Transmission Expansion Advisory Committee

Reliability Analysis Update

September 10, 2015

Reliability Analysis Update

High Voltage in PJM Operations

High Voltage in PJM Operations - Overview

- In PJM Operations, the AEP transmission zone and northeastern Mid-Atlantic regions have experienced a large increase in high voltage warnings over the past year; Additionally, AEP has also experienced a large increase in reactor switching for both low and high voltage conditions

- There are several drivers that include changes in dispatch due to new and deactivated generation, reactive support deficiencies and increased line charging from new transmission facilities

- Conditions generally occur during light load periods

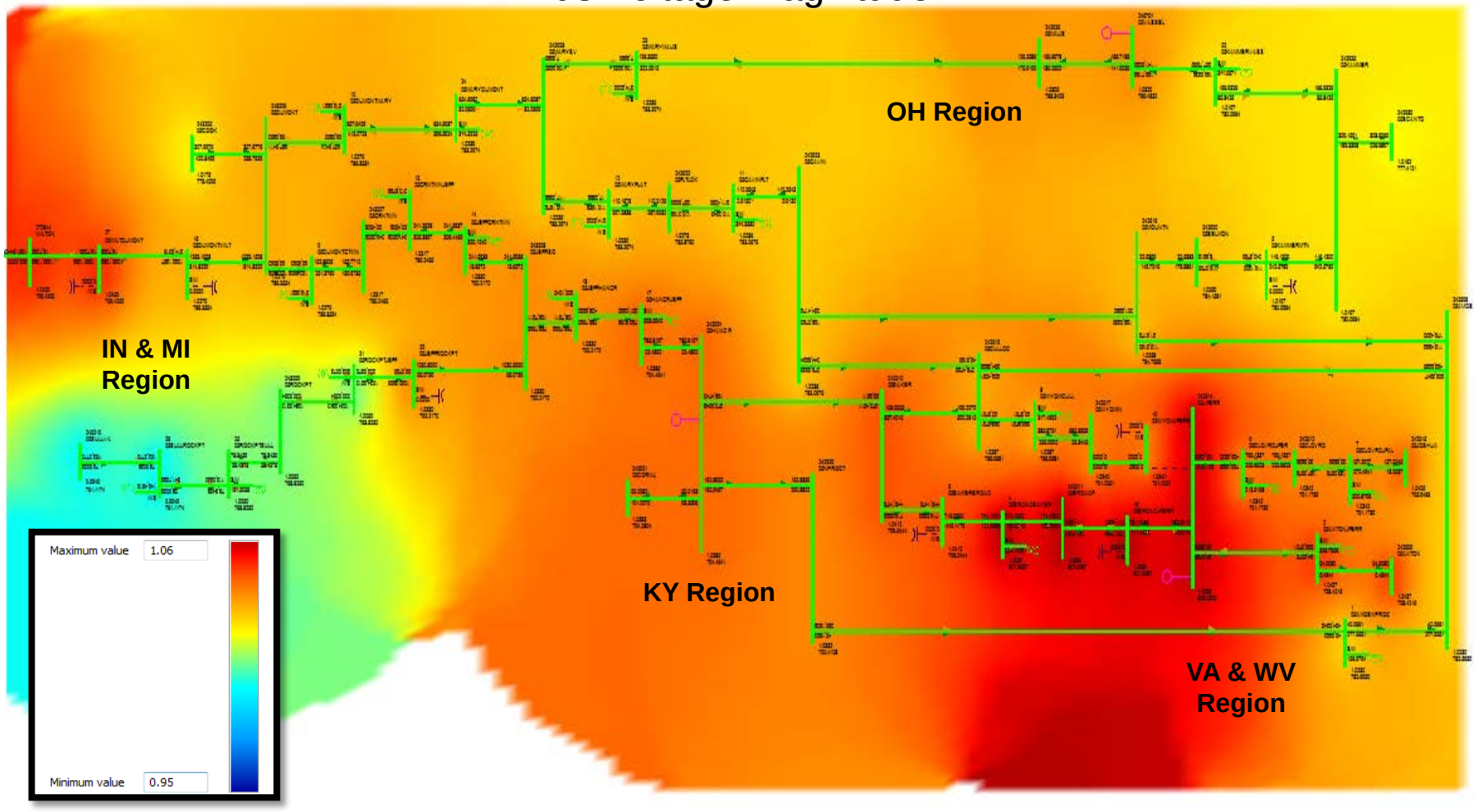
- Approved RTEP reactive devices planned to come online over the next several years will help lower the voltages to some extent, but anticipated generation deactivations and additional line charging from planned transmission facilities will further aggravate the problem

High Voltage in PJM Operations - AEP

- Large increase in number high voltage alarms over the past year
- Operating conditions have required 765 kV circuits to be taken out of service to manage high voltages
- Over 5,000 MW of deactivations in 2015
  - Large reduction in dynamic reactive support
- Large increase in amount of switching of existing reactors for both high and low voltage conditions resulting in multiple failed reactors and reduced life expectancy.
- Simulations demonstrate a potential solution of new SVCs and replenishment of the existing reactors and inclusion of circuit breakers for enhanced switching capability. The first component of this solution has been identified and will be proposed as an immediate need solution.

Simulation of Severe Operating Event in Fall 2014

Bus Voltage Magnitude



Southern AEP Transmission Zone High Voltages

Potential Immediate Need Reliability Solutions:

- Install a +/- 450 MVAR SVC at Jacksons Ferry 765 kV substation
- Install a 300 MVAR shunt line reactor on the Broadford end of the Broadford – Jacksons Ferry 765 kV line

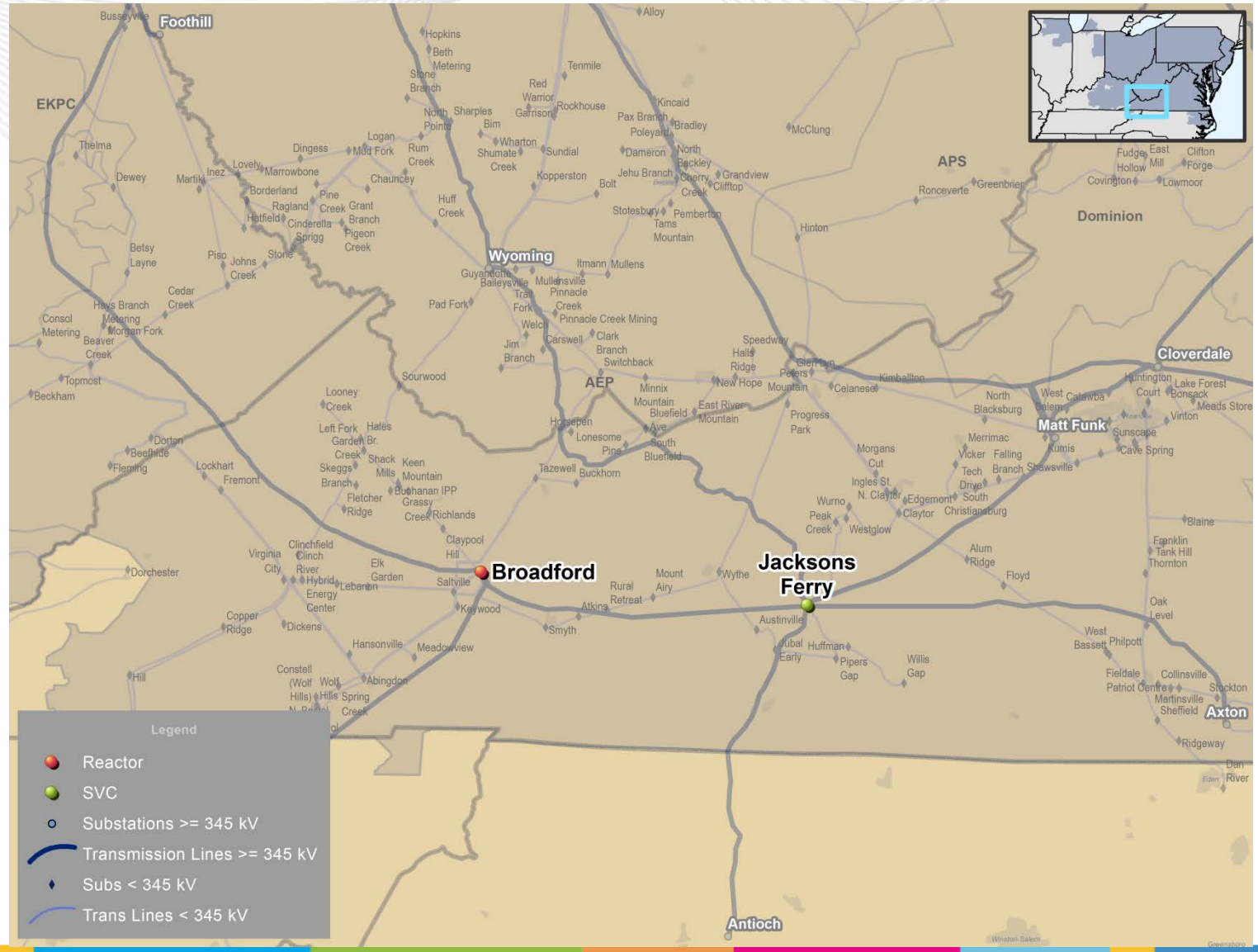
Estimated Project Cost:

$ 51M

- $36.5M for SVC
- $14.5M for 300 MVAR Reactor

Projected IS Date:

6/1/2018



Northeastern Mid-Atlantic High Voltages

- PJM Operations observes high voltages mainly on the 500 kV system
  - Map shows the locations of recent high voltage locations
- Largest driver is increased line charging due to new required RTEP upgrades located mostly in the PSEG area coupled with loss of dynamic MVAR due to generation deactivations
- On the order of 1,500 MVARs of approved reactors and SVCs planned to go in service in 2015 and 2016 in this region – greatly reduces (improves) the voltage profile
- Planning studies, however, show that future planned transmission will require additional reactive devices to control voltages in the area

Northeastern Mid-Atlantic High Voltages

- The need for additional shunt reactors has been identified on the PSEG system.
- Potential new shunt reactor installations:
  - 350 MVARs at Roseland/Hopatcong 500 kV
  - 100 MVAR at Bergen 230 kV
  - 150 MVAR at Essex 230 kV
  - 200 MVAR at Bergen 345 kV
  - 200 MVAR at Bayway 345 kV
  - 100 MVAR at Bayonne 345 kV
- The first three devices are required as soon as possible to address the ongoing operational performance issues.
- The remaining three devices will be staged to accommodate the addition of the Bergen to Linden Corridor 345 kV project
- Working to finalize
  - Shunt reactor technology (variable or static)
  - Cost estimates and in service dates

High Voltage in PJM Operations Next Steps

- Next steps
  - Southern AEP Transmission Zone
    - Continue to validate the potential SVC and shunt line reactor
  - Northeastern Mid-Atlantic Transmission Zone
    - Continue to validate the potential shunt reactors
  - October TEAC
    - Make final recommendations to the TEAC

Winter Peak Study Update

Analytical Overview

- Analysis Performed With and Without Gas Contingencies
  - Not Including Gas Contingencies
    - Baseline N-1, Generator Deliverability and Common Mode Outage Thermal Results
    - Baseline N-1 Voltage Results
    - N-1-1 Thermal
    - N-1-1 Voltage
  - Gas Contingencies Included
    - Baseline N-1, Generator Deliverability and Common Mode Outage Thermal Results
    - Baseline N-1 Voltage Results
    - N-1-1 Thermal
    - N-1-1 Voltage
    - Winter Load Deliverability (Thermal & Voltage)

Potential overloaded branches in each zone not including the issues caused by deactivation generation and FSA units

	Potential Thermal Overloads							Total by TO
	138/69KV	138KV	161/138KV	161KV	230KV	345KV	765KV	
APS								1
ATSI		1						1
AEP		16	1	1		1	1	20
ComEd		4						4
PSEG		2				1		3
DPL	1							1
DOM					1			1
Total	1	23	1	1	1	2	1	30

Potential N-1 Baseline Voltage Violations in each zone

	Voltage Mag High			Voltage Mag Low		Voltage Drop				Total by TO
	115KV	138KV	345KV	115kV	138KV	115KV	115KV	138KV	230KV	
AEP		3			14			19		36
DPL		2								2
METED	6									6
PN						4				4
PPL									2	2
PSEG			2							2
Total	6	5	2		14	4		19	2	52

Potential thermal violations in each zone

	Potential Thermal Overloads			Total by TO
	138KV	345/230KV	500/230KV	
AEP	18			18
PSEG				0
PECO			2	2
Total	18	0	2	20

Potential voltage violations in each zone

	Voltage Mag Low		Voltage Drop		Total by TO
	138kV	230KV	138KV	230KV	
AEP	5		48	2	55
APS			11		11
PPL		8		3	11
DOM				7	7
Total	5	8	59	12	84

Gas Contingencies in the NERC TPL-001-4 Standard

New NERC TPL-001-4 Standard

- Enforceable on 1/1/2016, the new TPL-001-4 standard requires PJM to evaluate extreme system events
- NERC provides the example of the “Loss of a large gas pipeline into a region or multiple regions that have significant gas-fired generation” as an example of an extreme event category for consideration by NERC Transmission Planners and Planning Coordinators

- In accordance with the standard, PJM simulated the 30 gas pipeline and compressor failure contingencies as the first contingency and all the single contingencies as the second contingency:
  - Thermal analysis
  - Voltage magnitude and voltage drop test procedures

Review - Gas Contingency Selection

- **Pipeline outages or compressor failure gas contingencies** (26 contingencies)
  - A complete set of PJM gas pipeline contingencies that results in 1000 MW or more of generation loss
    - Assume all gas generation downstream of the gas contingency on the same gas infrastructure is lost
    - Assume that all gas generation is lost, regardless of dual fuel status
- **Temperature threshold gas contingencies** (4 contingencies)
  - At a pre-determined temperature threshold, assume that non-firm customers (i.e. non-heating demand and 100% of natural gas generation customers in that zone) will be interrupted

Gas Contingency - Year 2020 Baseline N-1 Results

Simulated 30 gas pipeline and compressor failure contingencies:

- No Thermal Violation identified
- Voltage Magnitude Test
  - All contingencies converged
  - Low voltage at two 500KV buses for a natural gas pipeline contingency outage in MAAC with a consequential loss of more than 11,000MW generation
  - High voltage violations at two 345kV buses for a weather related gas contingency outage in EMAAC that results in the consequential loss of more than 7,000MW of generation
- Voltage Drop Test
  - Two contingencies are not converged. Both are pipeline outages in EMAAC with one for losing more than 11,000MW generation and the other for losing more than 10,000MW generation
  - An additional two contingencies cause voltage drop violations at multiple 500KV and 230KV buses in EMMAC.
    - One contingency is weather (temperature) related and results in the loss of more than 7,000MW of generation
    - The other contingency is a pipeline outage that results in the loss of more than 8,000 MW generation.

Gas Contingency - Year 2020 N-1-1 Results

- Thermal Test: For all the converged contingency pairs, One gas contingency, which is weather related and loses more than 7,000MW generation, will cause one 230KV EMAAC line overloaded that can't be dispatched below Normal Rating.

- Voltage Magnitude Test:
  - Two pipeline outages, in EMAAC with one for losing more than 11,000MW generation and the other for losing more than 10,000MW generation, have not converged for second contingencies that lose the 765kV line or one of the three 500KV lines.
  - The same two gas contingencies have low voltage violations for multiple 500kV buses with second contingencies that lose specific 500KV lines

Year 2020 Gas Contingency N-1-1 Results

- Voltage Drop Test:
  - Pipeline outage in EMAAC with one for losing more than 11,000MW generation has not converged second contingencies for losing one of several 765KV lines, 500kV lines, 345kV lines or 138kV lines;
  - Pipeline outage in EMAAC with one for losing more than 10,000MW generation has not converged second contingencies for losing one of several 765KV lines or 500kV lines and 345KV lines; The same pipeline outage has local voltage drop violation at some 138kV buses in the WEST
  - Pipeline outage in MAAC with one for losing more than 8,000MW generation has not converged second contingencies for losing one of several 765KV lines or 500kV lines;
  - Pipeline outage in MAAC with one for losing more than 7,000MW generation has not converged second contingencies for losing the 500kV line;
  - Weather related outage for losing more than 7,000MW generation in EMAAC has not converged second contingencies for losing the 765KV line or one of the two 500kV lines;

Year 2020 Winter Load Deliverability

- Use 2020 RTEP winter power flow case
- Examine LDAs that have a significant share of their annual loss of load risk in the winter
- Examine LDAs that could potentially be impacted by gas pipeline contingencies

LDA	LOLE Risk in Winter	Gas Contingency Affected Area?
AE	0%	Yes
AEP	45%	Yes
APS	49%	Yes
ATSI	0%	Yes
BGE	0%	Yes
CL	0%	Yes
COMED	0%	Yes
DAY	7%	Yes
DQE	29%	No
VEPO	1%	Yes
DPL	0%	Yes
DPLS	0%	Yes
DUKE	0%	Yes
EKPC	94%	No
JCPL	0%	Yes
METED	12%	Yes
PECO	0%	Yes
PEPCO	0%	Yes
PLGRP	53%	Yes
PN	41%	No
PS	0%	Yes
PSN	0%	Yes
SPJMMA	0%	Yes
WPJMMA	46%	Yes
EPJMMA	0%	Yes
PJMMA	0%	Yes
PJMWEST	0%	Yes

Year 2020 Winter Load Deliverability

- Use 2020 RTEP winter power flow case
- Examined all LDAs that have a significant share of their annual loss of load risk in the winter
- Examined other LDAs that could potentially be impacted by gas pipeline contingencies
  - Did not examine LDAs that are importing significantly more than the CETO in the base case N-1 study
- No load deliverability violations were identified

LDA	MW CETO	MW Base Imports	Base Imports - CETO / ABS(CETO)	MW CETL
AE	270	109	-60%	>270
AEP	2270	98	-96%	>2270
APS	2700	1918	-29%	>2700
ATSI	3140	1906	-39%	>3140
BGE	3800	3599	-5%	>3800
CLEV	3070	1330	-57%	>3070
COMED	-6060	-4995	18%	>-6060
DAYTON	1030	-460	-145%	>1030
DLCO	1690	-302	-118%	>1690
DPL	1030	1836	78%	*
DPL SOUTH	1210	1311	8%	>1210
DUKE	3420	1291	-62%	>3420
EKPC	610	1543	153%	>610
EMAAC	-6100	1603	126%	*
JCPL	1490	2268	52%	*
MAAC	-14030	556	104%	*
METED	1310	1154	-12%	>1310
PECO	1640	2482	51%	*
PENELEC	340	-1163	-442%	>340
PEPCO	3220	3120	-3%	>3220
PJM WEST	-2020	1000	150%	*
PLGRP	-340	-269	21%	>-340
PSEG	2850	2798	-2%	>2850
PSEG NORTH	1330	809	-39%	>1330
SWMAAC	3920	4722	20%	>3920
VAP	-960	4443	563%	*
WMAAC	-7010	-5774	18%	>-7010

* Base case imports - CETO > 50% of CETO so load deliverability was not performed

PJM Winter Reliability Criteria Next Steps

- See today's Planning Committee materials for additional information and Draft Winter Reliability Criteria language
- September Planning Committee
  - Review corresponding Manual 14B language
- September MRC
  - First Read
- October Planning Committee
  - Request endorsement of Manual 14B language
- October MRC
  - Request endorsement of Manual 14B language

Pratts Area Update

Pratts Evaluation

- Key decision factors in the Pratts evaluation
  - Performance
  - Cost
  - Risk (Siting, Feasibility and cost commitment)

Pratts Area Proposal Evaluation - Background

- At the June TEAC
  - Reaffirmed the previous recommendation to implement the 2014_2-13A proposal from Gordonsville – Pratts - Remington and assign construction responsibility to First Energy and Dominion.
  - This recommendation was not yet reviewed by the PJM Board
- In the previous evaluation process, new ROW was recognized as an important issue and a significant element of risk “common to all new ROW proposals.”
- Further routing analysis indicates that the total length of potential new ROW for the 13A proposal is 15-18 mi.
- Virginia SCC Guidelines of Minimum Requirements for Transmission Line Applications

Siting Considerations: Virginia SCC Guidelines

- Virginia State Corporation (SCC)
  - COMMONWEALTH OF VIRGINIA STATE CORPORATION COMMISSION, DIVISION OF ENERGY REGULATION
  - Guidelines of Minimum Requirements for Transmission Line Applications Filed Under Virginia Code Section 56-46.1 and The Utility Facilities Act
    - To the extent permitted by the property interest involved rights-of-way should be selected with the purpose of minimizing, conflict between; the rights-of-way and present and prospective uses of the land on which they are to be located. To this end, existing rights-of-way should be given priority as the locations for additions to existing transmission facilities, and the joint use of existing rights-of-way by different kinds of utility services should be considered.
  - https://www.scc.virginia.gov/pue/docs/trans.pdf

Pratts ROW Summary by Proposal

Project ID	Proposing Entity	Major Route	Estimated Project Cost ($M) from Project Sponsor	New ROW mileage	Existing ROW mileage	Total
2014_2-13C	Dominion	Gordonsville-Remington	103.7	0	36	0
2014_2-6B	ITC Mid Atlantic	Gordonsville-Pratts-Remington	142	36	0	36
2014_2-13A	Dominion/First Energy	Gordonsville-Pratts-Remington	149.3	7.3	30.2	37.5
2014_2-14A	Ameren	Gordonsville-Pratts-Remington	139.35	55	0	55
2014_2-7I	Northeast Transmission Development (NTD)	Gordonsville-Remington	87.7 (cost contained) plus an additional estimated 8.2 for Mitchell – Mountain Run 115kV fix = 95.9	38	0	38

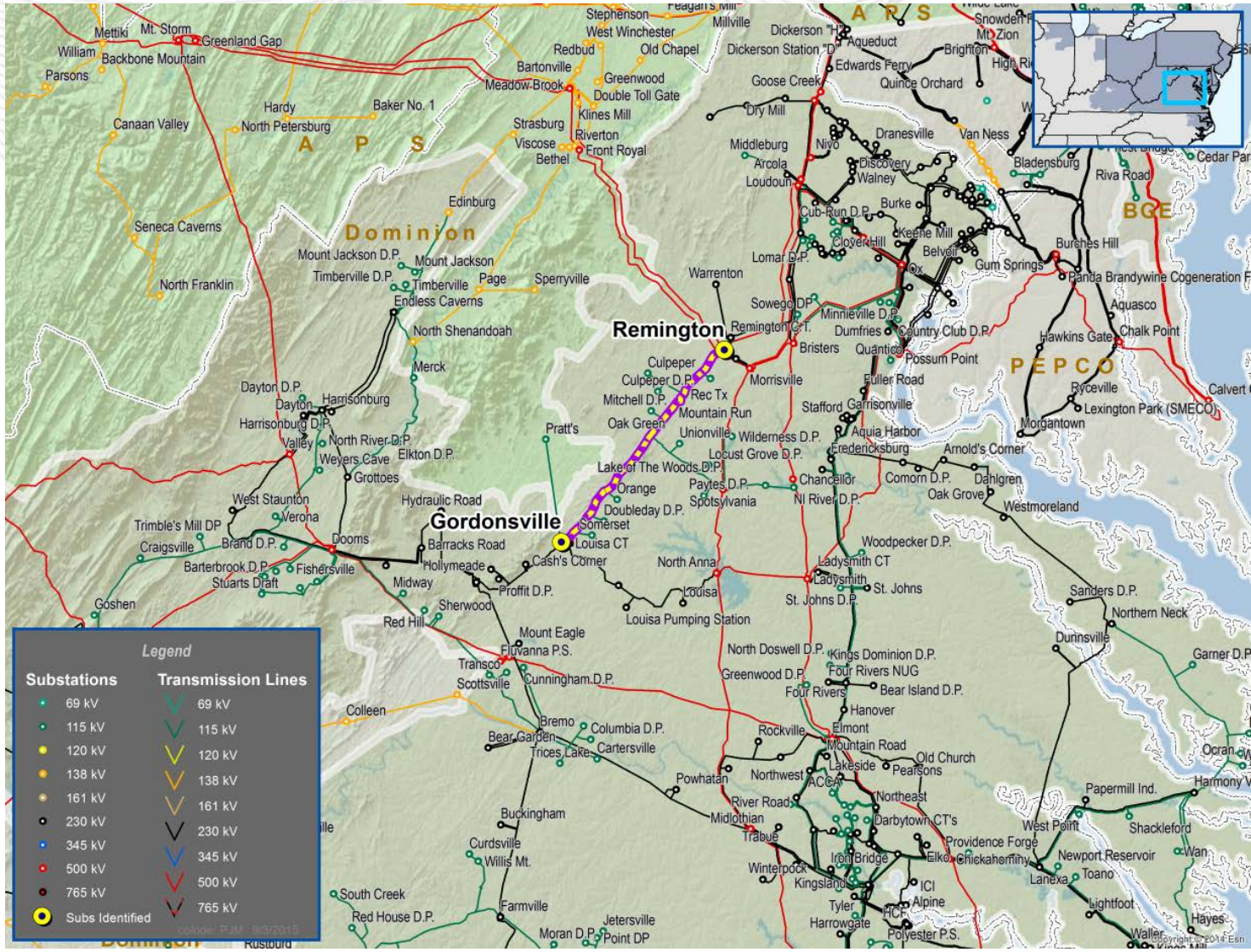
Pratts Area Recommendation

- The Dominion 13C proposal from Gordonsville - Remington
  - Resolves the required reliability criteria violations
  - Among the least cost proposals
  - Has the least risk due to all of the existing ROW and ownership of existing local stations

Pratts Area Recommendation

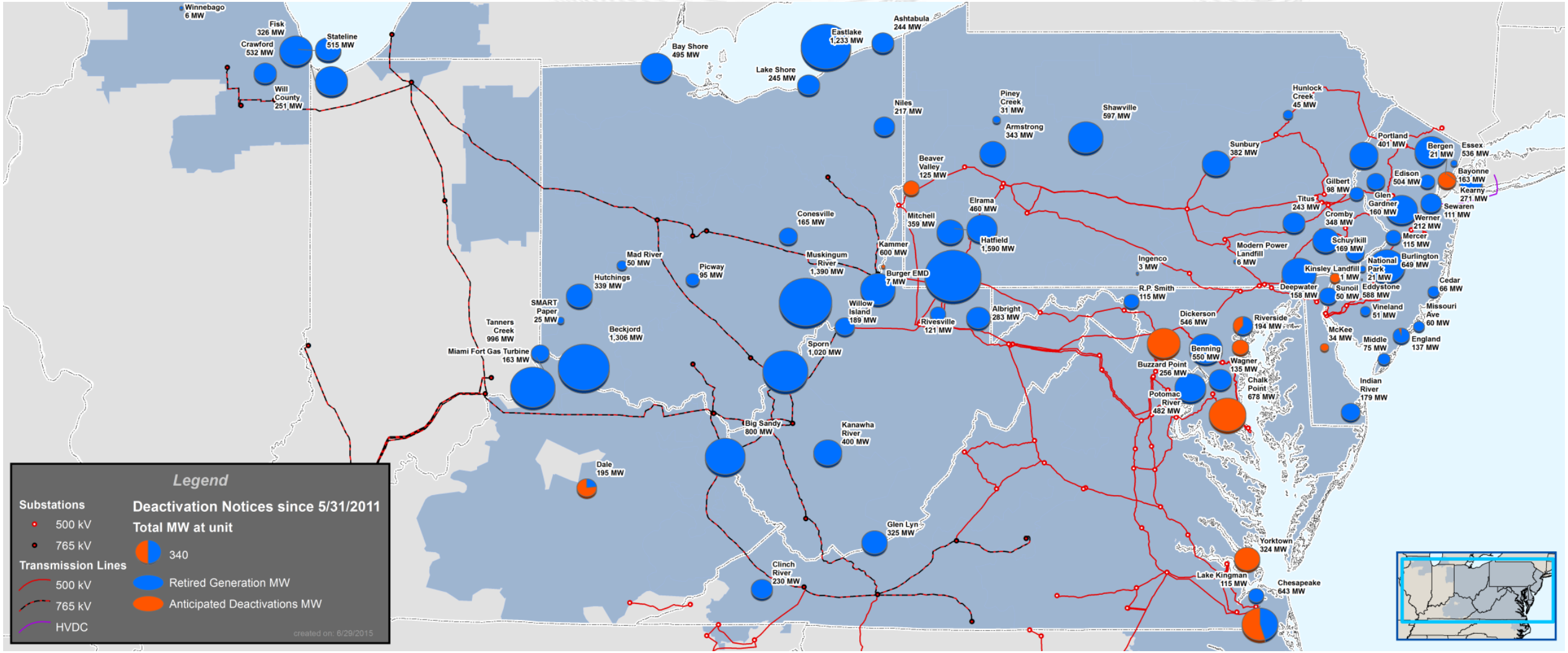
Recommendation: Construct the Dominion / FirstEnergy 13C proposal

- Construction Designation: Dominion (the local Transmission Owner)
- Build a 230kV Line from Remington Substation to Gordonsville Substation utilizing existing ROW. Install a 3rd 230-115kV transformer at Gordonsville Substation
- Cost Estimate : $103.7 M
- Required In-Service Date: 6/1/2018



Generation Deactivation Notification Update

Deactivation Notifications as of 9/1/2015

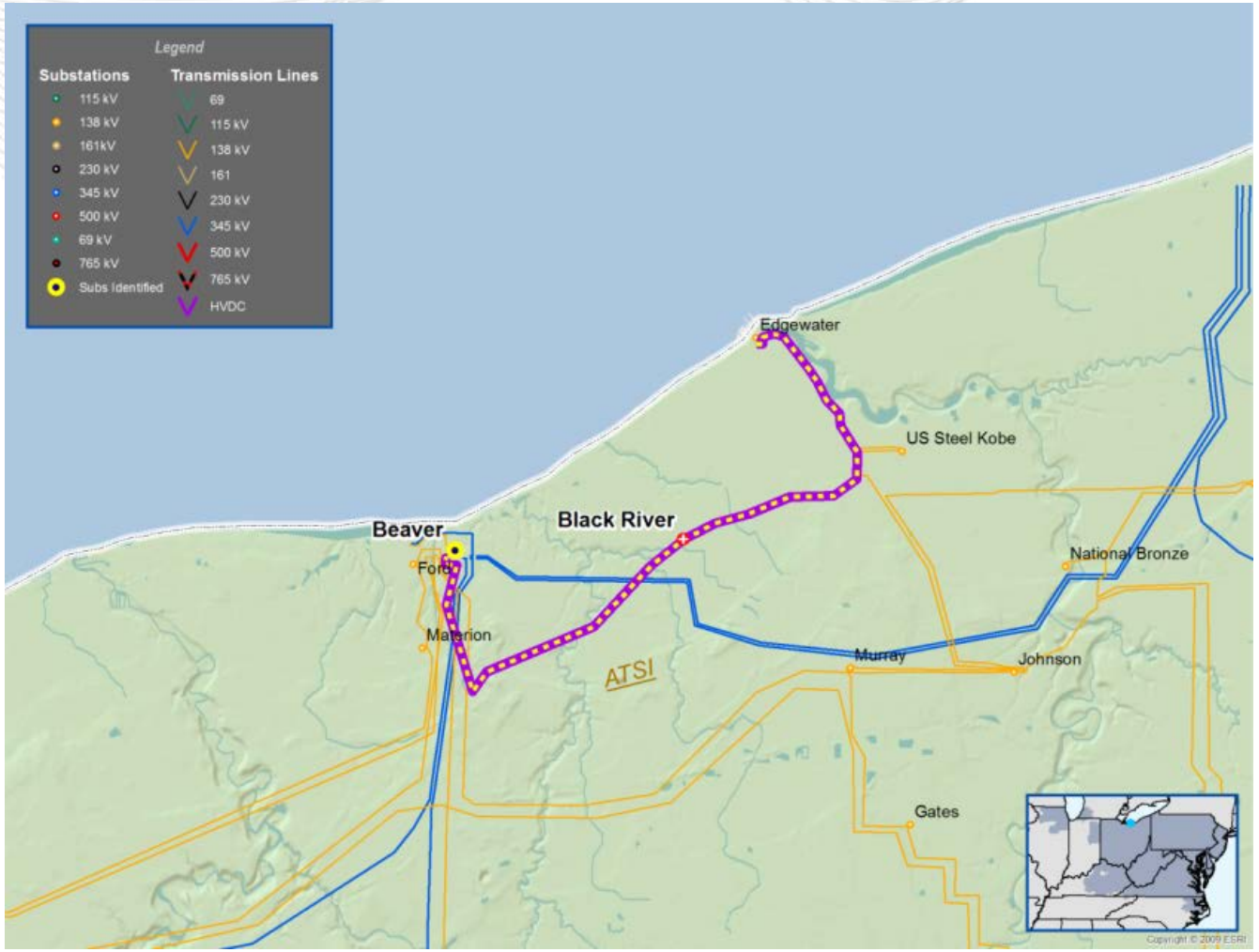


Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
East Lake 1, 2 and 3 (396 MW) and Lakeshore 18 (245 MW)	ATSI	04/15/2015 (Previous 9/15/2014)	Reliability analysis complete to determine the impact of not having East Lake (both MWs and MVARs) and Lakeshore (MWs only due to the planned conversion of Lakeshore to a synchronous condenser) in 2015
Arnold Green Mountain (10 MW)	PENELEC	November 5, 2015	Reliability analysis complete. No impacts identified.

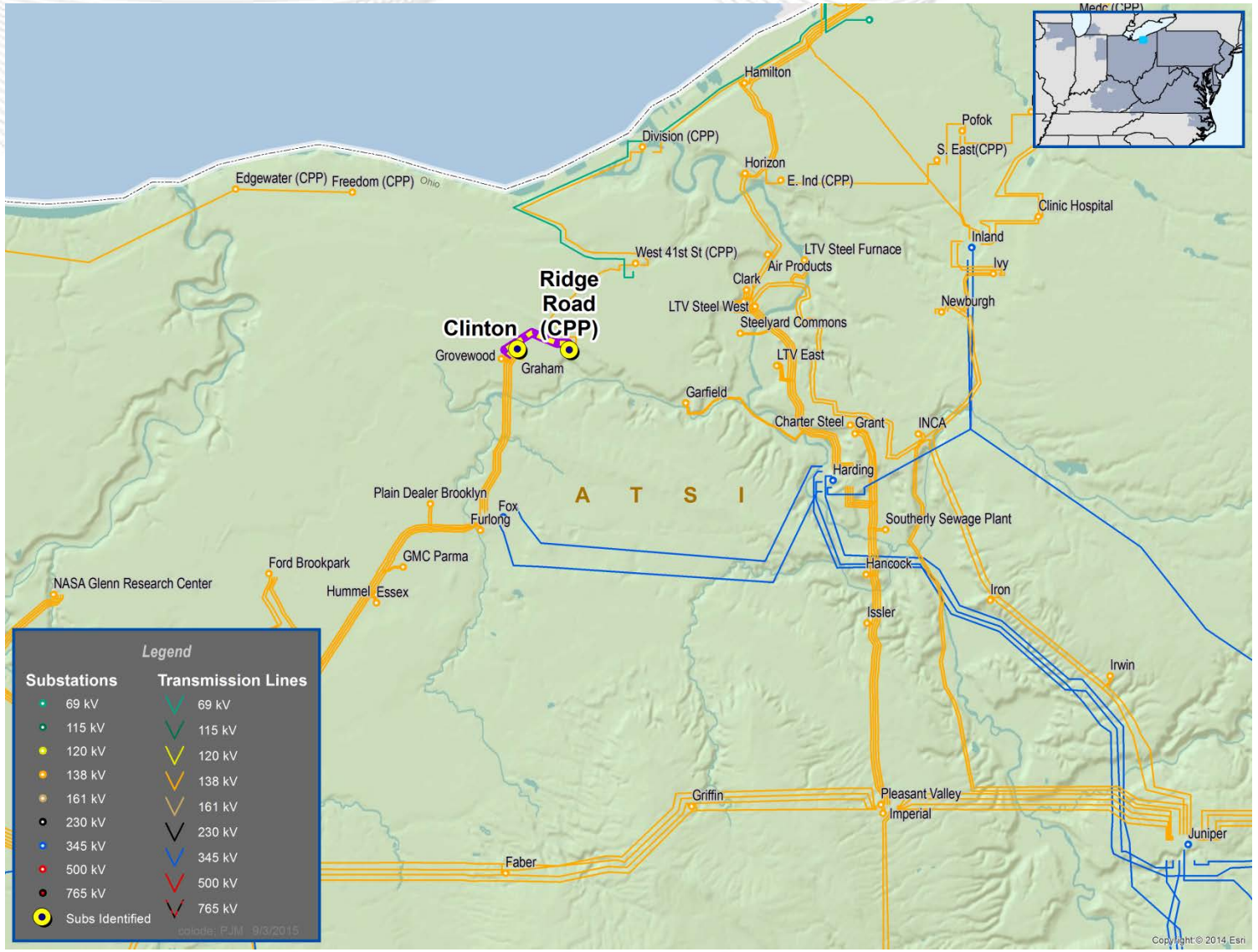
ATSI Transmission Zone

- **NERC N-1-1 Violation**
- The Beaver to Black River 138 kV line is overloaded for the loss of Beaver to Johnson 138 kV line (B_LINE1_CR_006)
- This is an immediate need project to address a thermal violation on the line until the anticipated conversion of the unit to a synchronous condenser is complete
- Immediate Need Proposed Upgrade (B2301.1): Wave trap and line drop replacement at Beaver
- Alternatives considered: Due to the short lead time and relative low cost of terminal equipment (wave trap and line drop), no additional alternatives were considered
- Estimated Project Cost: $40,300
- Required IS Date: 6/1/2015
- Due to the short lead time, a proposal window is infeasible. The local TO will be the Designated Entity
- ATSI (the local TO) will be the designated entity



ATSI Transmission Zone

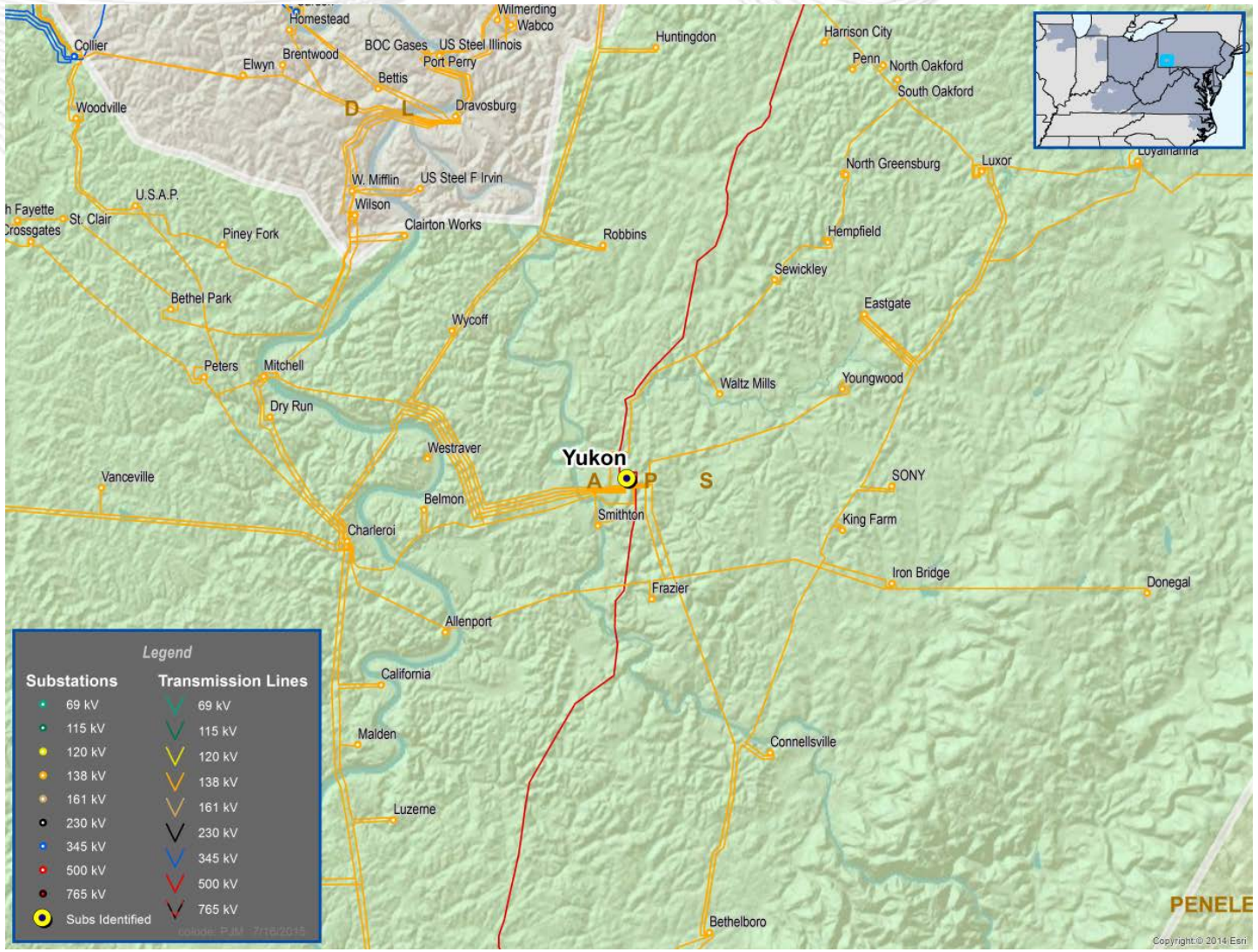
- **N-1-1 Violation**
- Clinton to CPP Ridge 138 kV line is overloaded for the loss of Inland to Ivy 138 kV line, Inland to Lakeshore 138 kV line, Inland to Holt A 138 kV line, Inland to Clifford Q-14 Inland 345/138 kV transformer (B_LINE1_NR_55A) + Loss of Harding Q-13 to LTV East 138 kV line, LTV East 138/11.5 kV transformers 2 and 3, LTV East to Jennings 138 kV line, Clark 138/11.5 kV transformer (B_LINE1_NR_033) .
- This is an immediate need project to address a thermal violation on the line until the anticipated conversion of the unit to a synchronous condenser is complete
- Proposed Upgrade (B2616): Addition of 4th 345/138 kV transformer at Harding
- Alternatives considered: No additional alternatives were considered
- Estimated Project Cost: $3 M
- Required IS Date: 6/1/2015
- Due to the short lead time, a proposal window is infeasible. The local TO will be the Designated Entity
- ATSI (the local TO) will be the designated entity



Short Circuit

APS Transmission Zone

- The Yukon 138kV breakers ‘Y-11’, ‘Y-13’, ‘Y-18’, ‘Y-19’, ‘Y-4’, ‘Y-5’, ‘Y-8’, ‘Y-9’, ‘Y10’, ‘Y12’, ‘Y14’, ‘Y2’, ‘Y21’, and ‘Y22’ are overstressed
- Proposed Solution: Replace the Yukon 138kV breakers ‘Y-11’, ‘Y-13’, ‘Y-18’, ‘Y-19’, ‘Y-4’, ‘Y-5’, ‘Y-8’, ‘Y-9’, ‘Y10’, ‘Y12’, ‘Y14’, ‘Y2’, ‘Y21’, and ‘Y22’ with 80kA breakers (b2666.1-b2666.14)
- Estimated Project Cost: $11.5M
- Required IS Date: 6/1/2020



15 Year Analysis Result

15 Year Analysis Result for 2014 RTEP

2015 RTEP 15 Year Analysis - Single Contingency Result							
Fr Bus	**Fr Name**	**To Bus**	**To Name**	**CKT**	**KVs**	**Areas**	**100% Year**
314935	8BRUNSWICK	314902	8CARSON	1	500/500	Dominion	2020
314228	6MESSER	314225	6CHARCTY	1	230/230	Dominion	2020
314072	6PL VIEW	314004	6ASHBURN	1	230/230	Dominion	2027
314287	6CHSTF B	314228	6MESSER	1	230/230	Dominion	2020
213519	CONOWG01	231006	COLOR_PE	1	230/230	PECO/DPL	2028
213520	CONOWG03	213844	NOTTNGHM	1	230/230	PECO	2029
243217	05DEQUIN	243878	05MEADOW	1	345/345	Dominion	2020

15 Year Analysis Result for 2014 RTEP

2015 RTEP 15 Year Analysis - Tower Contingency Result							
Fr Bus	**Fr Name**	**To Bus**	**To Name**	**CKT**	**KVs**	**Areas**	**100% Year**
208034	MILT	208109	SUNB	1	230/230	PPL	2030
206314	28RED OAKA	206305	28RAR RVR	1	230/230	JCPL	2028
228401	MCKLTON	228402	MONROE	1	230/230	AE	2029
208040	MONT	208034	MILT	1	230/230	PPL	2021
228401	MCKLTON	228402	MONROE	2	230/230	AE	2029

2015 RTEP Proposal Window #1

2015 RTEP Proposal Window #1

- Registration
  - All individuals registered for the 2015 RTEP Proposal Window #1 are automatically registered for this Window #1
  - If you are not currently registered, complete CEII documentation and email RTEP@pjm.com
- Email Communication
  - Public announcements will be sent to the registered TEAC users through the “My Email Lists” feature of PJM.com
  - Registered Window #1 users (all CEII authorized) are on a separate list and will receive email communication from PJM that contains CEII and other necessary detail
- Web address
  - Public: http://pjm.com/planning/rtep-development/expansion-plan-process/ferc-order-1000/rtep-proposal-windows.aspx
  - Registered Window Participant with CEII Access : http://www.pjm.com/planning/rtep-development/expansion-plan-process/ferc-order-1000/rtep-proposal-windows/2014-rtep-proposal-window-2.ashx
  - 2015 Proposal Window #1 Tracking by Proposal: http://www.pjm.com/~/media/committeesgroups/committees/teac/20150813/20150813-2015-rtep-proposal-window-1-tracking-by-proposal.ashx
  -

- Analytical Procedures
- Reference PJM M14B
  - http://www.pjm.com/~/media/documents/manuals/m14b.ashx
- NERC TPL Criteria
  - http://www.nerc.com/pa/stand/Pages/ReliabilityStandardsUnitedStates.aspx?jurisdiction=United%20States
- Reference TO Criteria
  - http://www.pjm.com/planning/planning-criteria/to-planning-criteria.aspx

TEAC Webcast on 9/1/2015

- Overview of Proposals
- Preliminary Recommendations
- http://mediastream.pjm.com/2015/0901/teac/2015-rtep-proposal/index.htm

Transmission Expansion Advisory Committee

The Transmission Expansion Advisory Committee (TEAC) provides advice and recommendations to aid in the development of the Regional Transmission Expansion Plan (RTEP).

Chair: Paul McGlynn
Secretary: Mike Herman

Postings	Date
Charter PDF	3.25.2011
Artificial Island Project Recommendation White Paper PDF	7.29.2015
Behind the Meter Business Rules PDF	1.11.2006

Webcasts

- 2015 RTEP Proposal Window 1 - Preliminary Recommendations - Recorded 9.1.2015
- 2015 RTEP Proposal Window 1 - Recorded 6.24.2015
- 2014 RTEP Proposal Window 2 - Preliminary Recommendations - Recorded 12.18.2014
- 2014/15 RTEP Long Term Proposal Window - Recorded 10.30.2014
- 2014 RTEP Proposal Window 2 - Recorded 10.17.2014

2015 RTEP Proposal Window #1

- Scope
  - Baseline N-1 (thermal and voltage)
  - Generation Deliverability and Common Mode Outage
  - N-1-1 (thermal and voltage)
  - Load Deliverability (thermal and voltage)
- Window Opened: 6/19/2015
- Window Closed: 7/20/2015
  - Proposal definitions, simulation data and planning cost estimate due
- Detailed Cost due: 8/4/2015
  - Additional 15 days to develop and provide detailed cost data
  - See the window documentation for additional information

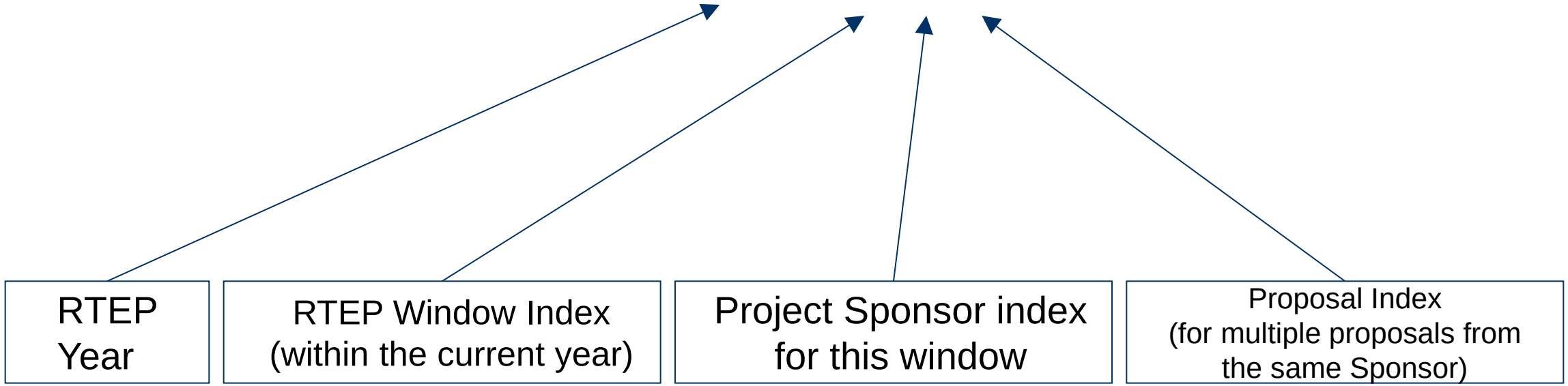
2015 RTEP Proposal Window #1 Proposals

- Based on the work done to date proposals fall into the following high level categories
  1. Recommended solutions
  2. Retirement/At Risk related (reliability violations will be re-evaluated pending the status of the retirement/at risk generation)
  3. FSA generation related (reliability violations will be re-evaluated pending the status of the planned generation)
  4. Technical evaluation is on-going as necessary to develop a recommended solution

2015 RTEP Proposal Window #1

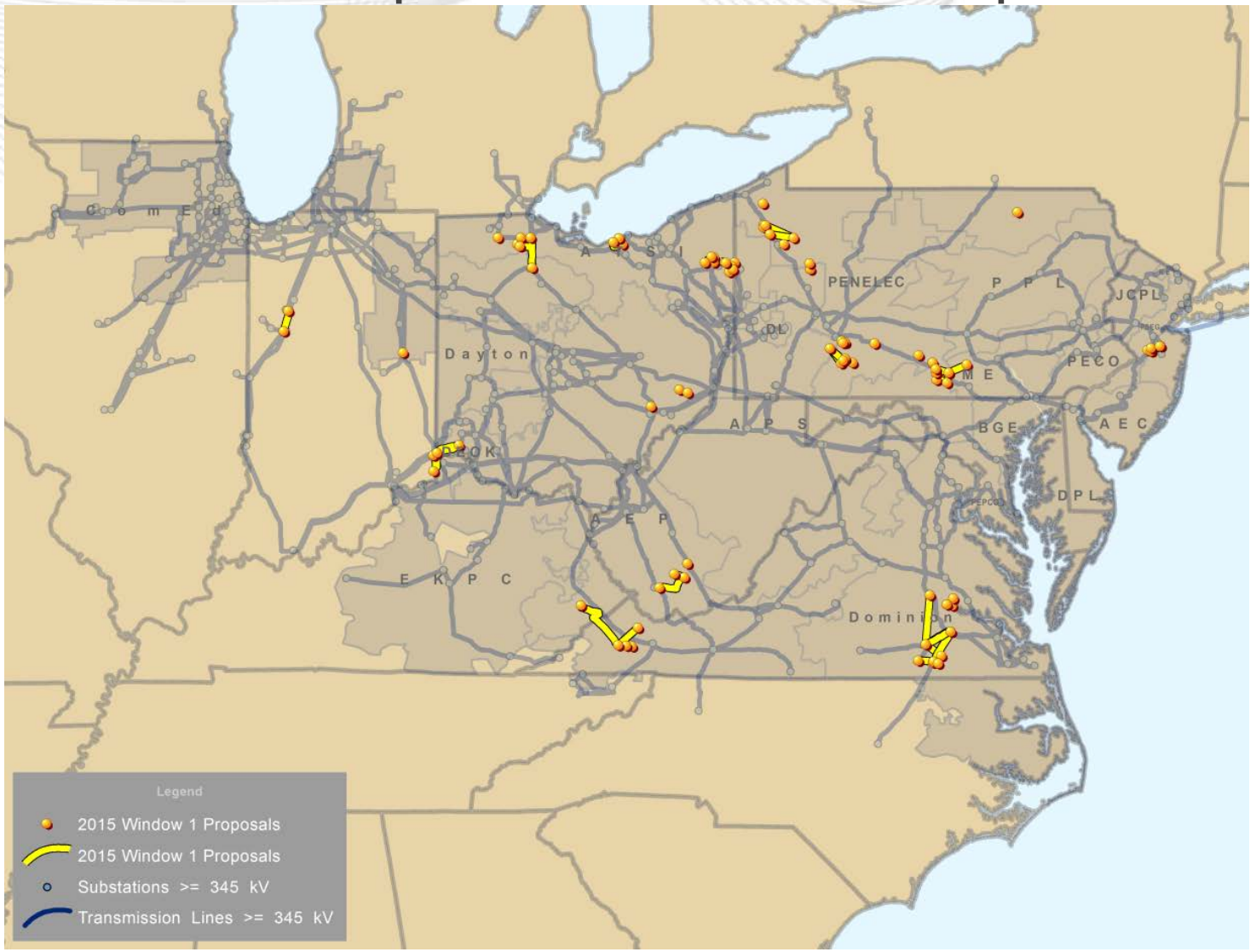
- Window opened on 6/19/2015
- Closed on 7/20/2015

- Project Naming Convention
- Project Identification Taxonomy: 2015_1-1A



2015 RTEP Proposal Window #1 Proposals

- 292 flow gates addressed
- 9 proposing entities
- 91 proposals
  - 26 Transmission Owner Upgrades
    - Cost range of $0.013M to $73M
  - 64 Greenfield Projects
    - Cost range of $6M to $167.1M
- 6 target zones

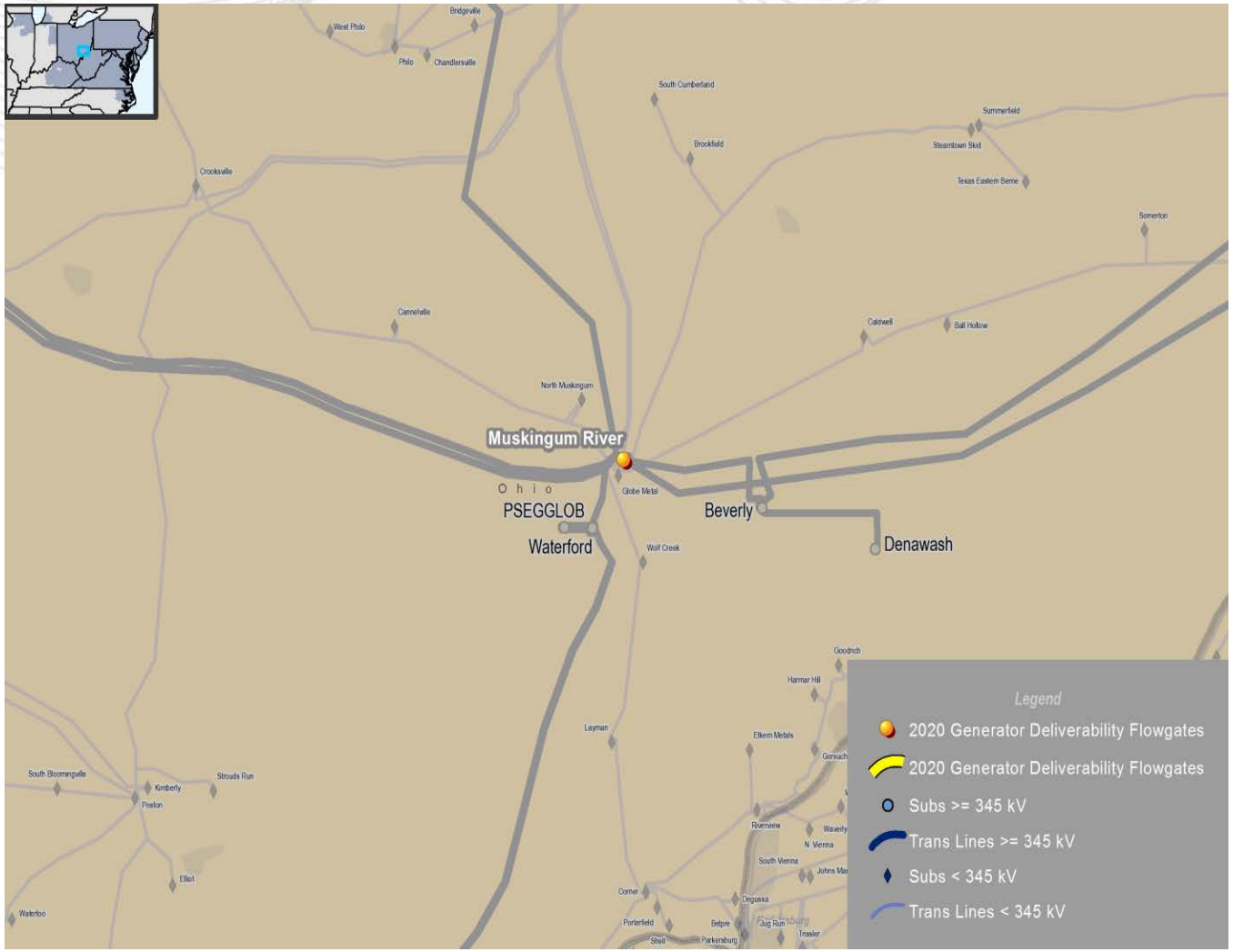


AEP Transmission Zone

- **Baseline and Common Mode Outage (FG# 152 and 865):**
- Muskingum River 138 kV bus section is overloaded for line fault stuck breaker contingency loss of the Muskingum – North Muskingum and Muskingum – Globe Metal 138 kV circuits.

