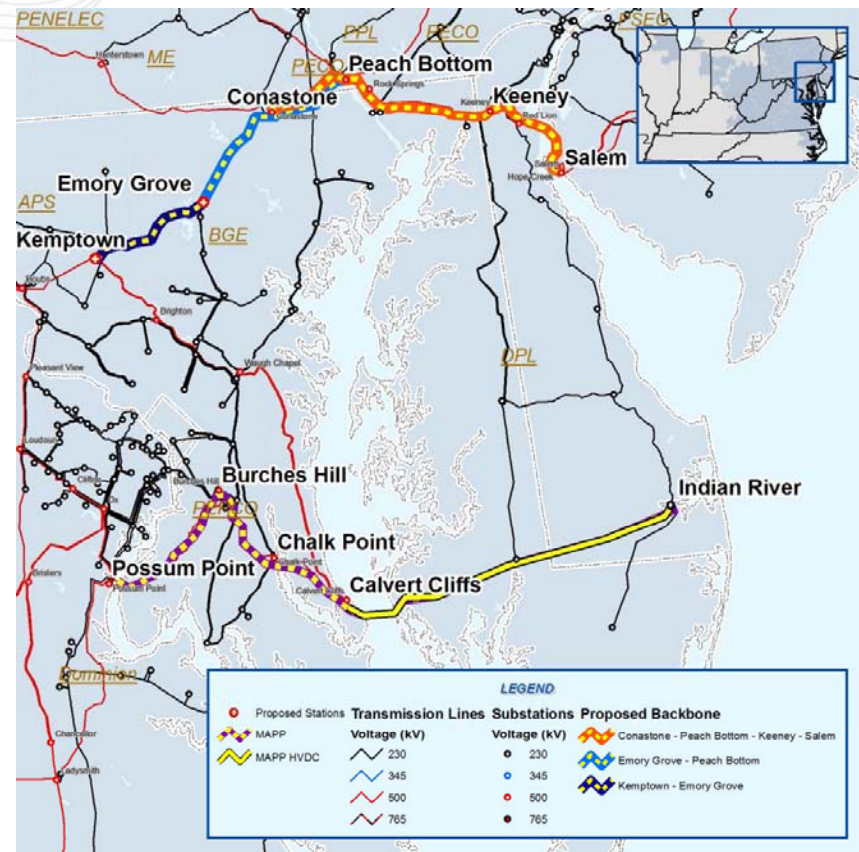
- Minimal impact to EMAAC result from TrAIL impedance correction

## Northern Route (Kemptown) Alternative

- A new 500 kV line from Kemptown to Peach Bottom to Keeney South to Salem with 500/230 kV substation at Emory Grove (near Northwest)

## MAPP Alternative

- MAPP (A new 500 kV line from Possum Point to Chalk Pt to Calvert Cliffs; HVDC circuits from Calvert Cliffs to Vienna to Indian River)

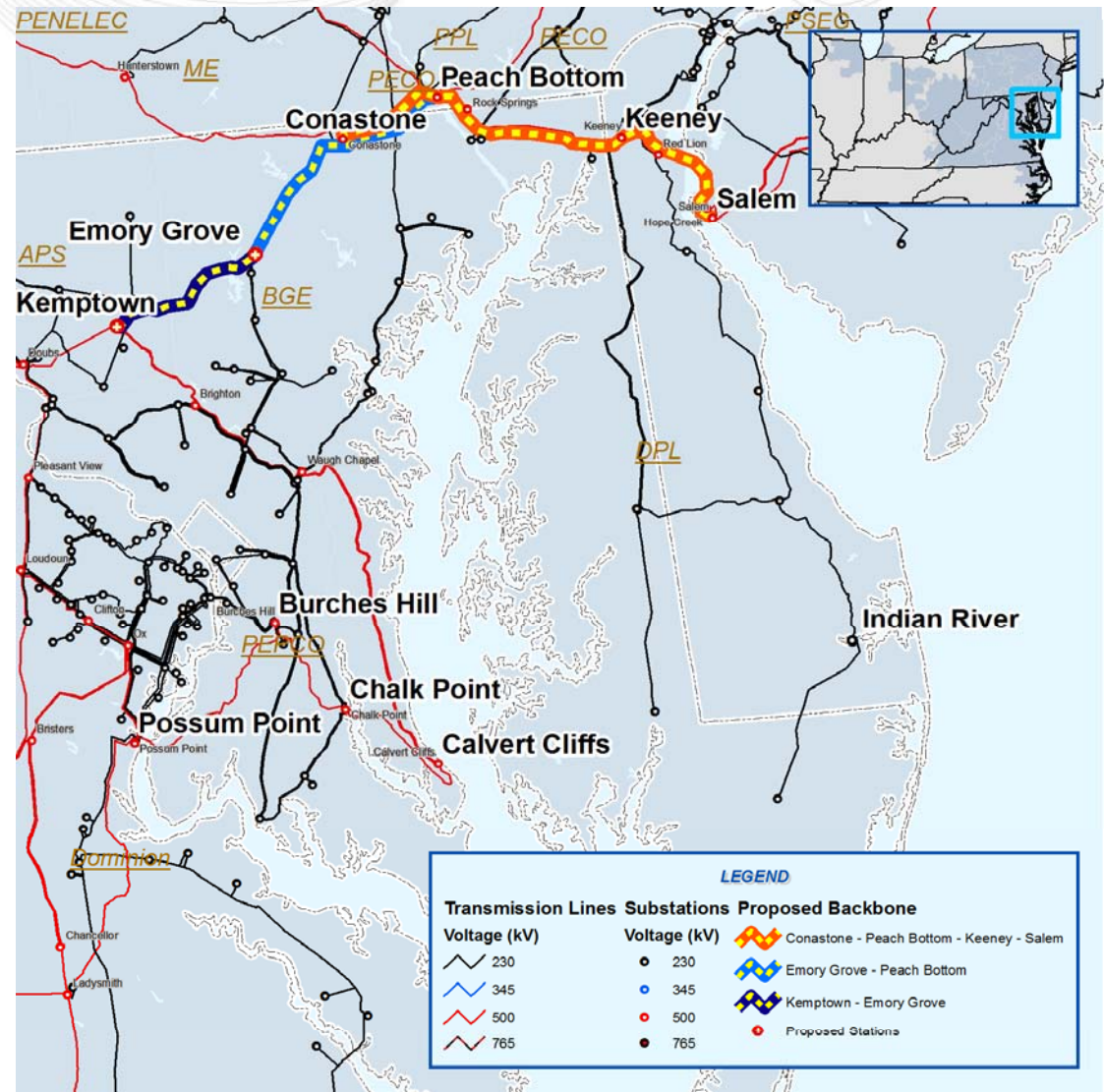




- Conceptual study of Northern Alternative performed by an independent consultant
  - Identification of possible route
  - Overall estimated project cost
  - Potential risks to completion
  - Estimated project duration
  - Assessment of the feasibility of successful completion of the project

# Northern Alternative Conceptual Study

- Identification of possible route
  - Possible route follows mostly existing right-of-way from Kemptown – Peach Bottom
  - New “Keeney South” substation
  - ROW congestion, especially in Keeney area



- Overall estimated project cost
  - \$1.15 B - \$1.46 B
- Estimated Project Duration
  - 111 month estimate, based on a very conservative approach
  - More aggressive estimate requested from the consultant

- Potential Risks to Completion
  - Water Crossings
    - C&D Canal
    - Delaware River
  - Environmental Permits
    - Delaware, NJ, MD, PA

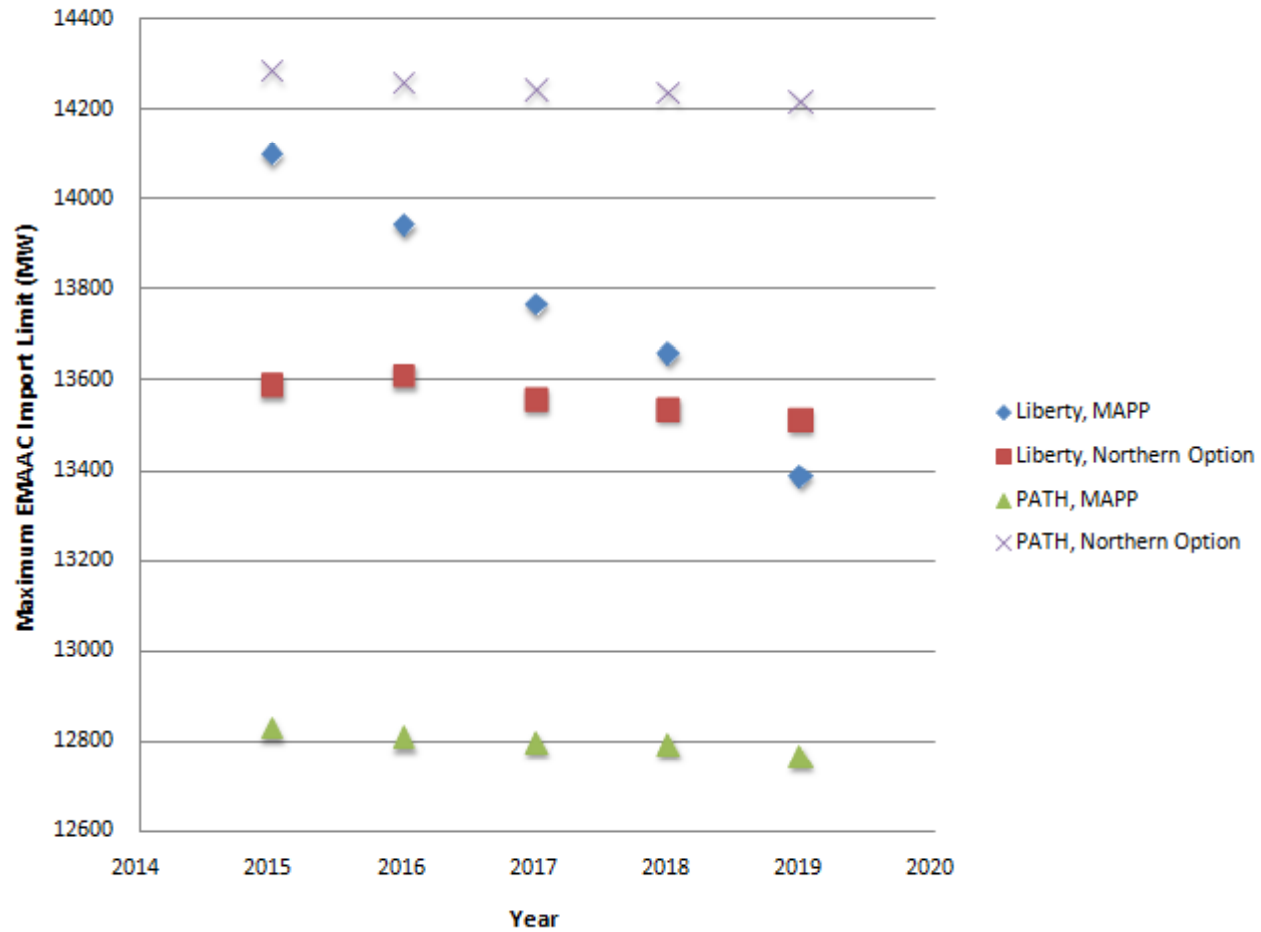


# EMAAC Alternative Side by Side Comparison

	Mileage			States	Cost
	Existing ROW	New ROW	Total		
MAPP	105	55*	160	MD, DE, VA (less than 1/2 mile)	\$1.20 B
Northern Route (Kemptown)	30.5	94.7	125	MD, PA, DE, NJ	\$1.15 B - \$1.46 B

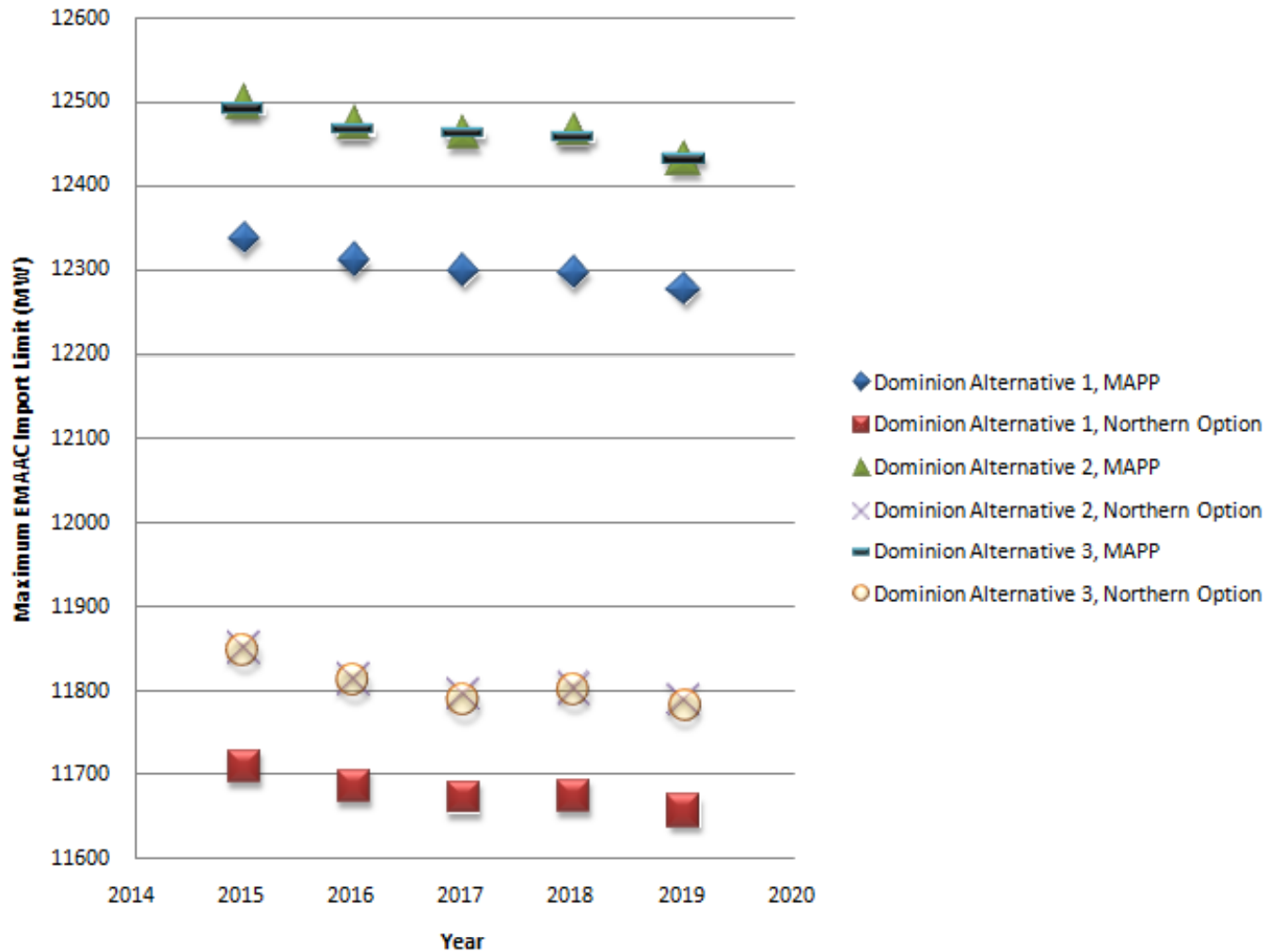
\* agreements in place for entire 55 miles, 39 miles is underwater

