Reliability Analysis Update

Subregional RTEP Committee

PJM West

April 21, 2017

Additional Scope for Existing Project B2689

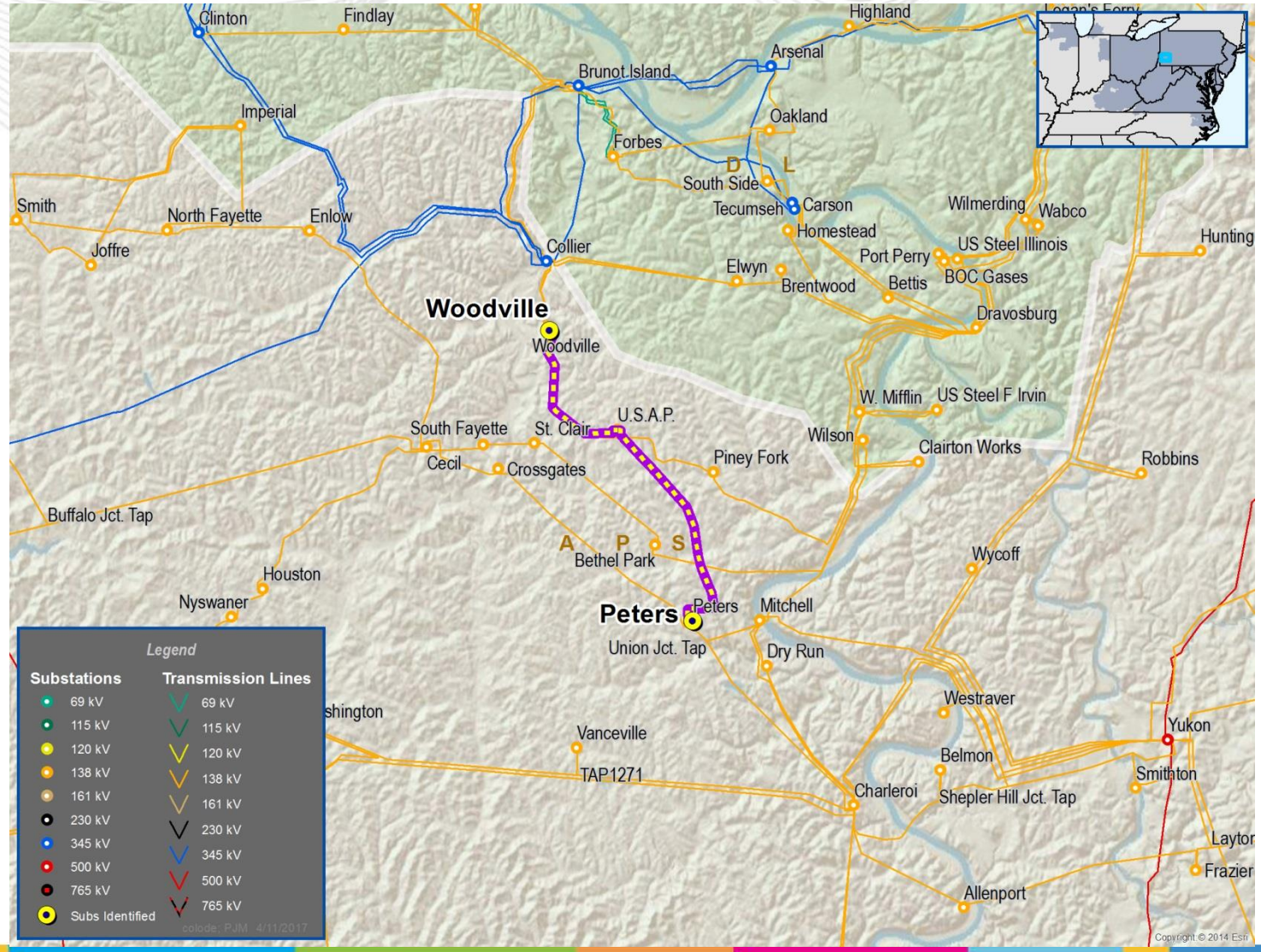
Problem Statement:

Baseline RTEP project b2689.1(Reconductor approximately 7 miles of the Woodville - Peters (Z-117) 138 kV circuit), assigned to Duquesne Light, reconductors the Woodville-Peters 138 kV line. The existing conductor will be upgraded from 795 ACSR to 795 ACSS. The termination point is located at structure 27A, which is owned and maintained by West Penn Power (WPP), FE. In order to accommodate baseline RTEP project b2689.1, FirstEnergy/WPP will need to upgrade associated facilities (i.e. insulators, clamps, jumpers, etc.).

B2689.3: Upgrade terminal equipment owned by FE related to B2689.1

Estimated Project Cost: $0.05M

Required IS date: 6/1/2018



AEP Transmission Owner Criteria Violation

Problem Statement:

The Kaiser Jct – Air Force Jct section (3/0 ACSR, 44 MVA rating) of the Kaiser - Heath 69 kV circuit is overloaded (129%) for the failure of the 138/69 kV transformer at West Hebron and subsequent failure of the 138/69 kV transformer at Newark Center in the 2021 RTEP case. –Newark Ohio, Northeast of Columbus

Potential Alternative Solutions Considered:

- Add a 2nd 138/69 kV transformer at Newark Center 138. Estimated cost: $3M
- Add a 2nd 138/69 kV transformer at West Hebron 138. Estimated cost: $3M
- Add a new 138 kV source to the area. Estimated cost: $7M

Preliminary Solution: Reconductor 0.53 miles (14 spans) of the Kaiser Jct-Air Force Jct Sw section of the Kaiser-Heath 69 kV circuit/line with 336 ACSR to match the rest of the circuit (73 MVA rating, 78% loading).

Estimated Project Cost: $1.096M

Required IS Date: 6/1/2021

Status: Scoping

AEP Transmission Owner Criteria Violation

Problem Statement:

The Speidel-Barnesville 69kV line section (#1 Copper, 31 MVA rating) is overloaded (117% worst loading) for multiple N-1-1 contingency pairs in the 2021 RTEP case. –Belmont County, Ohio

Potential Alternative Solution Considered:

- Rebuild the 69kV line through the city of Barnesville. This would involve tearing down and rebuilding 1 mile of line through town. Ultimately, this would be an overly expensive option, and would face siting and construction challenges. Estimated cost: $2.1M

Preliminary Solution: Install a new 3-way 69kV line switch to provide service to AEP's Barnesville distribution station. Remove a portion of the #1 copper T-Line from the 69kV through-path. The Speidel-Summerfield 69 kV line and future bypass route was previously submitted to and reviewed by PJM as s1158. An additional plan of service is being discussed with AEP Ohio.

Estimated Project Cost: $0.35M

Required IS Date: 6/1/2021

Status: Scoping

AEP Transmission Owner Criteria Violation

Problem Statement:

The Brues-Glendale Heights 69kV line section (3/0 copper, 46 MVA rating) is overloaded (120% worst loading) for multiple N-1-1 contingency pairs, common towerline, and breaker-failure contingencies in the 2021 RTEP case.

The 5-mile long Brues-Glendale line was built in 1917. 81% of the line is still on the original 1917 wood poles. –Boarder of Ohio and West Virginia

Potential Alternative Solution Considered:

- Re-arrange the Brues 138/69kV breaker layout and add a 3rd 138-69kV XFMR. A third line between West Bellaire and Brues would also be required, approximately 5 miles in length through very congested areas with ROW and siting challenges. Estimated cost: $27M

Preliminary Solution: Rebuild the Brues-Glendale Heights 69kV line section (5 miles) with 795 ACSR (128 MVA rating, 43% loading)

Estimated Project Cost: $16.7M

Required IS Date: 6/1/2021

Status: Scoping

AEP Transmission Owner Criteria Violation

Problem Statement:

Voltage drop violation (0.915 pu) at Sarahsville 34.5kV bus for a Caldwell 138/34.5kV transformer fault or bus fault contingencies Caldwell in the 2021 RTEP case.– Noble County, Ohio

Potential Alternative Solution Considered:

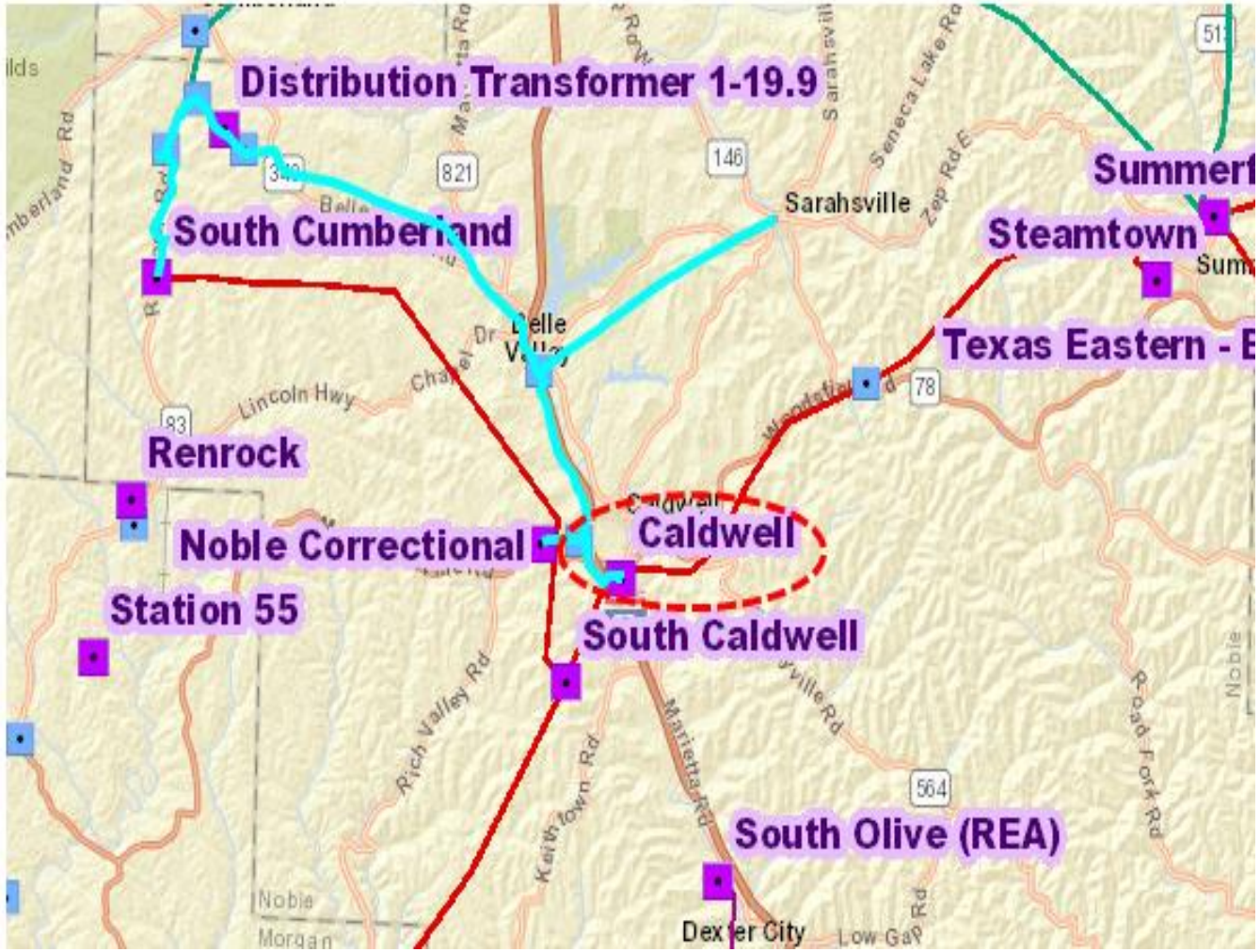
- A fixed tap change of the South Cumberland 138-34.5kV XFMR was considered but did not alleviate the violation. Estimated cost: $0.05M
- Install a second transformer at Caldwell station and rearrange the station breaker layout. Estimated cost: $8M

Preliminary Solution: Install a 3 MVAR, 34.5kV cap bank at Caldwell substation.

Estimated Project Cost: $0.426M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

The West Rockaway Switch – East Tiffin 69kV line (#1 Copper, 31 MVA, 203%), the Greenlawn – East Tiffin 69kV line (2/0 ACSR, 39 MVA, 161%), the Chatfield – New Washington Switch 69kV line (#1 Copper, 31 MVA, 112%), the Howard – Willard 69kV line (3/0 ACSR, 44 MVA rating, 101%), the Broken Sword – Nevada Switch 69kV line (#1 Copper, 31 MVA rating, 117%), and the Upper Sandusky – Nevada Switch 69kV line (#1 Copper, 31 MVA rating, 124%) are overloaded for a Chatfield 138-69 kV XFMR fault or similar bus fault contingencies near Chatfield and for multiple N-1-1 contingency pairs in the 2021 RTEP case. Voltage drop (9.6%) and voltage magnitude violation (0.916 pu) at West Shelby, Hinesville and other surrounding 69KV buses for multiple contingencies are also seen in the 2021 RTEP case.

The East Tiffin-Howard 69 kV path was originally constructed in 1918 with wood pole structures utilizing #1 Copper conductor. There are 285 open conditions on the 57-mile long line associated with structure, hardware, and shielding. There has also been increased IPP activity in this area, resulting in increased power flows on lines. –Richland County, Ohio

Potential Alternative Solution Considered:

- Install a new capacitor bank at West Shelby and cut the Howard-Willard line into West Shelby station. West Shelby station is not easily expandable and would require rebuilding in the clear. Rebuild & upgrade Upper Sandusky-Broken Sword and East Tiffin-Greenlawn 69kV line sections to address N-1-1 violation. Install a new transformer at Howard or Chatfield station. This option does not address the rehabilitation needs on the East Tiffin-Howard line. Estimated cost: $40M
- Install a new 138/69kV station near Hinesville station or add a new 138/69 kV transformer at Howard station. Rebuild Saint Stephens Switch – Hinesville. This option does not address all of the rehabilitation needs on the East Tiffin-Howard line Estimated cost: $30M

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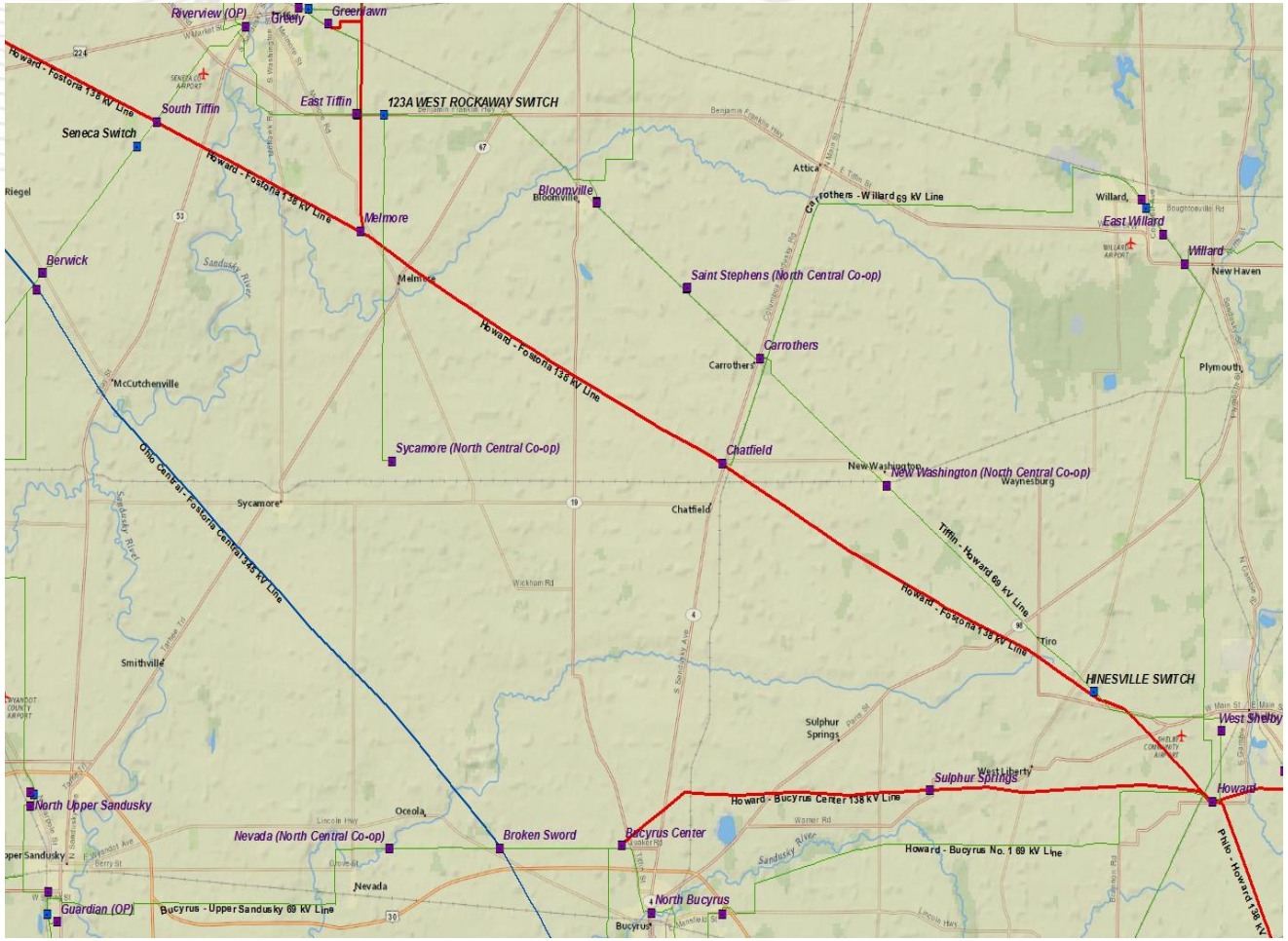

AEP Transmission Owner Criteria Violation and Supplemental Project

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Preliminary Solution:

Rebuild portions of the East Tiffin-Howard 69kV line from East Tiffin to West Rockaway Switch (0.8 miles) using 795 ACSR Drake conductor (129 MVA rating, 50% loading)-and from St. Stephen's Switch to Hinesville (14.7 miles) using 795 ACSR Drake conductor (90 MVA rating, non-conductor limited, 38% loading). Install a new 138/69kV 90 MVA transformer with 138kV & 69kV protection at Chatfield station. Install new 138kV & 69kV protection at existing Chatfield transformer. (Baseline)