- **Alternatives considered:**
  - 2015_1-2F ($0.144 M)
- **Recommended Solution:**
  - Replace the Muskingum 138 kV bus # 1 and 2. (2015_1-2F) (B2667)
- **Estimated Project Cost:** $0.144 M

- **Required IS Date:** 6/1/2020



AEP Transmission Zone

- Generation Deliverability (FG# 59):
- Dequine to Meadow Lake 345 kV circuit #1 is overloaded for loss of the Dequine to Meadow Lake 345 kV circuit #2.
- **Alternatives considered:**
  - 2015_1-2G ($25.6 M)
  - 2015_1-2I ($27.5 M)
  - 2015_1-2J ($26.6 M)
  - 2015_1-2K ($5.1 M)
  - 2015_1-7A ($34.2 M)
- **Recommended Solution:**
  - Reconductor Dequine to Meadow Lake 345 kV circuit #1 utilizing dual 954 ACSR 54/7 cardinal conductor. (2015_1-2K)
    (B2668)
- **Estimated Project Cost:** $5.1 M
- **Required IS Date:** 6/1/2020

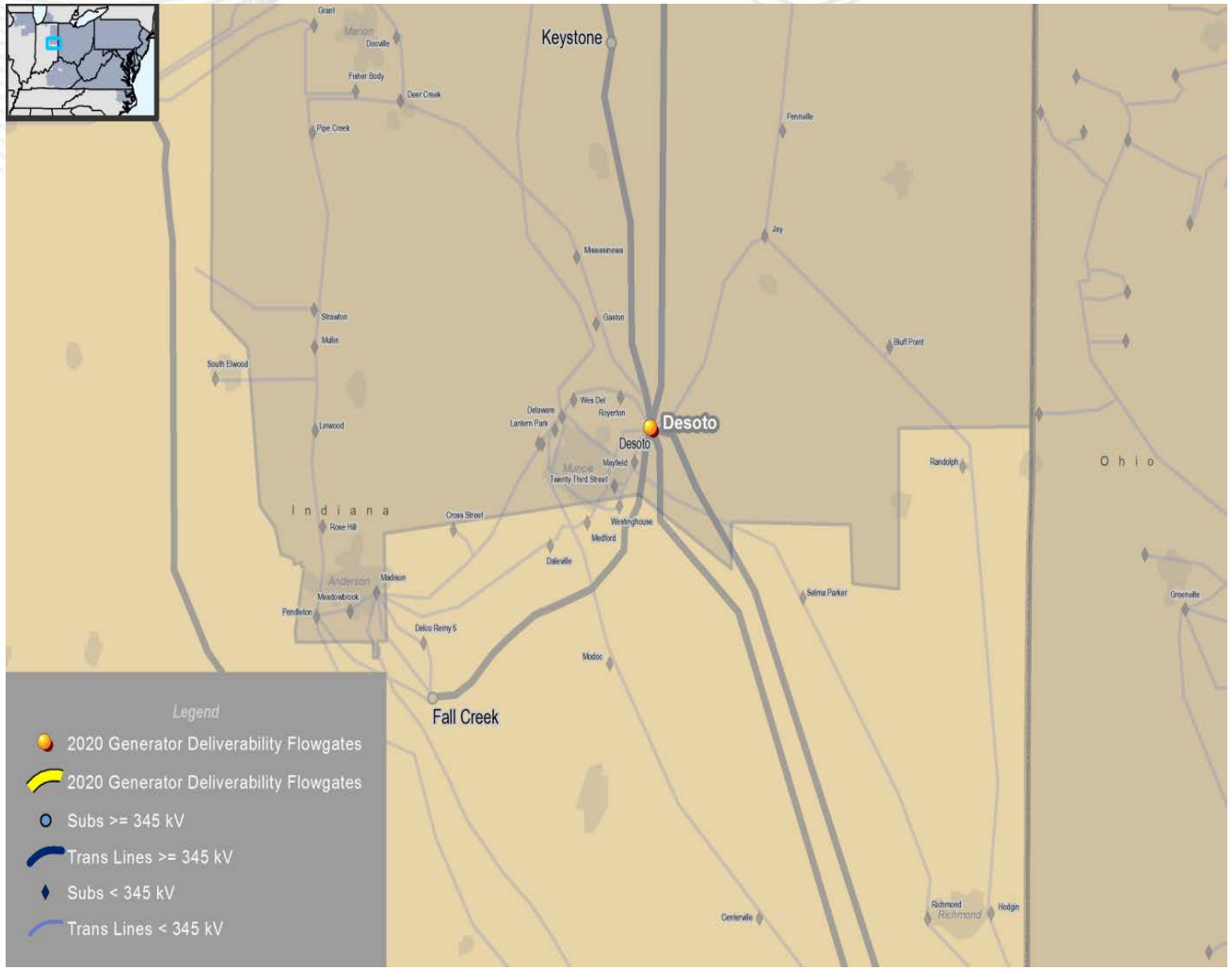
AEP Transmission Zone

- Common Mode Outage (FG# 653):
- The Desoto 345/138 kV transformer is overloaded for tower outage loss of the Desoto – Sorenson and Keystone – Sorenson 345 kV circuits.

- **Alternatives considered:**
  - 2015_1-2H ($10.6 M)

- **Recommended Solution:**
  - Install a second 345/138 kV transformer at Desoto. (2015_1-2H) (B2669)
- **Estimated Project Cost:** $10.6 M

- **Required IS Date:** 6/1/2020



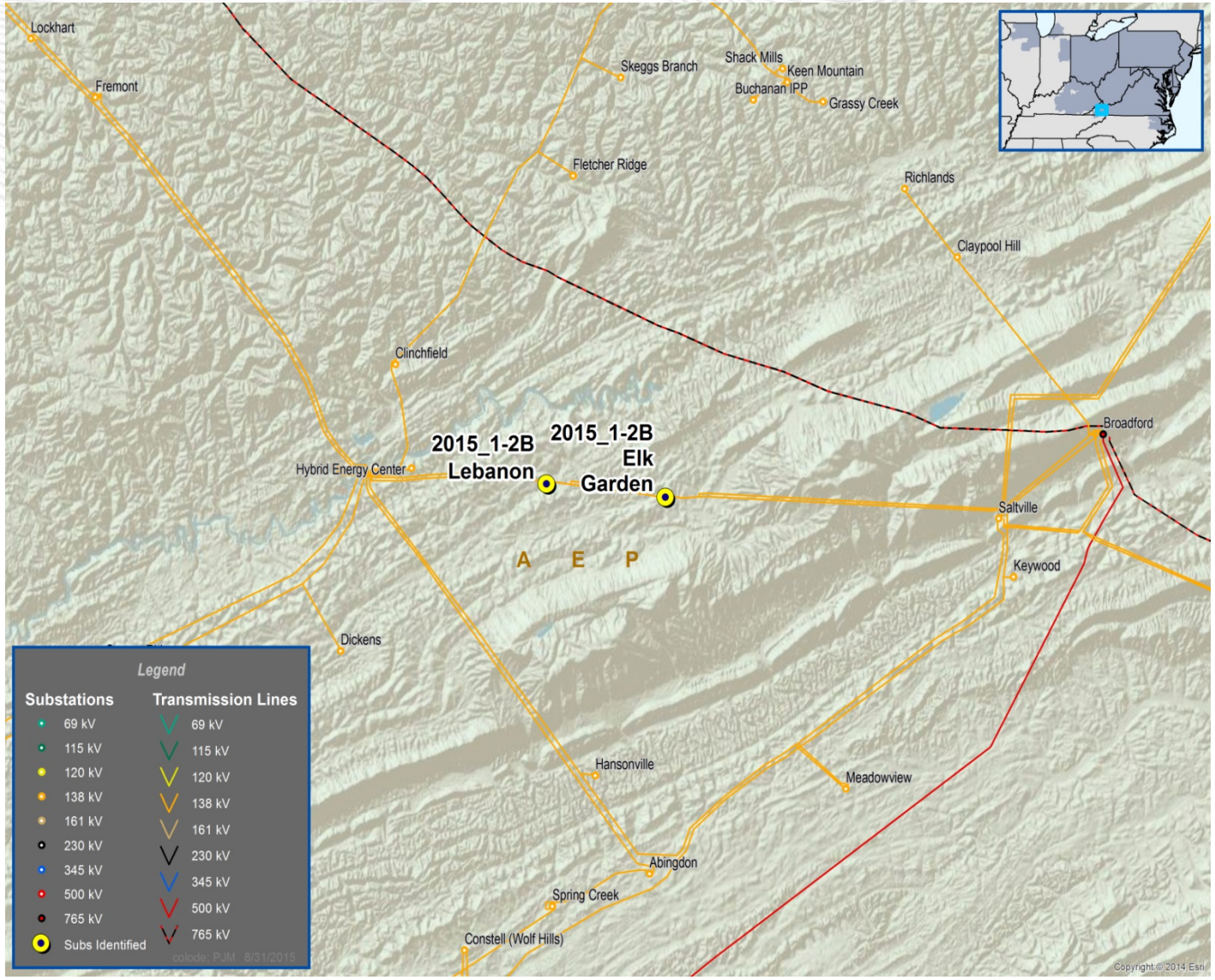
AEP Transmission Zone

- Common Mode Outage (FG# 801):
- The Lebanon – Elk Garden 138 kV circuit is overloaded for line fault stuck breaker contingency loss of the Broadford – Sullivan 500 kV circuit and Broadford 765/500 kV transformer.

- **Alternatives considered:**
  - 2015_1-2B ($1.25 M)
  - 2015_1-2C ($2.5 M)
  - 2015_1-2D ($38.5 M)
  - 2015_1-2E ($95 M)

- **Recommended Solution:**
  - Replace switch at Elk Garden 138 kV substation (on the Elk Garden – Lebanon 138 kV circuit). (2015_1-2B) (B2670)
- **Estimated Project Cost:** $1.25 M

- **Required IS Date:** 6/1/2020



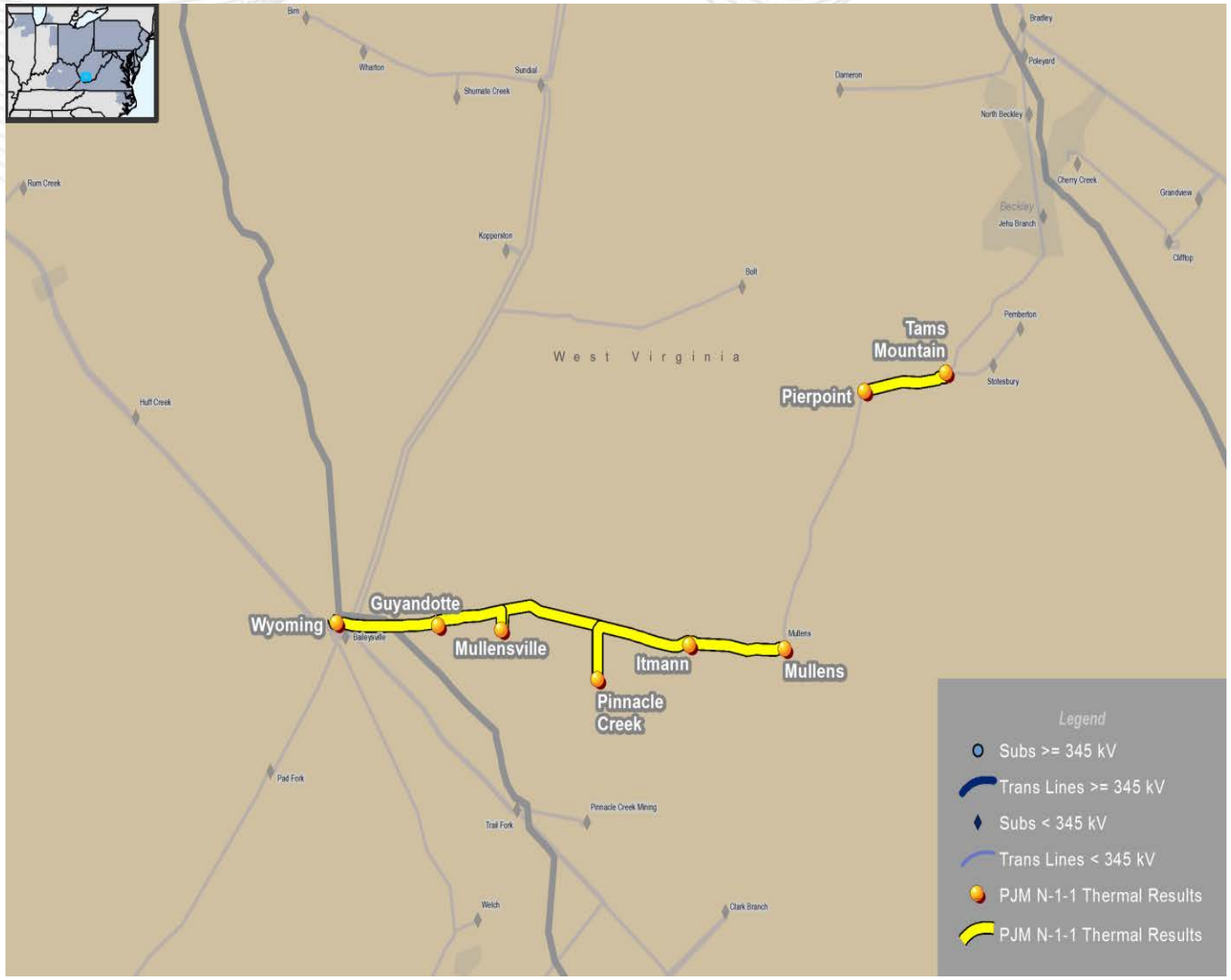
AEP Transmission Zone

- **N-1-1 Thermal Violation (FG# N2-T4 - 15):**
- Wyoming – Guyandotte - Mullensville – Pinnacle Creek – Itmann - Mullens and Pierpoint – Tams Mountain 138 kV circuits are overloaded for N-1-1 contingency loss of the Glen Lyn – Hinton 138kV line and the loss of the Poleyard - Bradley-Grandview 138kV circuits.

- **Alternatives considered:**
  - 2015_1-2A (5.36 M)
  - 2015_1-7H ($135.8 M)
  - 2015_1-8C ($23 M)
  - 2015_1-8Z ($19.2 M)

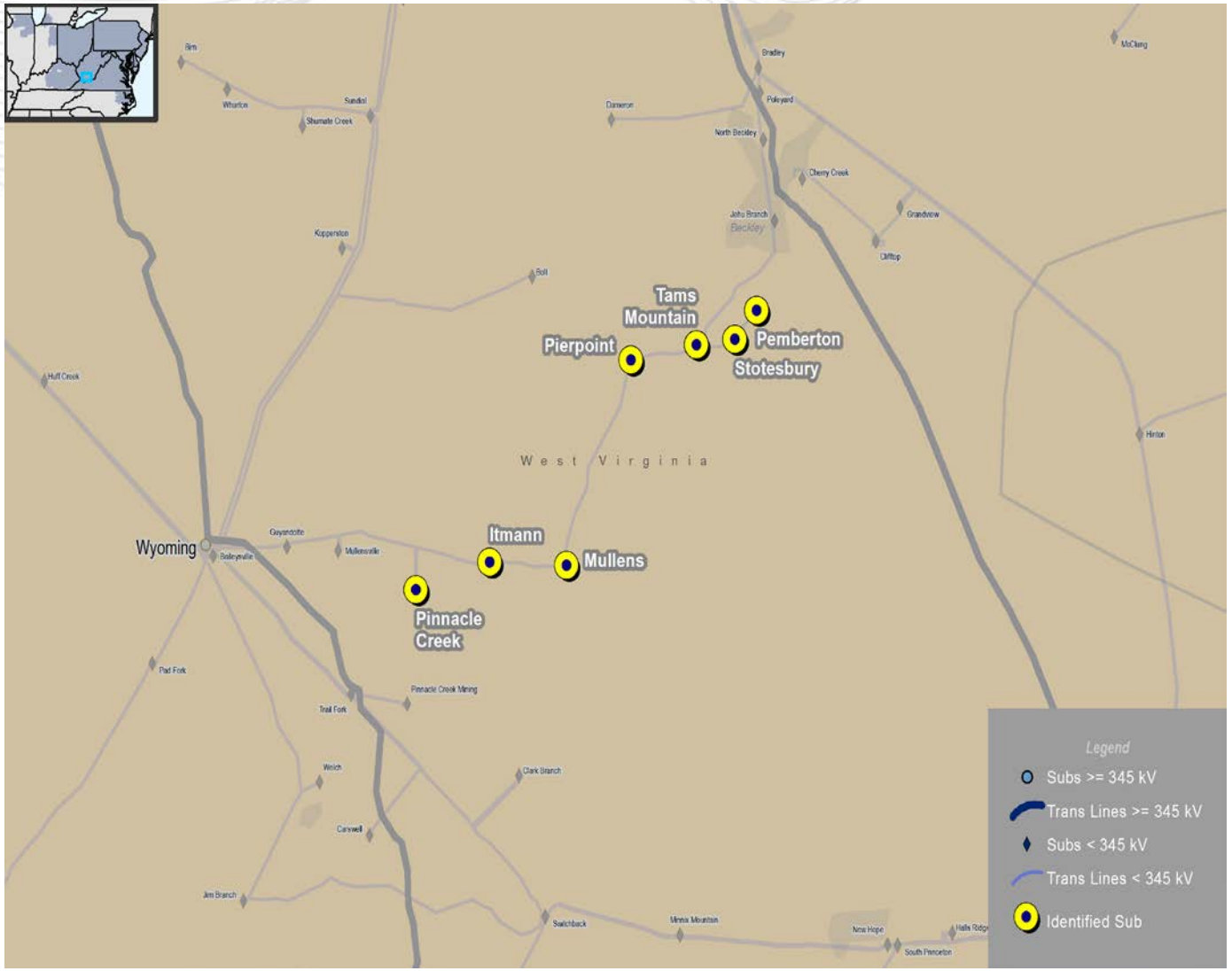
- **Recommended Solution:**
  - Replace/upgrade/add terminal equipment at Bradley, Mullensville, Pinnacle Creek, Itmann, and Tams Mountain 138 kV substations. Sag study on Mullens – Wyoming and Mullens – Tams Mt. 138 kV circuits. (2015_1-2A) (B2671)
- **Estimated Project Cost:** $5.36 M

- **Required IS Date:** 6/1/2020



AEP Transmission Zone

- **N-1-1 Voltage (FG# N2-VM65 – 69, N2-VD75 – 90):**
- Low voltage at Pemberton, Stotesbury, Tams Mountain, and Pierpoint 138KV buses and Voltage drop at Pemberton, Stotesbury, Tams Mountain, Mullens, Itmann, Pinnacle Creek and Pierpoint 138KV buses for the loss of the Glen Lyn – Hinton 138kV line and the loss of the Poleyard-Bradley-Grandview 138kV line
- Voltage drop at Pemberton, Stotesbury, Tams Mountain 138kV buses for the loss of the Poleyard-Bradley-Grandview 138kV line and the loss of the Wyoming - Guyandotte- Mullensville –Tams Mountain 138kV line
- **Alternatives considered:**
  - 2015_1-2A ($5.36 M)
  - 2015_1-8C ($23 M)
  - 2015_1-8Z ($19.2 M)
- **Recommended Solution:**
  - Replace/upgrade/add terminal equipment at Bradley, Mullensville, Pinnacle Creek, Itmann, and Tams Mountain 138 kV substations. Sag study on Mullens – Wyoming and Mullens – Tams Mt. 138 kV circuits. (2015_1-2A) (B2671)
- **Estimated Project Cost:** $5.36 M
- **Required IS Date:** 6/1/2020

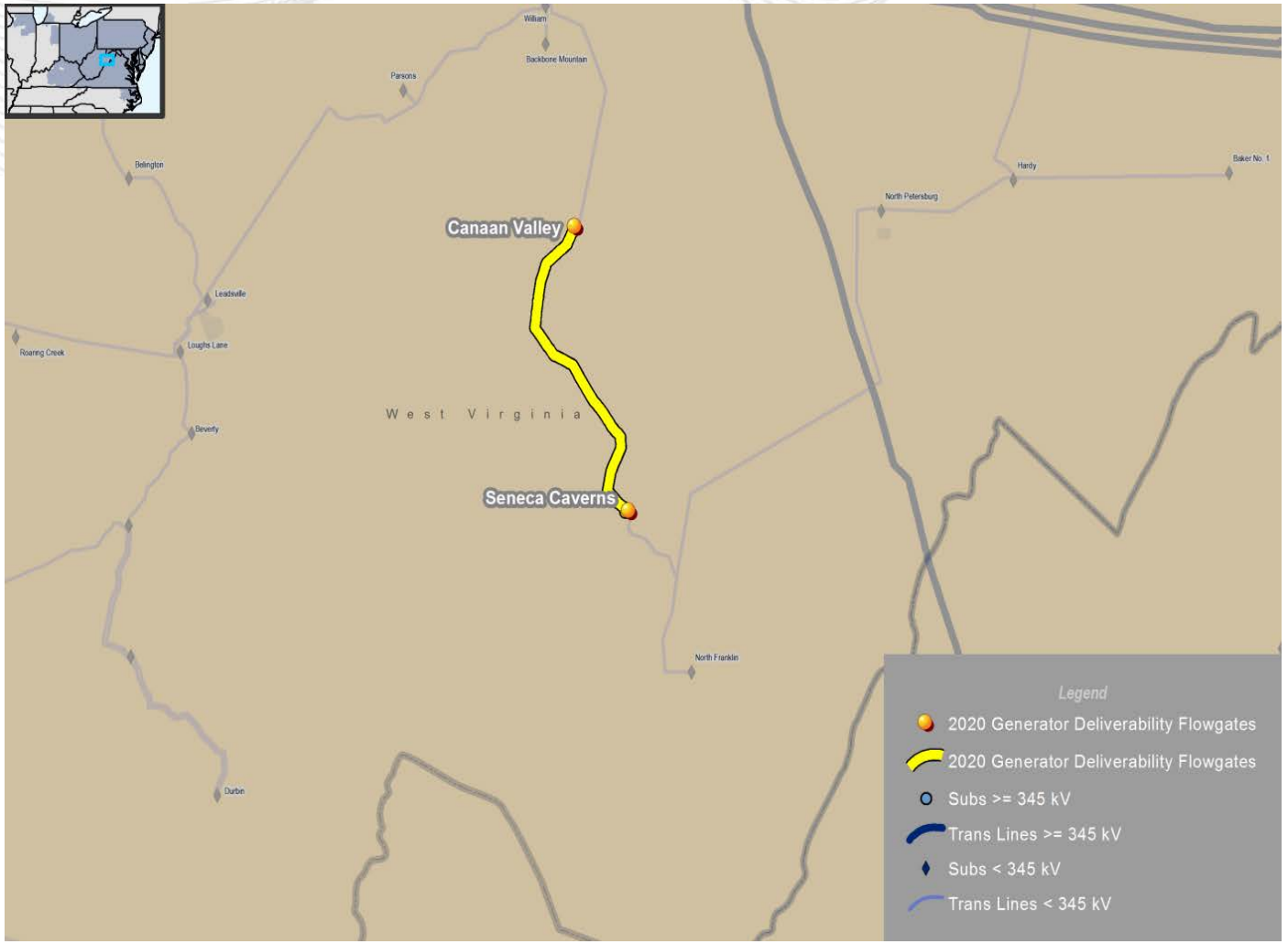


APS Transmission Zone

- **Common Mode Outage (FG# 589, 859, 860, 861):**
- Canaan Valley to Seneca Caverns 138 kV circuit is overloaded for several contingencies.

- **Alternatives considered:**
  - 2015_1-4G ($0.013 M)
- **Recommended Solution:**
  - Change CT Ratio at Seneca Caverns from 120/1 to 160/1 and adjust relay settings accordingly. (2015_1-4G)
    (B2672)
- **Estimated Project Cost:** $0.013 M

- **Required IS Date:** 6/1/2020



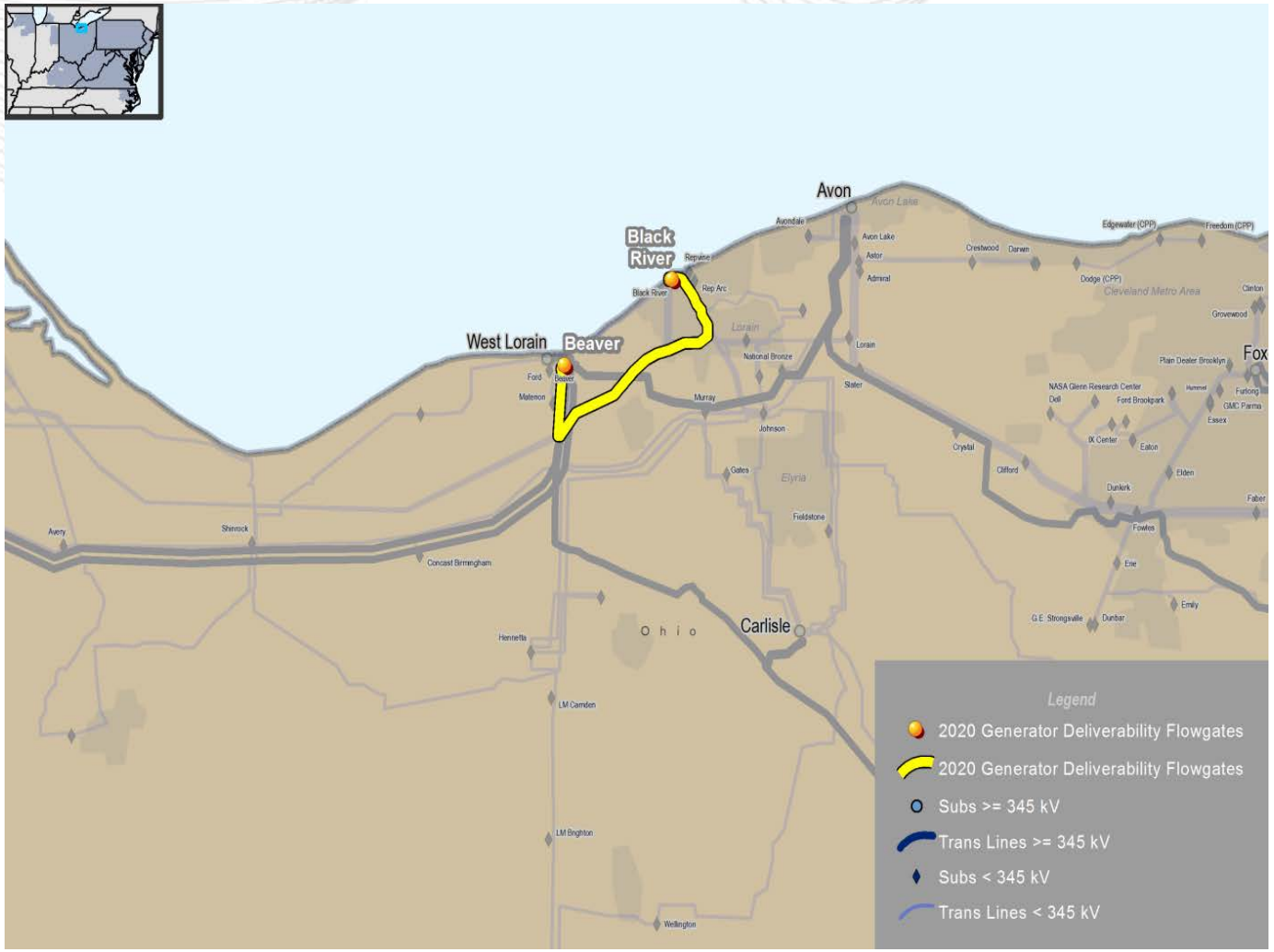
ATSI Transmission Zone

- **Common Mode Outage (FG# 664):**
- Beaver to Black River 138 kV circuit is overloaded for tower outage loss of the Beaver – Lake Ave #1 & #2 345 kV circuits.

- **Alternatives considered:**
  - 2015_1-4A ($5.1M)
  - 2015_1-7E ($30.7 M)
  - 2015_1-7F ($19.1 M)
  - 2015_1-7G ($39 M)

- **Recommended Solution:**
  - Rebuild the existing double circuit tower line section from Beaver substation to Brownhelm Jct. approx. 2.8 miles. (2015_1-4A) (B2673)
- **Estimated Project Cost:** $5.1 M

- **Required IS Date:** 6/1/2020



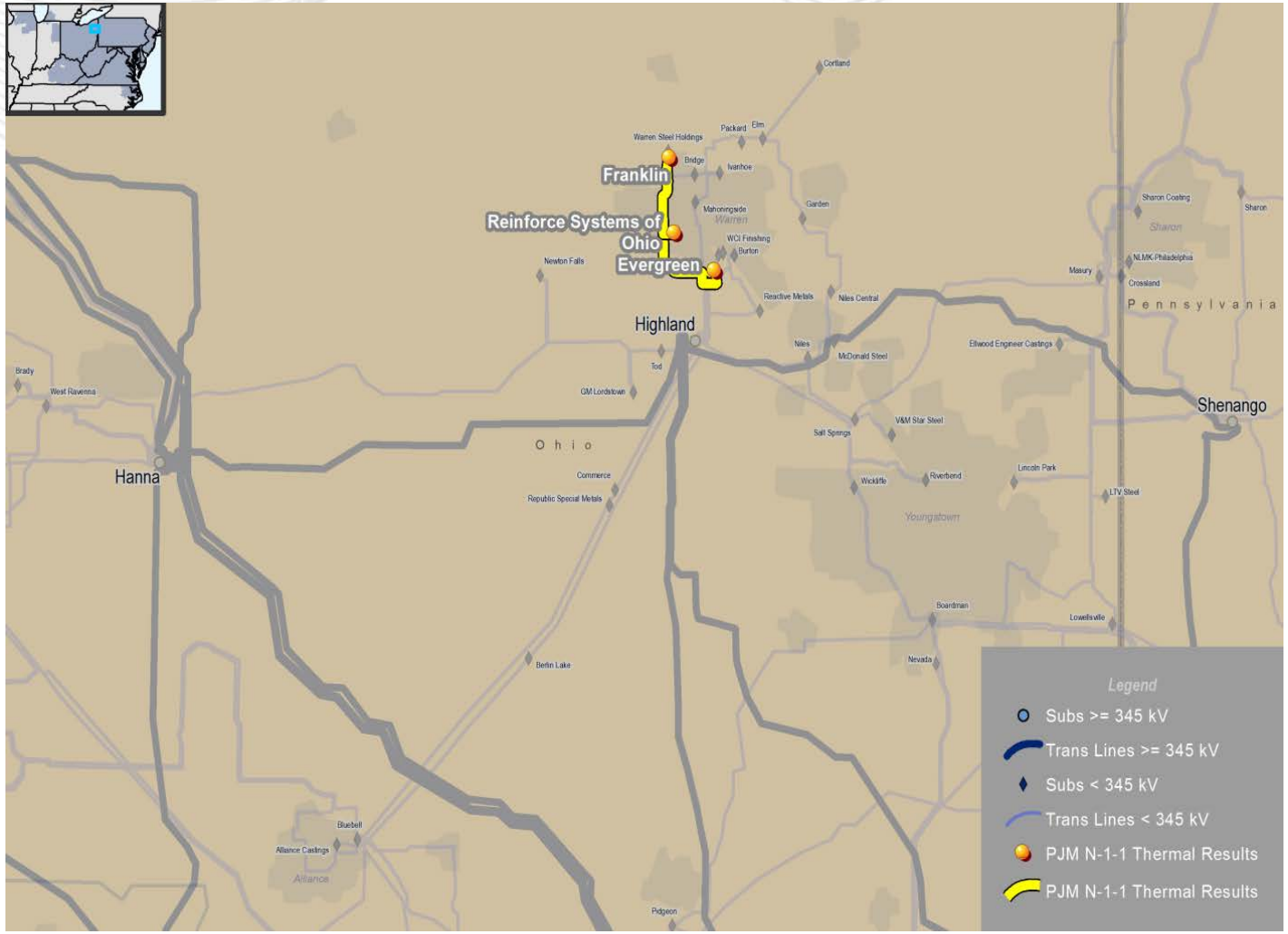
ATSI Transmission Zone

- **N-1-1 Thermal Violation (FG# N2-T1 – T3):**
- Evergreen – RSYSOH – Franklin 138 kV circuit is overloaded for N-1-1 contingency loss of the Niles – Niles Central and Mahoningside – Ivanhoe 138 kV circuits.

- **Alternatives considered:**
  - 2015_1-4C ($4.6 M)
  - 2015_1-8V ($19.6 M)
  - 2015_1-8AD ($19.4 M)

- **Recommended Solution:**
  - Rebuild the 6.6 miles of Evergreen to Ivanhoe 138 kV circuit with 477 ACSS conductor. (2015_1-4C) (B2674)
- **Estimated Project Cost:** $4.6 M

- **Required IS Date:** 6/1/2020



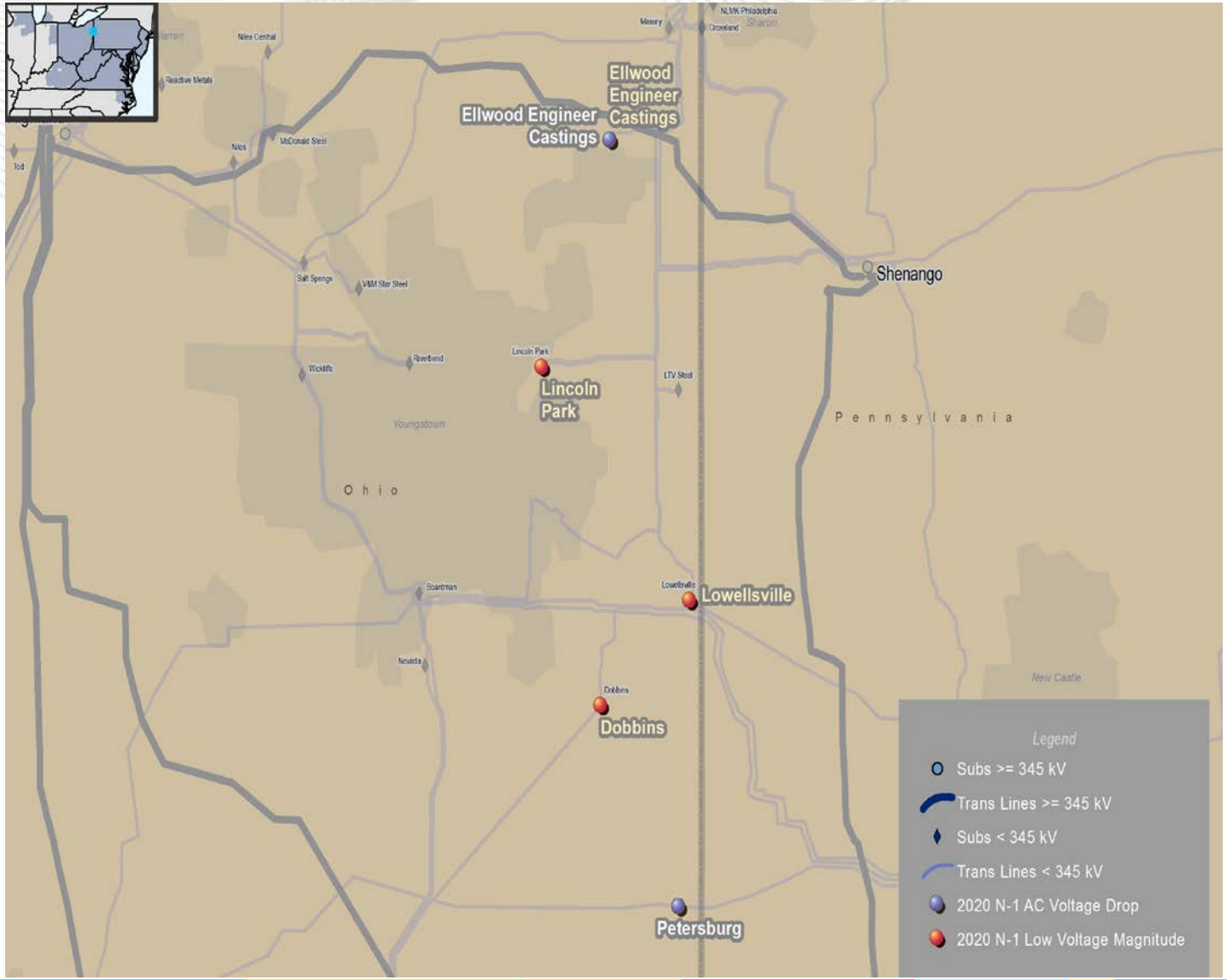
ATSI Transmission Zone

- **Baseline Voltage Violation (FG# N1-VM2 - VM13, N1-VD2 and VD3):**
- Voltage magnitude and drop violation on the Dobbins, Ellwood, Lincoln Park, Lowellsville and Pennant 138 kV substations for several contingencies.

- **Alternatives considered:**
  - 2015_1-4B ($1.015 M)
  - 2015_1-8AA ($12 M)
  - 2015_1-8AB ($6 M)
  - 2015_1-8AC ($6 M)

- **Recommended Solution:**
  - Install 26.4 MVAR capacitor and associated terminal equipment at Lincoln Park 138 kV substation. (2015_1-4B) (B2675)
- **Estimated Project Cost:** $1.015 M

- **Required IS Date:** 6/1/2020



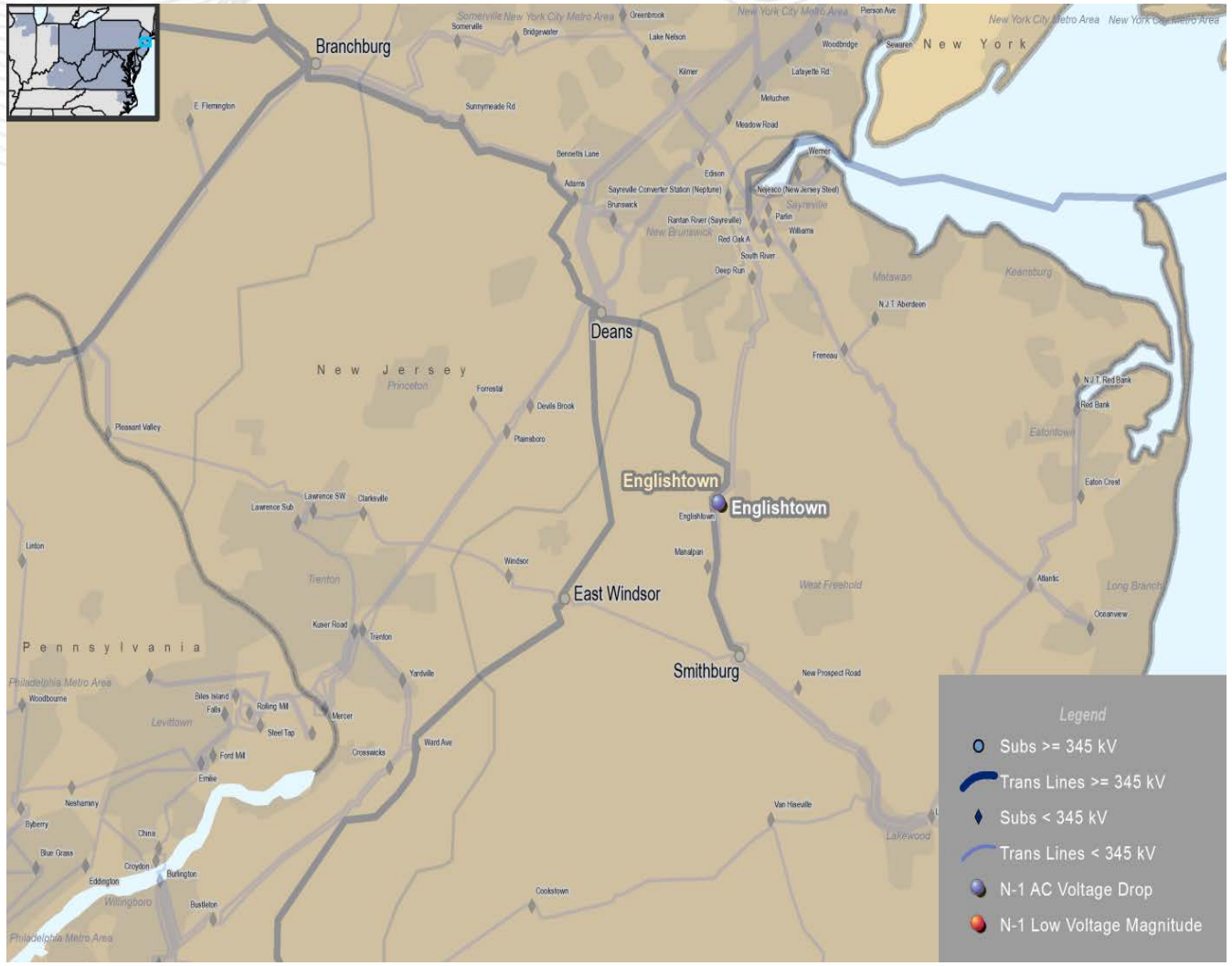
JCPL Transmission Zone

- **Baseline and N-1-1 Voltage Violation (FG# N1-VD1, N2-VD2, N2-VD3 and N2-VD4):**
- Voltage drop violation at the Englishtown 230 kV substation for several contingencies

- **Alternatives considered:**
  - 2015_1-4E ($5.924 M)
  - 2015_1-4F ($1.5 M)
  - 2015_1-7B ($39.8 M)
  - 2015_1-7C ($48.5 M)
  - 2015_1-8I ($17.1 M0
  - 2015_1-8J ($26 M)

- **Recommended Solution:**
  - Install one (1) 72 MVAR fast switched capacitor at the Englishtown 230 kV substation. (2015_1-4F) (B2676)
- **Estimated Project Cost:** $1.5 M

- **Required IS Date:** 6/1/2020



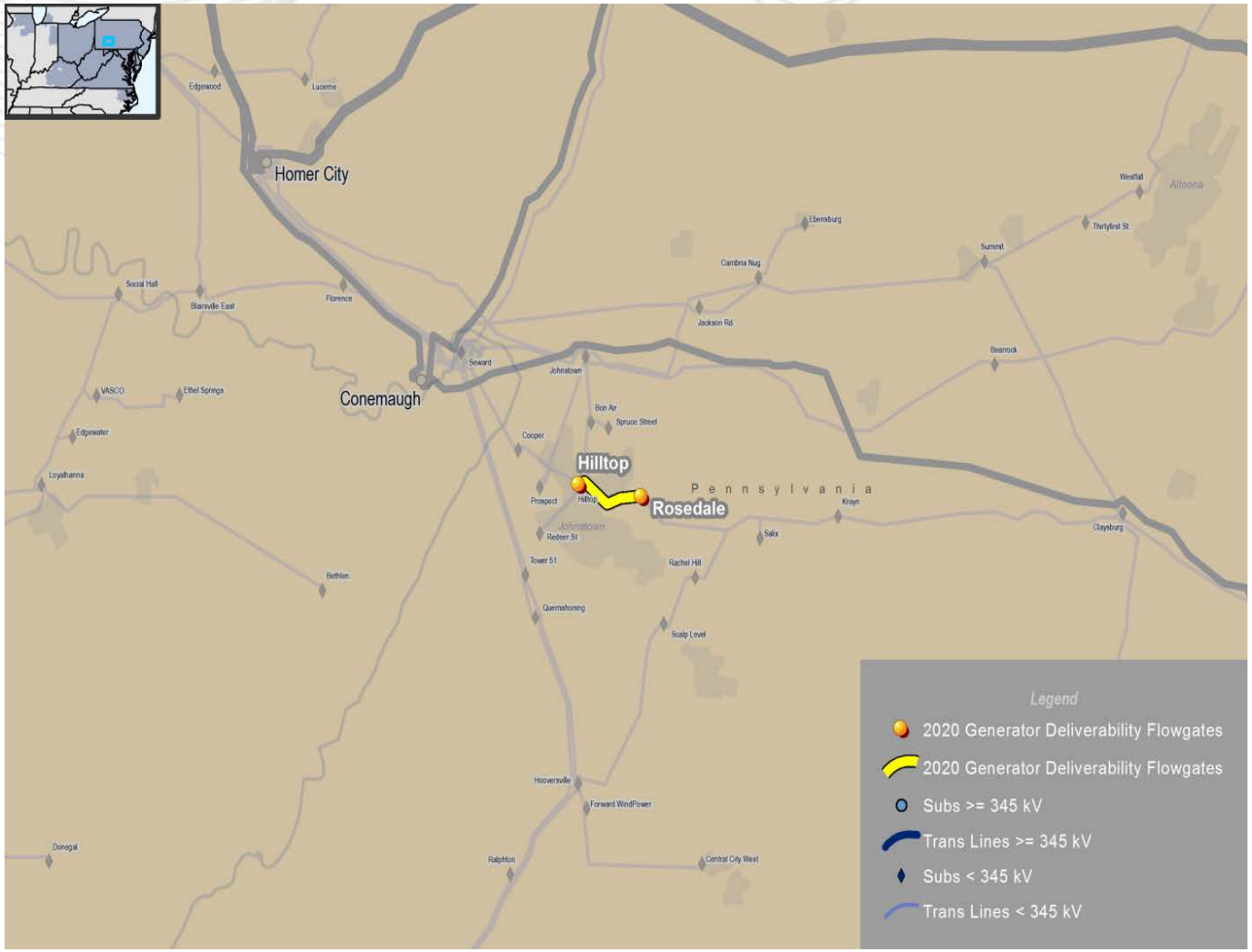
PenElec Transmission Zone

- **Baseline and Common Mode Outage (FG # 204 and 674):**
- Rosedale – Hill top 115 kV circuit is overloaded for tower line outage of Homer City – Hooversville 230 kV and Seward – Tower 115 kV circuits.

