Transmission Expansion Advisory Committee

Reliability Analysis Update

January 7, 2016

Review of 2016 RTEP Assumptions (Continued from December 2015 TEAC)

2016 RTEP - Dynamic Load Modeling

- TPL-001-4 R2.4.1:

  System peak Load levels shall include a Load model which *represents* the expected dynamic behavior of Loads that could impact the study area, considering the *behavior of induction motor Loads*. An aggregate System Load model which represents the overall dynamic behavior of the Load is acceptable.

- Enforceable – January 1, 2016

2016 RTEP - Dynamic Load Modeling

- All TOs have submitted dynamic load models.
- PJM has completed a sanity check and found several simulation issues with:
  - Negative equivalent loads.
  - Small (near zero MW) loads.
  - High equivalent distribution network impedance (R&X) for low voltage level loads (e.g. below 34.5kV), etc.
- Sensitivity studies are in progress to better understand the impact of the submitted dynamic load models.

2016 RTEP - Dynamic Load Modeling

- PJM is developing recommendations to resolve the identified issues and will notify the TOs soon
- PJM will develop an implementation plan that includes:
  - Stability study scenarios to evaluate the impact of dynamic load models.
  - Validation and mitigation process for potential stability issues due to dynamic load models.
  - Dynamic load model update and submission procedure
- Please send your comments to MOD-032@pjm.com regarding the dynamic load modeling.

RTEP - 2021 Power Flow Model Status

- Base Case
  - TO updates incorporated
  - Updated queued generation information incorporated
- In progress
  - Contingency update and check
  - Update interchange
  - Update generation dispatch
    - Machine list will be presented at February TEAC
  - Update load per latest 2016 load forecast

Year 2021 Summer RTEP Case Build Update

- End of January 2016
  - Incorporate final TO feedback and updates
  - Finalize case and associated files
- February 2016
  - Exercise the model using analysis, coordinate quality control check and benchmark
- February 2016 - March 2016
  - Begin formal RTEP analysis

Year 2021 Summer RTEP Model Assumptions

- Load forecast
  - Latest 2016 load forecast for 2021 50/50 summer peak load
- Interchange
  - Based on latest reservations for 2021 in OASIS
- External topology
  - MMWG 2015 series 2021 summer peak
- Internal topology
  - Include all PJM Board approved upgrades through the December 2015 PJM Board of Manager approvals

Year 2020 Summer RTEP Model Assumptions

- Machine list
  - Updated Capacity Interconnection Rights (CIR's) for existing units
  - Queues with an executed FSA or higher as of October 1, 2015 will be included in the base model
    - Consult posted machine list for exact modeling assumption
    - FSA will be turned off but allowed to contribute to problems in Generator Deliverability
    - Any identified network upgrades driven by included queue projects will also be modeled
    - Any exceptions will be reviewed with TEAC
  - Units that cleared in previous RPM auctions that do not yet have an executed FSA or higher will be modeled
  - 2021 RTEP machine list will be presented at February 2016 TEAC

RTEP Proposal Window Fee

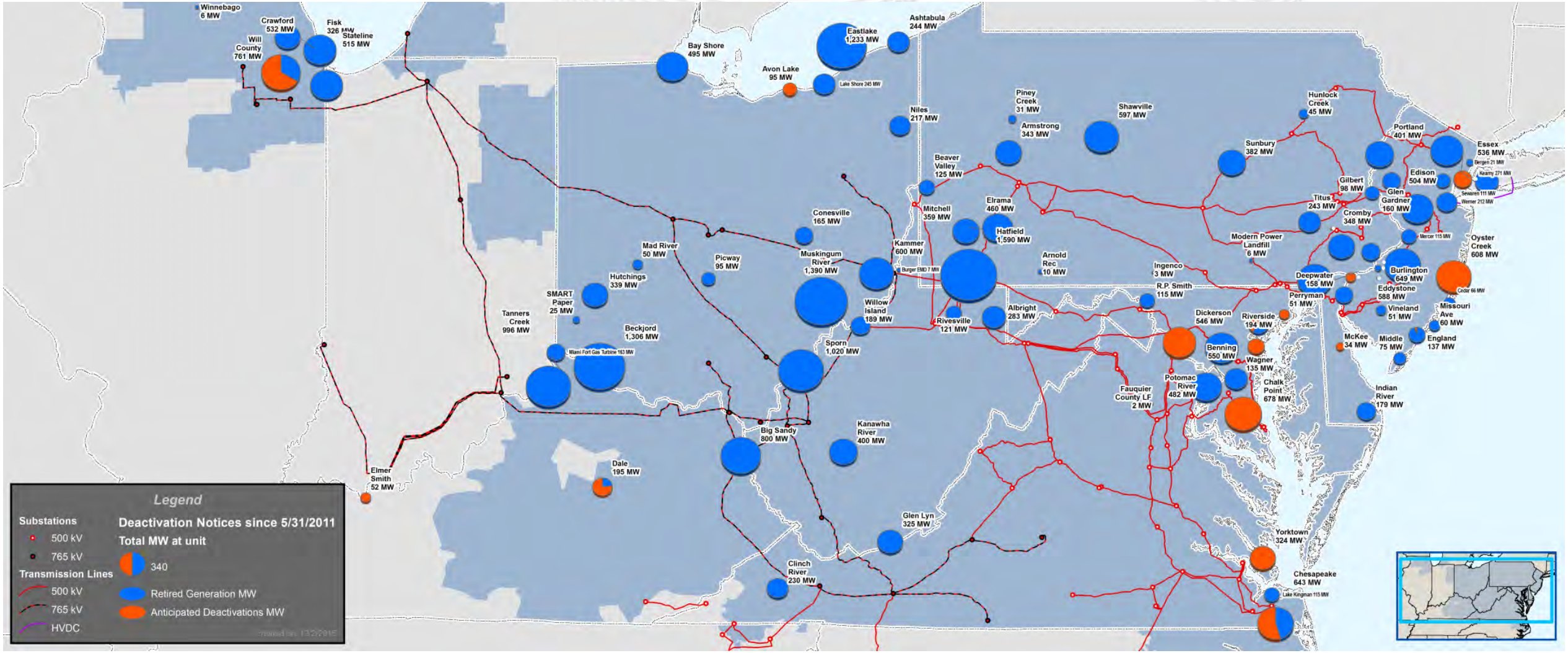
- FERC approved the Order No. 1000 Project Proposal Window Fee on 11/3/2015
- Tiered, upfront, non-refundable per project fee
  - No fee ($0) for any proposed projects (upgrade and greenfield) with estimated costs below $20M
  - $5,000 fee for any proposed projects (upgrade and greenfield) with estimated costs greater than $20M and less than $100M
  - $30,000 fee for any proposed projects (upgrade and greenfield) with estimated costs greater than $100M

2016 RTEP Assumptions

- Assumptions Next Steps
  - TOs to notify PJM of any planned Supplemental Upgrades
  - PJM to post the final machine list
  - PJM to finalize and quality control check models

Generation Deactivation Notification Update

Generation Deactivation

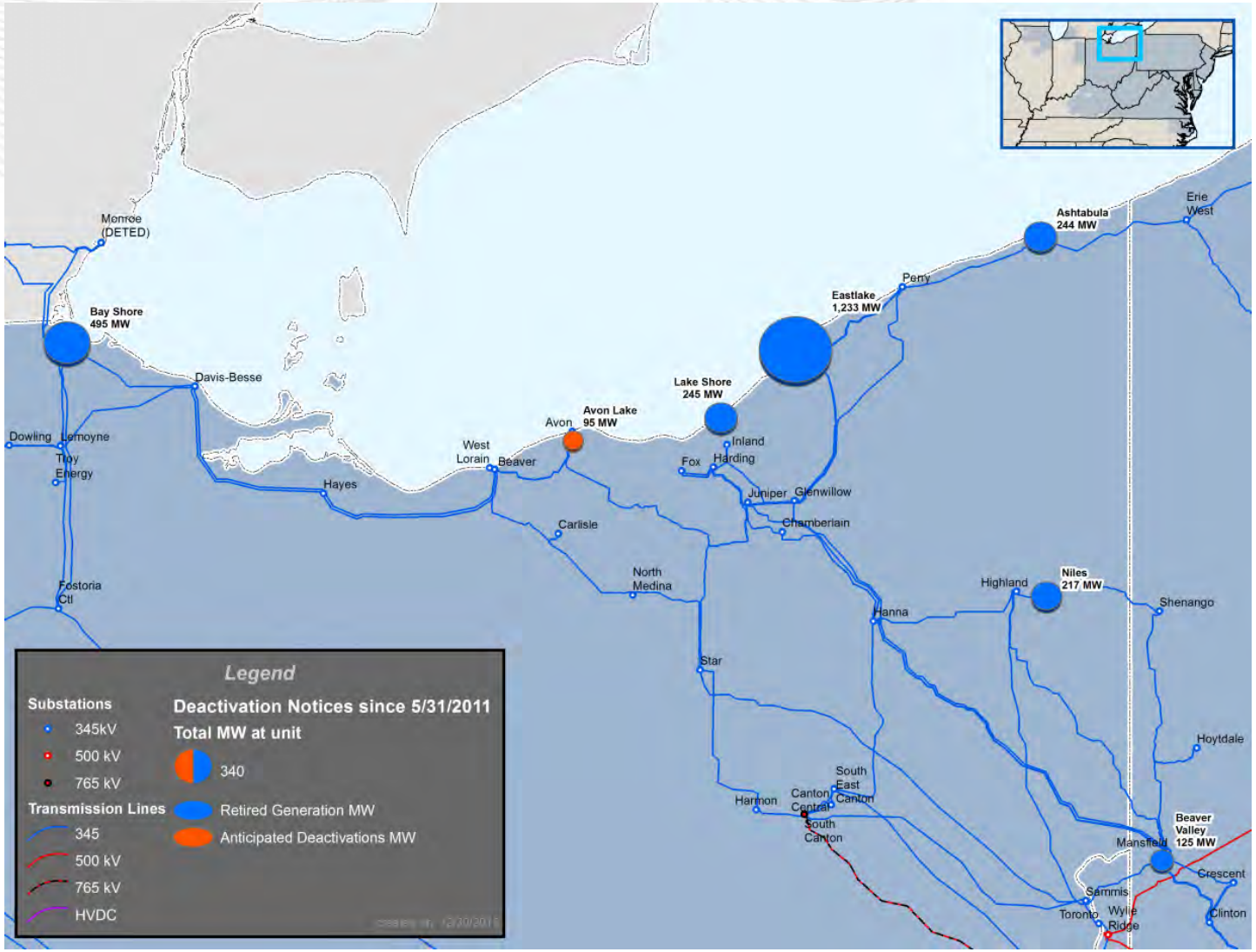


Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Fauquier County Landfill (0 MW Capacity, 2 MW Energy)	DOM	02/29/2016	Reliability analysis complete. No impacts identified.
Elmer Smith Unit 1 (52)	LGEE (External)	06/01/2019	Reliability analysis complete. PJM did not identify any reliability violations.
Oyster Creek Nuclear Generating Station (607.7 MW)	JCPL	12/31/2019	Reliability analysis complete. No impacts identified.
Avon Lake unit 7 (94.6 MW)	ATSI	04/16/2016	Reliability analysis complete. Impacts identified.
Will County unit 4 (510 MW)	ComEd	05/31/2018	Reliability analysis complete. Impacts identified.

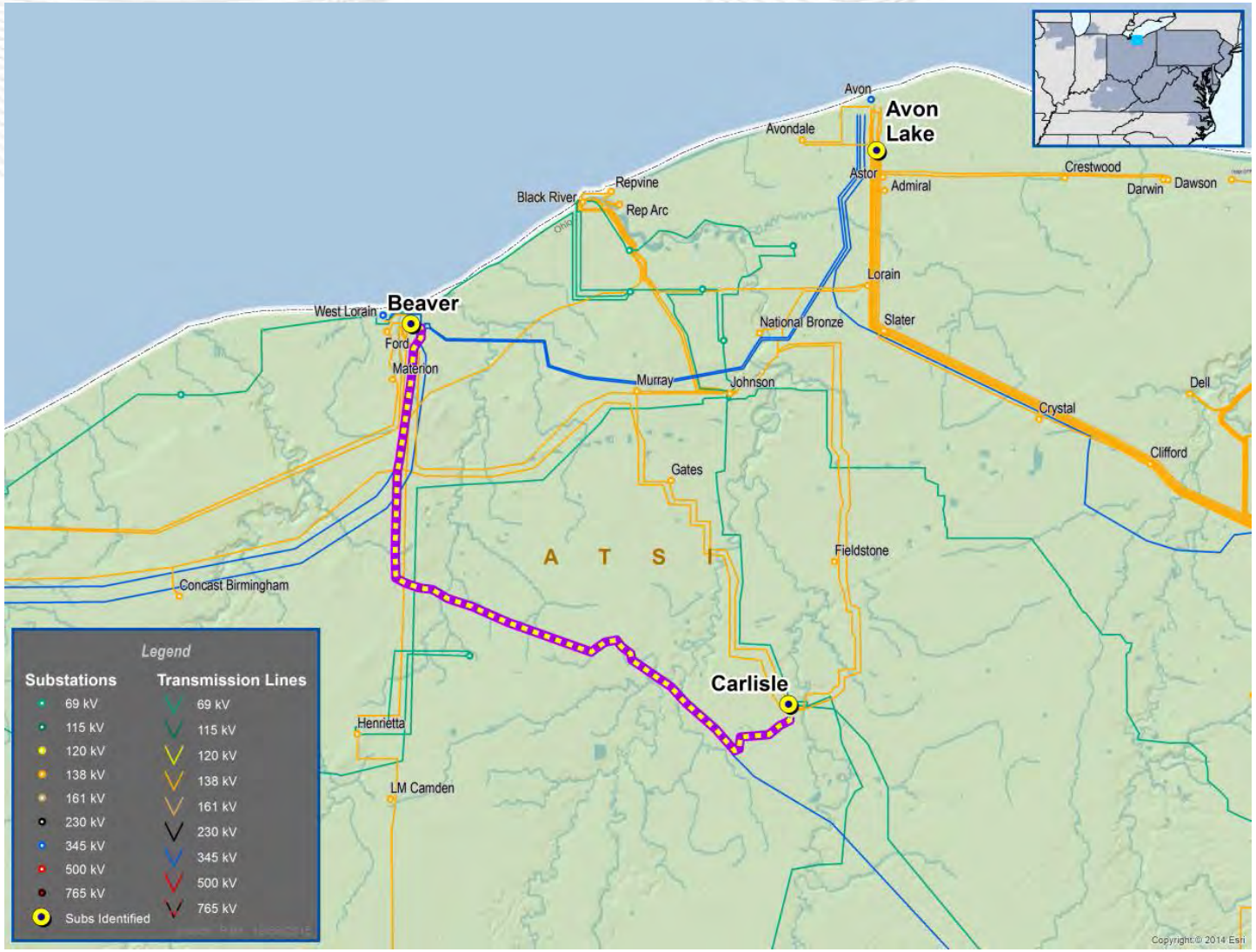
Deactivation Update: Deactivation Notifications

- Avon Lake Unit 7
  - ATSI Transmission Zone
  - 94.6 MW
  - Deactivation date: 04/16/2016