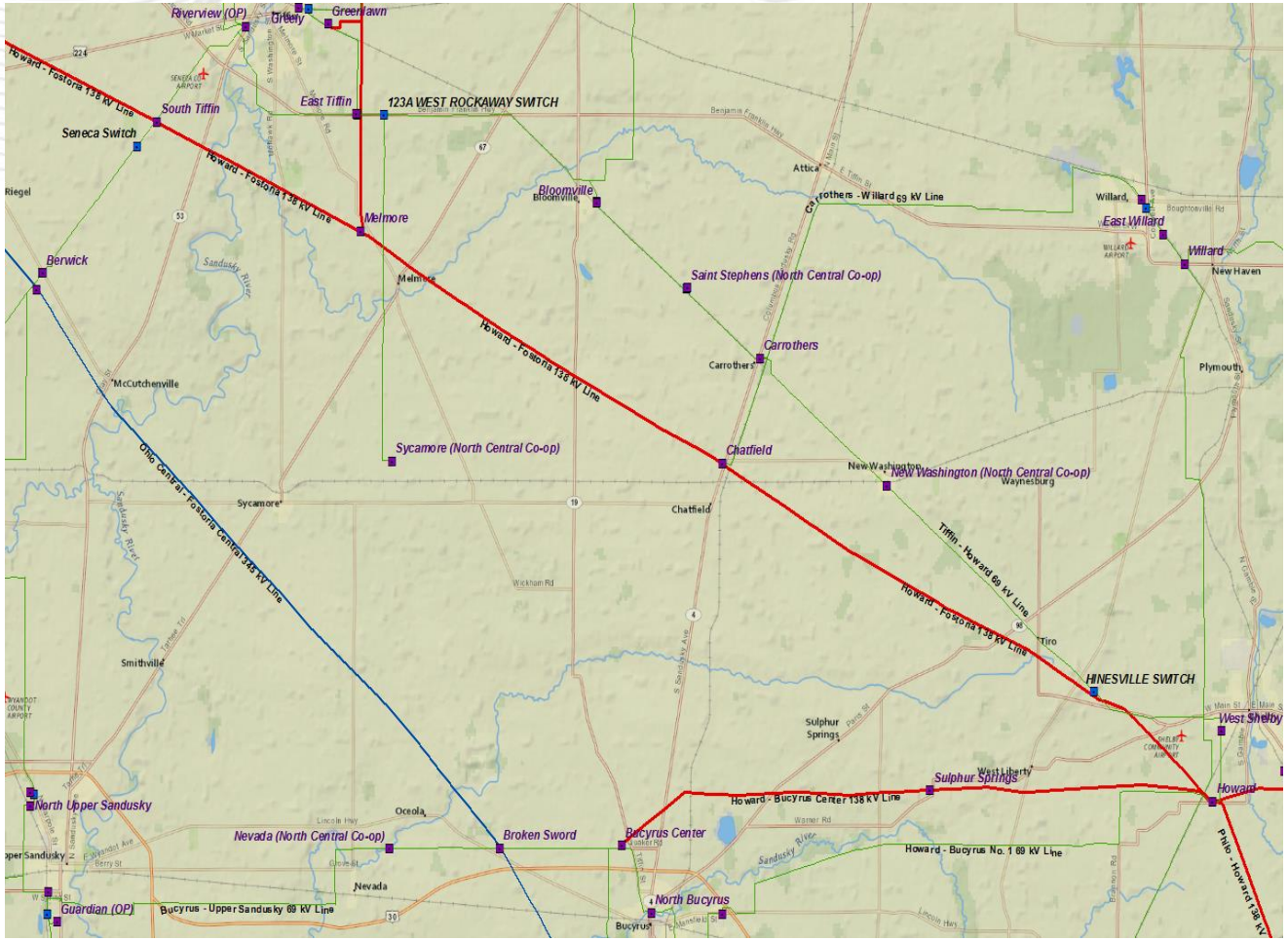
Estimated Project Cost: $20.386M

Rebuild 69kV line from West Rockaway Switch-St. Stephen's Switch (10.6 miles) using 795 ACSR Drake conductor. Rebuild Hinesville-Howard (6.1 miles) using 795 ACSR Drake conductor. New 138kV circuit switcher at existing South Tiffin transformer. Replace -69kV CB's A & B at Chatfield with 40 kA units. (Supplemental)

Estimated Project Cost: $21.751M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Owner Criteria Violation

Problem Statement:

The Elliott 138/69 kV transformer (89 MVA rating) and the Elliott – Ohio University 69 kV line (336 ACSR, 73 MVA rating) are overloaded (108% and 104% respectively) for the loss of the Poston – Strouds Run – Crooksville 138kV Line. The Clark Street – Strouds Run 69 kV line (336 ACSR, 73 MVA rating) is overloaded (107%) for the loss of the Dexter – Elliot – Poston 138kV line in the 2021 RTEP case. –Athens, Ohio

Potential Alternative Solution Considered:

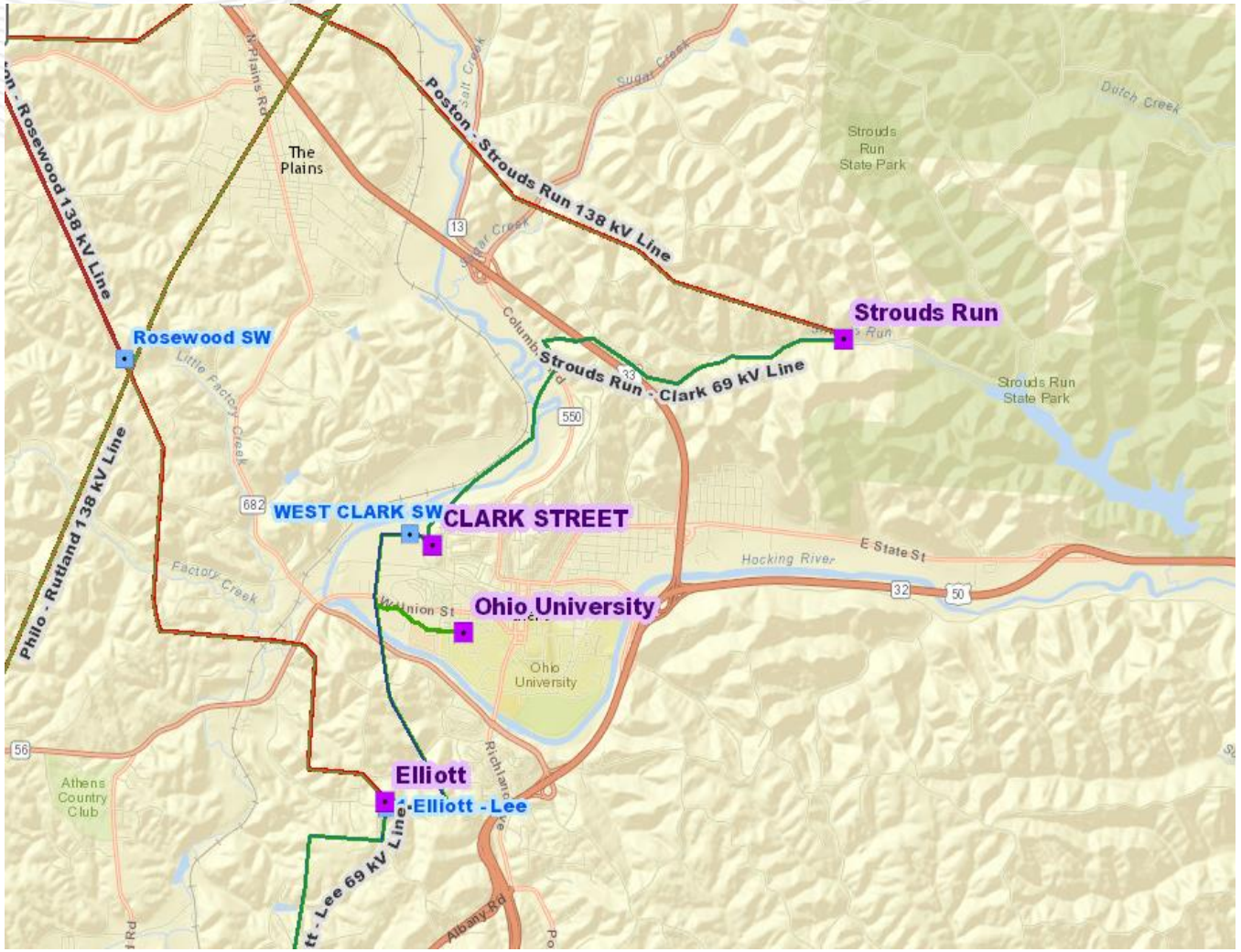
- Build a parallel line for Clark Street – Strouds Run line. Cost prohibitive and ROW would be hard to get in this area due to terrain and the line passing through park areas. Estimated cost: $10M.
- Construct a new switching station at Rosewood and install a 138/69 kV transformer. Construct a new 69 kV line to Clark Street station. While this alleviates the overloads, siting and new line construction through this area is prohibitive. Estimated cost: $20M

Preliminary Solution: Replace the Elliott transformer with a 130 MVA unit, Reconductor 0.42 miles of the Elliott – Ohio University 69 kV line with 556 ACSR to match the rest of the line conductor (102 MVA rating, 73% loading) and rebuild 4 miles of the Clark Street – Strouds Run 69 kV with 556 ACSR conductor (102 MVA rating, 76% loading).

Estimated Project Cost: $5.76M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Owner Criteria Violation

Problem Statement:

The Fremont Center – Riverview 69 kV circuit is overloaded (118%) for the loss of the Fremont Center 138/69 kV transformer #1 and the Fremont 138/69 kV transformer #1 in the 2021 RTEP case. – Fremont, Ohio.

Potential Alternative Solution Considered:

- Greenfield switching station connecting to First Energy's Flat Rock -Clyde 69 kV line to connect to Republic with an approximately 8.10 mile line. Estimated cost: $11M
- Install a new 138/69 kV station connecting to First Energy's Fremont Center – Fremont 138 kV line. Install a 69 kV line of approximately 1.6 miles to connect between Birchard Avenue Switch - Fremont Center section of the Fremont – Fremont Center #1 69 kV circuit. Estimated cost: $15M
- Install a second 138/69 kV transformer at Fremont station. Estimated cost: $5M

Preliminary Solution: Energize the spare Fremont Center 138/69 kV 130 MVA transformer #3. Reduces overloaded facilities to 46% loading.

Estimated Project Cost: $0.081M

Required IS Date: 6/1/2021

Status: Scoping

AEP Transmission Owner Criteria Violation

Problem Statement:

Low Voltage (0.883 pu) and voltage drop (17% worst drop) violations at South Upper Sandusky, Harpster, Ridgedale, South Morral, Meeker, and Decliff 69kV buses for the outage of the Upper Sandusky 69kV bus in the 2021 RTEP case.

The Harpster area has had over 670,000 customer minutes of interruptions over the past three years, including 360,000 minutes on the Harpster-Decliff line. –Marion, Ohio

Potential Alternative Solution Considered:

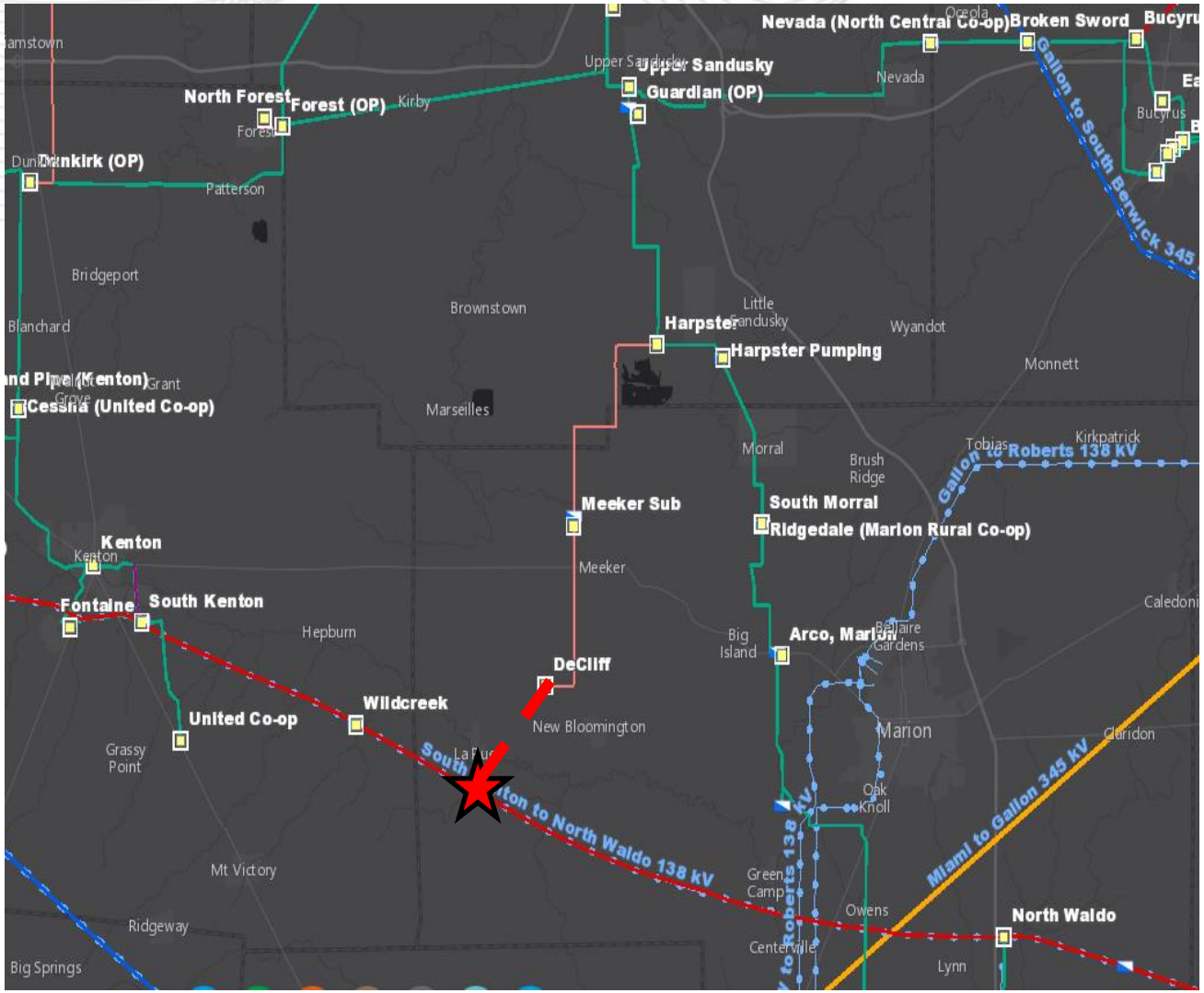
- Convert Upper Sandusky 69kV to a 69kV ring bus. Create a new Upper Sandusky-South Upper Sandusky circuit. Rebuild Upper Sandusky-South Upper Sandusky Switch as double circuit. Install CB's at South Upper Sandusky. This option still requires a new 138 kV source in the area for violations caused by loss of the Harpster-South Upper Sandusky 69 kV line. Estimated cost: $20M
- Construct new 138/69kV station tapping nearby First Energy Galion-Roberts 138kV lines and feeding into the existing 69kV lines approximately 6 miles away at South Morral station. This can solve the violations but does not address the historical reliability issues on the 34.5kV radial. Estimated cost: $14M
- Construct 138/69kV station between Wildcreek and North Waldo, construct a new 69 kV line to Decliff, and convert existing 34.5kV to 69kV, removing transformer at Harpster station. Requires additional station conversions to 69 kV, including a co-op delivery point. Estimated cost: $15M

Preliminary Solution: Construct new 138/69/34kV station and 1-34kV circuit (designed for 69kV) from new station to Decliff station, approximately 4 miles, with 556 ACSR conductor (51 MVA rating).

Estimated Project Cost: $12.65M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Owner Criteria Violation

Problem Statement:

Low Voltage (0.916 pu) and voltage drop (10.7% worst drop) violations at Stillwell, Glenmont, and Killbuck 34.5kV buses for the outage of the South Millersburg 34.5kV bus in the 2021 RTEP case. – Holmes County, Ohio

Potential Alternative Solution Considered:

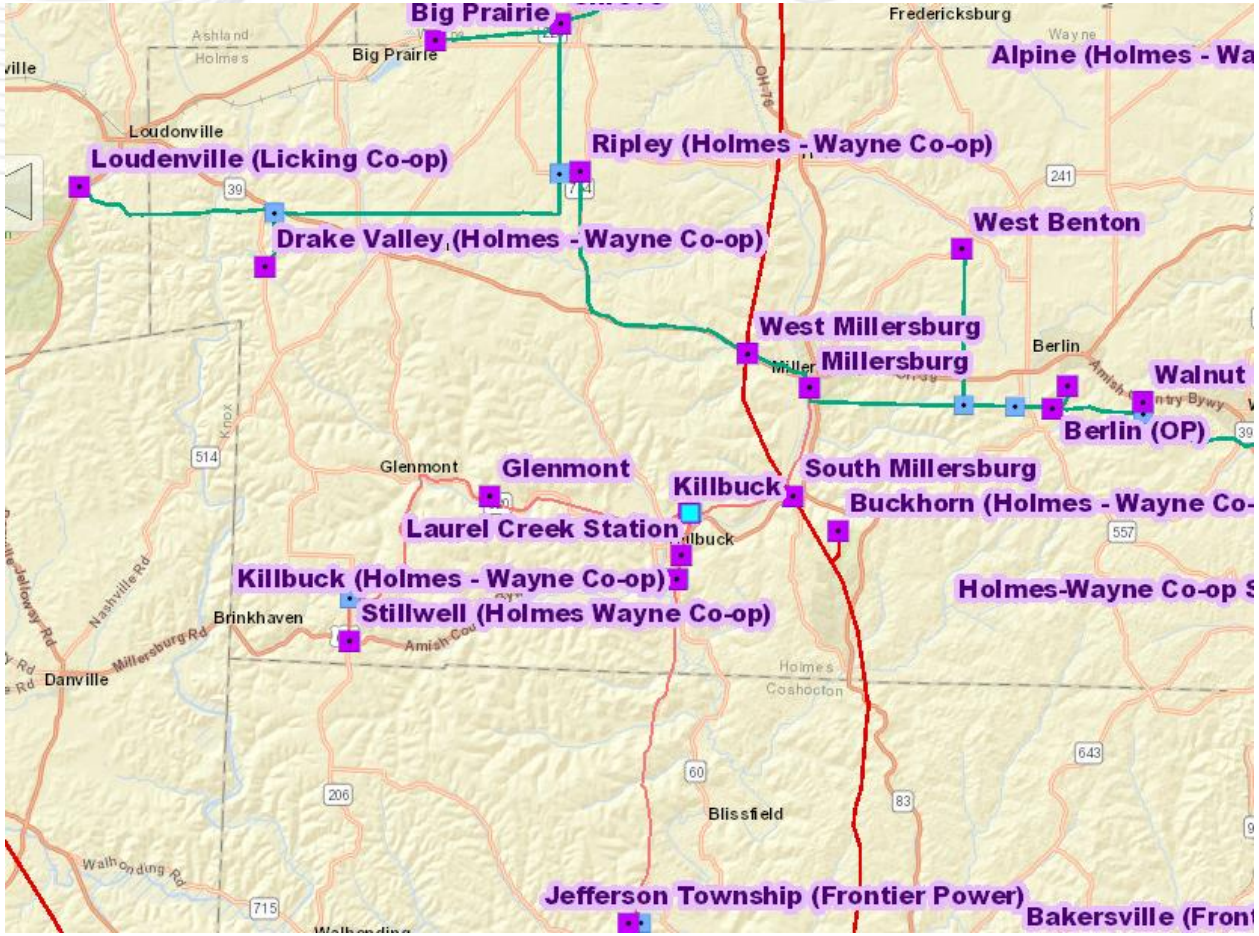
- Construct a 34.5 kV line from Stillwell to Jefferson Township stations (~11 miles). Estimated cost: $20M

Preliminary Solution: Install a 34.5 kV 4.8 MVAR capacitor bank at Killbuck 34.5kV station.(B2795)

Estimated Project Cost: $0.482M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Owner Criteria Violation

Problem Statement:

The Malvern - Oneida Switch 69kV line section (4/0 Copper, 54 MVA rating) is overloaded (128% worst loading) for multiple N-1 and N-1-1 contingencies in the 2021 RTEP case. – Carroll County, Ohio

Potential Alternative Solution Considered:

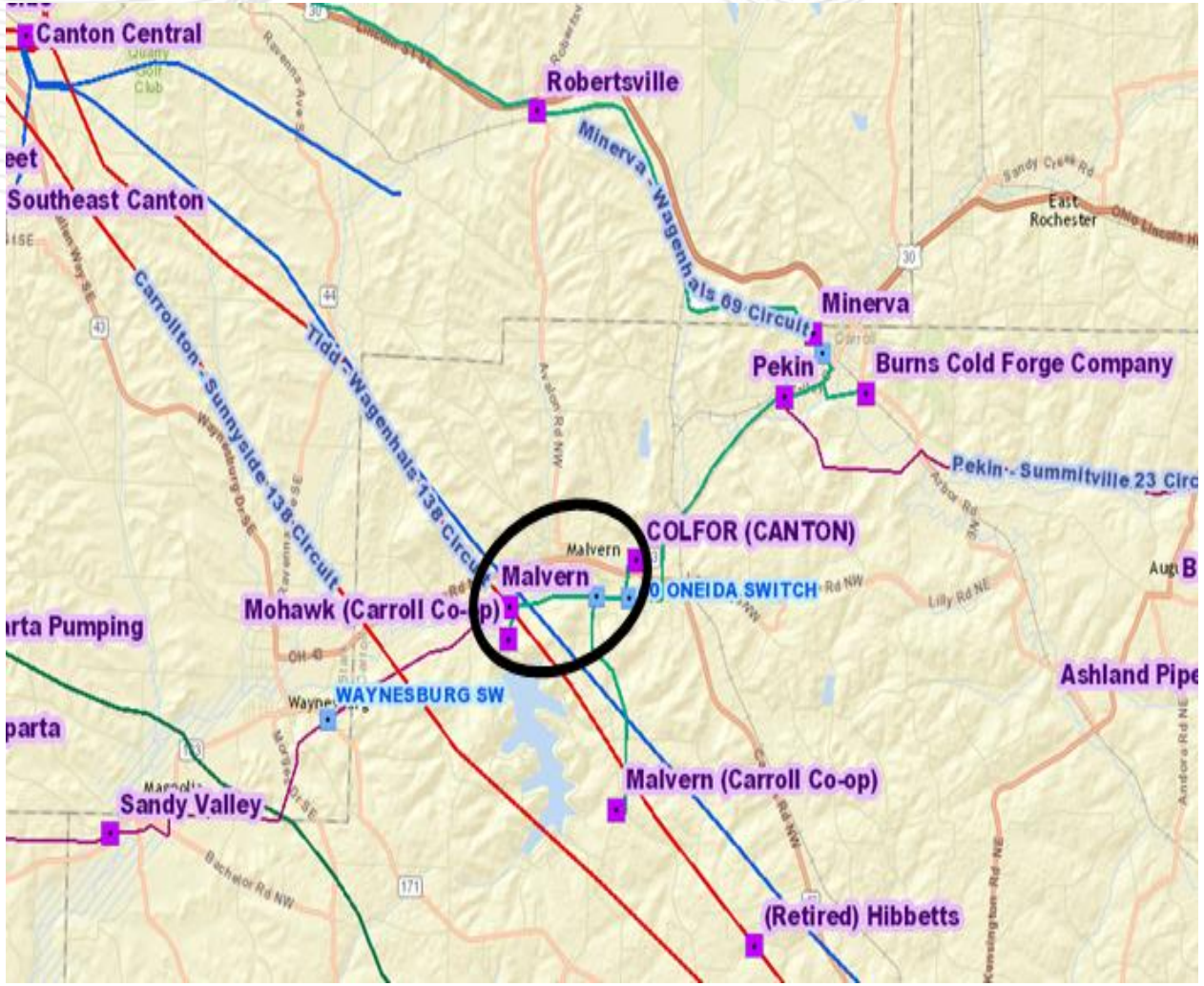
- A new 138-69kV interconnection station with FirstEnergy's Knox-Nottingham 138kV circuit. However, this would be a more expensive project for both utilities, and has a lesser impact on system overloads (only left 3 MVA of margin). Estimated cost: $12M
- A new 138-69kV interconnection with FirstEnergy's Sammis-Hagan 138kV or Toronto-Congress 138kV circuits. However, this would be a more expensive project for both utilities, and has a lesser impact on system overloads (only left 11 MVA of margin). Estimated cost: $12M

Preliminary Solution: Rebuild the Malvern-Oneida Switch 69kV line section with 795 ACSR (1.8 miles, 125 MVA rating, 55% loading). (B2796)

Estimated Project Cost: $4.1M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Zone

AEP Transmission Owner Criteria Violation

Problem Statement:

The Ohio Central - Conesville 69kV line section (4/0 Copper and 336 ACSR, 54 MVA rating) and the Ohio Central 138/69 kV transformer (50 MVA rating) are overloaded (135% worst loading) for multiple N-1 and N-1-1 contingencies in the 2021 RTEP case.
– Coshocton County, Ohio

Potential Alternative Solution Considered:

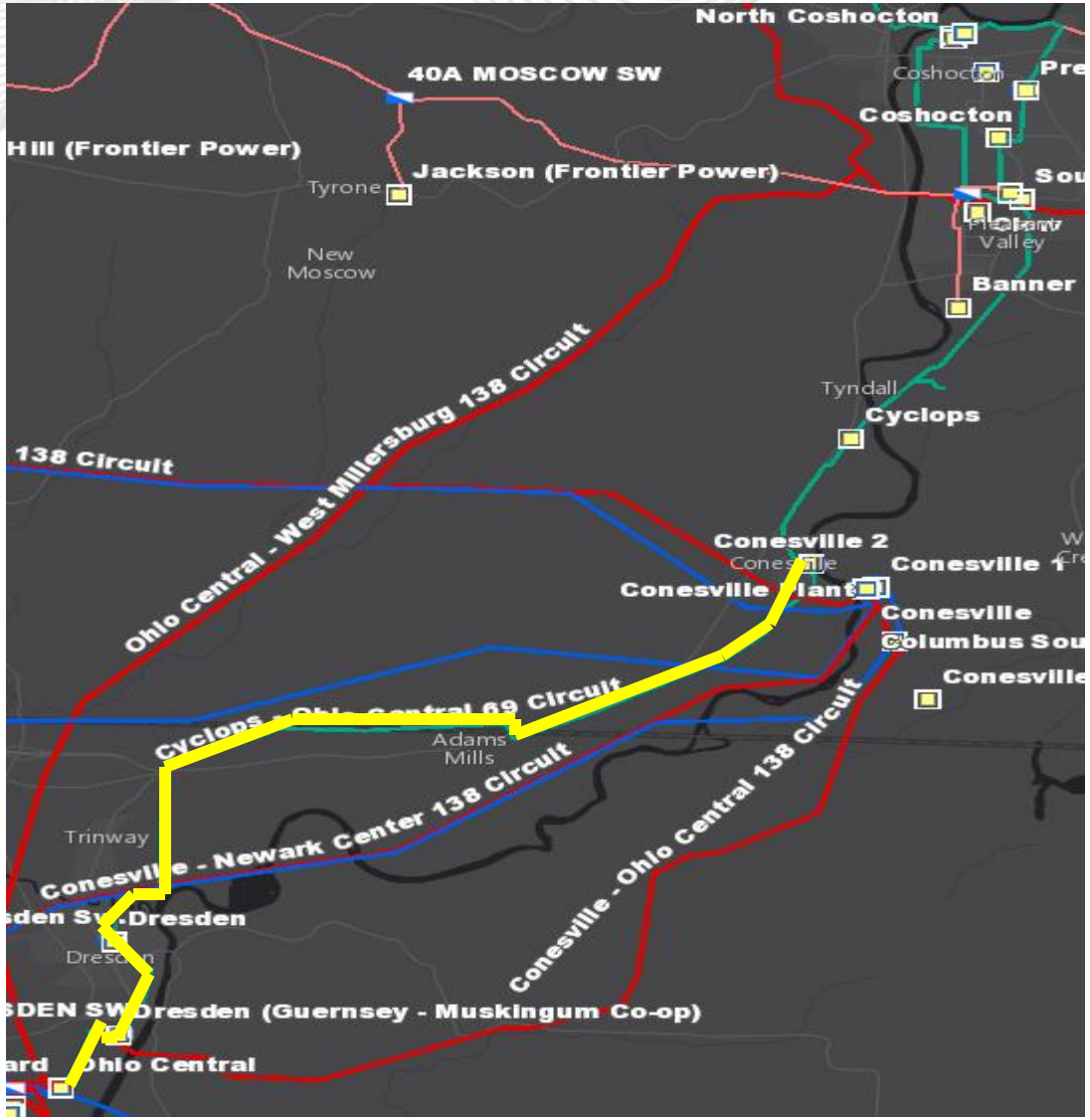
- Mitigate some of the contingencies involved, by adding XFMR high-side breakers, line breakers, etc., to limit the extent of facilities outaged by a fault. Construct a new 5-mile 138 kV line between Conesville and South Coshocton. Estimated cost: $25M
- A new 138-69kV substation south of Conesville ("Adams Street") connecting AEP's Conesville-Centerburg 138kV circuit to the Ohio Central-Cyclops 69kV circuit, and injecting a 90 MVA transformer source. However, the new 138-69kV source just shifts the overload further north, requiring 9.5 miles of additional 69 kV rebuilds north of Conesville 69 kV station to North Coshocton station. Estimated cost: $30M

Preliminary Solution: Rebuild the Ohio Central-Conesville 69kV line section (11.8 miles) with 795 ACSR conductor (128 MVA rating, 57% loading). Replace the 50 MVA Ohio Central 138-69kV XFMR with a 90 MVA unit.

Estimated Project Cost: $20.6M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Owner Criteria Violation

Problem Statement:

Low voltage violation (0.905 pu) at West Hicksville station for loss of the South Hicksville 69 kV bus in the 2021 RTEP case. –Hicksville, Ohio

Potential Alternative Solution Considered:

- Build a new 138/69kV station cut into South Hicksville-Grabill 69kV circuit. Estimated cost: $12M
- Convert the South Hicksville 69kV bus to ring bus configuration. Estimated cost: $7M

Preliminary Solution: Install a 14.4 MVAr capacitor bank at West Hicksville station. Replace ground switch/MOAB at West Hicksville with a circuit switcher

Estimated Project Cost: $1.3 M

Required IS Date: 6/1/2021

Status: Scoping

AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

Low voltage violations at 19 different stations (0.70 pu voltage and 33% worst drop) were identified, along with thermal violations on the Hartford – Almena (336 ACSR conductor, 73 MVA rating, 141% worst loading), Riverside – South Haven (4/0 Copper conductor, 54 MVA, 142%), and Valley – Almena (556 AAC conductor, 90 MVA, 111%) 69kV lines. Additionally, Valley 138/69 kV transformer 1 (93 MVA, 117%), Riverside 138/69 kV transformer 5 (71 MVA, 111%), and Hartford 138/69 kV transformer 1 (120 MVA, 102%) overload for multiple N-1-1 type contingencies involving the 138/69 kV sources and lines in the area in the 2021 RTEP case.

The Riverside-South Haven 69 kV line was constructed in the 1960s on wood poles with 4/0 Copper conductor (54 MVA rating). This line has experienced over 6,000,000 customer minutes of interruption over the past three years. There are 57 open A conditions along this 24 mile long line, mostly related to rotten wood poles and cross-arms, burnt insulators, and missing ground lead wire. Transmission Operations cannot sectionalize this line without momentarily dropping all customers currently served from this line. AEP's MOAB installation criteria calculations justify the installation of a MOAB at Vector Switch.

The Almena-Hartford 69 kV line was also constructed in the 1960s with 336 ACSR conductor (73 MVA rating). There are 21 open A conditions on this 16 mile long line and has had 34 momentary and 4 permanent outages over the past three years.

The Almena-Valley 69 kV line was built in 1971 with 556 AAC conductor (99 MVA rating). It has 18 open A conditions along the 11 mile long line.

The existing 69kV bus tie CB A at South Haven station is a 1200 A 20 kA GE, FK-type oil filled breaker that was manufactured in 1966. This breaker has a total 265 fault operations, exceeding the manufacturer limit of 10. The current configuration at South Haven station combines more than 3 elements into one protection zone. The existing bus tie protection scheme exposes all three transformers to line faults and increases the probability of relay misoperations. This has been a concern to the customers in the City of South Haven because this is the only transmission source in the area.

At Hickory Creek station, 138 kV breakers L, A and J are 1200 A 20 kA oil filled breakers and 34.5 kV breakers H, G, C, and F are 1200 A 15 kA oil filled breakers. 138 kV circuit breaker B is a 2000 A 40 kA air insulated breaker. During winter conditions, breaker B is at a higher risk of failure than a typical oil filled breaker due to the lack of a dryer system associated with the air system and the loss of heating source. There have been several instances in the past where this breaker has frozen, putting the system at risk of a breaker failure. Additionally, air breakers tend to fail violently and their porcelain bushings disperse particles into the surrounding area, which is a safety concern. Breaker J has had 47 fault operations. Breaker A has had 57 fault operations. Breaker H has had 28 fault operations. Breaker G has had 22 fault operations. Breaker F has had 85 fault operations. All these exceed the manufacturer recommendation of 10. These breakers all have some combination of the following documented conditions: age, bushing damage, number of fault operations, a lack of available repair parts, and PCB contamination. Additionally, 138/34.5 kV 30 MVA transformers 1 and 3 are showing significant signs of deterioration. Drivers for replacement include dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), and accessory damage (bushings).

At Main Street station, 138 kV 1200 A 20 kA breaker A and 34.5 kV 1200 A 22 kA breakers B, C, D, and E are all oil filled breakers. Breaker A has had 59 fault operations. Breaker B has had 20 fault operations. Breaker C has had 58 fault operations. Breaker D has had 15 fault operations. Breaker E has had 17 fault operations. All exceed the manufacturer recommendation of 10. These breakers all have some combination of the following documented conditions: age, bushing damage, number of fault operations, and PCB contamination. Additionally, 138/34.5 kV 30 MVA transformer 3 is showing significant signs of deterioration. Drivers for replacement include dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), and accessory damage (bushings).

At Riverside station, 69 kV 1200 A 20 kA breaker L and 138 kV 800 A 15 kA breaker R are oil filled breakers manufactured in 1965 and 1947. Breaker L has had 126 fault operations, exceeding the manufacturer recommendation of 10. These breaker have the following documented conditions: age, number of fault operations, a lack of available repair parts, and PCB content. Additionally, 138/69/34.5 kV 50 MVA Transformer #5 is beginning to show signs of deterioration. Drivers for replacement include dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), accessory damage (bushings), and high temperature (winding thermal condition). Transformer #5 also has high levels of dissolved Ethylene and Carbon Dioxide in the oil.

At Hartford station, 69 kV breakers G and H are 1200 A 20 kA oil filled breakers manufactured in 1965 and 1966. Breaker G has had 207 fault operations. Breaker H has had 199 fault operations. Both exceed the manufacturer recommended limit of 10. These breakers have the following documented conditions: age, bushing damage, number of fault operations, and PCB content. Additionally, 138/69/34.5 kV 115 MVA Transformer #1 is showing signs of deterioration. Drivers for replacement include dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), and accessory damage (bushings).

In general, oil breakers have become more difficult to maintain due to the required oil handling. Oil spills occur often during routine maintenance and failures, which can become an environmental concern.

–Kalamazoo, MI

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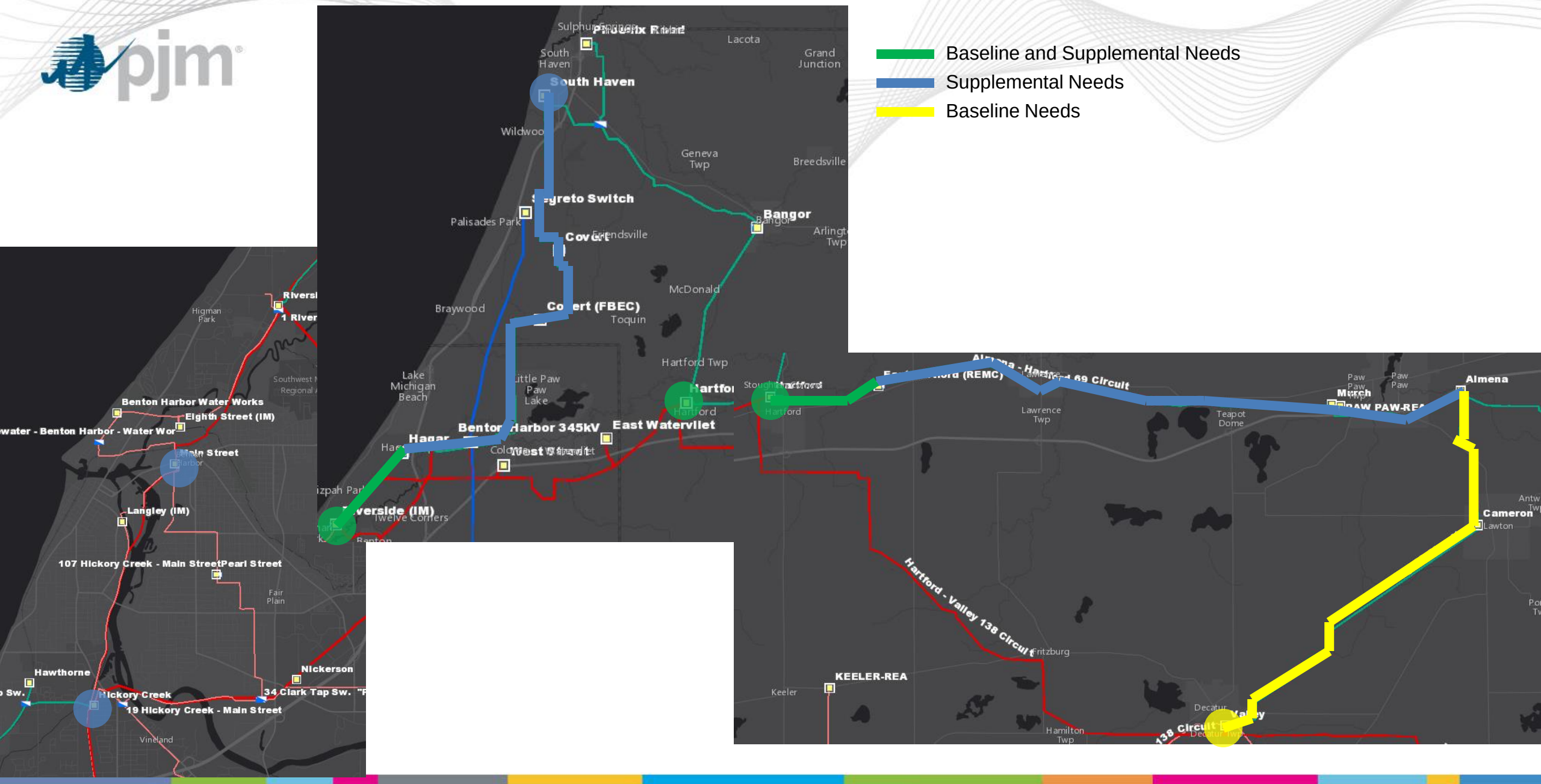
Baseline and Supplemental Needs
Supplemental Needs
Baseline Needs
South Haven
Wildwood
Geneva Twp
Breedsville
Palisades Park
Bangor
Covert
Friendsville
McDonald
Braywood
Covert (FBEC)
Toquin
Hartford Twp
Lake Michigan Beach
Little Paw Paw Lake
Hartford
Hagar
Benton Harbor 345kV
East Watervliet
West Watervliet
Riverside (IM)
Twelve Corners
Benton Harbor Water Works
Eighth Street (IM)
Main Street
Langley (IM)
107 Hickory Creek - Main Street
Pearl Street
Fair Plain
Hawthorne
Hickory Creek
19 Hickory Creek - Main Street
Nickerson
34 Clark Tap Sw.
Vineland
Lawrence Twp
Teapot Dome
Almena
Cameron
Lawton
Hartford - Valley 138 Circuit
Fritzburg
KEELER-REA
Keeler
Hamilton Twp
Decatur

AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Supplemental Project

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Potential Alternative Solution Considered:

- Construct new 10 mile 138 kV line between Valley and Murch stations. Rebuild Murch as a 138/69 kV station on a new location due to site constraints at the existing station site. Add 138 kV line exit and breaker at Valley towards Murch. Establish 138/69 kV source at Benton Harbor station. Rebuild 18 miles of the Benton Harbor – South Haven 69 kV line as double circuit. Rebuild 4 miles of the Murch-Almena 69 kV line. Estimated cost: $70M

Preliminary Solution:

Rebuild 12 miles of Valley – Almena 69kV line as a double circuit 138kV/69kV line using 795 ACSR conductor (360 MVA rating) to introduce a new 138 kV source into the 69 kV load pocket around Almena station. Rebuild 3.2 miles of Almena to Hartford 69kV line using 795 ACSR conductor (90 MVA rating). Rebuild 3.8 miles of Riverside – South Haven 69V line using 795 ACSR conductor (90 MVA rating). At Valley station, add new 138kV line exit with a 3000 A 40 kA breaker for the new 138 kV line to Almena and replace CB D with a 3000 A 40 kA breaker. At Almena station, install a 90MVA 138kV/69kV transformer with low side 3000 A 40 kA breaker and establish a new 138kV line exit towards Valley. At Hartford station, install a second 90MVA 138/69kV transformer with a circuit switcher and 3000 A 40 kA low side breaker. (Baseline)

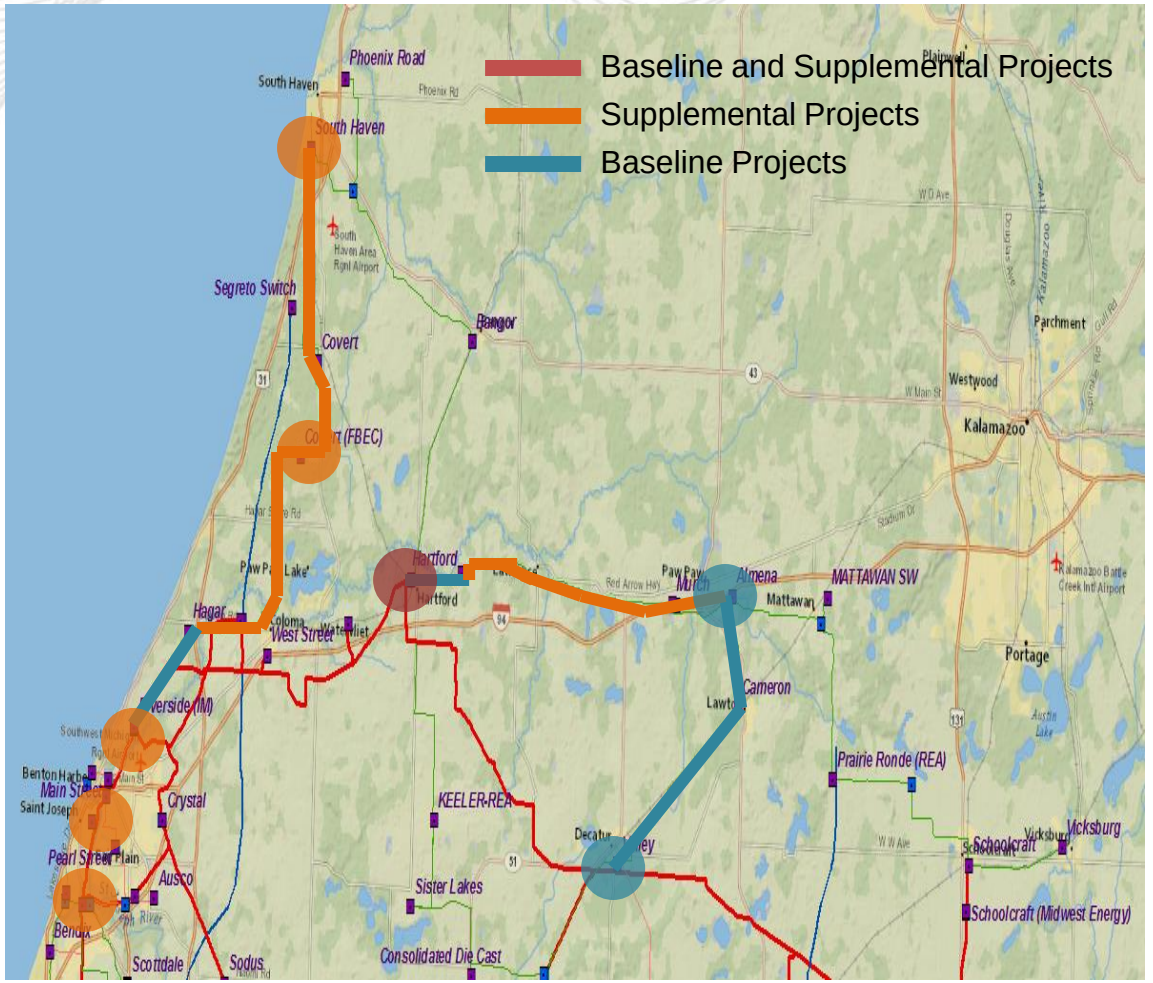
Estimated Baseline Project Cost: $53.0 M

Rebuild remaining 13.8 miles of Almena to Hartford 69kV line using 795 ACSR conductor (90 MVA rating). Rebuild remaining 21.2 miles of Riverside – South Haven 69V line using 795 ACSR conductor (90 MVA rating). At Hartford station, replace transformer 138/69kV 1 with a 90 MVA unit and replace 69kV CB H and G with 3000 A 40 kA breakers. At Riverside station, replace Transformer 5 with a new 90MVA 138/69kV transformer, replace 69 kV CB L and 138 kV CB R with 3000 A 40 kA breakers. At Main Street station, rebuild the entire station on existing property at the site and install a 90 MVA transformer with 3000 A 40 kA breakers. At Hickory Creek station, rebuild the 34.5 kV yard, replace the 138kV CBs with 3000 A 40 kA breakers, replace the existing 138/34.5 kV transformers #1 and #3 with a single 138/69/34.5 kV 90 MVA bank and move the distribution feeds from 34.5 kV to 138 kV service. At South Haven station, retire bus tie CB A and install two new 69kV 3000 A 40 kA breakers towards Riverside and Hartford remote end stations. At the Covert FBEC hard tap location, install a new phase-over-phase switch (Vector Switch) with load splitting capability. (Supplemental)

Estimated Supplemental Project Cost: $143.0 M

Required IS Date: 6/1/2021

Status: Scoping



AEP Transmission Owner Criteria Violation

Problem Statement:

The Cannonsburg – South Neal 69 kV line section (336 ACSR, 75 MVA rating, 100%) overloads for loss of Bellefonte 69 kV bus #2 or loss of Bellefonte – Hoods Creek 69 kV in the 2021 RTEP case. – Ashland, KY

Potential Alternative Solutions Considered:

- Reconfigure the 69 kV bus at Bellefonte to eliminate the contingency causing the overload. However, due to space limitations, aging infrastructure concerns, and outage constraints, the 69 kV yard would likely need to be rebuilt in the clear. After taking into account the feasibility of finding a viable location to build in the clear and a conceptual look at all of the line work entailed (8 lines terminate on the 69kV bus at Bellefonte), it was determined that this would not be a cost effective alternative. Estimated cost: $20M

Preliminary Solution:

Rebuild approximately 4.77 miles of the Cannonsburg – South Neal 69 kV line section utilizing 795 ACSR conductor (90 MVA rating, 83%) .

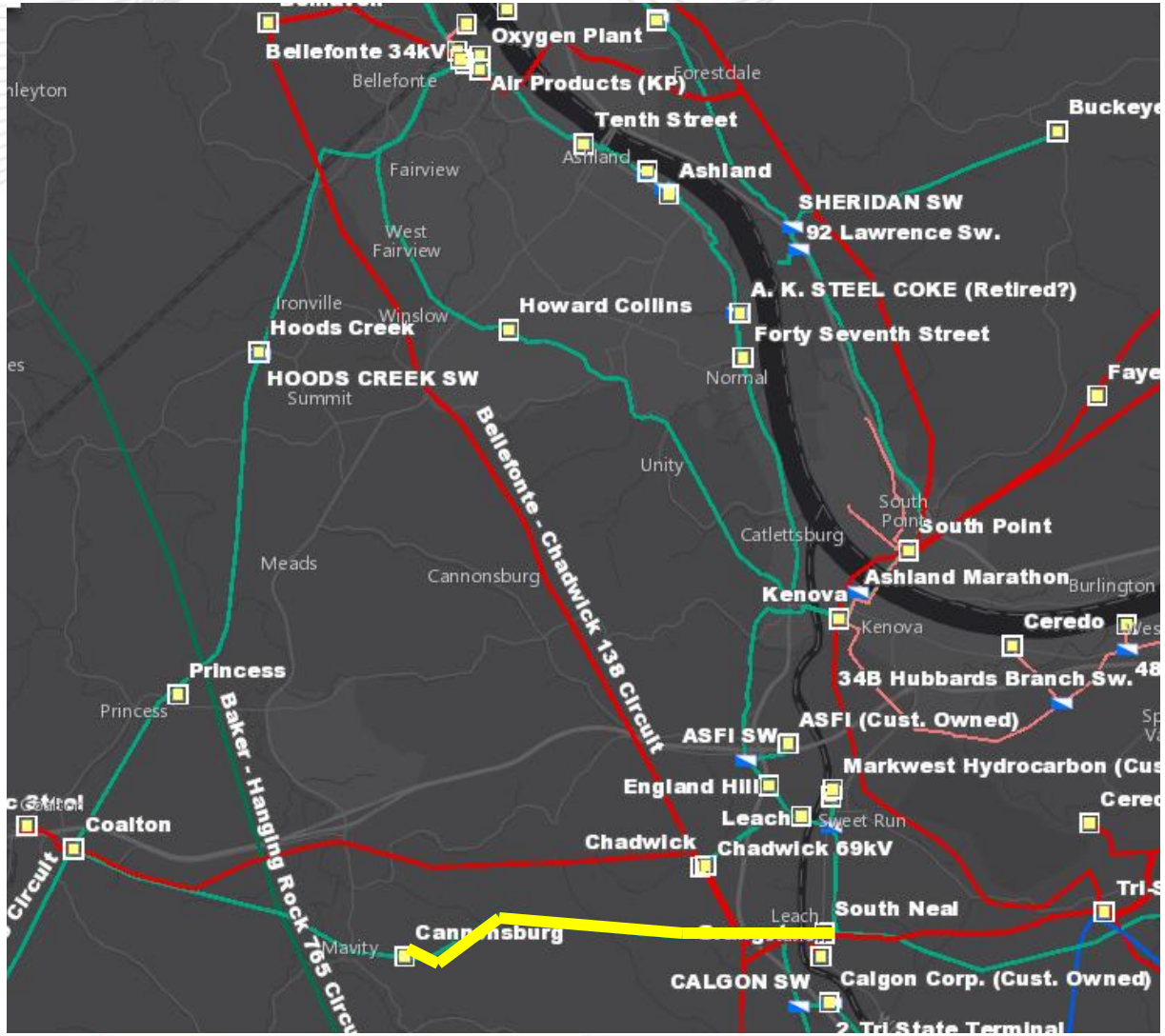
Additional Benefit:

In addition to the planning criteria violation, this rebuild will address three open category A conditions on the Cannonsburg – South Neal line section. These conditions include damaged equipment and cross arm.

Estimated Project Cost: $12.5M

Required IS Date: 6/1/2021
Projected IS Date: 12/1/2018

Status: Scoping



AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

The Dunnhollow – London 69 kV line (3/0 Copper, 31 MVA rating, 103%) overloads for loss of Kanawha River 138 kV Bus #1 or multiple breaker failure contingencies at Kanawha River in the 2021 RTEP case.

In addition to the planning criteria violation, the Carbondale – London 46kV line is a poor performing circuit in the APCo region. From 2013-2016, this circuit has experienced 9 permanent outages and 1,721,181 customer minutes of interruption. Approximately 2.4 miles of this circuit utilizes structures from 1915. There are currently 65 category A open conditions along the 5.9 mile long line. These open conditions include damaged/rotted poles and damaged guy wires, shield wire, conductor, insulator and cross arms. -- Charleston, WV

Potential Alternative Solutions Considered:

- Reconfigure the 138kV bus arrangement at Kanawha River station into a breaker and a half to resolve the thermal violation caused by various stuck breaker/bus outages at Kanawha station. Due to space and outage constraints, it would need to be rebuilt in the clear. Rebuilding the station would leave aging infrastructure and small conductor concerns unresolved on the Carbondale - London 46kV line that drives the supplemental portion of the project. Estimated cost: $31M

Preliminary Solution:

Rebuild ~1.7 miles of the Dunn Hollow – London 46kV line section utilizing 795 26/7 ACSR conductor (58 MVA rating, non-conductor limited, 55%). (Baseline)

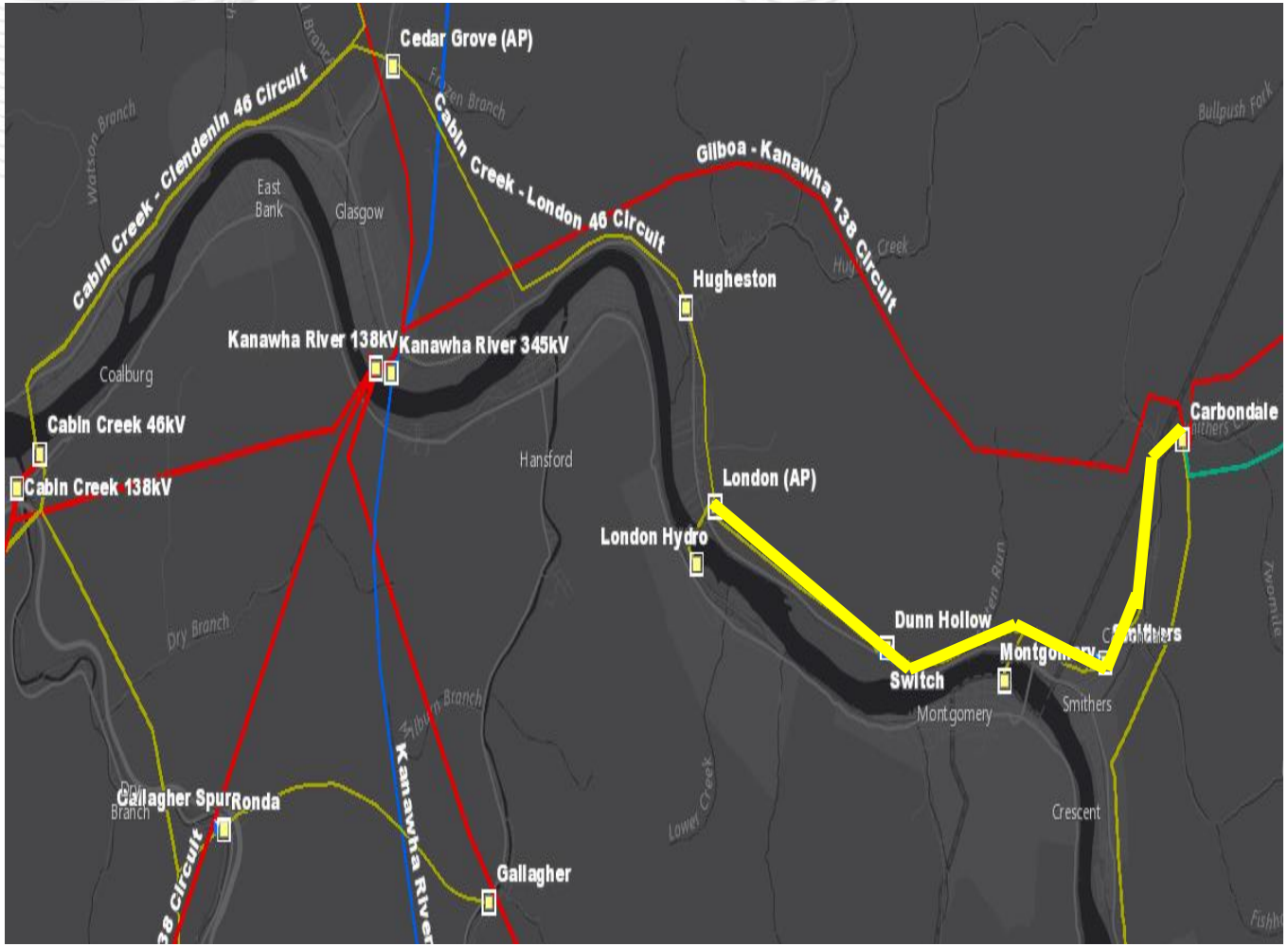
Estimated Project Cost: $4.5M

Rebuild ~3.5 miles of the Carbondale – Dunn Hollow 46kV line section with 795 ACSR conductor. This section of line is currently comprised of a mix of 2/0, 3/0, and 4/0 Copper conductor. The line portion to Montgomery station is of newer construction with larger conductor . (Supplemental)

Retire the Smithers Switch structure. Smithers load will be served out of Carbondale station via a new transformer. Replace existing Dunn Hollow Switching Structure with new 3-way phase over phase Structure. (Supplemental)

Estimated Project Cost: $9.4M

Required IS Date: 6/1/2021
Projected IS Date: 12/1/2018
Project Status: Engineering



AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

The Reusens – Peakland Switch 69 kV line (4/0 Copper, 54 MVA rating, 106%) overloads for loss of the Peaksview 69 kV bus in the 2021 RTEP case.