- **Alternatives considered:**
  - 2015_1-4P ($0.6 M)
  - 2015_1-5C ($21.4 M)
  - 2015_1-8A ($59.4 M)
  - 2015_1-8B ($58.1 M)

- **Recommended Solution:**
  - Replace wave trap, bus conductor and relay at Hilltop 115 kV substation. Replace relays at Prospect and Cooper substations. (2015_1-4P) (b2677)
- **Estimated Project Cost:** $0.6 M

- **Required IS Date:** 6/1/2020



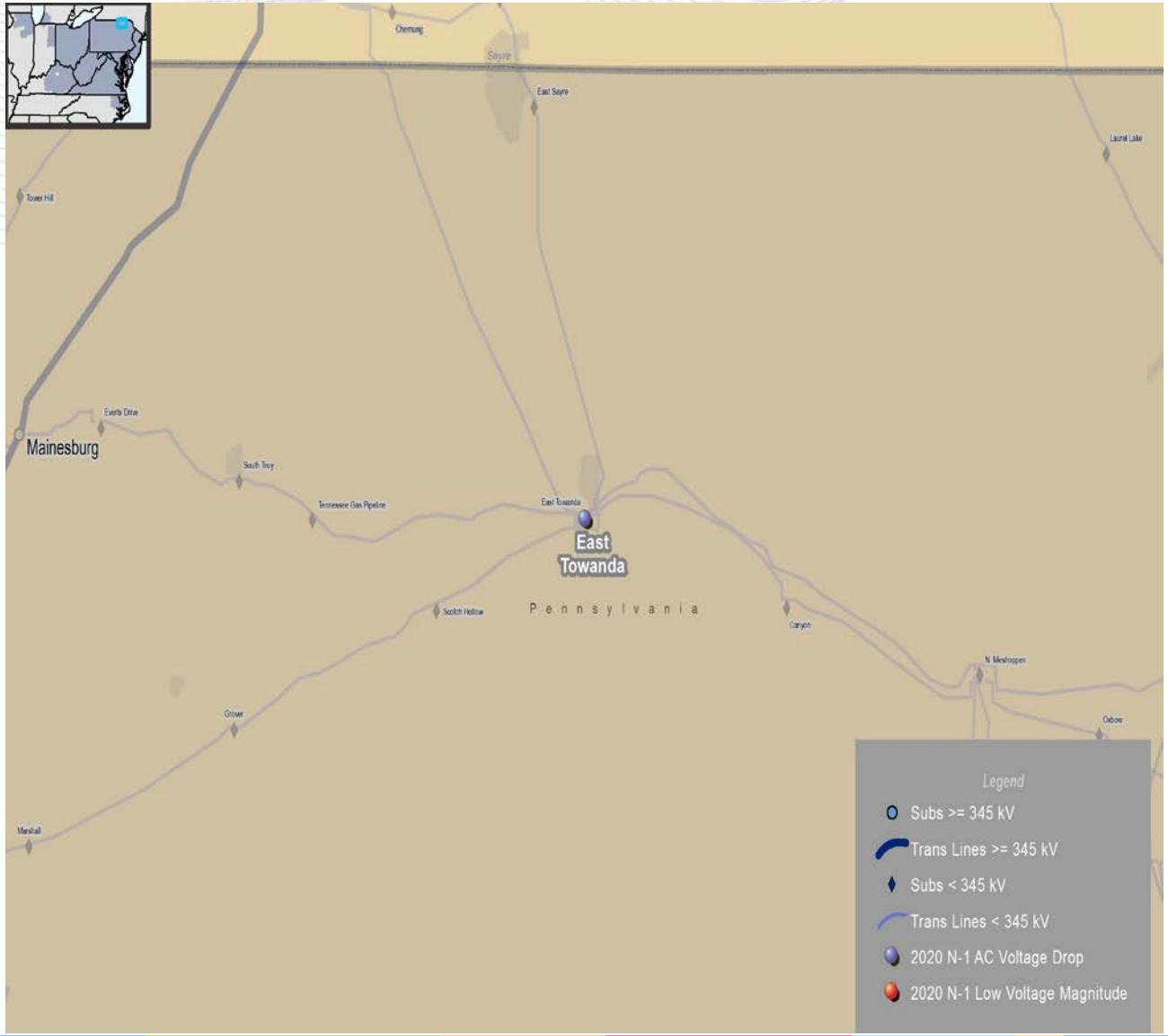
PenElec Transmission Zone

- **Baseline Voltage Violation (FG# N1-VD4):**
- Voltage drop violation at Towanda 115 kV bus section for line fault stuck breaker contingencies loss of another Towanda 115 kV bus section.

- **Alternatives considered:**
  - 2015_1-4O ($13.25 M)

- **Recommended Solution:**
  - Convert the East Towanda 115 kV substation to breaker and half configuration. (2015_1-4O) (B2678)
- **Estimated Project Cost:** $13.25 M

- **Required IS Date:** 6/1/2020



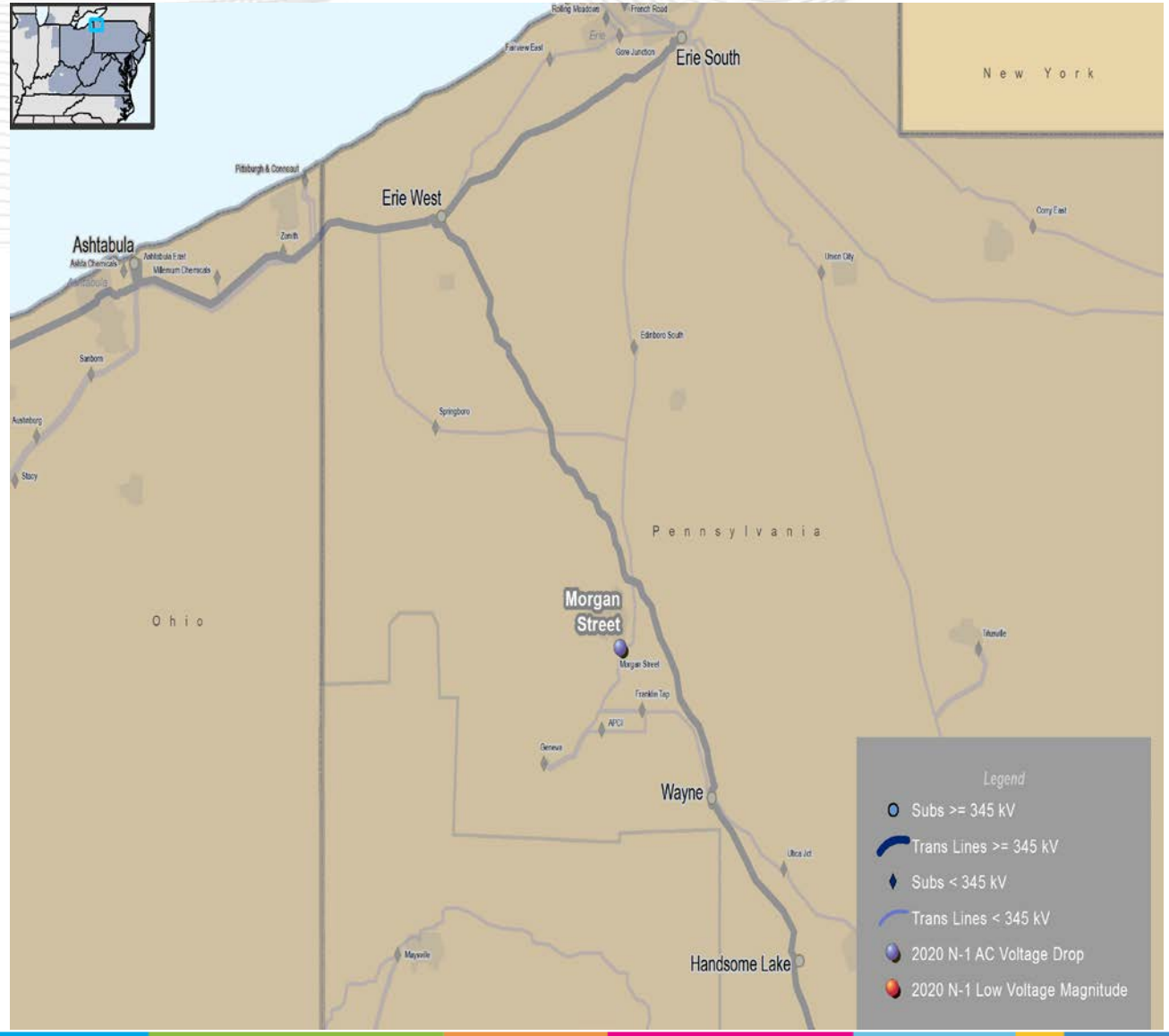
PenElec Transmission Zone

- **Baseline Voltage Violation (FG# N1-VD7):**
- Voltage drop violation at Morgan St. 115 kV bus substation for line fault stuck breaker contingencies loss of Morgan St – Edinboro South – Erie South 115 kV circuit.

- **Alternatives considered:**
  - 2015_1-4M ($1.066 M)
  - 2015_1-8F ($45.3 M)
  - 2015_1-8G ($45.3 M)
  - 2015_1-8H ($29.9 M)
  - 2015_1-8O ($45.3 M)
  - 2015_1-8P ($45.4 M)
  - 2015_1-8Q ($30 M)

- **Recommended Solution:**
  - Install 115 kV Venango Jct. line breaker at Edinboro South. (2015_1-4M) (B2679)
- **Estimated Project Cost:** $2.066 M

- **Required IS Date:** 6/1/2020



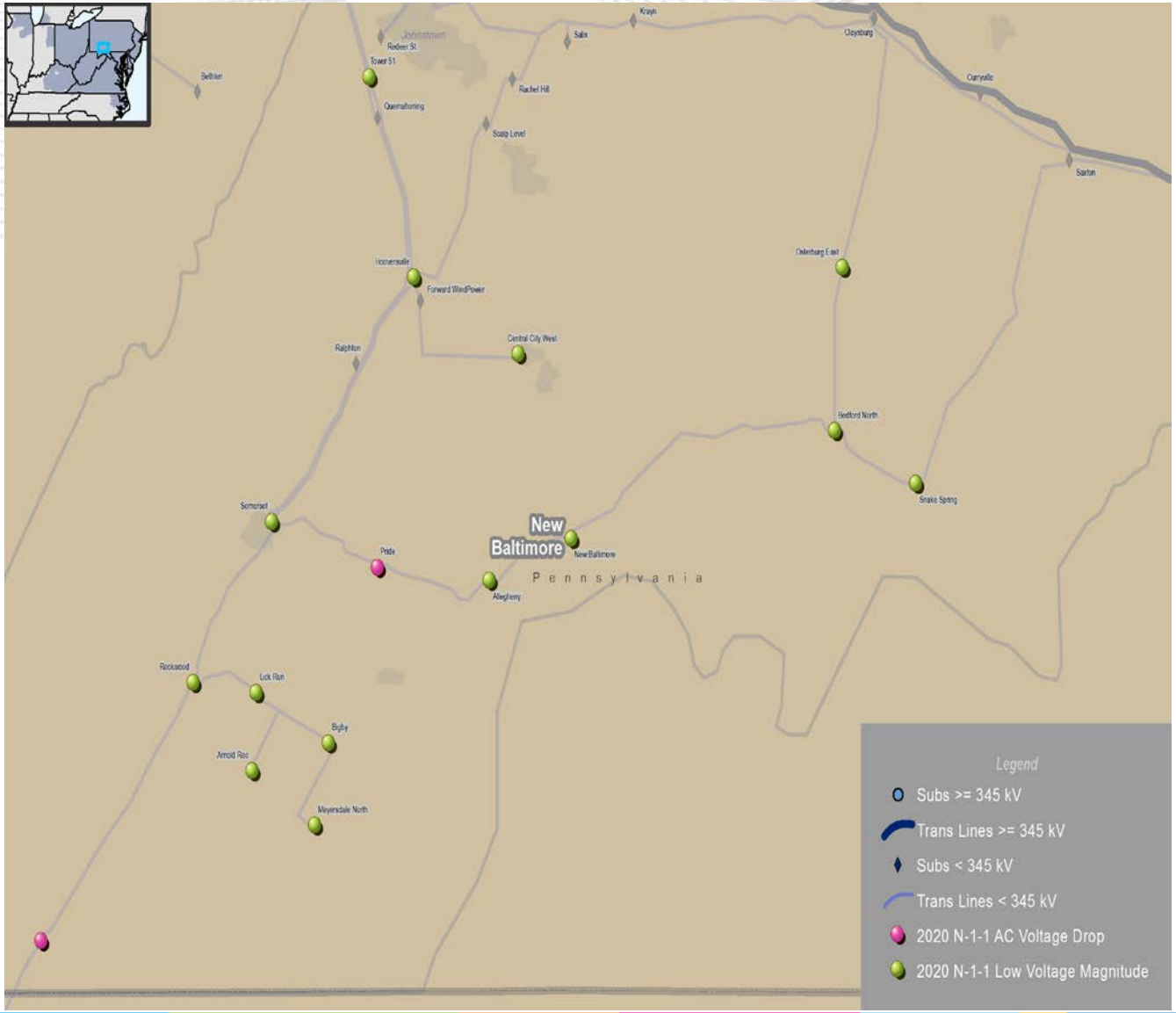
PenElec Transmission Zone

- **N-1-1 Voltage Violation (several FGs):**
- Voltage magnitude and drop violation on several 115 kV substations along the Hooversville- Somerset – New Baltimore – Bedford North circuit for several N-1-1 contingencies.

- **Alternatives considered:**
  - 2015_1-4I ($0.725 M)
  - 2015_1-5C ($21.4 M)
  - 2015_1-8A ($59.4 M)
  - 2015_1-8B ($58.1 M)

- **Recommended Solution:**
  - Install 115 kV breaker on Hooversville #1 115/23 kV transformer. (2015_1-4I) (B2680)
- **Estimated Project Cost:** $0.725 M

- **Required IS Date:** 6/1/2020



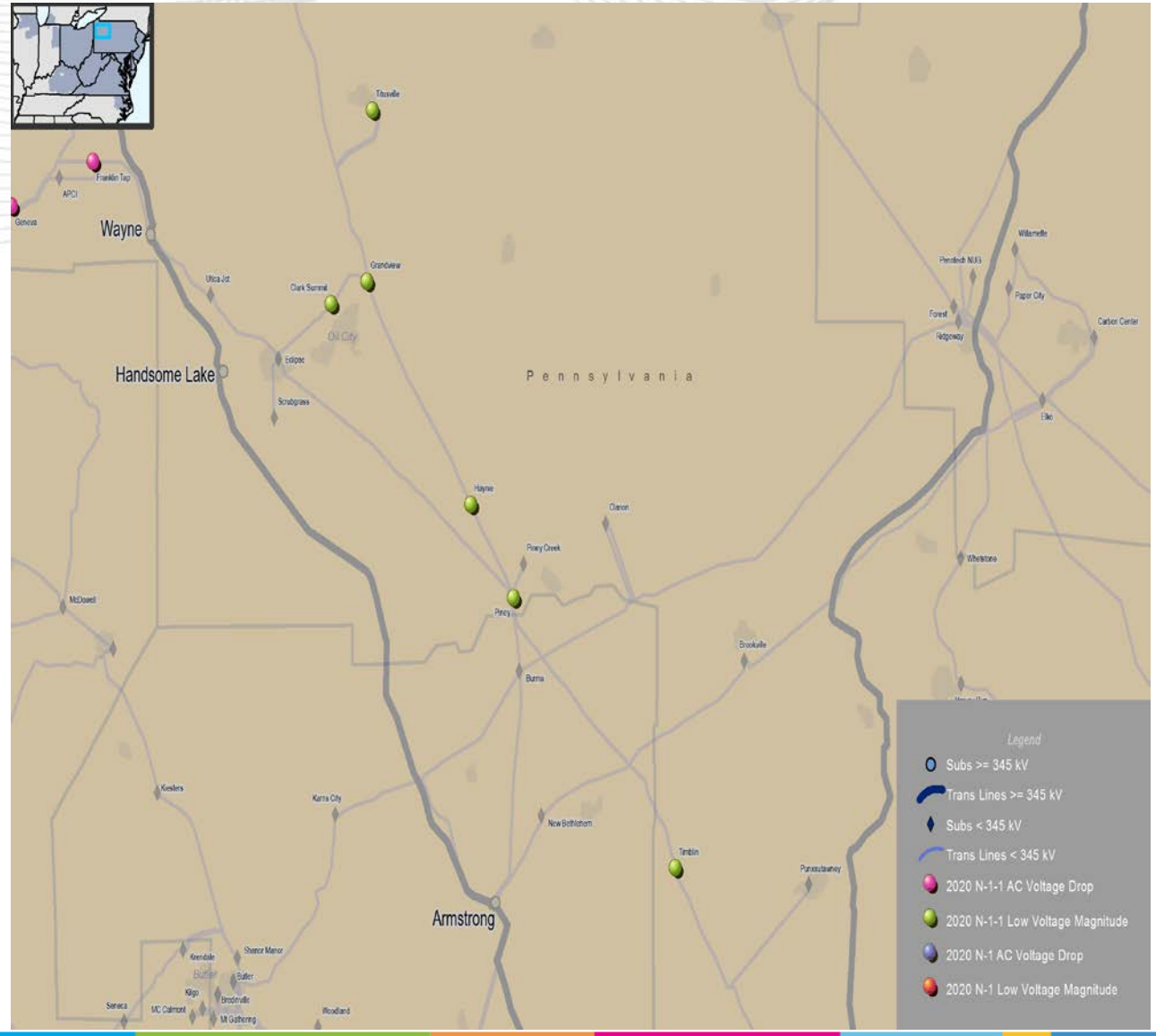
PenElec Transmission Zone

- **N-1-1 Voltage Violation (Several FG # N2-VM11, N2-VM14-25 and N2-VD40-45):**
- Voltage magnitude and drop violation on the Grandview, Clark Summit, Titusville, Haynie, Piney and Timblin 115 kV substations for several N-1-1 contingency pairs.

- **Alternatives considered:**
  - 2015_1-4J ($0.383 M)
  - 2015_1-8F ($45.3 M)
  - 2015_1-8G ($45.3 M)
  - 2015_1-8H ($29.9 M)
  - 2015_1-8O ($45.3 M)
  - 2015_1-8P ($45.3 M)
  - 2015_1-8Q ($30 M)

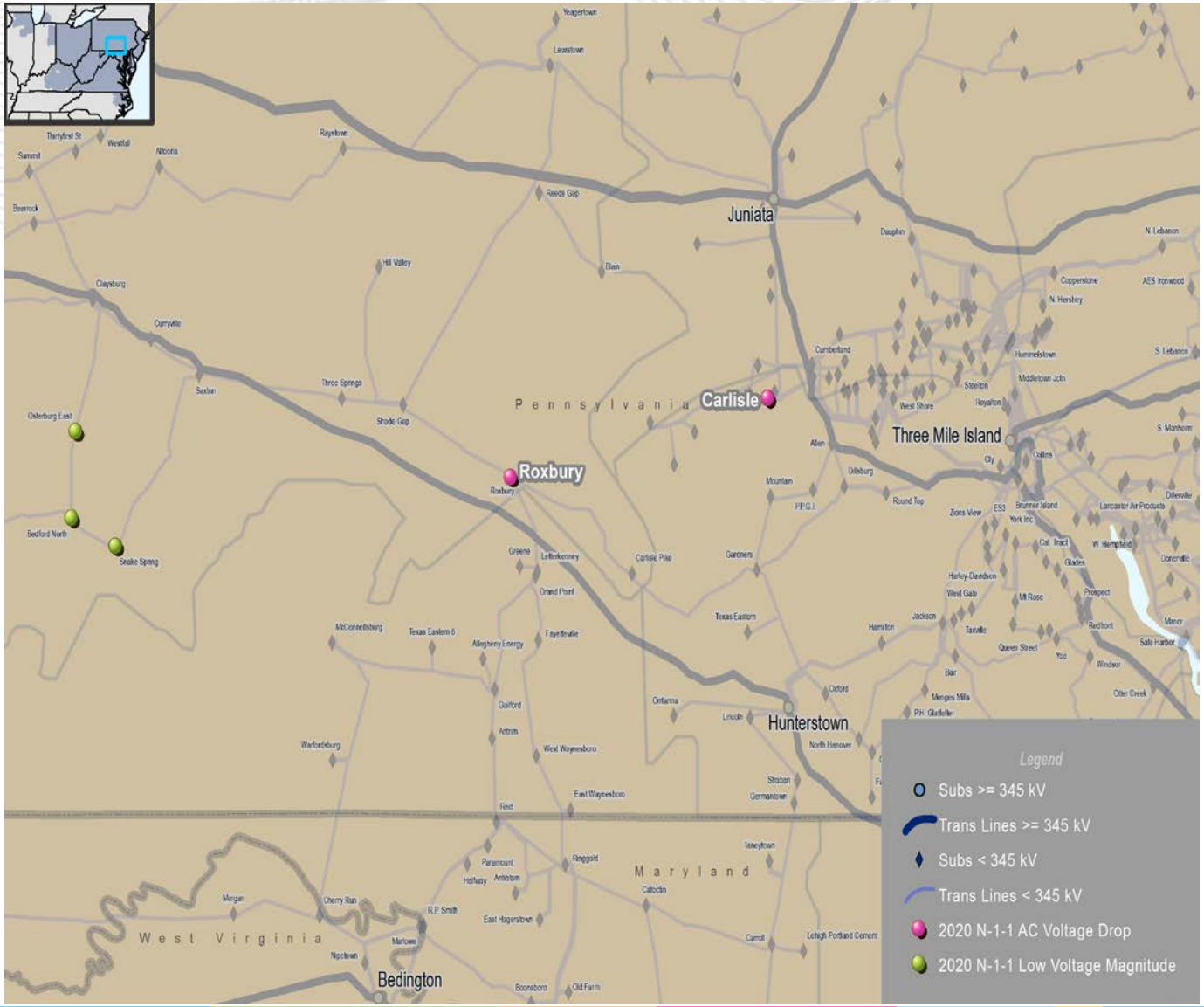
- **Recommended Solution:**
  - Install a 115 kV breaker on the Eclipse #2 115/34.5 kV transformer. (2015_1-4J) (B2681)
- **Estimated Project Cost:** $0.383 M

- **Required IS Date:** 6/1/2020



PenElec Transmission Zone

- **N-1-1 Voltage Violation (FG# N2-VD46, N2-VD47, N2-VD53, N2-VD60, N2-VD61 and N2-V72):**
- Voltage drop violation on the Carlisle Pike and Roxbury115 kV substations for several N-1-1 contingency pairs.
- **Alternatives considered:**
  - 2015_1-4H ($2.5 M)
  - 2015_1-5D ($22.9 M)
  - 2015_1-5E ($16.89 M)
  - 2015_1-8K ($21.5 M)
  - 2015_1-8L ($22.2 M)
  - 2015_1-8M ($21.7 M)
  - 2015_1-8N ($22.3 M)
  - 2015_1-8T ($16.9 M)
  - 2015_1-8U ($32.3 M)
- **Recommended Solution:**
  - Install two 21.6 MVAR capacitor at the Shade Gap 115 kV substation. (2015_1-4H)
    (B2682)
- **Estimated Project Cost:** $2.5 M
- **Required IS Date:** 6/1/2020



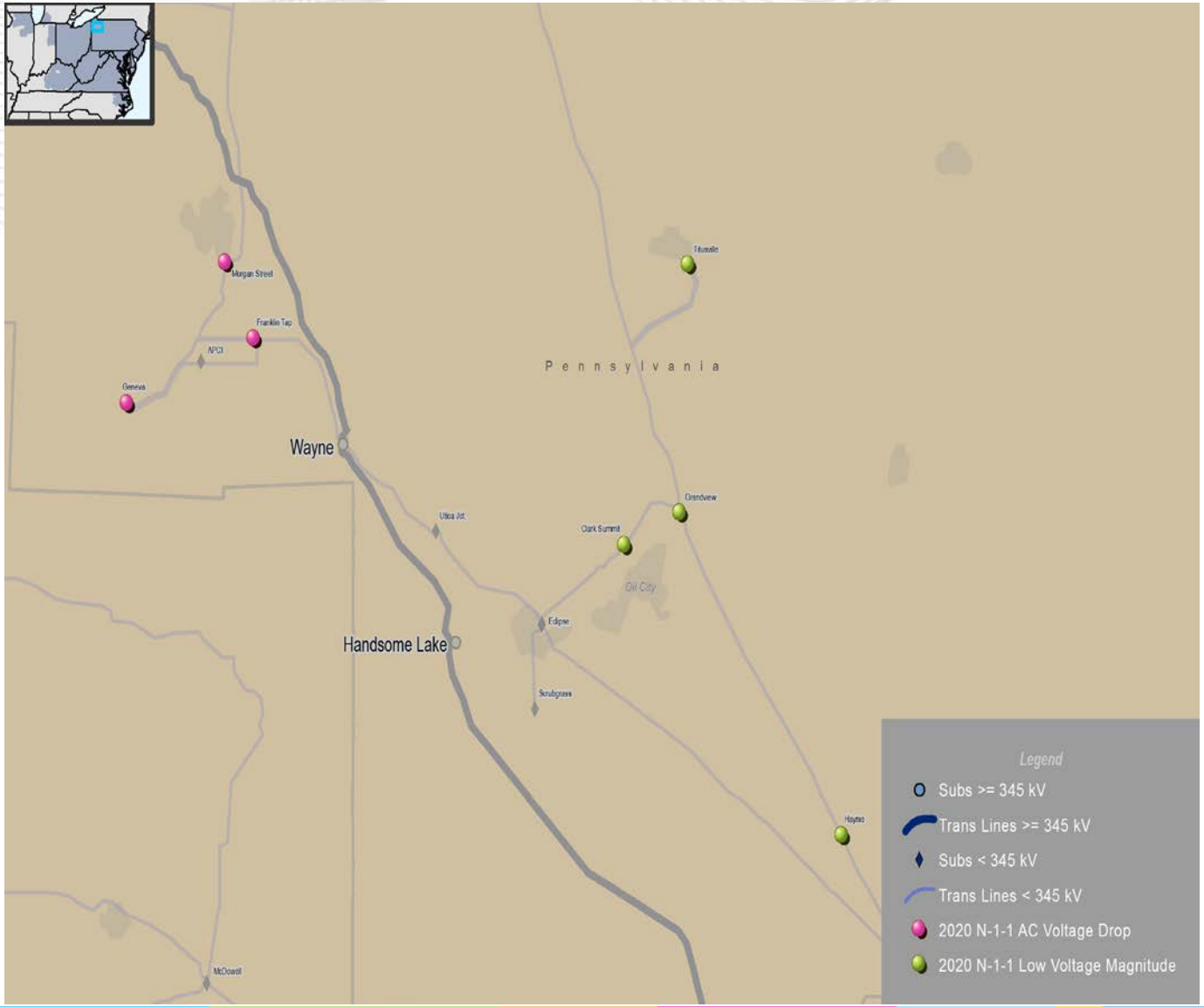
PenElec Transmission Zone

- **N-1-1 Voltage Violation (FG# N2-VD5 - 9):**
- Voltage drop violation on the Morgan St., Geneva, PPGAPI, Frankline115 kV kV substations for N-1-1 contingencies loss of Wayne 345-115 kV transformer and Morgan St. – Springboro – Edinboro South 115 kV circuit.

- **Alternatives considered:**
  - 2015_1-4L ($1.518 M)
  - 2015_1-8F ($45.3 M)
  - 2015_1-8G ($45.3 M)
  - 2015_1-8H ($29.9 M)
  - 2015_1-8O ($45.3 M)
  - 2015_1-8P ($45.4 M)
  - 2015_1-8Q ($30 M)

- **Recommended Solution:**
  - Install a 36 MVAR 115 kV capacitor and associated equipment at Morgan Street substation. (2015_1-4L) (B2683)
- **Estimated Project Cost:** $1.518 M

- **Required IS Date:** 6/1/2020



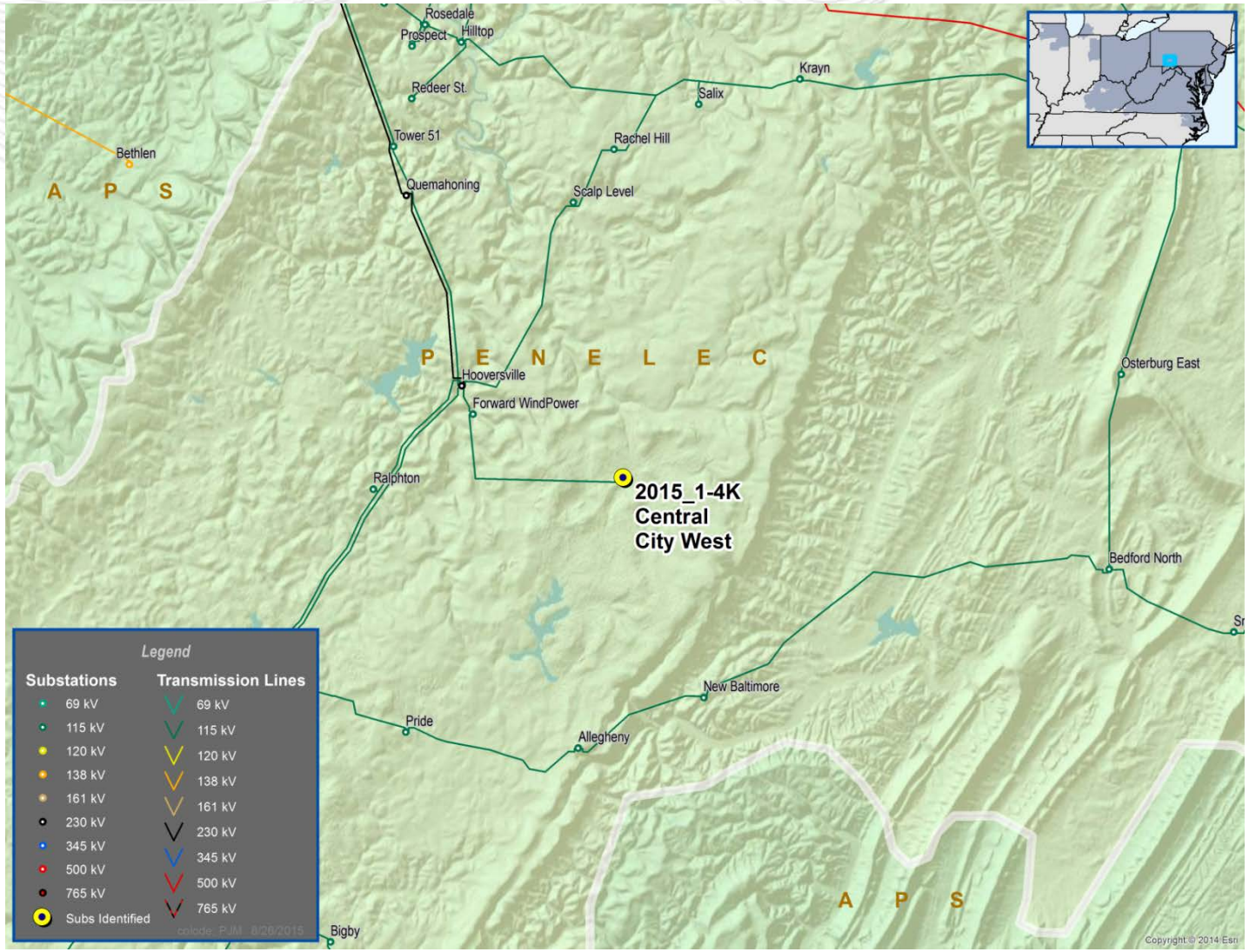
PenElec Transmission Zone

- **N-1-1 Voltage Violation (FG# N2-VM1, N2-VM2, N2-VM3, N2-VM4 and N2-VD40):**
- Voltage magnitude and drop violation on the Bedford North, Snake Springs and Hooversville 115 kV substations for several N-1-1 contingency pairs.

- **Alternatives considered:**
  - 2015_1-4K ($1.5 M)
  - 2015_1-5C ($21.4 M)
  - 2015_1-8A ($59.4 M)
  - 2015_1-8B ($58.1 M)

- **Recommended Solution:**
  - Install 36 MVAR 115 kV capacitor at Central City West substation. (2015_1-4K)
    (B2684)
- **Estimated Project Cost:** $1.5 M

- **Required IS Date:** 6/1/2020



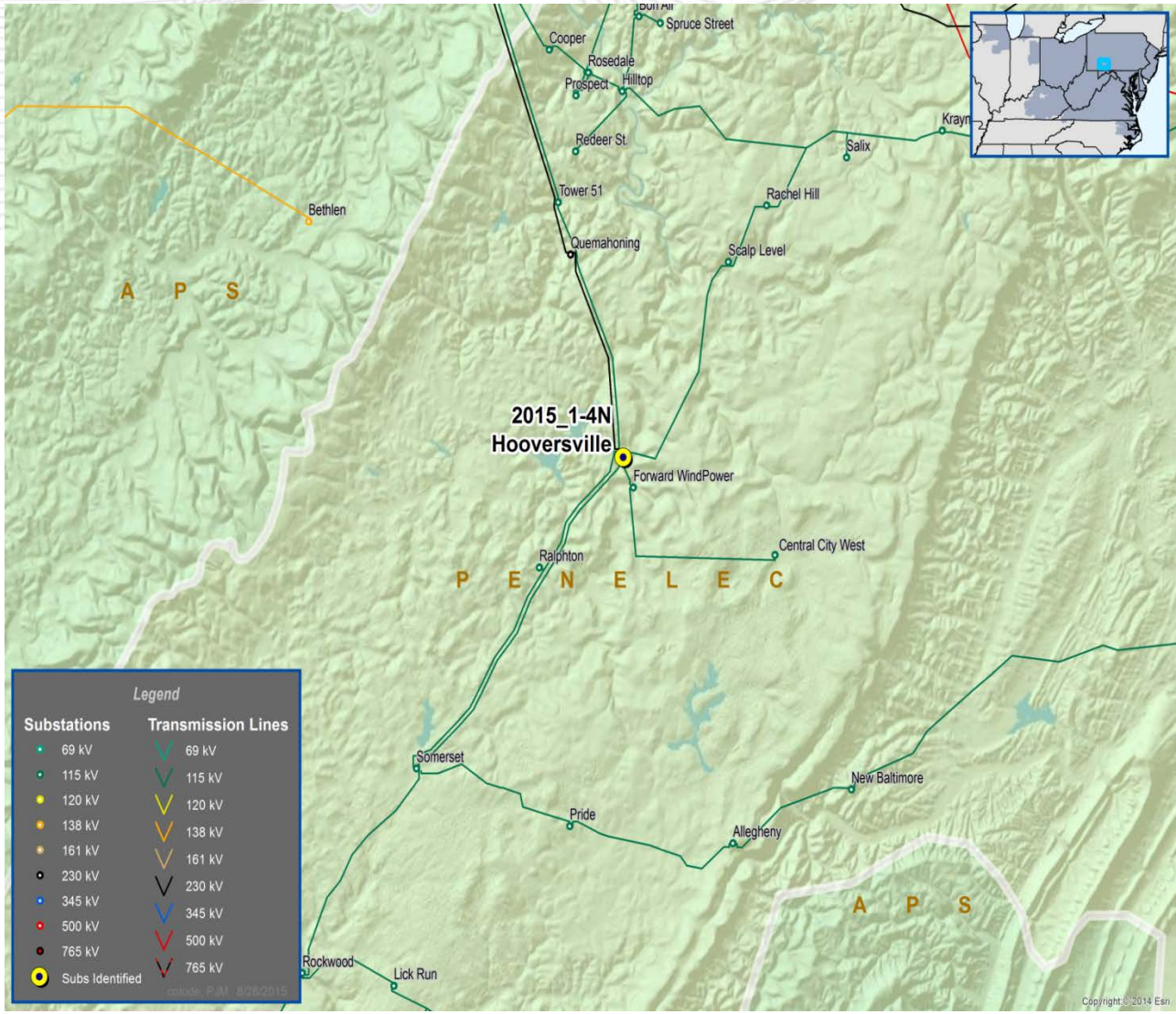
PenElec Transmission Zone

- **Baseline Voltage Violation (FG# N1-VD5 and N1-VD6):**
- Voltage drop violation at Central City West and Ralphton 115 kV substation for line fault stuck breaker contingency loss of 115 kV bus section.

- **Alternatives considered:**
  - 2015_1-4N ($1.419 M)
  - 2015_1-8A ($59.4 M)
  - 2015_1-8B ($58.1 M)

- **Recommended Solution:**
  - Install a second 115 kV 3000A bus tie breaker at Hooversville substation. (2015_1-4N) (B2685)
- **Estimated Project Cost:** $1.419 M

- **Required IS Date:** 6/1/2020

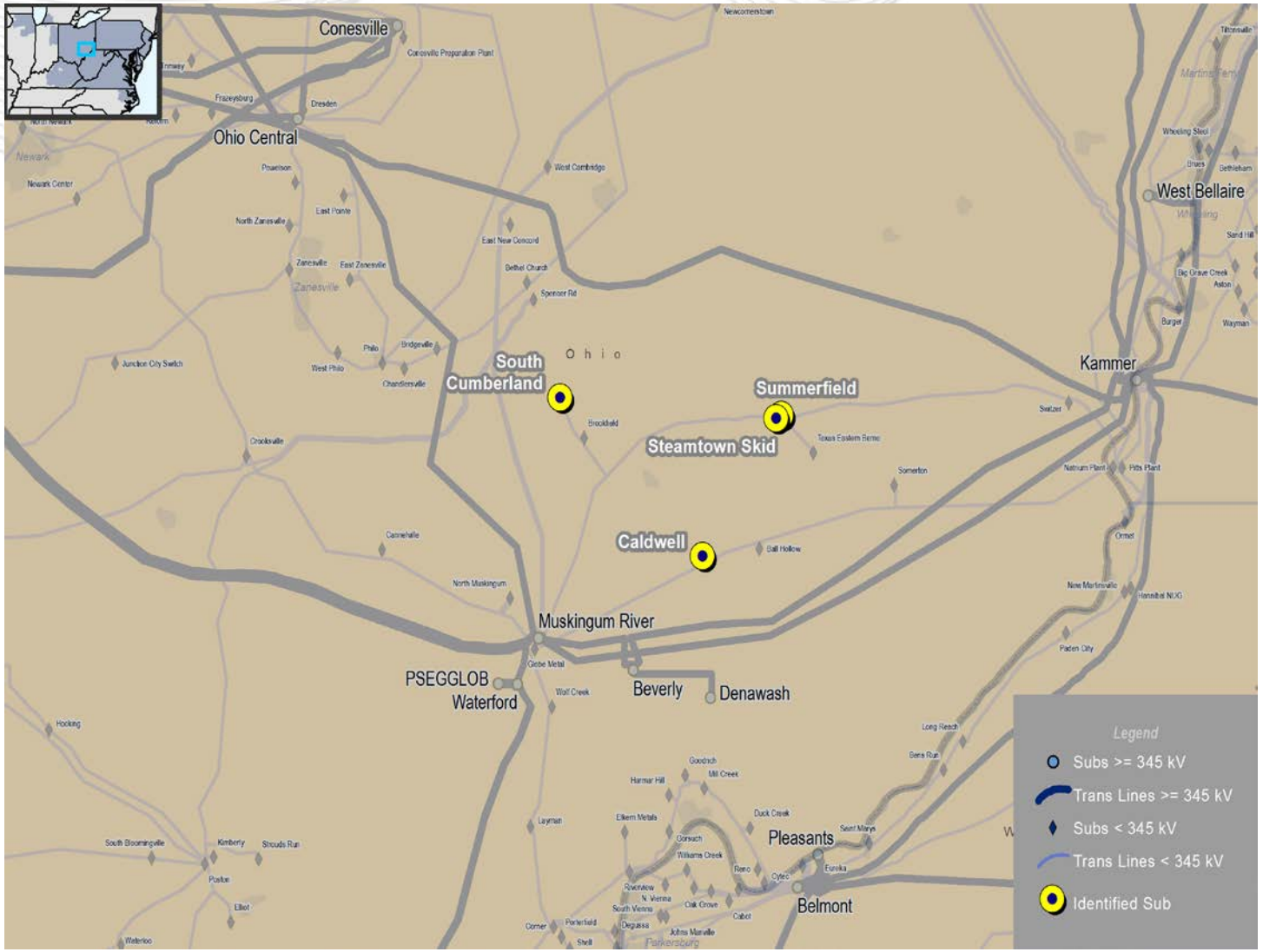


2015 RTEP Proposal Window #1

- Solution alternative evaluations are ongoing for the violations in the AEP zone listed on the next slide.

AEP Transmission Zone

- **N-1-1 Voltage (FG#: N2-VM70 – 76, N2-VD73 – 74):**
- Low voltage at South Cumberland, Summerfield 138kV buses for several contingency pairs
- Low voltage at South Caldwell and Steamtown 138kV buses and voltage drop at South Caldwell and South Cumberland 138kV buses for the loss of the Muskingum – South Caldwell 138kV line and the loss of the Muskingum –East New Concord-West Cambridge 138kV line
- **Alternatives considered:**
  - 2015_1-2L ($25.82 M)
  - 2015_1-8R ($7.4 M)
- **Recommended Solution Status:** Technical Evaluation in progress

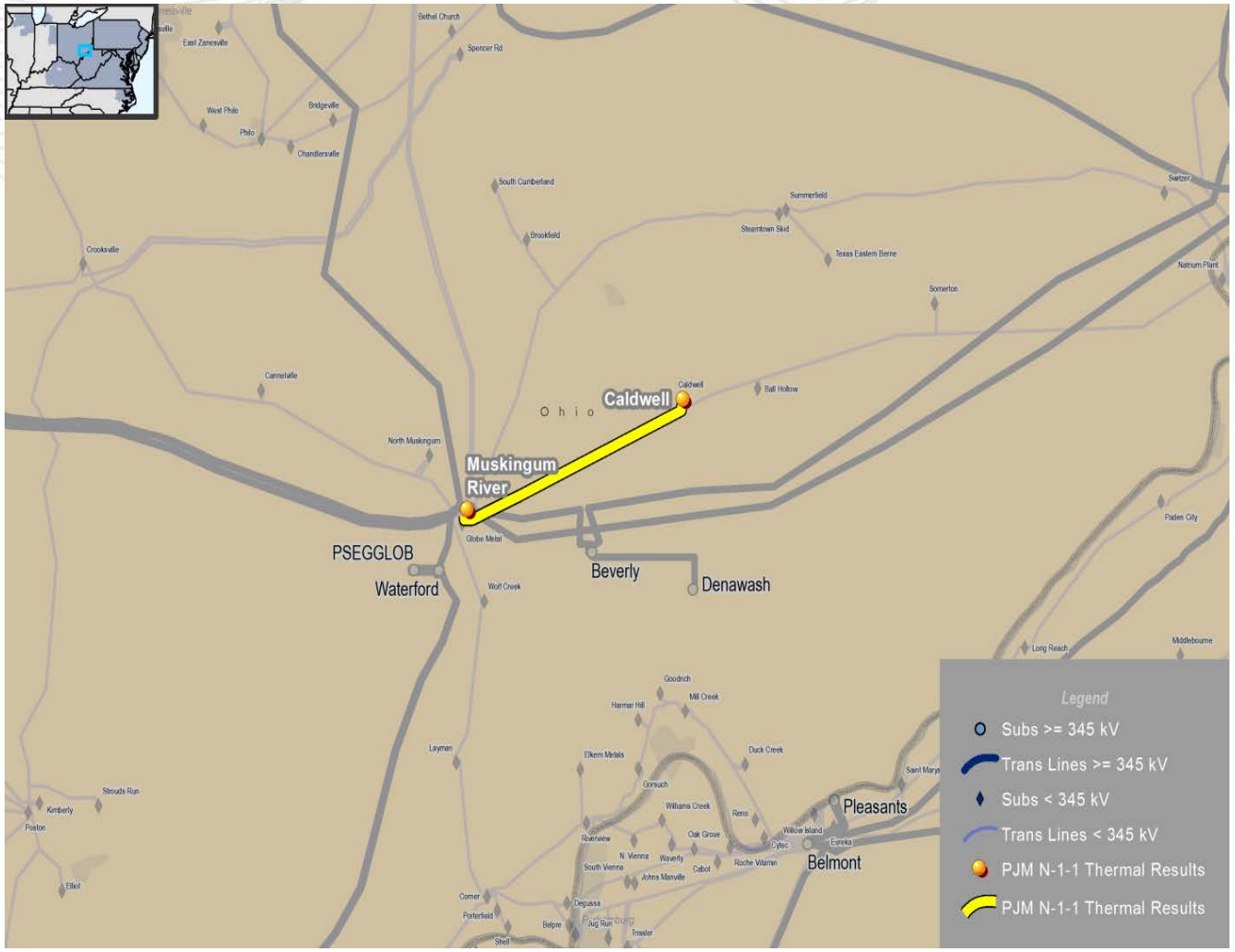


AEP Transmission Zone

- **N-1-1 Thermal Violation (FG# N2-T16 and N2-T17):**
- South Caldwell – Muskingum 138 kV circuit is overloaded for several contingencies.

- **Alternatives considered:**
  - 2015_1-2L ($25.82 M)
  - 2015_1-8R ($7.4 M)
- **Recommended Solution**

  Status: Technical Evaluation in progress



2015 RTEP Proposal Window #1

- The violations in the Dominion zone on the next two slides are attributed to FSA generation.

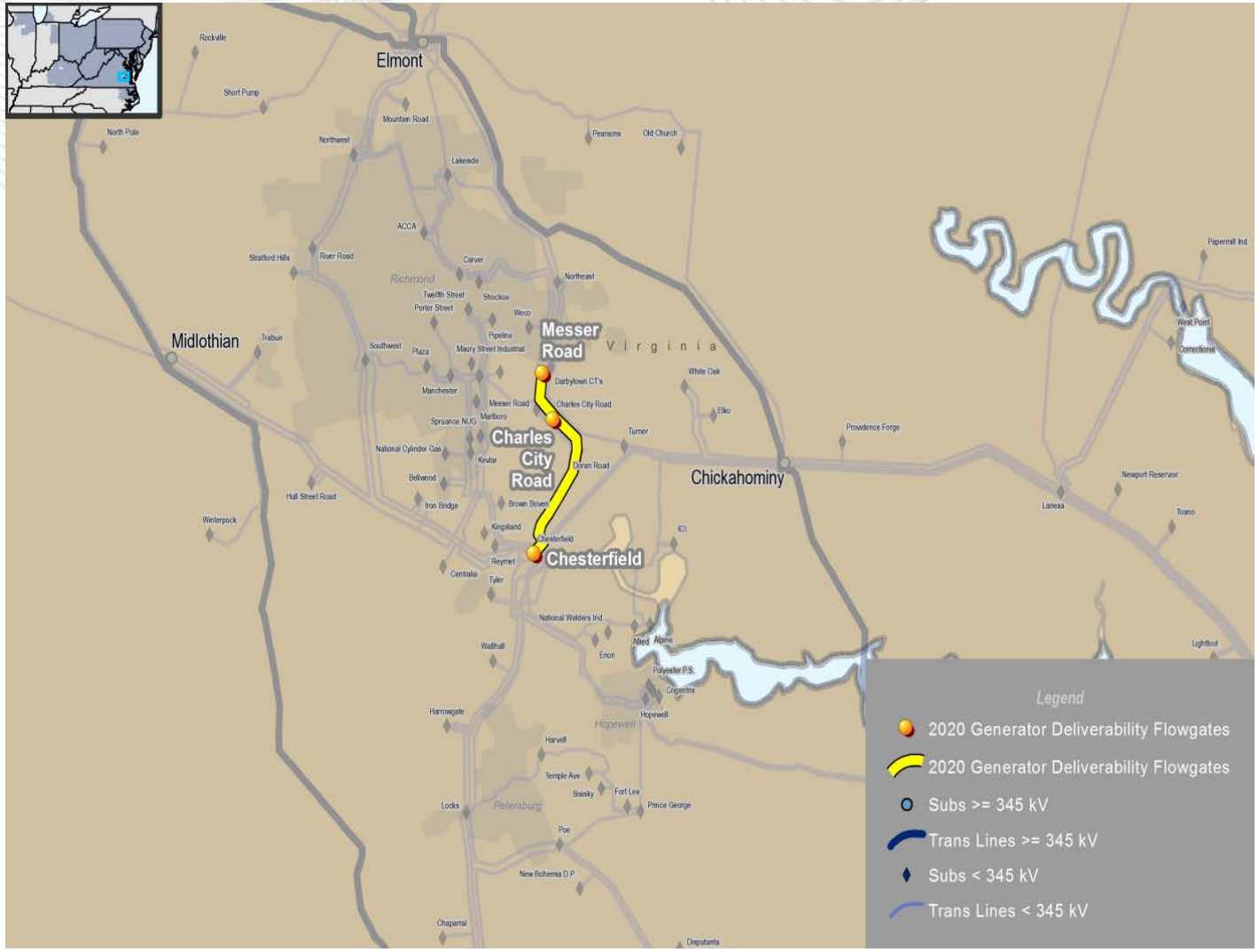
- The FSA generation related reliability violations will be re-evaluated pending a status change of the planned generation.

DOM Transmission Zone

- **Generation Deliverability Violation (FG# New-32, New-34, New-36 and New-37)**
- The Chesterfield – Messer Road – Charles City Road 230kV circuit is overloaded for several contingencies

- **Alternatives considered:**
  - 2015_1-1A ($17.54 M)
  - 2015_1-8S ($15.6 M)
  - 2015_1-8W ($29.4 M)
  - 2015_1-9A ($167.1 M)
  - 2015_1-9B ($118.9 M)
  - 2015_1-9D ($135.2 M)
  - 2015_1-9E ($94.2 M)

- **Status:** These violations have been identified as FSA related generation violations. PJM will perform an evaluation if the associated planned FSA generation signs an ISA



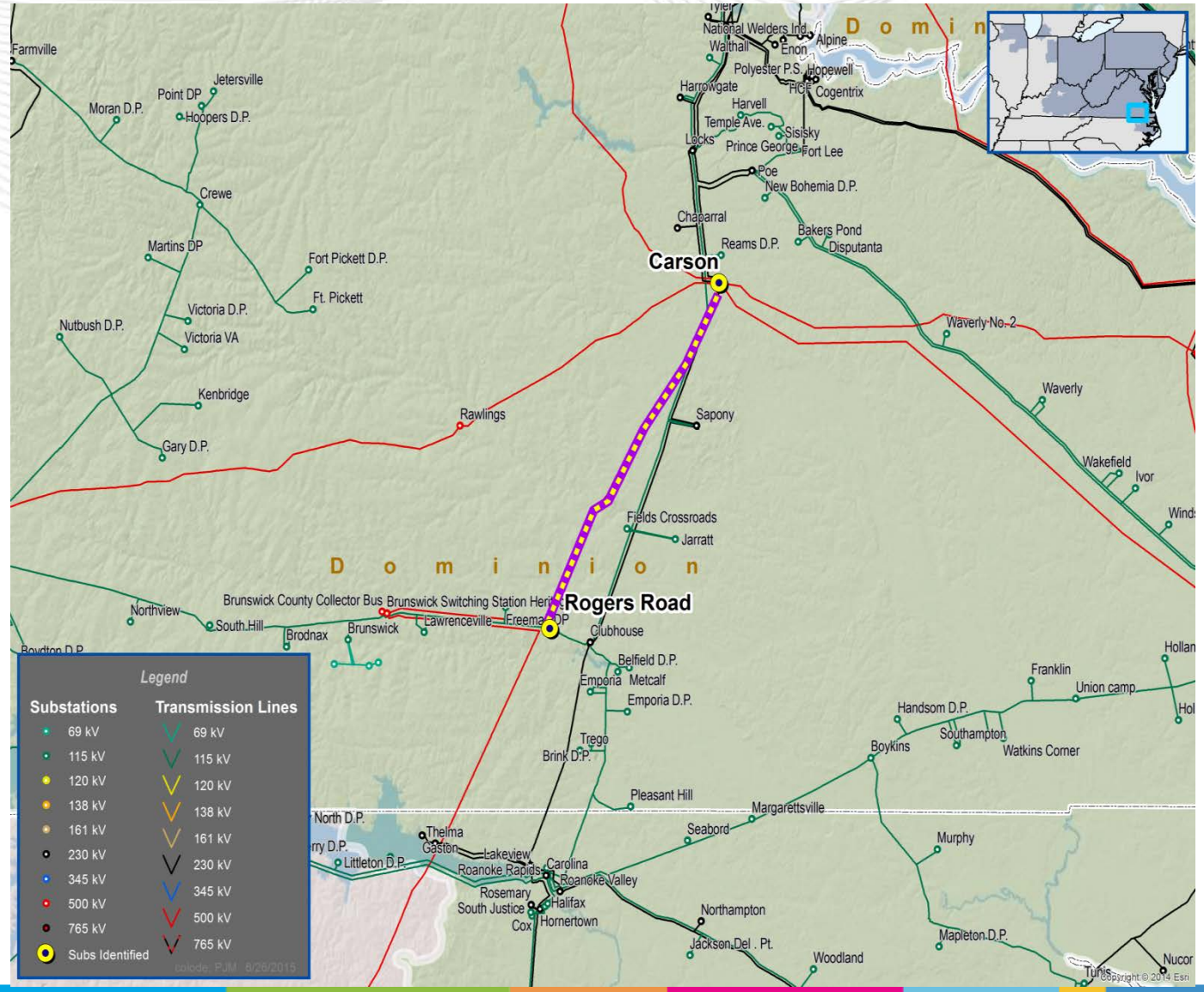
DOM Transmission Zone

- **Generation Deliverability Violation (FG# New-52)**
- The Carson – Rogers Rd 500 kV circuit is overloaded for single contingency loss of the Carson – Rawlings 500 kV circuit.