## EMAAC Alternative Comparison



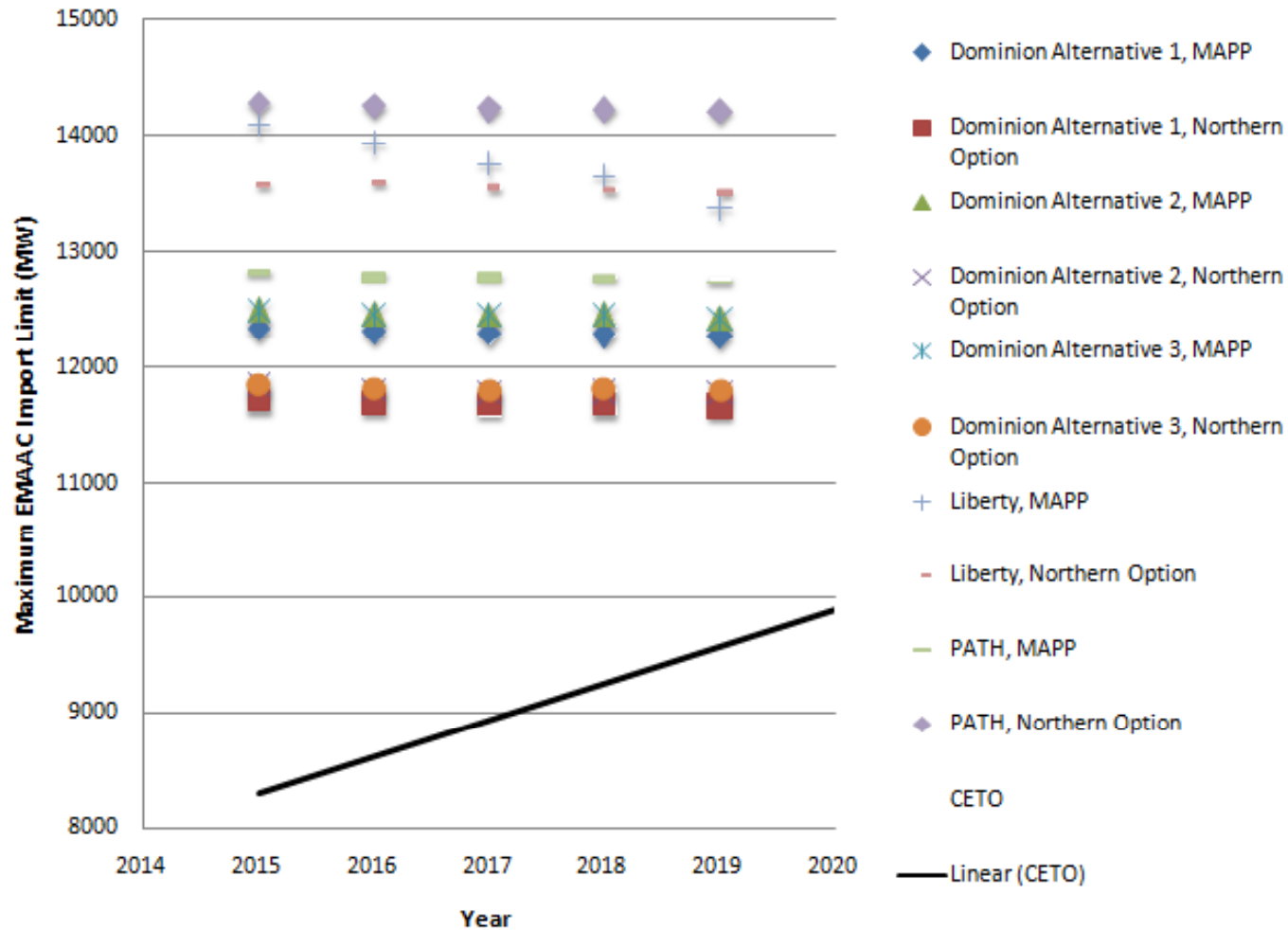
\* All EMAAC alternatives assume additional reactive support

## EMAAC Alternative Comparison



\* All EMAAC alternatives assume additional reactive support

## EMAAC Alternative Comparison



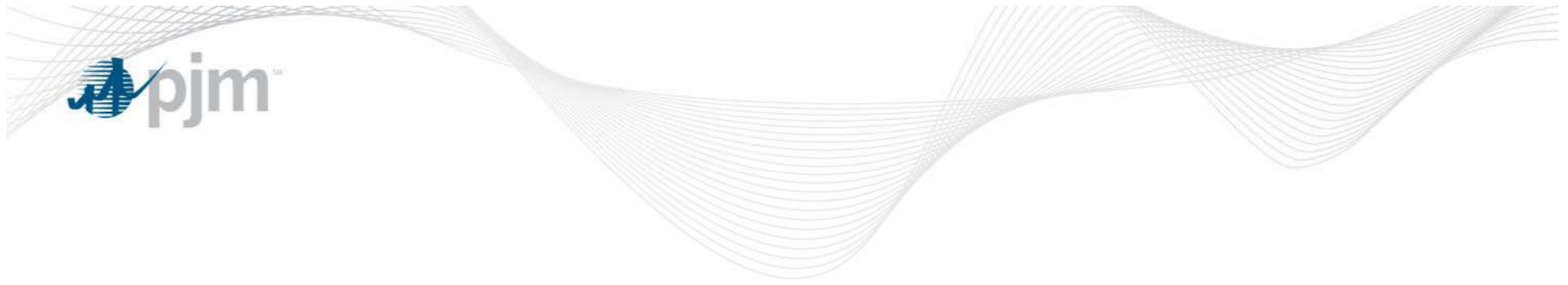
\* All EMAAC alternatives assume additional reactive support



- Both alternatives solve the EMAAC voltage issues through 2019
- The Northern Option is less robust than MAPP without a strong source into Kempton
- Finalize Northern Alternative conceptual study
- More detailed side by side comparison
- Remaining analysis

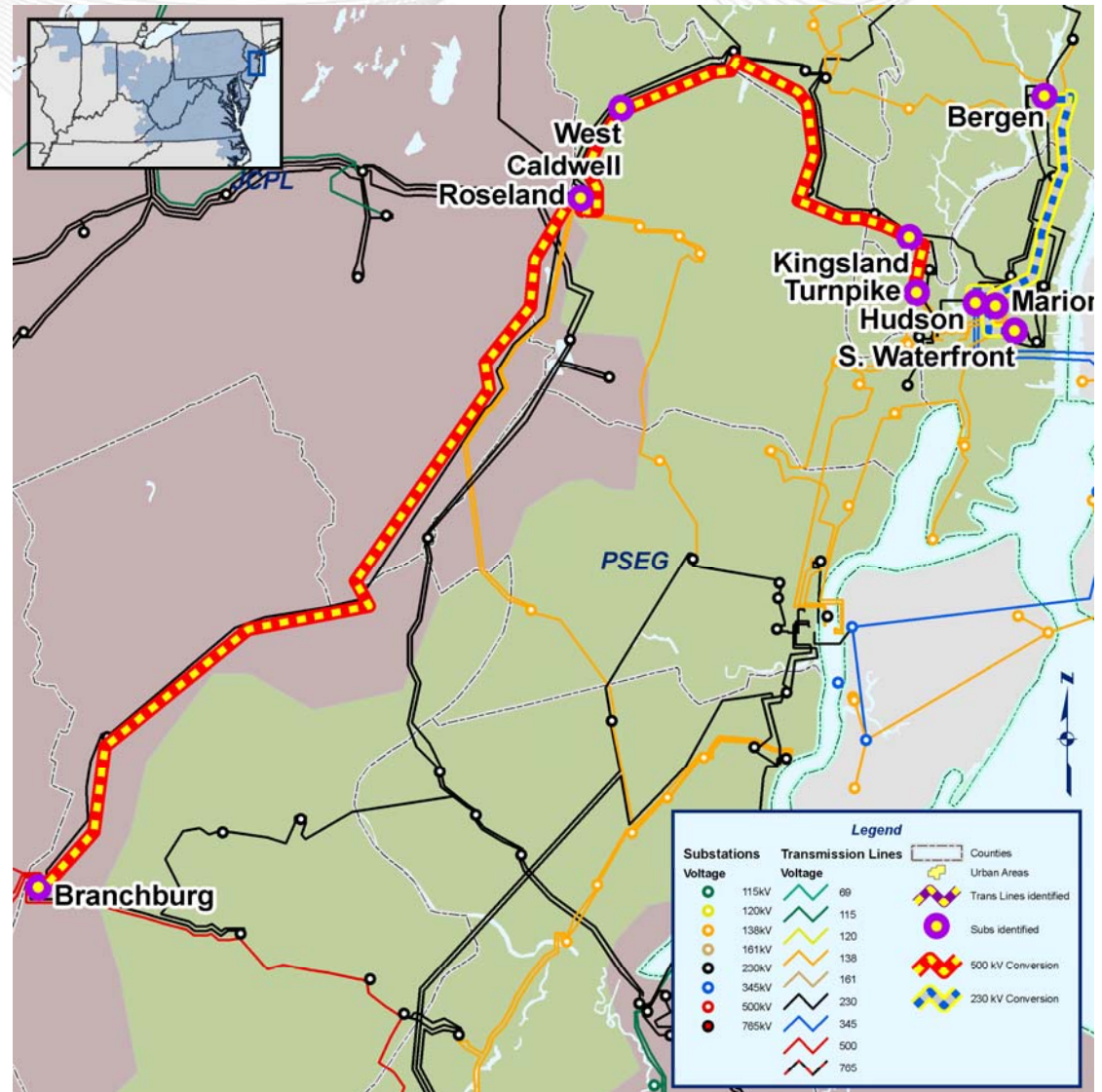


# Baseline Reliability Update



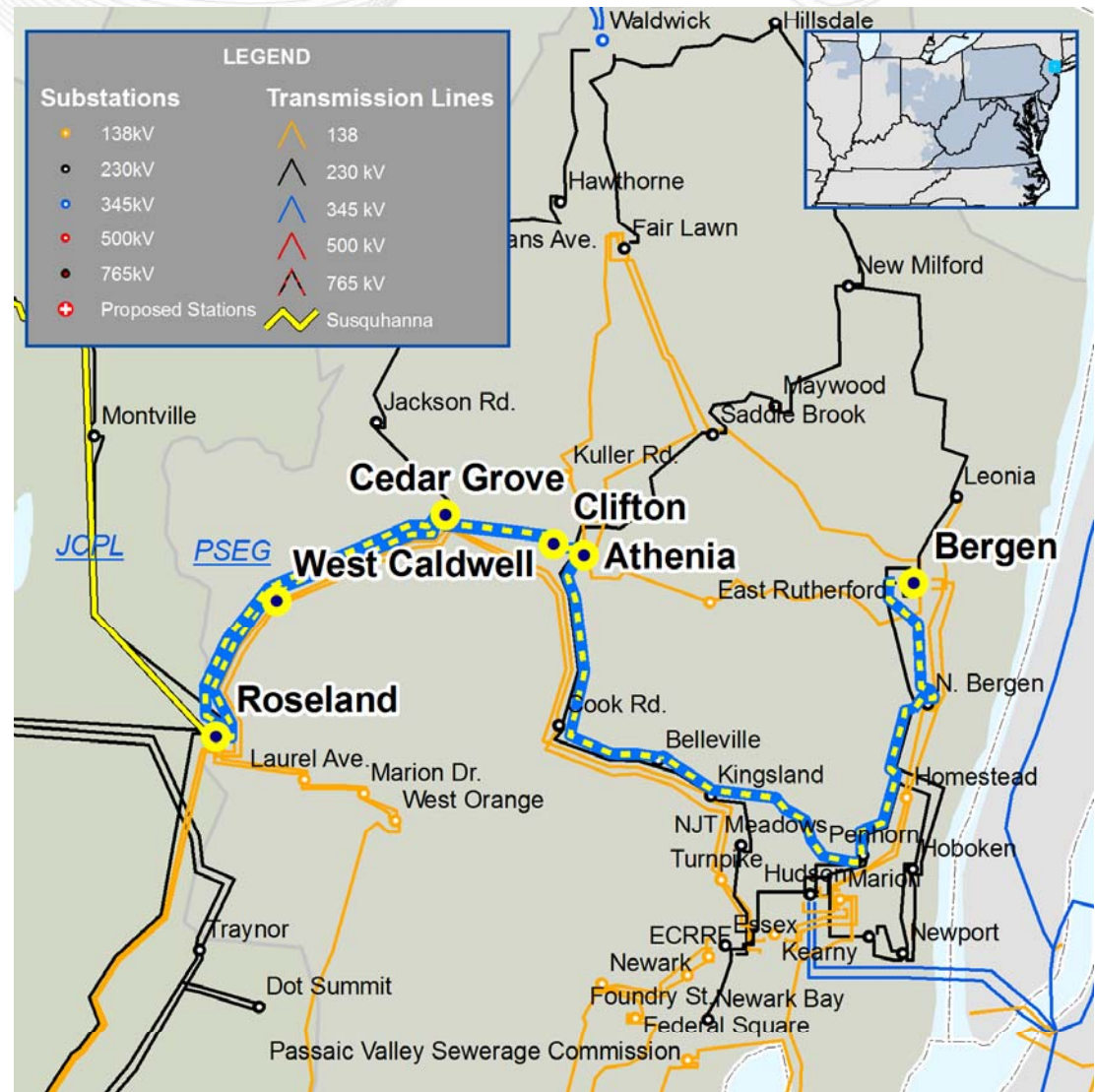
# BRH Alternatives

- Branchburg – Roseland – Hudson
- 2008 RTEP identified several overloads in northern PS starting in 2013
- Updated analysis completed as part of this year's RTEP shows fewer violations
- PJM currently evaluating below 500 kV alternative solutions