The Dearington – Reusens 69kV is a poor performing circuit in the APCo region. From 2013 – 2016, the circuit has experienced 12 permanent outages with 1,469,505 customer minutes of interruption. Approximately 75% of the structures of this circuit are 1925 vintage. There are currently 60 category A open conditions along the 5.2 mile long line. These conditions include damaged pole/crossarm/shield wire and conductor. – Lynchburg, VA

Potential Alternative Solutions Considered:

- Construct a new 138kV line from East Lynchburg to Peaksview (~3 miles) to create a second 138 kV source into Peaksview. Install 6 138kV CBs, 2 69kV CBs and 138/69kV 130MVA XFR at Peaksview Station. Reconfigure East Lynchburg Station to accommodate new line to Peaksview and install 2 138kV CBs. While this alternate would address the planning criteria violations, the equipment needs in the area would not be addressed. Estimated cost: $21.5M
- Reconfigure the bus at Peaksview into a ring bus to eliminate the contingency causing the overloads. Outages on this bus are difficult to obtain and the station would need to be built in the clear in order to maintain service to the 69 kV system. While this alternate would address the planning criteria violations, the equipment needs in the area would not be addressed. Estimated cost: $15M

Preliminary Solution:

Rebuild the Reusens - Peakland Switch 69 kV line (approximately 0.8 miles) utilizing 795 ACSR conductor (86 MVA rating, non-conductor limited, 67%).(Baseline)

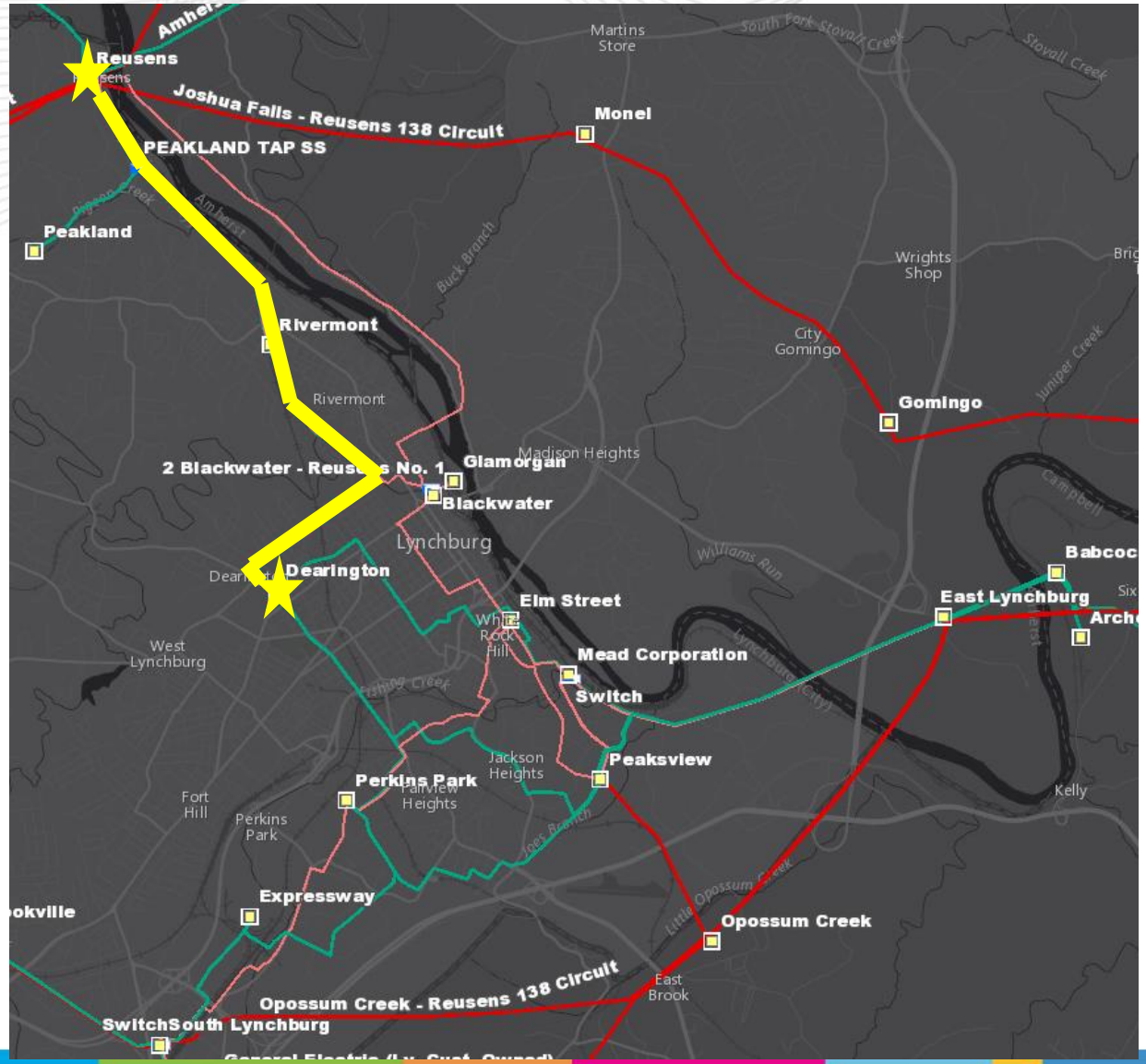
Replace existing Peakland S.S. with new 3 way switch phase over phase structure.(Baseline)

Estimated Project Cost: $2.9M

Rebuild Peakland – Dearington 69 kV circuit (approximately 4.4 miles) utilizing 795 26/7 ACSR conductor. A portion of this line shares a common tower with the Dearington – Blackwater 34.5 kV circuit. This line is currently comprised of 4/0 Copper, 1/0 Copper and 336 ACSR conductor.(Supplemental)

Estimated Project Cost: $12.7M

Required IS Date: 6/1/2021
Projected IS Date: 12/1/2018
Status: Scoping



AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

The Craneco – Pardee – Three Forks – Skin Fork 46kV line (3/0 Copper, 37 MVA rating, 126%) overloads due to N-1-1 outage of the Huff Creek 138/69/46 kV and Chauncey 138/46 kV transformers in the 2021 RTEP case.

The Becco – Skin Fork circuit is a poor performer in the APCO region. From 2013-2016, the Becco – Skin Fork circuit has experienced 15 permanent outages, resulting in 8,031,079 customer minutes of interruption. Approximately 11.5 miles of the line utilizes 1955 wood structures. There are 78 open category A conditions along the 18 mile long line. These include damaged poles and crossarms, conductor/shield wires, and guy anchor/knee/vee braces. –Logan, WV

Potential Alternative Solutions Considered:

- Reconfigure Huff Creek Station and install 6 138kV CBs and a second 138/69kV 90 MVA transformer. Install a second 138/69kV transformer at Sundial Station with 2 69kV breakers and 2 Circuit Switchers. There are concerns about acquiring additional land and a significant amount of grading would be need in order to perform the work at Sundial. This alternate would address the baseline criteria violations but would not address the equipment concerns on the system. Estimated Cost: $16M

Preliminary Solution:

Rebuild the Craneco – Pardee – Three Forks – Skin Fork 46kV line section (approximately 7.2 miles) utilizing 795 26/7 ACSR conductor (108 MVA rating, 43%). (Baseline)

Estimated Cost: $12.2M

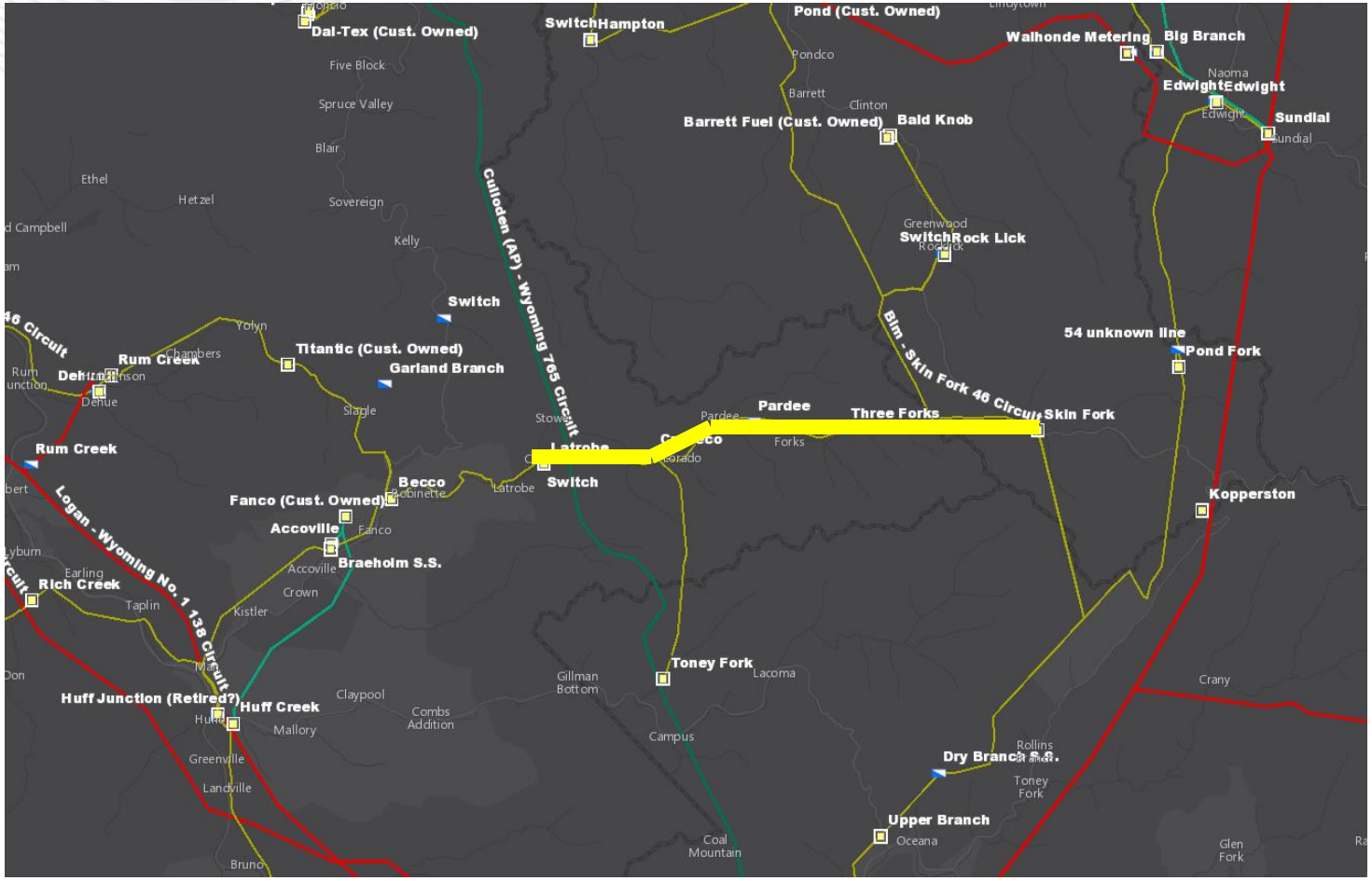
Rebuild Latrobe – Craneco 46kV line section (approximately 2.3 miles) utilizing 795 26/7 ACSR conductor. The existing conductor on this line is 3/0 Copper. (Supplemental)

Estimated Cost: $4M

Required IS date: 6/1/2021

Projected IS date: 4/1/2018

Status: Engineering



AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

Numerous thermal and voltage deviation violations on the Kingsport 34.5 kV sub-transmission system for various N-1 and N-1-1 outages were identified in the 2021 RTEP case. –Kingsport, TN

Potential Alternative Solutions Considered:

- Rebuild and replace the overloaded 34.5 kV facilities and associated transformers. This alternative would not be cost effective in comparison to the Nagel transformer addition. Estimated cost: $30M

Preliminary Solution:

Install a second transformer at Nagel station, comprised of 3 single phase 250MVA 500/138kV transformers. Presently, TVA operates their end of the Boone Dam – Holston 138 kV interconnection as normally open preemptively for the loss of the existing Nagel 500/138 kV XF. By adding a second 500/138 kV transformer at Nagel, TVA will close in the interconnection, providing an additional source to the Kingsport area. (Baseline)

Estimated Cost: $13M

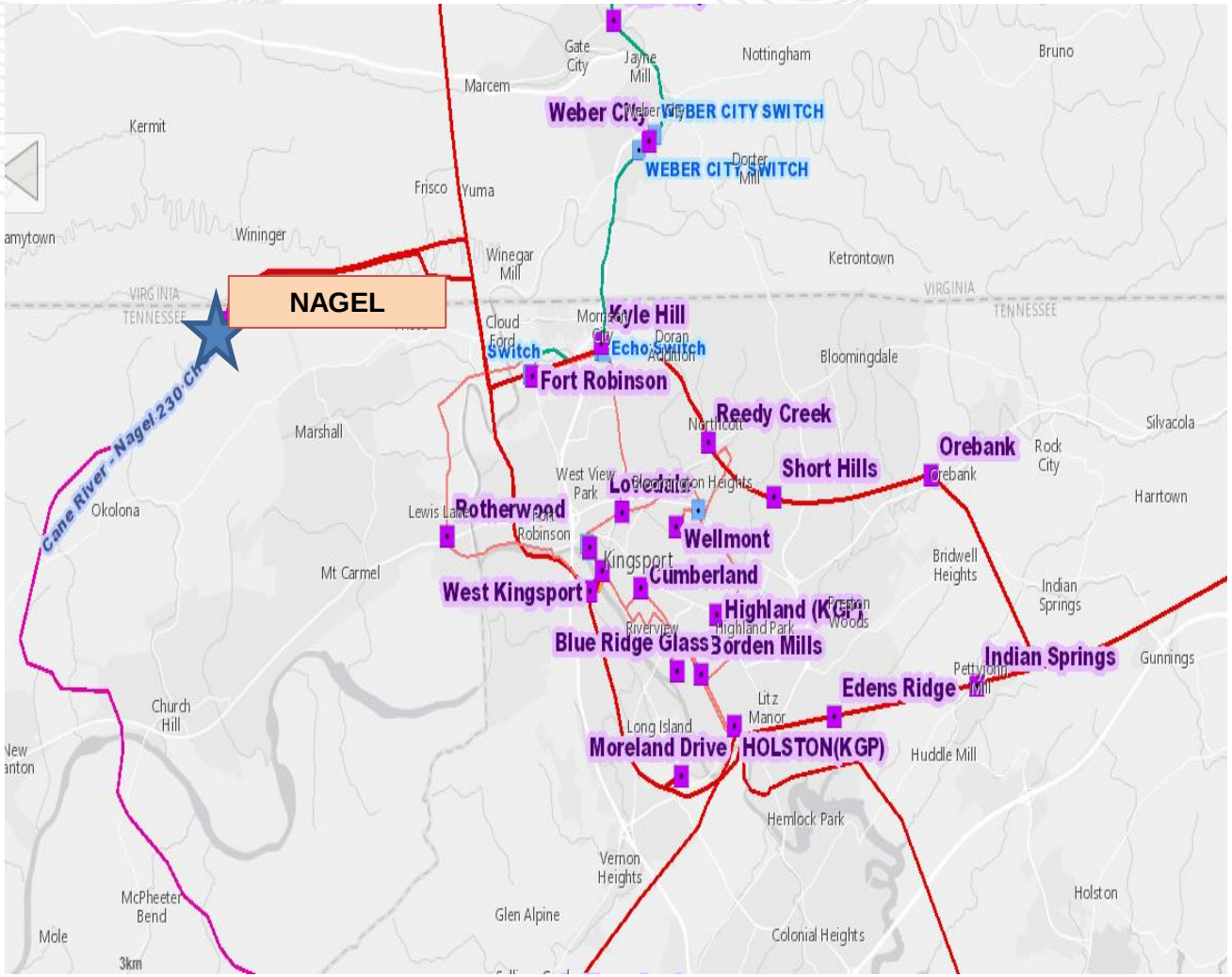
Purchase single phase 250MVA 500/138kV bank to be a shared spare for Nagel Station existing transformer 3 and for the proposed transformer.(Supplemental)

Estimated Cost: $2.8M

Required IS date: 6/1/2021

Projected IS date: 12/1/2019

Status: Scoping



AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

The City of Jackson has requested a new 69kV delivery point (Ironman Switch) capable of carrying their entire load, which will be ~37 MW due to a 4 MW load increase by the City. This new delivery point will be redundant with the existing 138kV delivery point out of Lick Station.

After the customer load is connected and is at the full capacity, there is an N-1 violation that drops the voltage at the customer bus to ~65% and thermally overloads the Lick-Ross 69kV Circuit to 130%. To solve this violation, a new 138/69kV station will be established (Rhodes Station), injecting a 3rd source onto the Lick-Ross 69kV circuit. Following the solution, no N-1 or N-1-1 violations appear.

The new City of Jackson delivery point is directly adjacent to the existing Berlin-Lick-Ross 69kV circuit. Of the 37+ miles of conductor on the circuit, 88% (32.96 miles) is original from the 1926 line construction – mostly 4/0 ACSR Penguin (50 MVA rating). Of the 275 structures, 98% (269) are wood and 43% (119) are older than 1960. There are 241 open conditions on the line, including issues with conductor, structures, and ROW encroachments. The line has been responsible for 1.4M CMI from 2013-2015, including over 12.5k customer interruptions. It is recommended that this circuit be rebuilt to 138kV standards in anticipation of a future 138kV conversion to become an additional 138kV path to support Ross Station as there is only one 138 kV source that currently feeds Ross station from the South.

Issues at every switch structure on this circuit (Coalton Sw, Pine Ridge Sw, Vigo, and Ginger) complicates any planned outages as momentary outages are required at all three stations in order to isolate a circuit section. AEP's MPOI calculation justifies the installation of breakers at Heppner station, which will replace Coalton switch. –City of Jackson, Jackson County, OH

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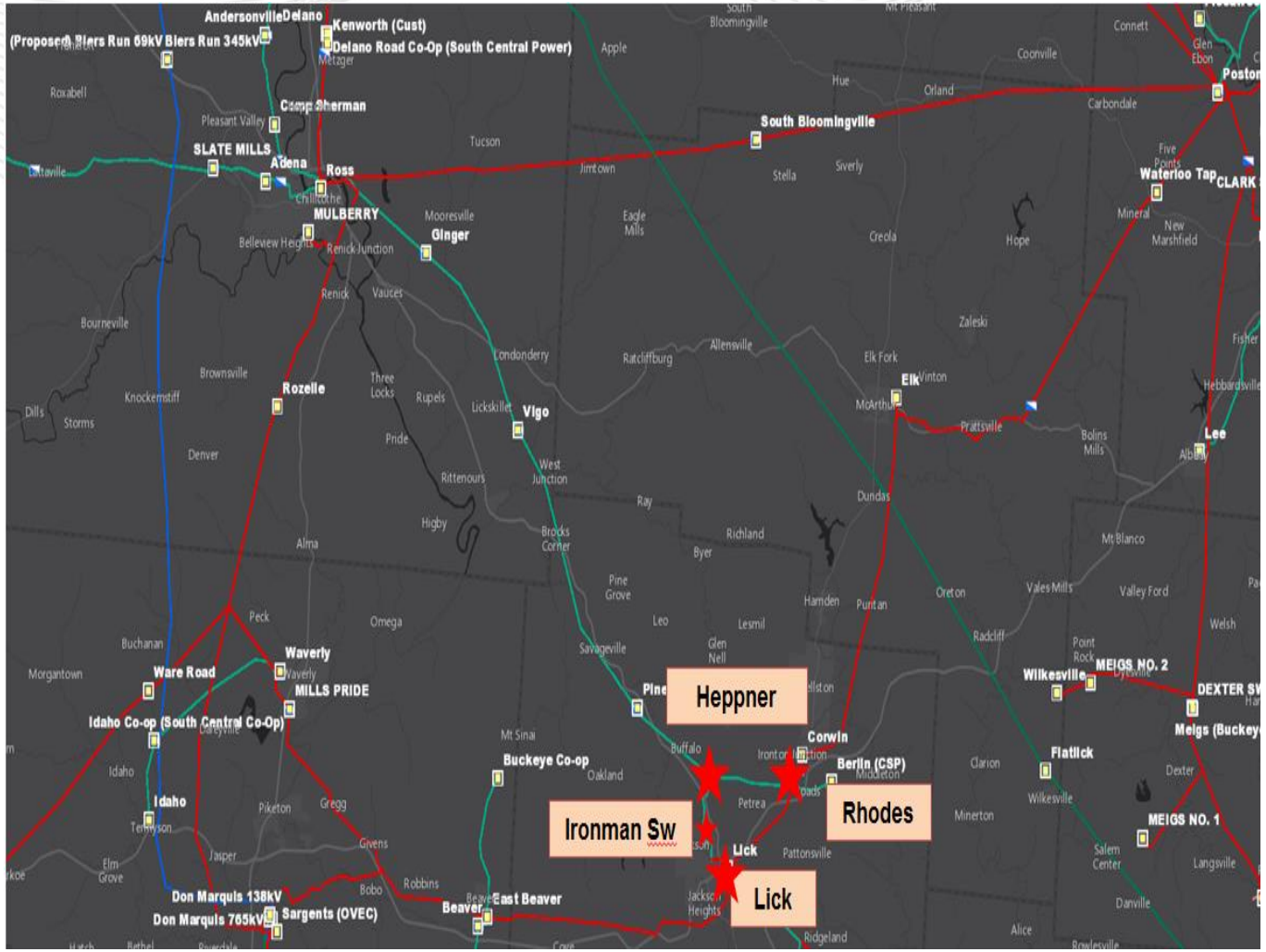