- **Alternatives considered:**

2015_1-1B	2015_1-1C	2015_1-1D	2015_1-1E
2015_1-1F	2015_1-5F	2015_1-6A	2015_1-6B
2015_1-6C	2015_1-7D	2015_1-8X	2015_1-8Y
2015_1-9A	2015_1-9B	2015_1-9C	2015_1-9D
2015_1-9E			

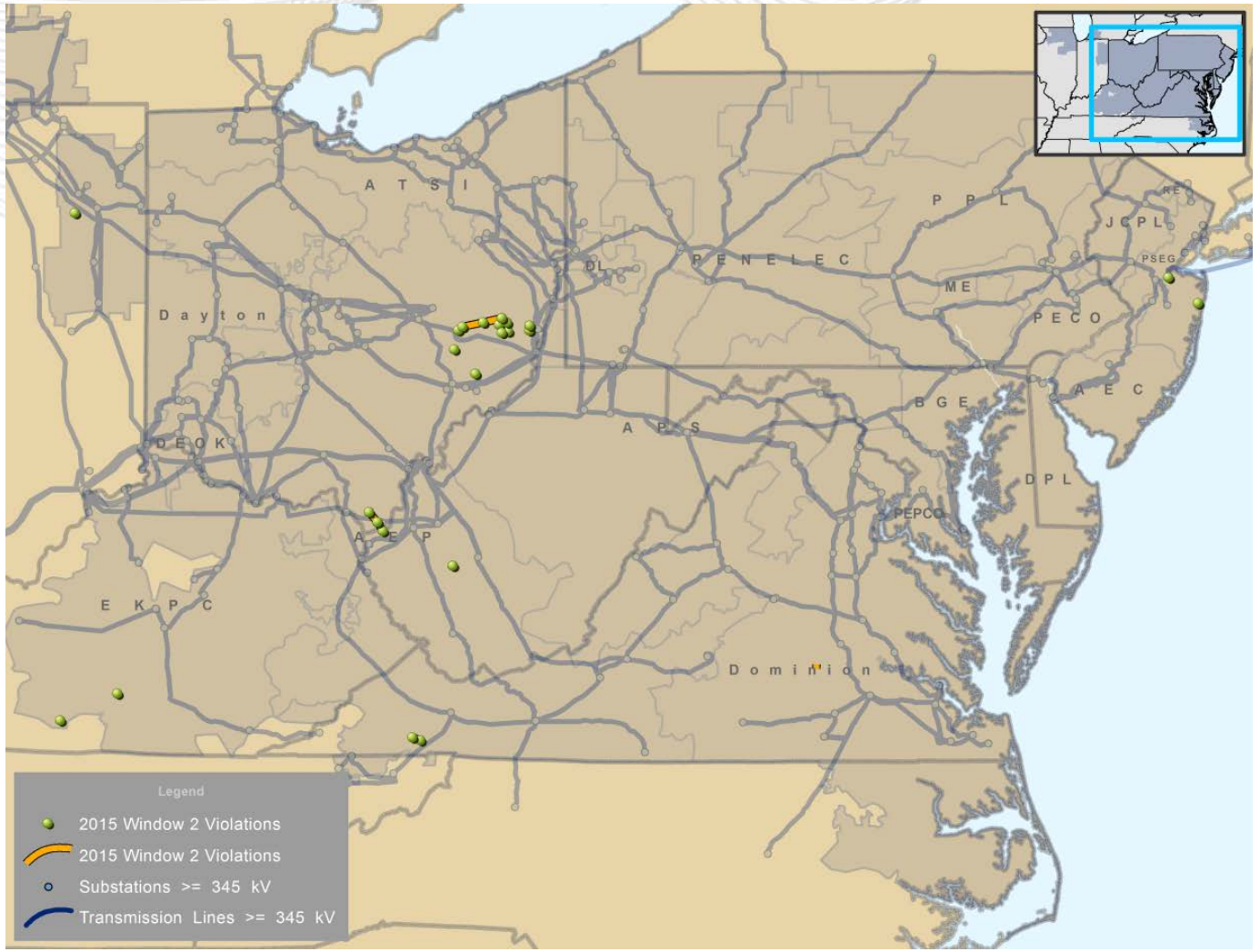
- **Cost: ($27.8 to 167.1 M)**
- **Status:** These violations have been identified as FSA related generation violations. PJM will perform an evaluation if the associated planned FSA generation signs an ISA



2015 RTEP Proposal Window #2

2015 RTEP Proposal Window 2

- Scope: Transmission Owner Criteria, Light Load Reliability Criteria Violations
  - Opened Wednesday August 5th, 2015
  - Closed Friday September 4th, 2015*
    - *All final cost estimates and greenfield proposals due 9/21/2015



- Transmission Owner Criteria Violations by TO and type

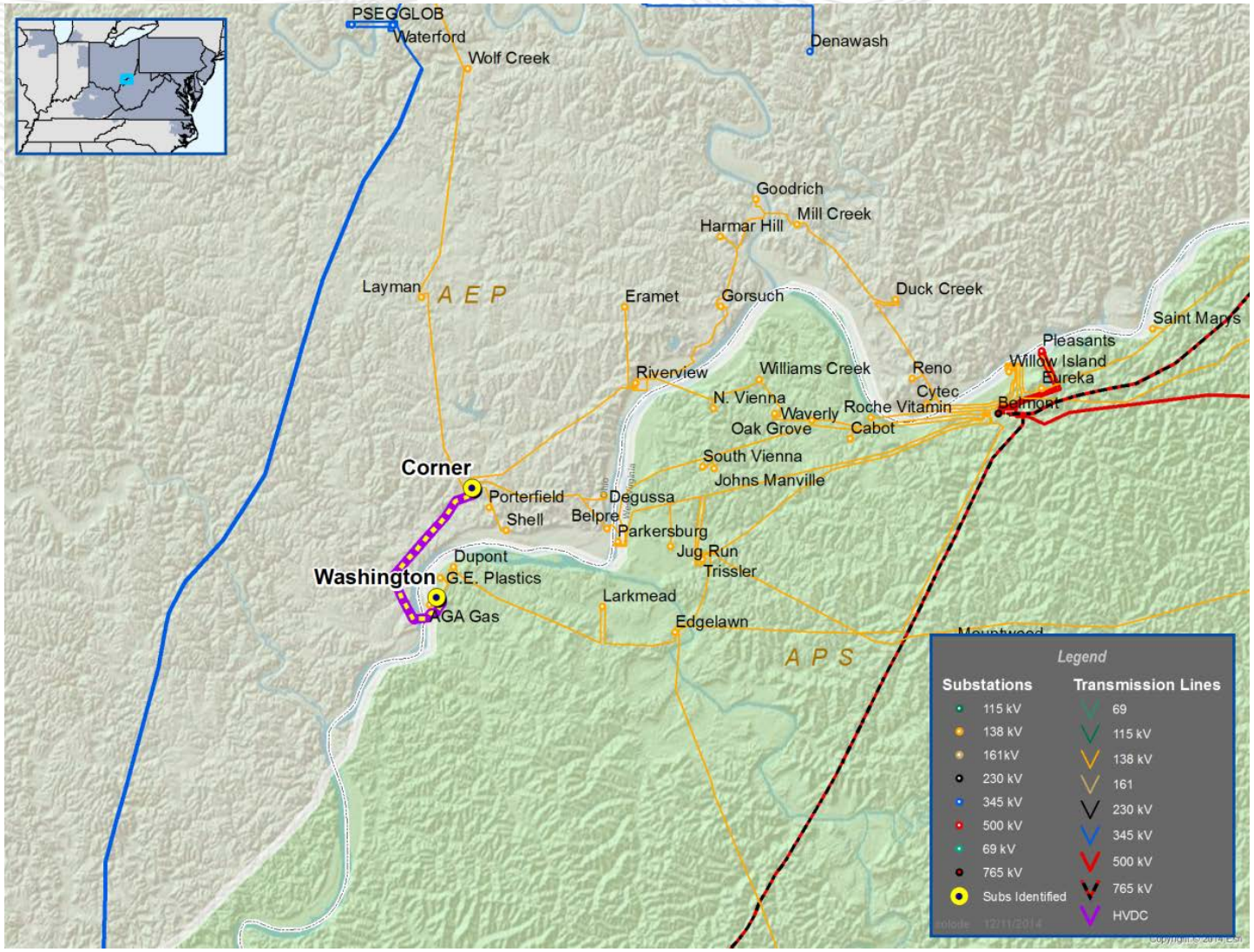
Transmission Owner	Thermal Violations	Voltage Violations
JCPL	4	0
EKPC	1	1
AEP	11	9

- Light Load Reliability Criteria Violations
  - No Light Load Reliability Criteria Violations were identified

Previously Reviewed Baseline Upgrades for the October 2015 PJM Board Recommendation

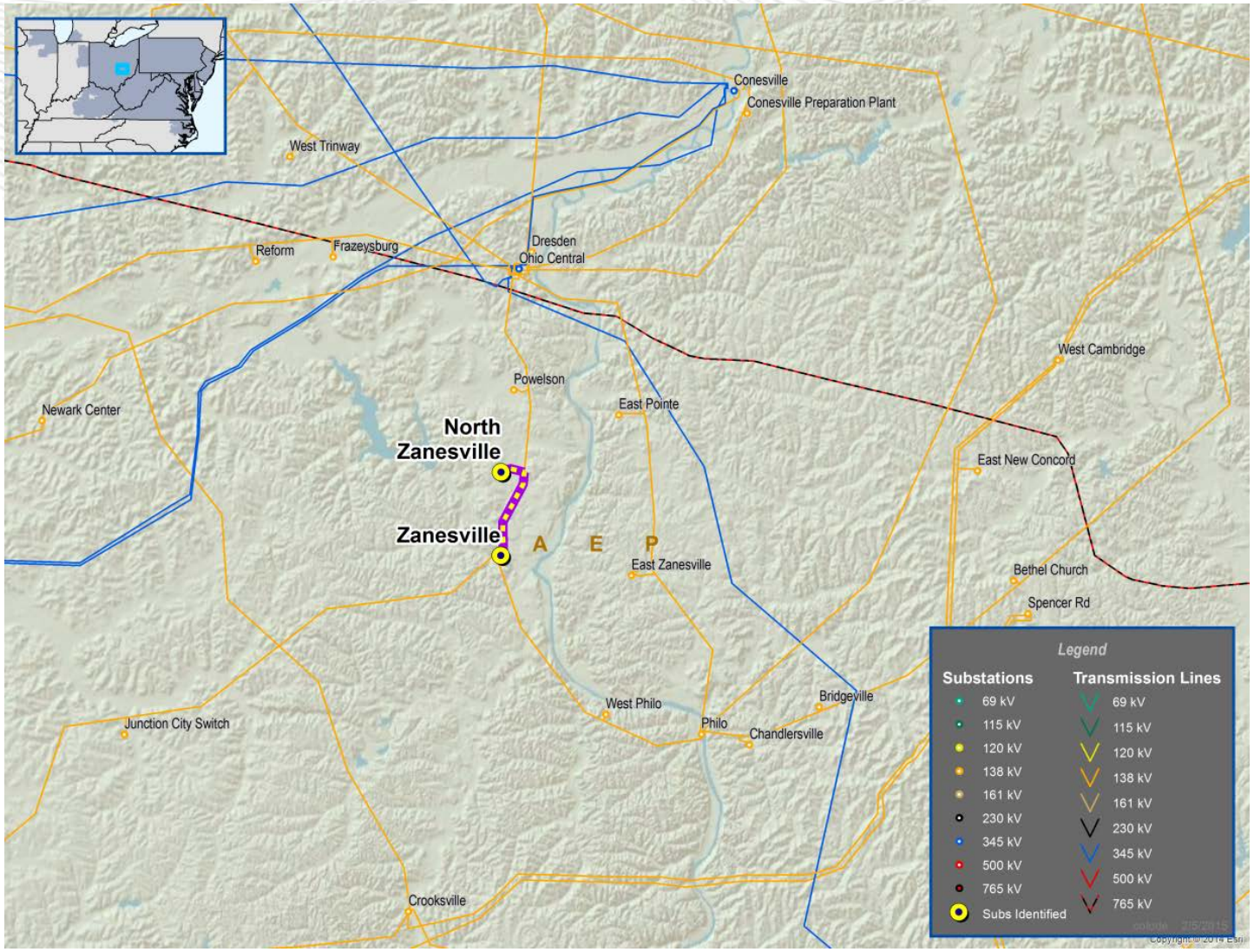
AEP Transmission Zone

- Temporary Operating Procedure
- Immediate need due to the delay of the B1464: Corner area 138kV upgrades
- Recommended Solution: Interim Operating Procedure until B1464 is in service: Open the Corner 138 kV circuit breaker 86 for an overload of the Corner – Washington MP 138 kV line. The tower contingency loss of the Belmont – Trissler 138kV line and the Belmont – Edgelawn 138kV should be added to the Operational contingency file (B2581)
- Estimated Project Cost: $0.0M
- Required IS Date: 6/1/2015



AEP Transmission Zone

- N-1-1 Violation due to the Miami Fort Unit 6 deactivation notification
- The North Zanesville – Zanesville 138 kV line is overloaded for the loss of Ohio Central to East Point to East Zanesville 138 kV line, Philo to East Zanesville 138 kV line, East Zanesville 138/69 kV transformers 1 and 2, East Point 138/12 kV transformer and East Zanesville – Oakland 69 kV line ('5163_B2_TOR739_WOMOAB').
- Proposed Upgrade: Build an Ohio Central 138 kV loop (B2645)
- Construction Designation: AEP (the local Transmission Owner)
- Cost estimate: $4.5 M
- Required IS date: 6/1/2015 (immediate need)



AEP Transmission Zone

- **Project Update – B2256**

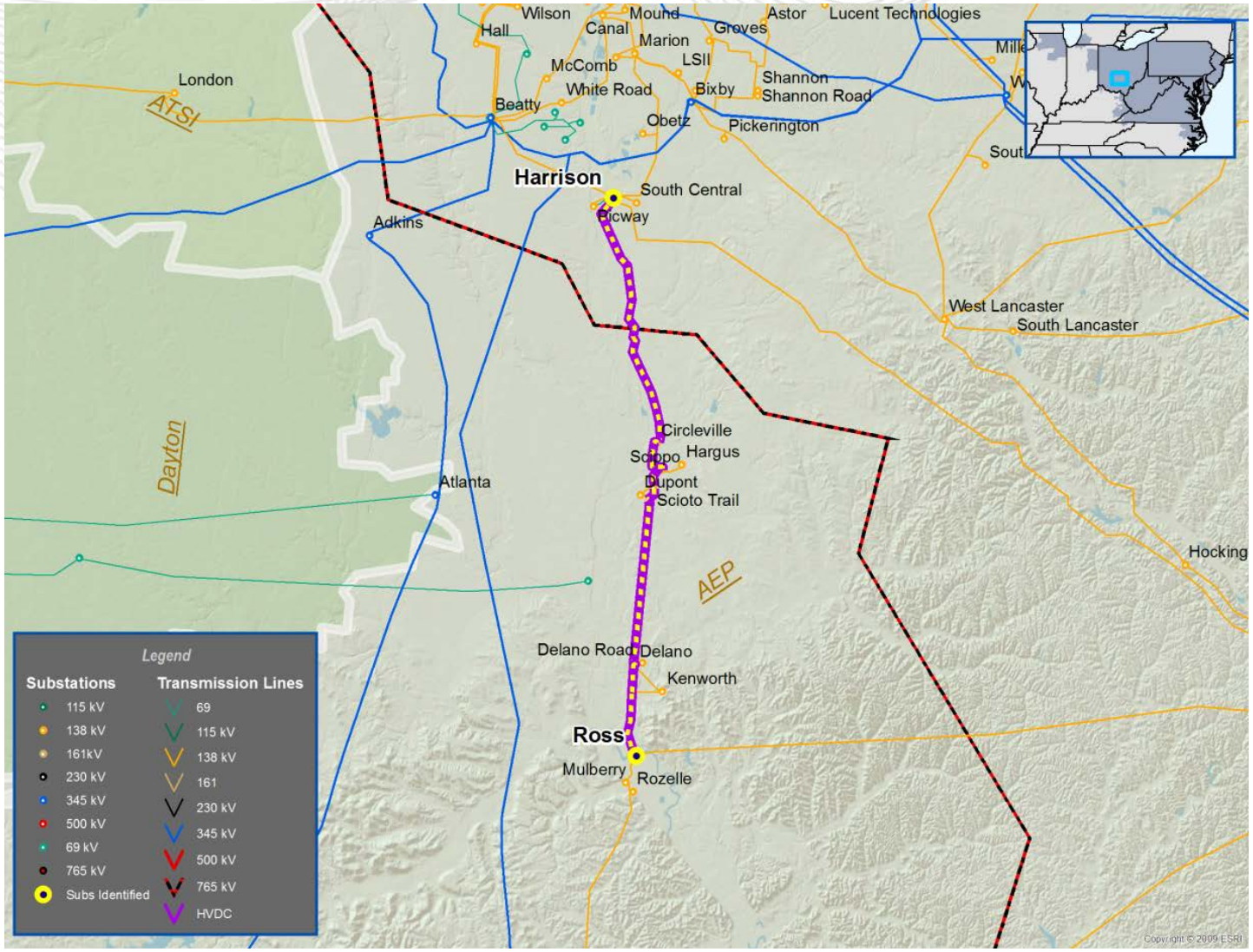
- B2256: Upgrade approximately 36 miles of 138 kV through path facilities between Harrison 138kV station and Ross 138KV station in Ohio.

- The outages of this line jeopardize a large pocket of load and a de-energized rebuild may take much longer than the required in-service. AEP has determined to rebuild the line while it is energized. This increases the cost.

- Previous Estimated Project Cost: $40.5M

- New Estimated Project Cost: $130M

- Required IS Date: 6/1/2017



AEP Transmission Zone

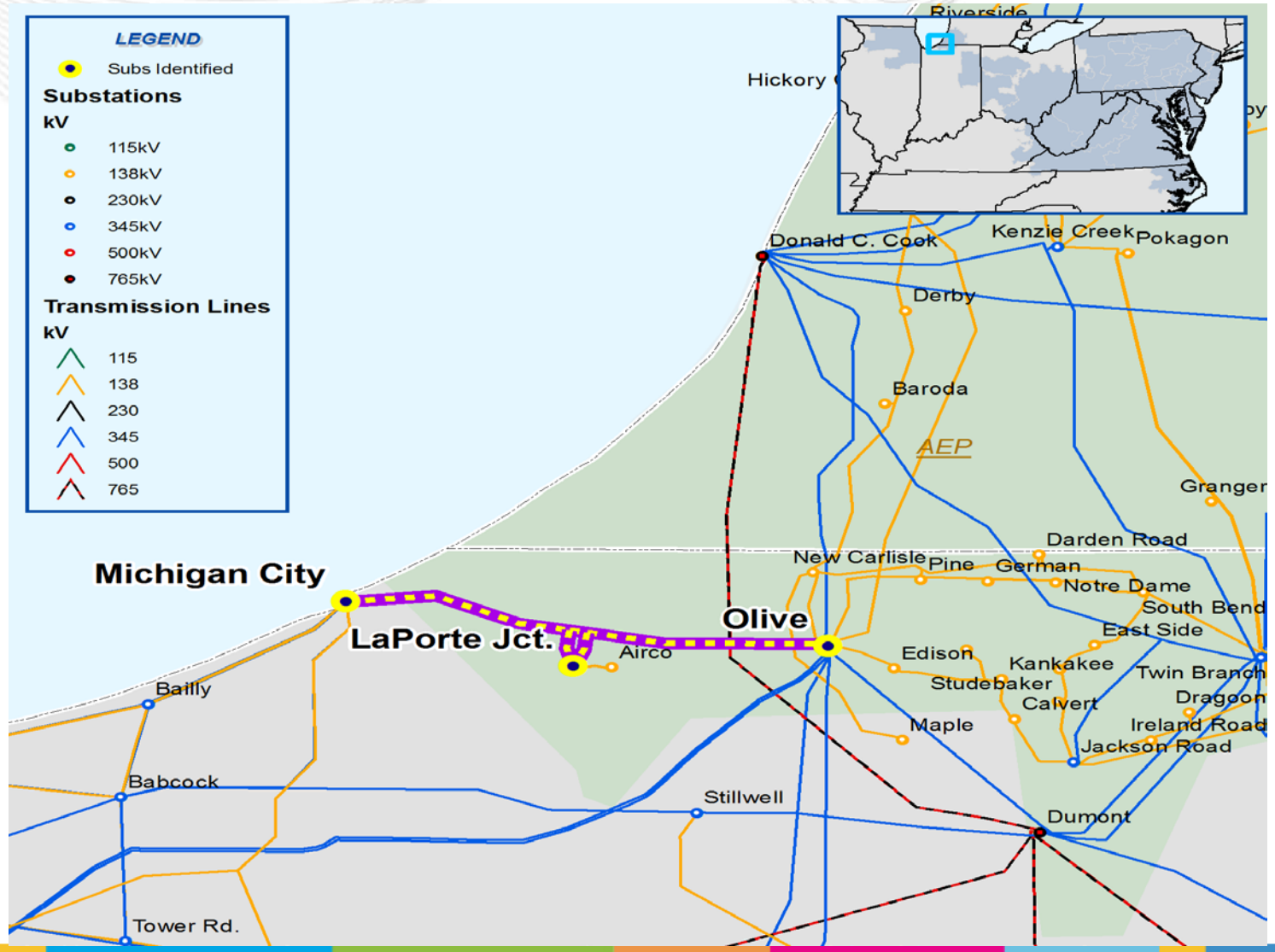
- **Project Scope Change: B1467.2**

- Old Scope: Reconfigure the 138 kV bus at LaPorte Junction station to eliminate a contingency resulting in loss of two 138 kV sources serving the LaPorte area

- New Scope: Build a Bosserman 138KV station approximately 200 feet from the existing LaPorte Junction station. Connected both stations wth a 200 feet tie line. All 69 kV and 34.5 kV facilities will remain at LaPorte Junction station and 138kV facilities move to the new station. The New Carlisle – Trail Creek 138KV line loops into the new substation. (B1467)

- Old Estimated Cost: $3 M
- New Estimated Cost: $13M

- Required IS Date: 6/1/2015

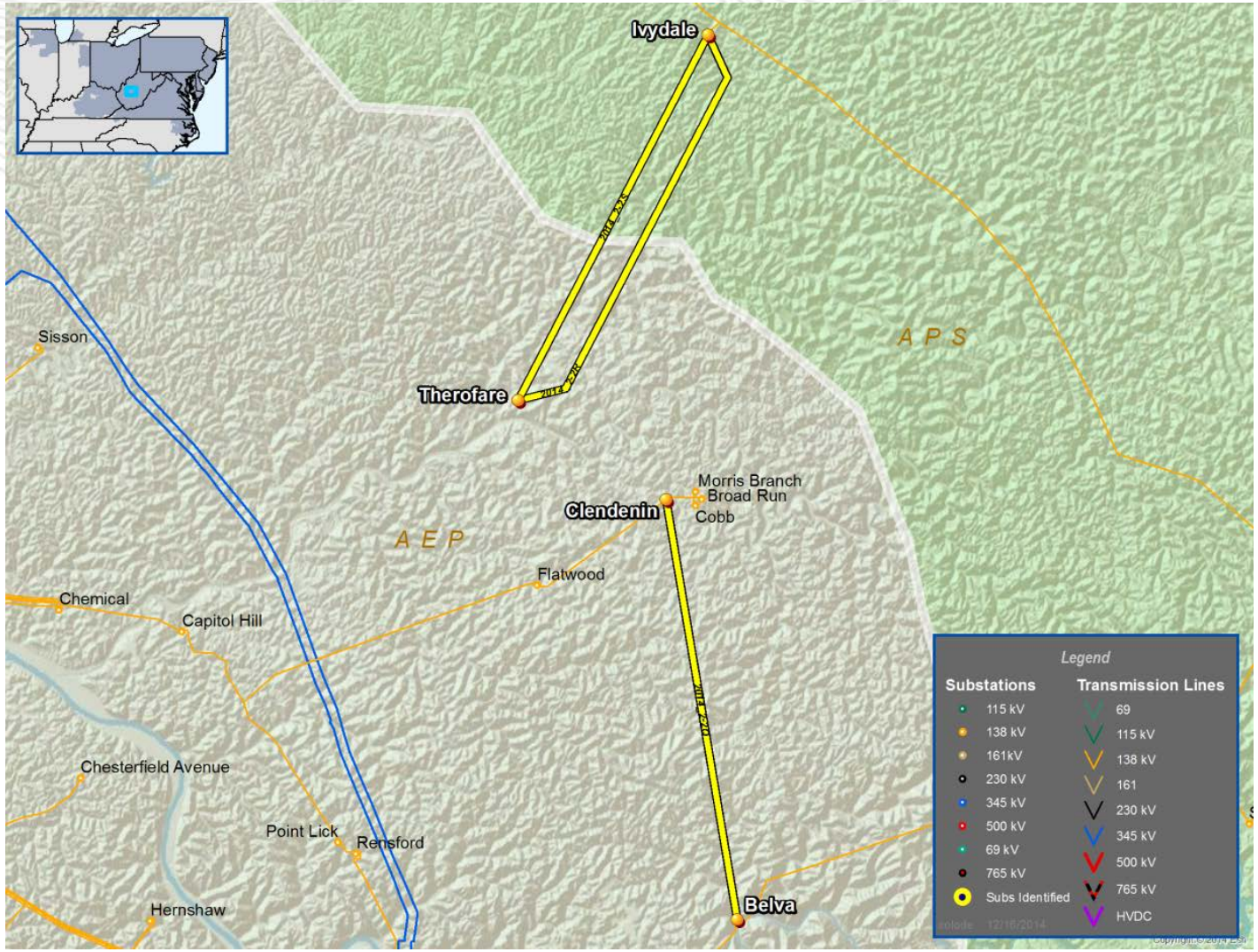


AEP Transmission Zone

Cost Change & Breakdown of b2609.1, b2609.3, b2609.4, and b2609.5

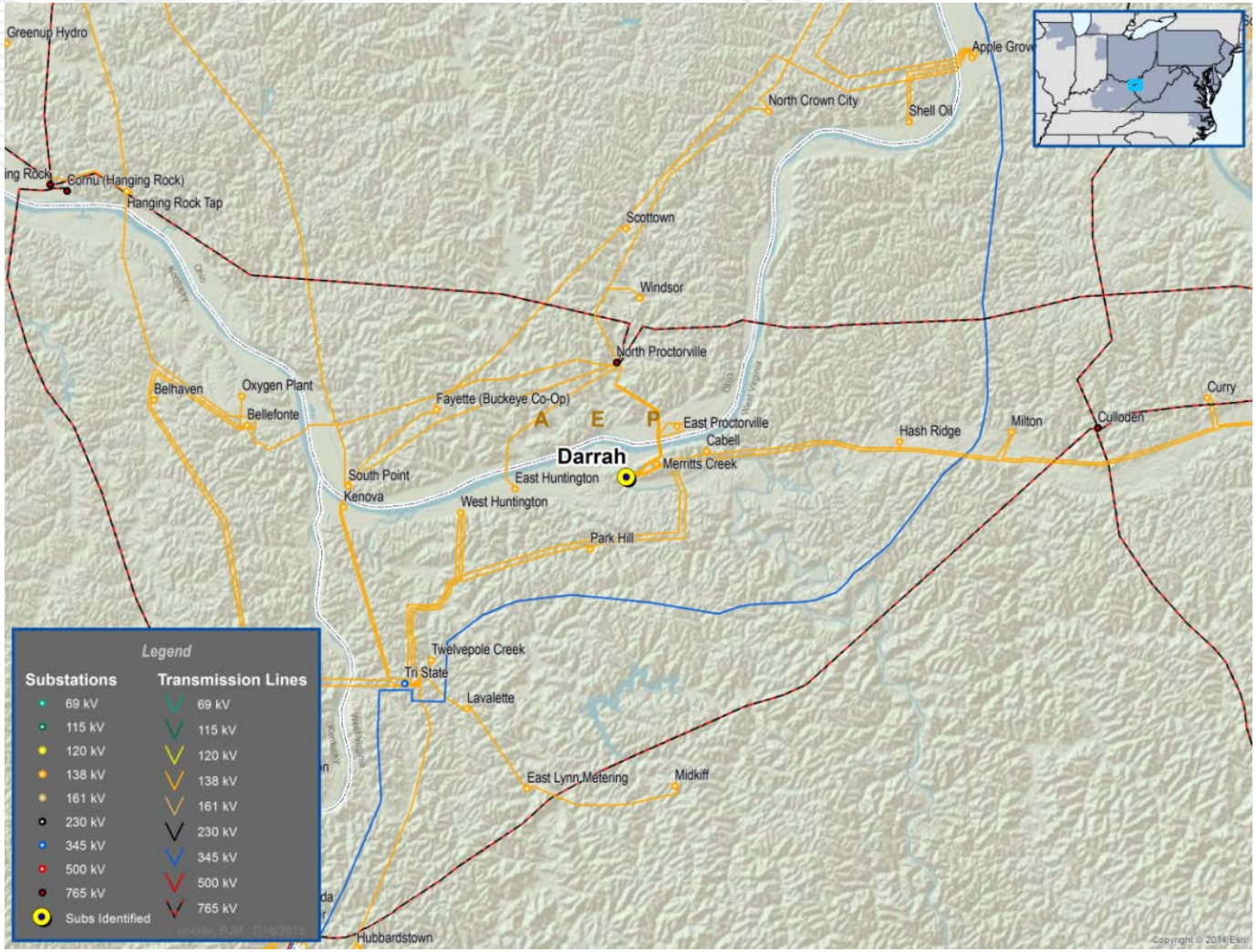
Updated Cost Breakdown:

- b2609.1: Install two 138 kV MOAB switches at Thorofare Creek substation
  - Transmission Owner: AEP
  - Updated Cost: $1.0 M
- b2609.3: Terminate the Flatwood, Kanawha and Capital Hill lines into the new Rutledge substation
  - Transmission Owner: AEP
  - Updated Cost: $2.1 M
- b2609.4: Establish new 138 kV tap substation on Powell Mountain - Goff Run, construct 15 miles of new 138 kV line from Thorofare Creek to the new 138 kV tap substation, establish Rutledge 138 kV substation
  - Transmission Owner: Transource
  - Updated Cost: $59.5 M
- b2609.5: Terminate the Powell Mountain and Goff Run lines into new substation and perform any associated relay upgrades or modifications required at Powell Mountain and Goff run to accommodate new substation
  - Transmission Owner: APS
  - Updated Cost: TBD
- Required IS Date: 6/1/2019



AEP Transmission Area

- The Darrah 138kV breaker ‘L’ is overstressed
- Proposed Solution: Replace the Darrah 138kV breaker ‘L’ with a 40kA breaker (b2643)
- Estimated Project Cost: $0.9M
- Required IS Date: 6/1/2019



APS Transmission Zone

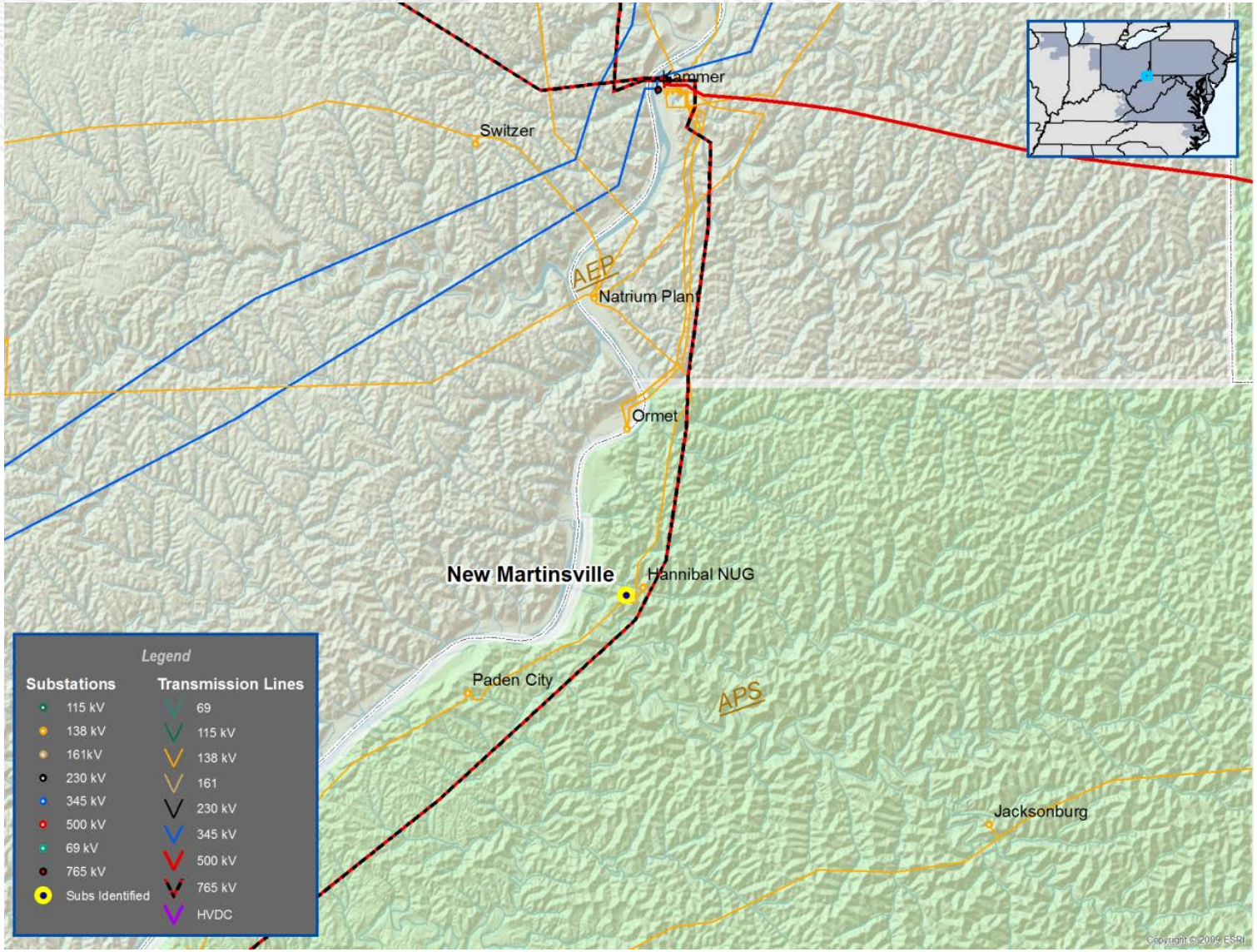
- **Project Cancellation**

- Cancel existing baseline reliability project: Add 44 MVAR Cap at New Martinsville. (B2118)

- Reason: This project is no longer needed due to a forecasted load decrease at Ormet 138kV bus in AEP

- Estimated Cost: $1.1M

- Projected IS Date: 06/01/2015



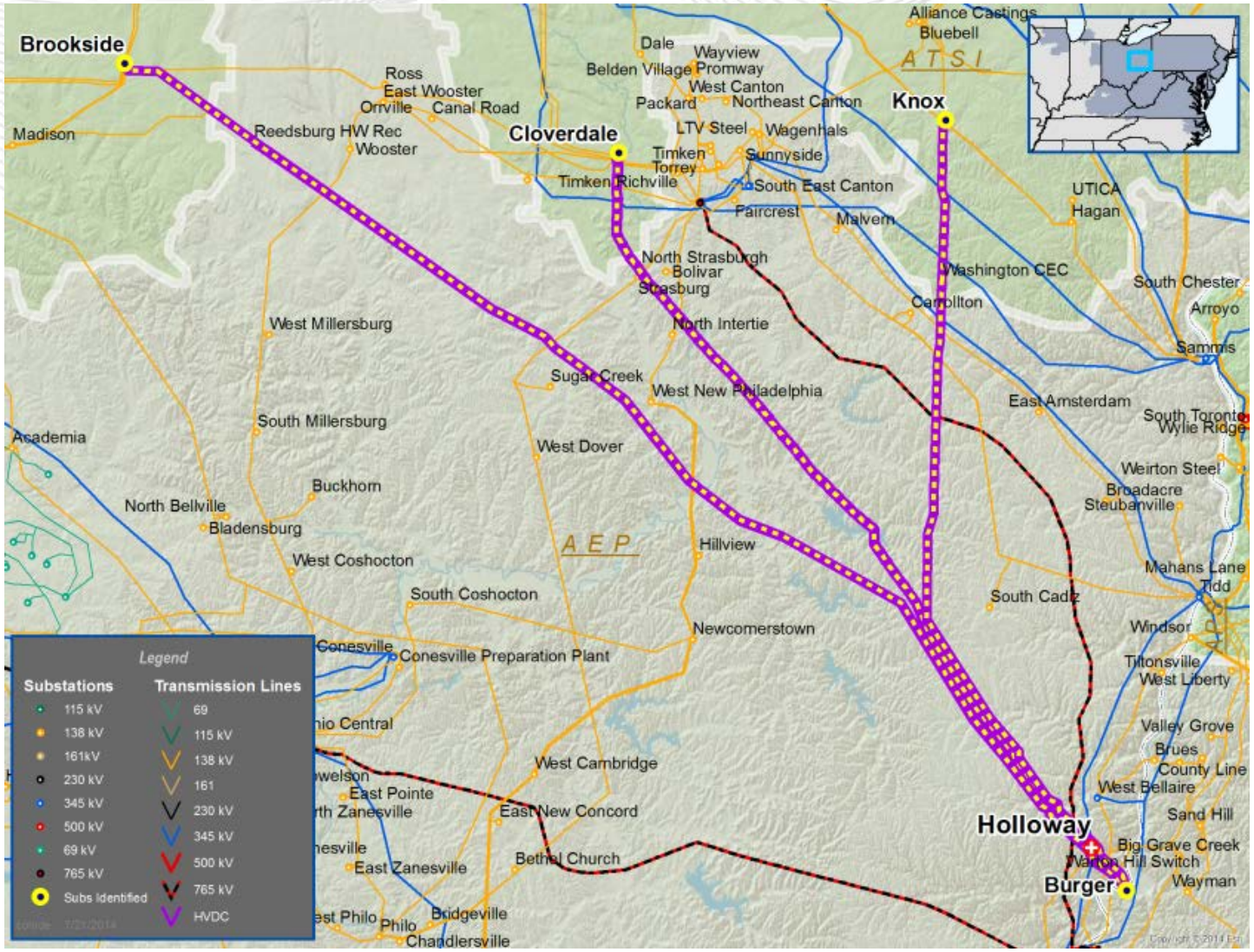
ATSI Transmission Zone

- **Revised B2019 Project Scope**

- Revised Scope: B2019: Establish Holloway 345/138 kV station

- Revised Scope: Terminate Burger-Longview 138 kV, Burger-Brookside 138 kV, Burger-Cloverdale 138 kV #1, Burger-Harmon 138 kV #1 and #2 and Burger - Knox 138 kV into Holloway substation. NOTE: The two 138 kV lines exits from Holloway to Burger are no longer required and have been canceled. (B2019.2)
- ATSI (the local TO) will be the designated entity

- Project Cancellation - Reconfigure Burger 138 kV substation to accommodate two 138 kV line exits and generation facilities (B2019.3)
- ATSI (the local TO) will be the designated entity

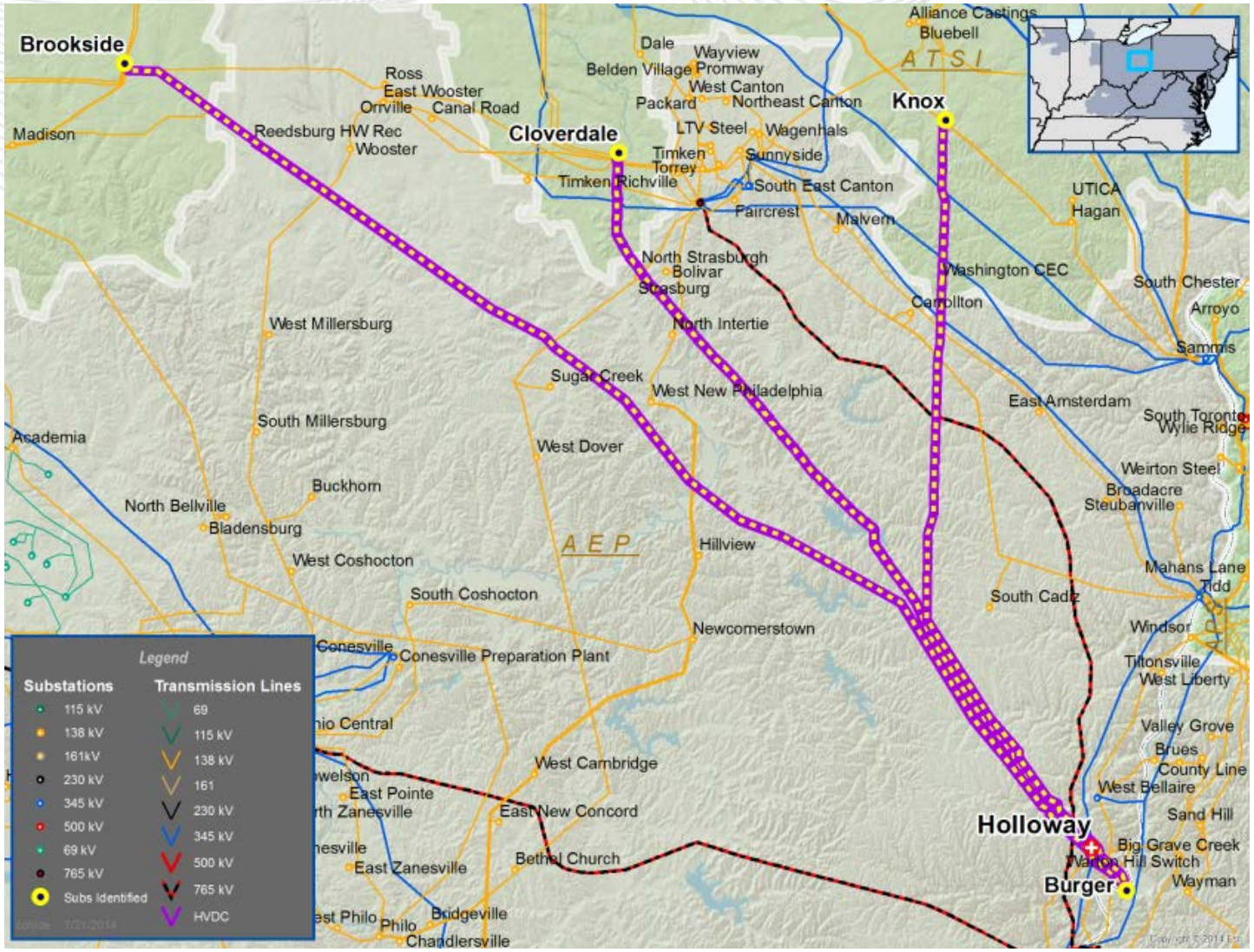


ATSI Transmission Zone

- **Revised B2019 Project Scope Contd..**

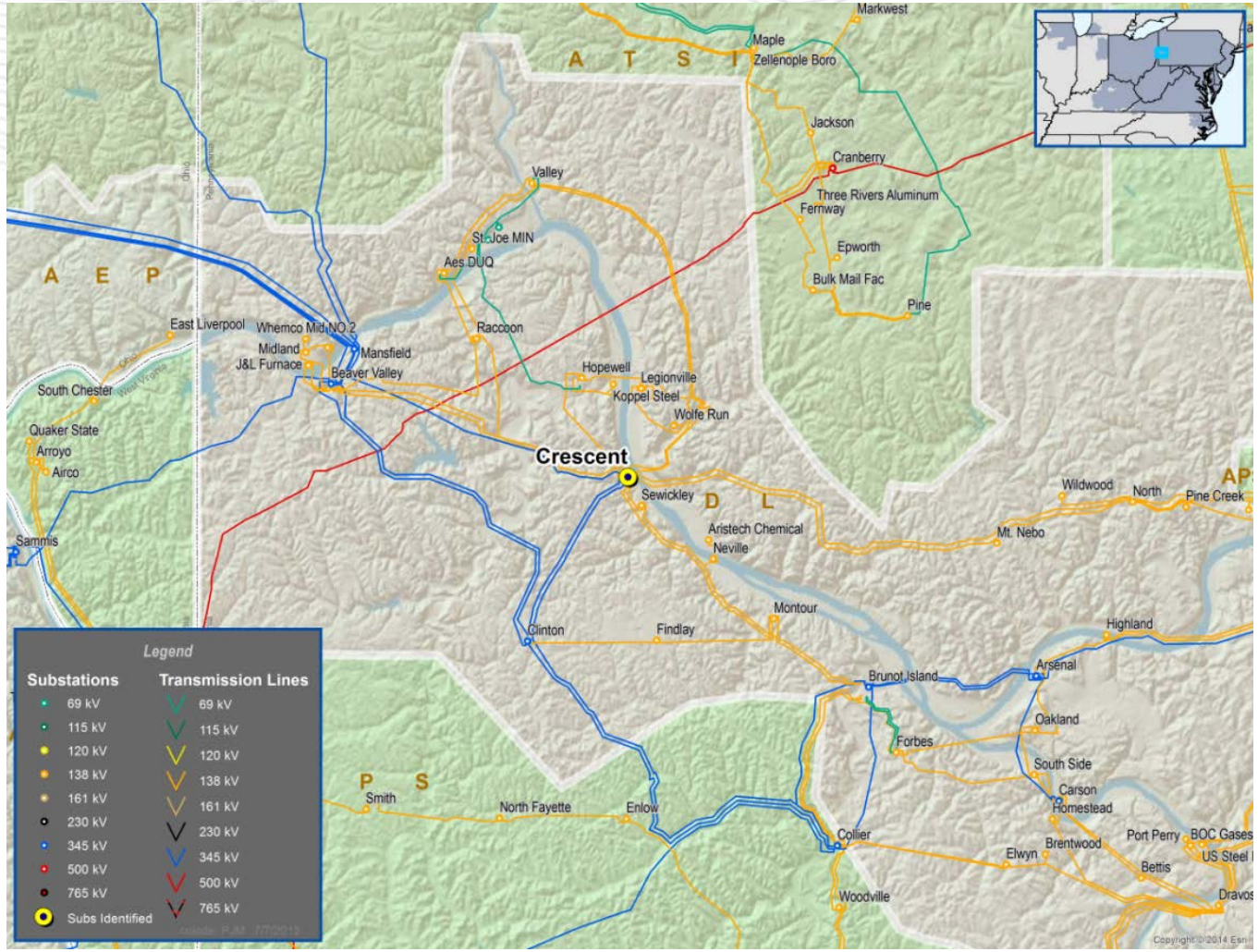
- New Baseline - Remove both Burger 138 kV substations (East and West 138 kV buses) and all 138 kV lines on the property (B2019.4)
- Estimated Project Cost: $2.15 M
- Required IS Date: 6/1/2016
- ATSI (the local TO) will be the designated entity

- New Baseline - Terminate and de-energize the 138 kV lines on the last structure before the Burger Plant property (B2019.5)
- Estimated Project Cost: $0.85 M
- Required IS Date: 6/1/2016
- ATSI (the local TO) will be the designated entity



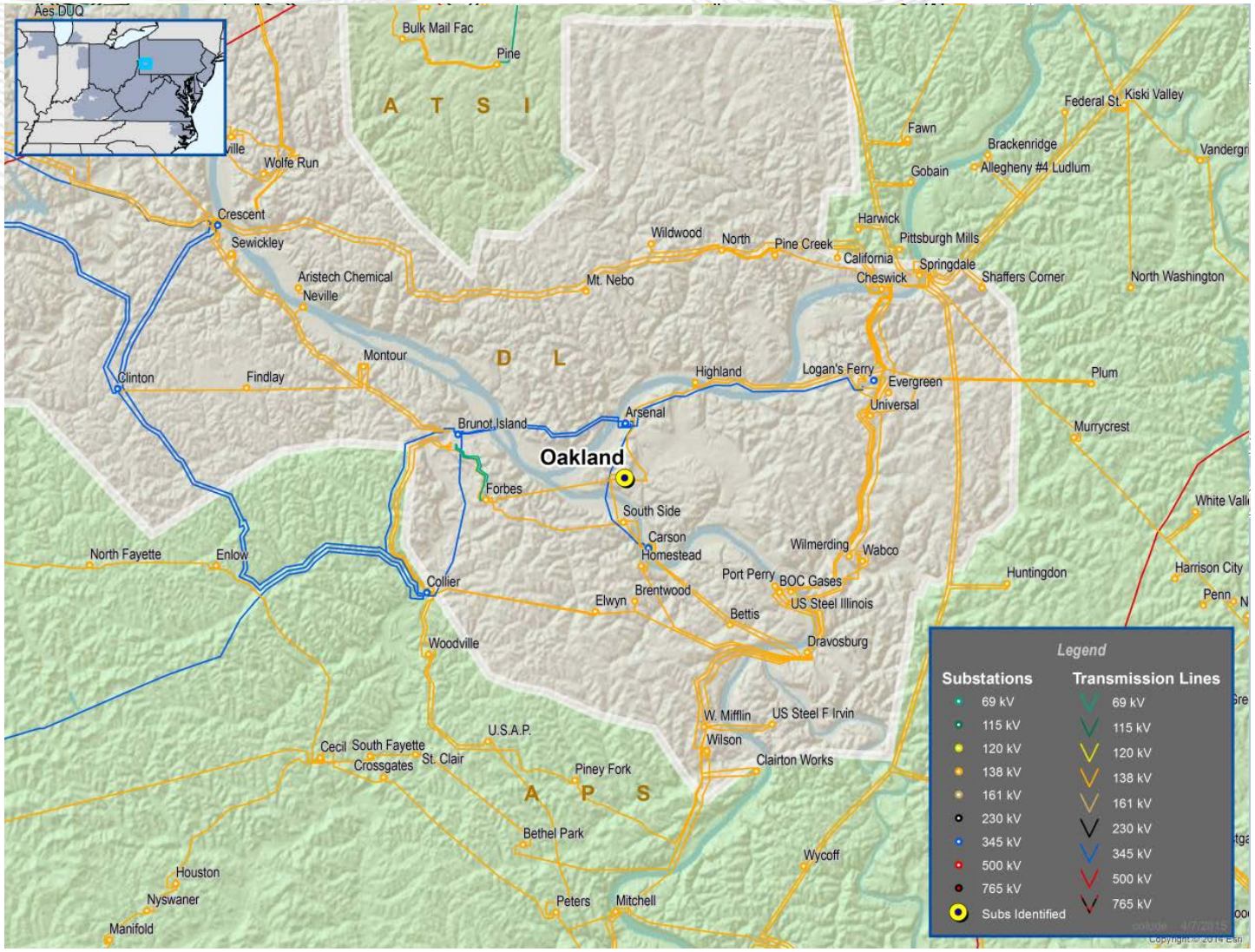
DLCO Transmission Area

- The Crescent 138kV breakers ‘NO3 - 4 138’, ‘Z143 SWCKLY’, ‘Z-24 MONTOUR’, and ‘Z-28 BEAVER’ are overstressed
- Proposed Solution: Replace the Crescent 138kV breakers ‘NO3 - 4 138’, ‘Z143 SWCKLY’, ‘Z-24 MONTOUR’, and ‘Z-28 BEAVER’ with 63kA breakers (b2639 – b2642)
- Estimated Project Cost: $0.33M per breaker
- Required IS Date: 6/1/2019



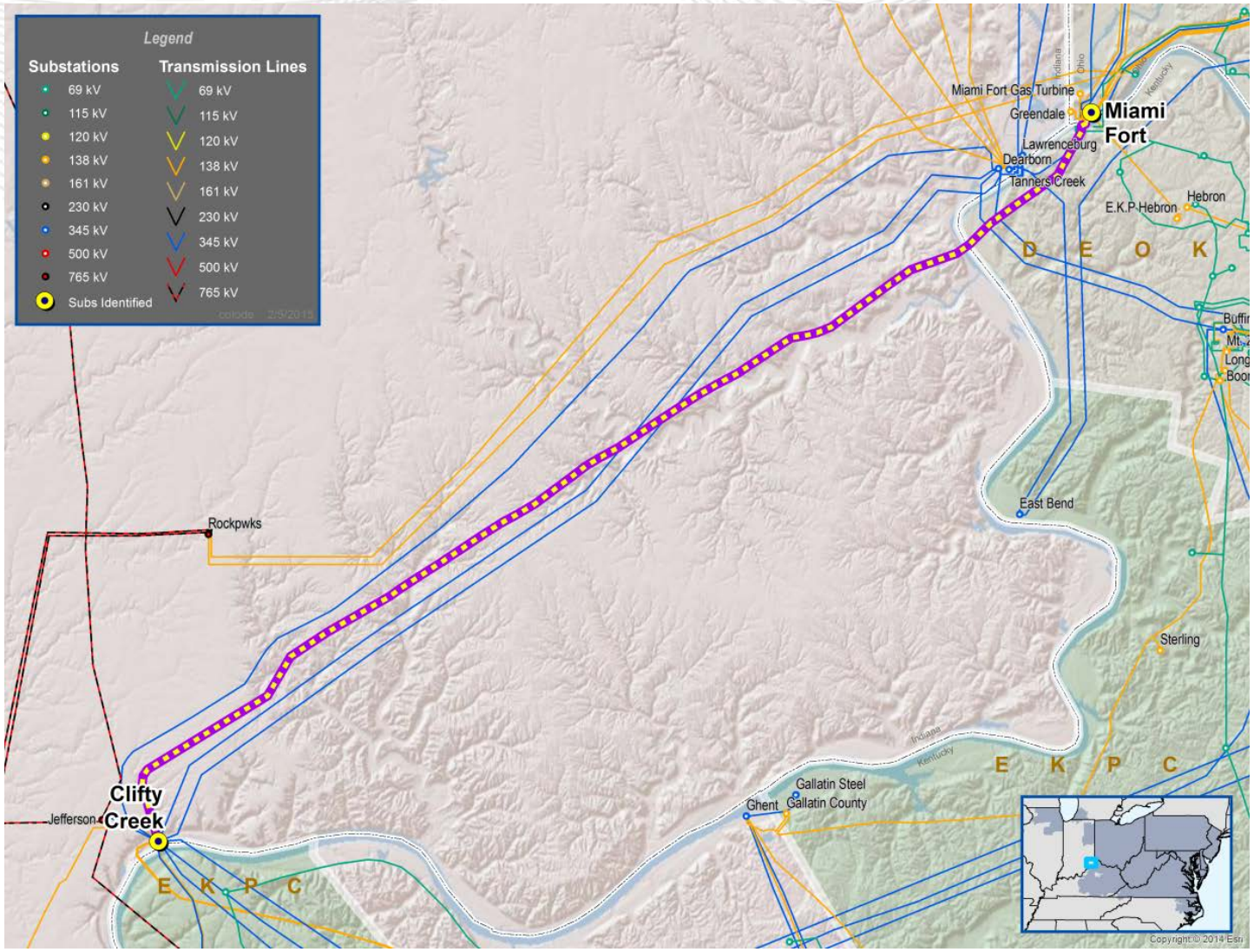
DUQ Transmission Area

- The Oakland 138kV ‘Z-101 Arsenal’ breaker is overstressed
- Proposed Solution: Replace the Oakland 138kV ‘Z-101 Arsenal’ breaker (b2632)
- Estimated Project Cost: $330 K
- Required In Service Date: 6/1/2019



DEOK Transmission Zone

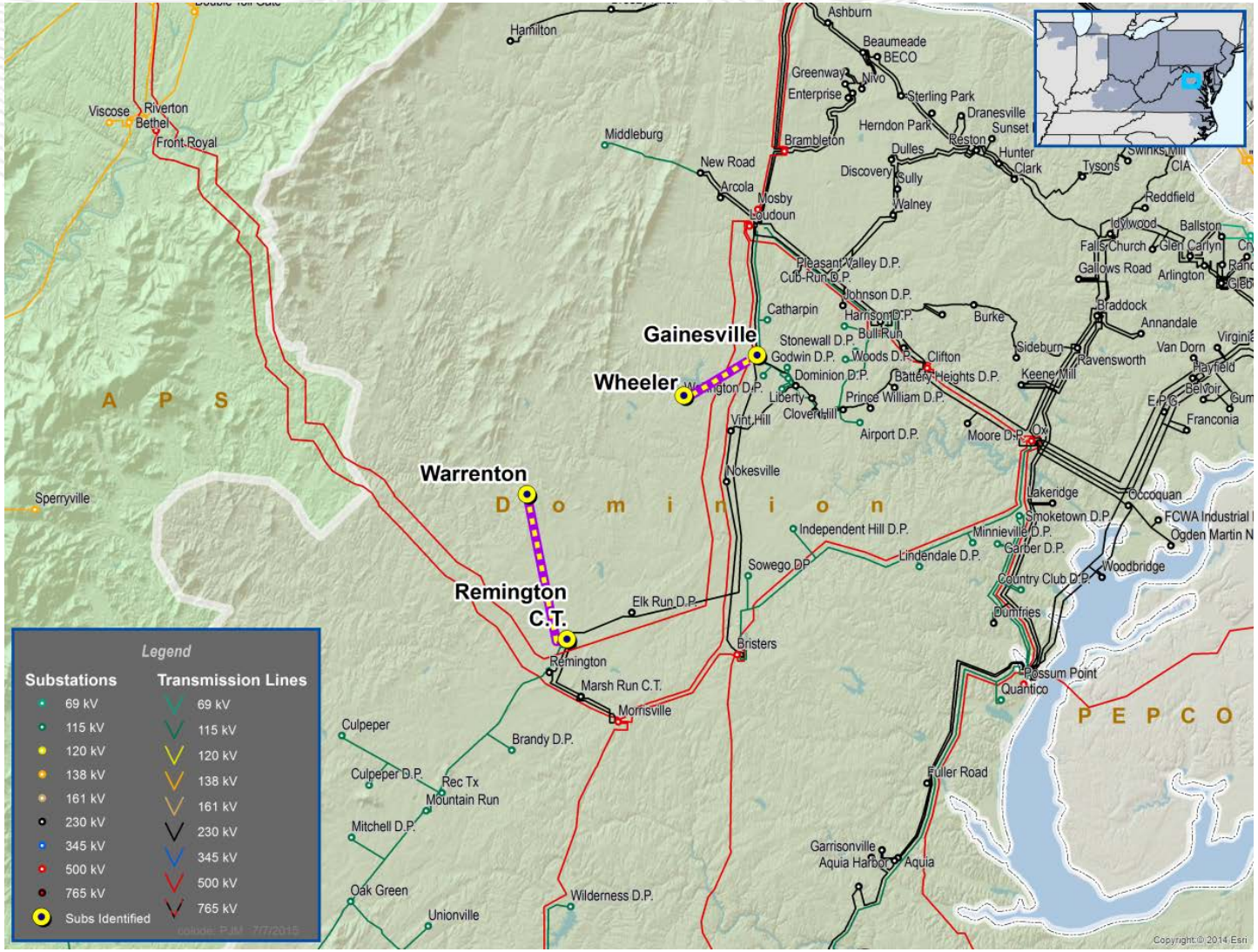
- N-1-1 Violation due to the deactivation notification of Miami Fort Unit 6
- The Clifty-Miami Fort 138 kV line is overloaded for the loss of Miami Fort-Glendale 138 kV line ('B2 MIAMI FORT-GREENDALE 1681') followed by the loss off Miami Fort-Tanner 138 kV line and Miami Fort transformers 9 and 10 ('B3 MIAMI FORT 345/138 TB9/TB10').
- Proposed Upgrade: Fix the 'B3 MIAMI FORT 345/138 TB9/TB10' contingency through station reconfiguration (B2634)
- Required IS date: 6/1/2015 (immediate need):
- Expected IS date: 05/2017
- Construction Designation: DEOK (the local Transmission Owner)
- Interim Solution: The operating procedure is to open Clifty to Miami Fort 138 kV branch and to open the tie 251579 08HEBRON to 341726 2HEBRON after the first contingency.