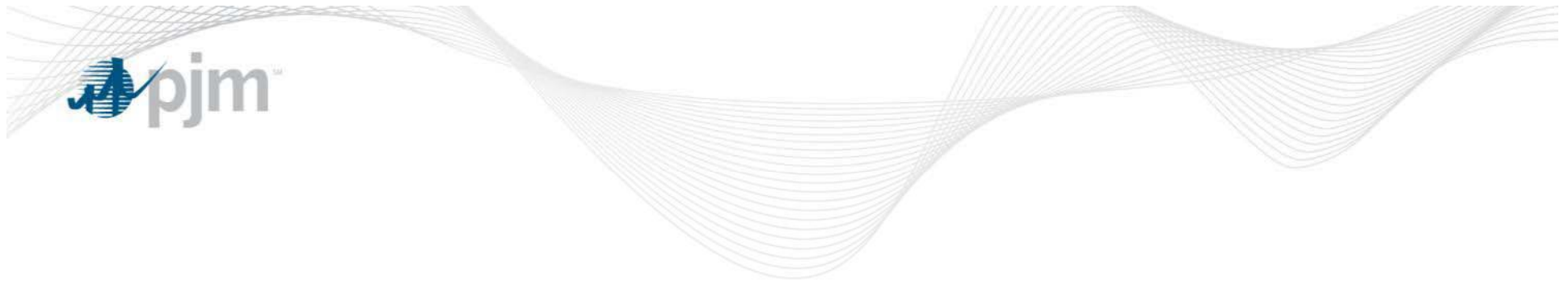


# 2015 PSEG Reliability Criteria Violations

- Generator Deliverability, Load Deliverability (PS and PSNorth), N-1-1
- Branchburg – Roseland – Hudson not modeled in 2015 case
- Reliability Violations (Thermal)
  - Roseland – Cedar Grove “F” circuit
  - Cedar Grove – Clifton “K”
  - Roseland – Cedar Grove “B” circuit
  - Cedar Grove – Clifton “B”
  - Clifton – Athenia “K”
  - Roseland – W. Caldwell
  - Athenia – Bergen 230 kV

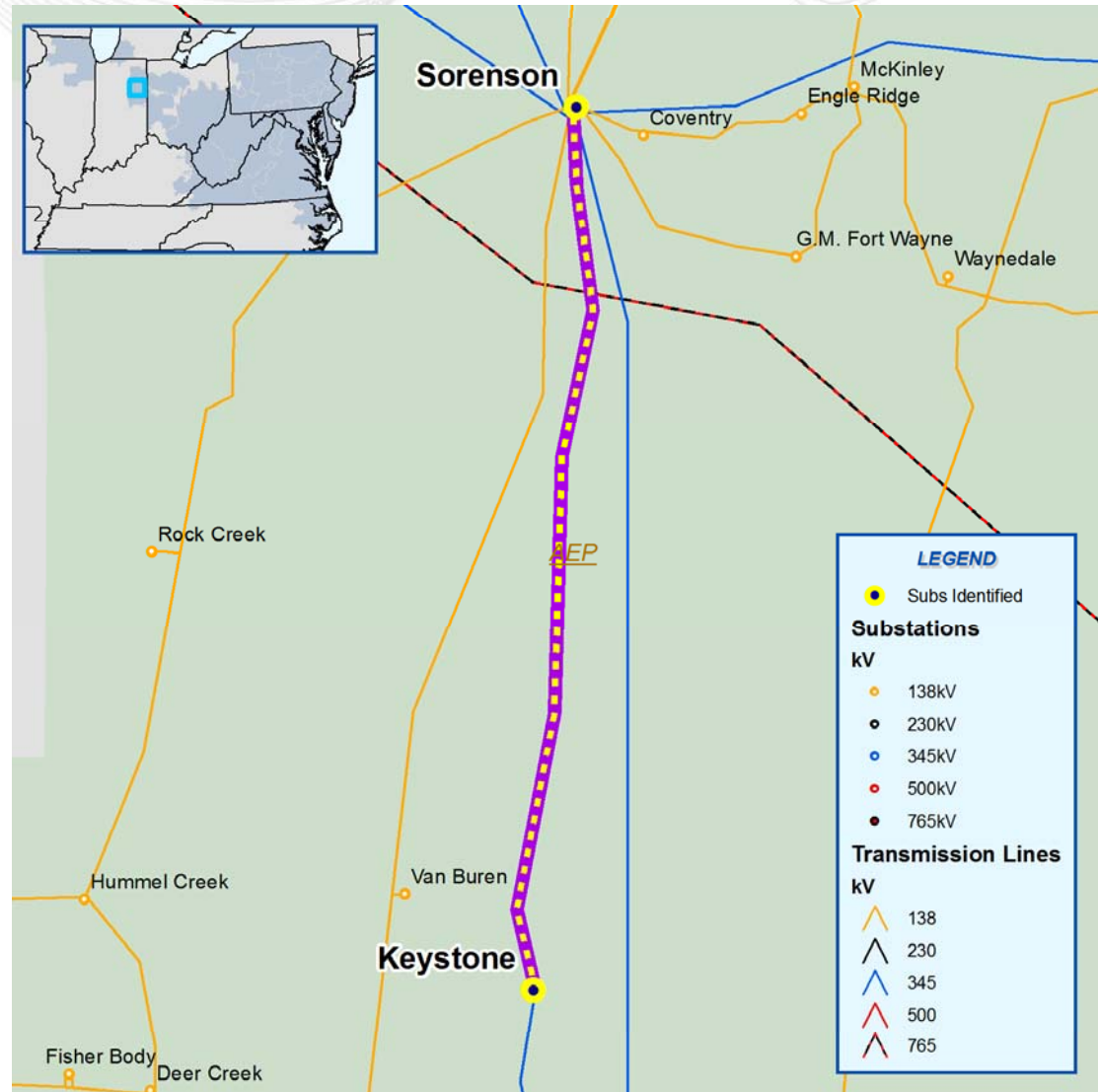


- Potential Alternative
  - Convert the existing two 138 kV circuits between Roseland – Kearny – Hudson to 230 kV operation
  - Expand existing Bergen 230 kV substation and build new underground cable from Bergen to Athenia
  
- Analysis underway



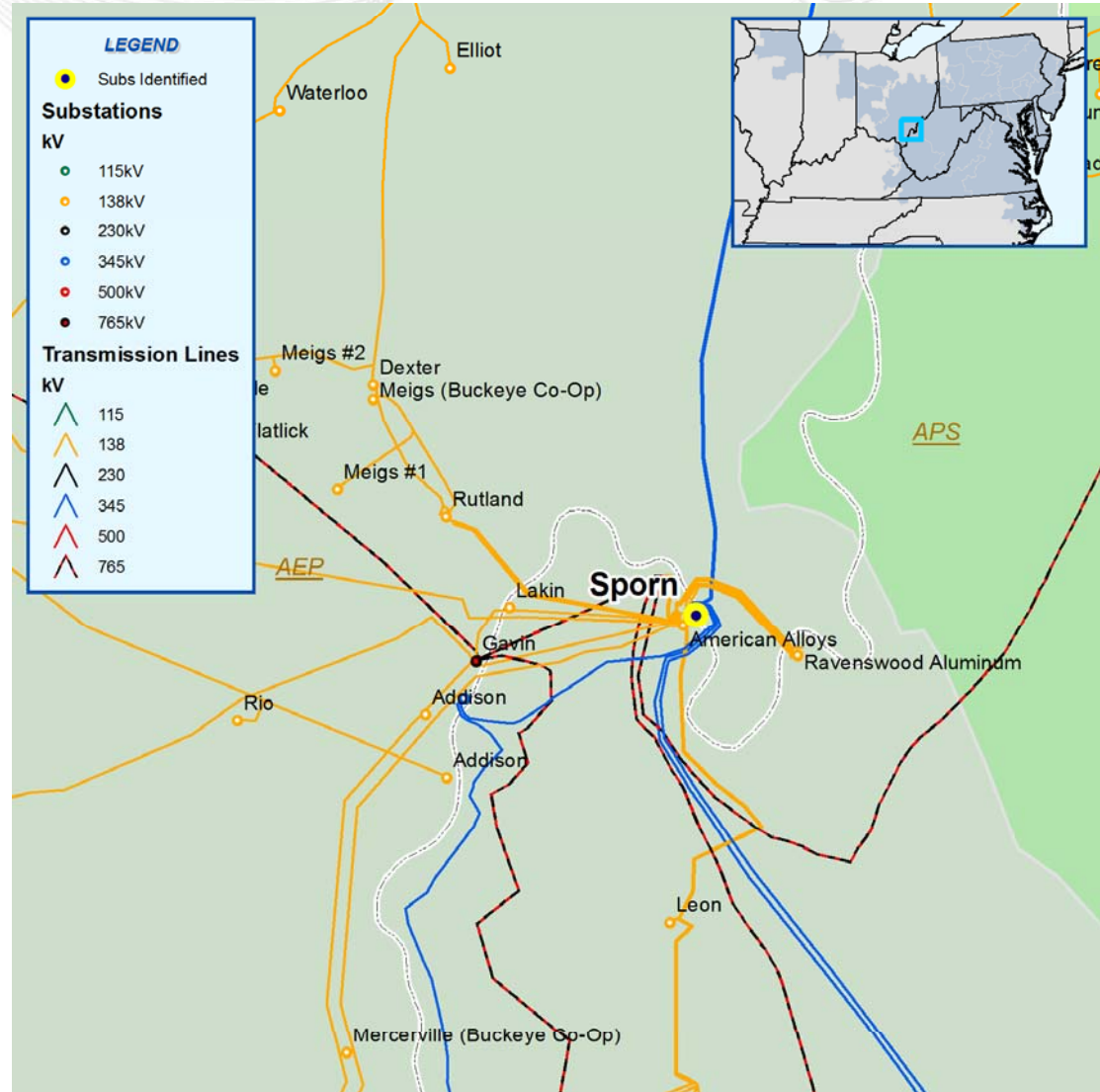
# Preliminary 2015 Solutions

- Potential N-1-1 Thermal Violation
- Keystone – Sorenson 345 kV is overloaded for the loss of Greentown - Jefferson 765 kV and the loss of Desoto - Sorenson 345 kV
- Potential Solution: A sag study will be required to potentially increase the emergency rating and determine if additional action is required in order to increase the rating
- Preliminary Estimated Project Cost: \$0.1012 M
- Estimated IS Date: 6/1/2015