AEP Transmission Owner Criteria Violation and Supplemental Project

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Potential Alternative Solutions Considered:

- Extend 69kV from East Beaver-Buckeye Co-Op to Pine Ridge, construct ring bus at Pine Ridge. This alternative was ruled out due to the need to rebuild the radial from East Beaver-Buckeye Co-Op (4.53 miles) and the need for 7 miles of new right-of-way to extend the line to Pine Ridge. Estimated Cost: $34M
- New 138/69kV Transformer at Corwin, 69kV line extension through AEP's retired Berlin Station. Expansion difficulties at Corwin would likely lead to a complete rebuild of the station, plus an additional mile of 69kV greenfield line in addition to constructing Rhodes station. Estimated Cost: $23M

Preliminary Solution:

Install a new Ironman Switch to serve a new delivery point requested by the City of Jackson for a load increase request. Establish a new 138/69 kV station (Rhodes) to serve as a third source to the area to help relieve overloads caused by the customer load increase. Replace Coalton Switch with a new three breaker ring bus (Heppner). (Baseline)

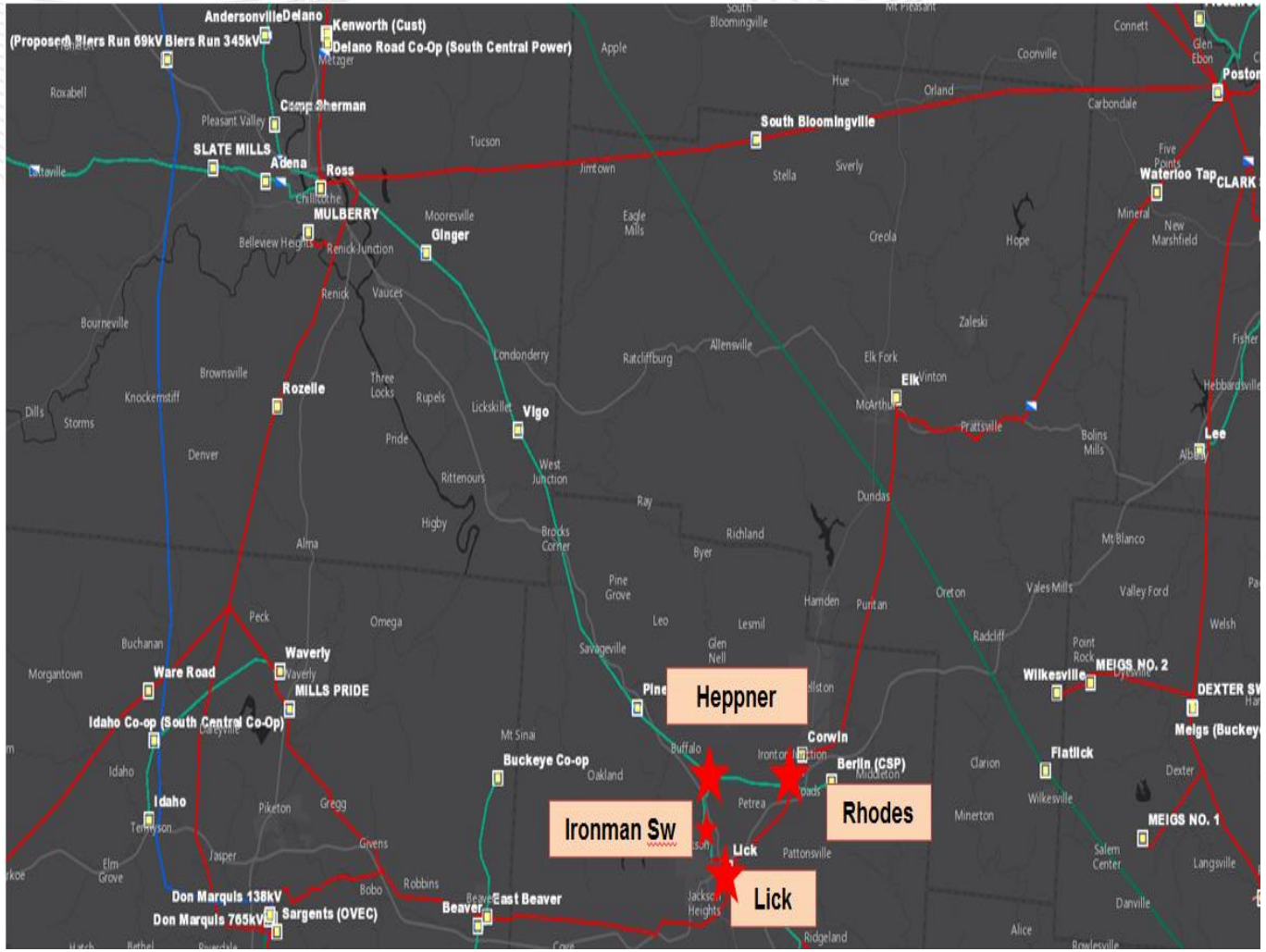
Estimated Cost: $13M

Rebuild approximately 6 miles of line from Rhodes to Heppner and from Heppner to Lick with 1033 ACSR (148 MVA rating). Build for future 138 kV conversion. (Supplemental)

Estimated Cost: $7M

Required IS date: 3/1/2018

Status: Engineering



AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

N-1-1 analysis identified an overload of the East End Fostoria-West End Fostoria 69 kV line and low voltage violations on the 69 kV system for loss of the West End Fostoria 138/69 kV transformer and the Buckley Road 138/69 kV transformer in the 2021 RTEP case.

At West End Fostoria, 69 kV circuit breakers S and BB are vintage GE, FK and Allis-Chalmer, FZO model oil filled circuit breakers manufactured in 1965 and 1961. Furthermore, the maintenance has become difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard.

The West End Fostoria breakers have the following documented conditions: unavailability of spare parts, obsolete interrupting medium, PCB content, and age.

The installation of a high side CB to replace the existing transformer #5 MOAB "XX" will eliminate the need to isolate the entire 138 kV bus for a transformer fault. This will ensure the path to Melmore/Chatfield, Lemoyne(FE) and Fostoria Central will remain intact for loss of the existing transformer. –Fostoria, OH

Potential Alternative Solutions Considered:

- Rebuild the West End Fostoria – East End Fostoria 69 kV line and install a new capacitor bank to alleviate the planning criteria violations. This solution does not address the equipment condition needs identified. Estimated cost: $9M

Preliminary Solution:

Install 90 MVA 138/69 kV transformer, new transformer high and low side 3000 A, 40 kA CBs, and a 138 kV 40 kA bus tie breaker at West End Fostoria. (Baseline)

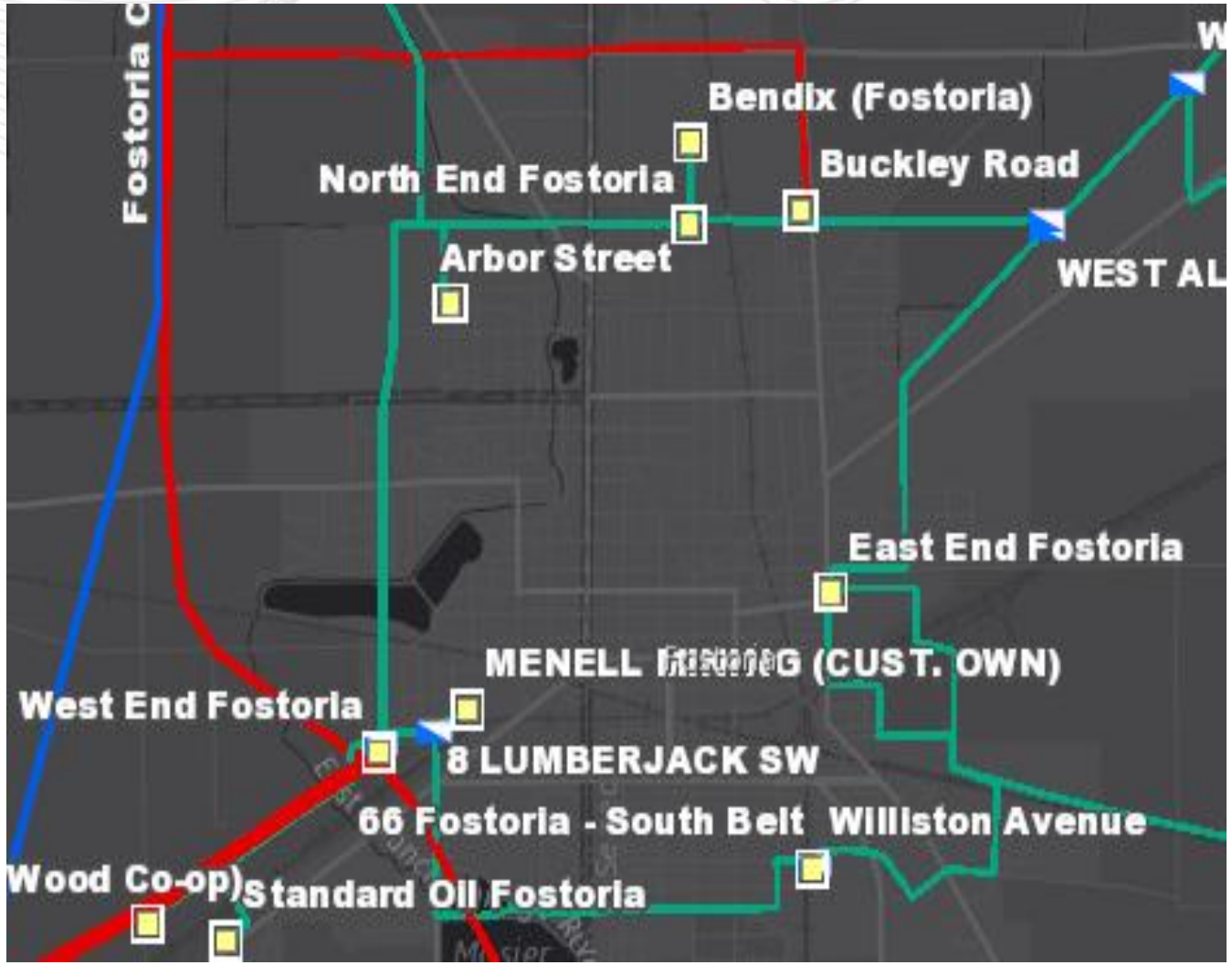
Estimated Cost: $3.2M

Replace 600 A 40 KA MOAB (XX) with new 40 kA transformer CB. Replace 69 kV CBs BB (21 kA) & S (12 kA) with new 40 KA units at West End Fostoria. (Supplemental)

Estimated Cost: $2.7M

Required IS date: 6/1/2021

Status: Engineering



AEP Transmission Zone

Common Mode Outage

Problem Statement:

The Mifflin-Stelzer 138kV line is overloaded for the loss of the Clinton – Morse Road 138kV line with the stuck breaker at Morse. – East side of Columbus, OH

Preliminary Solution:

Add 2-138kV CB's and relocate 2-138kV circuit exits to different bays at Morse Road. Eliminate 3 terminal line by terminating Genoa-Morse circuit at Morse Road.

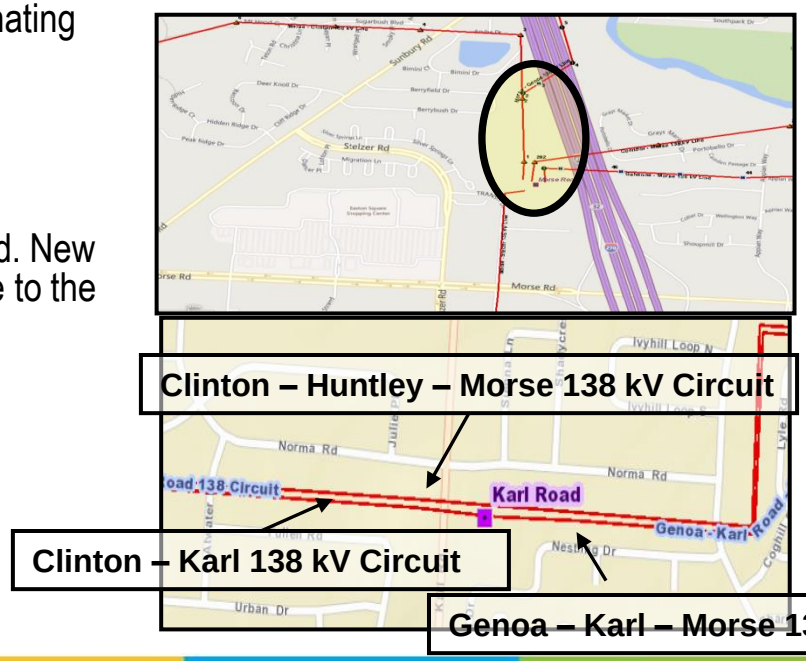
Alternatives Considered:

- No good transmission alternatives were identified. New construction in the area is difficult to execute due to the urban nature of the area.

Estimated Cost: $3.0M

Projected IS date: 12/31/2019

Status: Engineering



AEP Transmission Zone

Common Mode Outage, Basecase Analysis and TO criteria violation

Problem Statement:

PJM identified the Elliot –Rosewood 138kV line is overloaded for multiple common mode contingencies at Poston 138kV substation

AEP and PJM identified the Elliot – Ohio-U 69KV line and Elliot transformer are overloaded for multiple common mode contingencies at Poston 138kV substation.

PJM identified Low Voltage and Voltage drop violations at Elliot 138kV bus for multiple common mode contingencies at Poston 138kV substation.

The physical equipment at Poston is deteriorated and is mostly over 60 years in age. The bus consists of cap and pin insulators which are a safety concern due to the fact that the mechanical strength of the supports is greatly weakened over time. These cap and pin arrangements have a high tendency to fail during switching and AEP has had multiple instances of cap and pin insulators cracking and breaking while being removed out of service. Additionally, this station has been subject to flooding in the past, making it very difficult to repair or replace existing equipment in place.

All except 1 breaker (138kV & 69kV) at Poston are oil breakers (1200 A 20 kA FK-439's and 600 A 13 kA GO-4Bs types) that were originally installed in the 1940's and 50's. These breaker types are obsolete and do not work well with modern relaying schemes. Oil breakers in general have become difficult to maintain due to the required oil handling. Breaker 552N has had 49 fault operations. Breaker 652S has had 18 fault operations. Breaker 452S has had 178 fault operations. Breaker 252N has had 138 fault operations. Breaker 352N has had 36 fault operations. Breaker 152S has had 82 fault operations. Breaker 152N has had 99 fault operations. Breaker 652 has had 79 fault operations. The manufacturer recommended limit for fault operations for these types of breakers is 10. These breakers have the following documented conditions: age, bushing damage, PCB content, and number of fault operations.

Poston 138/69 kV 47 MVA transformer 2 also needs to be replaced. The drivers for replacement are age, dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), and accessory damage (bushings).

The Poston – Trimble 69 kV line was originally built in 1924 utilizing 336 ACSR conductor (75 MVA rating) and currently has 30 open conditions along the 9.7 mile long line. In coordination with AEP Ohio and transmission operations and transmission field services, a plan to replace the existing 69 kV radial line with a new 138 kV tap to serve customers at Trimble station was developed.

–Athens,OH

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

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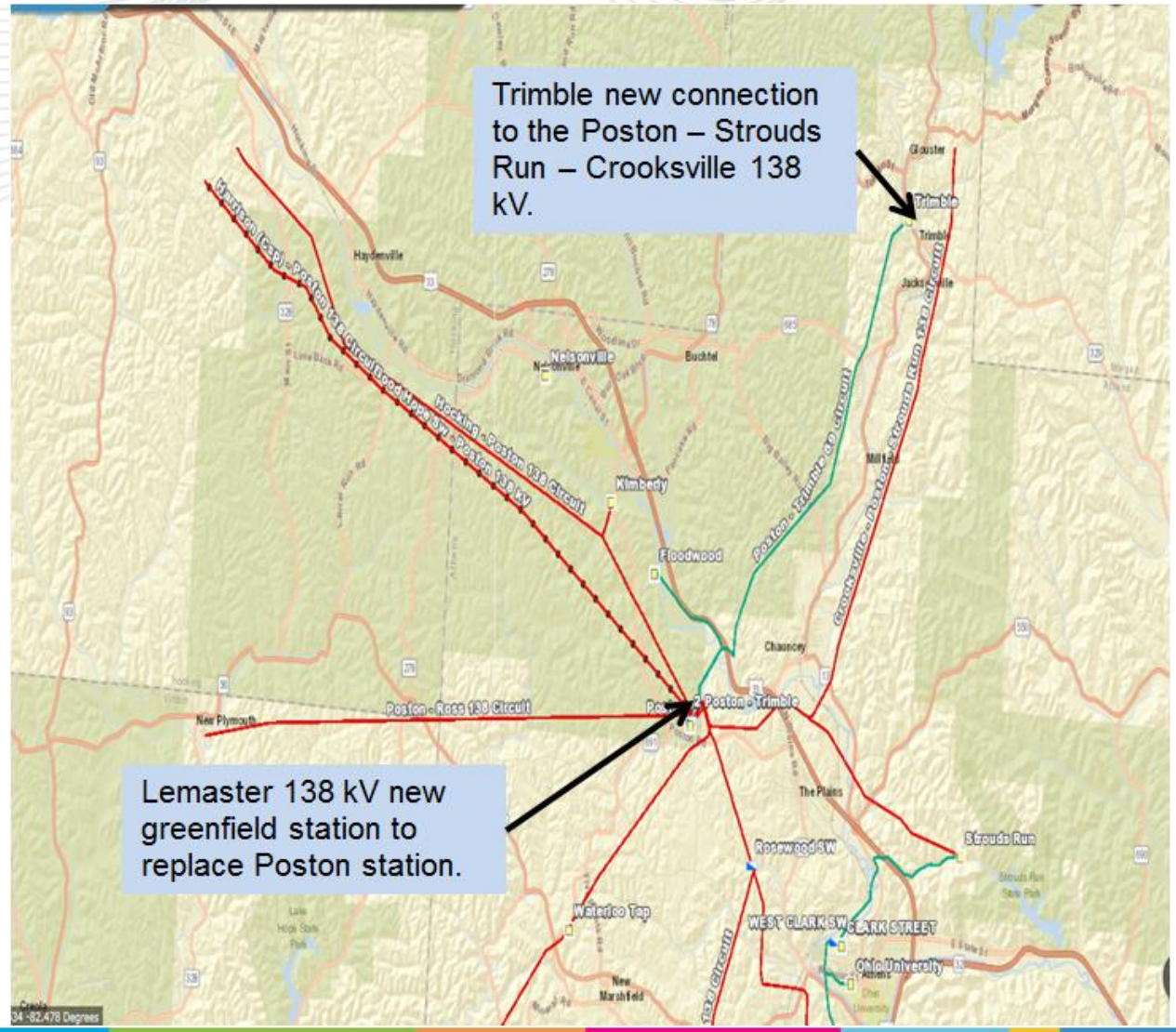

Common Mode Outage, Basecase Analysis and TO criteria violation

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Alternatives Considered:

- Replace all equipment at Poston in place. This is not practical as the station is prone to flooding. Outages are difficult to obtain to replace the equipment considering nearly every piece of equipment needs to be replaced. Relocate the Trimble 69 kV delivery point to 138 kV off the Poston-Strouds Run-Crooksville circuit. Retire the Poston-Trimble line. Estimated cost: $18M

Proposed Solution:

Remove and retire the Poston 138kV station.