Dominion Transmission Zone (slide 1 of 4)

Problem: Dominion Radial Line Criteria Violation

- Loading on radial Remington CT-Warrenton 230 kV is projected to exceed 100 MW by Summer 2017.
- Existing load on NOVEC's radial 115 kV Gainesville-Wheeler line exceeds 110 MW.
- Loss of Gainesville Substation results in over 300 MW being dropped.
- This need is time sensitive due to the criteria violation in the immediate need timeframe.
- When this criteria violation was identified, the need date was already in the immediate need timeframe.
- Previous reliability models did not demonstrate this immediate need violation.



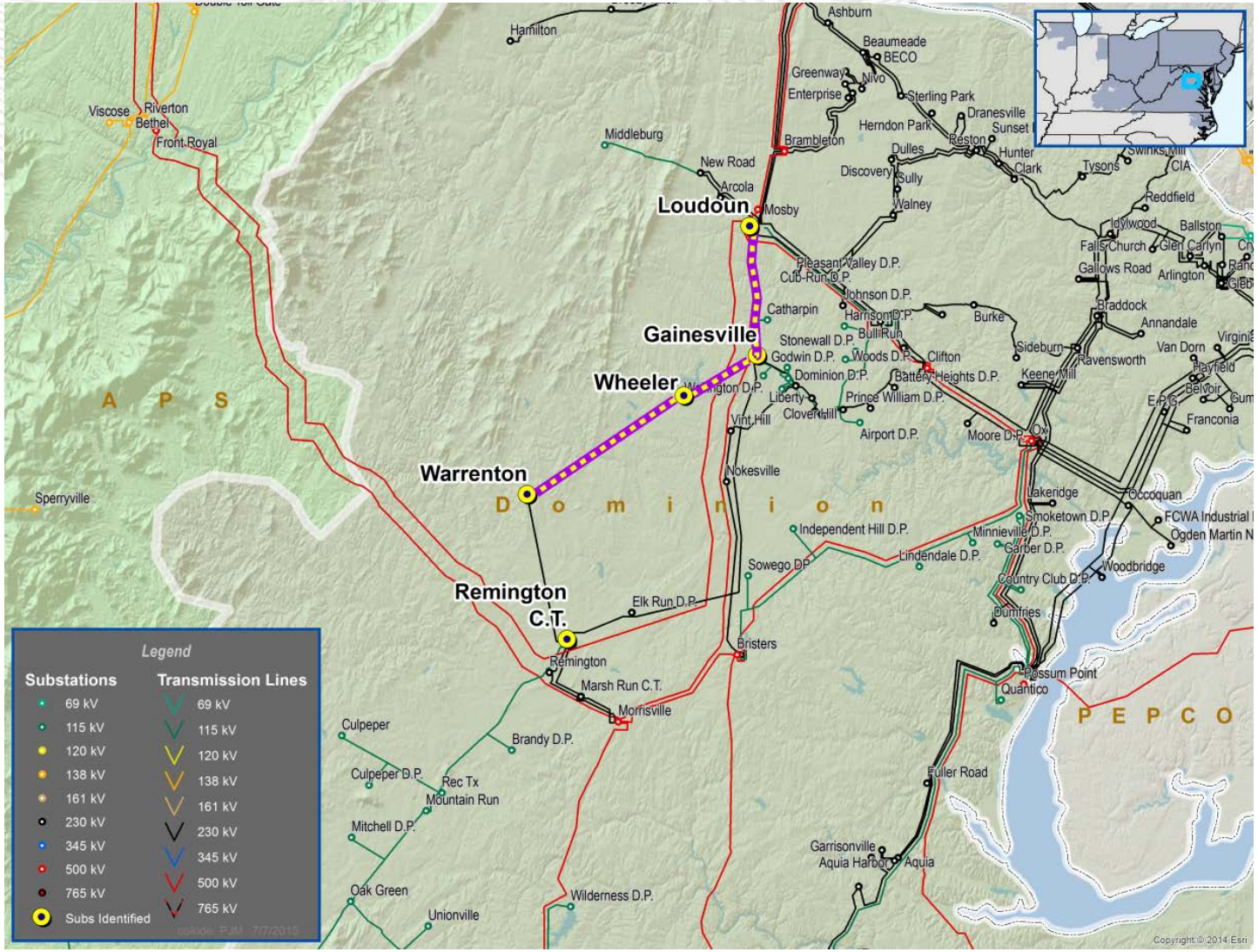
Dominion Transmission Zone (Slide 2 of 4)

Alternatives Considered

Several other options were considered but concluded would not sufficiently or efficiently address the immediate reliability need,

A. Construct a 230kV OH line approx. 9 miles from Warrenton to Wheeler Substation. Convert NOVEC's Gainesville-Wheeler line (approx 6 miles) to 230kVand terminate at Gainesville to complete a Remington CT-Warrenton-Wheeler-Gainesville networked line. Constructing this Option A underground would be approx 8 miles between Warrenton and Wheeler ($86 - $168 M)

- Solution A has permitting constraints associated with OH facilities through historical battlefields, conservation easements, and governmental land along the route. The cost estimate for Solution A is based on the assumption of being able to obtain a "buildable" route.

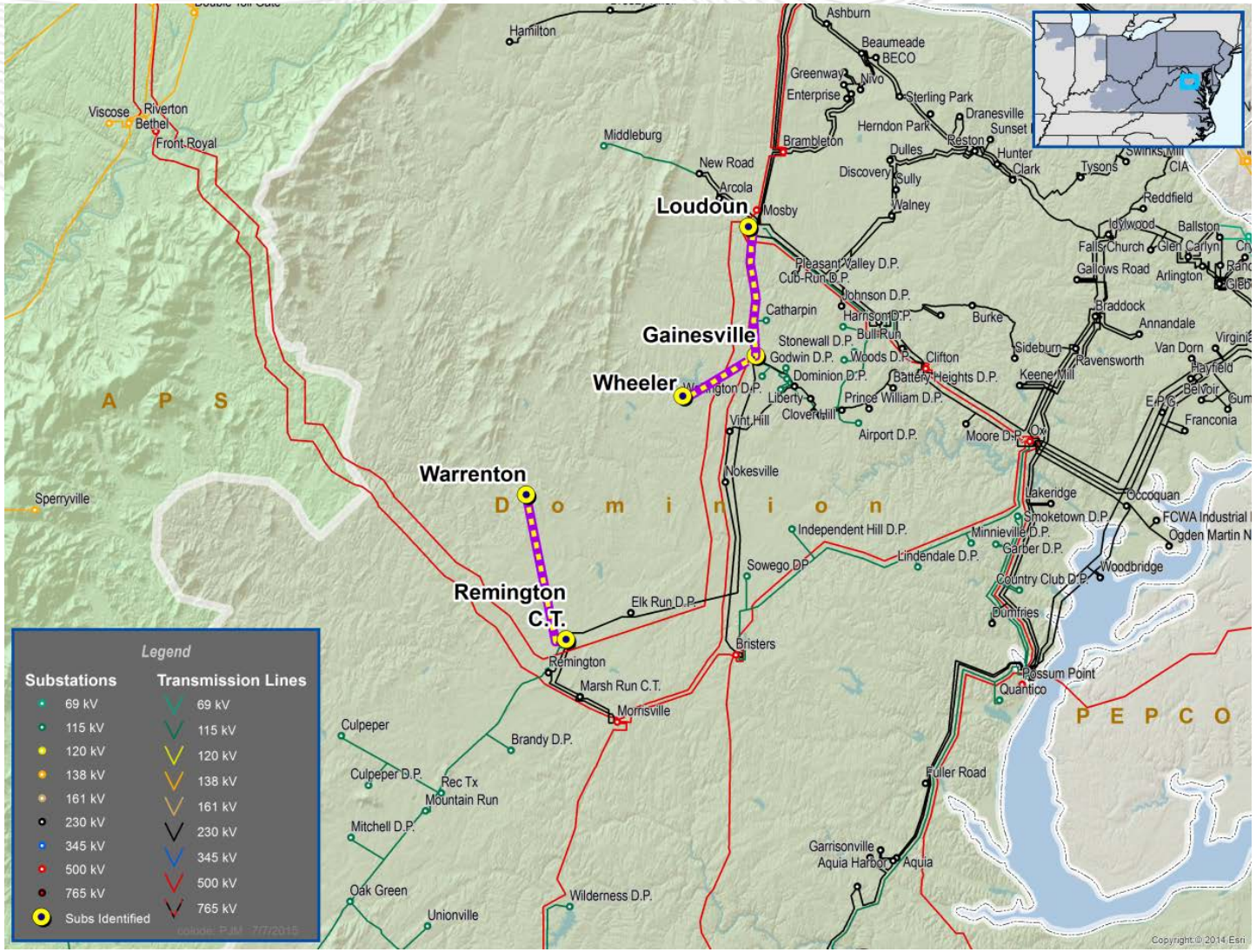


Dominion Transmission Zone (Slide 3 of 4)

Alternatives Considered

B. Wreck-and-rebuild existing Line Remington CT – Warrenton 230 kV (approx. 12 miles) Wreck-and-rebuild NOVEC's Gainesville-Wheeler line (approx. 6 miles) as a double-circuit 230kV line. Terminate one line at Gainesville to create a new Gainesville-Wheeler line. Bypass Gainesville with the other line and utilize Gainesville-Loudoun 230kV to create a 230kV Loudoun-Wheeler line. ($94 M)

- Solution B is not preferred due to its long-term impact, performance, routing, and permitting constraints compared to the Proposed Solution



Dominion Transmission Zone (Slide 4 of 4)

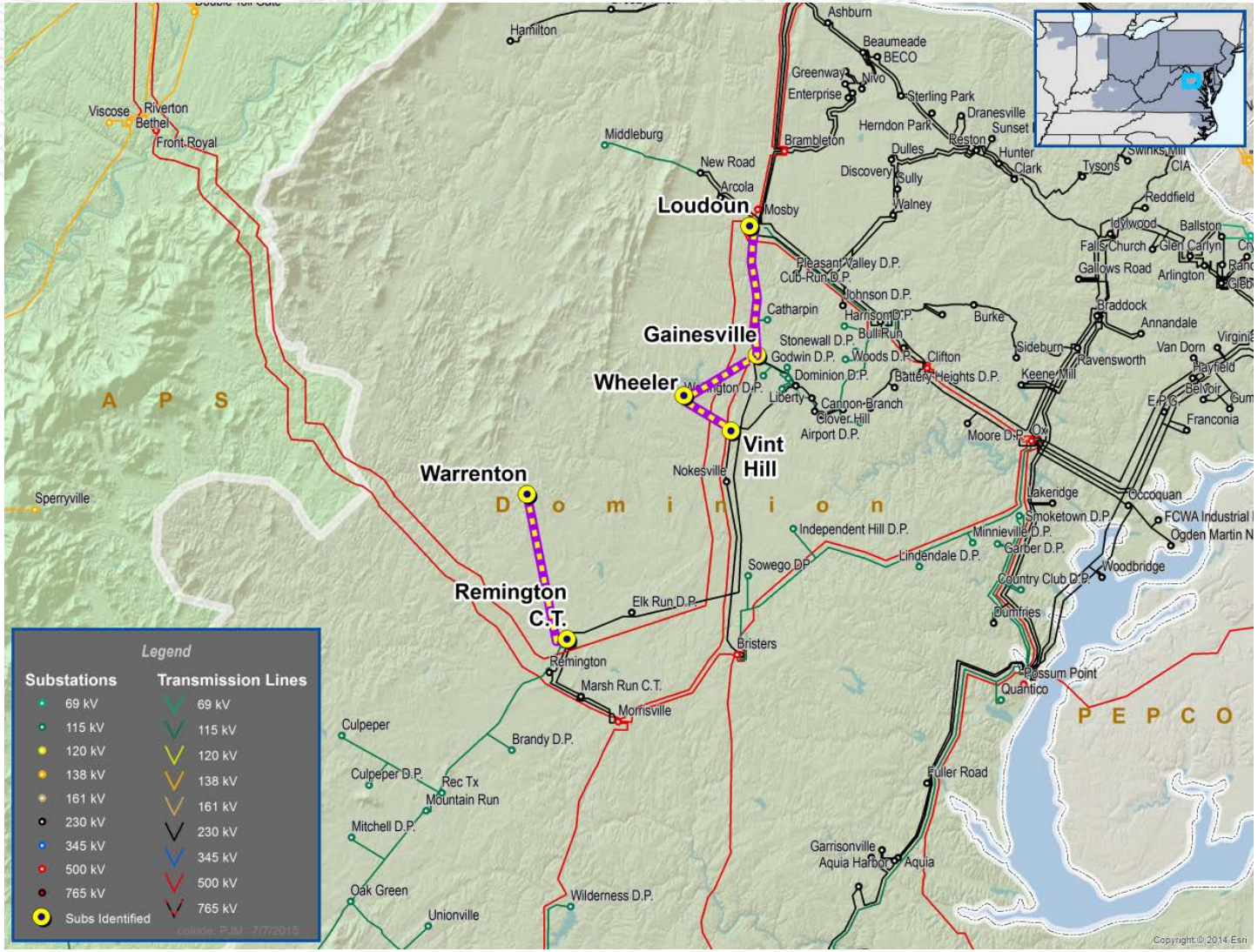
Proposed Immediate Need Solution

Due to the immediate need the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Wreck and rebuild existing Remington CT - Warrrenton 230 kV (approx. 12 miles) as a double-circuit 230 kV line (b2461)
- Construct a new 230 kV line approximately 6 miles from NOVEC's Wheeler Substation to new 230 kV switching station in Vint Hill area (b2461.1)
- Convert NOVEC's Gainesville - Wheeler line (approximately 6 miles) to 230 kV (b2461.3)
- Terminate at Gainesville to complete a Vint Hill - Wheeler - Gainesville 230 kV networked line

Estimated Project Cost: $105 M

Projected IS Date: 6/1/2017



Dominion Transmission Zone

Driver:

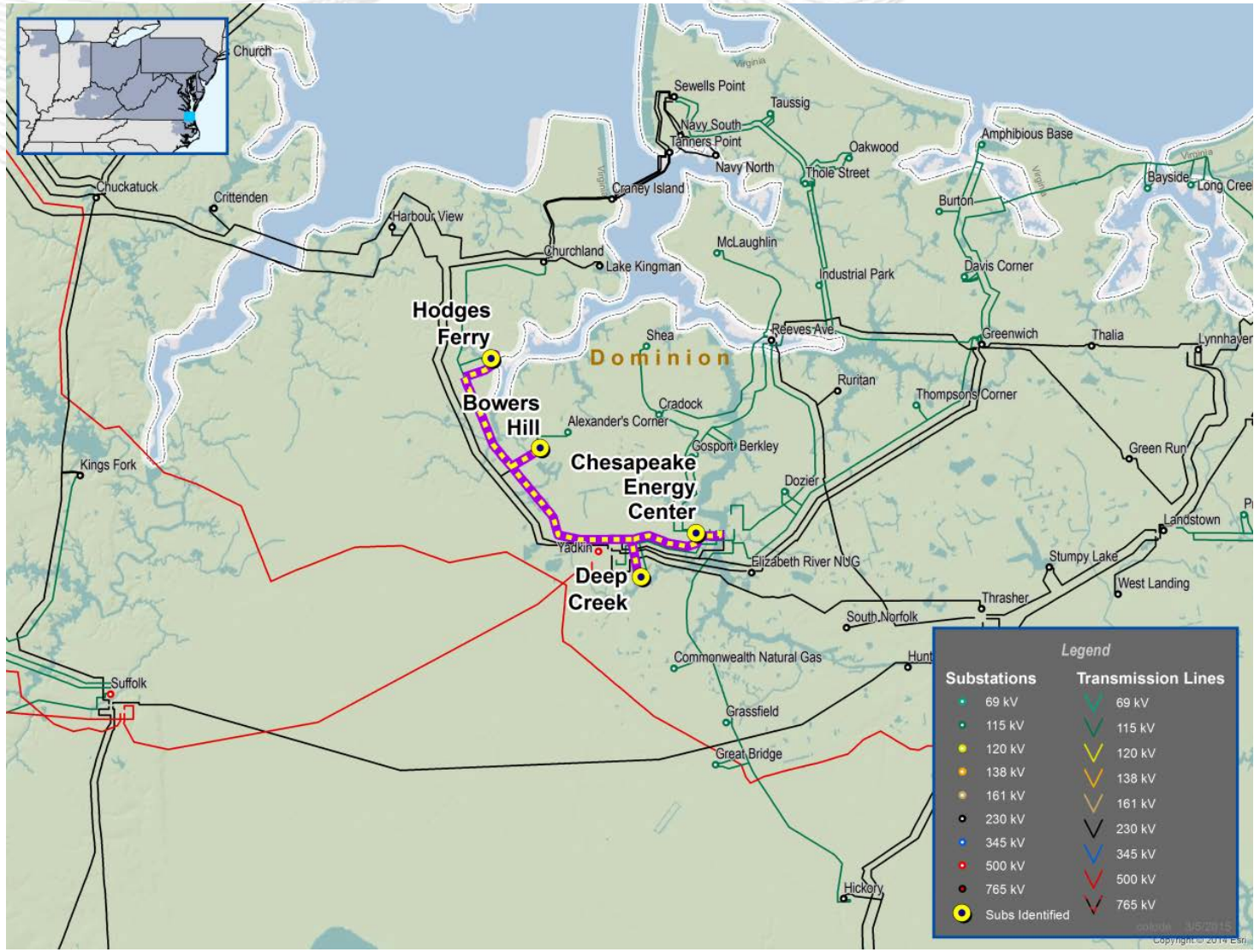
- The Chesapeake - Deepcreek - Bowers Hill - Hodges Ferry 115 kV line is overloaded for various GenDeliv and N-1-1 contingencies

Proposed Solution:

- Wreck and rebuild the Chesapeake - Deepcreek - Bowers Hill - Hodges Ferry 115 kV line; minimum rating 239 MVA normal/emergency, 275 MVA load dump rating (b2620)

Estimated Project Cost: $10 M

Required IS Date: 6/1/2016



Dominion Transmission Zone

Problem:

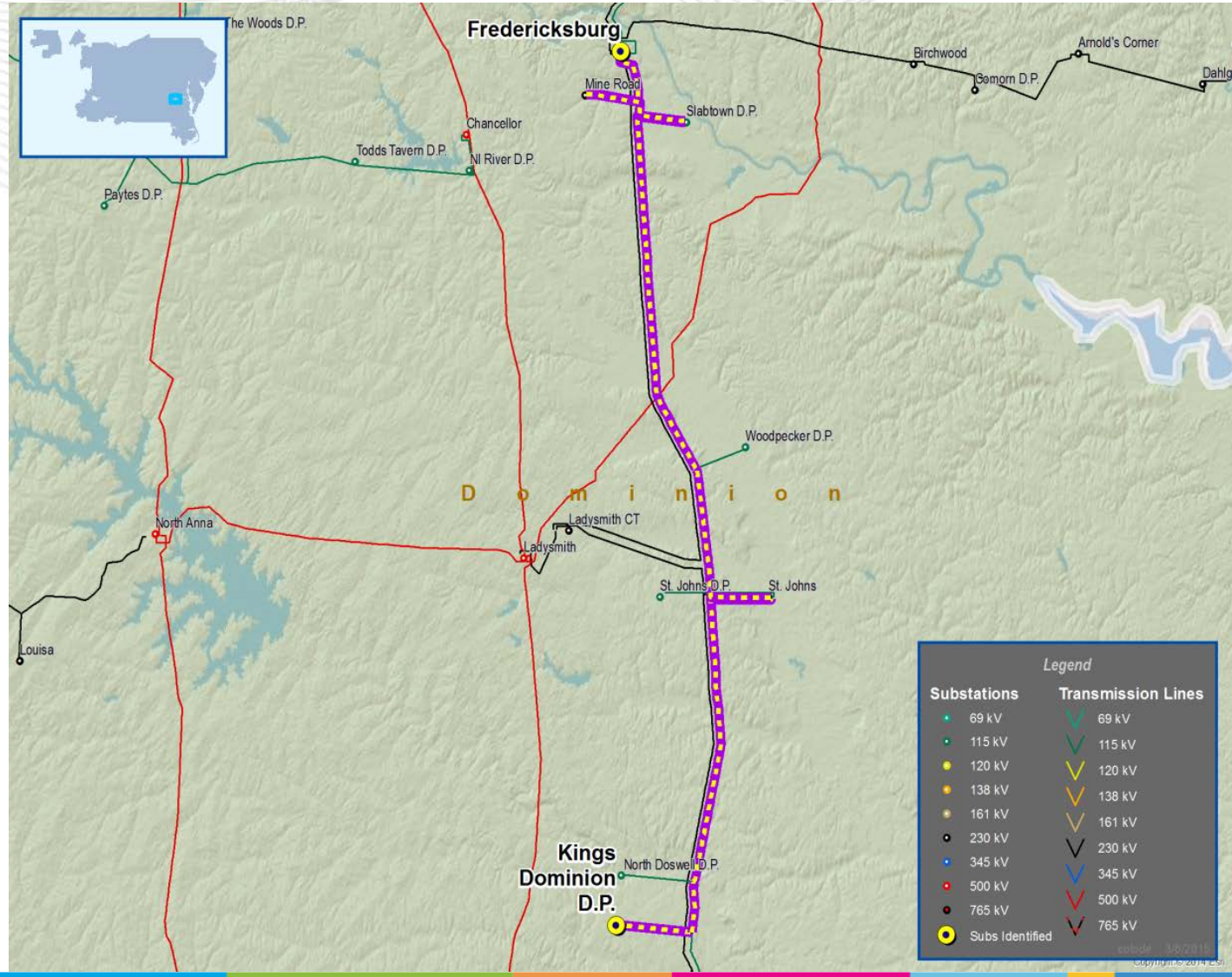
- End of Life Criteria -The 34 mile section of the Line #47 between Kings Dominion 115kV and Fredericksburg 115kV was constructed on wood H-frames in 1957 and has 795 ACSR conductor with a 3/8” steel static wire.
- System Impact Assessment - Failure of Line #47 would permanently drop 96 MW of load

Proposed Solution:

- Rebuild Line #47 between Kings Dominion 115kV and Fredericksburg 115kV to current standards with a summer emergency rating of 353 MVA at 115kV. (B2622)

Estimated Project Cost: $51.0 M

Projected IS Date: 12/31/2017



Dominion Transmission Zone

Problem:

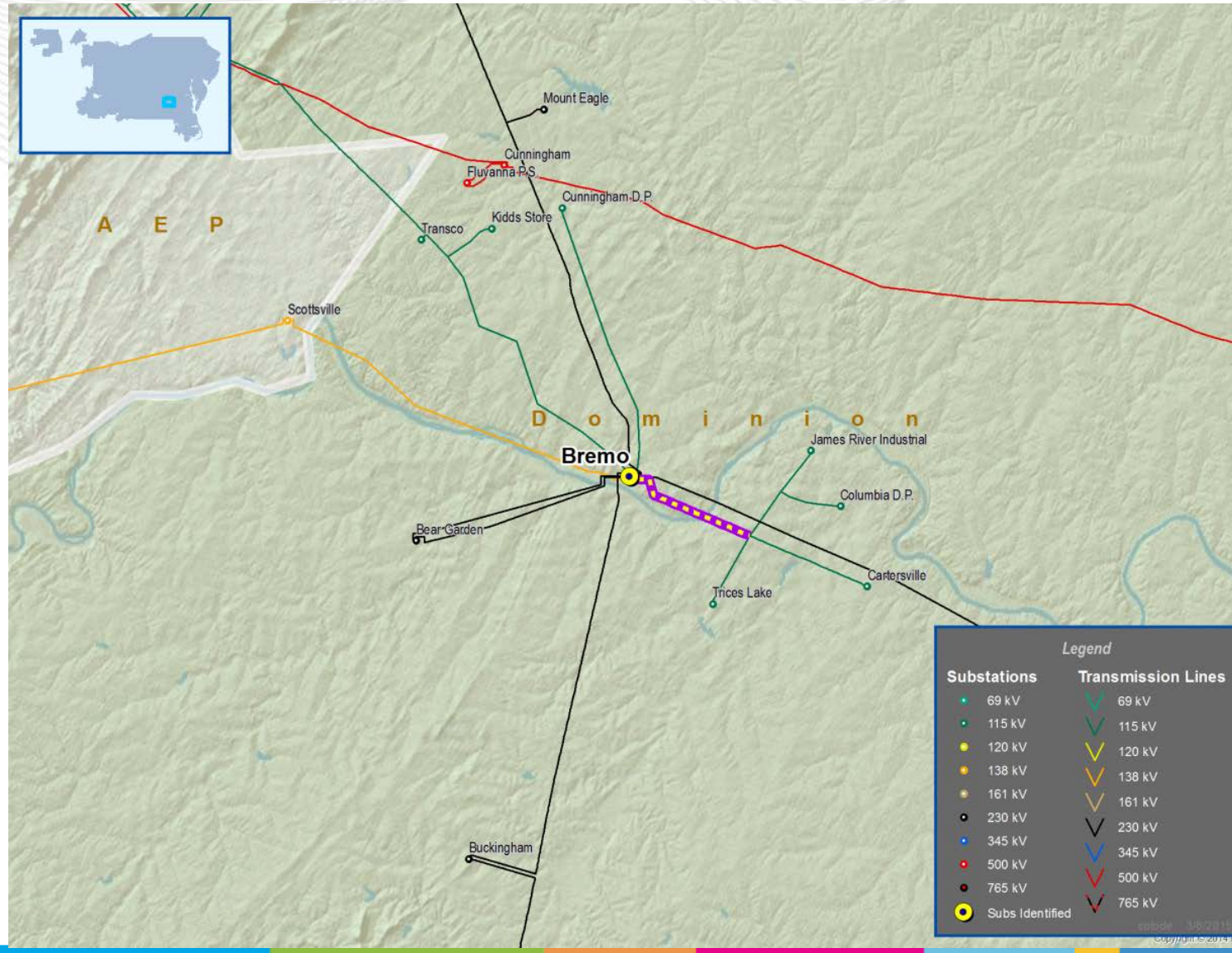
- End of Life Criteria - Line #4 between Bremo 115kV and Structure 8474 115kV was constructed on wood H-frame structures in 1947. This line has copper conductor and 3/8" steel static.
- System Impact Assessment - Failure of Line #4 would permanently drop 86.7 MW of load

Proposed Solution:

- Rebuild Line #4 between Bremo and Structure 8474 (4.5 miles) to current standards with a summer emergency rating of 261 MVA at 115kV. (B2623)

Estimated Project Cost: $6.8 M

Projected IS Date: 12/31/2016



Dominion Transmission Zone

Problem:

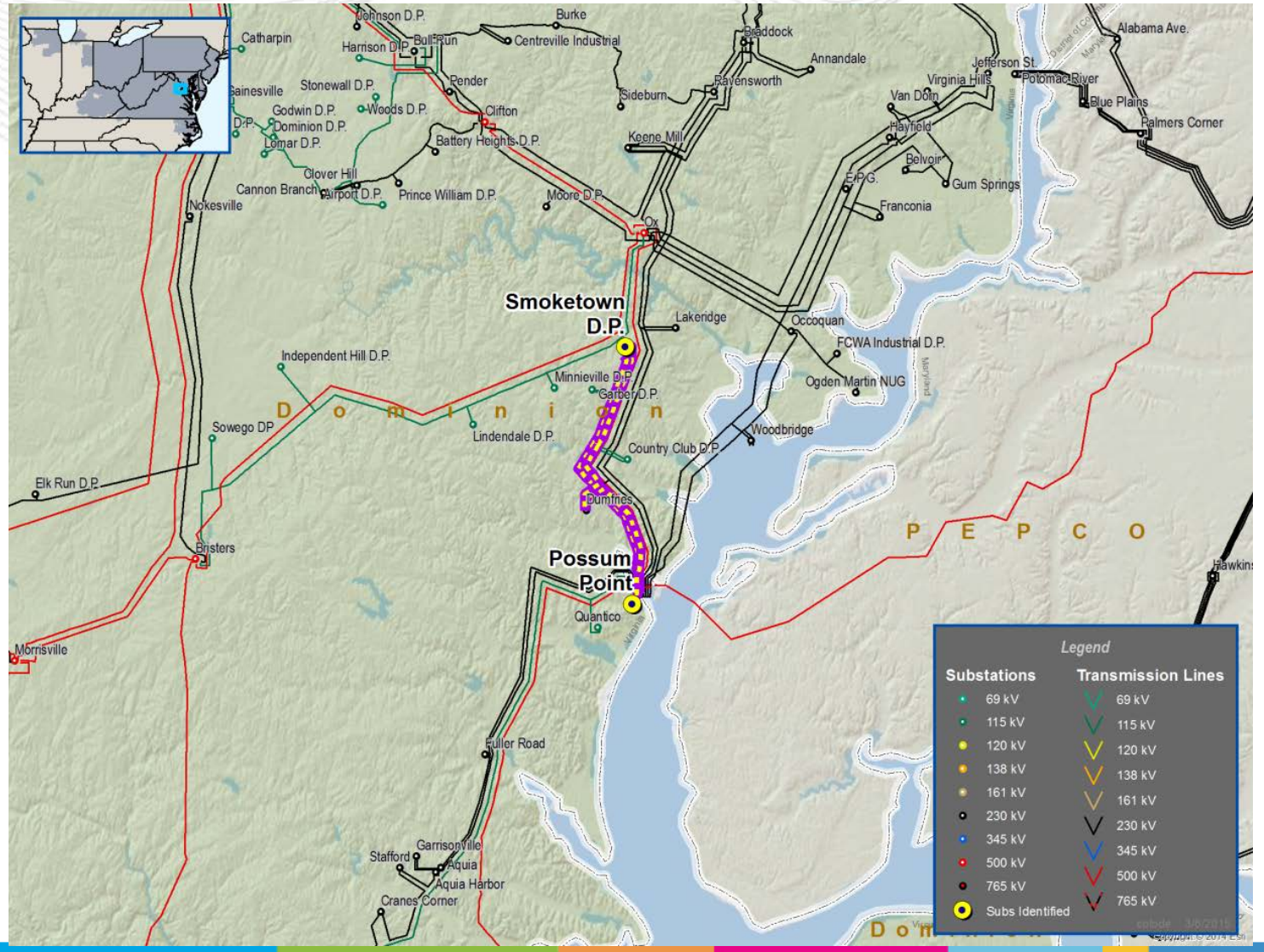
- End of Life Criteria - 115kV Lines #18 and #145 are approximately 8.35 miles long and were constructed on double-circuit, 3-pole wood H-frame structures in the timeframe between 1948 and 1954..
- System Impact Assessment - Failure of Lines #18 & #145 would permanently drop 68.5 MW of load

Proposed Solution:

- Rebuild 115kV Lines #18 and #145 between Possum Point Generating Station and NOVEC's Smoketown DP (approx. 8.35 miles) to current 230kV standards with a normal continuous summer rating of 524 MVA at 115kV (1047 MVA at 230kV) (B2624)

Estimated Project Cost: $24.7 M

Projected IS Date: 12/31/2016



Dominion Transmission Zone

Problem:

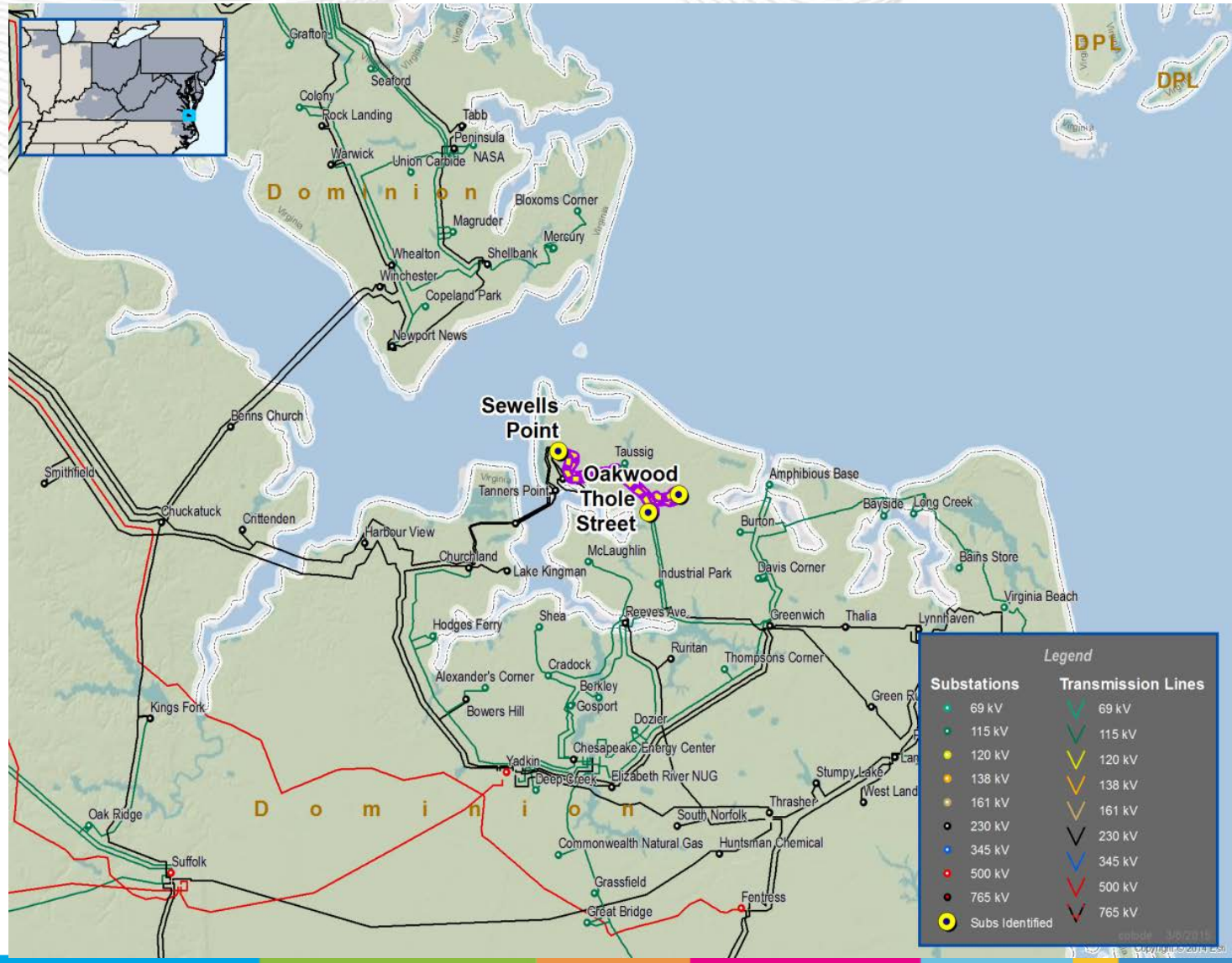
- End of Life Criteria - The 115kV Lines #48 (Sewells Point to Thole Street) and #107 (Sewells Point to Oakwood) were built on double circuit weathering steel (corten) towers in 1965. Field reports and condition assessment indicate the corten structures are in poor condition and additional structure loading will be required due to a need for fiber to be installed on these structures
- System Impact Assessment - Failure of Lines #48 & #107 would permanently drop 27 MW of load

Proposed Solution:

- Rebuild 115kV Line #48 between Thole Street and structure 48/71 to current standard. The remaining line to Sewells Point is 2007 vintage. Rebuild 115kV Line #107 line between structure 107/17 and 107/56 to current standard (B2625)

Estimated Project Cost: $15.3 M

Projected IS Date: 12/31/2018



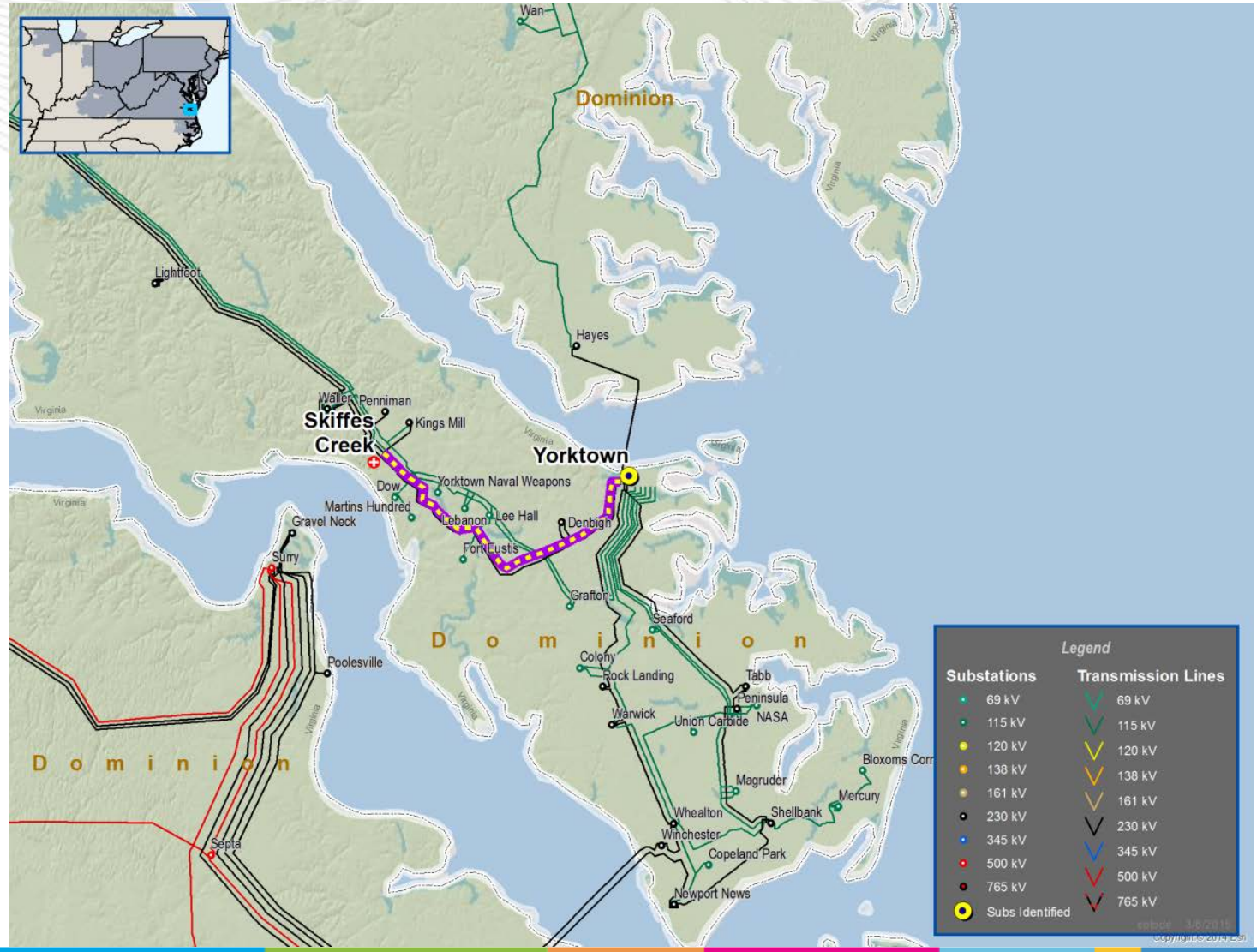
Dominion Transmission Zone

Problem:

- End of Life Criteria - The 13 mile 115kV Line #34 from Skiffes Creek – Yorktown was built on wood H-frames in the 1940's and 1950's. This line has sections of 4/0 copper conductor and 3/8" steel static. The first 4.5 miles out of Yorktown is on 3 pole double circuit wood H-frames with the Line #61 line.
- System Impact Assessment - Failure of Lines #34 & #61 would permanently drop 198 MW of load

Proposed Solution:

- Rebuild the 115kV Line #34 and the double circuit portion of 115kV Line # 61 to current standards with a summer emergency rating of 353 MVA at 115kV. (B2626)
- **Estimated Project Cost:** $24 M
- **Projected IS Date:** 12/31/2018



Dominion Transmission Zone

Problem:

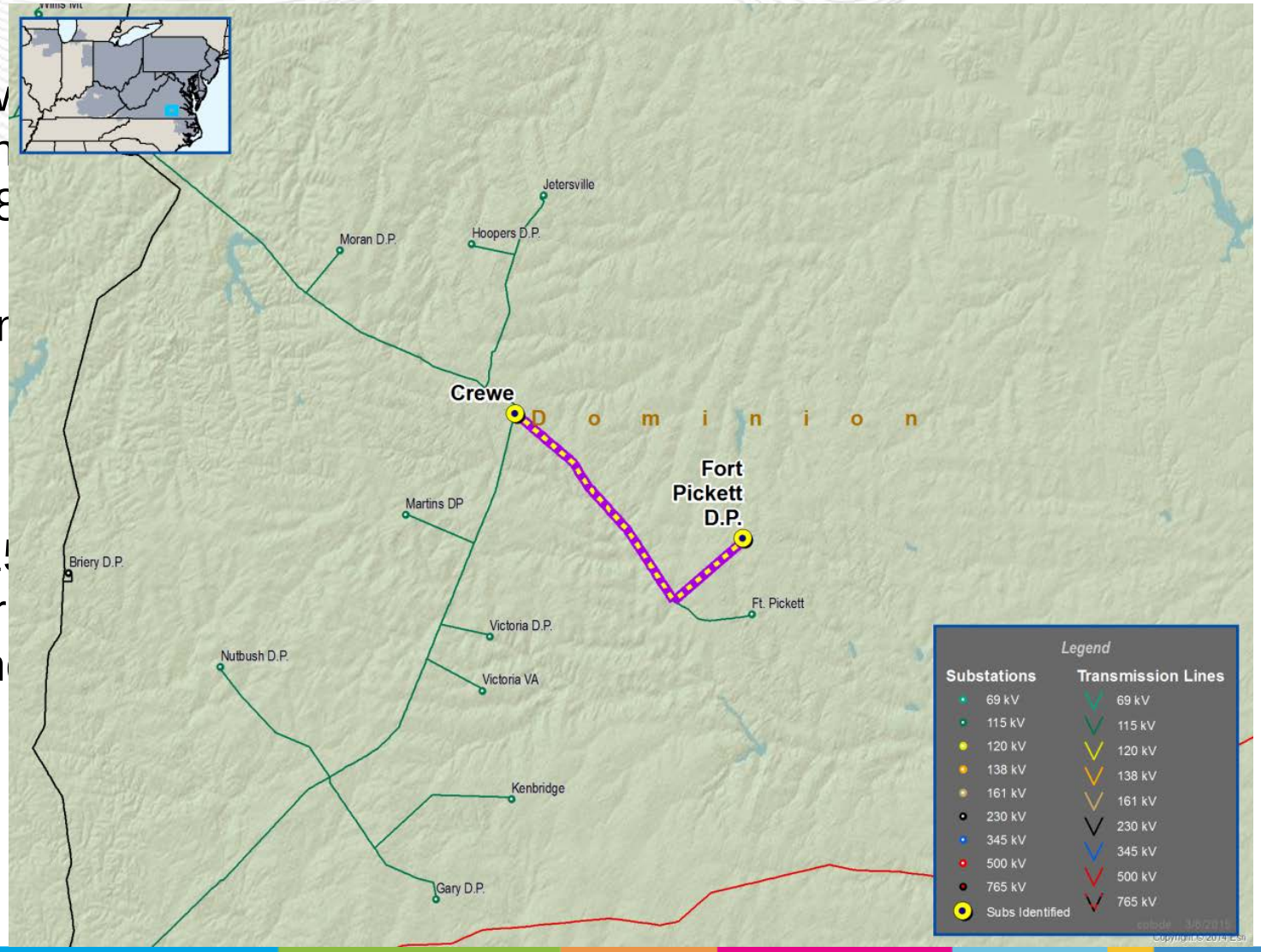
- End of Life Criteria - The 115kV Line # 1 w
  constructed on wood H-frame structures in
  This line has 2/0 copper conductor and 3/8
  static.
- System Impact Assessment - Failure of Lir
  permanently drop 31 MW of load

Proposed Solution:

- Rebuild 115kV Line #1 between Crewe 11
  Fort Pickett DP 115kV (12.2 miles) to curr
  standards with a summer emergency ratin
  MVA at 115kV. (B2627)

Estimated Project Cost: $18.3 M

Projected IS Date: 12/31/2016



Dominion Transmission Zone

Problem:

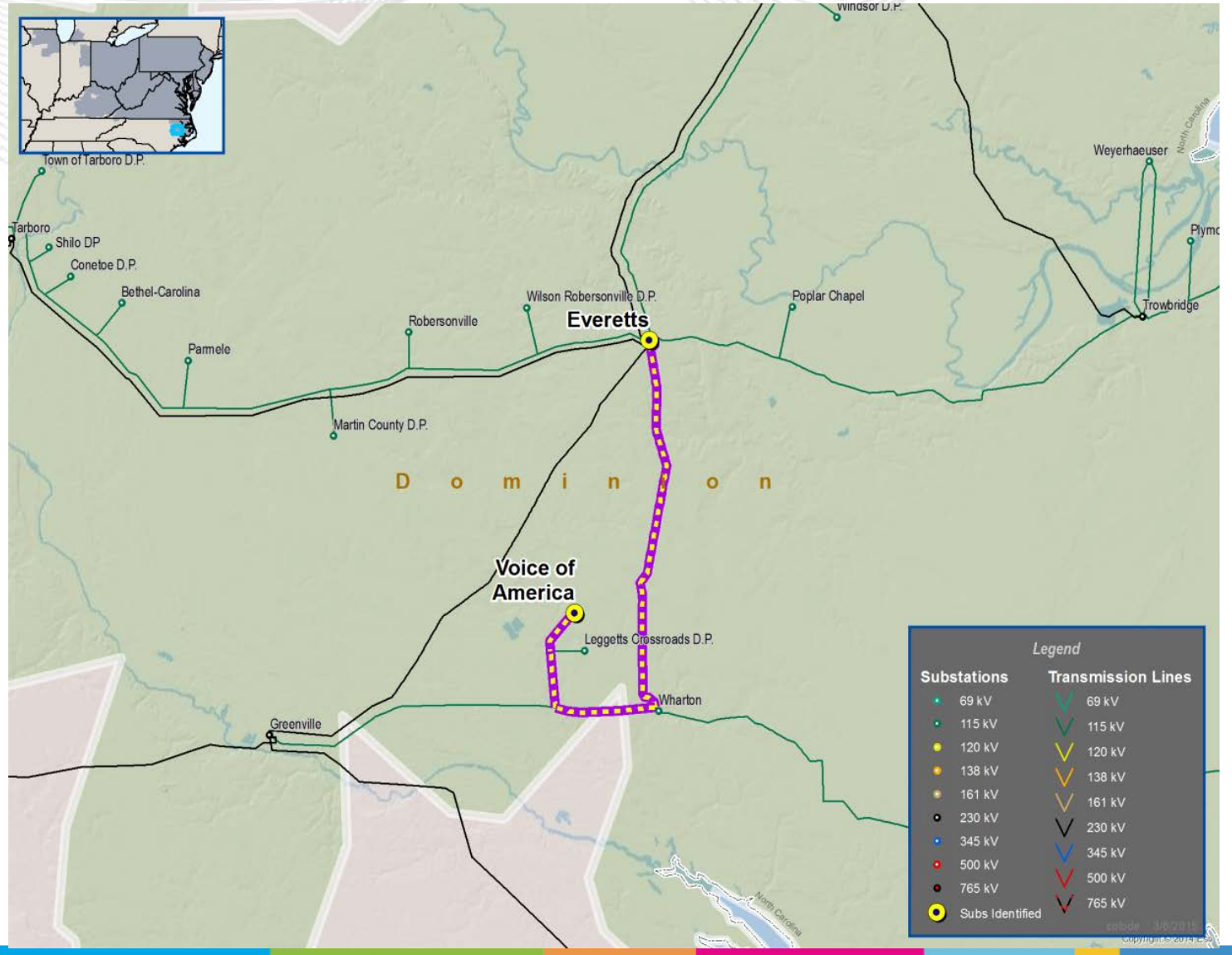
- End of Life Criteria - The Line #82 line was constructed on wood H-frame structures in 1953. This line has ACSR conductor and 3/8 inch steel static.
- System Impact Assessment - Failure of Line #82 would permanently drop 49 MW of load