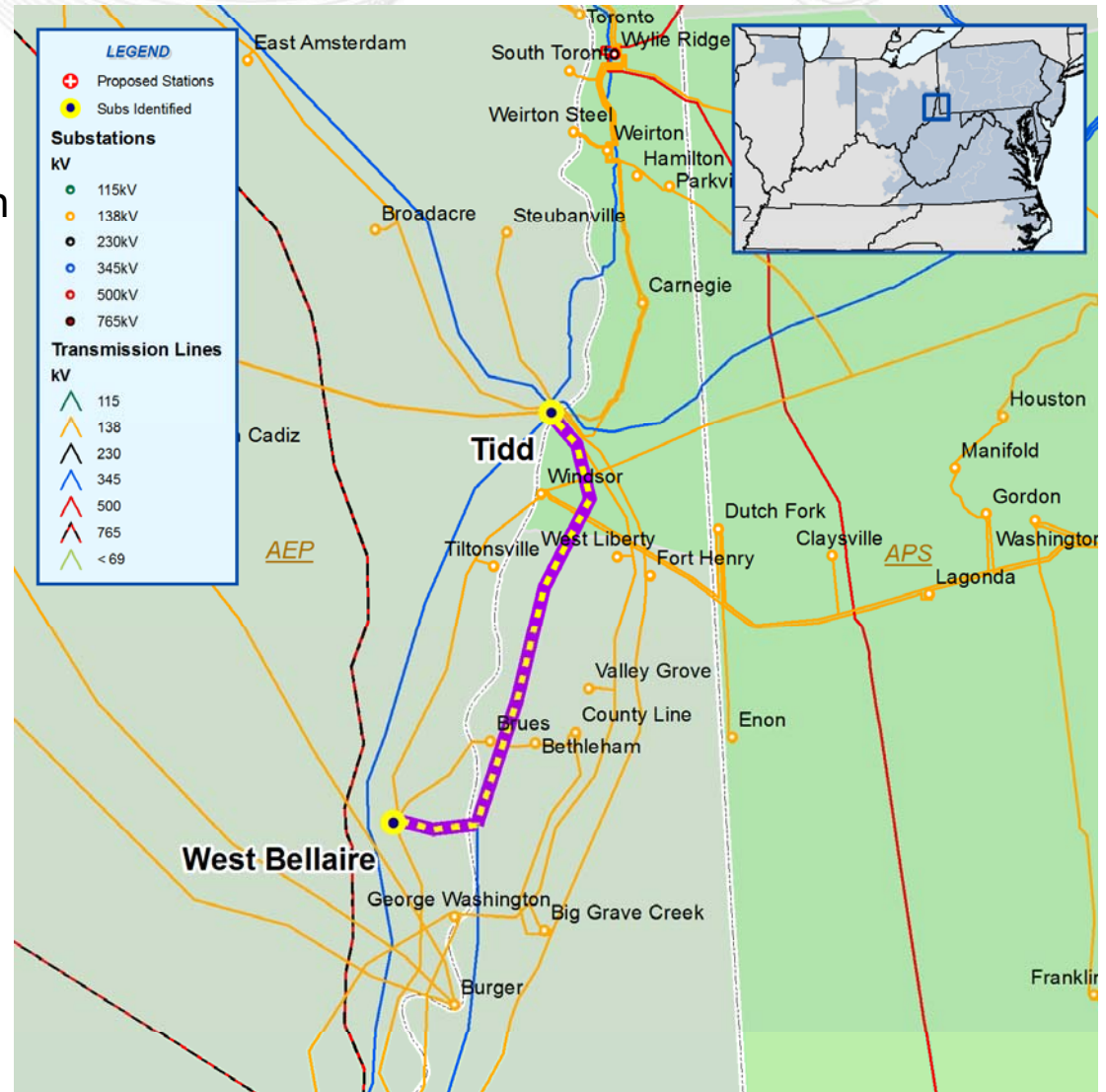




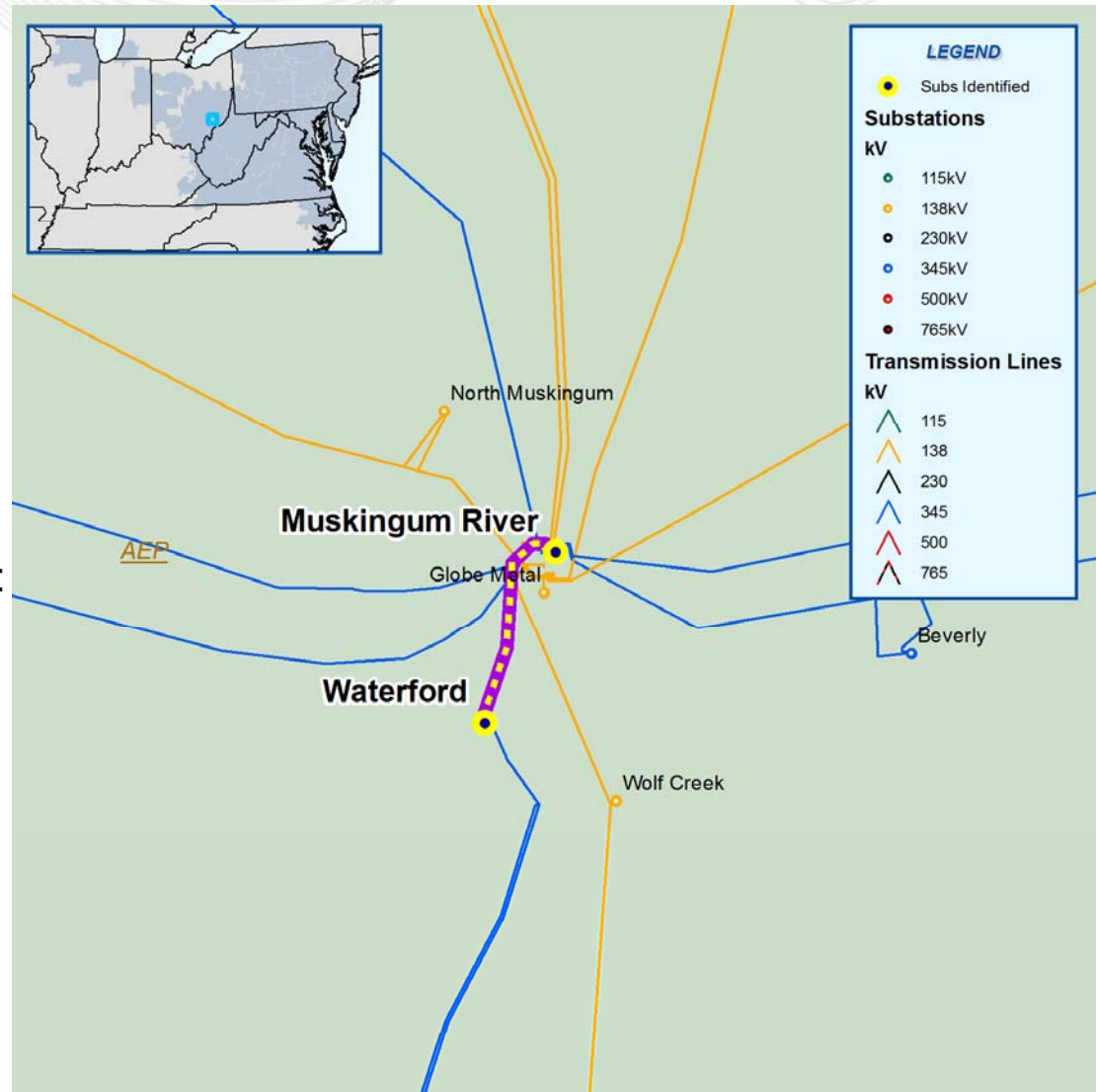
- Potential Generator Deliverability Violation
- N42 Tap - Sporn 345 kV is overload for the loss of Muskingum River – Waterford 345 kV
- Potential Solution: Replace the riser at the Sporn station to increase the thermal rating
- Preliminary Estimated Project Cost: \$0.3 M
- Estimated IS Date: 6/1/2015



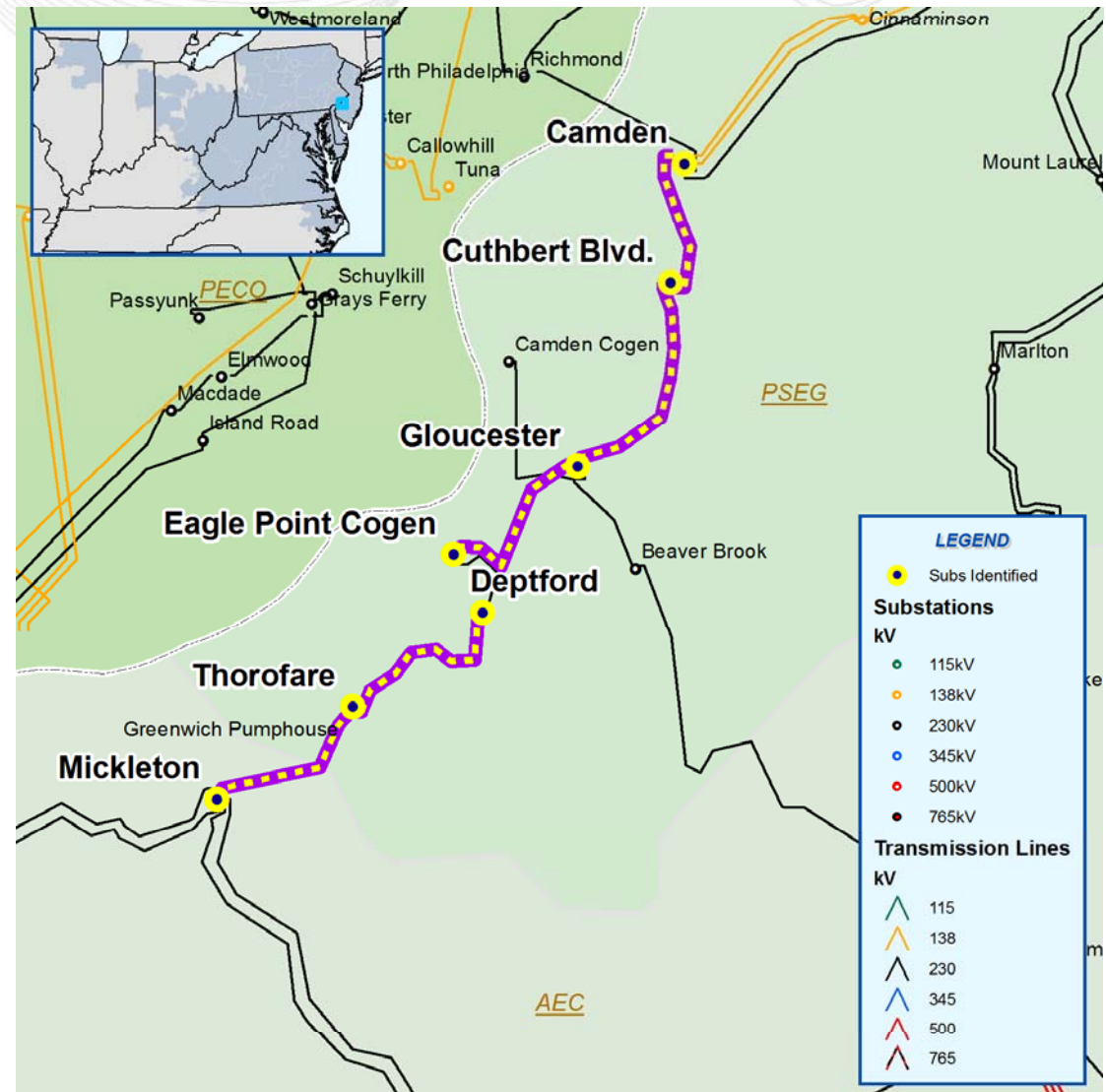
- Potential Common Mode Outage Violation
- West Bellaire – Tidd 345KV is overloaded for a Kammer – South Canton 765 kV line fault with a stuck breaker at Kammer
- Potential Solution: Tidd - West Bellaire 345 kV would need an electrical clearance study to determine if a higher emergency rating can be utilized
- Preliminary Estimated Project Cost : \$0.078 M
- Estimated IS Date: 6/1/2015

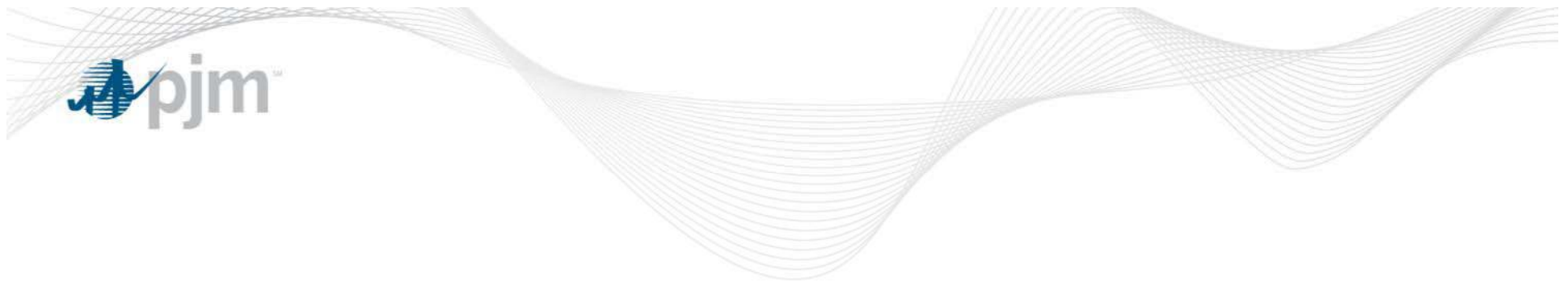


- Potential Generator Deliverability Violation
- Waterford – Muskingum River 345kV is overloaded in the base case and for the loss of Kammer - Belmont – Mountaineer 765 kV
- Potential Solution: Reconductor Waterford – Muskingum 345 kV (5 miles) with ACSR and upgrade Muskingum risers
- Preliminary Estimated Project Cost: \$14 M
- Estimated IS Date : 6/1/2015