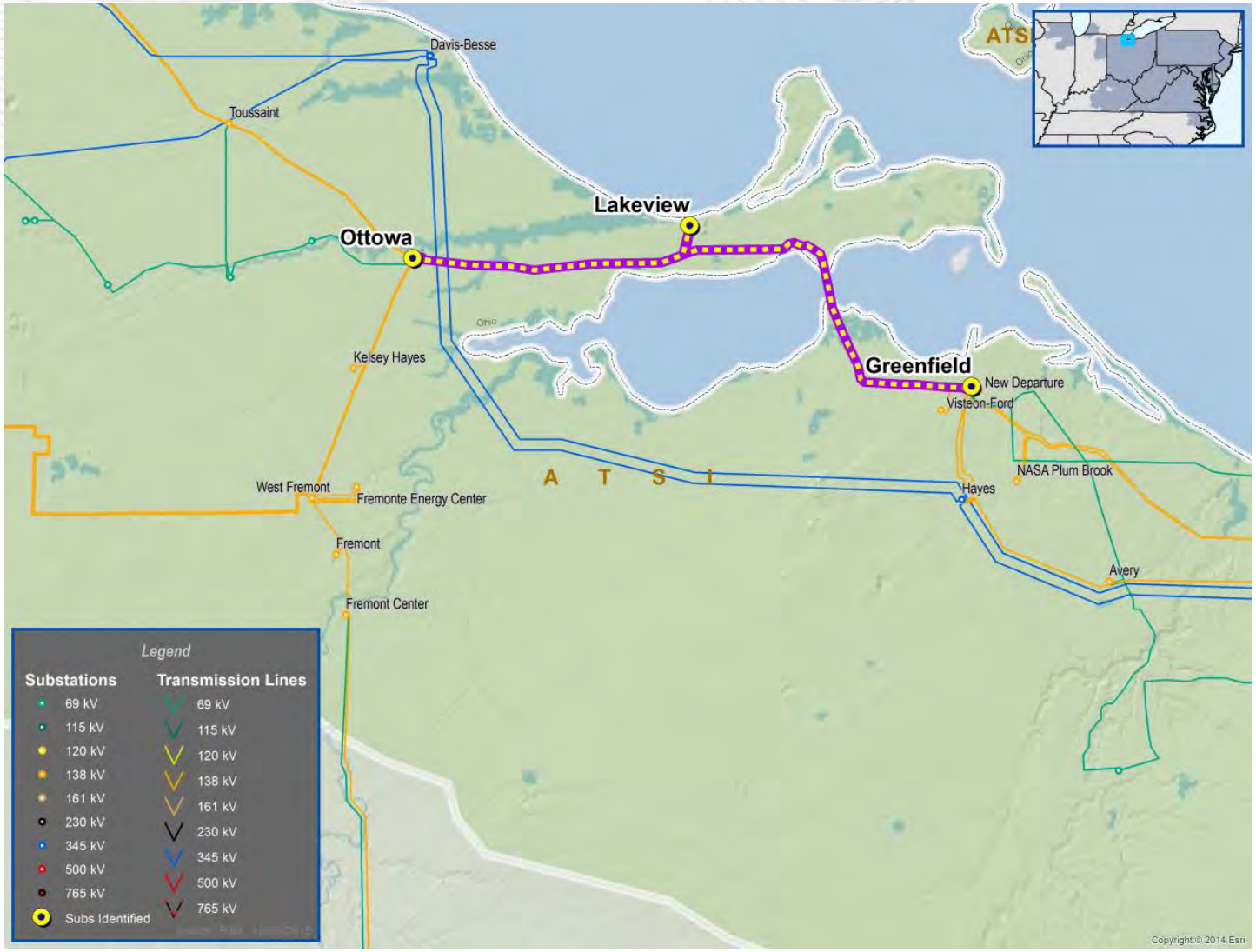
ATSI Transmission Zone

- Common Mode Outage:
- Beaver to Lake Avenue 345 kV line ckt 2F is overloaded for the line fault stuck breaker contingency outage of Beaver to Lake Avenue 345 kV line and Beaver to Carlisle 345 kV line for the breaker failure at Beaver B121 ('C2-BRK-CR016A1_NEW')
- Immediate Need
  - Due to the timing of the need for the reinforcement an RTEP proposal window is infeasible
- Alternatives Considered
  - Due to the immediate need of the project no alternatives were considered
- Existing Supplemental upgrade (S0663 and S0663.1) is being converted to a Baseline upgrade (B2725 and B2725.1):Build new 345/138 kV Lake Avenue substation w/breaker and a half high side (2 strings), 2-345/138 kV transformers and breaker and a half (2 strings) low side (138 kV). Substation will tie Avon - Beaver 345 kV #1/#2 and Black River - Johnson #1/#2 lines
- Construction Designation
  - Due to the immediate need, the local Transmission Owner will be the Designated Entity
- Cost estimate: $40 M
- Required IS Date: 06/01/2016
- Projected IS Date: 12/31/2016
- Interim Solution: PJM and ATSI (the local Transmission Owner) are reviewing possible operating measures



ATSI Transmission Zone

- Common Mode Outages:
- Lakeview to Greenfield 138 kV line and the Ottawa to Lakeview 138 kV lines are overloaded for the tower contingency outage of Davis-Besse to Hayes 345 kV line and Davis-Besse to Beaver 345 kV line ('C5-TWL-CR040_X1-027')
- Existing Baseline upgrade (B1959): Build a new West Fremont-Groton-Hayes 138kV line
- Cost estimate: $45 M
- Required IS Date: 06/01/2016
- Projected IS Date: 08/31/2018
- Interim Solution: An operating procedure exists to open the Lakeview – Greenfield 138 kV line at Greenfield to avoid the overloads

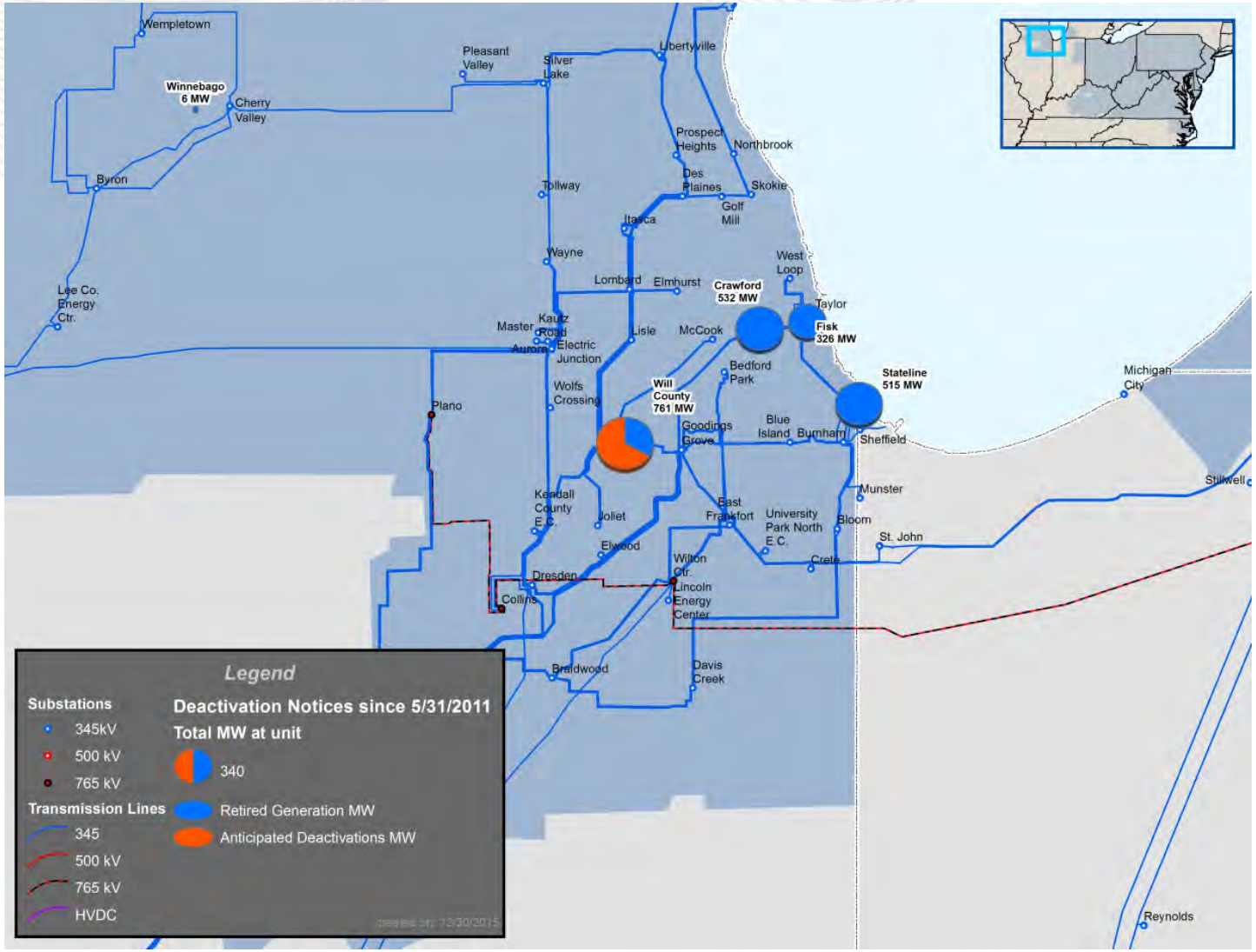


ATSI Transmission Zone

- Common Mode Outage and N-1-1 Violation:
- Black River to Lorain Q-2 138 kV line is overloaded for the line fault stuck breaker contingency outage of Lake Avenue to Avon 345 kV line ckt 1F and Lake Avenue to Avon 345 kV line ckt 2F ('C2-BRK-NR125') as well as being overloaded for the loss of Avon Lake 345/138 kV transformer#92 ('B_TRAN_SY_60B') followed by loss of Avon Lake 345/138 kV transformer #91 ('B_TRAN_SY_60A')
- Existing Baseline upgrade (B2559): Reconductor the Black River - Lorain 138 kV line and upgrade Black River and Lorain substation terminal end equipment
- Cost estimate: $9.6 M
- Required IS Date: 06/01/2016
- Projected IS Date: 06/01/2019
- Interim Solution: The contingencies causing the violation may be observed in the PJM EMS and operated to in real time to maintain system security as an interim fix

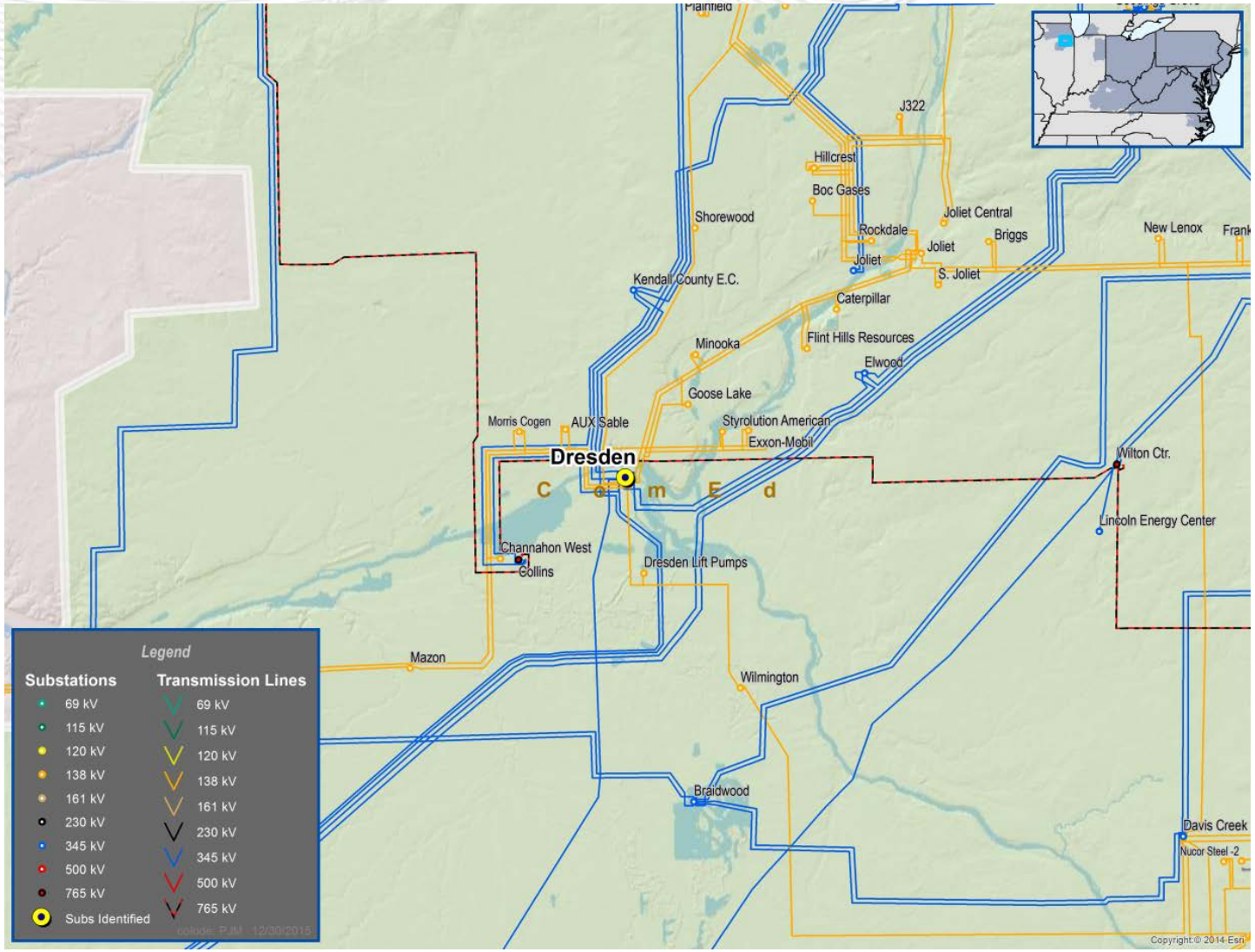
Deactivation Update: Deactivation Notifications

- Will County Unit 4
  - ComEd Transmission Zone
  - 510 MW
  - Deactivation date: 05/31/2018



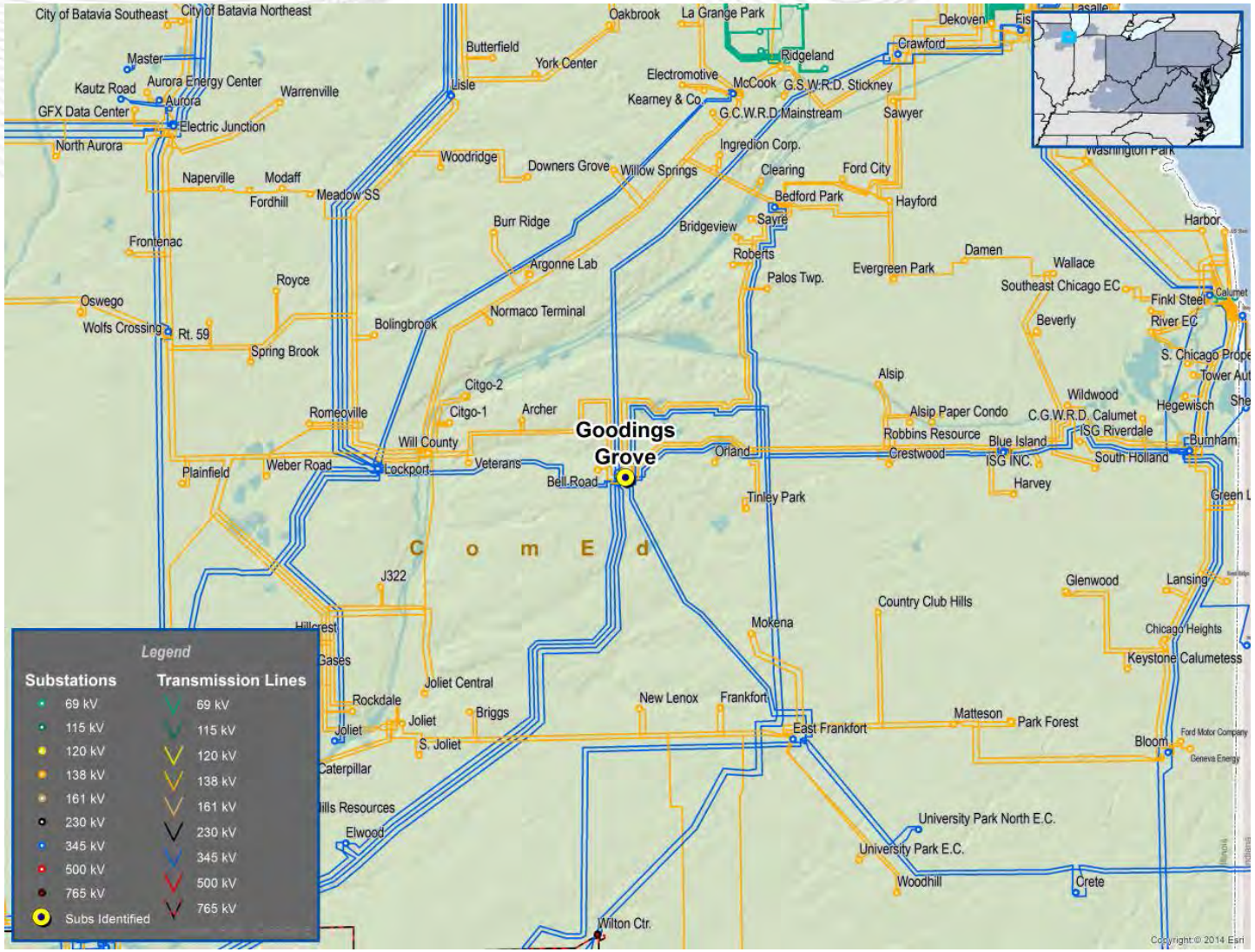
ComEd Transmission Zone

- Common Mode Outage:
- Dresden 345/138 kV transformer 83 is overloaded for the line fault stuck breaker contingency loss of Goodings Grove to Elwood 345 kV circuit and Elwood bus tie ('900-45-BT4-5')
- Existing Baseline upgrade (B2561): Install a new 345 kV circuit breaker 5-7 at Elwood substation
- Cost estimate: $2.6 M
- Required IS Date: 06/01/2018
- Projected IS Date: 06/01/2018