Proposed Solution:

- Rebuild 115kV Line #82 Everetts – Voice of America (20.8 miles) to current standards with a summer emergency rating of 261 MVA at 115kV (B2628)

Estimated Project Cost: $24 M

Projected IS Date: 12/31/2017



Dominion Transmission Zone

Problem:

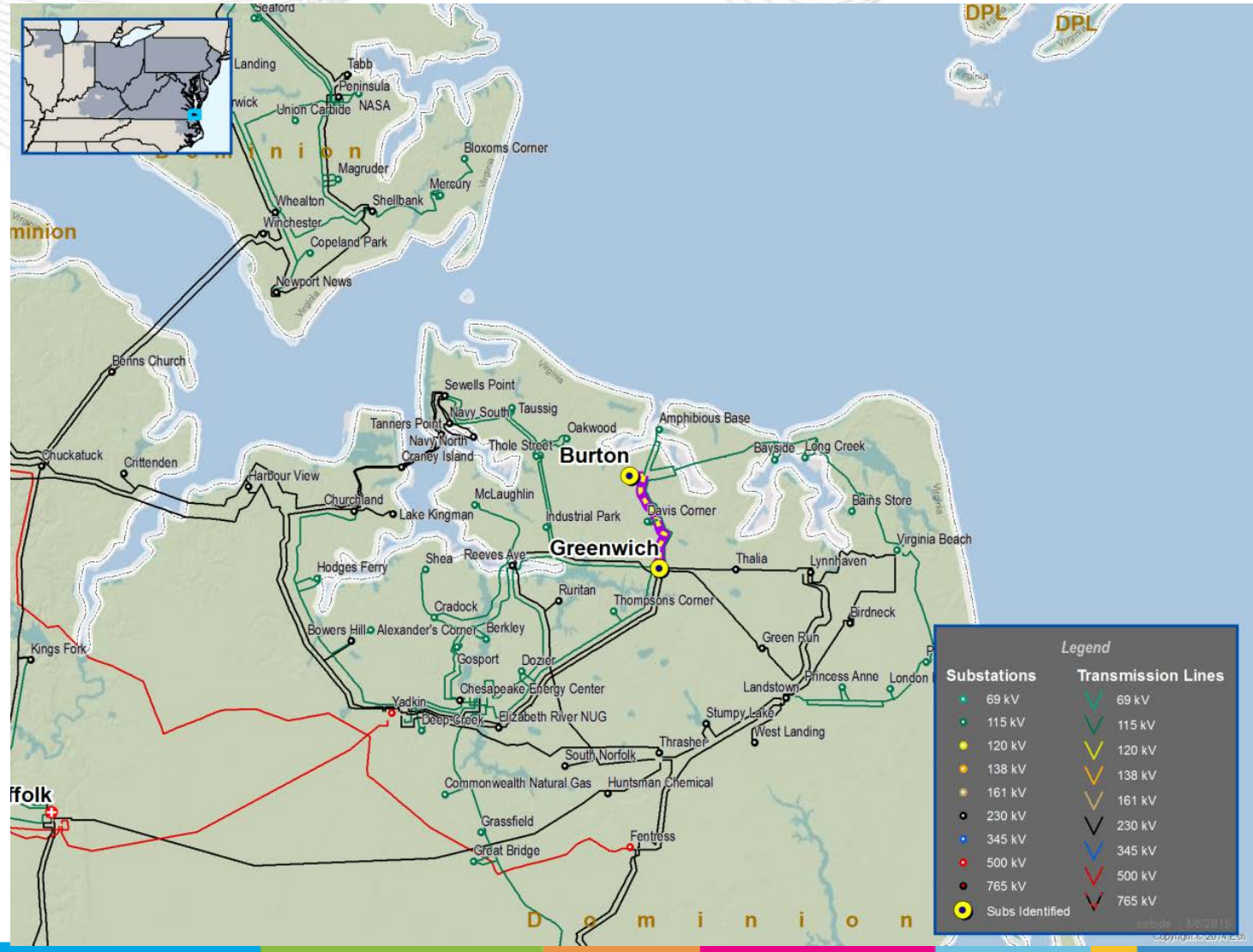
- End of Life Criteria - The 115kV Lines #27 (new line 166) and # 67 lines from Greenwich to Burton were built on double circuit weathering steel (Corten) towers in 1964. The corten structures are in poor condition and additional structure loading will be required due to a need for fiber to be installed on these structures.
- System Impact Assessment - Failure of Lines #27 & #67 would permanently drop 90 MW of load

Proposed Solution:

- Rebuild the 115kV Lines #27 & #67 lines from Greenwich 115kV to Burton 115kV Structure 27/280 to current standard with a summer emergency rating of 262 MVA at 115kV (B2629)

Estimated Project Cost: $8.85 M

Projected IS Date: 12/31/2019



Dominion Transmission Zone

Problem:

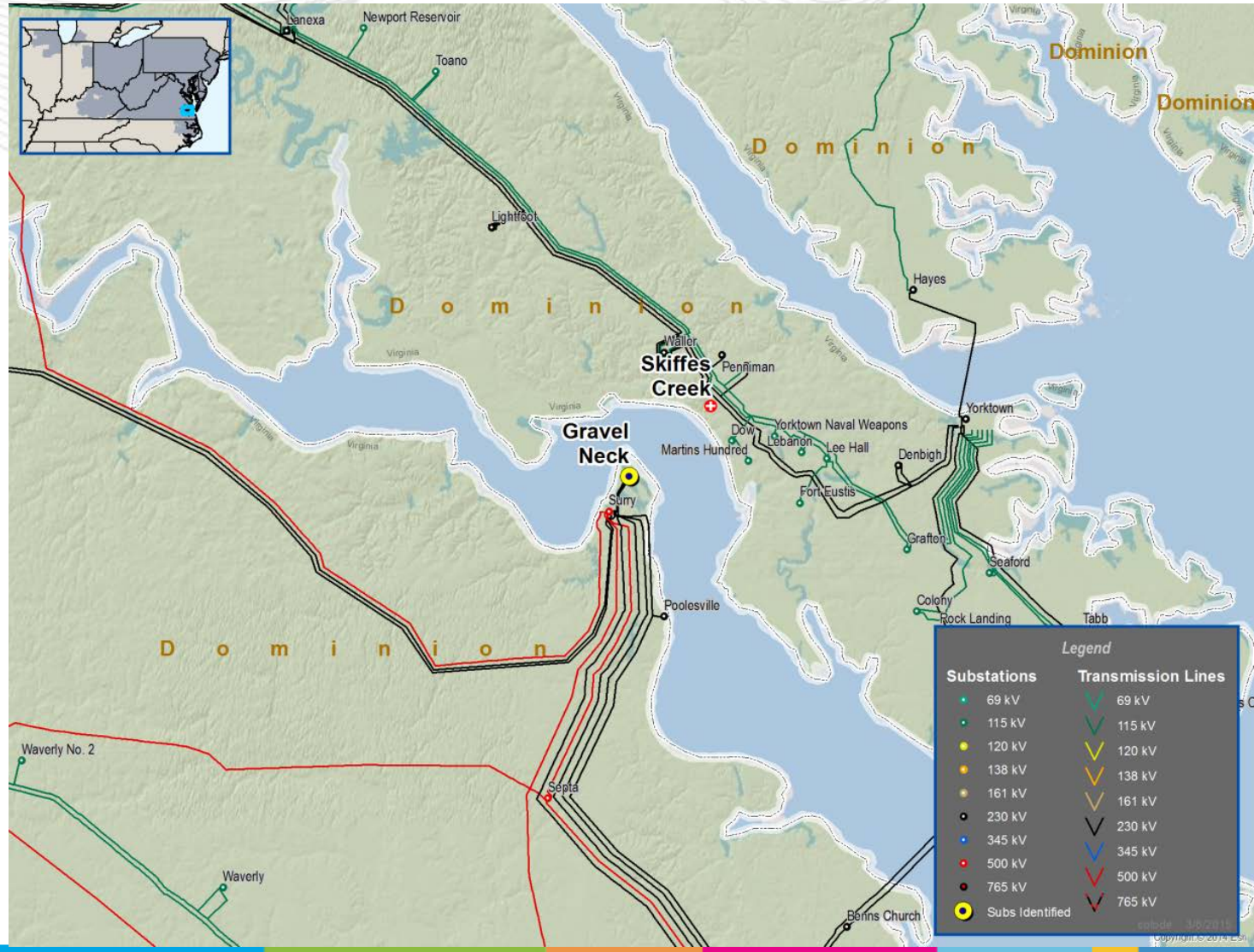
- Transmission upgrades are needed on GSU units #4 and #5 for Operational Performace.

Proposed Solution:

- Install circuit switchers on GSU units #4 and #5. Install two 230kV CCVT's on Lines #2407 and #2408 for loss of source sensing (B2630)

Estimated Project Cost: $662 K

Projected IS Date: 5/31/2015



Immediate Need Project

Dominion Transmission Zone

Operational Performance Problem:

- The Northern Neck area has recently been experiencing high voltage issues on the 230kV system in the area during light load conditions

Alternatives Considered:

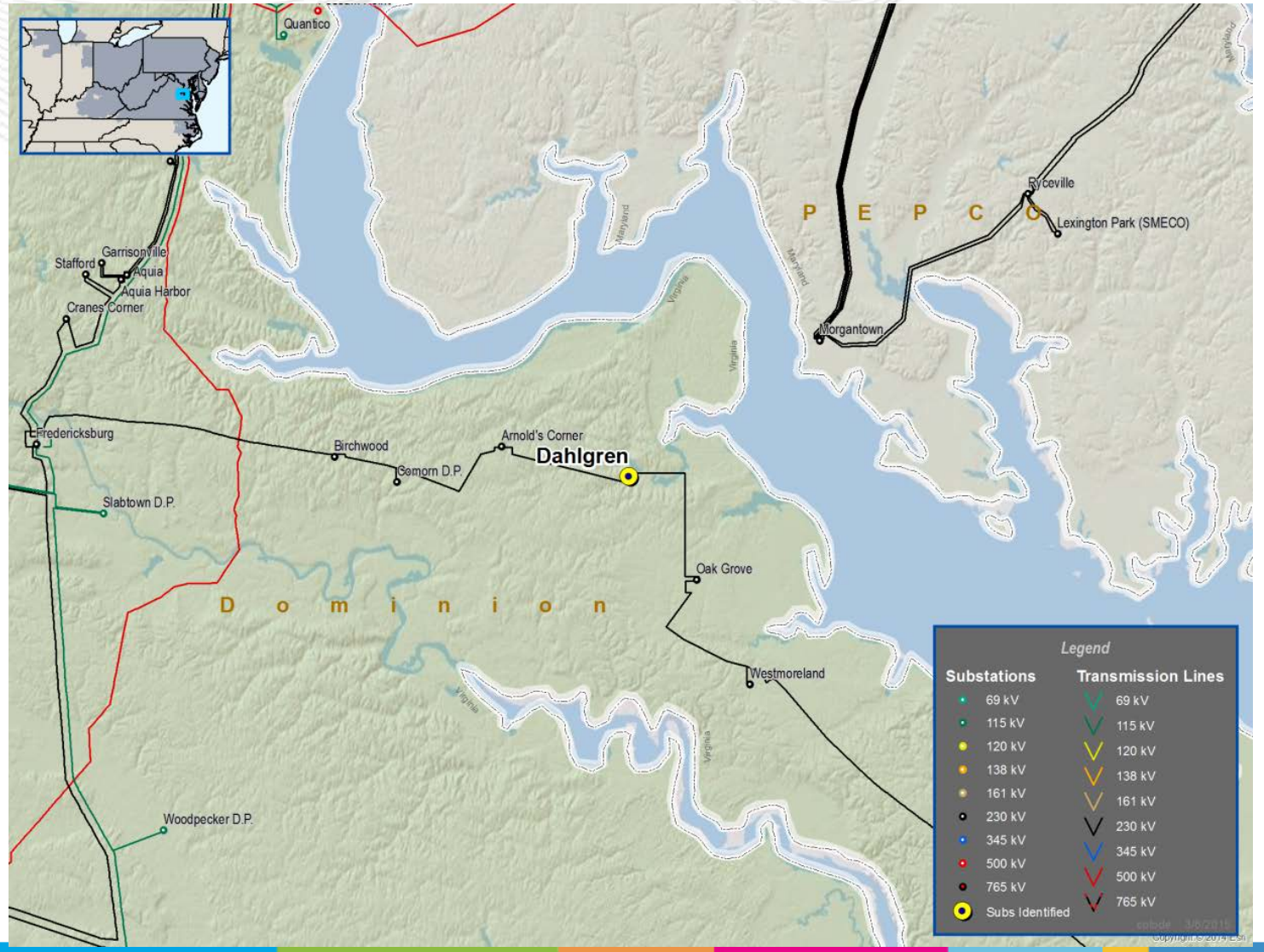
- PJM Operations has implemented operational adjustments such as switching out the Yorktown-Hayes lines and cap banks, however the high voltages still persist

Preliminary Proposed Solution:

- At Dahlgren, Install three 230kV bus breakers and a 230kV, 100MVAR Variable Shunt Reactor (B2636)
- Due to the time sensitive nature that this current issue presents, Dominion (Local TO) will be the Designated Entity

Estimated Project Cost: $6.7 M

Required IS Date: 5/1/2016



Dominion Transmission Area

Problem: DOM End-Of-Life Criteria Violation

- End of Life Criteria - The Boydton Plank Rd to Kerr Dam 115kV line was constructed on wood H-frames in 1955. This line serves Mecklenburg's Boydton delivery point.
- System Impact Assessment - Permanent MW load loss for removal of this line is 4MW.
- This is an immediate need project based on "End of Life" criteria.
- When this criteria violation was identified, the need date was already in the immediate need timeframe This is an immediate need project based on "End of Life" criteria.

Alternatives Considered

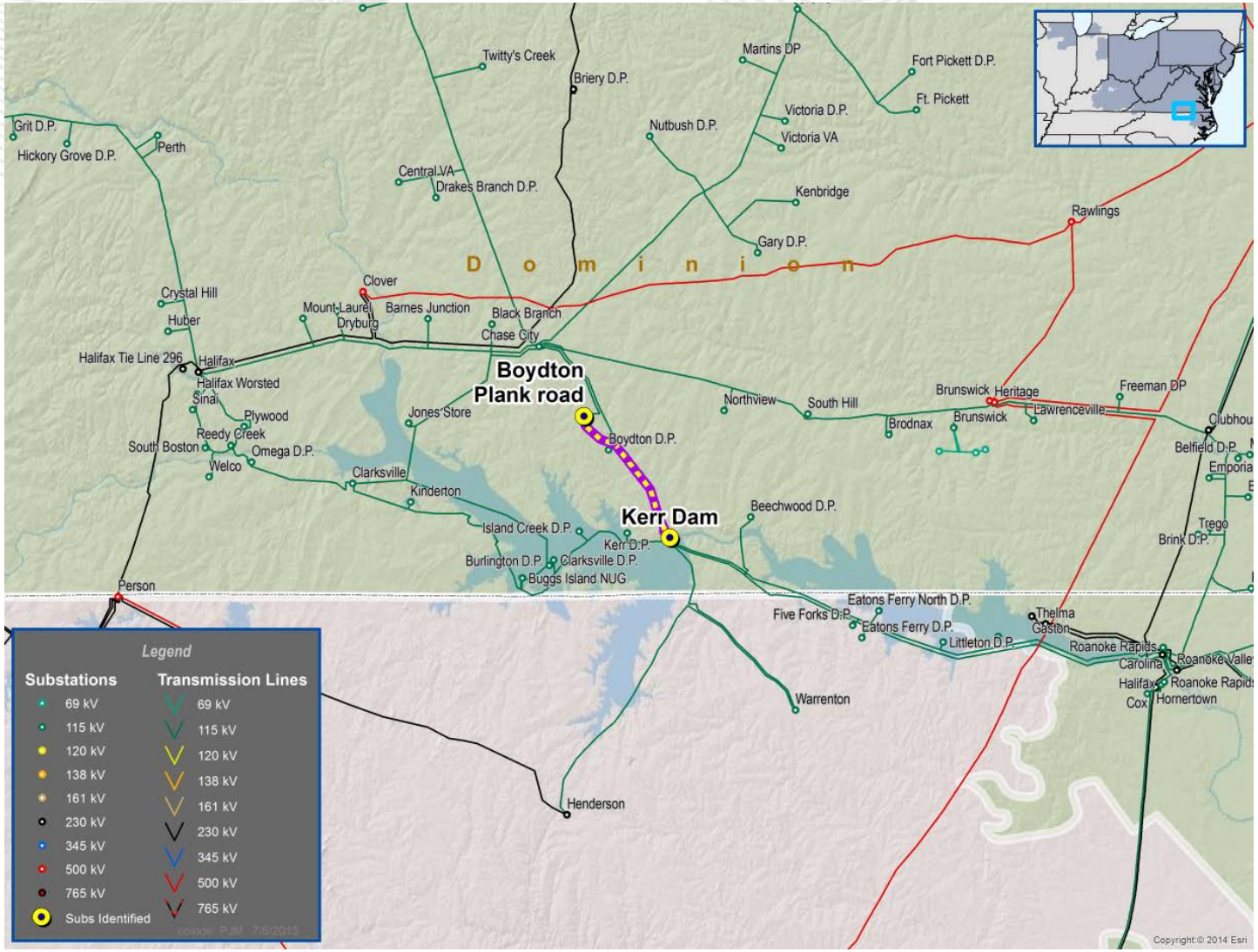
- Given the immediate need timing of the violation, alternatives that would require new lines to be built were not considered.

Proposed Immediate Need Solution

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

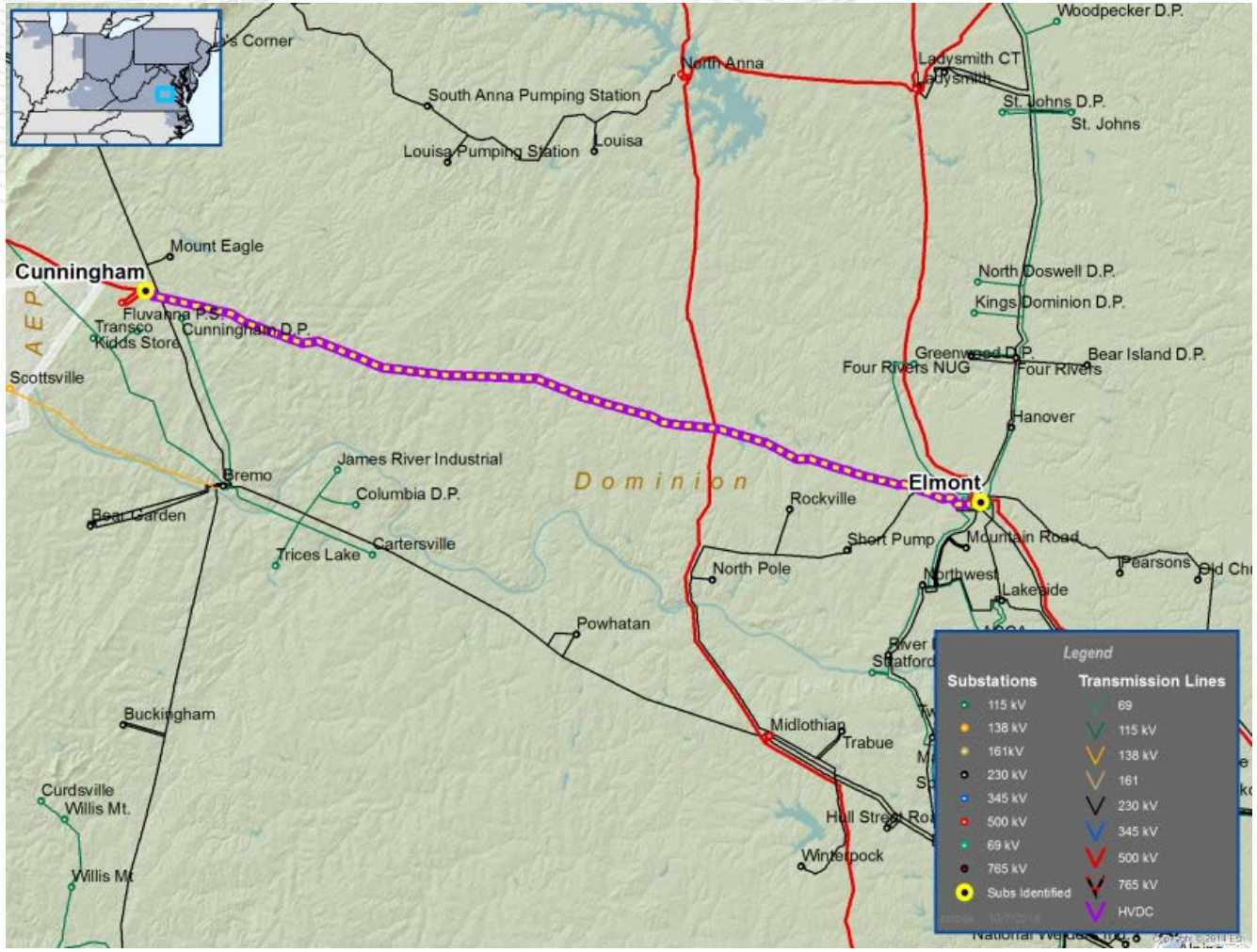
- Rebuild 115kV Line # 38 from Boydton Plank Rd and Kerr Dam (8.3 miles) to current standards with a summer emergency rating of 353 MVA at 115kV (b2647).

Estimated Project Cost: $12.5 M
Projected IS Date: 12/31/2020



Dominion Transmission Zone

- Dominion Transmission Planning Criteria - End of Life Criteria Violation on the Cunningham to Elmont 500 kV Line
- Dominion 500 kV assessment by third party
  - Initiated by Dominion
  - Evaluate the condition of the 500 kV system in Dominion
    - Physical infrastructure evaluation
    - Power flow simulation
- Assessment Result
  - Due to condition, Cunningham – Elmont 500 kV has reached it's end of life
  - Facility list ranked by priority



Dominion Transmission Area

Problem: DOM End-Of-Life Criteria Violation

- End of Life Criteria - The Carolina to Kerr Dam 115kV line was constructed on wood H-frames in 1953. This line serves Halifax ED and Mecklenburg EC delivery points Beechwood and Five Forks.
- System Impact Assessment - Permanent MW load loss for removal of this line is 32 MW.
- This is an immediate need project based on “End of Life” criteria.
- When this criteria violation was identified, the need date was already in the immediate need timeframe This is an immediate need project based on “End of Life” criteria.

Alternatives Considered

- Given the immediate need timing of the violation, alternatives that would require new lines to be built were not considered.

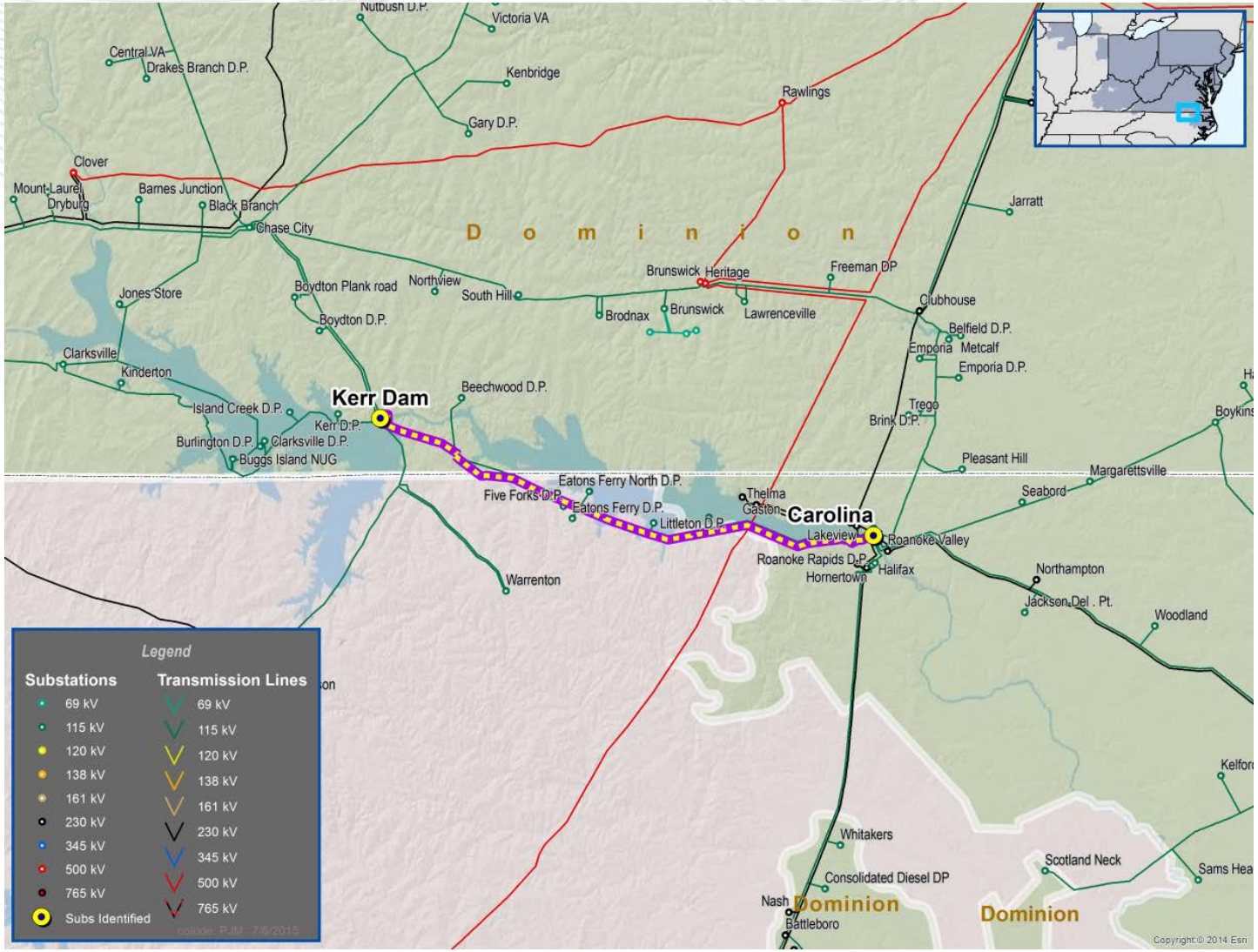
Proposed Immediate Need Solution

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Rebuild 115kV Line #90 from Carolina to Kerr Dam 115kV (38.7 miles) to current standards with a summer emergency rating of 353 MVA at 115kV (b2648).

Estimated Project Cost: $58.6 M

Projected IS Date: 12/31/2019



Dominion Transmission Area

Problem: DOM End-Of-Life Criteria Violation

- End of Life Criteria - The Clubhouse to Carolina 115kV line was constructed on wood H-frames and single poles in 1962. This line serves Mecklenburg delivery points Brink, Belfield and Emporia.
- System Impact Assessment - Permanent MW load loss for removal of this line is 42 MW.
- This is an immediate need project based on “End of Life” criteria.
- When this criteria violation was identified, the need date was already in the immediate need timeframe This is an immediate need project based on “End of Life” criteria.

Alternatives Considered

- Given the immediate need timing of the violation, alternatives that would require new lines to be built were not considered.

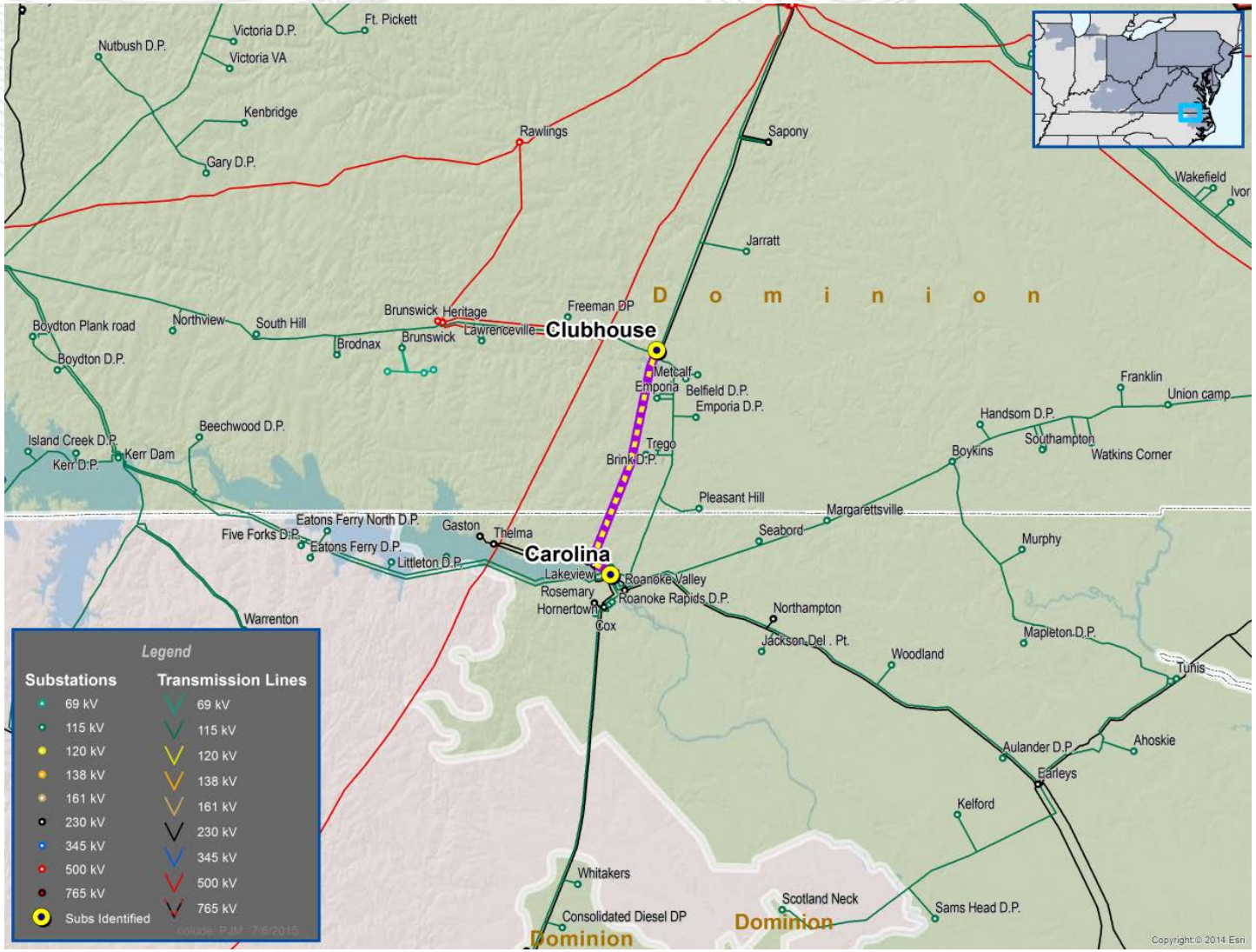
Proposed Immediate Need Solution

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Rebuild 115kV Line #130 from Clubhouse to Carolina (17.8 miles) to current standards with a summer emergency rating of 353 MVA at 115kV (b2649).

Estimated Project Cost: $27.0 M

Projected IS Date: 12/31/2019



Dominion Transmission Area

Problem: DOM End-Of-Life Criteria Violation

- End of Life Criteria - The Twittys Creek to Pamplin line was constructed on wood H-frames in 1953. This line serves Southside delivery points Drakes Branch and Madisonville..
- System Impact Assessment - Permanent MW load loss for removal of this line is 18 MW.
- This is an immediate need project based on “End of Life” criteria.
- When this criteria violation was identified, the need date was already in the immediate need timeframe This is an immediate need project based on “End of Life” criteria.

Alternatives Considered

- Given the immediate need timing of the violation, alternatives that would require new lines to be built were not considered.

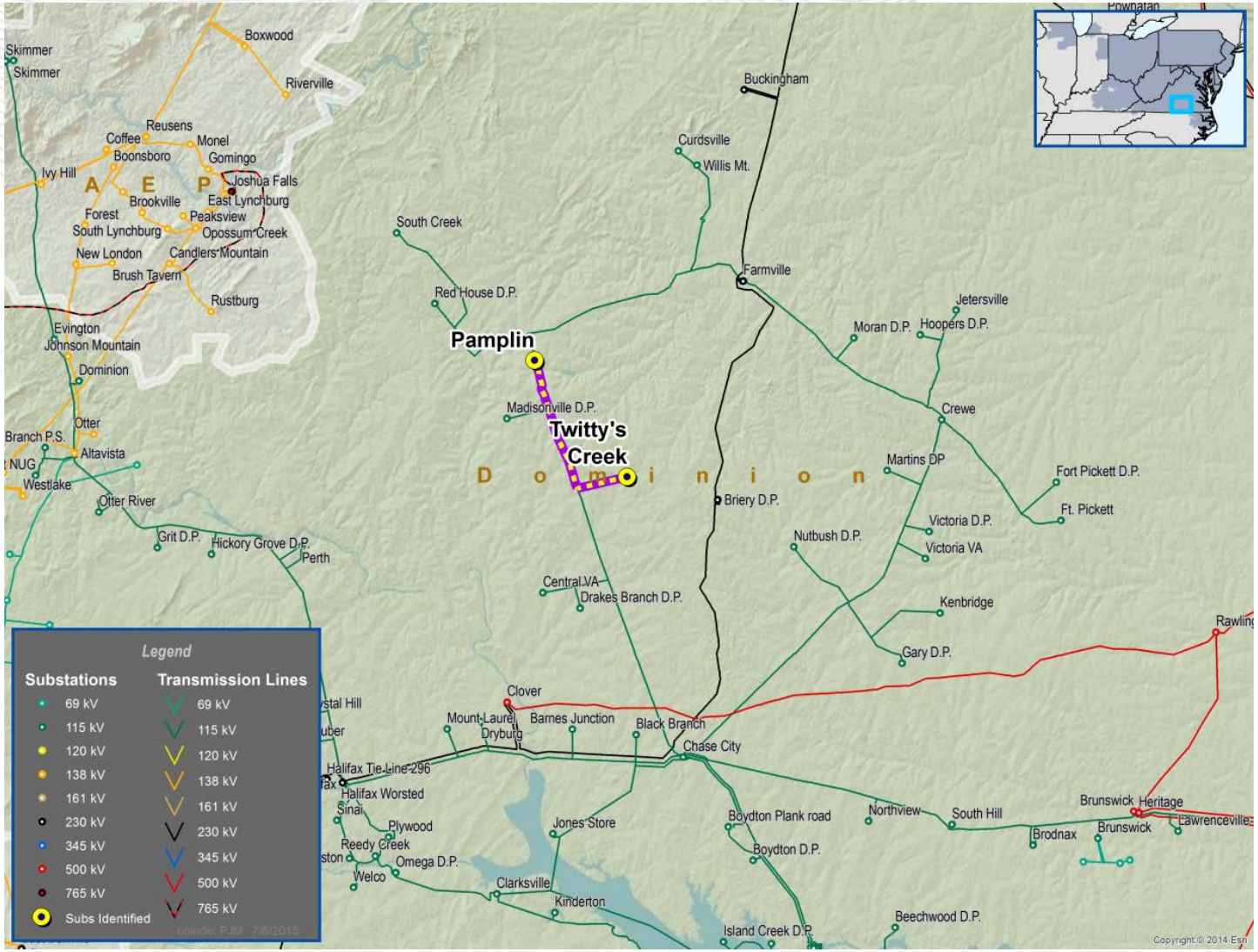
Proposed Solution:

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Rebuild 115kV Line #154 from Twittys Creek to Pamplin (17.8 miles) to current standards with a summer emergency rating of 353 MVA at 115kV (b2650).

Estimated Project Cost: $25.7 M

Projected IS Date: 12/31/2020



Dominion Transmission Area

Problem: DOM End-Of-Life Criteria Violation

- End of Life Criteria - The Buggs Island to Plywood 115kV line was constructed on wood H-frames. The original construction date has not been identified in our records. A portion of the line was re-insulated and reconductored for 115kV operation in 1970. This line serves Mecklenburg delivery point Omega.
- System Impact Assessment - Permanent MW load loss for removal of this line is 10 MW.
- This is an immediate need project based on “End of Life” criteria.
- When this criteria violation was identified, the need date was already in the immediate need timeframe This is an immediate need project based on “End of Life” criteria.

Alternatives Considered

- Given the immediate need timing of the violation, alternatives that would require new lines to be built were not considered

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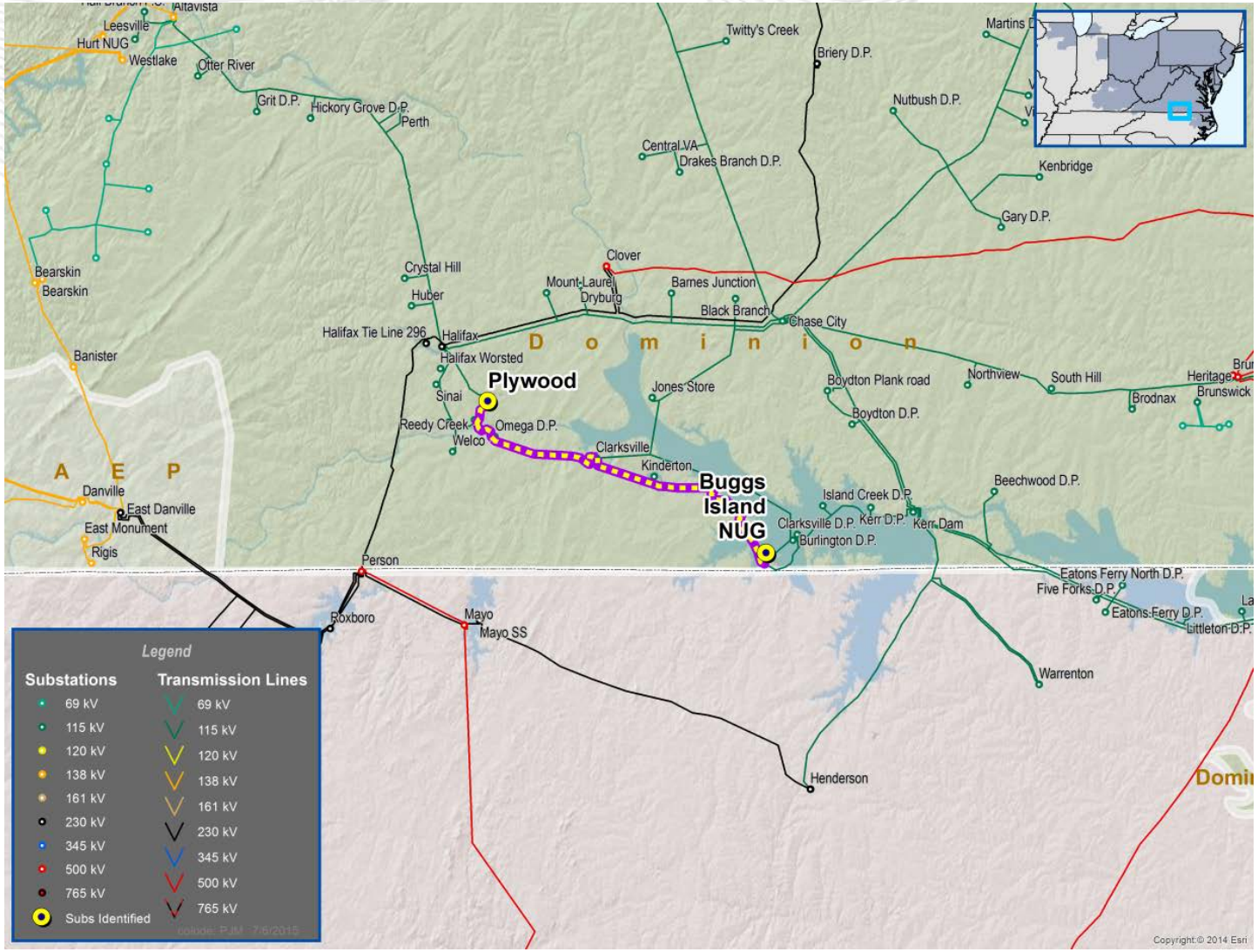

Dominion Transmission Area

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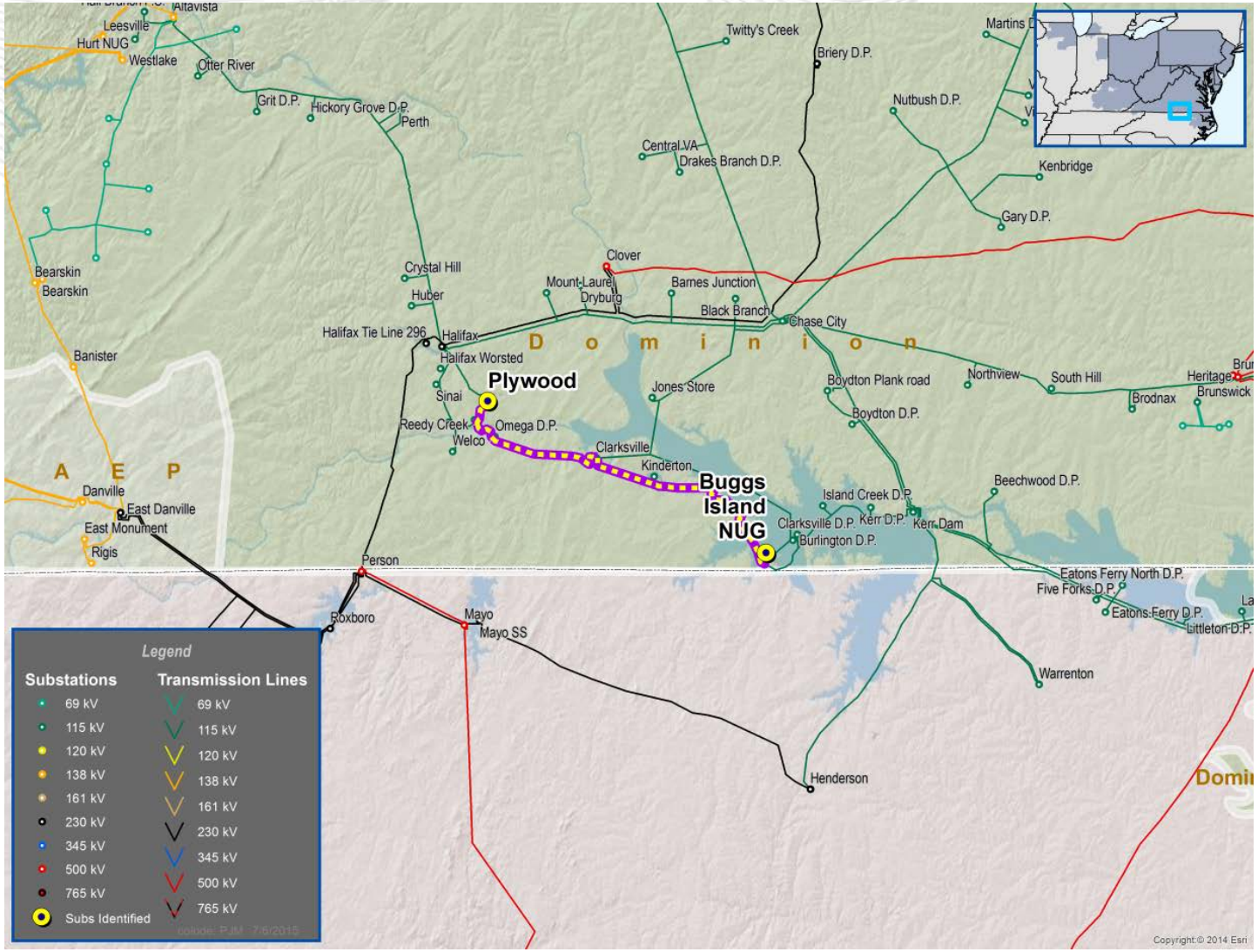
Proposed Immediate Need Solution

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Rebuild 115kV Line # 127 from Buggs Island to Plywood (25.8 miles) to current standards with a summer emergency rating of 353 MVA at 115kV. The line should be rebuilt for 230kV and operated at 115kV (b2651).

Estimated Project Cost: $38.7 M

Projected IS Date: 12/31/2021



Dominion Transmission Area

Problem :DOM End-Of-Life Criteria Violation

- End of Life Criteria - The Greatbridge to Hickory and Greatbridge to Chesapeake E.C.)were constructed on wood H-frames and Corten Towers in 1953 and 1967. The lines have ACSR conductor and mixture of 3/8" steel and 3#6 ALW static.

- System Impact Assessment - Permanent MW load loss for removal of these lines is 83MW.

- This is an immediate need project based on "End of Life" criteria.
- When this criteria violation was identified, the need date was already in the immediate need timeframe This is an immediate need project based on "End of Life" criteria.

Alternatives Considered

- Given the immediate need timing of the violation, alternatives that would require new lines to be built were not considered

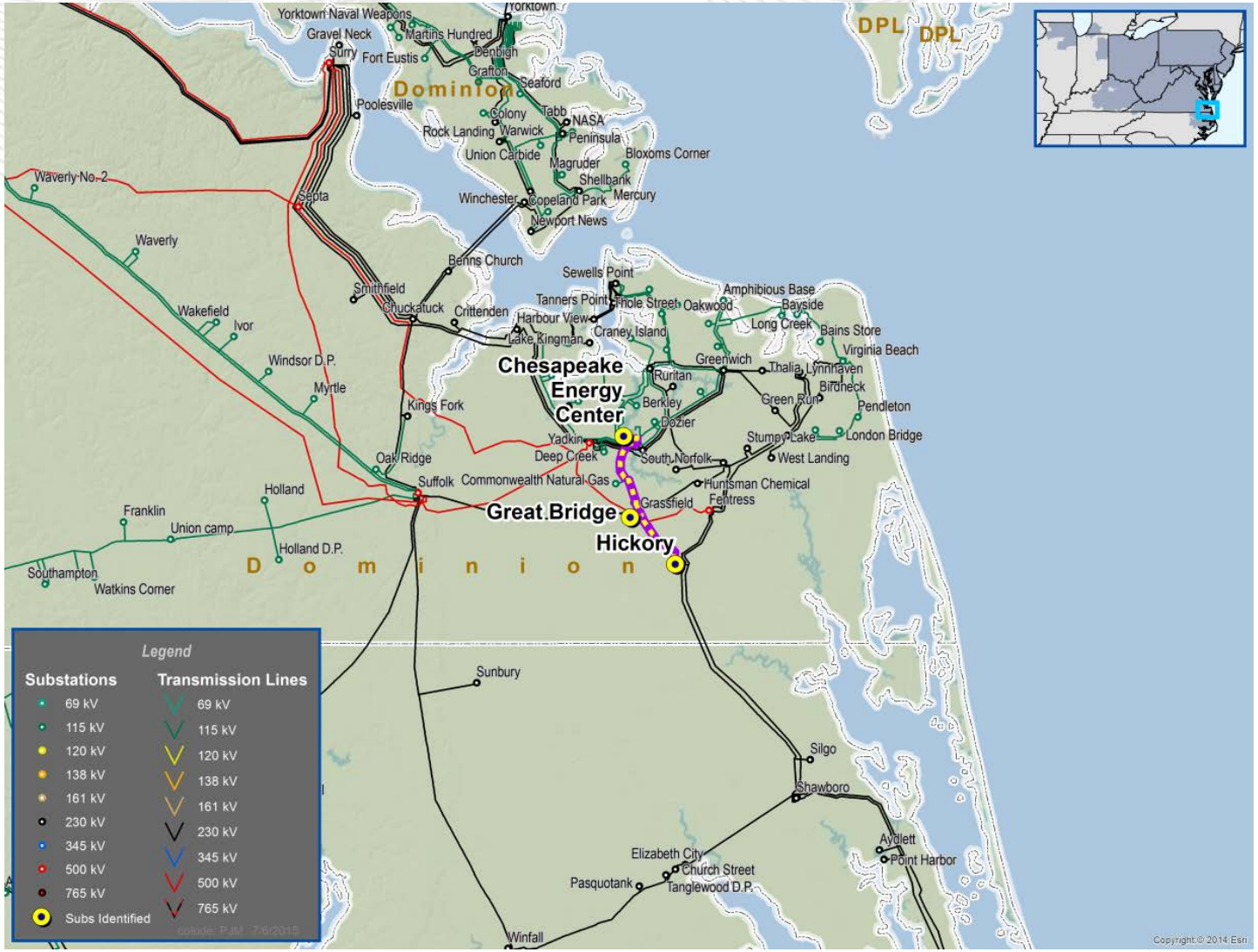
Proposed Immediate Need Solution

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Rebuild the 115kV Lines #16 and #74 from Greatbridge to Hickory and from Greatbridge to Chesapeake E.C. to current standard with a summer emergency rating of 353 MVA at 115kV (b2652).

Projected IS Date: 12/31/2021

Estimated cost: $ 22.0 M



Dominion Radial Transmission Lines

- **Radial transmission lines**
  - A Radial transmission line is defined as a single line that originates in a substation, serves load and does NOT tie to any other transmission line or substation
- Loading on single source radial transmission lines will be limited to the follow:
  - 100 MW Maximum
  - 700 MW-Mile Exposure (MW-Mile = Peak MW X Radial Line Length)

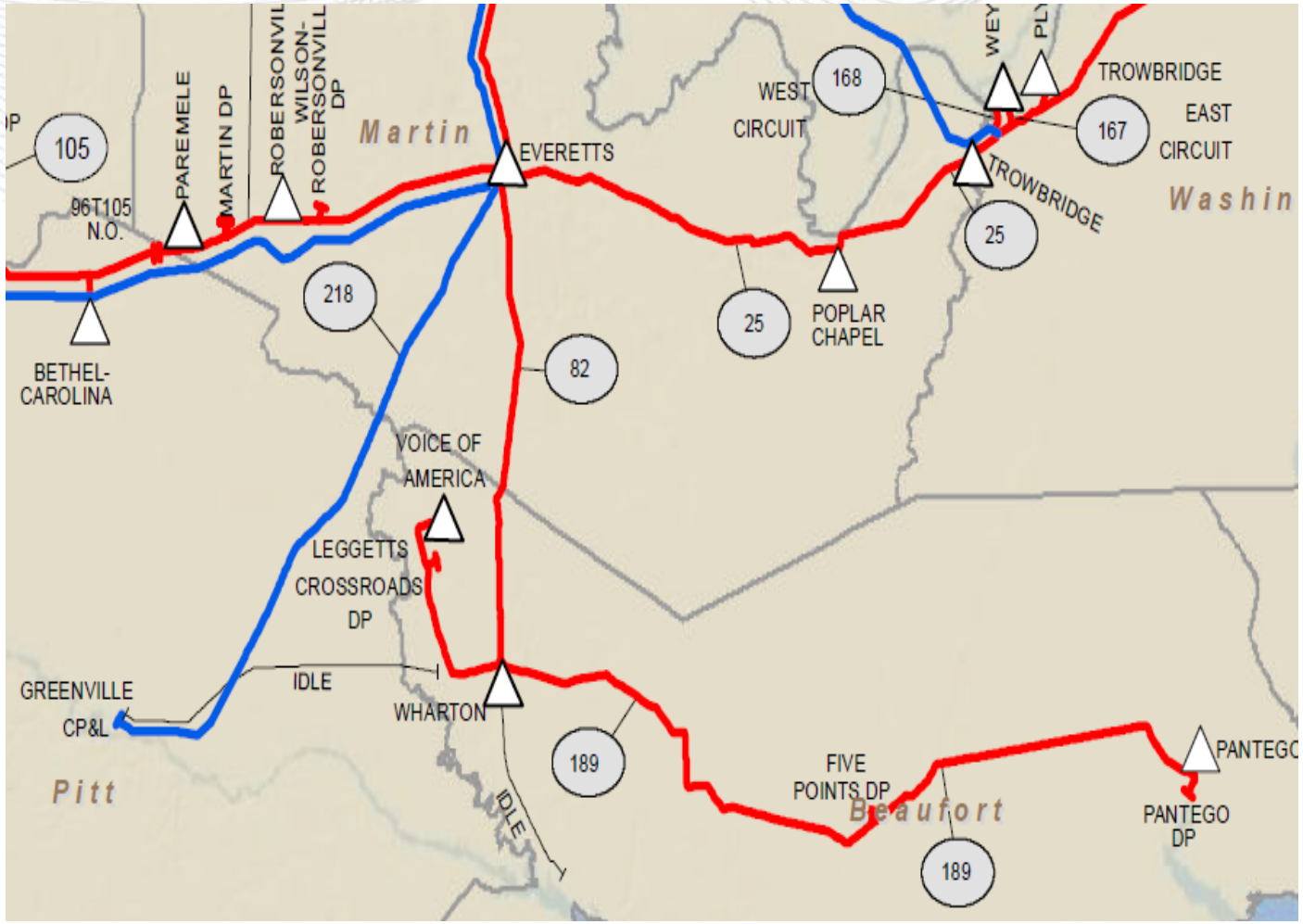
Dominion Transmission Area

Problem: DOM Radial Line Criteria Violation

- Line #82 is a 115kV radial line from Everetts to Wharton (13.8 miles) that feeds radial line #189 from Wharton to Pantego (30.2 miles).
- The MW-miles for Lines #82 and #189 are 2156 and 1419 MW-miles respectively, a violation of the DOM radial line criteria.
- This need is time sensitive due to the criteria violation in the immediate need timeframe.
- When this criteria violation was identified, the need date was already in the immediate need timeframe.