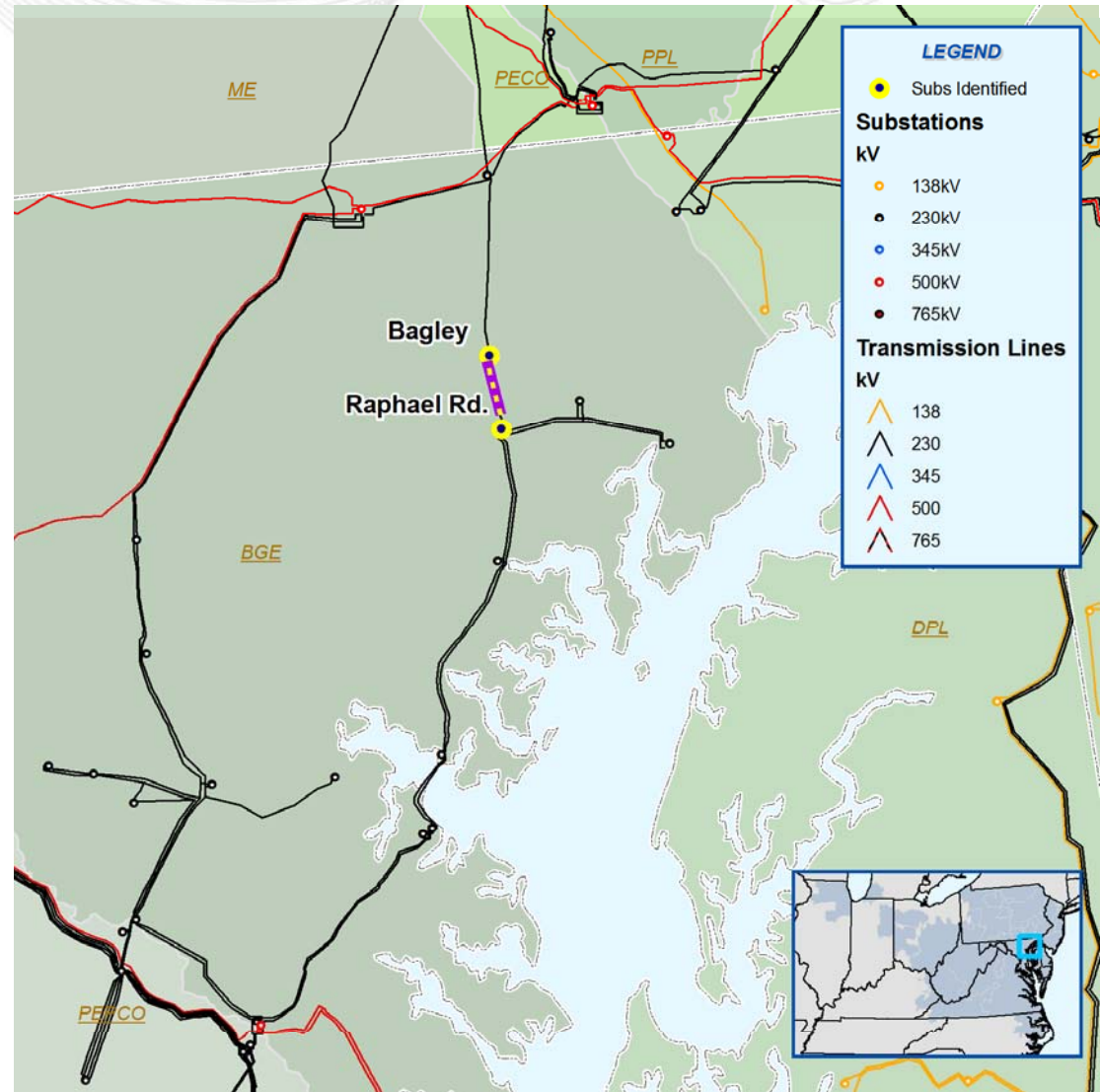
- PSE&G Violations:
- The following 230 kV circuits in PSE&G area are overloaded for several contingencies.
  - Gloucester – Cuthbert
  - Cuthbert – Camden
  - Eagle Point – Gloucester
  - Thorofare – Deptford
  - Mickleton – Thorofare
- Potential Solution:
  - Build two new underground 230 kV circuits from Gloucester to Camden and install shunt reactor at Gloucester
  - Build a new parallel overhead 230 kV circuit from Gloucester – Eagle Point – Thorofare – Mickleton and reconductor the existing Gloucester – Eagle Point – Deptford - Thorofare – Mickleton 230 kV circuit



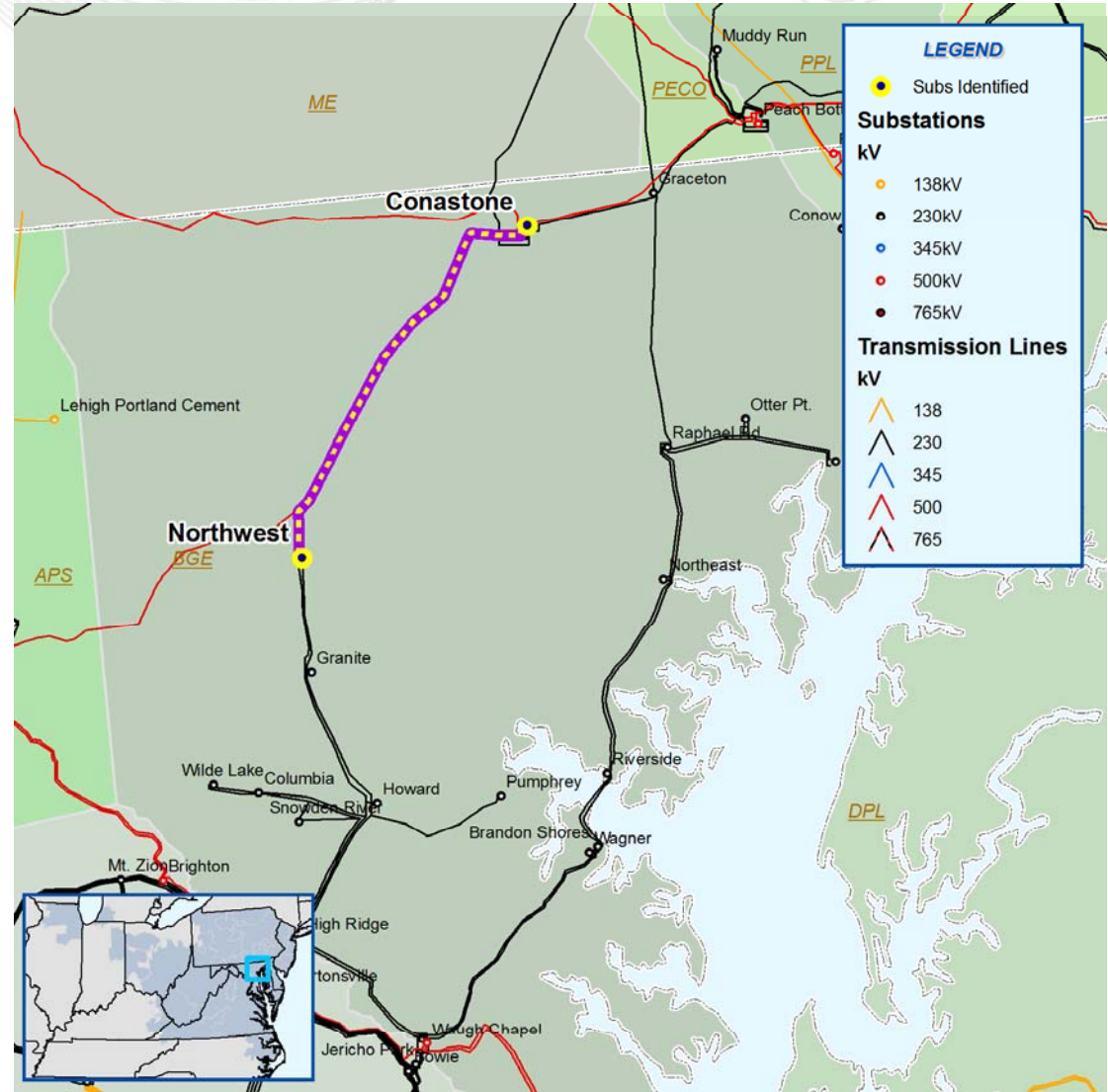


# 2015 Analysis Update

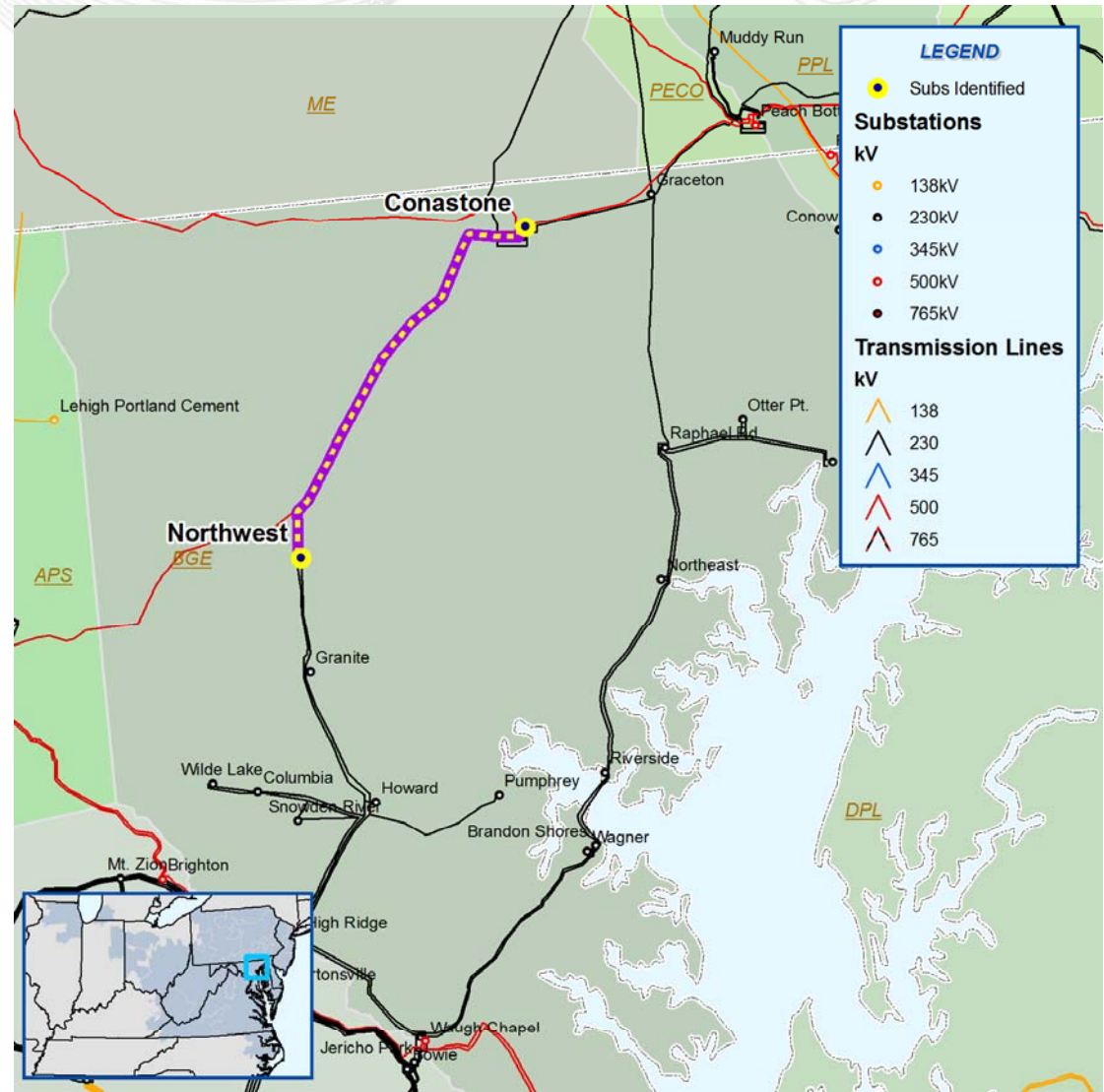
- Common Mode Outage Procedure
- The Bagley – Raphael 230 kV circuit is overloaded for the loss of the Conastone – Northwest 230 kV double circuit tower contingency
- Recommended Solution: Rebuild the existing Bagley – Raphael Road 230 kV line to a double circuit 230 kV line (B2051) and reconfigure Raphael Road to terminate the new circuit (B2051.1)
- Estimated Project Cost: \$30 M
- Expected IS Date: 6/1/2015



- **Baseline Voltage Violation**
  - The loss of the Conastone – Northwest 230 kV double circuit tower contingency causes a voltage collapse
  
- **N-1-1 Thermal Violation**
  - The Northwest – Conastone 230 kV circuit ‘2322’ has a violation of the normal rating for the loss of the Northwest – Conastone 230 kV circuit ‘2310’
  
- **Generation Deliverability**
  - The Conastone – Northwest 230 kV circuit is overloaded for the loss of the Brighton – Doubs and Brighton – Conastone 500 kV double tower contingency

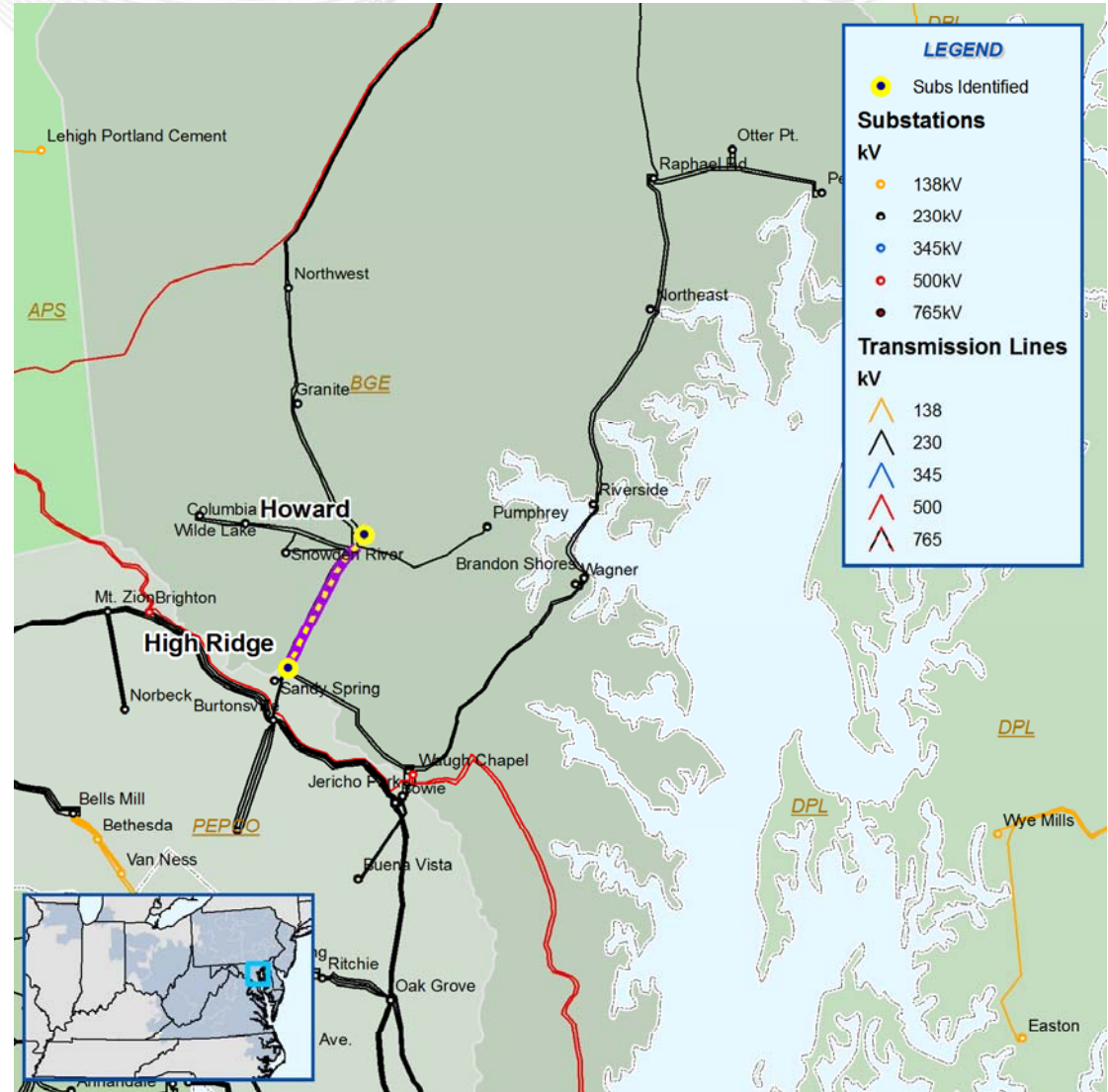


- Recommended Solution:  
Construct 500/230 kV Emory Grove station with a 500 kV double breaker configuration by tapping the Conastone–Brighton 500 kV, Conastone – Northwest 230 kV and rebuild Emory Grove to the Northwest circuits to separate pole-lines with bundled conductor (B2054)
- Estimated Project Cost:  
\$71 M
- Expected IS Date:  
6/1/2015