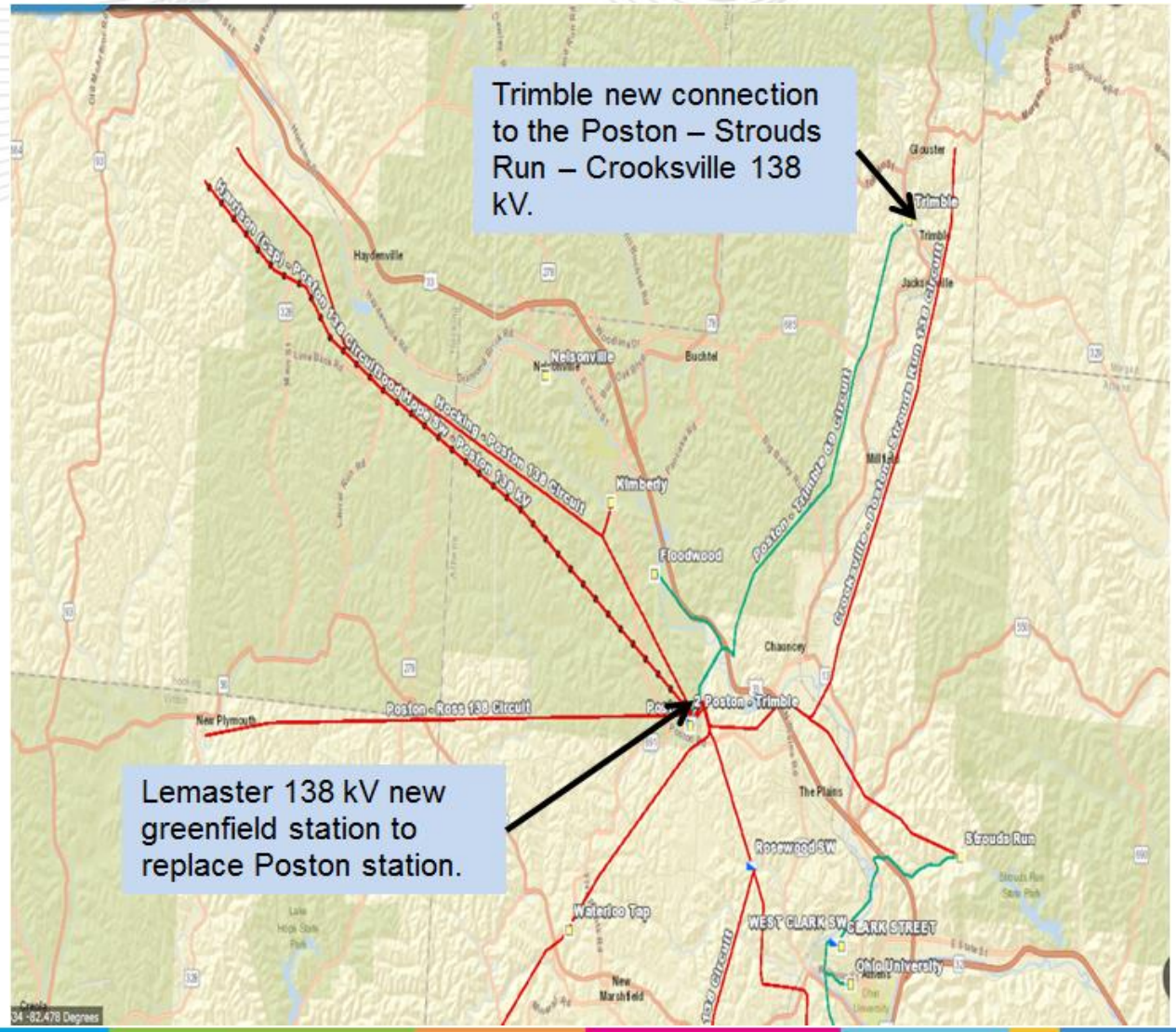
Install a new greenfield station, Lemaster 138kV Station, in the clear as a 138 kV switching station utilizing 3000 A 40 kA breakers.

Relocate the Trimble 69 kV AEP Ohio radial delivery point to 138 kV, to be served off of the Poston – Strouds Run – Crooksville 138 kV circuit via a new three-way switch. Retire the Poston-Trimble 69kV line.

Estimated Cost: $26.97M

Projected IS date: 12/31/2018

Status: Engineering



AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

The Cliffview – Lee Highway 69 kV line (1/0 Copper, 48 MVA rating, 139%) overloads for loss of the Jubal Early 138/69 kV transformer in the 2021 RTEP case.

The ~13 mile double circuit line section north of Byllesby (Wythe – Cliffview and Wythe – Byllesby) is approximately 93 years old and has small 1/0 CU conductor. ~4 miles of this double circuit line is also in the national forest near Byllesby.

There is approximately 120 MW of load being served directly off the 138kV system in this area. Under N-1-1 conditions on the 138kV system, this entire load would be dropped. There is no opportunity to sectionalize the 138kV system as this would force the 69kV system to support the existing 90 MW of load plus the 120 MW of load on the 138kV, resulting in the entire 69kV system overloading. –Wytheville, VA

Potential Alternative Solutions Considered:

- 6-wire the existing ~13 mile line section from Lee Highway to Byllesby to increase the capacity on the line section subject to the thermal violation. This project was not pursued due to the fact the line is approximately 93 years old and will still be loaded to around 90% of its thermal limit under N-1-1 conditions. Any future load increase will likely push the 6-wired line beyond its thermal limit. Estimated Cost: $500K
- Tap the existing Austinville – Jubal Early 138kV line and construct ~2 miles in/out to Byllesby Station. Install 138/69kV transformer and CBs at Byllesby. This project was not pursued due to space constraints at Byllesby Station: the station is located in the national forest near the New River. This new double circuit line would need to cross the new river and require the Byllesby Station to be expanded in the national forest, which is not feasible. This project would also create a new N-1-1 pair and require the replacement of the existing Wythe 138/69 transformer as well as include the 6 wire option mentioned above. The sectionalizing at new Byllesby 138kV would also cause through flow issue on the 69kV system in an 138kV N-1-1 event. Estimated Cost: $22M
- Rebuild the existing ~13 mile double circuit line section subject to the thermal violation. This project was not pursued due to cost and siting challenges as it passes through a national forest. Estimated Cost: $52M

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AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Supplemental Project

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Preliminary Solution:

Cliffview Station: Establish 138kV bus. Install two 138/69kV XFRs (130 MVA), six 138kV CBs (40kA 3000A) and four 69kV CBs (40kA 3000A). (Baseline)

Cliffview Line: Tap the existing Pipers Gap – Jubal Early 138kV line section. Construct double circuit in/out (~2 miles) to newly established 138kV bus, utilizing 795 26/7 ACSR conductor. (Baseline)

Byllesby – Wythe 69kV: Retire all 13.77 miles (1/0 CU) of this circuit (~4 miles currently in national forest). (Baseline)

Galax – Wythe 69kV: Retire 13.53 miles (1/0 CU section) of line from Lee Highway down to Byllesby. This section is currently double circuited with Byllesby – Wythe 69kV. Terminate the southern 3/0 ACSR section into the newly opened position at Byllesby 69kV, creating a new Galax – Byllesby 69kV circuit. (Baseline)

Estimated Baseline Project Cost: $30M

Pipers Gap: Install five 138kV CBs (40kA 3000A). (Supplemental)

Jacksons Ferry: Install one 138kV CB. (Supplemental)

Jacksons Ferry – Pipers Gap 138kV: Construct a new 138kV line (~10 miles) from Jacksons Ferry to Pipers Gap utilizing 1033.5 ACSR conductor. (Supplemental)

Estimated Supplemental Project Cost: $35M

Required IS Date: 6/1/2021

Projected IS Date: 6/1/2021

Status: Scoping

AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Baseline Scope Change

Problem Statement:

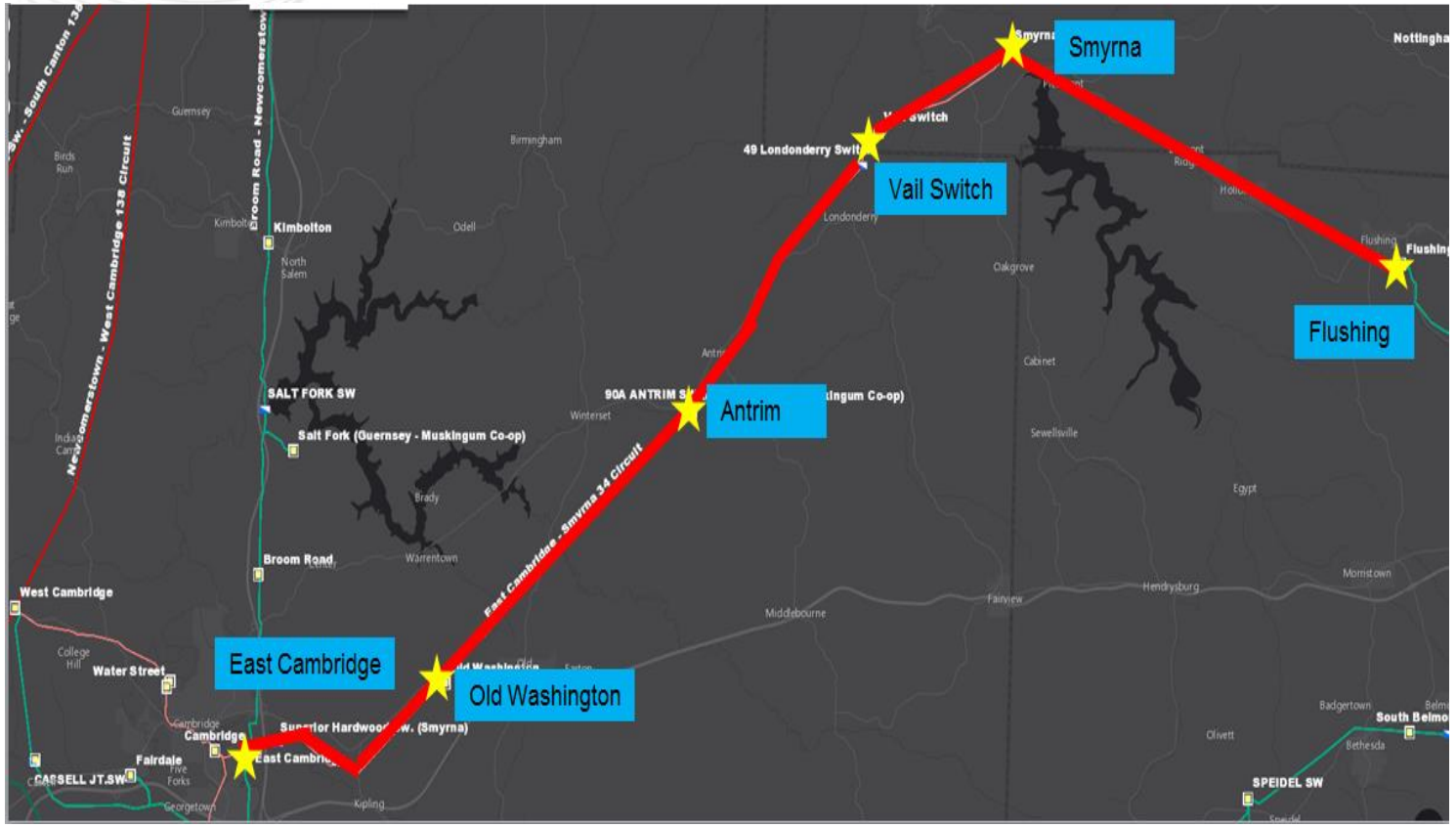
The Fairdale-Cambridge 69 kV line (266 ACSR, 64 MVA rating), the Summerfield-Derwent 69 kV line (336 ACSR, 75 MVA rating), and the Cambridge-West Cambridge 34.5kV line (4/0 Copper, 27 MVA rating) are overloaded for several combinations of N-1-1 contingencies in the Cambridge area in the 2021 RTEP.

The East Cambridge – Smyrna 34.5 kV circuit was built originally in 1954 and is comprised of mostly 1/0 and 4/0 ACSR conductor (17 MVA rating). It presently has 135 open A conditions on the 23.5 mile long line associated with conductor and structure concerns and has resulted in over 3.1M customer minutes of interruption between 2013 and 2016

The East Cambridge-Smyrna lines and associated stations can't be adequately maintained without shutting power off to customers. After significant outreach and discussions with all stakeholders, including AEP Distribution and the Guernsey-Muskingum Co-op, a commitment to the 69kV loop was agreed to. –Cambridge, OH

Potential Alternative Solutions Considered:

- Rebuild the overloaded facilities, approximately 30 miles, and convert West Cambridge-East Cambridge 34.5 kV line to 69 kV operation. While this option would eliminate the planning criteria violations, it does not address customer concerns or the existing condition concerns on the East Cambridge-Smyrna line. Estimated cost: $50M



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AEP Transmission Owner Criteria Violation and Baseline Scope Change

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Preliminary Solution:

Rebuild 23.55 miles of the East Cambridge – Smyrna 34.5 kV circuit with 795 ACSR conductor (128 MVA rating) and convert to 69 kV.

East Cambridge: Install a 2000 A 69 kV 40 kA circuit breaker for the East Cambridge – Smyrna 69 kV circuit.

Old Washington: Install 69 kV 2000 A two way phase over phase switch.

Antrim Switch: Install 69 kV 2000 A two way phase over phase switch.

Modify the scope for PJM project b2715 ($4M increase over original b2715 cost

Estimated Cost: $40.25M

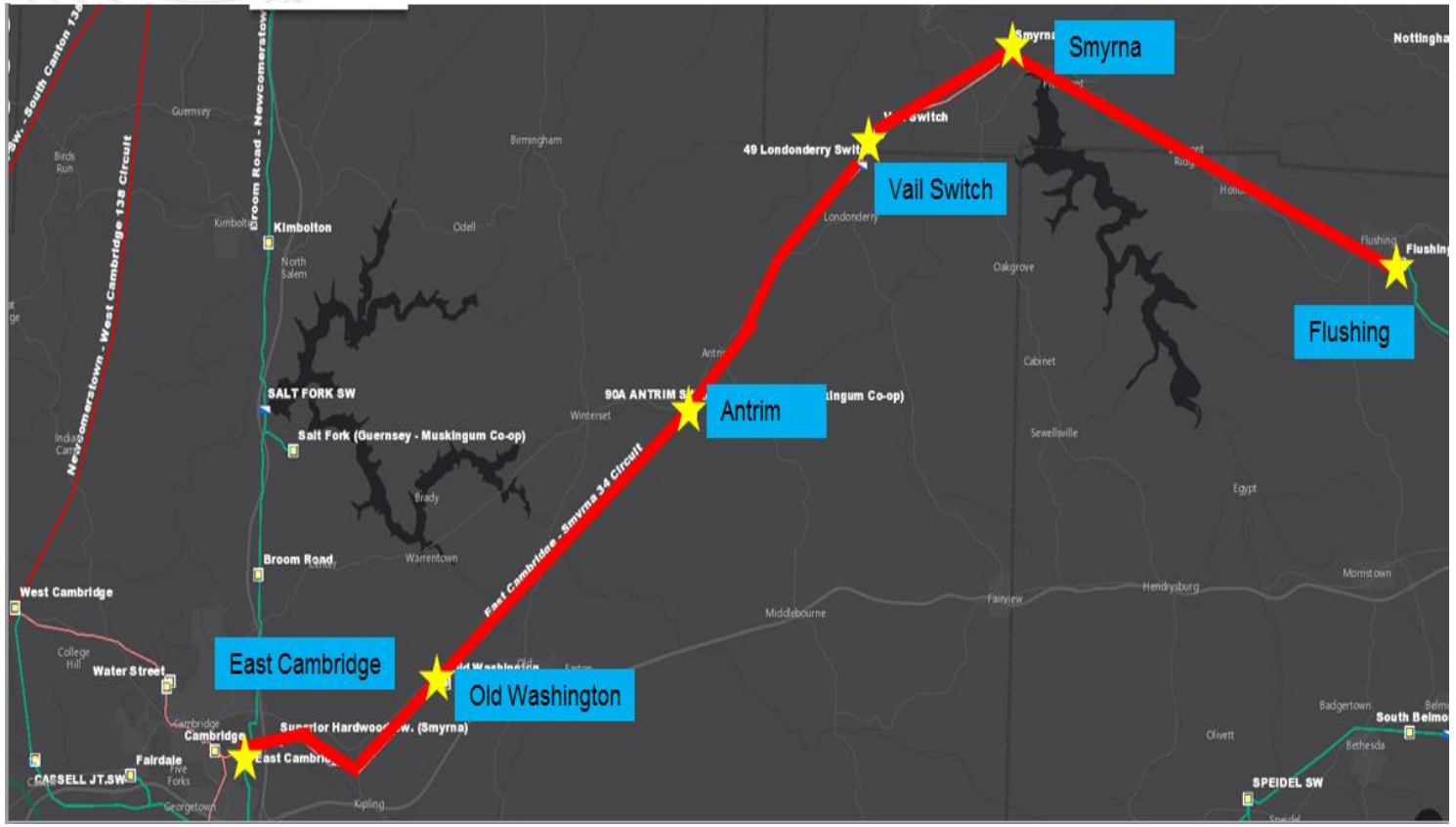
Required IS Date: 6/1/2021

Status: Engineering

B2715 original Scope: Build approximately 11.5 miles of 34.5 kV line with 556.5 ACSR 26/7 Dove conductor on wood poles from Flushing station to Smyrna station.
Original Estimated cost: $14.355M, Old Required IS Date: 6/1/2020

B2715 new Scope: Install a 69 kV ring bus at Flushing instead of a 69/34.5 kV transformer, Convert Smyrna to 69 kV and install two 69 kV breakers, Convert Vail to 69 kV and serve AEP Distribution via a 69/34.5 kV transformer, Build the Flushing – Smyrna line to 69 kV instead of 34.5 kV.