Alternatives Considered:

1) Network Line #82 by acquiring new right-of-way and building a 4.5 mile 115kV line from Line #218 to Line #82 near Voice of America. Acquire land and build a substation at the Line #218 end with a 230-115kV transformer, 230kV 3 breaker ring and 115kV breaker. Install a 115kV 3 breaker ring at Wharton. ($23 M)
2) Rebuild Line #189 (30.2 miles) with a 115kV double circuit line. Install a 3 breaker ring at Pantego and a 3 breaker ring at Wharton. ($60 M)



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Dominion Transmission Area

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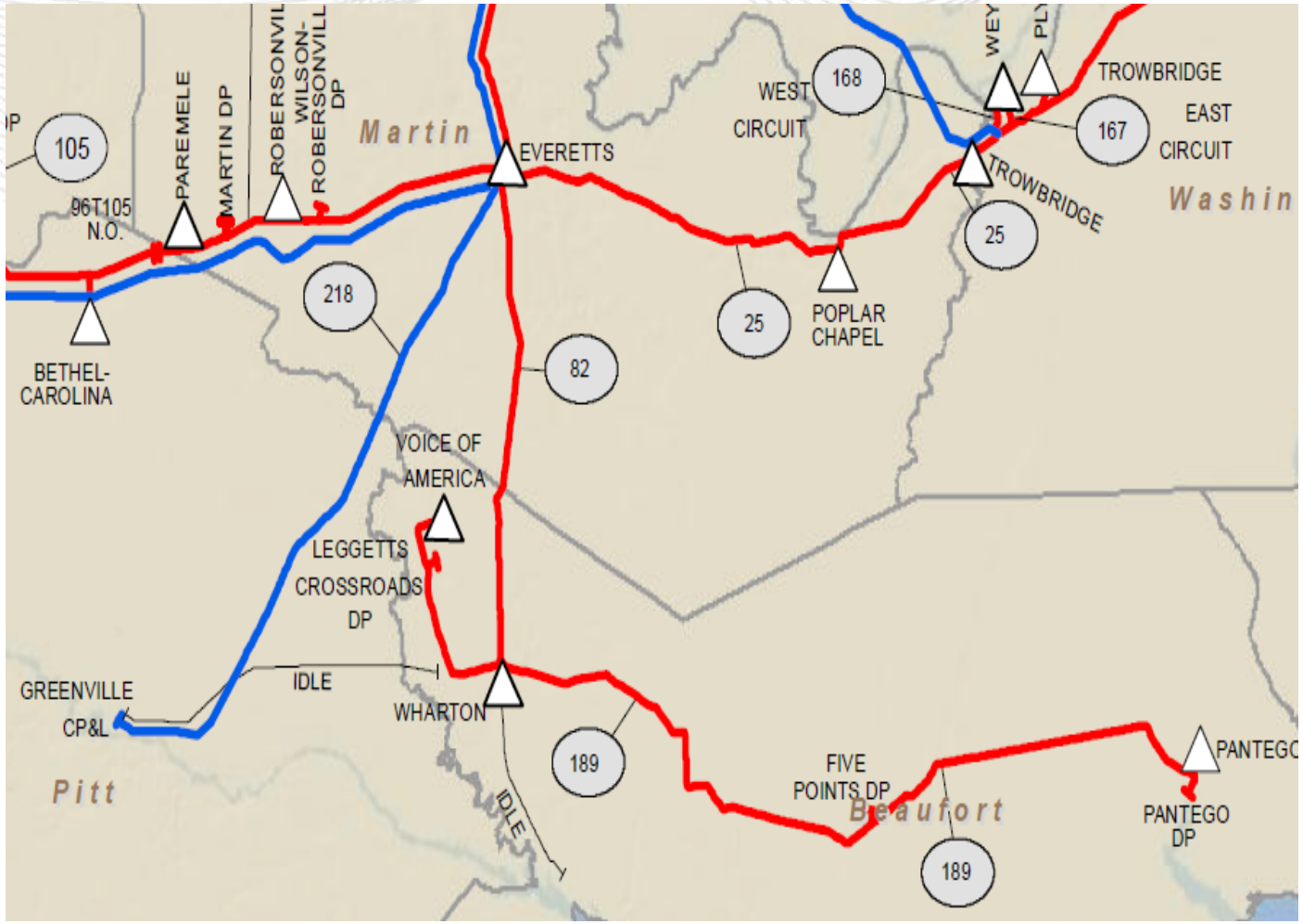
Proposed Immediate Need Solution

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Network Lines #82 and #189 by building a 20 mile 115kV line from Pantego to Trowbridge with a summer emergency rating of 353 MVA. (b2653.1)
- Install a 115kV four breaker ring at Pantego (b2653.2) and a 115kV breaker at Trowbridge (b2653.3).

Estimated Project Cost: $35.4 M

Projected IS Date: 6/1/2018



Dominion Transmission Area

Problem: DOM Radial Line Criteria Violation

- Line #126 is a 115kV 25 mile radial line from Earleys to Scotland Neck on 2 pole wood H frames mostly built in 1969.
- The MW-miles for Line #126 is 775 MW-miles, a violation of the DOM radial line criteria.
- This need is time sensitive due to the criteria violation in the immediate need timeframe.
- When this criteria violation was identified, the need date was already in the immediate need timeframe

Alternatives Considered:

1) Network Line #126 by building a 17 mile 115kV line from Scotland Neck to Line 55 at Tar River. Install a 115kV breaker at Scotland Neck. ($30 M)
2) Network Line #126 by rebuilding Line #126 as a double circuit line. Install a 115kV breaker at Scotland Neck and at Earleys. ($48 M)

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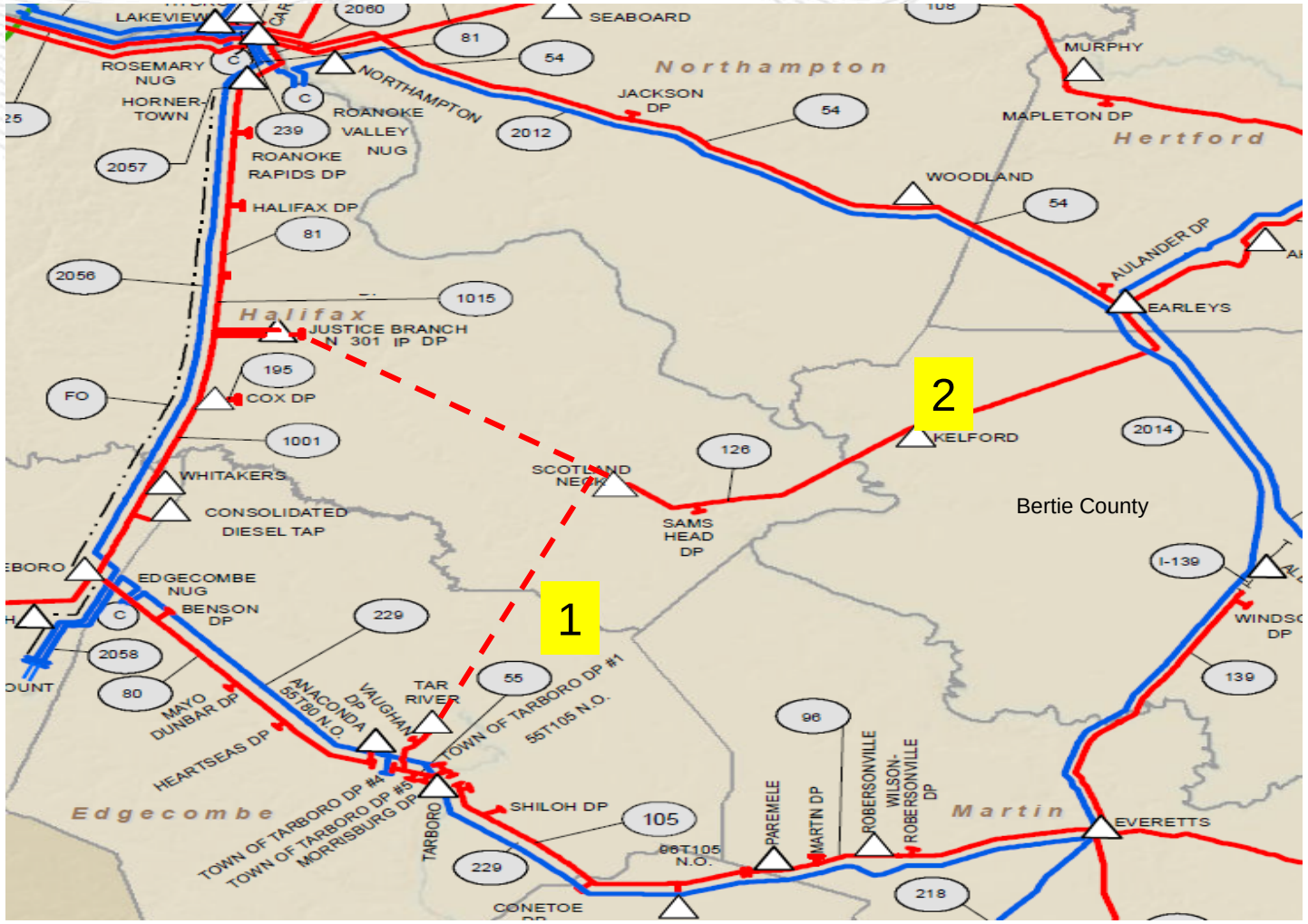

Dominion Transmission Area

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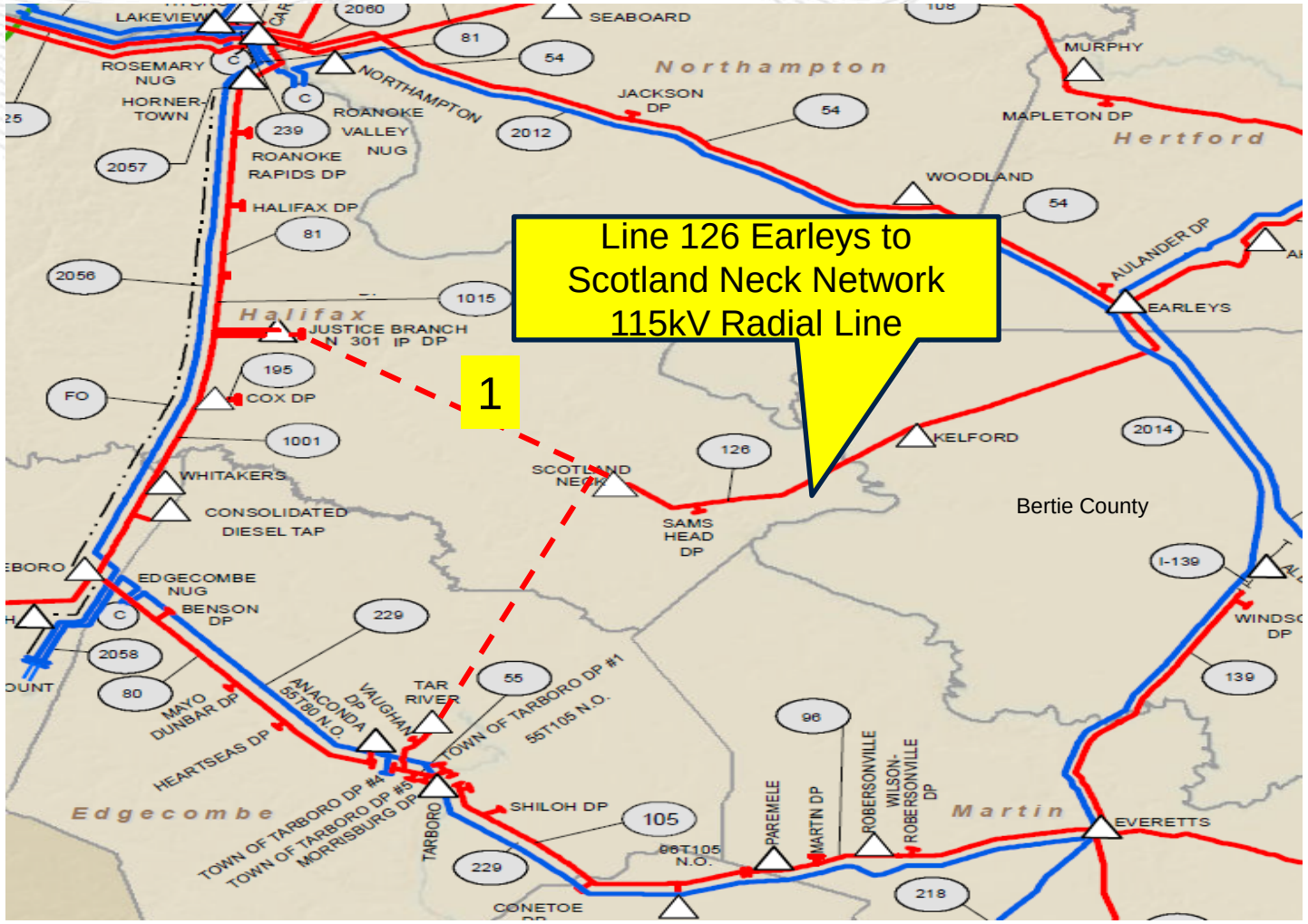
Proposed Immediate Need Solution

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be Designated Entity.

- Network Line #126 by building a 15 mile 115kV line from Scotland Neck to S. Justice Branch with a summer emergency rating of 262 MVA (b2654.1).
- Install a 115kV three breaker ring at S Justice Branch (b2654.2) and a 115kV breaker at Scotland Neck (b2654.3).
- Install a 2nd 224 MVA 230-115kV transformer at Morning Star (b2654.4) for contingency support. The new line would be routed to allow HEMC to convert Dawsons Crossroads DP from 34.5kV to 115kV.

Estimated Project Cost: $33.3 M

Projected IS Date: 6/1/2018



Dominion Transmission Zone

- Dominion End of Life Criteria Violation on the Cunningham to Dooms 500 kV Line
- Third party evaluation:
  - Confirmed the Cunningham to Doom 500 kV is nearing or has reached its End of Life
  - Performed a Risk Assessment
- Reliability Assessments without the line result in Criteria violations:
  - PJM validated the following violations
- NERC B “N-1” (New NERC TPL-001-4 P3) Violations:
  - Initial Loss of Front Royal generation followed by loss of Mt Storm- Valley 500kV line
    - Overload of Edinburg - Strasburg 138 Kv

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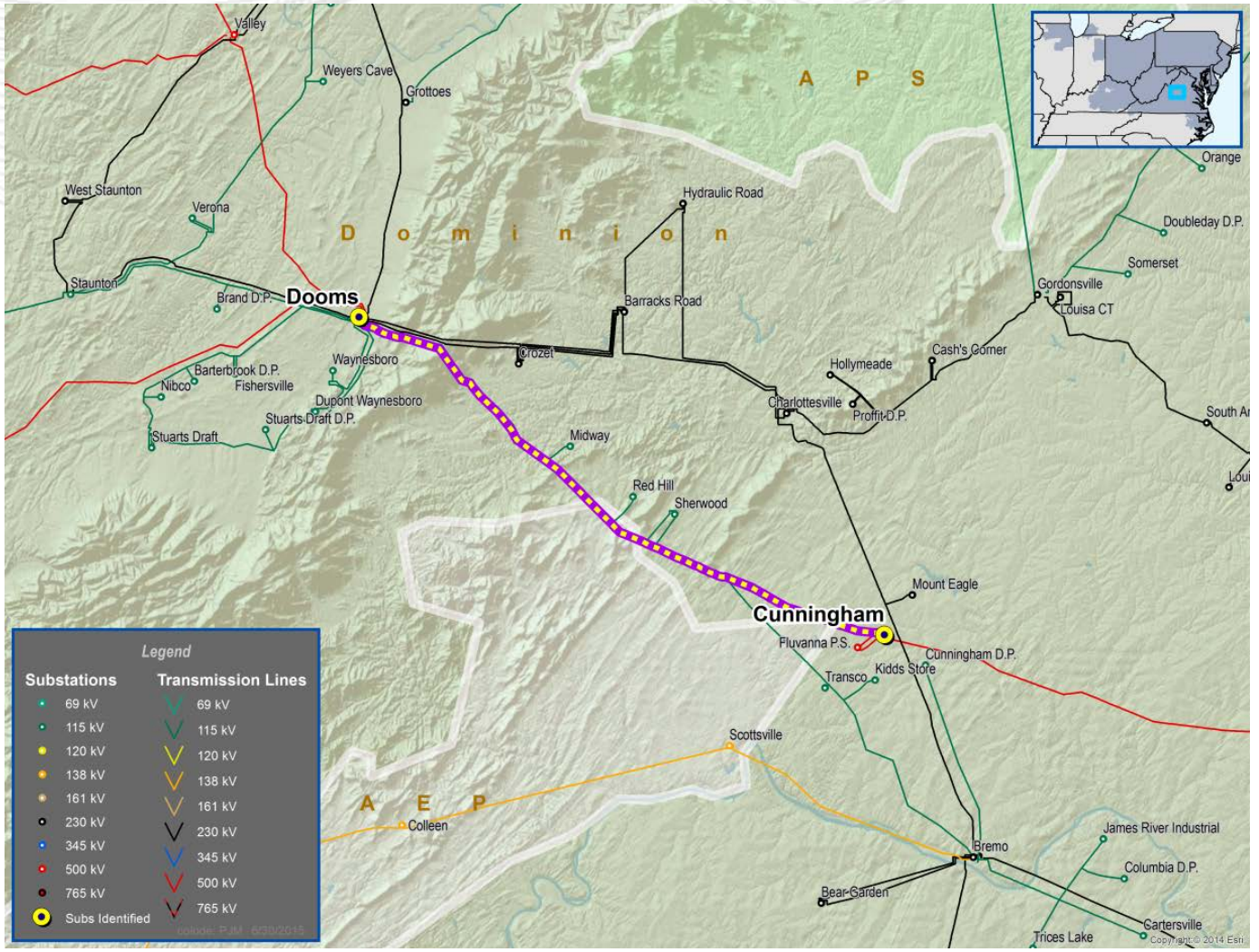

Dominion Transmission Zone

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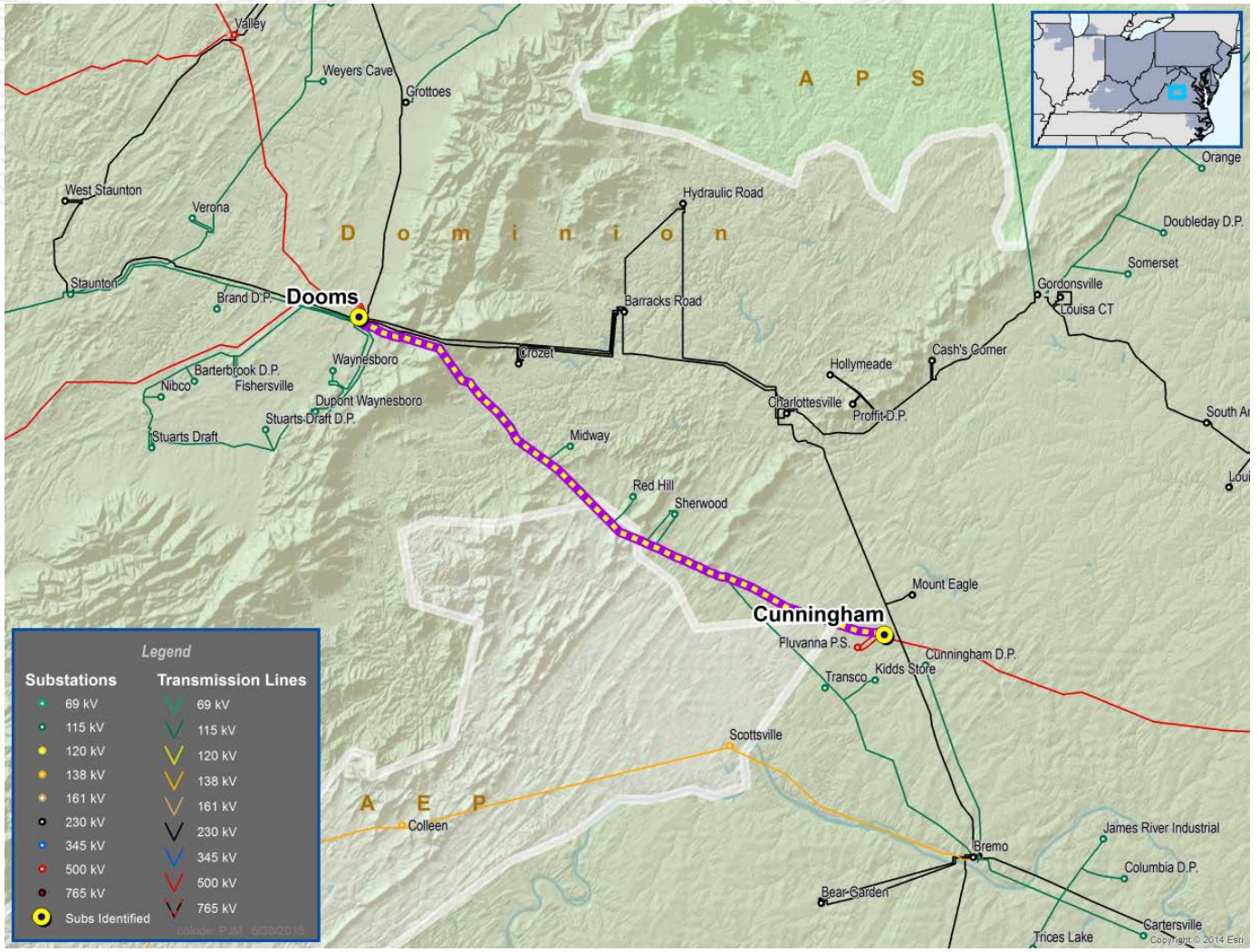
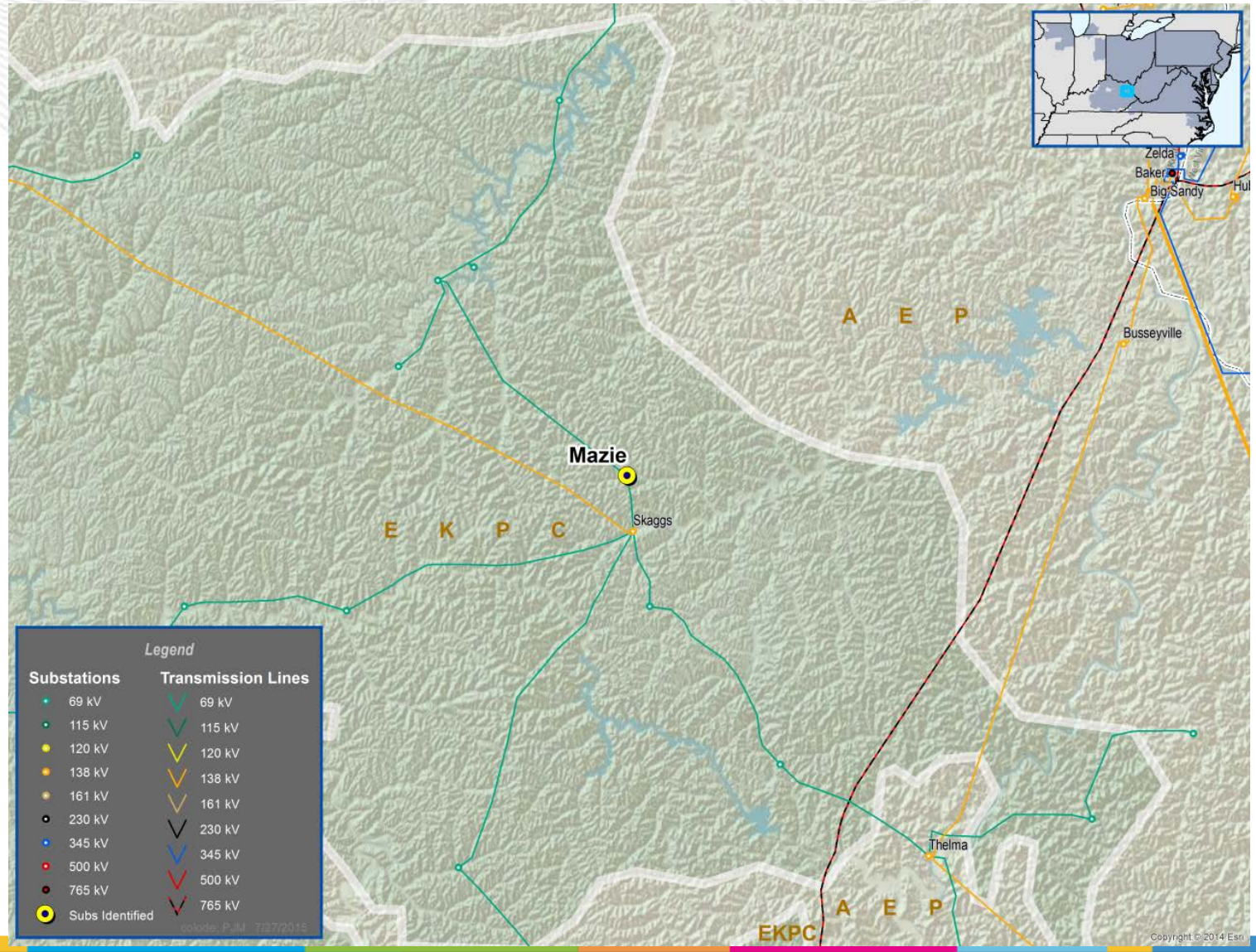
- NERC C3 “N-1-1” (New NERC TPL-001-4 P6)
  - Loss of Lexington – Cloverdale 500kV and Bath County – Valley 500kV lines:
    - Low voltage and voltage drop in the 500kV area of Bath County, Dooms, Lexington, and Valley
    - Voltage drop in the 230kV area of Lexington Low Moor, and Clifton
- Recommended Solution: Rebuild the Cunningham – Dooms 500 kV line as a PJM baseline upgrade (B2665)
- Estimated Cost: $110 M
- Projected In Service Date: June 2020



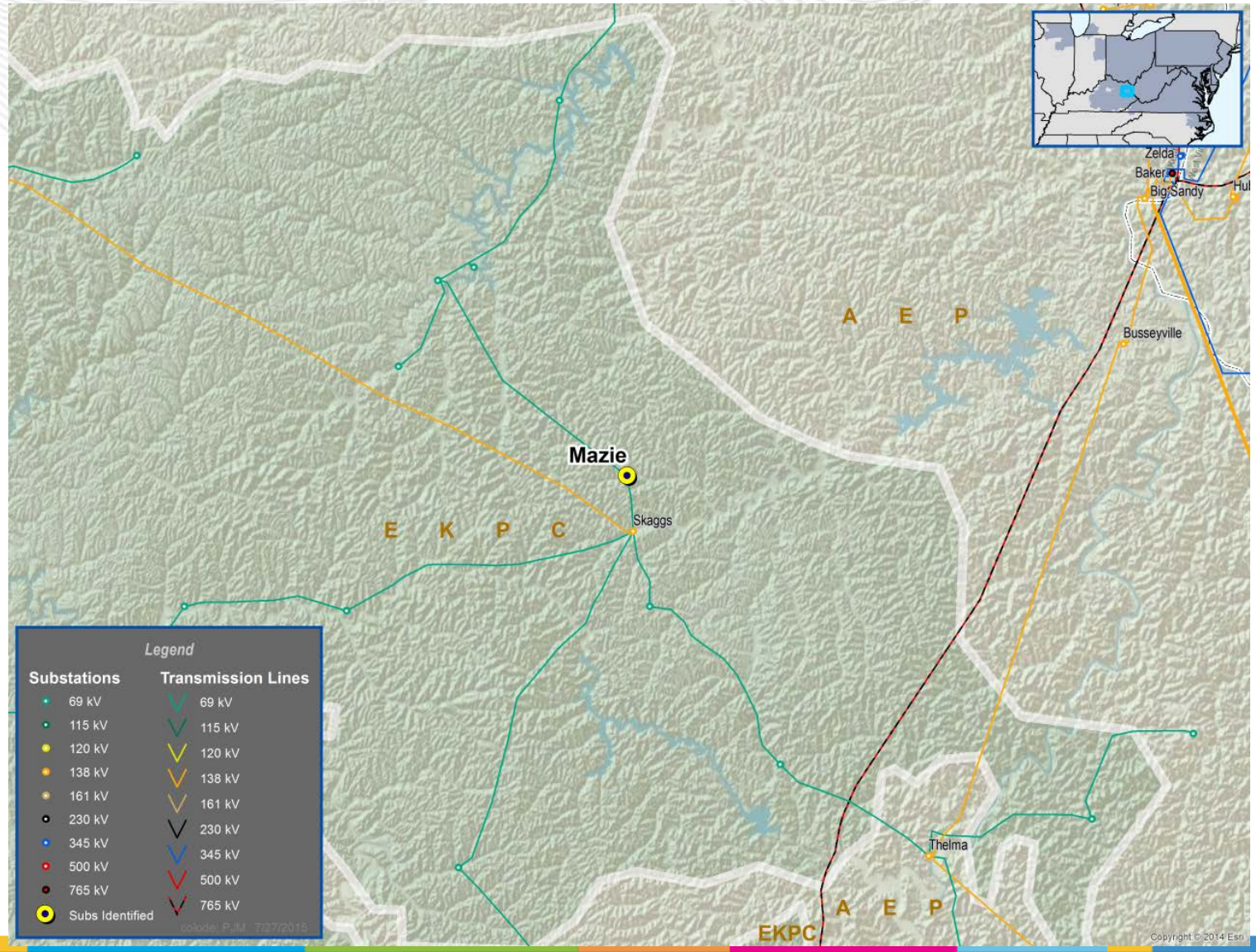
EKPC Transmission Zone

- **TO Criteria Violation**
- Low voltage violation at the Mazie 69kV bus for the loss of the Mazie - Skaggs 69kV line section and the loss of the Cooper 1 and Cooper 2 generators
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The low voltage condition violates EKPC planning criteria in the 2016/17 winter screening of the 2015 series case. This low voltage condition was noted in past studies in the 2019/2020 winter case but load forecast changes from the 2014 series to 2015 series case led to the increased need for voltage support.
- **Alternatives Considered:** Other transmission and non-transmission options that were considered but concluded would not sufficiently address the immediate reliability need.
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity.
- Increase the size of the existing Leon 69KV capacitor bank from 13.2 MVAR to 18.36 MVAR (B2655)
- **Estimated Cost:** $0.035M
- **Projected IS Date:** 12/1/2016



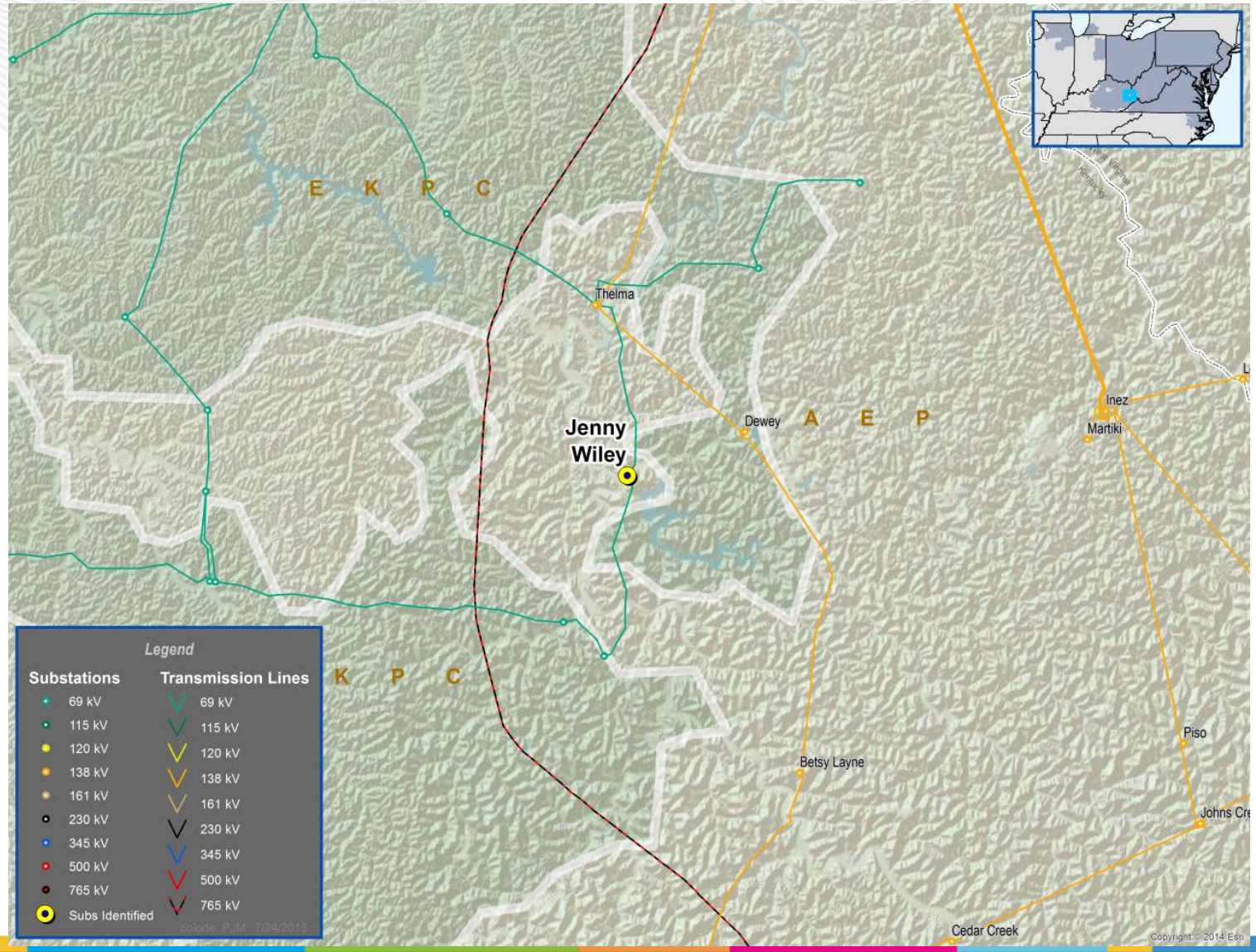
EKPC Transmission Zone

- **TO Criteria Violation**
- Low voltage violation at the Mazie 69kV bus for the loss of the Mazie - Skaggs 69kV line section and the loss of the Cooper 1 and Cooper 2 generators
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The low voltage condition violates EKPC planning criteria in the 2016/17 winter screening of the 2015 series case. This low voltage condition was noted in past studies in the 2019/2020 winter case. Due to load forecast changes from the 2014 series to 2015 series case and the planed Leon capacitor bank size increase in 12/1/2016 has shifted the ISD to 12/1/2018.
- **Alternatives Considered:** Increasing the output of the capacitor banks in the area was considered, however the output cannot be increased without violating EKPC capacitor bank criteria.
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity.
- Re-conductor the Leon-Airport Road 69 kV line section (5.72 miles) using 556.5 MCM ACTW conductor (B2656)
- **Estimated Cost:** $1.65M
- **Projected IS Date:** 12/1/2018



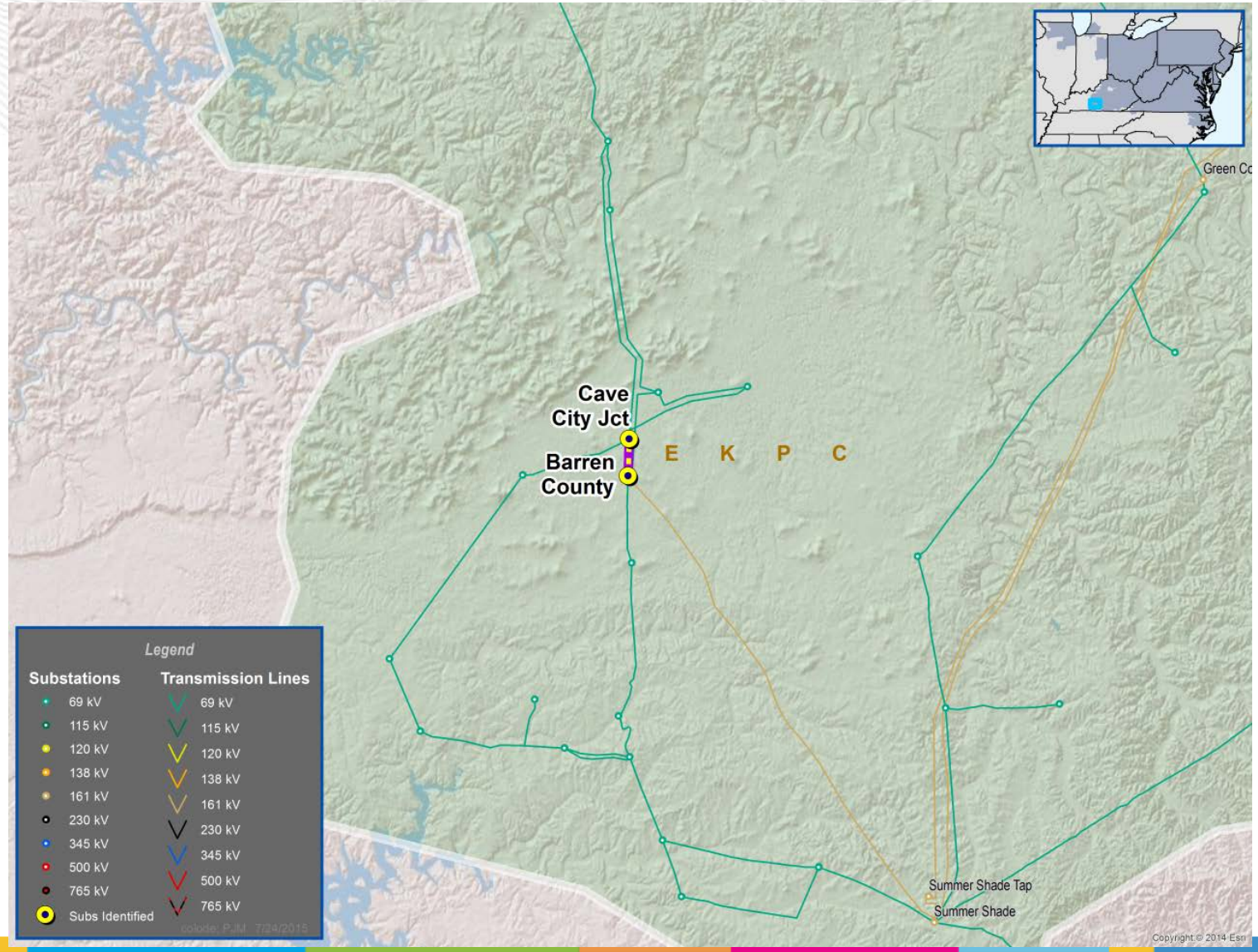
EKPC Transmission Zone

- **TO Criteria Violation**
- Low voltage violation at Jenny Wiley 69kV bus for the loss of the Thelma 69kV tie with AEP and the loss of the Cooper 2 generator
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The low voltage condition violates EKPC planning criteria in the 2016/17 winter screening of the 2015 series case. Load forecast changes from the 2014 series to 2015 series case in the AEP Zone led to the increased need for voltage support.
- **Alternatives Considered:** Capacitor bank output in the area becomes unavailable due to the lack of a dedicated breaker on the Thelma Tie.
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity.
- Add 69kV breaker at Thelma - AEP Thelma 69kV Tie (B2657)
- **Estimated Cost**: $0.2M
- **Required IS Date:** 12/1/2016



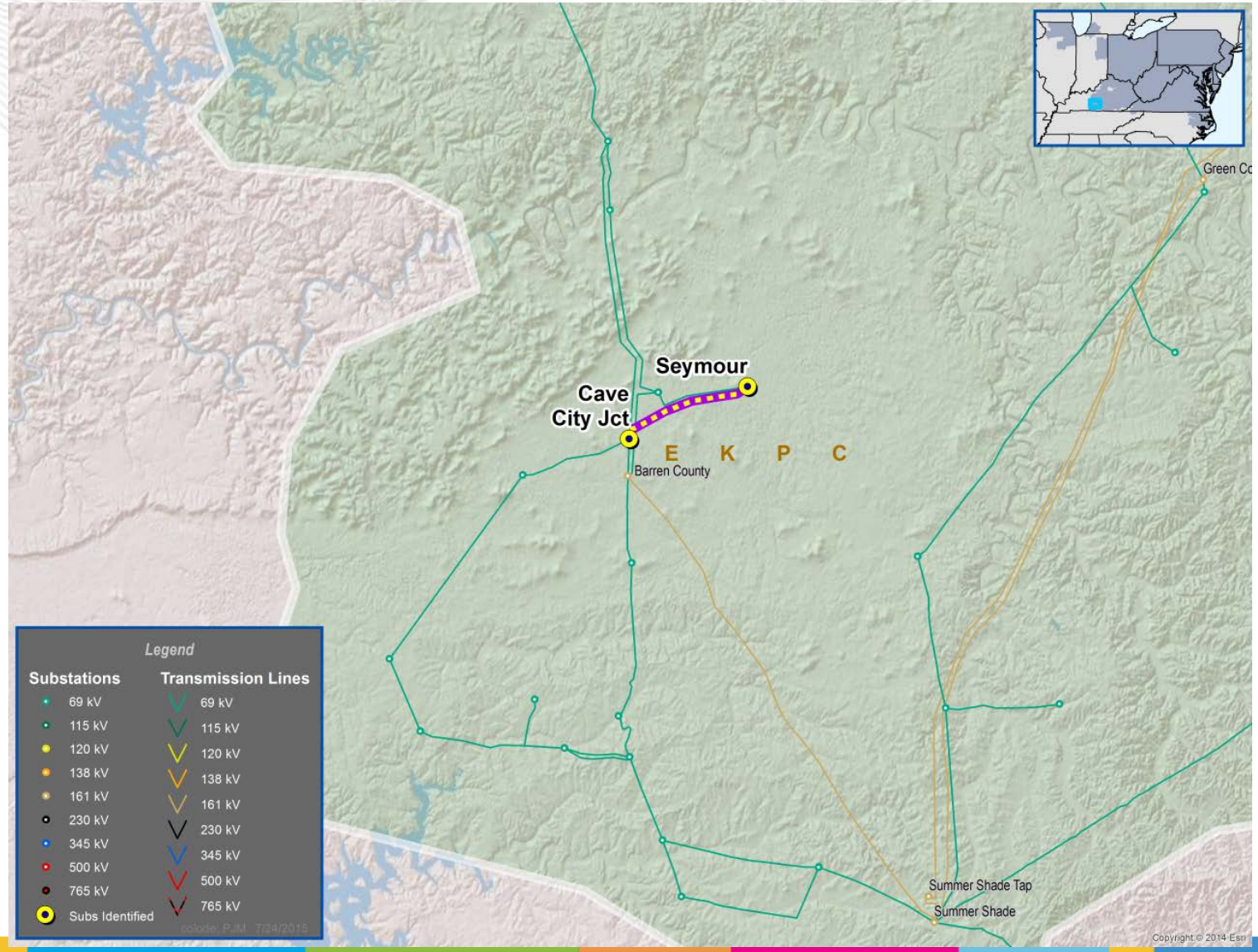
EKPC Transmission Zone

- **TO Criteria Violation**
- The Barren Co. – Horse Cave Jct. 69kV line for the loss of the Bonniville – Bonnieville Distribution 69kV line section and the loss of the Cooper 1 and Cooper 2 generators
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The overload violates EKPC planning criteria in the 2016 summer screening of the 2015 series case. Load forecast changes from the 2014 series to 2015 series case led to the increased post-contingency line flow.
- **Alternatives Considered:** Given the timing and cost of the proposed solution, no alternative was evaluated
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity
- Increase the zone 3 distance relay setting at Barren County associated with the Barren Co-Horse Cave Jct. line to at least 103 MVA.(B2658)
- **Estimated Cost:** $0
- **Required IS Date:** 6/1/2016



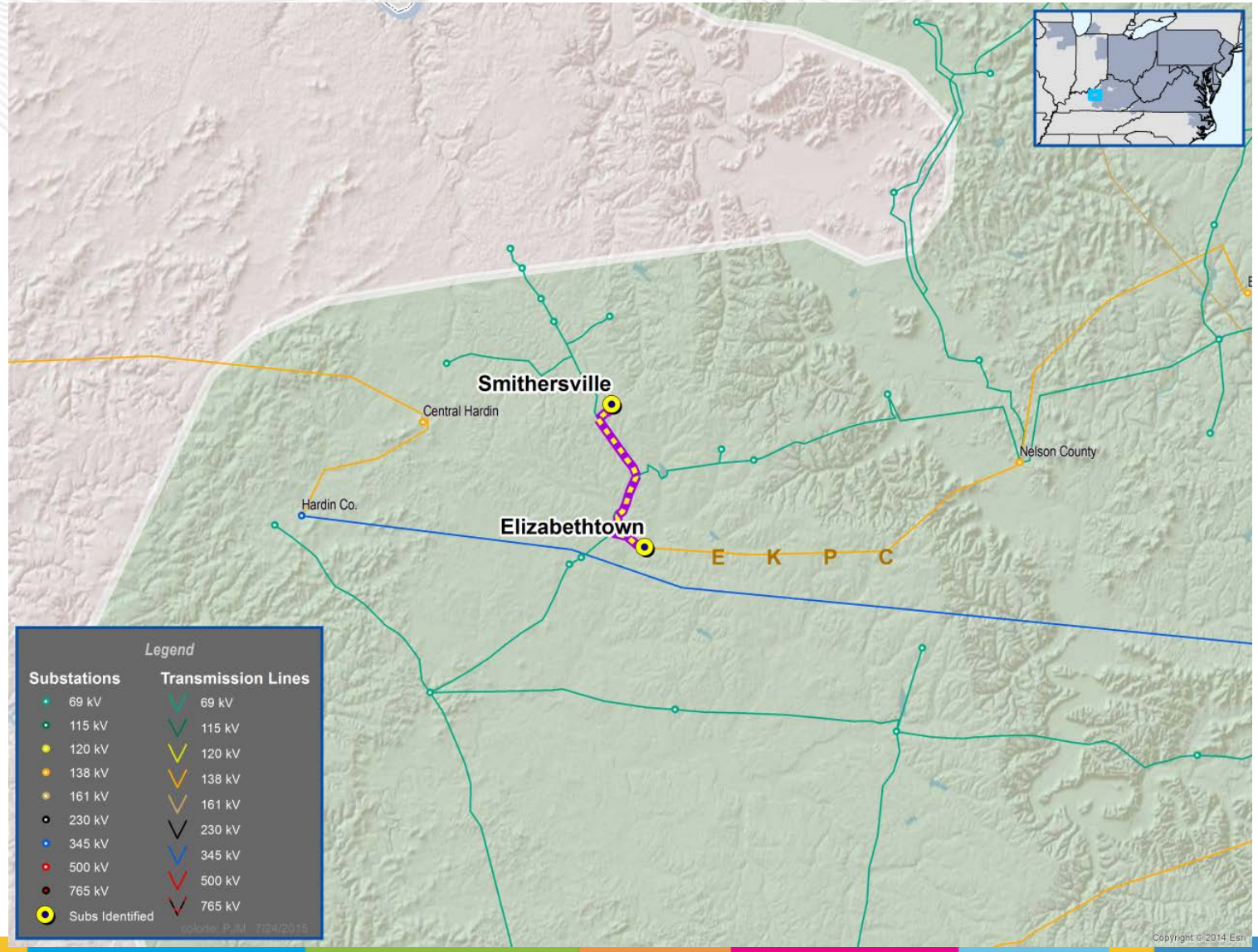
EKPC Transmission Zone

- **TO Criteria Violation**
- The Seymour Tap-KU Horse Cave Tap 69kV line is overloaded for the loss of the Barren Co. – Horse Cave Jct. 69kV line section coupled with the switching operation of closing the normally open Horse Cave Jct – Horse Cave Tap switch and the loss of the Cooper 1 and Cooper 2 generators
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The overload violates EKPC planning criteria in the 2016 summer screening of the 2015 series case. This overload has been noted in past studies but load forecast changes from the 2014 series to 2015 series case led to the increased post-contingency line flow.
- **Alternatives Considered:** A high temperature upgrade was considered for the Cave City Jct. – Seymour 69kV line section. A re-conductor of the line section would then be scheduled for June of 2018. It is more economical to re-conductor the 0.51 mile line section initially.
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity
- Rebuild the Seymour Tap-KU Horse Cave Tap 69 KV line section (1.98 miles) to 302°F. (LTE at 284°F) (B2659)
- **Estimated Cost:** $0.4M
- **Required IS Date:** 6/1/2016



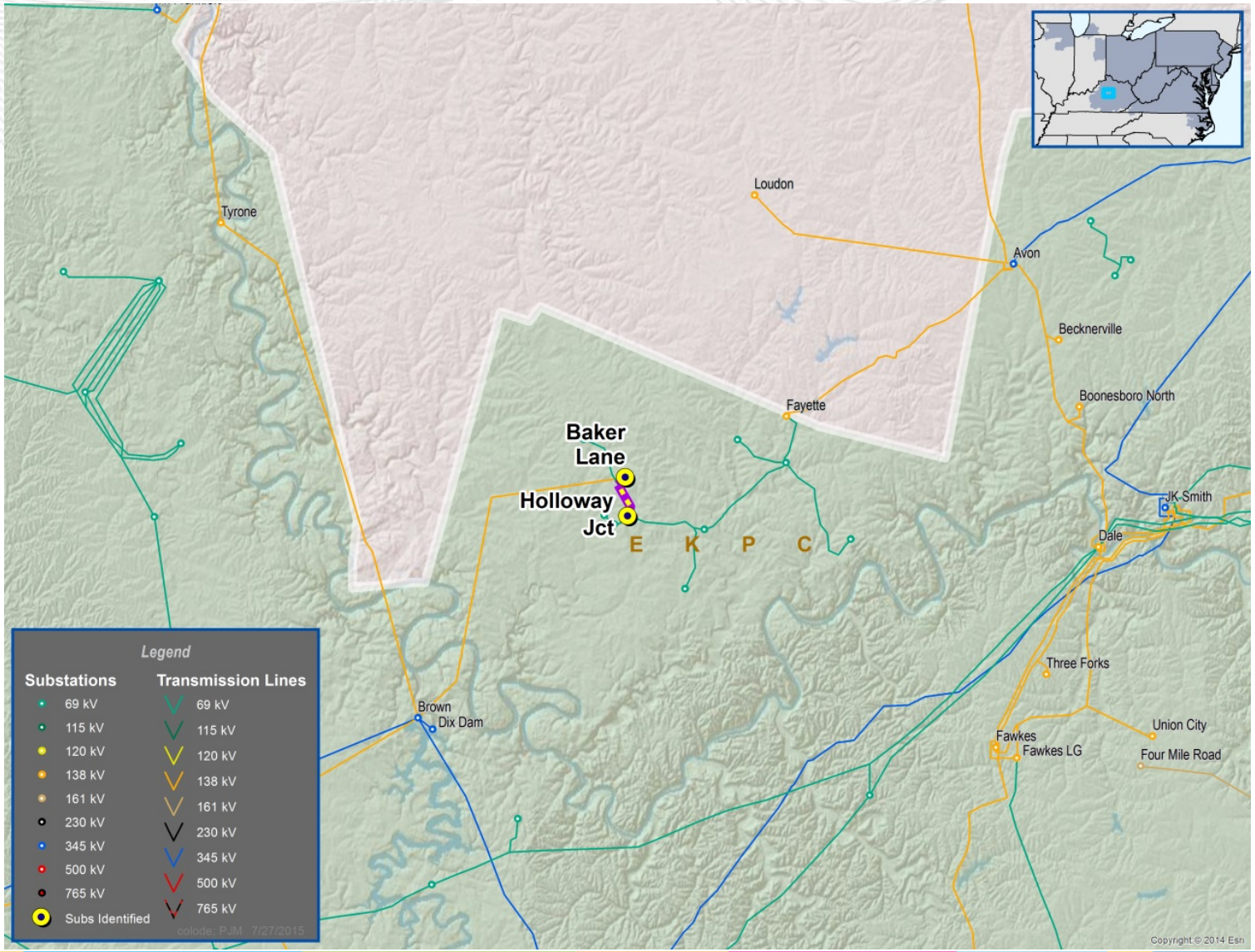
EKPC Transmission Zone

- **TO Criteria Violation**
- The Elizabethtown-Smithersville 69kV line is overloaded for the loss of the Rogersville 69kV tie line and the loss of the Cooper 2 generator
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The overload violates EKPC planning criteria in the 2016/17 winter screening of the 2015 series case. Load forecast changes from the 2014 series to 2015 series case led to the increased post-contingency line flow.
- **Alternatives Considered:** Given the cost of the proposed solution, no alternative is needed
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity
- Increase the zone 3 distance relay setting at Elizabethtown associated with the Elizabethtown-Smithersville line section to at least 100 MVA. (B2660)
- **Estimated Cost:** $0
- **Required IS Date:** 12/1/2016