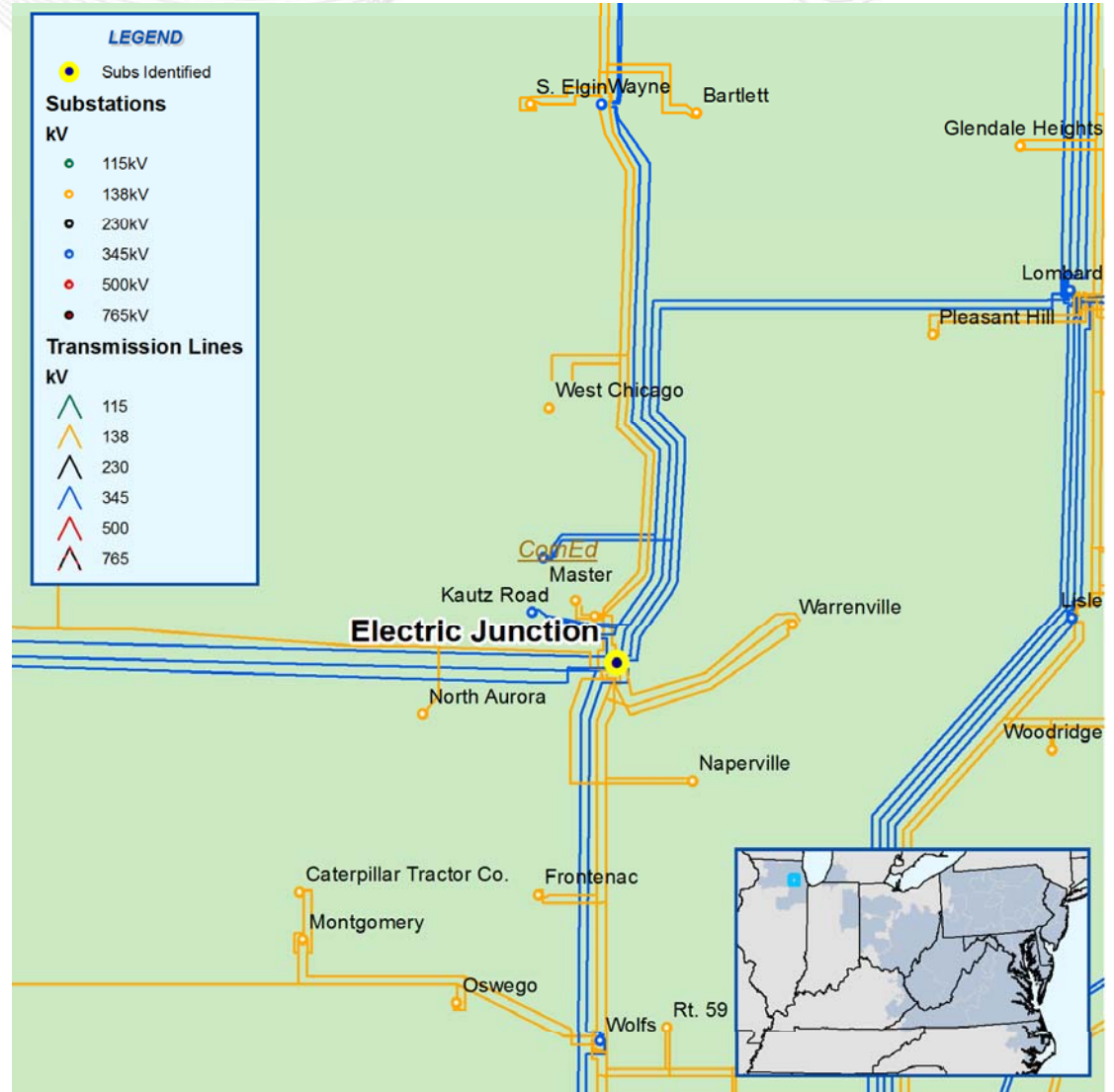




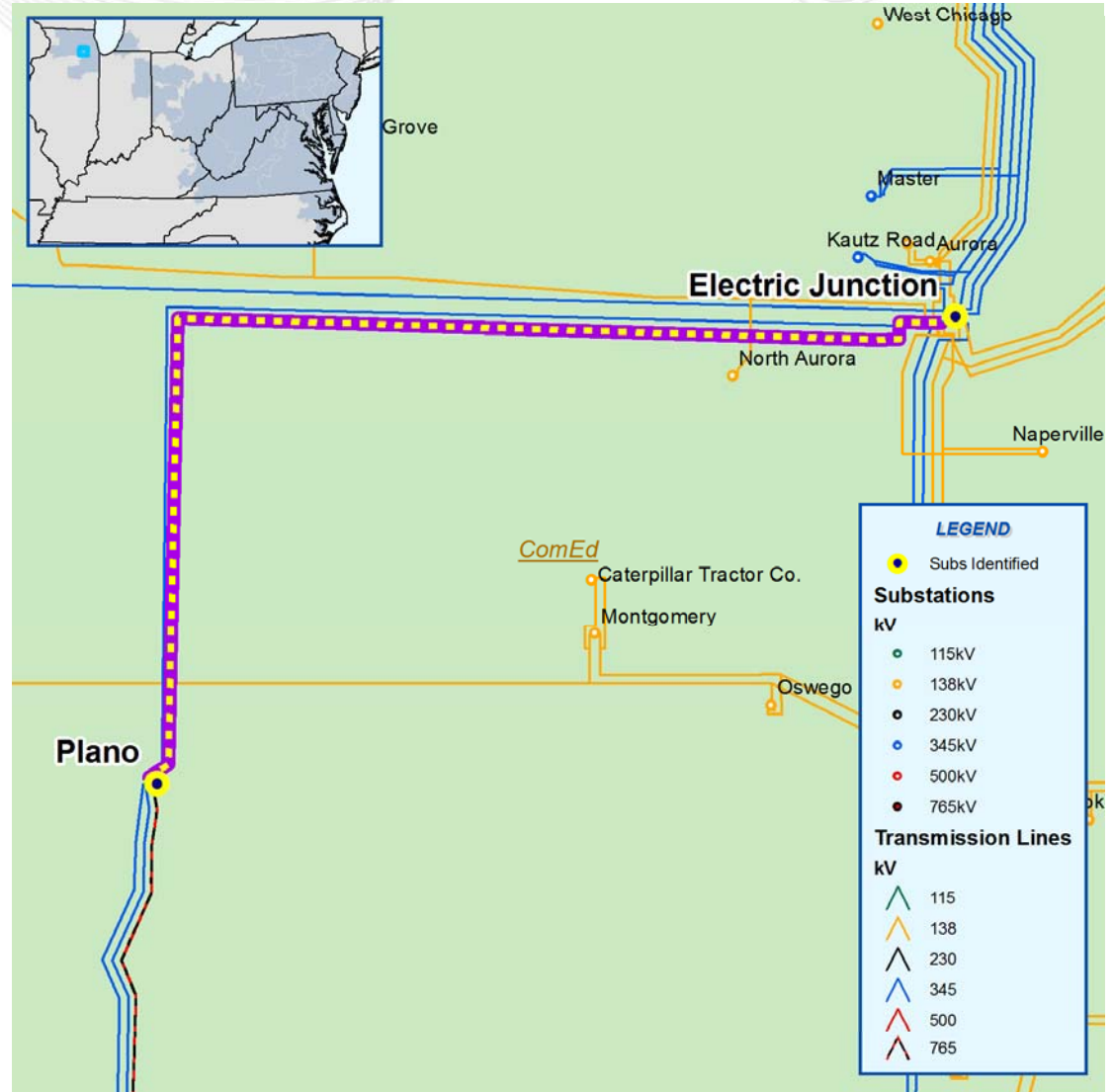
- Baseline NERC Category C Thermal Violation
- The High Ridge – Howard 230 kV circuit is overloaded for the loss of the Conastone – Northwest 230 kV double circuit tower contingency
- Recommended Solution: Replace terminal equipment at Pumphrey tap 230 kV (B2052)
- Estimated Project Cost: \$0.1 M
- Expected IS Date: 6/1/2015



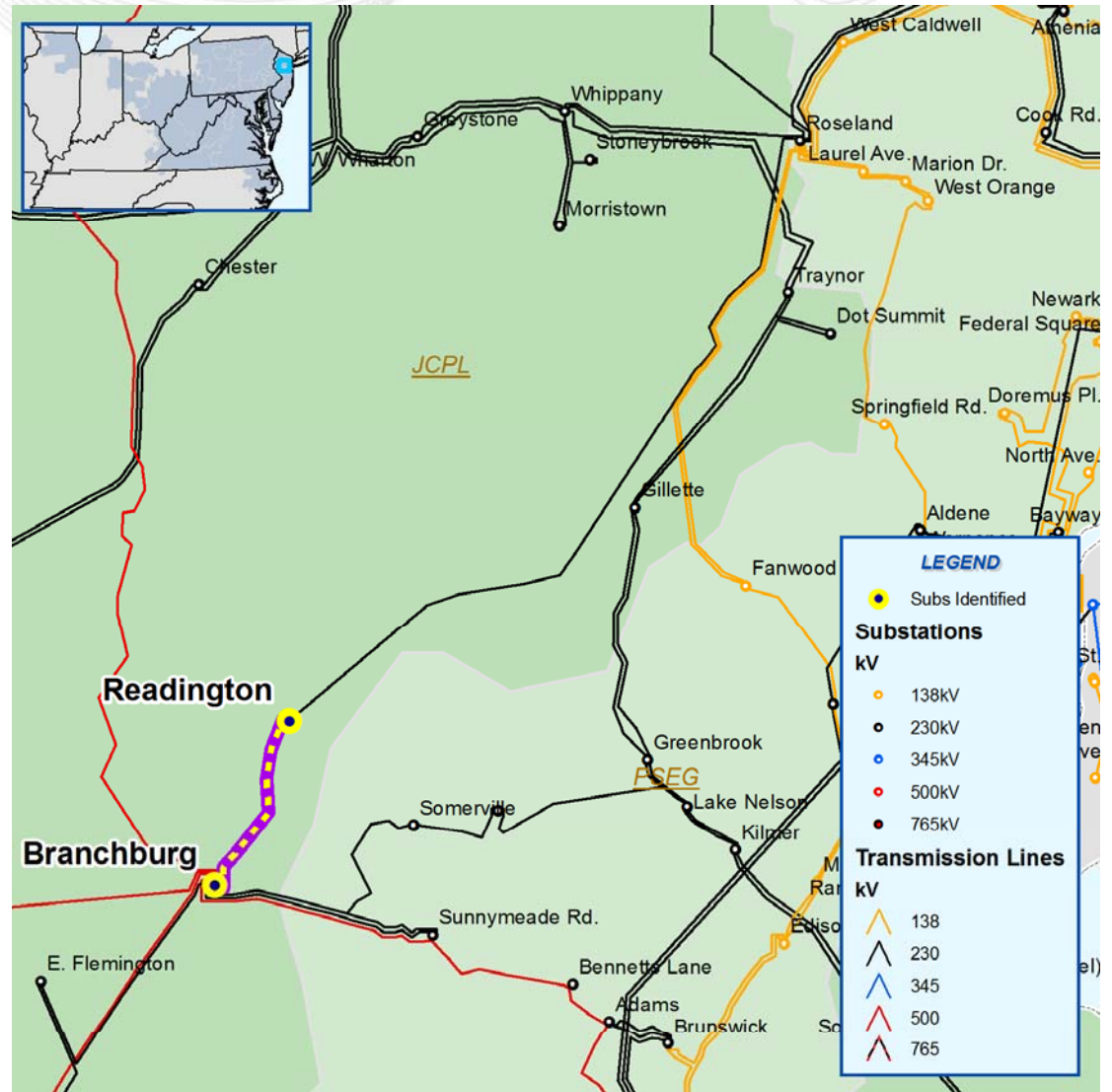
- Common Mode Outage Violation
- Electric Junction 345/138 kV Transformer and related 345 kV and 138 kV terminal lines at Electric Junction overloaded for loss of Electric Junction 345 kV bus 3 or bus tie 3-4
- Recommended Solution: Move line 16703 termination from bus 4 to bus 3 at Electric Junction
- Estimated Project Cost: \$3.0 M
- Expected IS Date: 6/1/2015