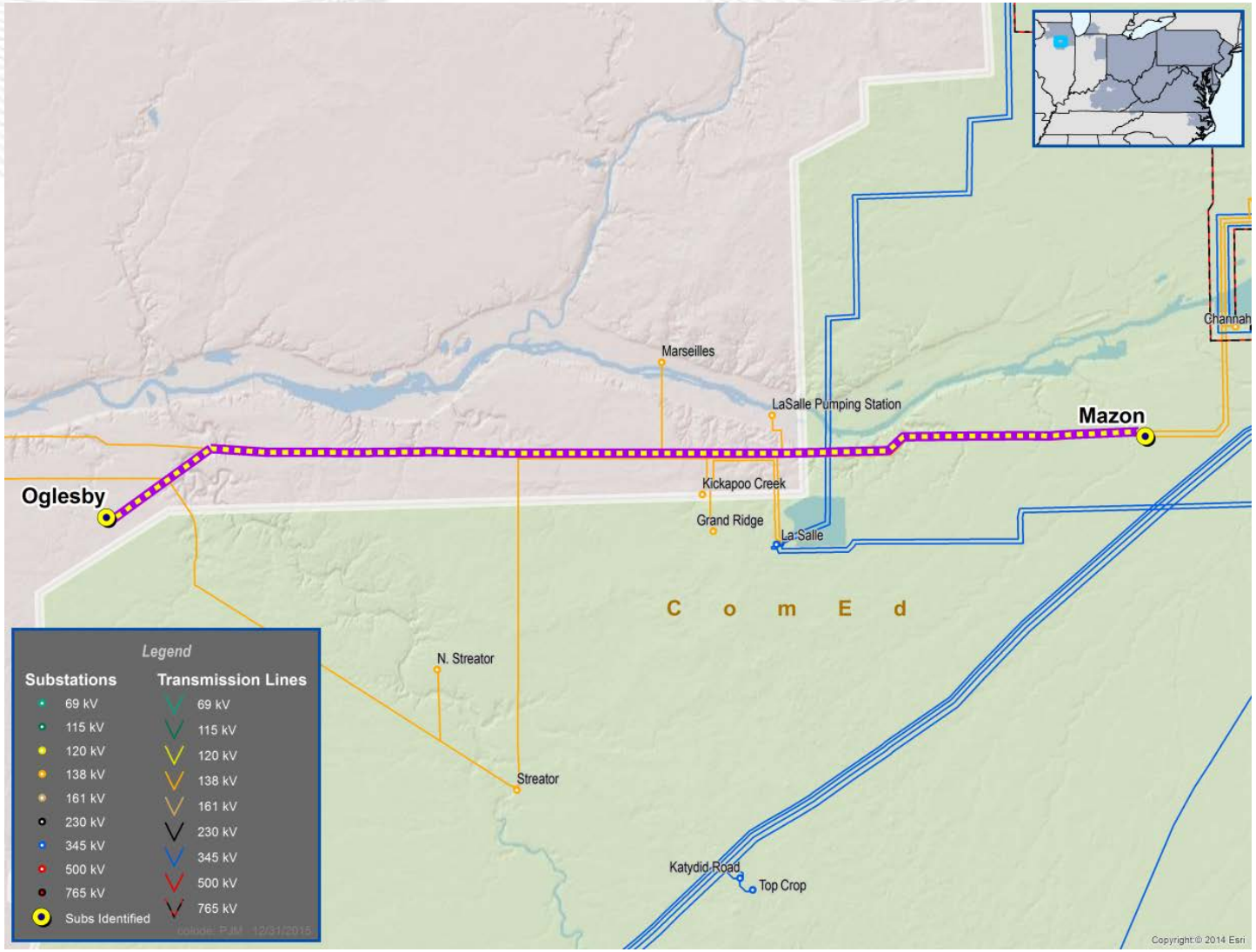
ComEd Transmission Zone

- Common Mode Outages:
- Goodings Grove 345/138 kV transformer is overloaded for the single contingency loss of Goodings Grove 345 kV line ('116-CB_34___') as well as being overloaded for the line fault stuck breaker contingency loss of Blue Island Tap Red bus to Blue Island Red bus 345 kV line, Goodings Grove to Blue Island Tap Red bus to Wilton Red bus 345 kV line ('116-45-L11614_')
- Immediate Need
  - Due to the timing of the need for the reinforcement an RTEP proposal window is infeasible
- Alternatives Considered
  - Due to the immediate need of the project no alternatives were considered
- Existing Supplemental upgrade (S0884) is being converted to a Baseline upgrade (B2721): Goodings Grove – Balance Station Load (swap bus positions for 345 kV lines 1312 & 11620 and 345 kV lines 11604 & 11622) and replace 138 kV bus tie 2-3
- Construction Designation
  - Due to the immediate need, the local Transmission Owner will be the Designated Entity
- Cost estimate: $5.4 M
- Required IS Date: 06/01/2018
- Projected IS Date: 06/01/2016



ComEd Transmission Zone

- Common Mode Outages:
- Oglesby to Mazon 138 kV line is overloaded for the bus fault contingency outage of La Salle County 138 kV bus ('001_LA-138B__1')
- Advance the required IS date of the existing Baseline upgrade (B2613): Replace relays at Mazon substation
- Cost estimate: $0.7 M
- Old Required IS Date: 06/01/2019
- New Required IS Date: 06/01/2018
- Projected IS Date: 06/01/2018



Reliability Analysis Update

Dominion Transmission Zone

Project Scope Change: B1912

Problem: N-1-1 Voltage

- Voltage collapse in the Va Beach area for an N-1-1 outage of Suffolk-Yadkin 500 kV Line and the Yadkin – Fentress 500 kV Line

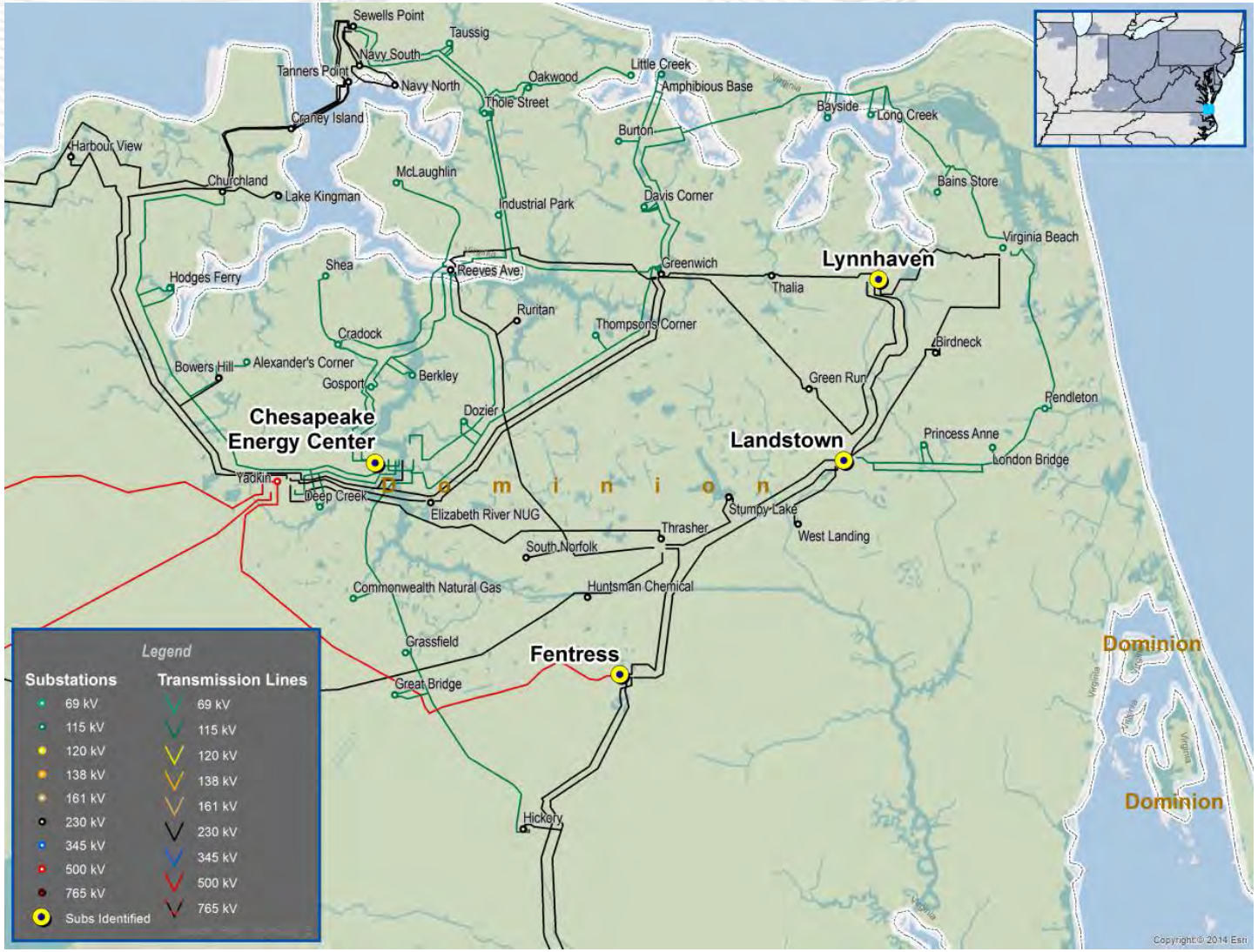
Previous Scope:

- Install three +/- 125 MVAr STATCOM at three different Substations (Landstown, Yadkin, Fentress)
  - Re-consider this solution to optimize reliability in the area
- New Scope: Install four +/- 125 MVAr STATCOM at Landstown, Chesapeake, Fentress, Lynnhaven

Old Estimated Cost: $70 M

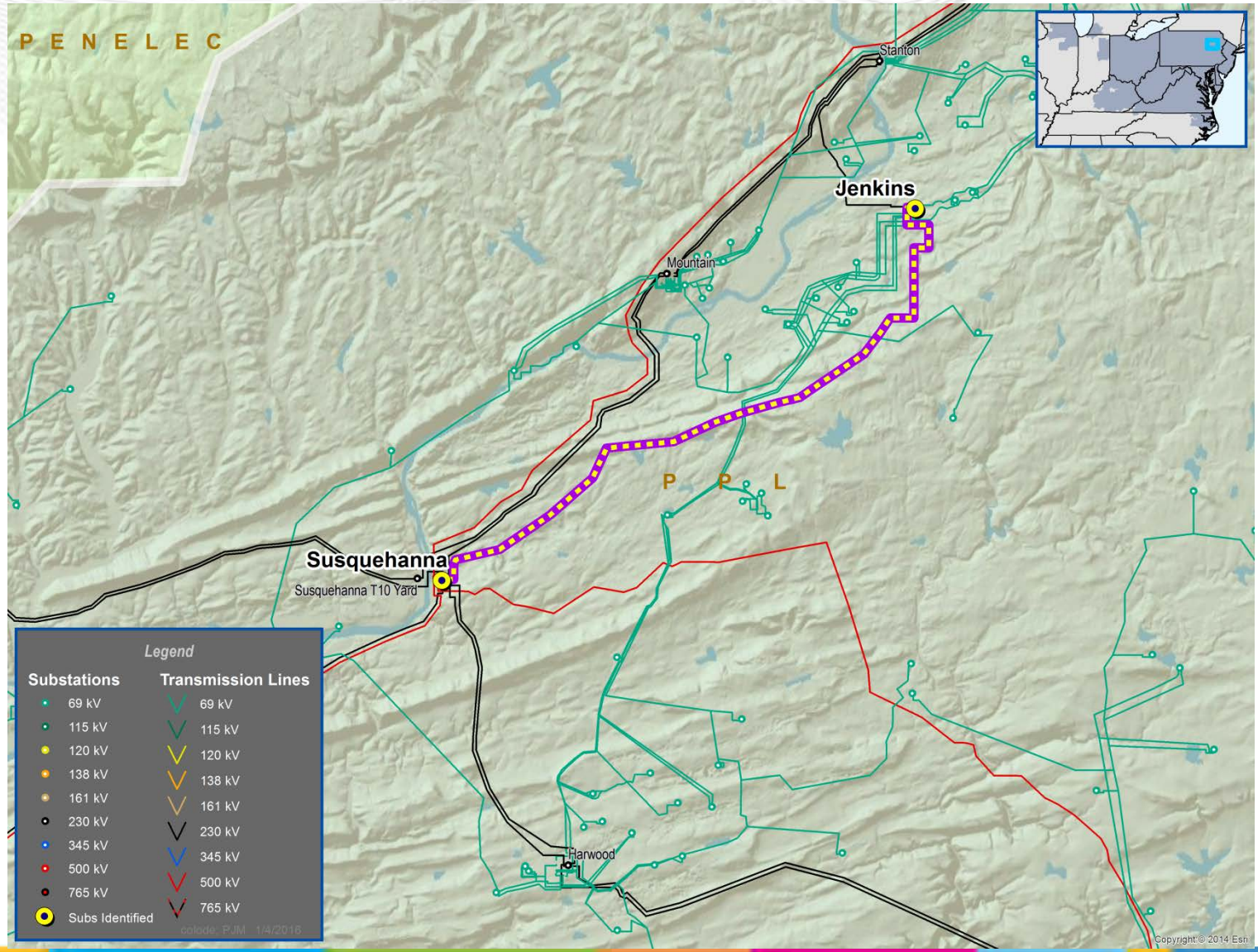
New Estimated Cost: $95 M

Projected IS Date: 06/01/2016



PPL Transmission Zone

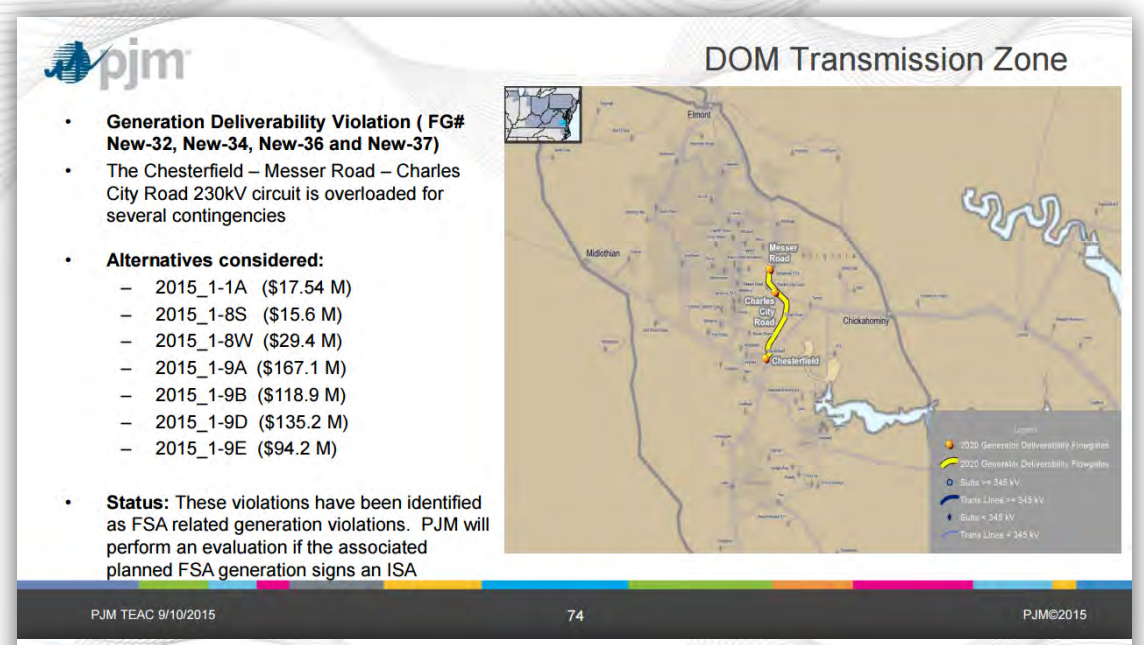
- Additional work is required to implement the B2269 Upgrade to Rebuild approximately 23.7 miles of the Susquehanna - Jenkins 230kV circuit.:
- Due to the extended outage required to rebuild the Susquehanna-Jenkins 230 kV circuit, there are anticipated N-1 and N-1-1 violations in the Stanton vicinity.
- Proposed Solution:
  - Rearrange the 230 kV lines out of the Stanton substation. (B2269.1)
  - Upgrade relays at Mountain 230 kV substation. (B2269.2)
- Estimated Project Cost:
  $ 2.5 M
- Projected IS Date:
  12/31/2016