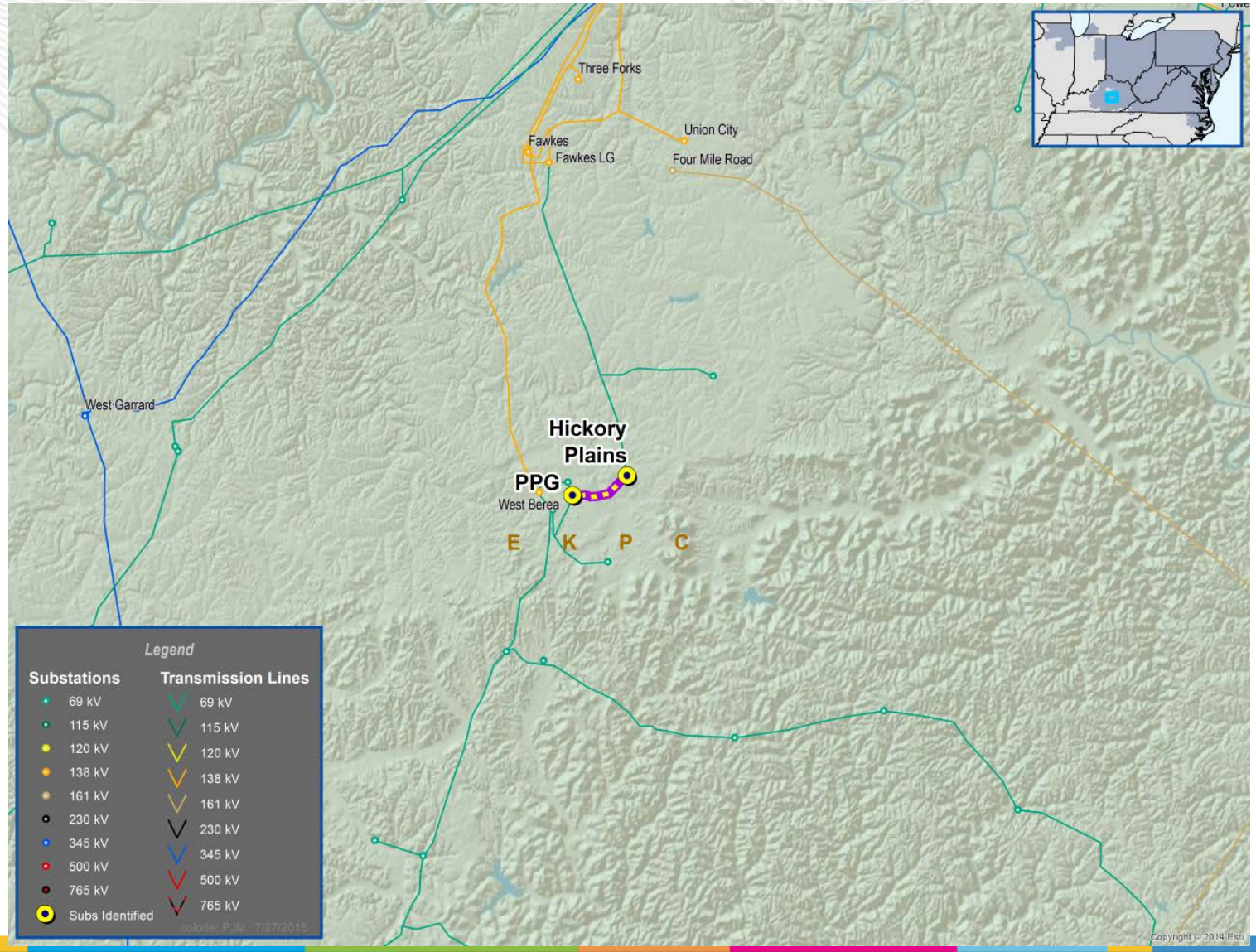
EKPC Transmission Zone

- **TO Criteria Violation**
- The Baker Lane-Holloway Jct. 69kV line is overloaded for the loss of the Avon – Fayette 138kV line section and the loss of the Cooper 1 and Cooper 2 generators
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The overload violates EKPC planning criteria in the 2016/17 winter screening of the 2015 series case. This overload has been noted in past studies in the 2023/24 winter case but load forecast changes from the 2014 series to 2015 series case led to the increased post-contingency line flow.
- **Alternatives Considered:** A high temperature upgrade was considered for the Baker Lane-Holloway Jct. 69 kV line section but did not relieve the overload.
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity
- Re-conductor the Baker Lane - Holloway Jct. 69 kV 1.28 mi line section using 556.5 MCM ACTW wire. (B2661)
- **Estimated Cost:** $0.335M
- **Required IS Date:** 12/1/2016



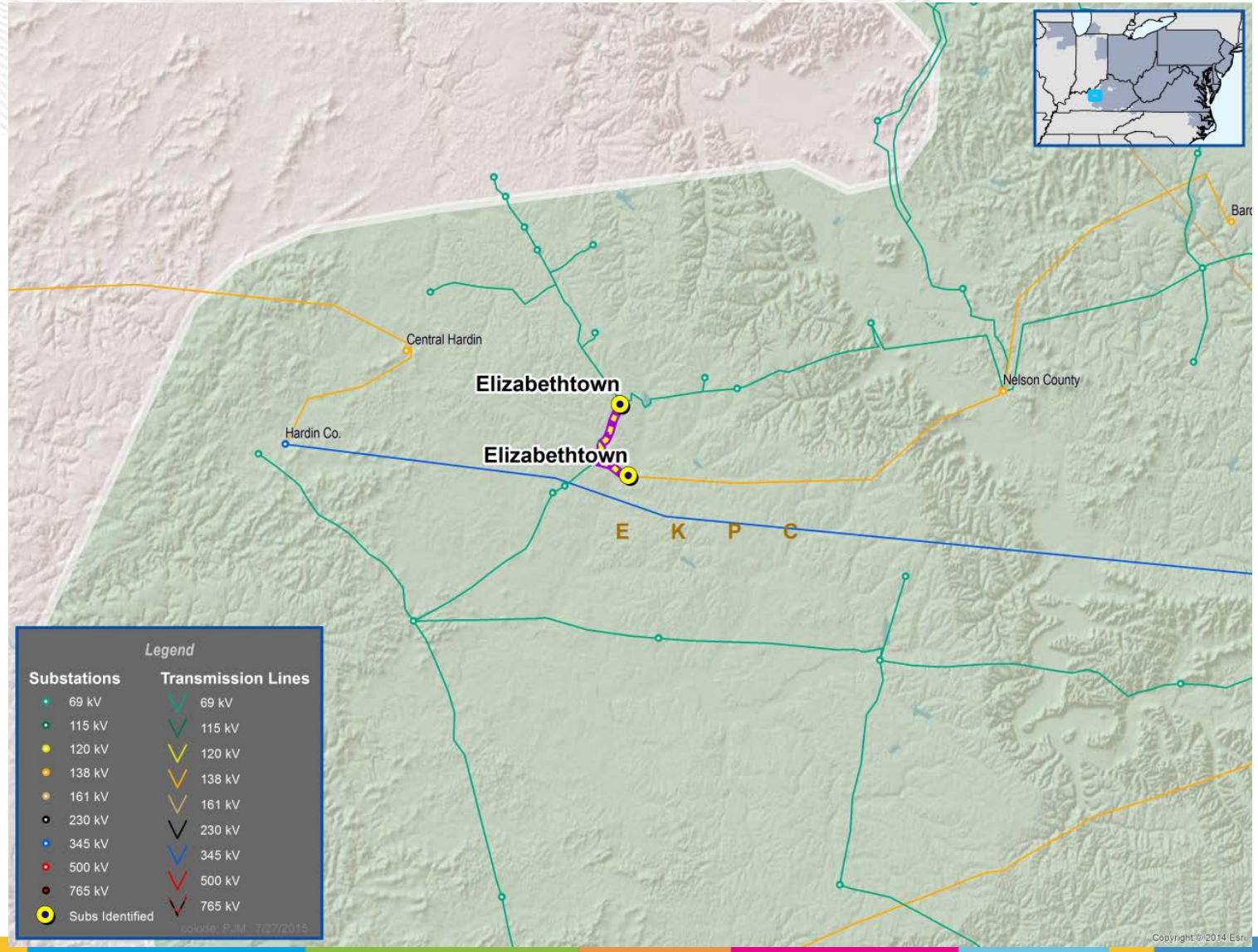
EKPC Transmission Zone

- **TO Criteria Violation**
- The Hickory Plains - PPG 69kV line is overloaded for the loss of the West Berea 138-69 kV Transformer and the loss of the Cooper 1 and Cooper 2 generators
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The overload violates EKPC planning criteria in the 2017 summer screening of the 2015 series case. Load forecast changes from the 2014 series to 2015 series case led to the increased post-contingency line flow.
- **Alternatives Considered:** A re-conductor was considered for the Hickory Plains-PPG 69 kV line section however a high temperature upgrade is more economical.
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity
- Increase the MOT of the Hickory Plains - PPG 69 KV line section (0.21 miles) to 266F. (LTE at 248F) (B2662)
- **Estimated Cost:** $0.01M
- **Required IS Date:** 6/1/2017



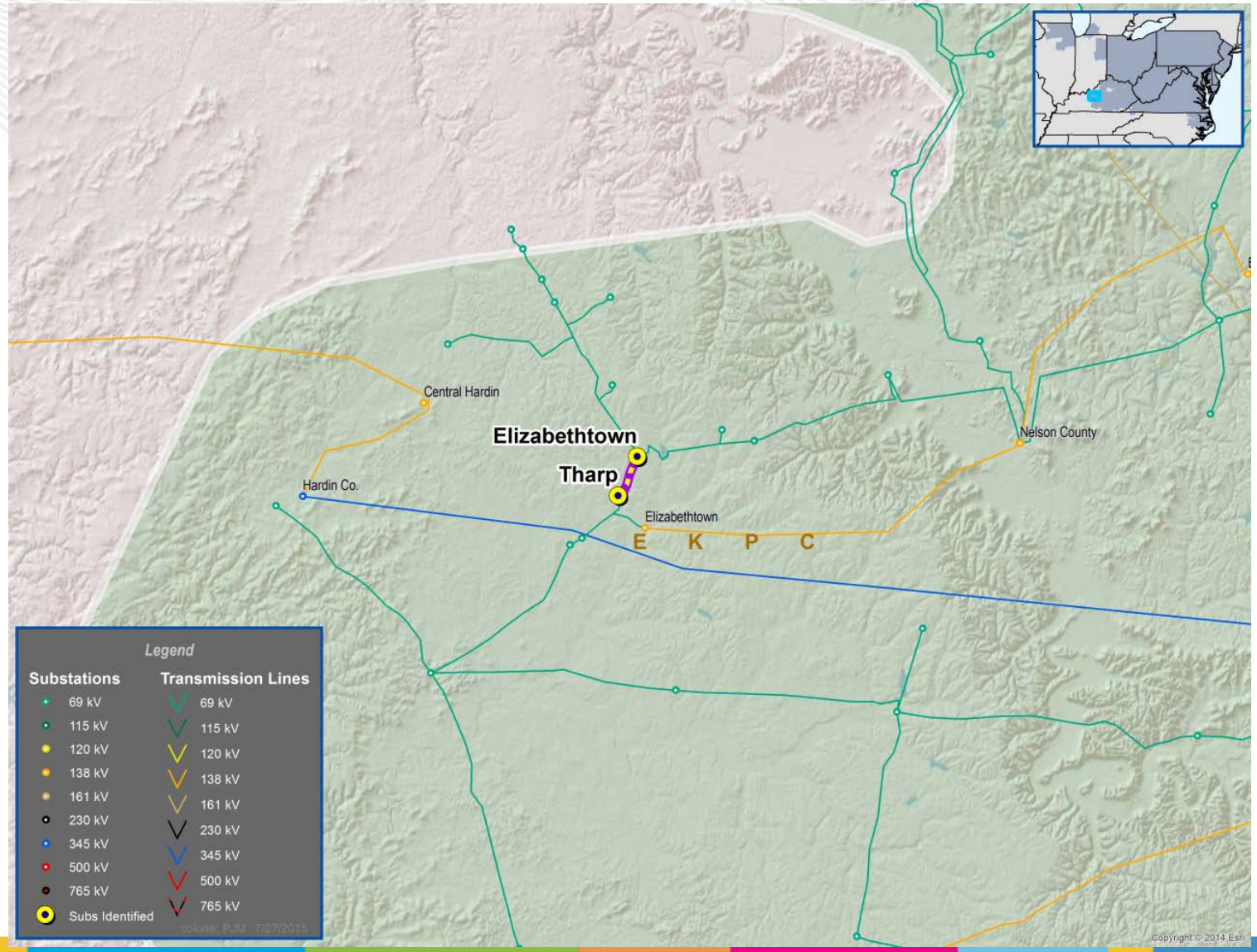
EKPC Transmission Zone

- **TO Criteria Violation**
- The EKPC Elizabethtown – KU Elizabethtown 69kV line is overloaded for the loss of the Rogersville – Rogersville Jct. 69kV line section and the loss of the LGE/KU Brown 3 generator.
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The overload violates EKPC planning criteria in the 2017/18 winter screening of the 2015 series case. Load forecast changes from the 2014 series to 2015 series case led to the increased post-contingency line flow.
- **Alternatives Considered:** Given the cost and timing of the proposed solution, no alternative is needed
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity
- Increase the zone 3 distance relay setting at EKPC Elizabethtown associated with the EKPC Elizabethtown to KU Elizabethtown 69kV line to at least 126MVA. (B2663)
- **Estimated Cost:** $0
- **Required IS Date:** 12/1/2017



EKPC Transmission Zone

- **TO Criteria Violation**
- The Tharp Tap - KU Etown 69kV line is overloaded for the loss of the Rogersville Jct. – Rogersville 69kV line section and the loss of the LGE/KU Brown 3 generator.
- This need is time sensitive due to the criteria violation in the immediate need time frame
- The overload violates EKPC planning criteria in the 2017/18 winter screening of the 2015 series case. Load forecast changes from the 2014 series to 2015 series case led to the increased post-contingency line flow.
- **Alternatives Considered:** A re-conductor was considered for the Tharp Tap-KU ETown 69 kV line section but a high temperature upgrade is more economical.
- **Proposed Immediate Need Solution**
- Due to the immediate need, a proposal window is infeasible. The local Transmission Owner will be the Designated Entity
- Increase the MOT of the Tharp Tap - KU Etown 69 KV line section (2.11 miles) to 266F. (LTE at 248F) (B2664)
- **Estimated Cost:** $0.075M
- **Required IS Date:** 12/1/2017



Immediate Need Project

MetEd Transmission Zone

N-1-1 Thermal Violation

- The Middletown Junction 230/115 kV transformer is overloaded for a fault on Middletown Jctn. transformer #1, #2, #3 or loss of the 230 kV #4 bus combined with the loss of the West Gates –Smith Street Tap – York Inc. 115 kV circuit
- This violation was identified recently due to a contingency file definition update to reflect current system topology

Alternatives Considered:

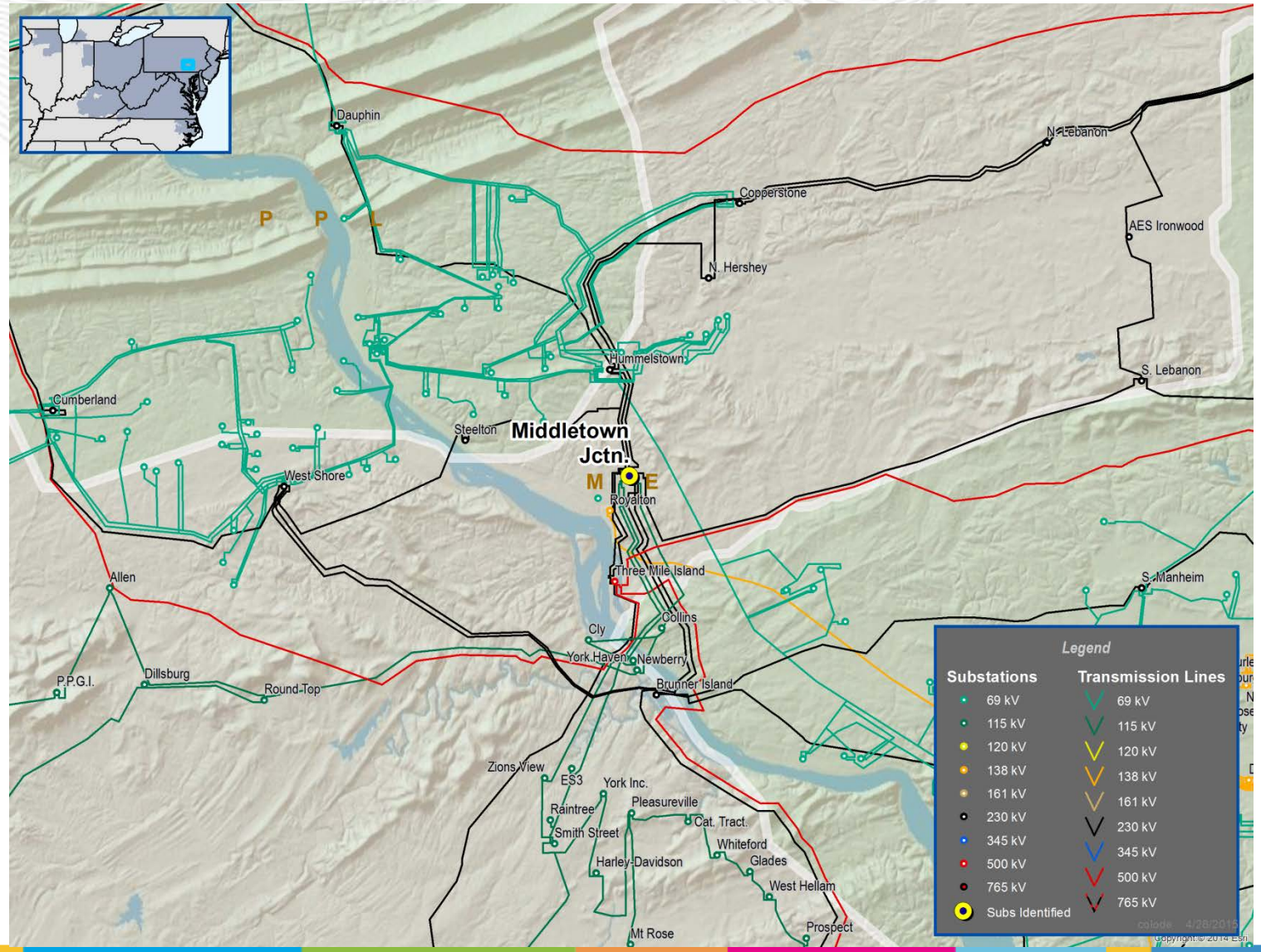
- Replace the Middletown 230/115 kV #5 transformer.

Proposed Solution:

- Convert Middletown Junction 230 kV substation to nine bay double breaker configuration (B2637)
- Due to the time sensitive nature that this current issue presents, MetEd/FirstEnergy (Local TO) will be the Designated Entity

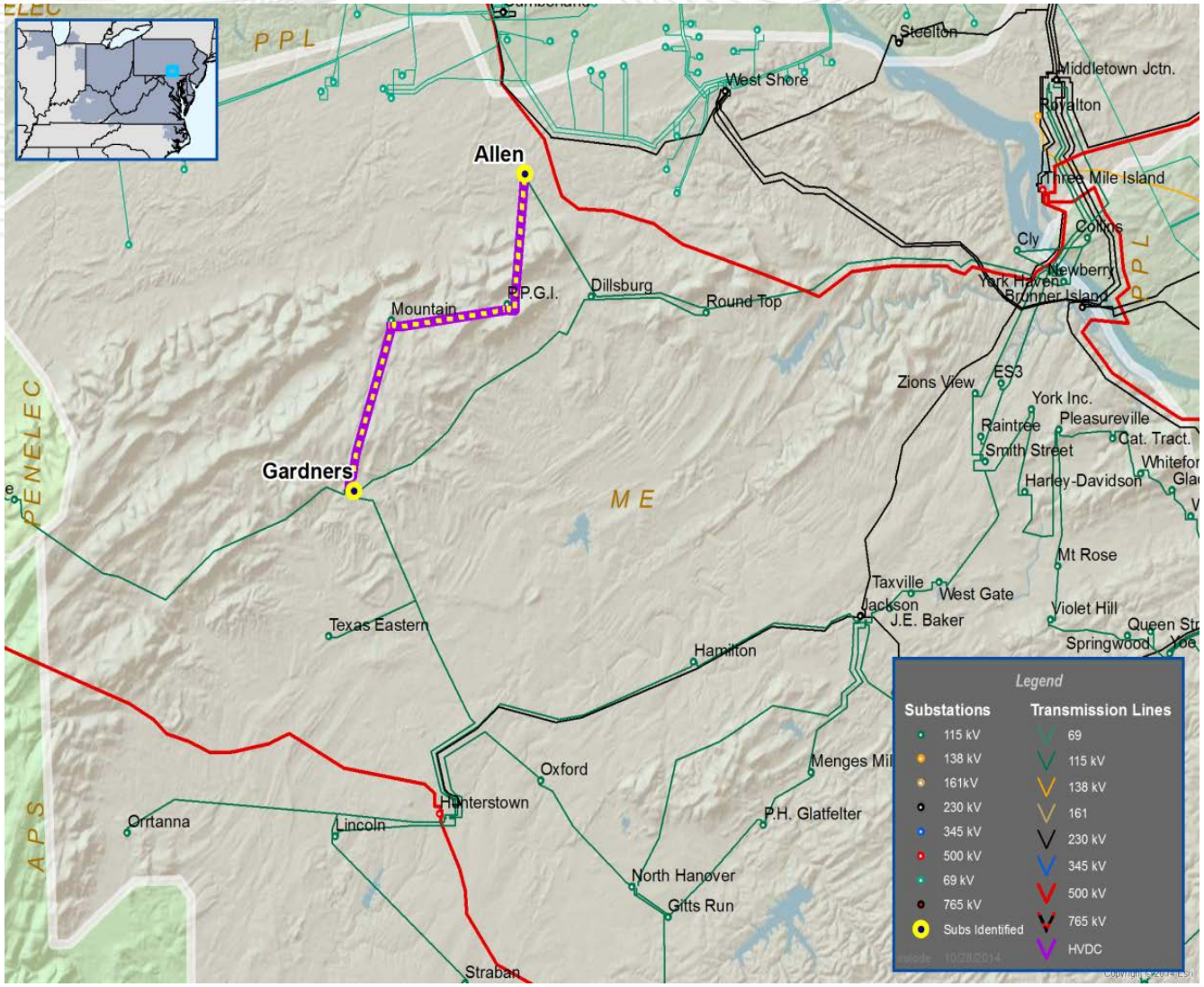
Estimated Project Cost: $15.5 M

Required IS Date: 6/1/2015



MetEd Transmission Zone

- N-1-1 Voltage Violation:
- Voltage drop violation in the Allen and Gardner vicinity for the N-1-1 contingency loss of the Hunterstown – Texas Eastern – Gardner and Middletown Jct. – Collins – Newberry – Round Top 115 kV circuits.
- Alternatives Considered:
  1) 2014_2B-4A ($11.94 M)
  2) 2014_2B-1B ($10.55 M)
  3) 2014_2B-1A ($16.13 M)
  4) 2014_2B-3A ($11.1 M)
  5) 2014_2B-3B ($13.9 M)
  6) 2014_2B-3C ($13.3 M)
  7) 2014_2B-3D ($17.4 M)
  8) 2014_2B-3E ($16.9 M)
  9) 2014_2B-3F ($25.5 M)
- Recommended Solution:
  Install a 28.8 MVAR 115 kV capacitor at the Mountain substation. (2014_2B-2A) -> (B2644)
- Estimated Project Cost:
  $0.96 M
- Required IS Date:
  6/1/2019



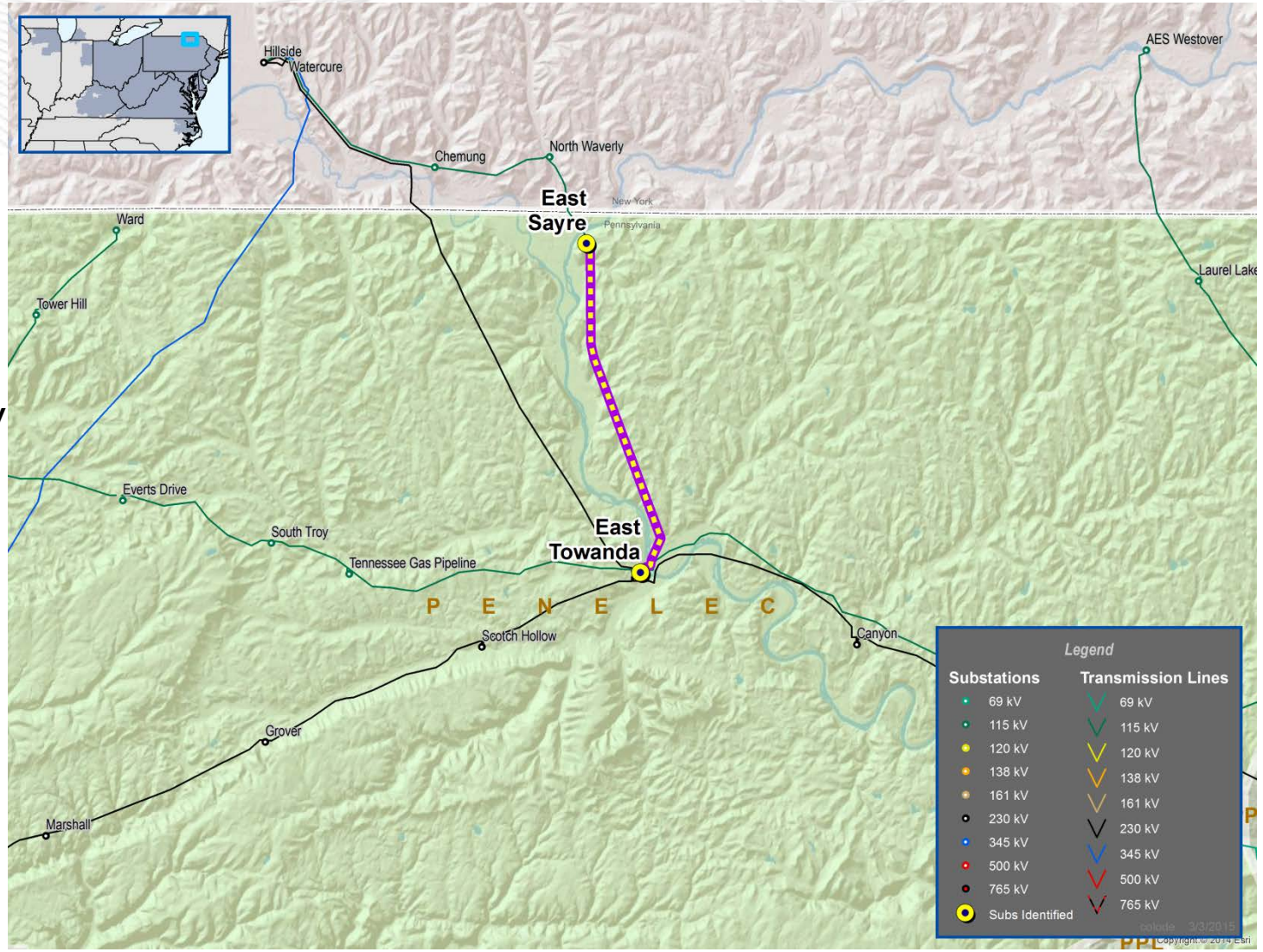
PenElec Transmission Zone

- Pre-FERC 1000 cleanup Item
- Upgrade developed as part of the 2013 RTEP
- Included in 2013 – Present RTEP models
- Not previously presented to TEAC

- Common Mode Outage:
- The East Towanda - East Sayre 115 kV circuit is overloaded for several contingencies.
- Proposed Solution:
  - Replace relays at East Towanda and East Sayre 115 kV substations (B2621).
- Estimated Project Cost:

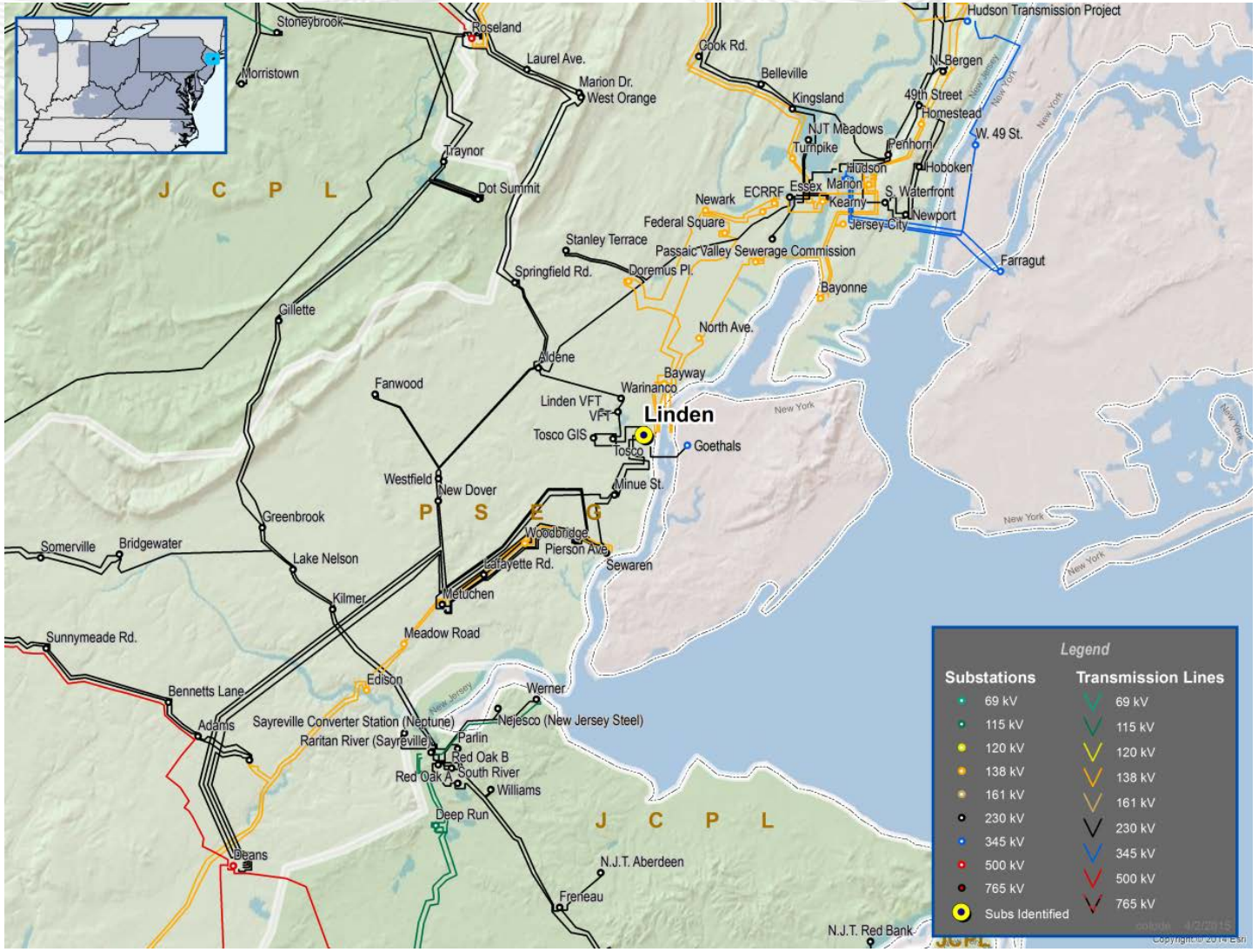
  $ 0.1 M
- Required IS Date:

  6/1/2018



PSE&G Transmission Area

- The Linden 230kV GSU breakers are overstressed
- Proposed Solution: Replace the four Linden 230 kV GSU breakers with 80kA breakers (b2631)
- Estimated Project Cost: $4.5 M
- Required In Service Date: 6/1/2018

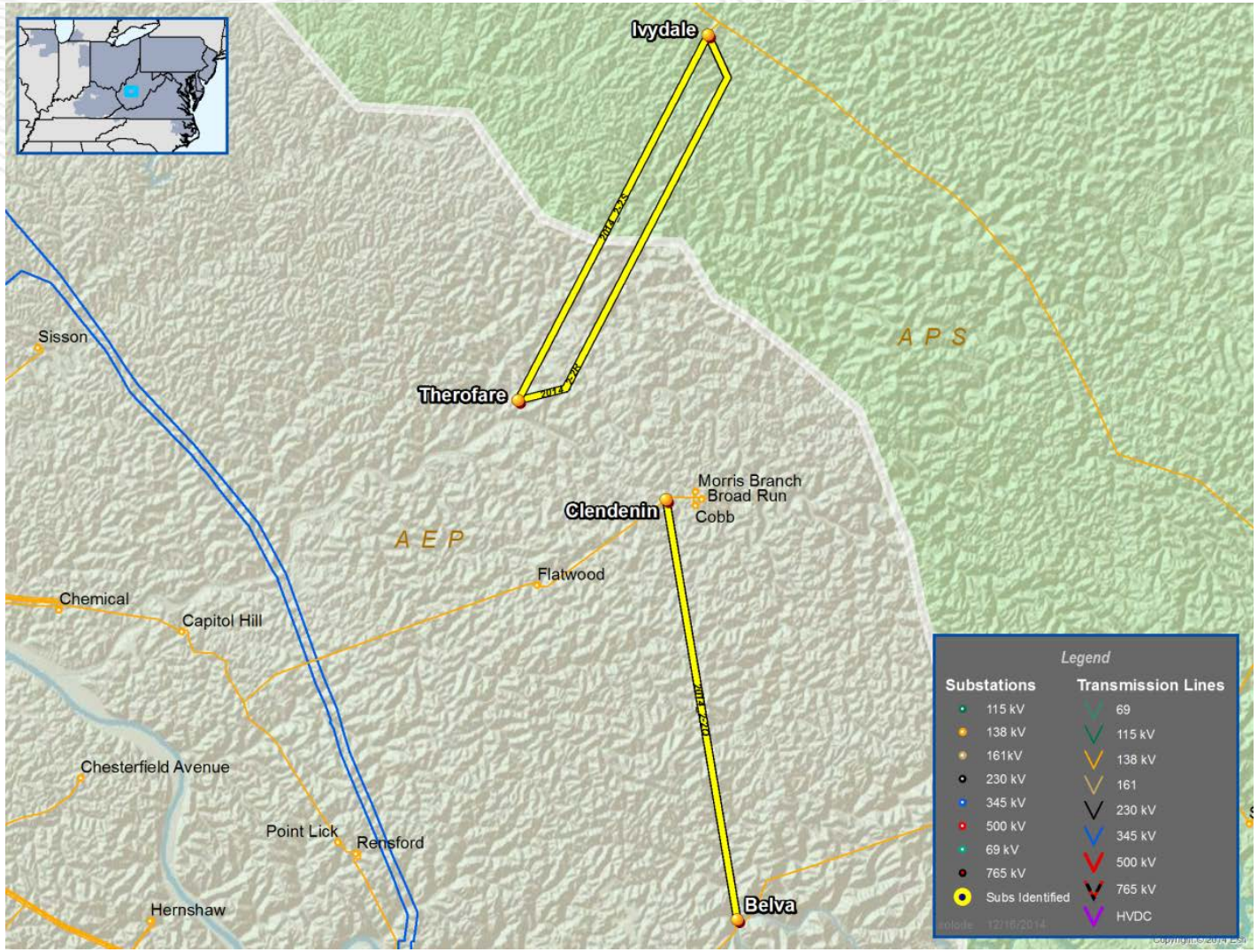


AEP Transmission Zone

Cost Change & Breakdown of b2609.1, b2609.3, b2609.4, and b2609.5

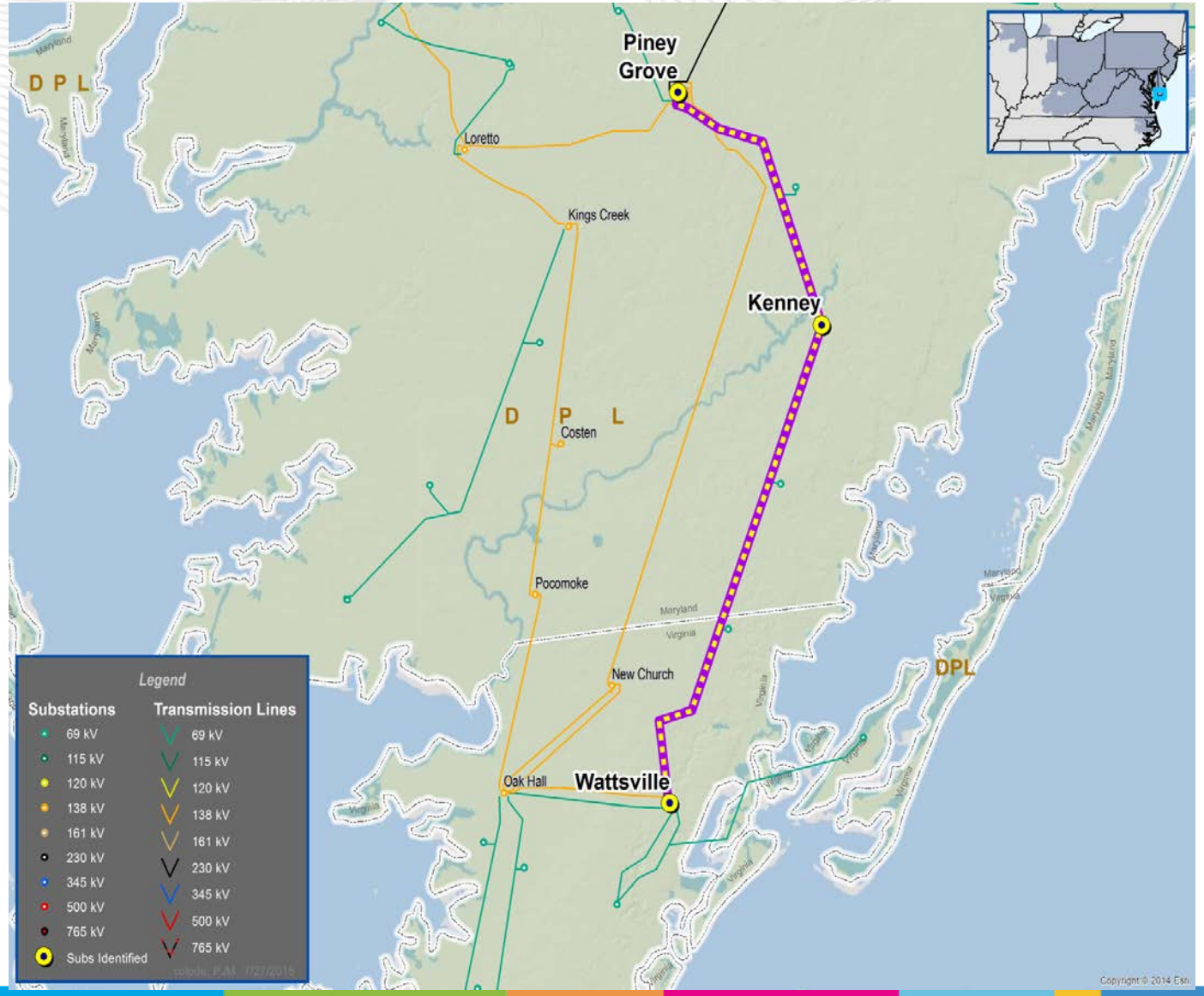
Updated Cost Breakdown:

- b2609.1: Install two 138 kV MOAB switches at Thorofare Creek substation
  - Transmission Owner: AEP
  - Updated Cost: $1.0 M
- b2609.3: Terminate the Flatwood, Kanawha and Capital Hill lines into the new Rutledge substation
  - Transmission Owner: AEP
  - Updated Cost: $2.1 M
- b2609.4: Establish new 138 kV tap substation on Powell Mountain - Goff Run, construct 15 miles of new 138 kV line from Thorofare Creek to the new 138 kV tap substation, establish Rutledge 138 kV substation
  - Transmission Owner: Transource
  - Updated Cost: $59.5 M
- b2609.5: Terminate the Powell Mountain and Goff Run lines into new substation and perform any associated relay upgrades or modifications required at Powell Mountain and Goff run to accommodate new substation
  - Transmission Owner: APS
  - Updated Cost: TBD
- Required IS Date: 6/1/2019



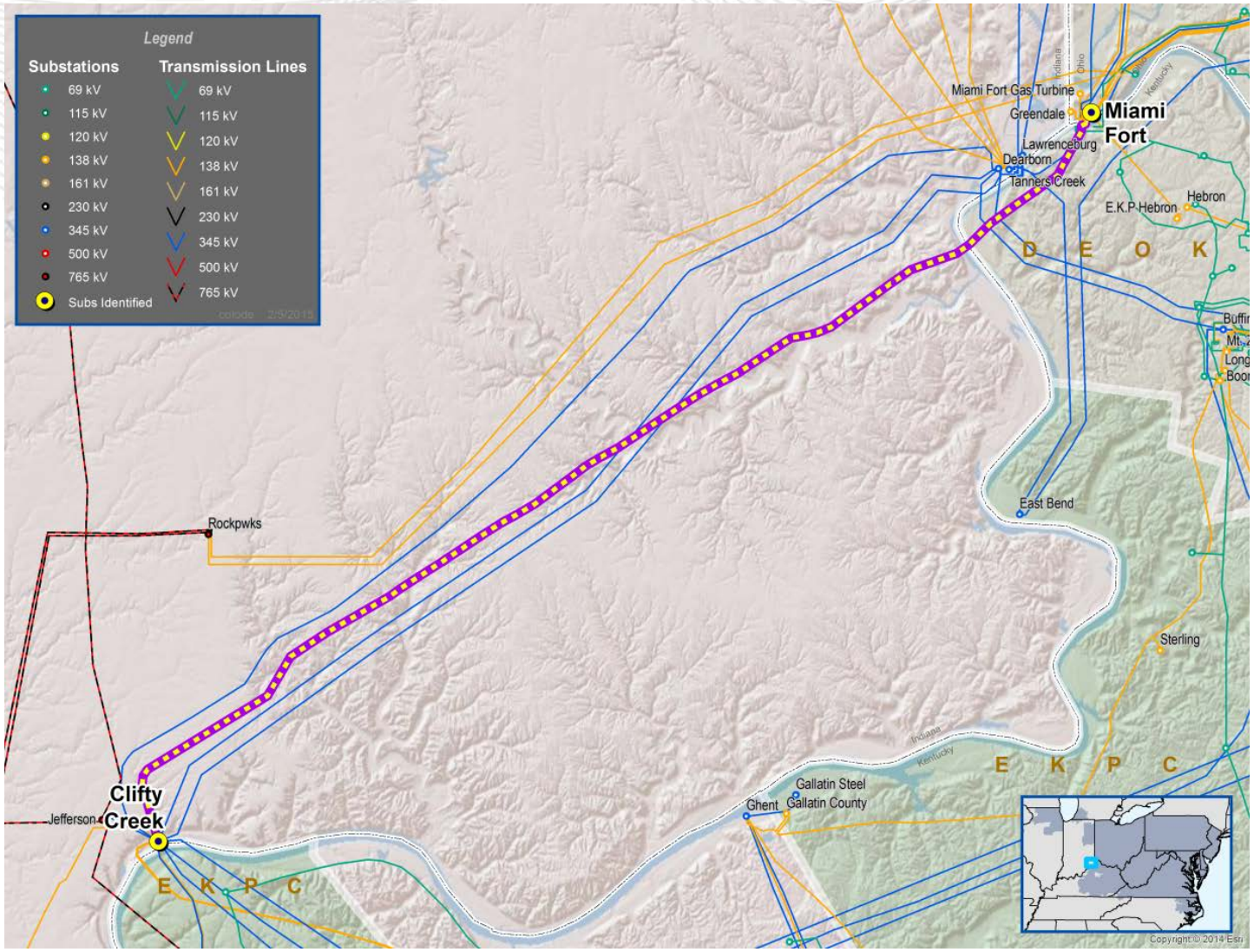
DPL Transmission Zone

- Cancel B1603 and modify the scope of the existing B2288 baseline reliability project:
- Old scope:
  - B1603 (Upgrade 19 miles conductor of the Wattsville - Signepost - Stockton - Kenney 69 kV circuit. $15 M)
  - B2288 (Build a new 138kV line from Piney Grove – Wattsville, $25 M)
- New Scope:
  - B2288 (Rebuild the Wattsville – Kenney – Piney Grove 69 kV and build a new 138 kV line from Piney Grove – Wattsville on the same tower).
- Estimated Project Cost:
  $ 45.7 M
- Projected IS Date:
  5/31/2018



DEOK Transmission Zone

- N-1-1 Violation due to the deactivation notification of Miami Fort Unit 6
- The Clifty-Miami Fort 138 kV line is overloaded for the loss of Miami Fort-Glendale 138 kV line ('B2 MIAMI FORT-GREENDALE 1681') followed by the loss off Miami Fort-Tanner 138 kV line and Miami Fort transformers 9 and 10 ('B3 MIAMI FORT 345/138 TB9/TB10').
- Proposed Upgrade: Fix the 'B3 MIAMI FORT 345/138 TB9/TB10' contingency through station reconfiguration
- Required IS date: 6/1/2015 (immediate need):
- Expected IS date: 05/2017
- Construction Designation: DEOK (the local Transmission Owner)
- Interim Solution: The operating procedure is to open Clifty to Miami Fort 138 kV branch and to open the tie 251579 08HEBRON to 341726 2HEBRON after the first contingency.

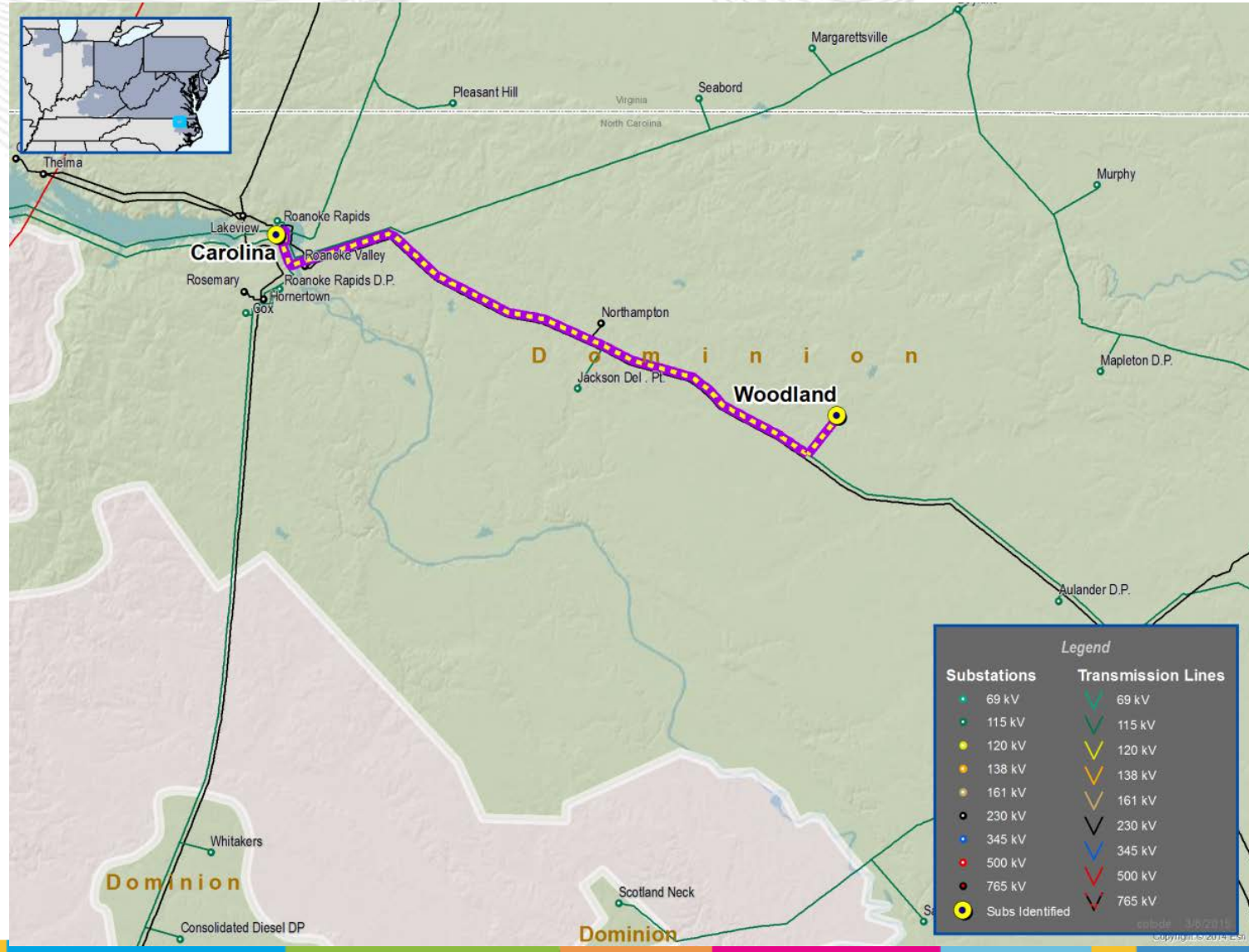


Dominion Transmission Zone

B2458.1 - B2458.4 Cost Increase

Existing Project Scope:

- Uprate Line #54 (Carolina – Woodland 115kV), 27 miles. Replace 14 wood H-frame structures with steel H-frame structures that are in the same line section. Replace 2.5 miles of static wire. Remove the Carolina 54 SPS to include relay logic changes, minor control wiring, relay resets and SCADA programming.



Proposed Addition to Existing Project Scope

- Dominion End of Life Criteria
- End of Life
  - 4.5 miles of conductor between Carolina 115kV and Jackson DP 115kV has a 60 year old conductor and the structures are between 43 and 60 years old.
- System Impact
  - Failure of the Carolina – Jackson facility would permanently drop 27.6 MW of load
- Addition to project scope due to End of Life criteria: Replace 4.5 miles of conductor between Carolina 115kV and Jackson DP 115kV with a minimum of 300 MVA summer STE rating and replace 8 wood H-frame structures located between Carolina and Jackson DP with steel H-frames. (B2458.5)

Previous Estimated Cost: $ 4.9 M

Revised Estimated Cost : $ 6.9 M

Projected IS Date: May 2016

October 2015 Recommendations to the PJM Board

October 2015 PJM Board Approval

- All recommended baseline solutions in today's presentation and all planned generation related network upgrades in the "TEAC – New Service Queue Studies Update" presentation that is posted with todays TEAC materials will be presented to the PJM Board in October and recommended for inclusion in the RTEP.

RTEP Next Steps

Next Steps

- Continue the technical evaluation of remaining areas of 2015 RTEP Proposal Window #1
  - Eastern Ohio
    - Voltage violations at South Cumberland, Summerfield, South Caldwell and Steamtown
- Begin Window #2 Evaluation
- Continue reliability evaluation of remaining market efficiency proposals
- October Board Approval

Questions?

Email: RTEP@pjm.com

Revision History

- Revision History
  - Original version posted to PJM.com – 9/4/2015
  - Updated version posted to PJM.com – 9/8/2015
    - MVA rating and cost estimates for DOM b2648, b2649, b2652, b2653, and b2654
    - Updated ATSI Transmission Zone Map
    - Updated DOM b2461 project description
    - Added High Voltage in PJM Operations Update
    - Added a Winter Study update
    - Added a Pratts area update
    - Slide s120, b2665 cost estimate update
    - Scope clarification for b2654