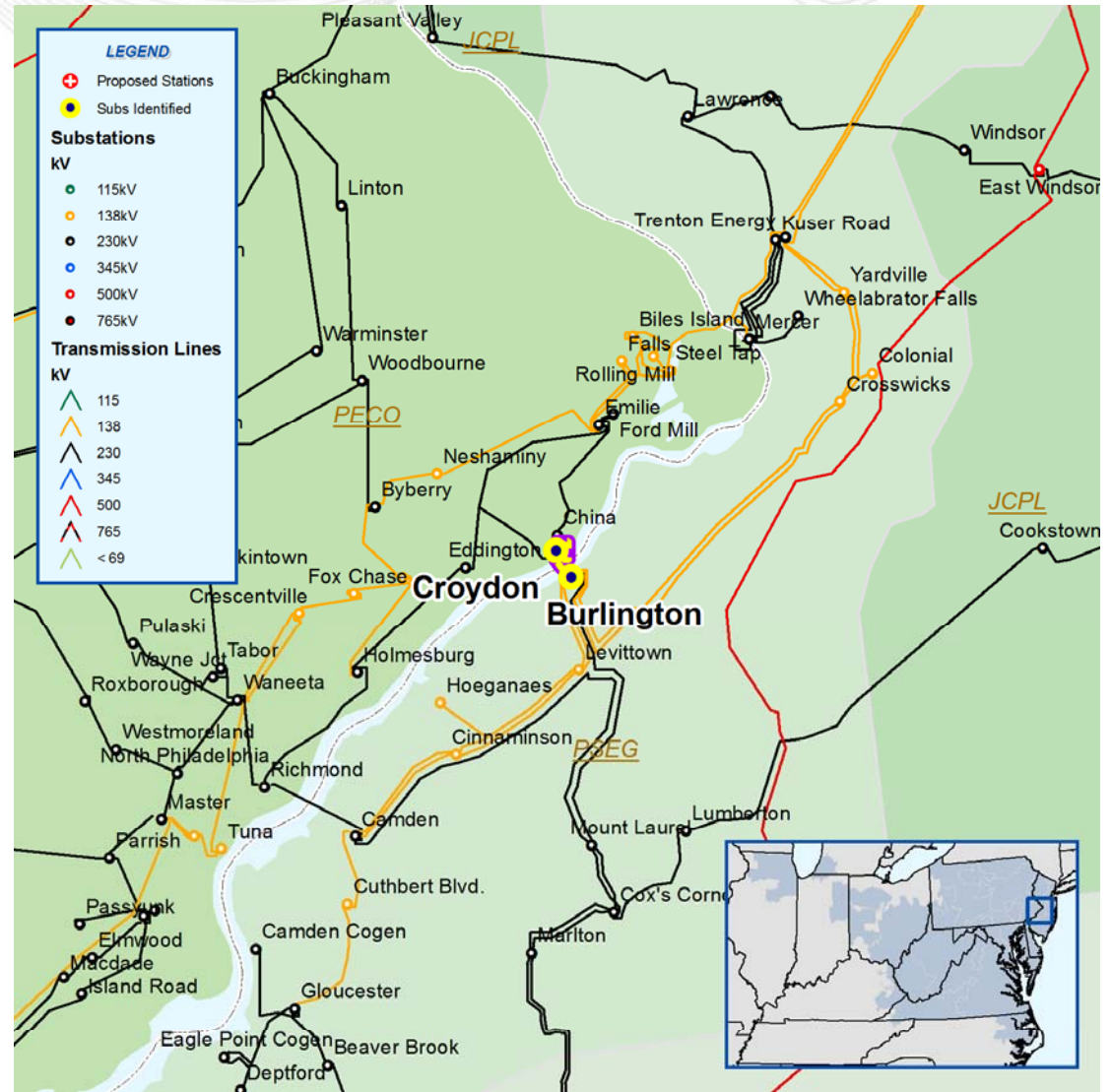
- Generator Deliverability violation
- Plano – Electric Junction 345 kV (line 16703) is overloaded for the loss of Plano – Electric Junction 345 kV (line 16704)
- Recommended Solution: Replace 345 kV bus ties 1-2 and 1-9 at Plano to increase rating on line 16703
- Estimated Project Cost: \$2.0 M
- Expected IS Date: 6/1/2015

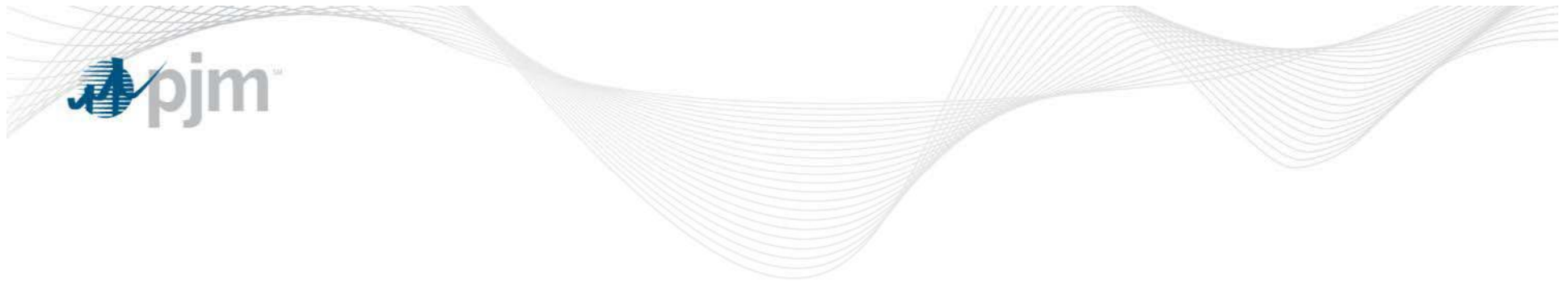


- PSEG Load Deliverability Violation
- Branchburg – Readington 230 kV circuit is overloaded for the loss of the Whippany – Roseland 230 kV circuit.
- Recommended Solution: Upgrade terminal equipment at Readington (substation conductor) (B0423.1).
- Estimated Project Cost: \$0.10M
- Expected IS Date: 6/01/2011



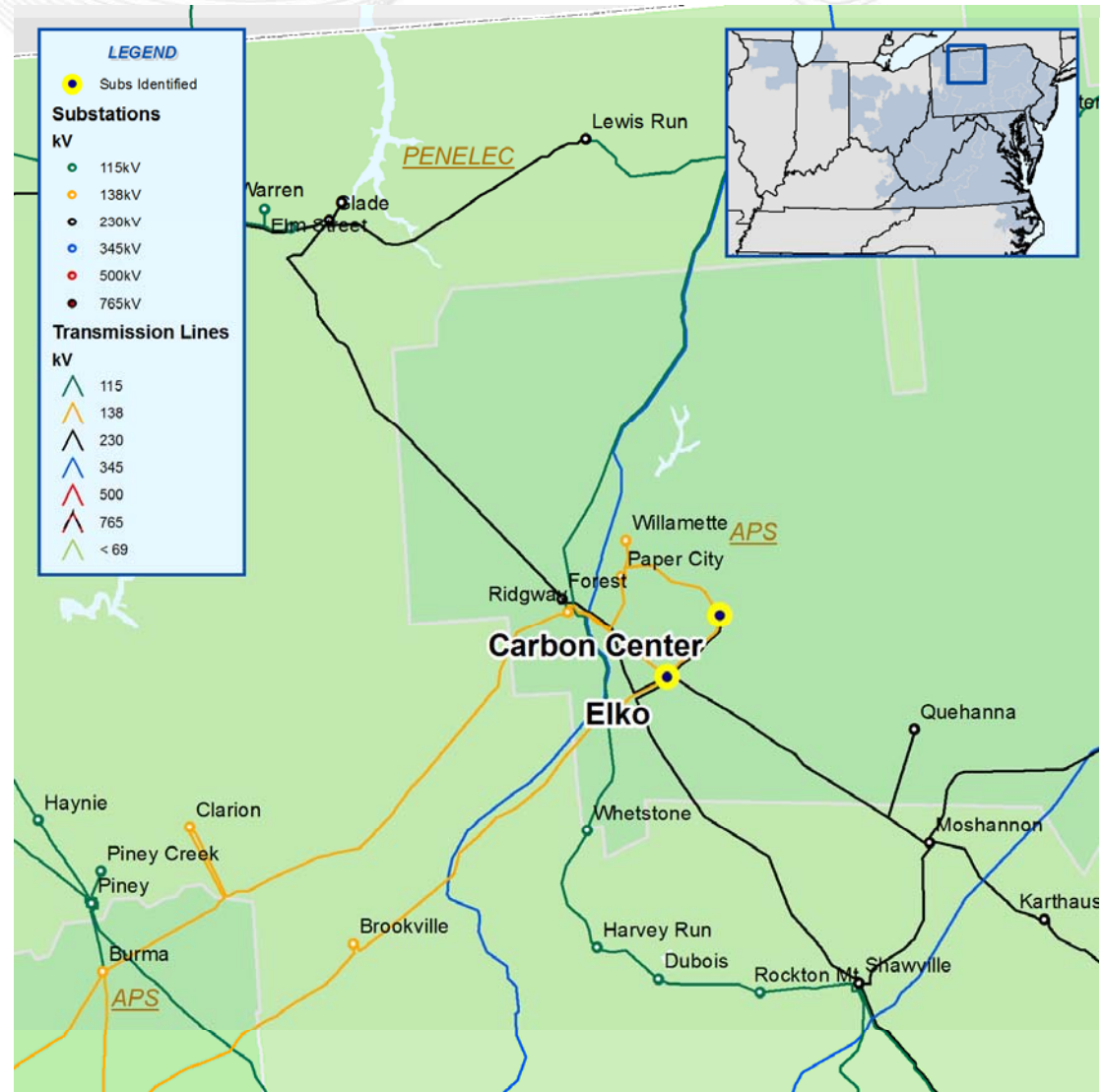
- Generation Deliverability
- Burlington – Croydon 230 kV is overloaded for several contingencies
- Recommended Solution: Reconductor the PSEG portion of the Burlington – Croydon circuit with 1590 ACSS (B1197.1)
- Estimated Project Cost: \$3.0 M
- Expected IS Date: 6/1/2015

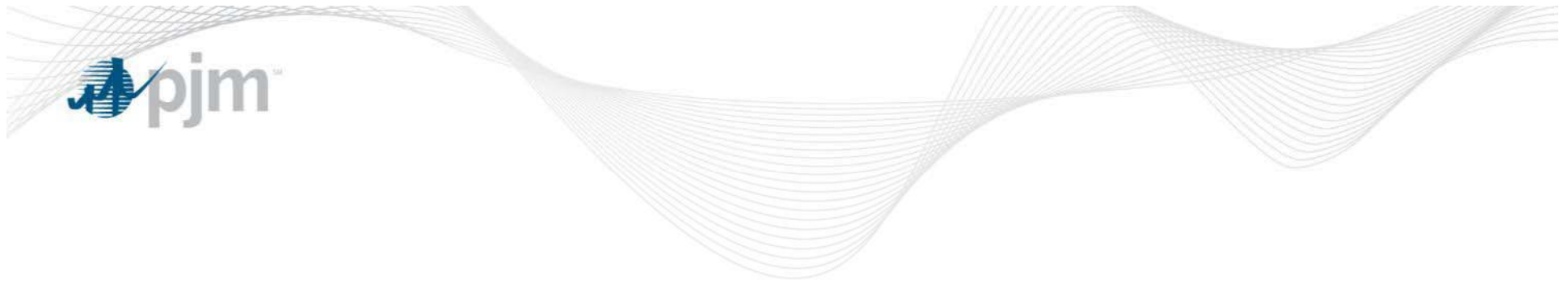




# 2014 Baseline Retool Update

- Baseline Voltage Violation
- Voltage collapse for several stuck breaker contingencies at Elko and Carbon Center
- Recommended Solution:
  - Convert Carbon Center from 138 kV to a 230 kV ring bus (B2021.1)
  - Estimated Project Cost - \$2.0M
  - Construct Bear Run 230 kV Substation with 230/138 kV transformer (B2021.2)
  - Estimated Project Cost - \$6.0M
  - Loop Carbon Center Junction – Willamette line into Bear Run (B2021.3)
  - Estimated Project Cost - \$3.2M
  - Carbon Center - Carbon Center Junction & Carbon Center Junction - Bear Run Conversion from 138 kV to 230 kV (B2021.4)
  - Estimated Project Cost - \$4.3M
- Total Estimated Project Cost: \$15.5M
- Expected IS Date: 6/1/2014