2015 RTEP Proposal Window Update

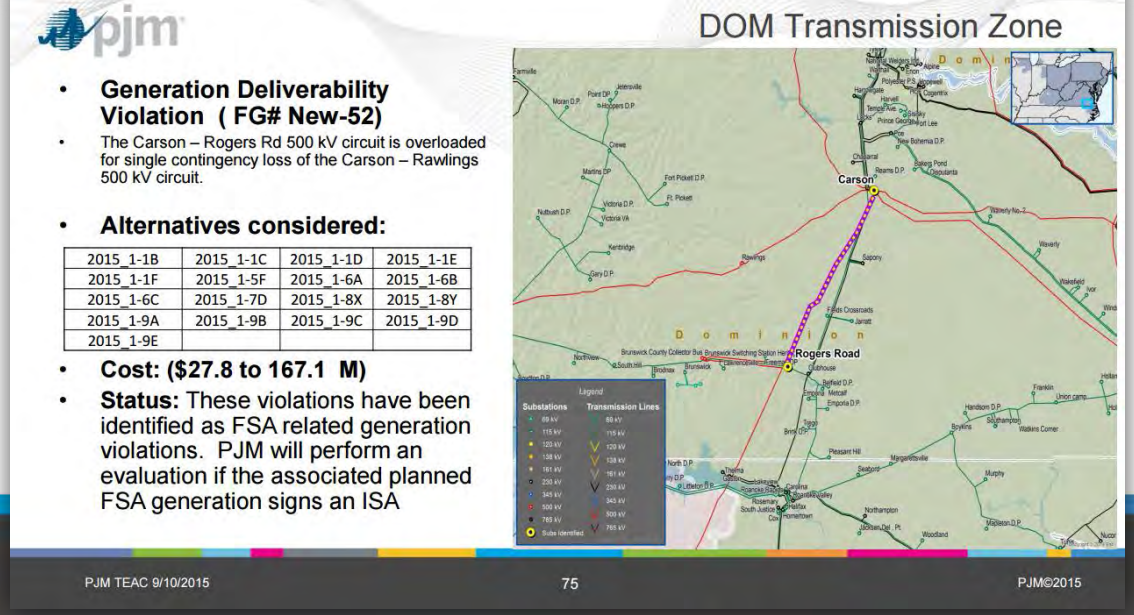
2015 RTEP Proposal Window #1

- As part of the 2015 RTEP, two locations in the Dominion Zone were impacted by FSA generation related violations
- The FSA generation has since signed an ISA and PJM is re-engaging the selection of a recommended solution
  - PJM Queue Z1-086
- Updated analysis



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			

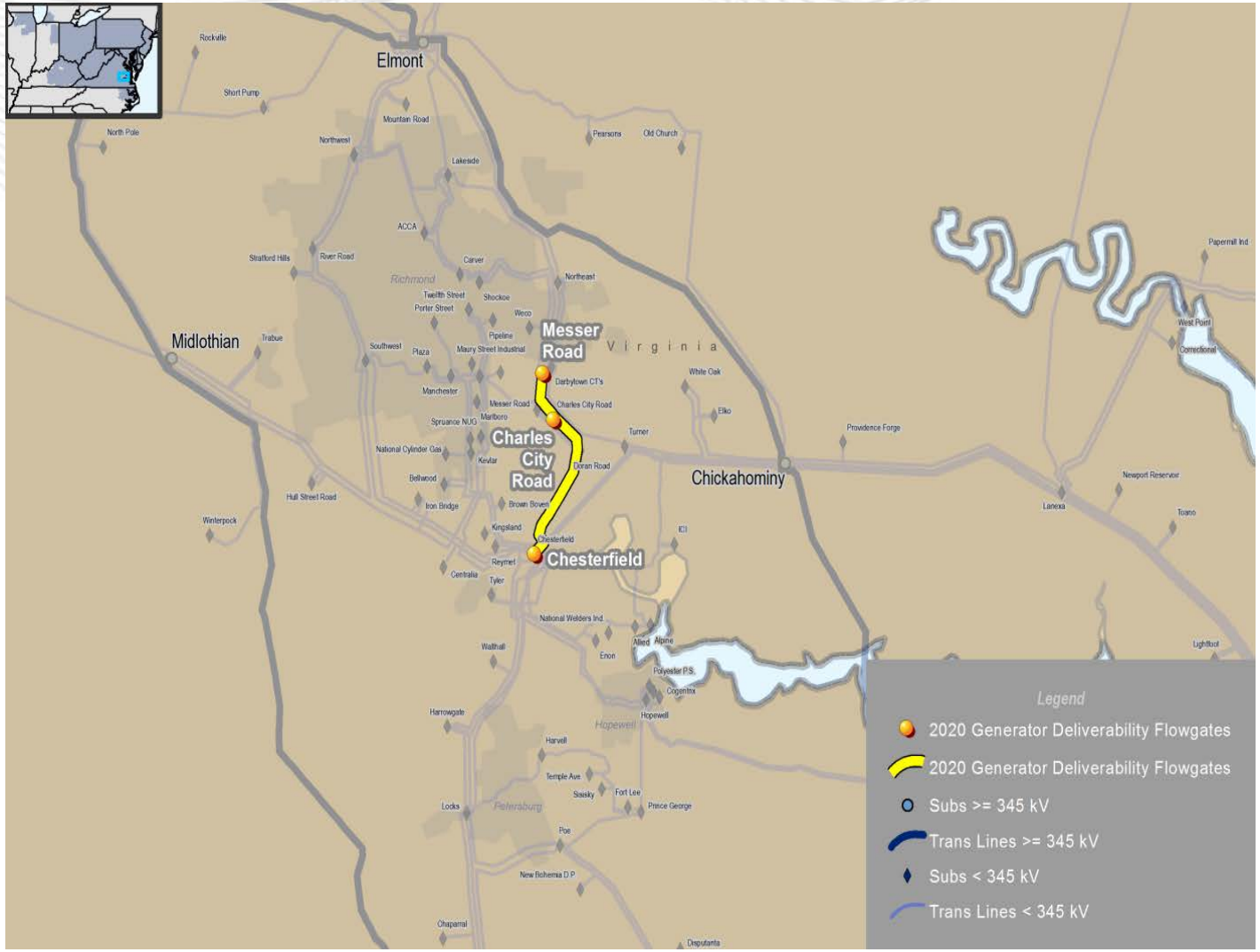
- **Cost: ($27.8 to 167.1 M)**
- **Status:** These violations have been identified as FSA related generation violations. PJM will perform an evaluation if the associated planned FSA generation signs an ISA

Dominion Transmission Zone

- **Generation Deliverability Violations (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)



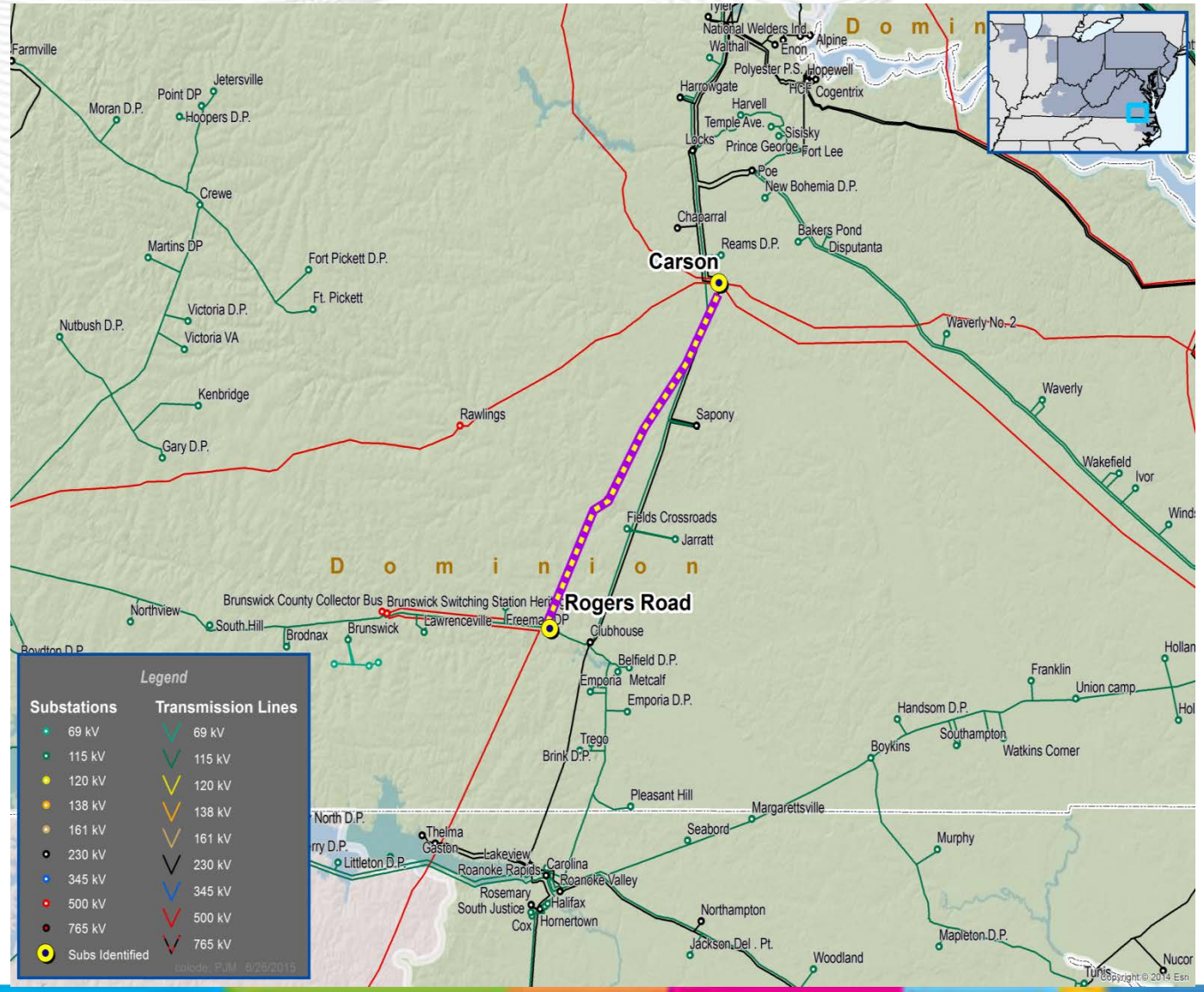
Dominion Transmission Zone

- **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:**

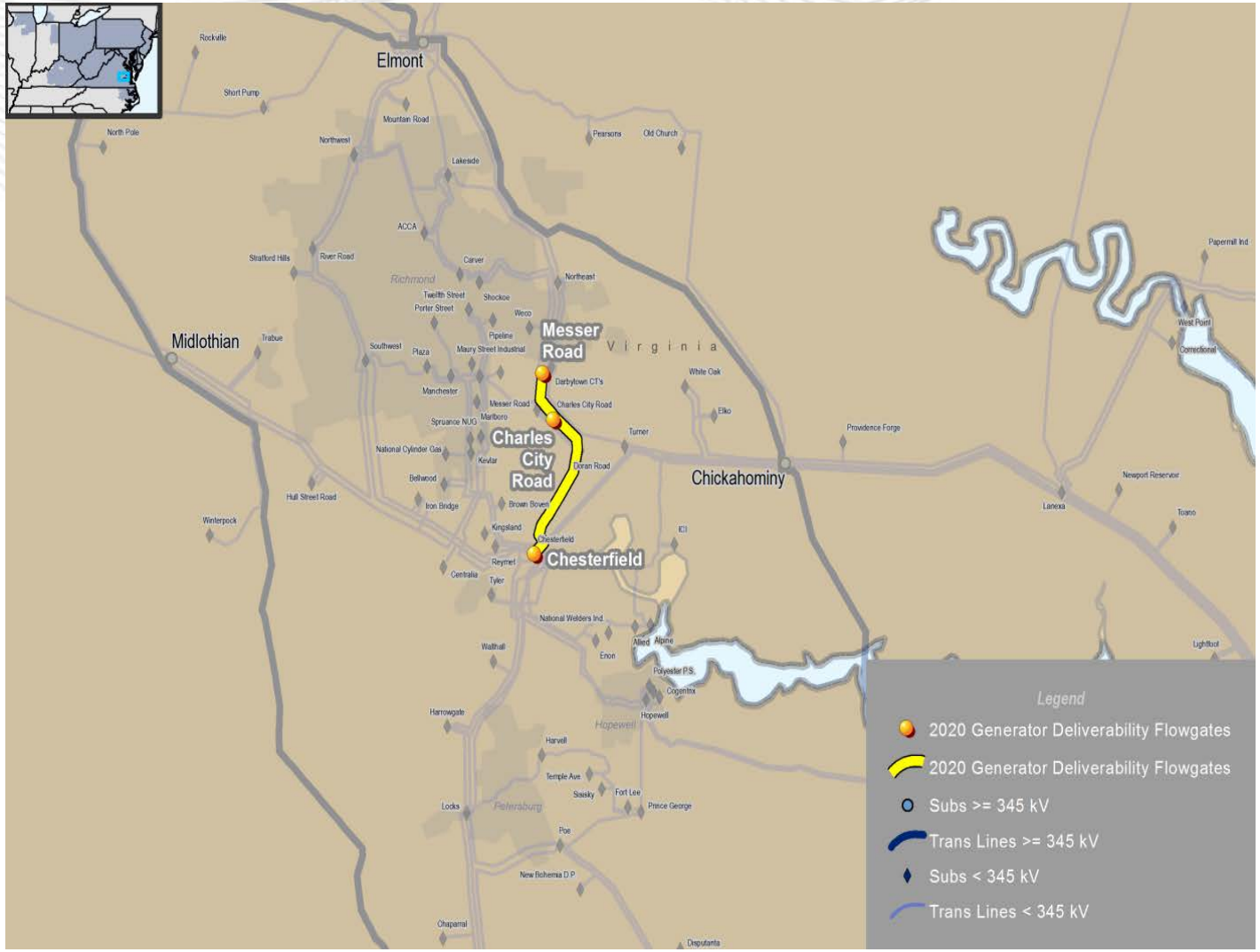
2015_1-1B	2015_1-1C	2015_1-1D	2015_1-1E
2015_1-1F	2015_1-5F	2015_1-6A	2015_1-6B
2015_1-6C	2015_1-7D	2015_1-8X	2015_1-8Y
2015_1-9A	2015_1-9B	2015_1-9C	2015_1-9D
2015_1-9E			

- **Cost: ($27.8 to 167.1 M)**



Dominion Transmission Zone

- **Additional Generator Deliverability Violations:**
  - Assumptions updated
  - The Chesterfield – Messer Road – Charles City Road 230kV circuit is overloaded for new additional single and tower contingencies compared to the 2015 analysis



2016 Proposal Window #1

- 2016 Proposal Window #1 Announcement

- Updated Year 2020 study
  - Updated 2016 Load Forecast in DOM
  - Updated Queue Generation

- Generator Deliverability and Common Mode Outage Thermal
  - Initial version to be posted prior to opening of window

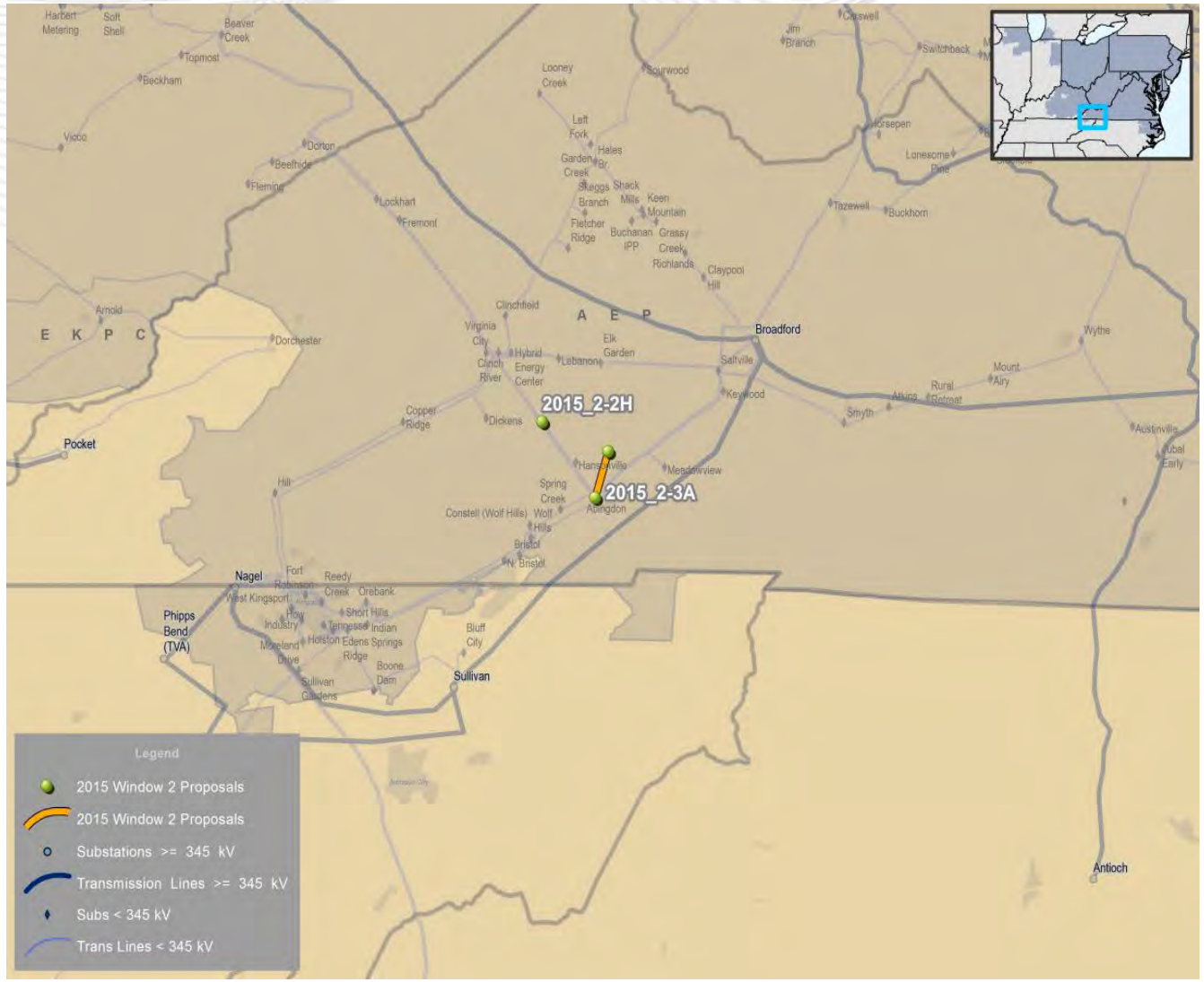
- Anticipated 2016 RTEP Proposal Window #1 Open in late January

AEP Transmission Zone

- **AEP Transmission Owner Criteria Violation (FG# AEP-T9)**

- **Violation description:**
  - The Abingdon – Hillman 69 kV line is overloaded for single contingency loss of the Broadford 765/500 kV transformer and Broadford – Sullivan 500 kV circuit.

- **PJM update:**
  - With the local supplemental project (S1068), this is not a valid violation any more.
  - PJM expects the same flowgate and other flowgates in the same area will shown up in 2016 winter study.
  - Please stay tuned for the 2016 windows and analysis



Short Circuit Upgrades

Dominion Transmission Zone

Problem: Short Circuit

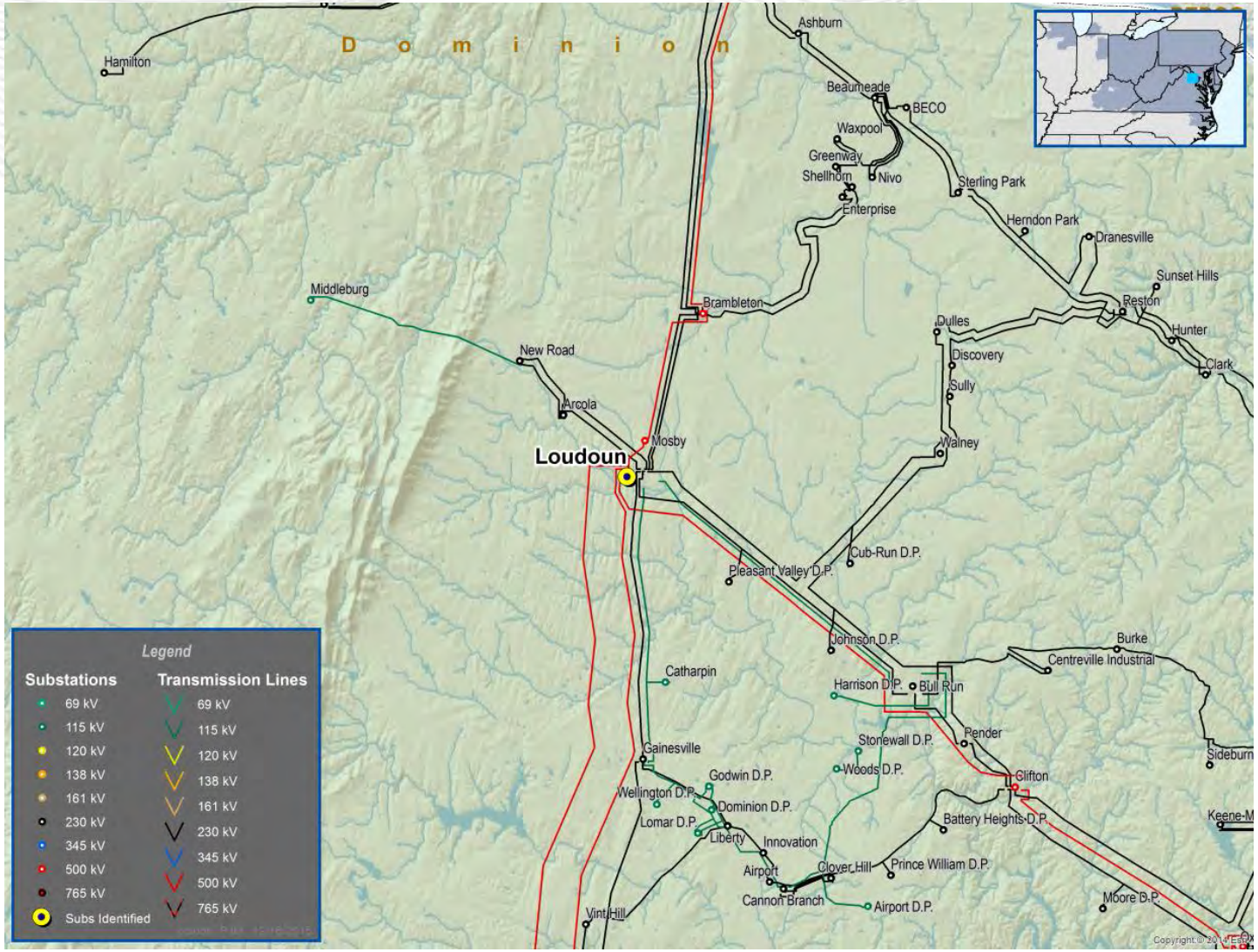
- The Loudoun 500kV ’H1T569’ breaker is overstressed

Proposed Solution:

- Replace the Loudoun 500kV ’H1T569’ breaker with a 50kA breaker

Estimated Project Cost: $900k

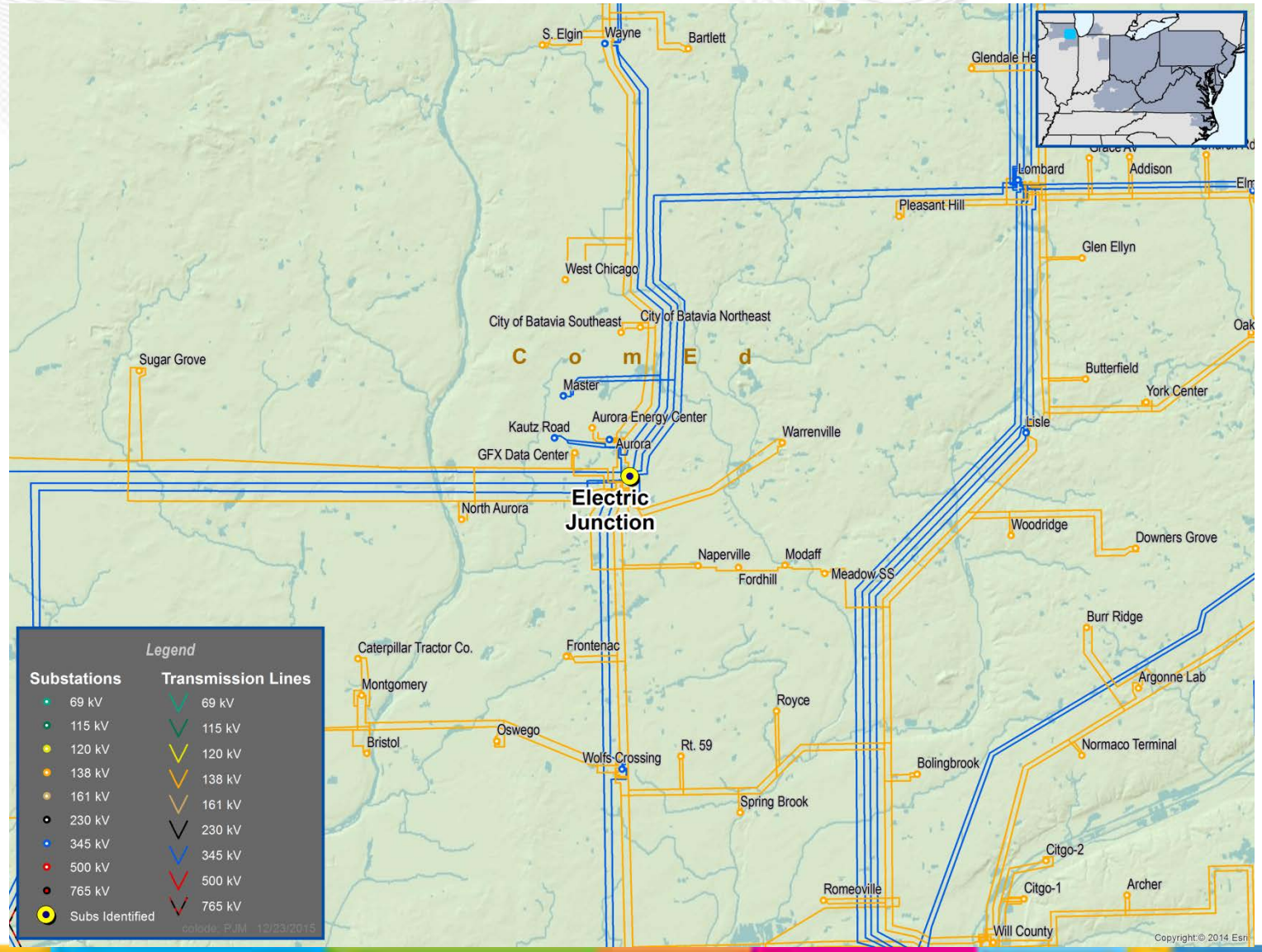
Projected IS Date: 06/01/2018



Supplemental Projects

ComEd Transmission Area

- **Supplemental Project**
- Replace the 345kV CB at Electric Junction on Electric Junction –Wolf Crossing 345kV line (line #1223). (S1108)
- Increase Short Circuit Capability
  - Old ;42KV
  - New: 63KV
- Material Condition, no line rating change
- Estimated Project Cost: $2.2M
- Projected IS Date: 12/31/2016



PPL Supplemental projects

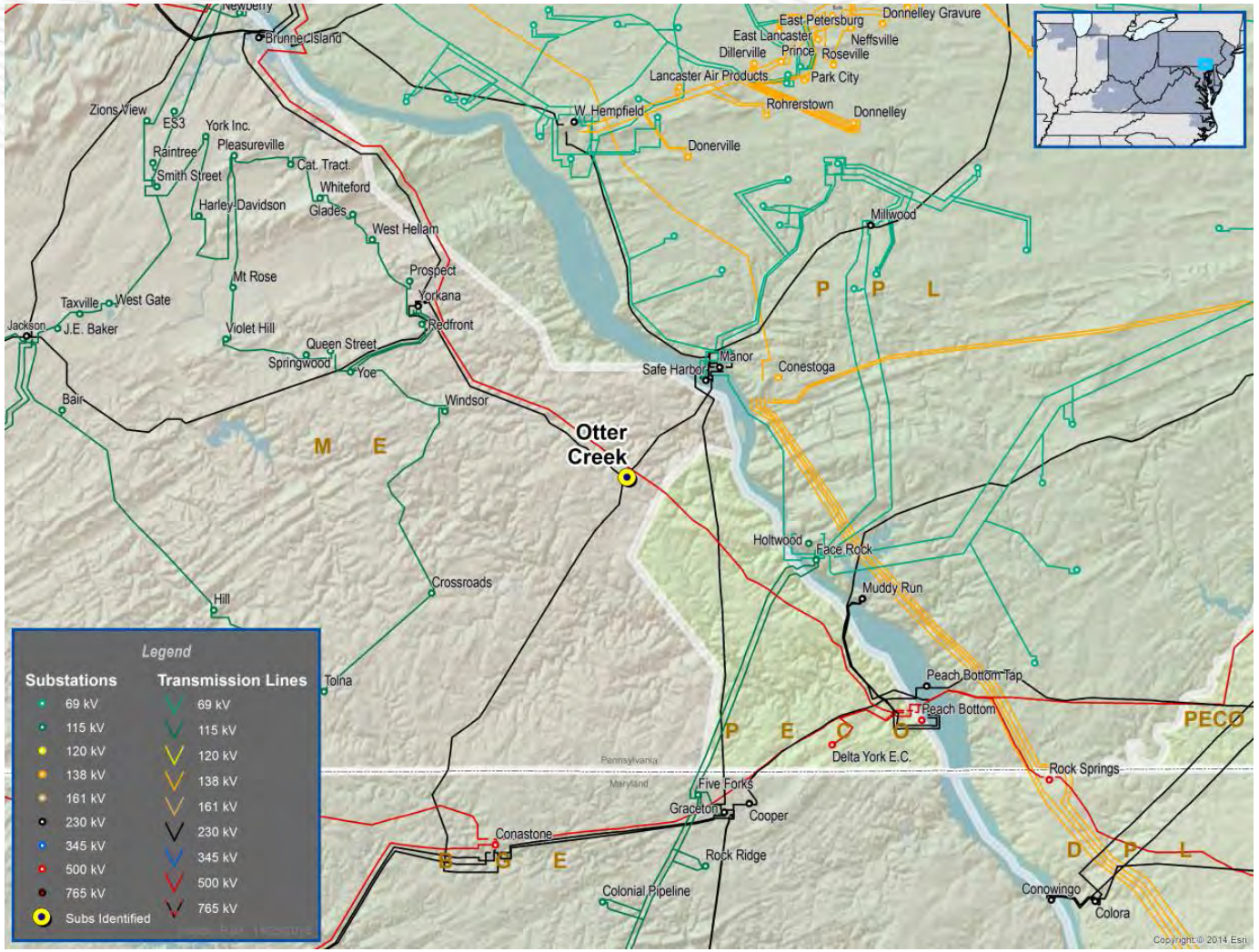
- Development of the PPL Electric Utility 10 year plan: 2015-2024
- Aging Infrastructure
  - A majority of PPL EU's transmission system was installed during expansion periods and it is now approaching the time where structures should be replaced to maintain integrity.
- Increase system reliability
  - Using latest PPL specifications in rebuilds will decrease the frequency and duration of outages due to failed components, lightning, and other weather-related events.
  - Rebuilding facilities to current standard designs will eliminate line tapped transformers at regional substations.
- Reduction in Maintenance Costs
- Combat specific line failure concerns
  - Particular assets though the industry standard at the time, such as cellon treated poles, wood upswept arms, conductor splices, were prone to increase in degradation.

PPL Supplemental projects

- Address Worst Performing Circuits
  - PPL has identified worst performing circuits which increase customer outages. Improvement on these lines will improve quality of service
- Increase in capabilities of equipment
  - Rebuilds utilizing new technology will provide better communication, analytics and operations that will restore customers in shorter periods of time.
- Work Efficiency
  - Bundling of work together will reduce outage impact to customers
- Relays and Control Houses
  - Reduced maintenance, remote monitoring, improved data recording, supports PPL EU fiber, upgrades, and upgraded battery systems.

PPL Transmission Zone

- Supplemental Upgrade:
- Build the Otter Creek 230kV station to current PPL design standards.
- Proposed Solution:
  - Upgrade the Otter Creek 230kV Yard to three bays breaker and a half arrangement, and replace relays (S1097)
- Estimated Project Cost:
  $ 10.7 M
- Projected IS Date:
  12/31/2026

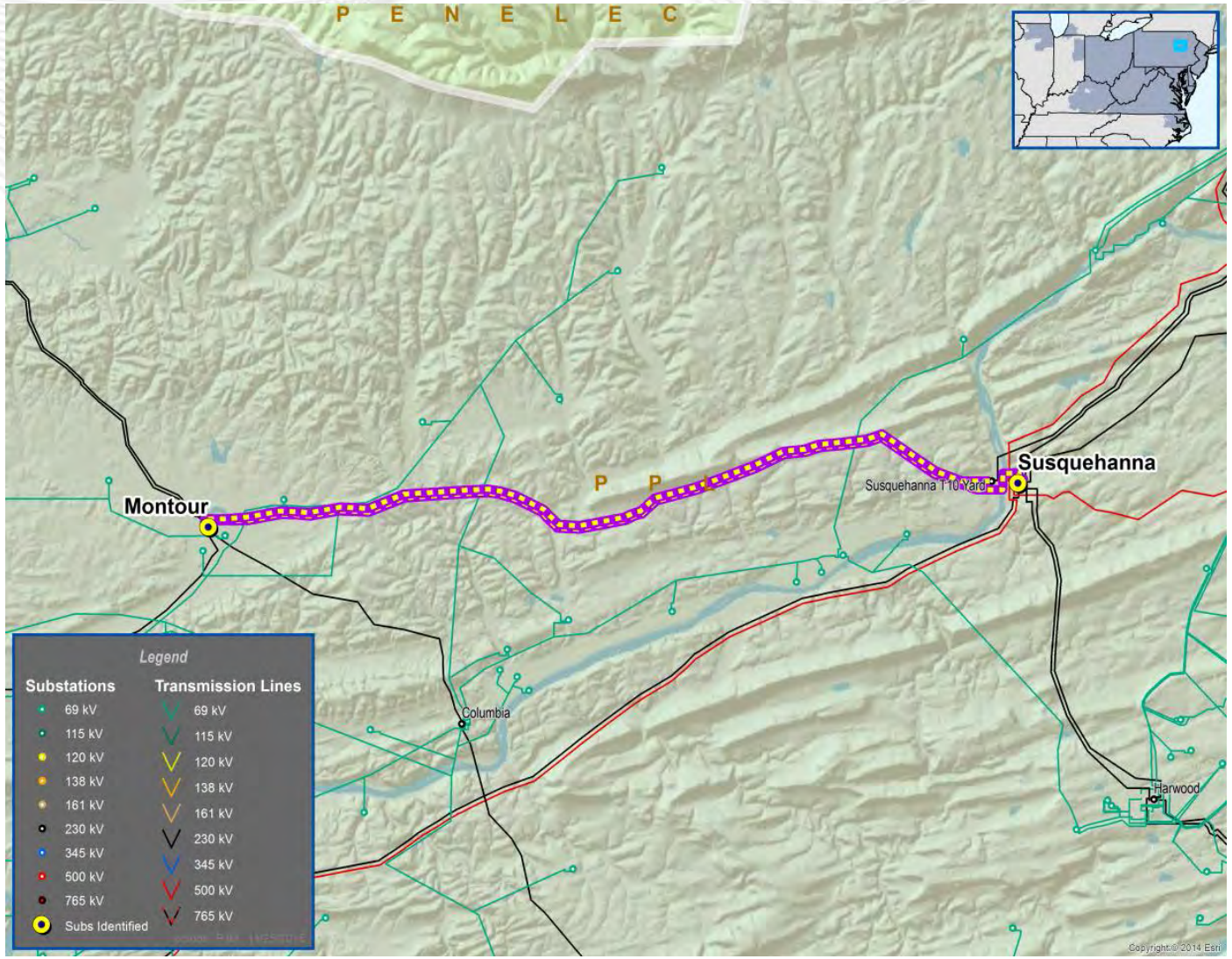


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability by building to current standards and separating PPL and merchant generation lines in different bay positions.
- Proposed Solution:
  - Montour - Build Bay 5 and 6 to standard breaker and a half configuration and Re-terminate the MONT-SU10 230kV Line into Bay 5 and the MONT-SUSQ 230kV Line into Bay 6. (S1098.1)
  - Upgrade relaying at Susquehanna 230kV Switchyard and Susquehanna T10 Switchyard. (S1098.2)
  - Remove two (2) Montour 230kV circuits breakers in Bay 1 and Bay 2. (S1098.3)
- Estimated Project Cost:

  $ 6.49 M
- Projected IS Date:

  12/31/2018

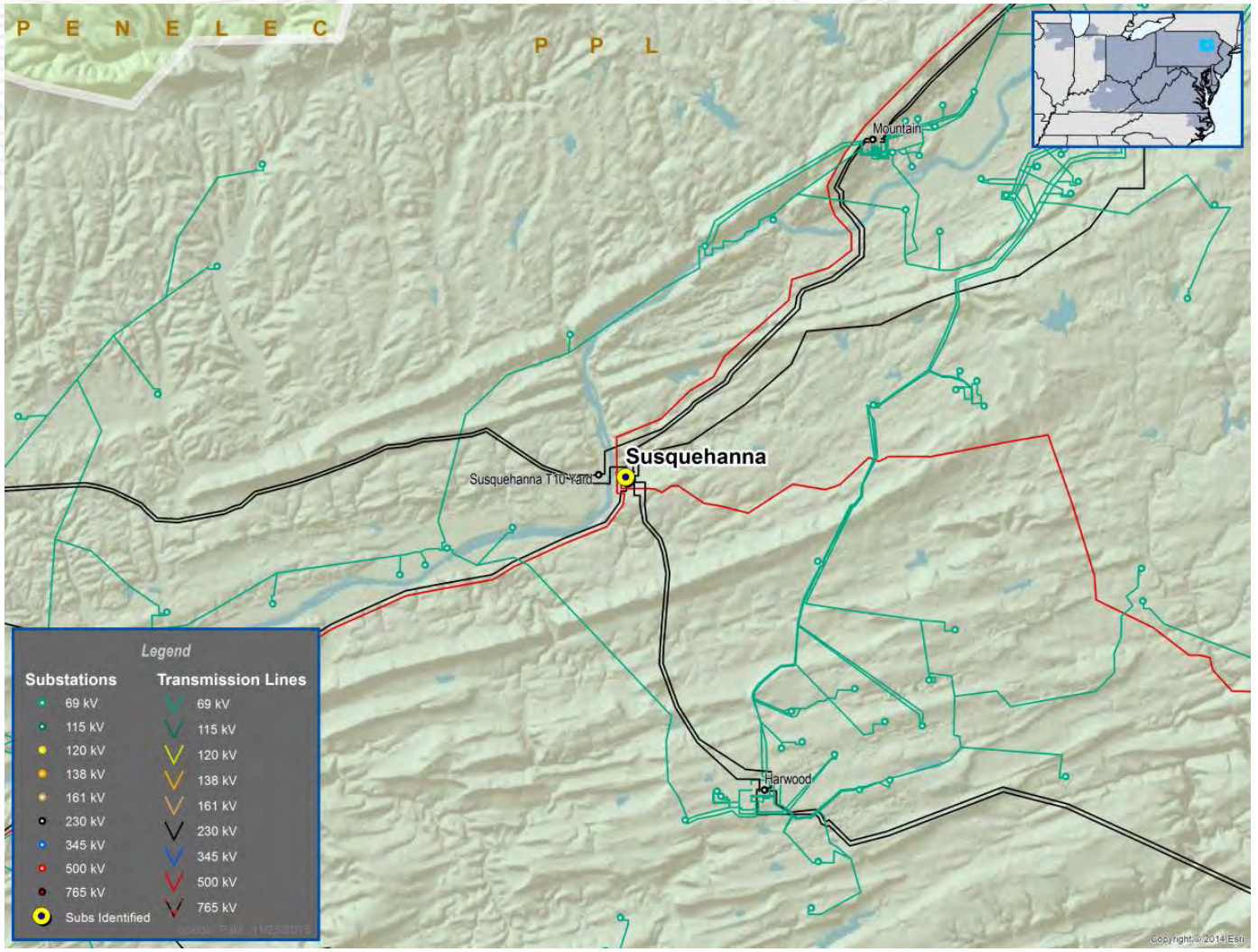


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability due to aging infrastructure.
- Proposed Solution:
  - Replace 3N and 3T Circuit breakers at Susquehanna 500 kV yard. (S1099)
- Estimated Project Cost:

  $ 2.8 M
- Projected IS Date:

  4/30/2017

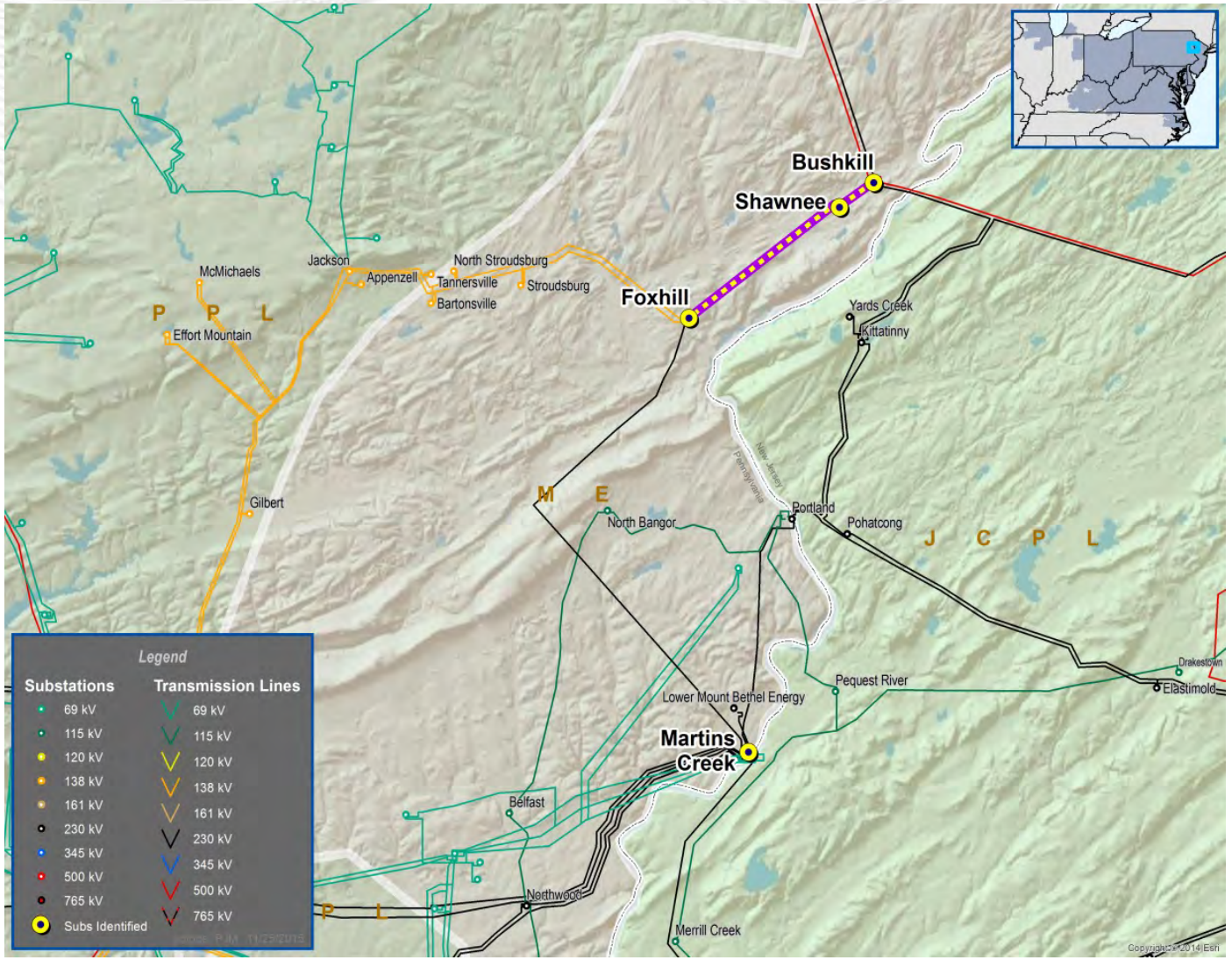


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability due to aging infrastructure.
- Proposed Solution:
  - Rebuild the existing Foxhill - Shawnee 230 kV line (Approximately 8.25 Miles). (S1100)
- Estimated Project Cost:

  $ 28.4 M
- Projected IS Date:

  12/31/2020

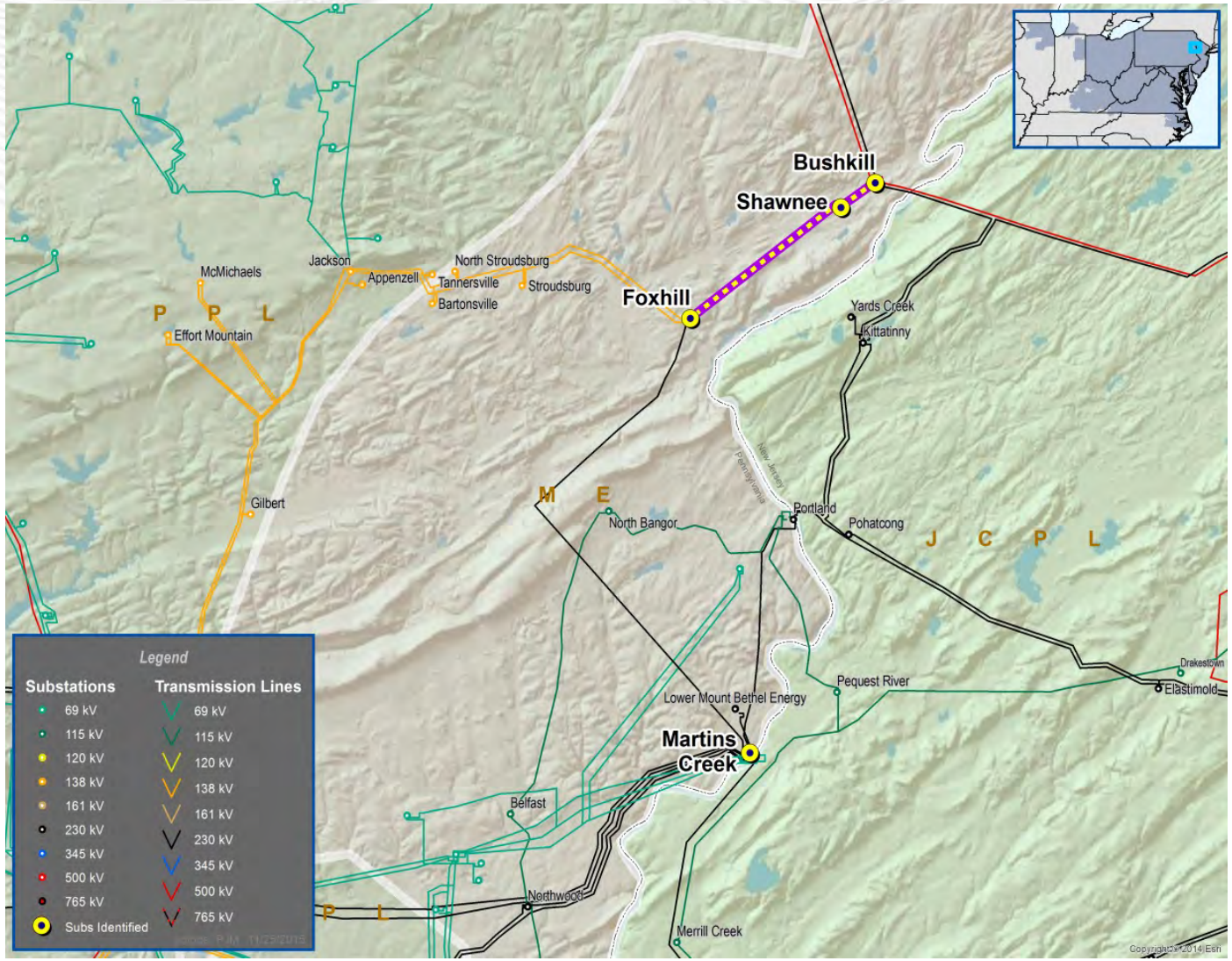


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability due to aging infrastructure.
- Proposed Solution:
  - Rebuild the existing Shawnee - Bushkill 230 kV line (Approximately 2.2 Miles). (S1101)
- Estimated Project Cost:

  $ 6.8 M
- Projected IS Date:

  5/31/2020

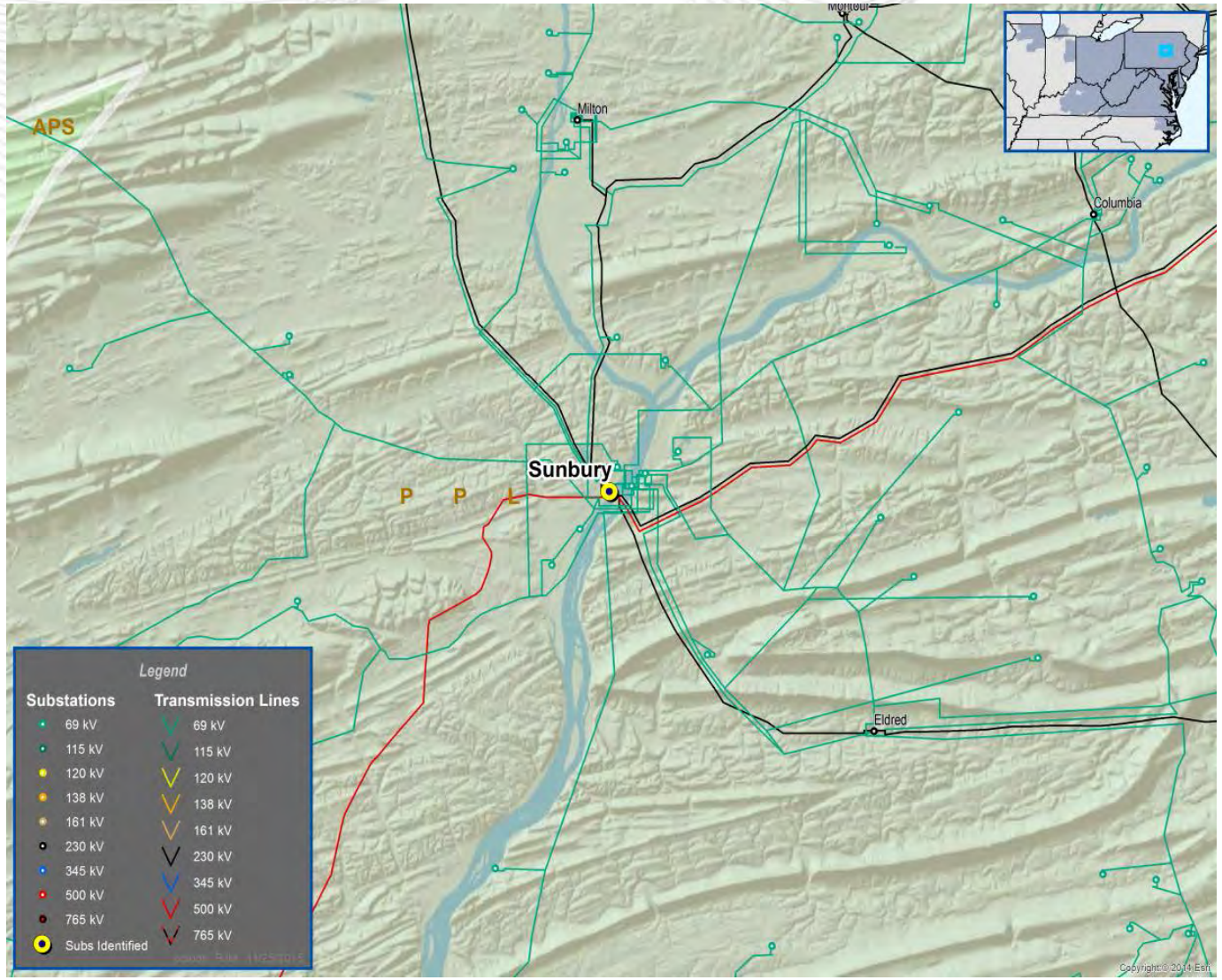


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability by replacing aging infrastructure and building the existing yard to current standards.
- Proposed Solution:
  - Construct a new 230 kV GIS yard at Sunbury Substation. (S1102)
- Estimated Project Cost:

  $ 25 M
- Projected IS Date:

  4/30/2018

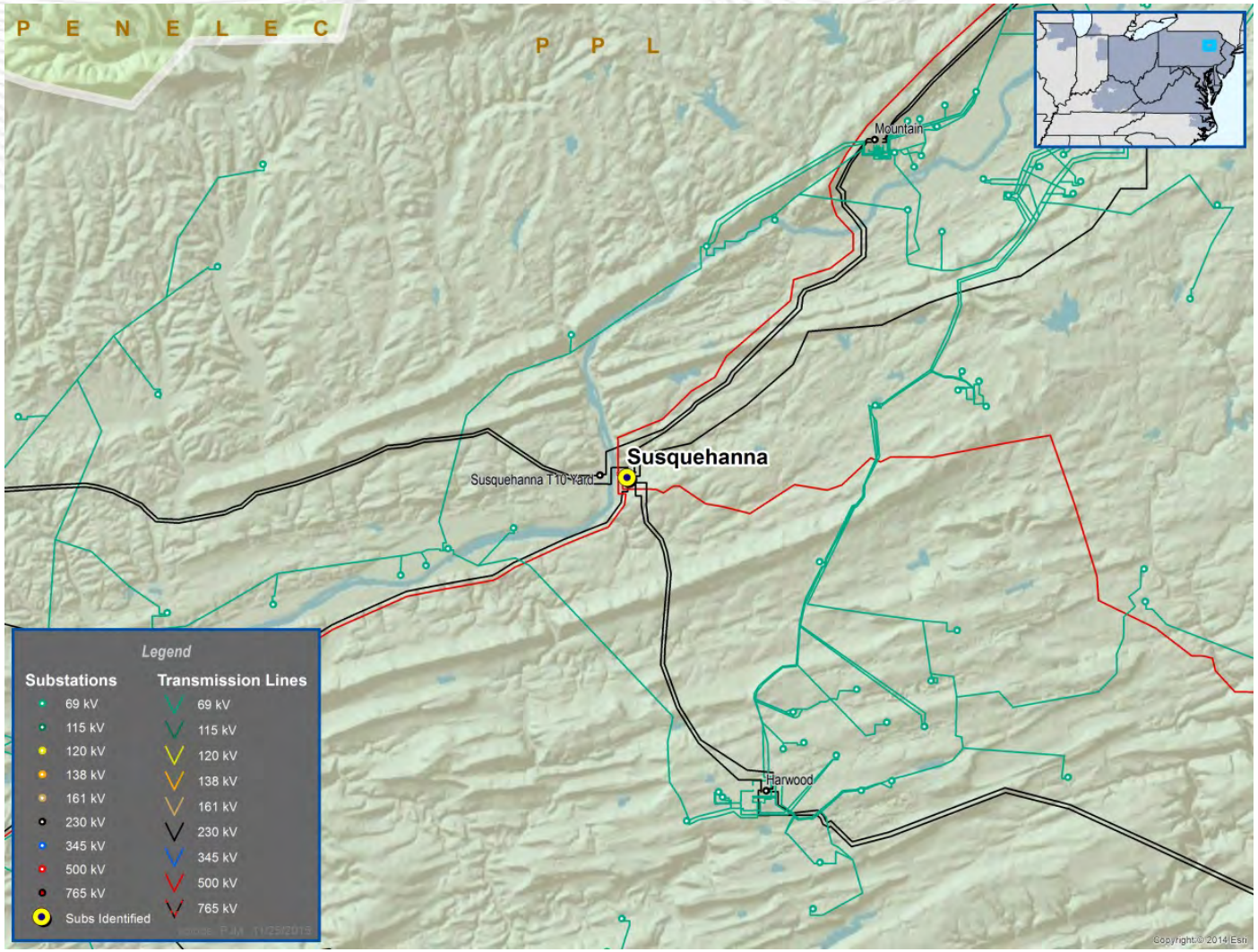


PPL Transmission Zone

- Supplemental Upgrade:
- The Susquehanna triple circuit outage scheme is no longer required with the Susquehanna – Roseland project.
- Proposed Solution:
  - Retire and Remove the Susquehanna Triple Circuit Outage Special Protection Scheme. (S1103)
- Estimated Project Cost:

  $ 0.84 M
- Projected IS Date:

  4/30/2016

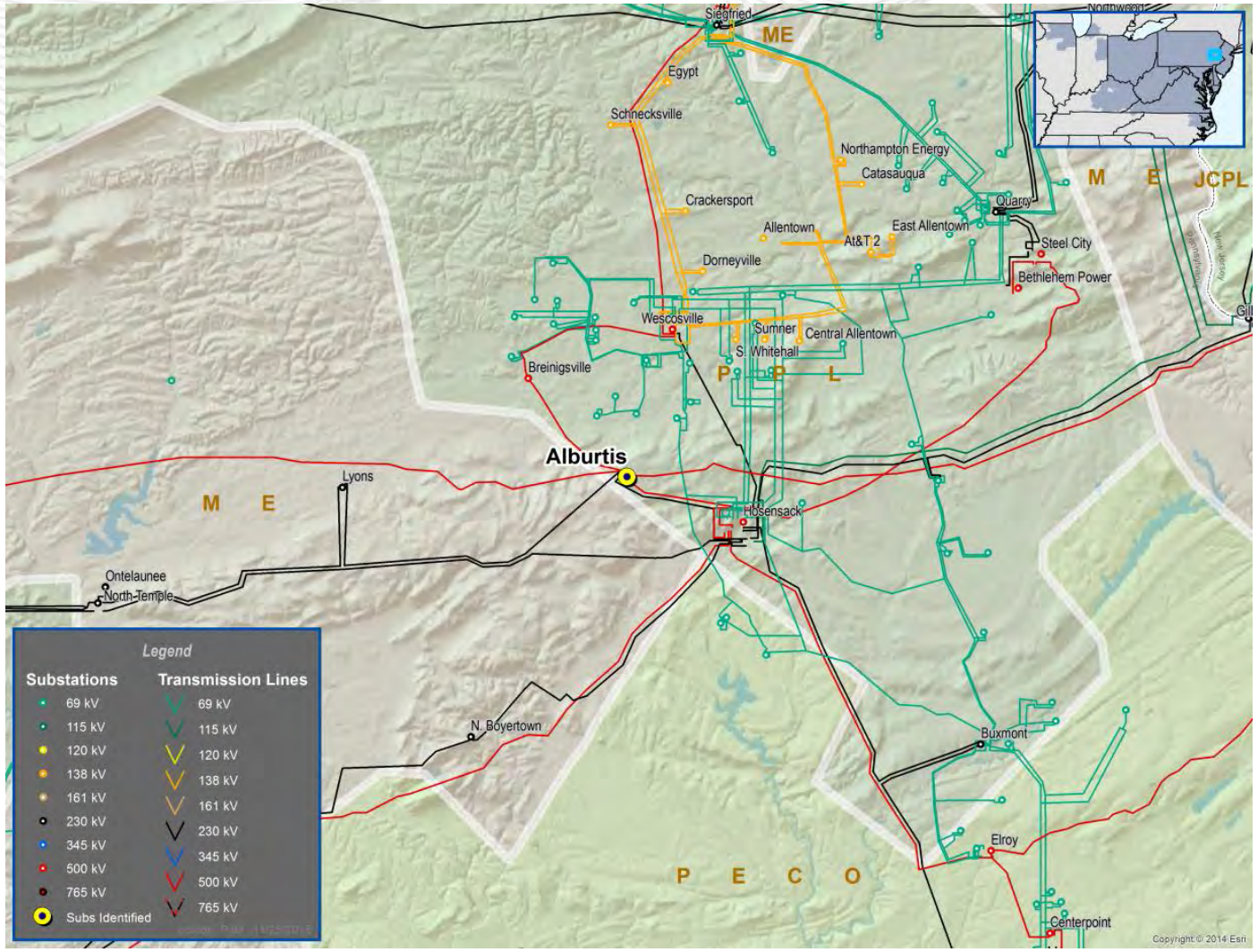


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability due to aging infrastructure.
- Proposed Solution:
  - Upgrade Alburtis 500 kV Switchyard by replacing old CBs, Cap bank, installing new control cubicle. (S1104)
- Estimated Project Cost:

  $ 6.6 M
- Projected IS Date:

  12/31/2017

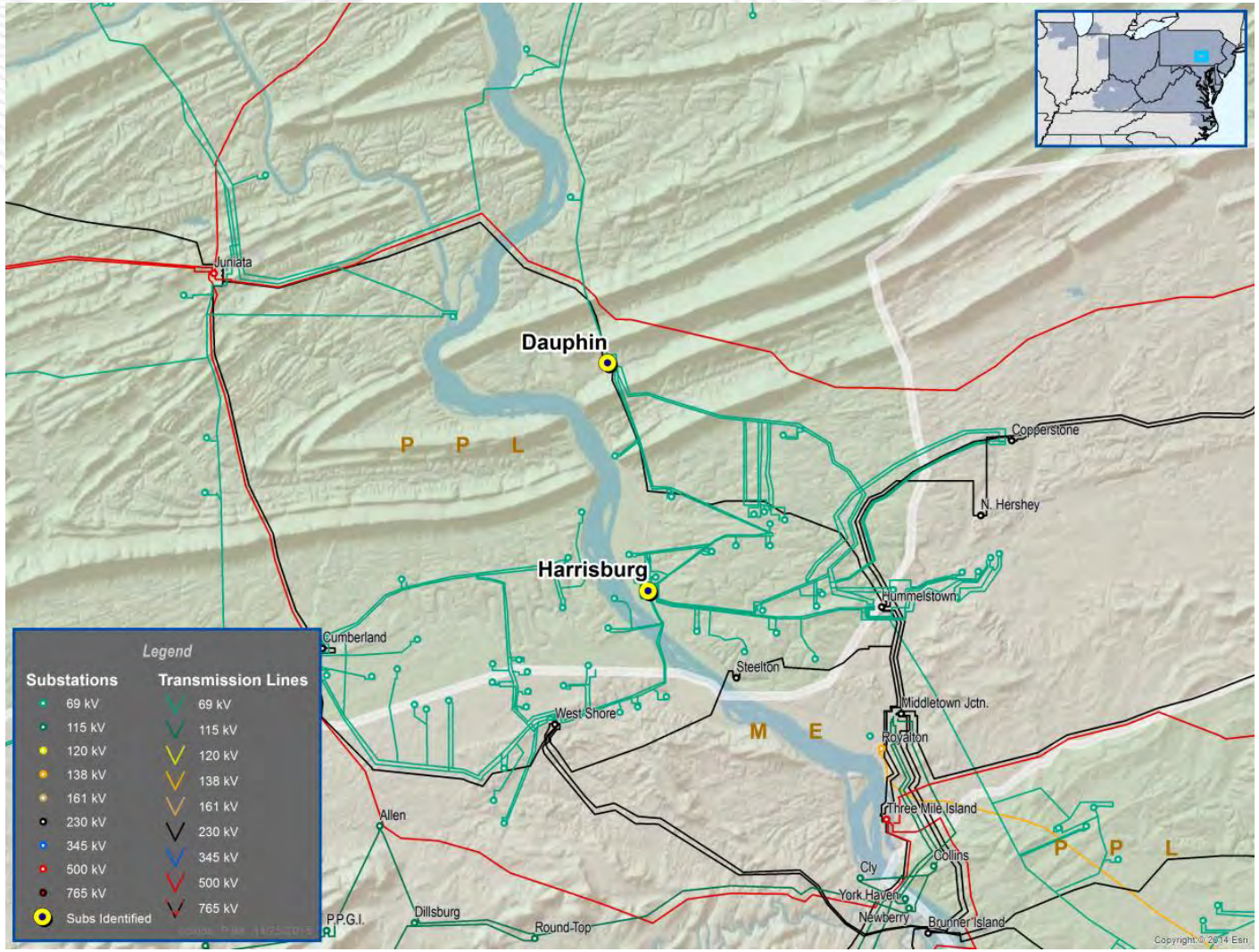


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability of Harrisburg region by reducing line exposure.
- Proposed Solution:
  - Build new 230 kV Line from Dauphin to New Harrisburg kV Substation. (S1105.1)
  - Build new UG 230 kV Line from West Shore to New Harrisburg Substation. (S1105.2)
- Estimated Project Cost:

  $ 88 M
- Projected IS Date:

  5/31/2026

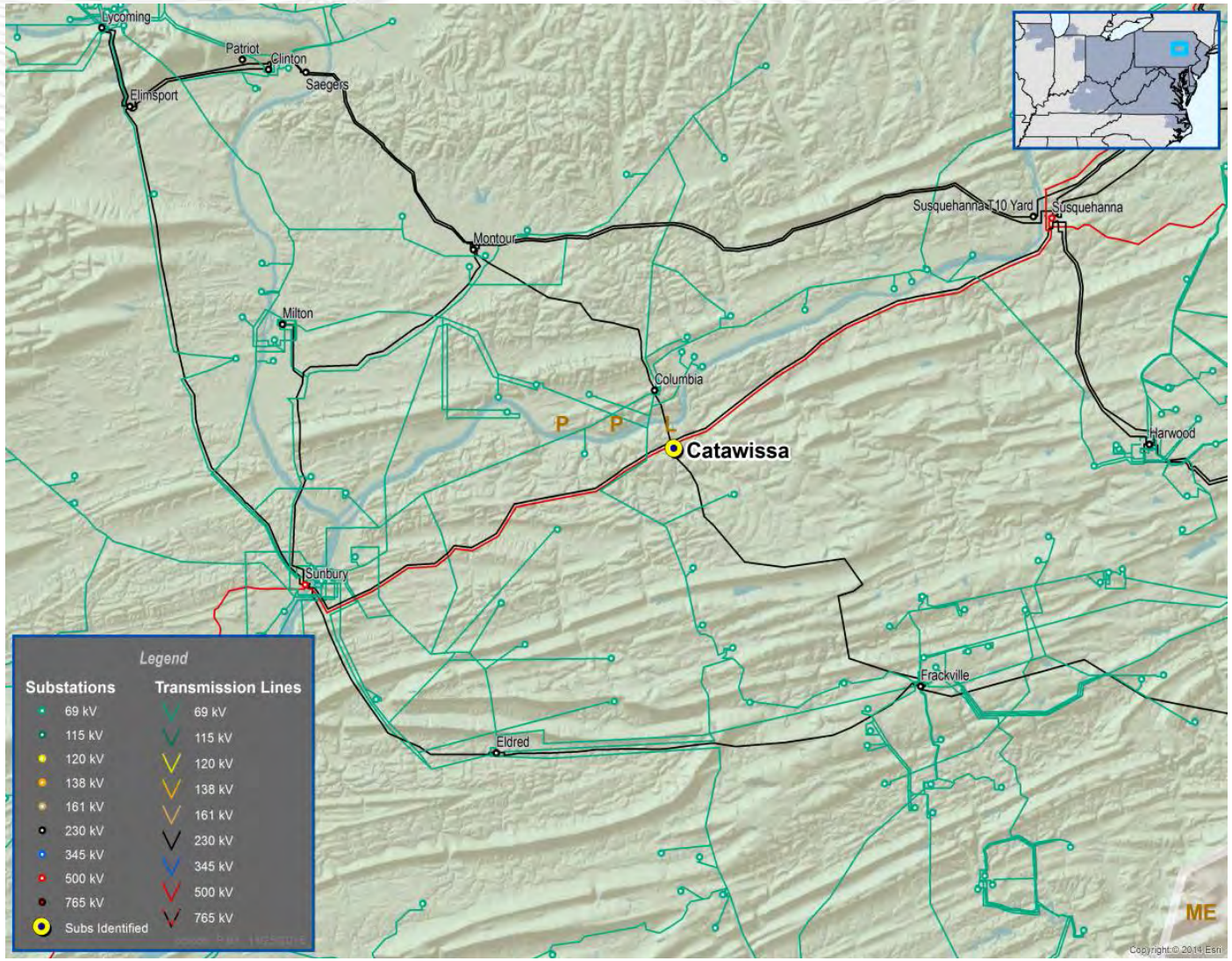


PPL Transmission Zone

- Supplemental Upgrade:
- To improve instability in the Montour area for three phase fault on a double circuit tower.
- Proposed Solution:
  - Build new 500-230 kV Substation and associated transmission work (tap Sunbury - Susquehanna 500 kV and Colombia - Frackville 230 kV). (S1106)
- Estimated Project Cost:

  $ 95 M
- Projected IS Date:

  12/31/2018

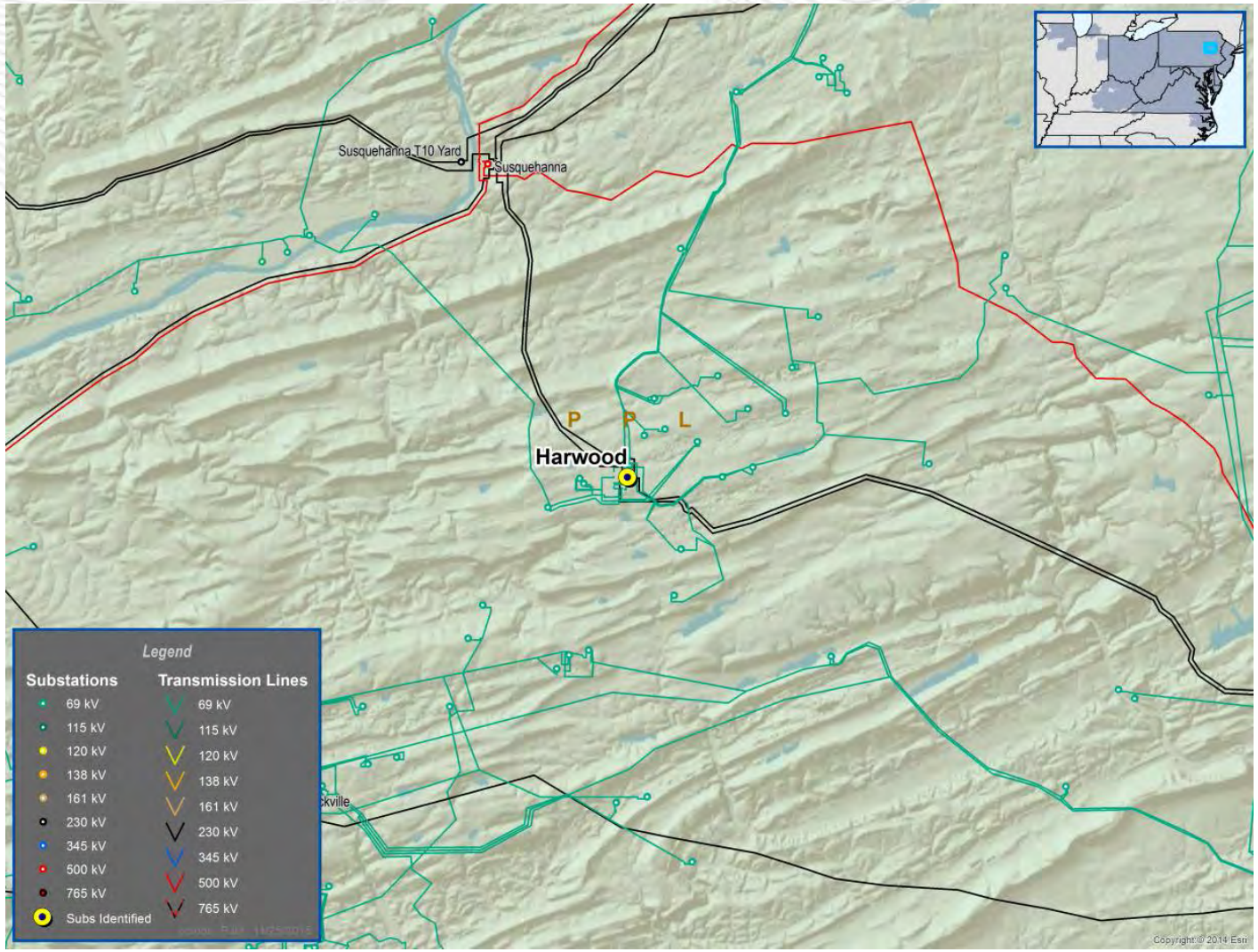


PPL Transmission Zone

- Supplemental Upgrade:
- To improve reliability by upgrading the Harwood station to the current PPL standard design.
- Proposed Solution:
  - Upgrade Harwood 230 kV Substation by building 230 kV yard to current standards and replacing old equipment. (S1107)
- Estimated Project Cost:

  $ 3.6 M
- Projected IS Date:

  12/31/2020



Dominion Local TO Criteria - End Of Life Criteria Update

Dominion End of Life Criteria

Dominion End of Life Criteria decision point metrics:

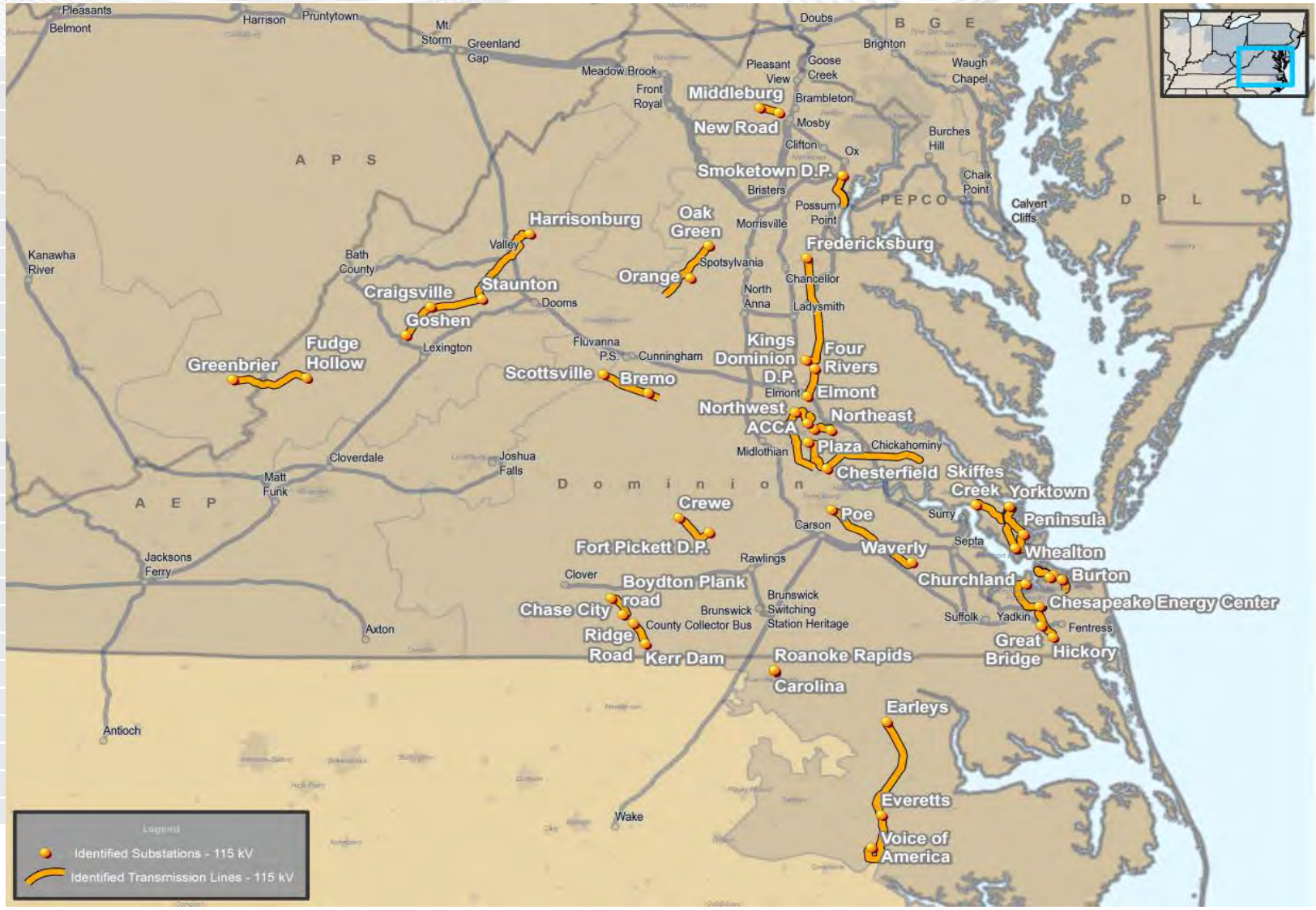
1) Facility is nearing, or has already passed, its end of life, and

2) Continued operation risks negatively impacting reliability of the transmission system.

- Dominion Local TO Criteria
  - End of Life Criteria
    1. End of Life Assessment
       - Industry guidelines indicate equipment life standards
         - Wood structures - 35-55 years,
         - Conductor and connectors - 40-60 years
         - Porcelain insulators - 50 years.
    2. Reliability and System Impact
       - PJM and DOM are analyzing the impacts of the facilities on the next slides

Dominion End Of Life Facilities

Line	Voltage	Length (mi.)
Carolina-Roanoke Rapids Hydro	115	2.76
Acca-Lakeside	115	3.21
Poe-Waverly	115	5.5
Northeast-Carver	115	6.03
Great Bridge-Hickory	115	6.28
Northwest-Acca	115	6.66
Whealton-Peninsula	115	7.51
Portsmouth-Great Bridge	115	8.36
Elmont-Four Rivers	115	8.97
New Road-Middleburg	115	9.75
Kerr Dam-Ridge Road	115	9.88
Yorktown-Peninsula	115	11.12
Chase City-Boydton Plank	115	11.41
Portsmouth-Greenwich	115	11.51
Chesterfield 115-Plaza	115	14.18
Bremo-Scottsville Inter	115	14.46
Portsmouth-Churchland	115	14.61
Earleys-Everetts	115	16.58
Yorktown-Whealton	115	17.44
Staunton - Craigsville (Radial)	115	19.32
Staunton-Craigsville	115	20.62
Goshen-Craigsville	115	21.24
Staunton-Harrisonburg	115	22.78
Str 551-Str 706	115	25.14
Northwest-Chesterfield 115	115	25.33
Chesterfield 115-Lanexa	115	33.27
Fudge Hollow-Greenbrier Inter	138	14.94



Dominion End Of Life Facilities

Line	Voltage	Length (mi.)
280 Marsh Run Ct 1 Remington 11 Va	230	1.24
210 Hayfield 1A Van Dorn 22 Va	230	2.9
2039 Morrisville 1A Marsh Run Ct 22 Va	230	3.92
239 Lakeview 58 Hornertown 90 Nc	230	4.06
216 Lakeside 1B Elmont 41 Va	230	5.74
221 Northwest 1A Elmont 34E Va	230	5.92
201 Brambleton 26A Pleasant View A Va	230	7.97
231 Yadkin 1A Landstown 103L Va	230	8.54
213 Thelma 1A Carolina 70 Nc	230	8.62
295 Loudoun 1A Bull Run 45A Va	230	8.67
2058 Edgecombe Nug 1A Rocky Mount Inter 34A Nc	230	9.34
2049 Chesterfield 230 1A Allied 75A Va	230	9.95
253 Harrisonburg 1A Valley 66 Va	230	10.58
204 Gum Springs 1A Jefferson St 86 Va	230	10.8
211 Chesterfield 230 1B Hopewell 71A Va	230	11.17
272 Dooms 115 1A Grottoes 80 Va	230	11.53
252 Fredericksburg 5397 Possum Point 5589 Va	230	11.85
205 Chesterfield 230 1B Locks 84 Va	230	12.23
259 Basin 1A Chesterfield 230 106A Va	230	12.4
2001 Possum Point 1A Occoquan 76 Va	230	12.61
2002 Carson 1A Poe 106A Va	230	12.68
283 Northeast 1A Elmont 91A Va	230	13.19
2008 Loudoun 1A Dulles 107A Va	230	13.25
262 Greenwich 1B Yadkin 87 Va	230	13.55
265 Clifton 1 Sully 108 Va	230	14.01
2024 Chickahominy 105A Lanexa 190 Va	230	14.26
Lanexa-Waller	230	14.52

Dominion End Of Life Facilities

Line	Voltage	Length (mi.)
289 Suffolk 1B Chuckatuck 92 Va	230	14.62
229 Everetts 1A Edgecombe Nug 372 Nc	230	16.4
285 Waller 362A Yorktown 490 Va	230	19.96
215 Possum Point 1A Hayfield 127 Va	230	21.02
Chesterfield 230-Lakeside	230	21.32
282 Midlothian Mw 1D Spruance Nug 148A Va	230	21.59
237 Possum Point 1A Braddock 147 Va	230	21.99
233 Charlottesville 1A Dooms 115 149 Va	230	22.66
266 Clifton 59 Glen Carlyn 251 Va	230	24.66
269 Fentress 1A - Shawboro	230	25.33
2028 Charlottesville 1A Bremo 186A Va	230	25.54
238 Carson 1A Clubhouse 264 Va	230	28.55
2102 Chickahominy 139A Waller 362B Va	230	28.68
2016 Lanexa 1B Harmony Village 213 Va	230	31.03
2052 Lexington 1 Clifton Forge 197 Va	230	33.42
293 Dooms 115 1A Valley 261 Va	230	33.97
2034 Earleys 1A Trowbridge 281 Nc	230	35.06
2084 Lexington 1A Lowmoor 224 Va	230	37.37
2056 Hornertown 89 Rocky Mount Inter 351 Nc	230	37.63
214 Winchester 1A Surry 200 Va	230	37.64
2012 Roanoke Valley Nug 1 Earleys 269 Nc	230	37.7
226 Surry 1A Churchland 216 Va	230	37.74
224 Northern Neck 1B Lanexa 306 Va	230	41.27
212 Surry 1A Hopewell 240A Va	230	42.97
223 Yadkin 86A Surry 338 Va	230	44.09
246 Suffolk 1C - Earlys	230	49.77
235 Farmville 1A Clover 436 Va	230	55.46

Dominion End Of Life Facilities

Line	Voltage	Length (mi.)
580 Meadowbrook Inter 1 Morrisville 248 Va	500	1.96
561 Clifton 64A Ox 101 Va	500	7.05
545 Bristers 113 Morrisville 159 Va	500	7.9
578 Surry 1A Septa 61 Va	500	11.46
559 Loudoun 1 Clifton 64 Va	500	12.08
573 North Anna 1A Morrisville 182 Va	500	14.02
575 North Anna 1A Ladysmith 79 Va	500	14.53
Valley – Dooms	500	22.56
557 Chickahominy 226A Elmont 359A Va	500	27.73
569 Loudoun 1 - 159 Va	500	31.78
585 Carson 1A - Rodgers Road	500	32.87
579 Septa 1 Fentress 256 Va	500	33.09
Elmont – Ladysmith	500	33.61
547 Bath County 1 Lexington 185 Va	500	34.7
531 Surry 1A Yadkin 255 Va	500	37.27
563 Carson 1A Midlothian 500 209A Va	500	37.41
562 Septa 61 Carson 251A Va	500	38.47
576 North Anna 1A Midlothian 500 209A Va	500	41.13
567 Surry 1A Chickahominy 226A Va	500	44.44
Ladysmith - Bristers	500	46.48
541 Morrisville - Front Royal	500	46.68
568 Possum Point 1A Ladysmith 258 Va	500	47.56
548 Bath County 1 Valley 274 Va	500	51.82
Mt Storm – Valley	500	82.38
570 - Heritage - Wake Intertie (Progress Duke)	500	109

Next Steps

- PJM will continue to assess the reliability impacts due to the End of Life Facilities and evaluate the need for Proposal Windows

End of Life Facilities Summary		
Voltage Level (kV)	# of facilities	Line Length Range (mi.)
115	26	2.76 - 33.27
138	1	14.94
230	54	1.24 - 55.46
500	25	1.96 - 109

RTEP Next Steps

Next Steps - February 2016 PJM Board

- As a result of the 2014/15 Long Term Window and resulting evaluation, PJM anticipates recommending several projects to the PJM board in February 2016
  - RPM Market Efficiency project in the ComEd transmission zone (Loretto – Wilton Center 345 kV uprate)
  - Installation of capacitors at four existing locations (Brambleton, Ashburn, Shelhorn, Liberty)
  - Acceleration of the existing baseline project B1254 – “Hanover Pike 500/230 kV”

RTEP Next Steps

- RPM Planning Parameters
- 2016 RTEP Models
- 2016 RTEP Analysis
  - 2016 RTEP Window #1
- February 2016 PJM Board approval of Market Efficiency Upgrades
  - See the Market Efficiency update posted with today's presentation

Questions?

Email: RTEP@pjm.com

- Revision History
  - Original version posted to PJM.com – 1/5/2016
  - Added slide #36 for a ComEd supplemental Project – 1/6/2016
  - Updates to slide #22 for Will County Unit 4 deactivation -1/7/2016
  - Updates to slide #36 for S1108 cost update and new short circuit capability – 1/7/2016