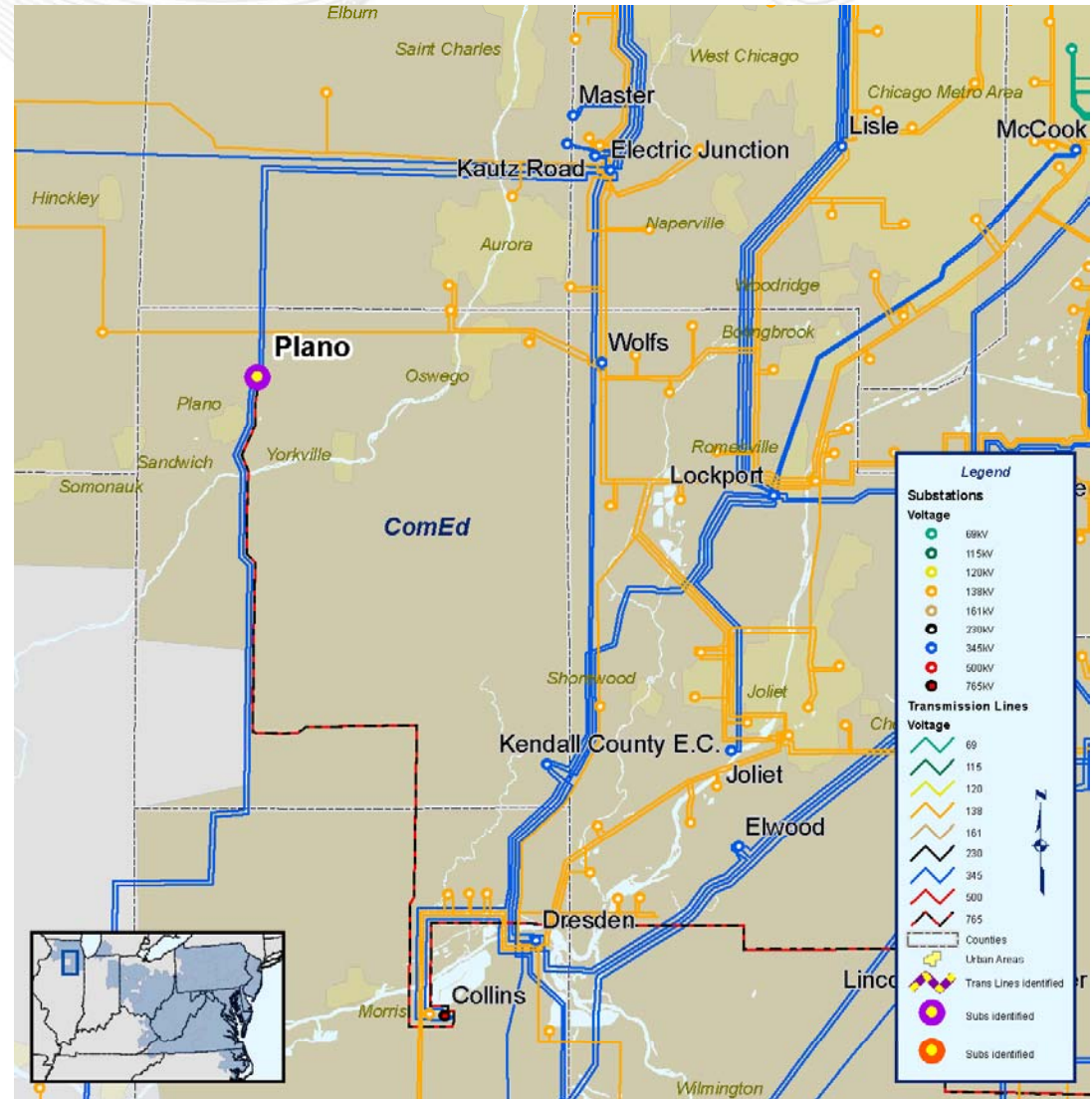




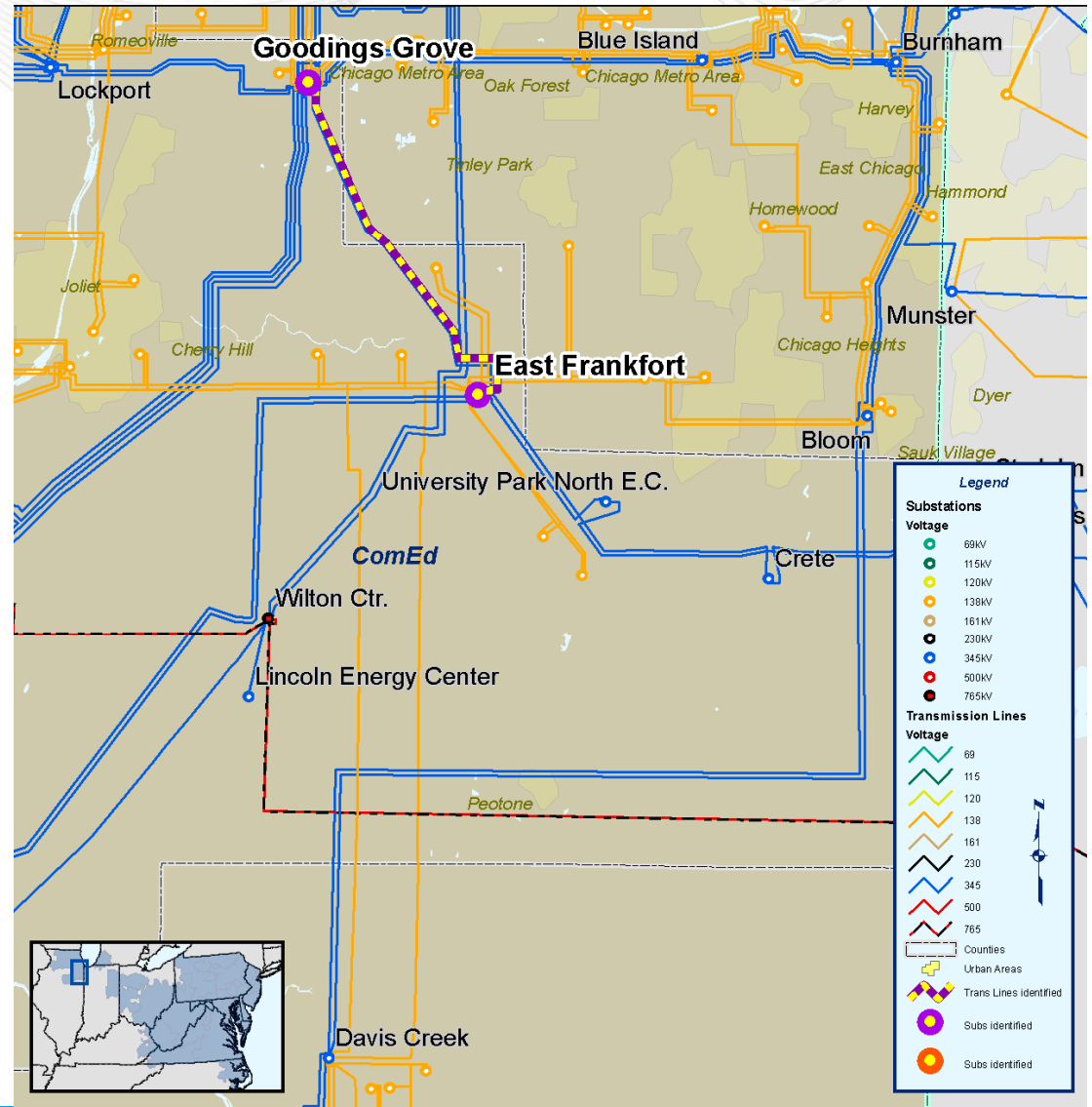
# 2013 Baseline Retool Update

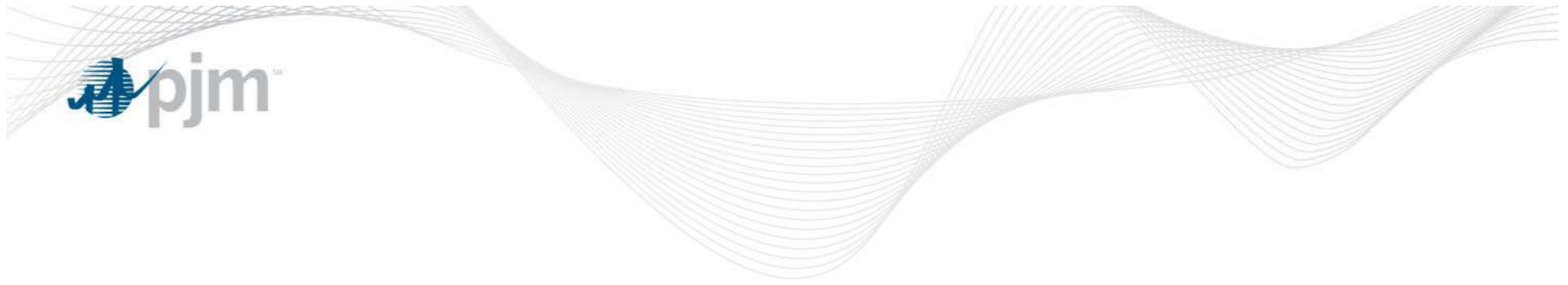


- B0661 : Install a Plano 345/138 kV Transformer
- 2013 retool analysis indicates that the in-service date can be deferred from 6/1/2013 to 6/1/2014



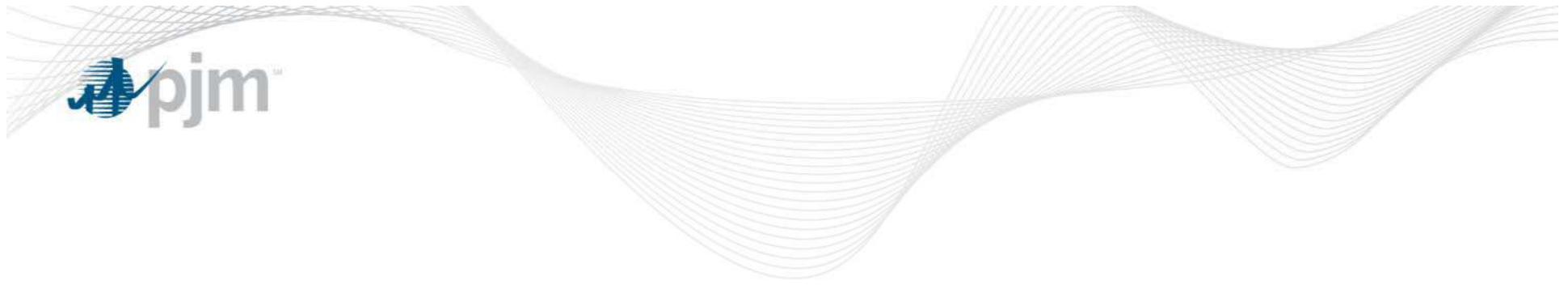
- B0663 : Reconductor East Frankfort - Goodings Grove 345 kV "Red"
- 2013 retool analysis indicates that the in-service date can be deferred from 6/1/2013 to 6/1/2014





# 2012 Baseline Retool Update

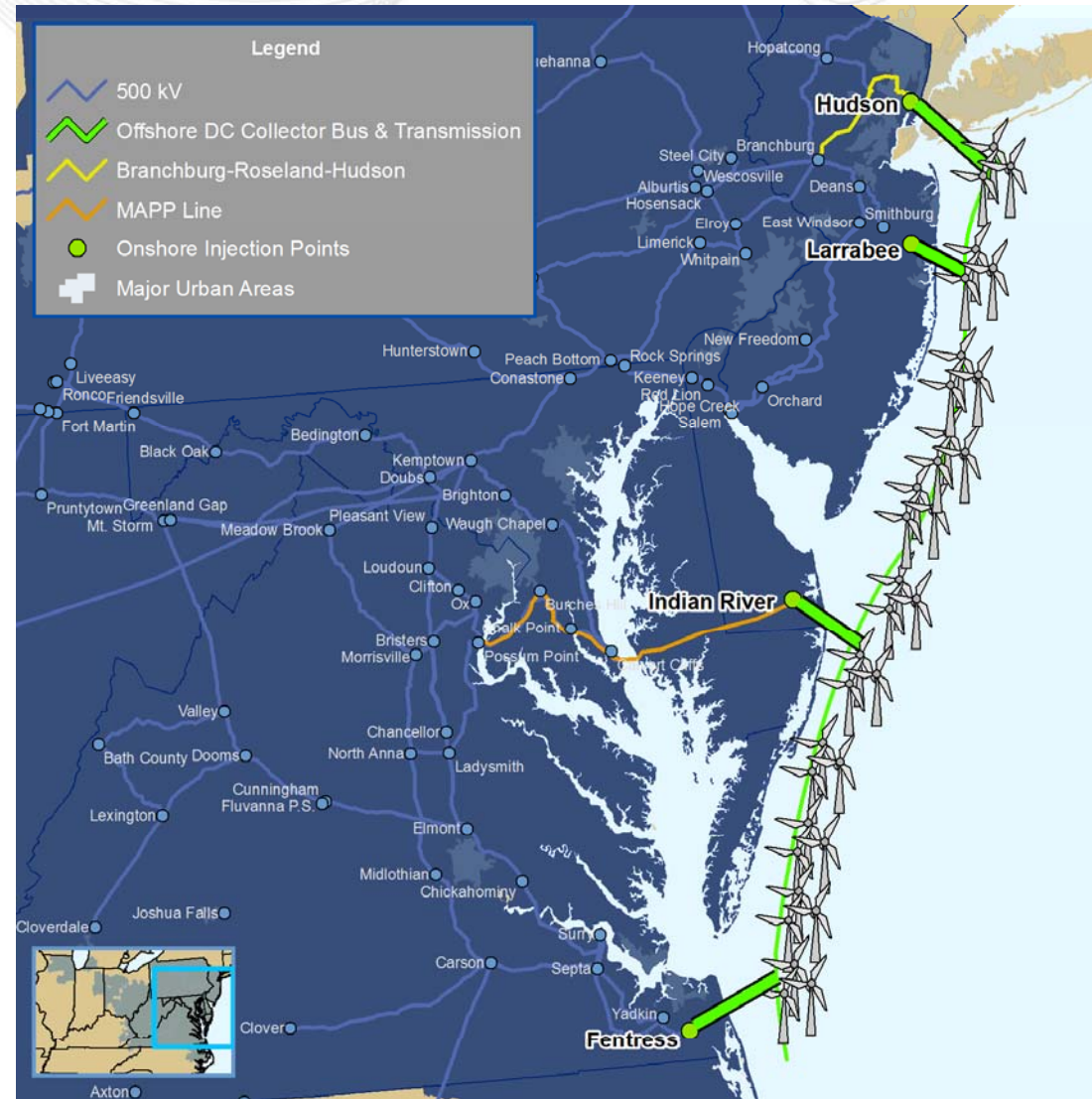
- 2012/2013 RPM First Incremental Auction Planning Parameters
  - To be posted later this week
- Additional RTEP study work



# Offshore Wind Study

- **Background**
  - Requested by the Organization of PJM States Inc. (OPSI)
- **Scope**
  - Evaluate the reliability and market efficiency of 10,000 MW of offshore wind
    - Reliability - Generator deliverability analysis
    - Market Efficiency - Promod production cost simulation
- **Timeline**
  - Initial results in early October 2010

- Develop study assumptions
- Develop and evaluate off-shore system configurations
- Evaluate and identify on-shore injection points (i.e. location and amount)
- Identify reinforcements that would be required to the existing system due to the injections
- Evaluate performance with respect to RPS requirements





# Next Steps





# Review Issues Tracking