New Estimate Cost: $18.355M, New Required IS Date: 6/1/2020



AEP Transmission Zone

AEP Transmission Owner Criteria Violation

Problem Statement:

The Midland Switch-East Findlay 34.5 kV line (4/0 ACSR, 25 MVA rating) is overloaded for the N-1-1 loss of the Ebersole 138/34.5 kV transformer and the Findlay Center 138/34.5 kV transformer. –Findlay, OH

Potential Alternative Solutions Considered:

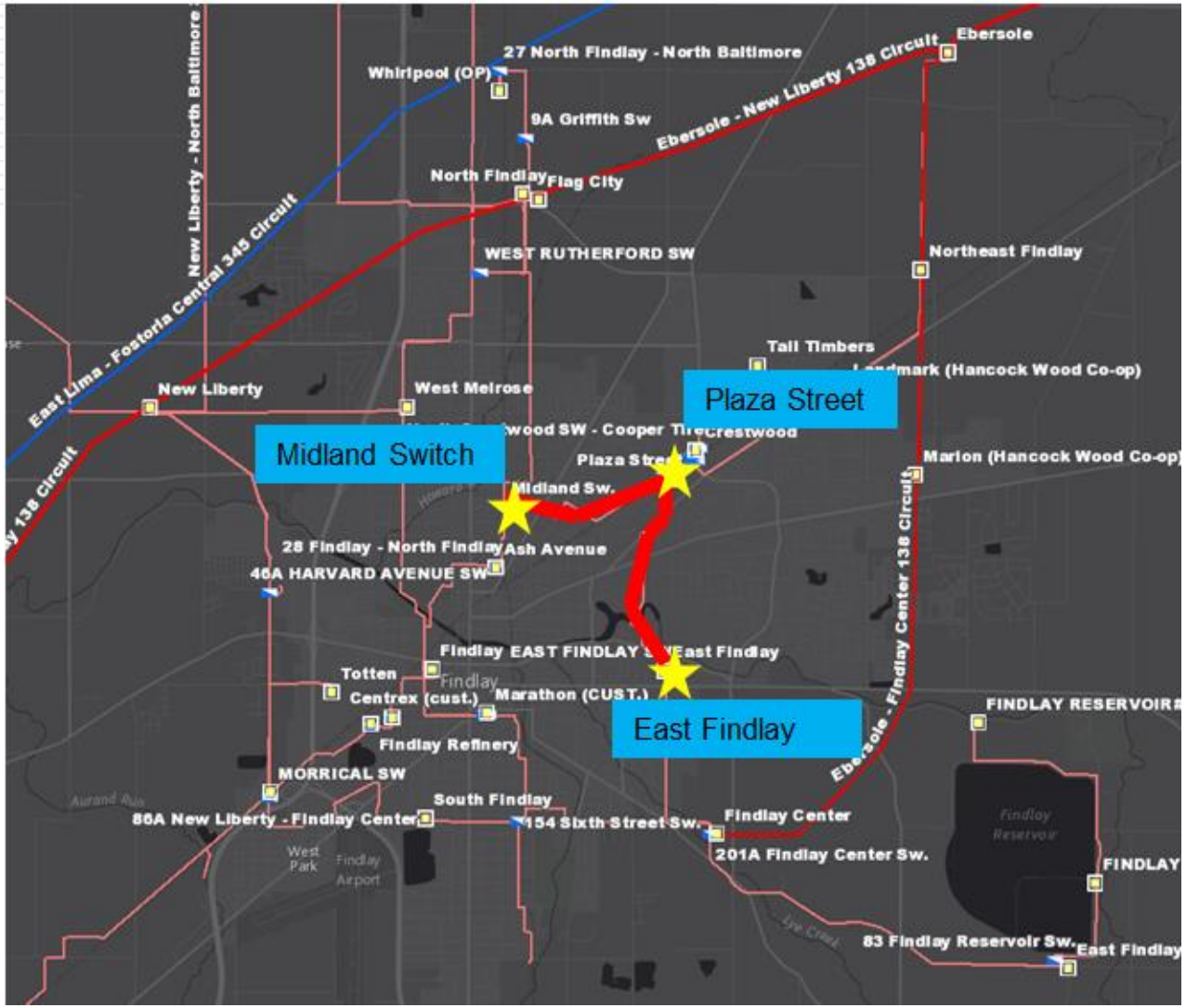
- Install a second 138/34.5 kV transformer at Findlay Center. This alternative is not practical as Findlay Center station is fed only by a radial 138 kV source and a loss of the 138 kV line will drop both the Findlay Center 138/34.5 kV transformers. Estimated cost: $5M
- Install a second 138/34.5 kV transformer at Ebersole. The additional transformer at Ebersole causes an overload of the Plaza Street to East Findlay 34.5 kV line, requiring a rebuild of this section in addition to the second transformer. Estimated cost: $6.1M

Preliminary Solution:

Rebuild the Midland Switch to East Findlay 34.5 kV line (3.31 miles) with 795 ACSR (63 MVA rating) to match other conductor in the area.

Estimated Cost: $4.8M

Required IS Date: 6/1/2021



AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Supplemental Project

Problem Statement:

The Leon-Ripley 69kV line (4/0 ACSR, 61 MVA rating, 125%) and 138/69kV transformers #3 at Leon (45 MVA rating, 100%) overload for N-1-1 loss of the Gavin – Meigs 69kV line in conjunction with the Lakin – Racine 69 kV line in the 2021 RTEP case. There are voltage violations (0.90 pu, 12% drop) at the Ripley bus for an N-1 loss of the Leon-Ripley line.

The Leon-Ripley line was constructed in 1957 utilizing 4/0 ACSR conductor on wood H-frame structures and has 209 open A conditions on the 13 mile long line. Most of the structures on this line (77%) are still original from 1957.

Leon 69 kV breaker A is a 1200 A 12 kA FK-type oil breaker manufactured in 1958. Breaker A has had 127 fault operations, exceeding the manufacturer recommended limit of 10. 138/69 kV 25 MVA transformers 1 and 3 at Leon have High concentrations of combustible gases due to Corona Partial Discharges. There is also significant increased trending in oil moisture content which reduces the oil dielectric strength, indicating a breakdown of the paper insulation of the transformer windings. Additionally, there are multiple overlapping zones of protection at Leon (two line exits, two transformers, and bus). The recommended maximum is two overlapping zones.

The Ravenswood 69 kV breakers G and H are 1200 A 20 kA CF-type oil filled breakers manufactured in 1968. Breaker G has had 125 fault operations. Breaker H has had 202 fault operations. Both exceed the manufacturer recommended limit of 10.

In general, oil breakers have become more difficult to maintain due to the required oil handling. Oil spills occur often during routine maintenance and failures, which can become an environmental concern.
– Charleston, WV

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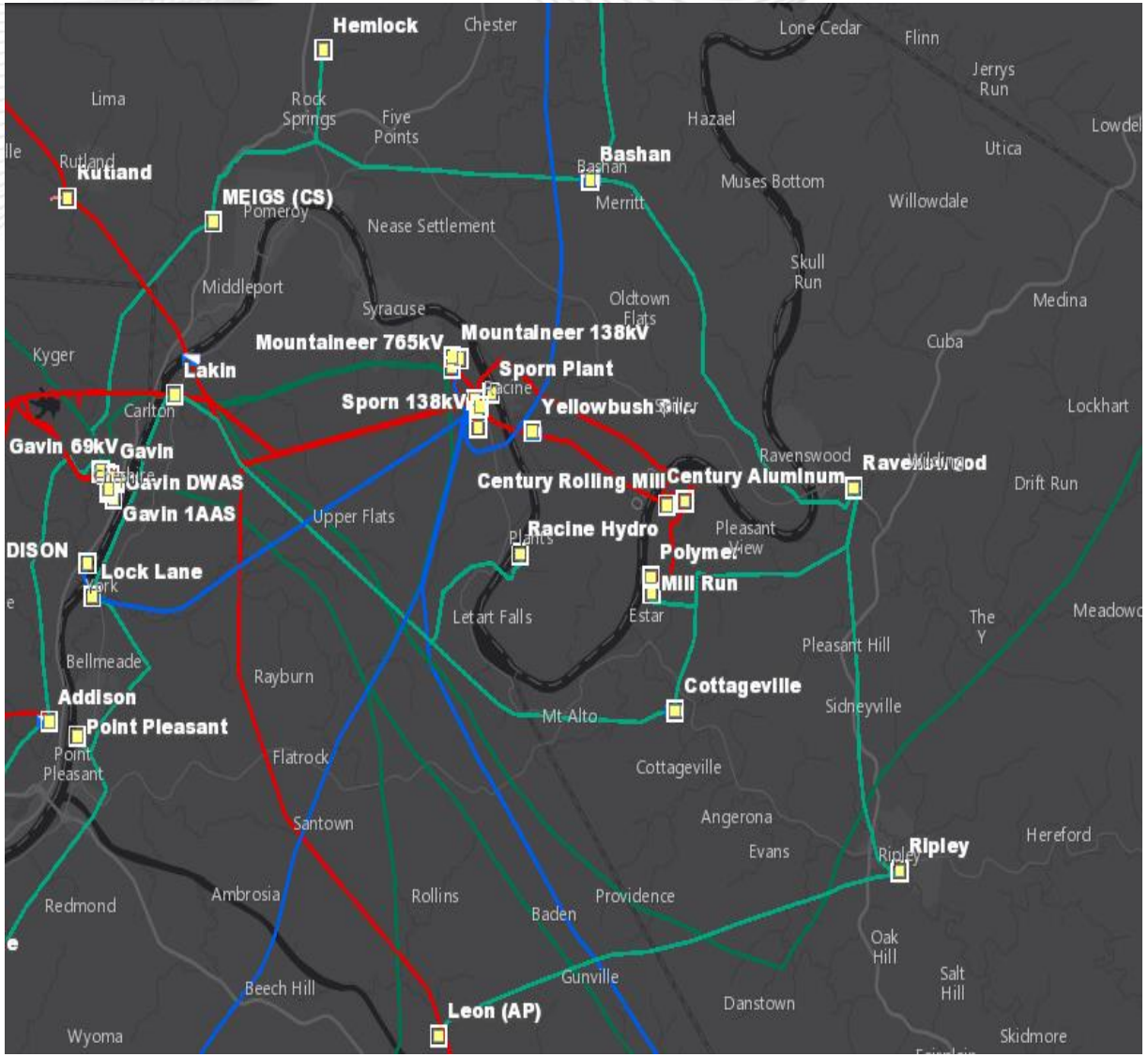

AEP Transmission Zone

AEP Transmission Owner Criteria Violation and Supplemental Project

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Potential Alternative Solutions Considered:

- Reconductor the Leon – Ripley 69kV branch with 795 KCM ACSR. Reconductoring corrects the thermal violation but requires an extended line outage. Additionally, a simple line reconductor would reuse vintage 1957 structures. An SVC is also required at Ripley to solve the voltage violations. A capacitor bank cannot be switched in and out of service due to voltage rise concerns on the 69 kV system, so a continuous voltage support device is required. Estimated cost: $40M
- Rebuild the Leon – Ripley 69kV branch but do not convert to 138kV. This option does not address aging 69 kV Leon station infrastructure needs. An SVC is also needed at Ripley to solve the voltage violation. A capacitor bank cannot be switched in and out of service due to voltage rise concerns on the 69 kV system, so a continuous voltage support device is required. Estimated cost: $50M
- Build a 138kV line from Polymer to Mill Run. This provides a new 138kV source into the Ravenswood area and reduces loading on the Leon-Ripley line. This option causes additional overloads on the Mill Run – Ravenswood and the Ravenswood – Ripley 69 kV lines, requiring rebuilds on these lines. Estimated cost: $50M

Preliminary Solution:

Install new 138/12kV transformer with high side circuit switcher at Leon and a new 138 kV line exit towards Ripley. Establish 138kV at Ripley station with a new 138/69 kV 130MVA transformer and move the distribution load to 138 kV service. Rebuild the existing 69kV Leon – Ripley branch with 1033 ACSR and operate at 138kV. Rebuild the Ripley 69 kV bus. (Baseline)

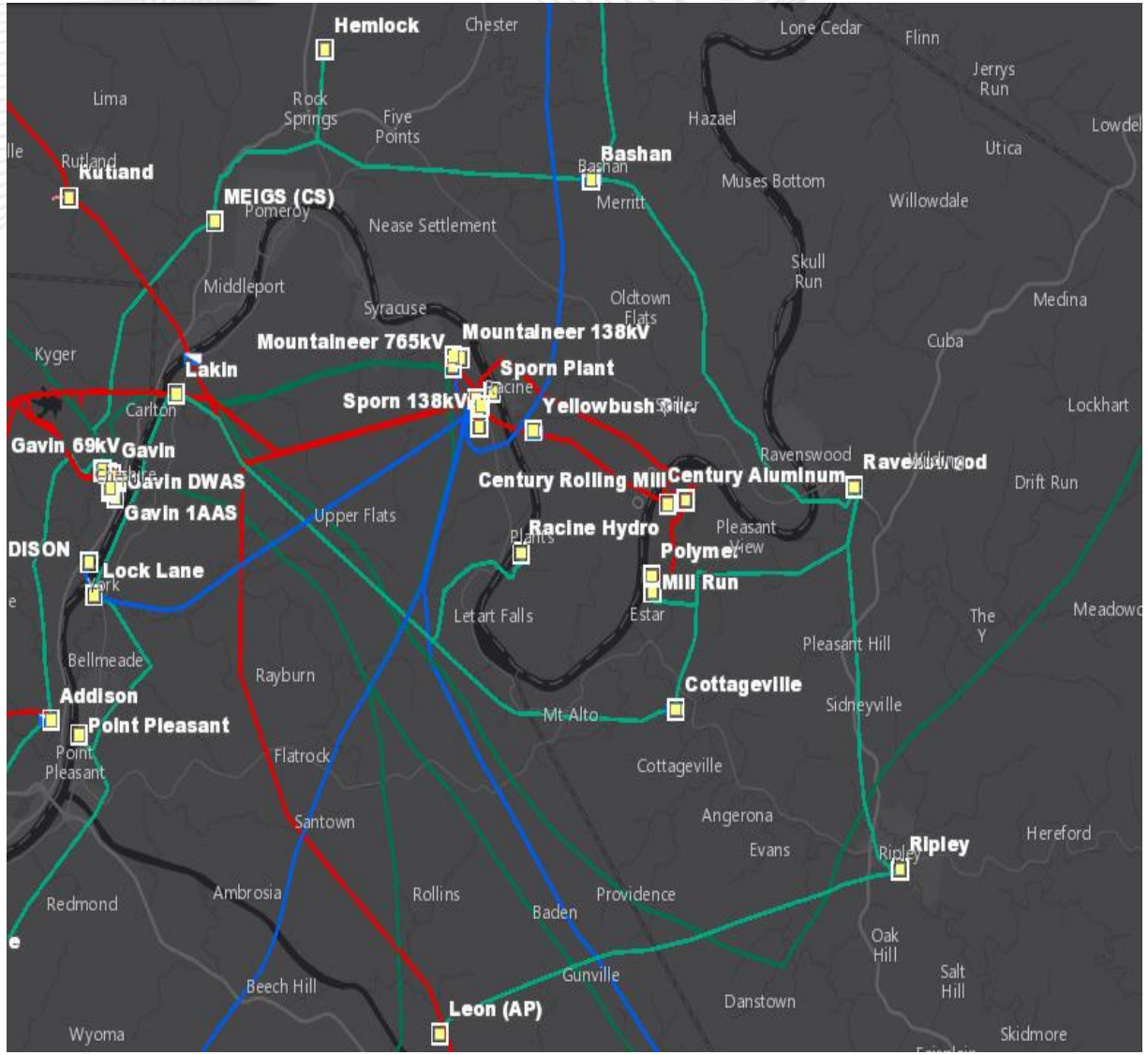
Estimated Cost: $27.1M

Replace circuit breakers G and H at Ravenswood station with 3000 A 40 kA breakers. Install 3000 A 40 kA circuit breakers on all line exits at Leon station. (Supplemental)

Estimated Cost: $4M

Required IS Date: 6/1/2021

Status: Engineering



EKPC Transmission Zone

EKPC Transmission Owner Criteria Violation

Problem Statement:

The Davis - Nicholasville 69kV line is overloaded for the loss of the Baker Lane-Baker Lane 138kV line and Trimble unit #2 .

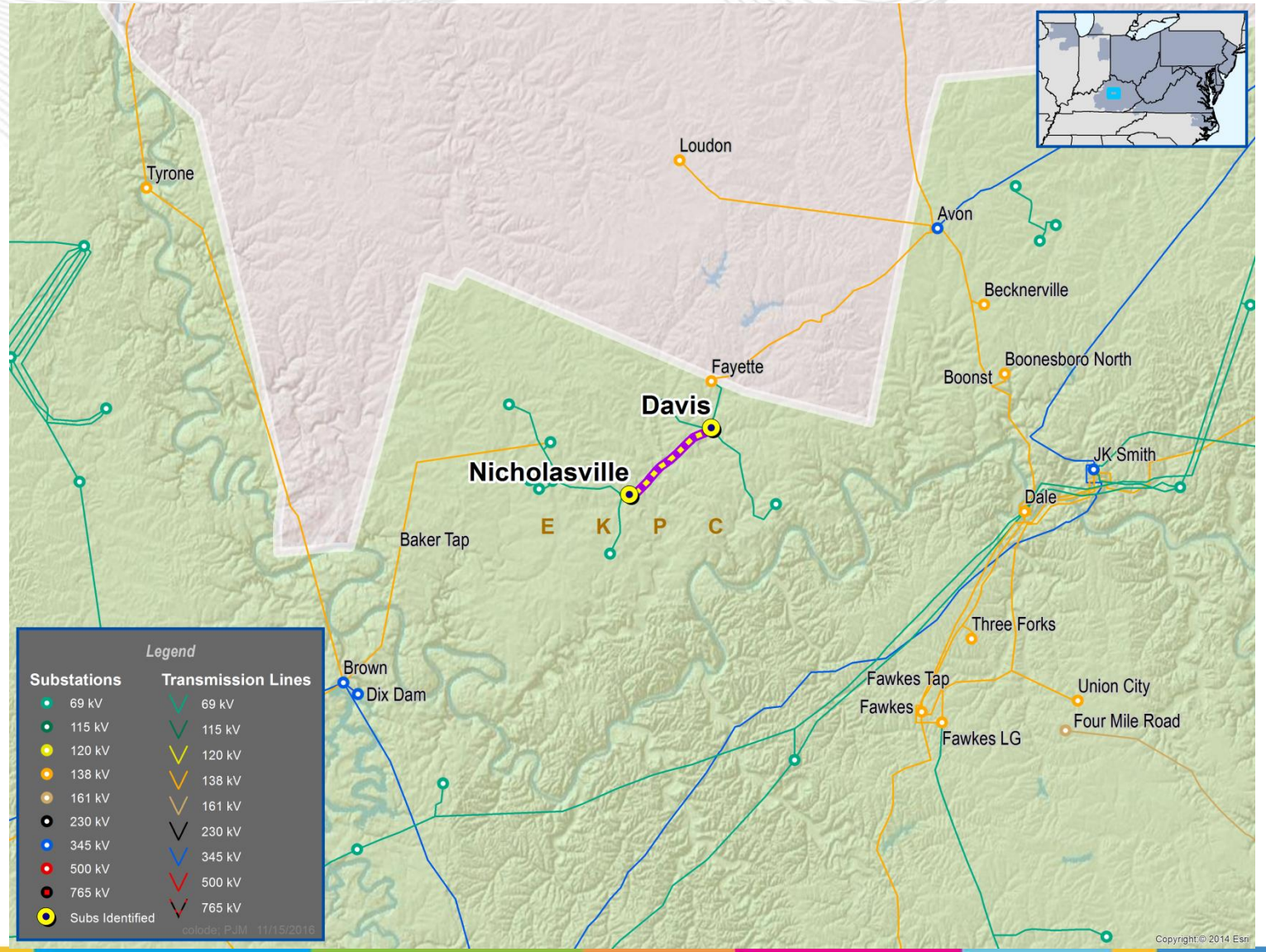
Potential Alternative Solutions Considered:

Rebuild Davis – Nicholasville 69kV line section using 556.5 MCM ACSR/TW (4 miles).
Estimated Cost: $1.7M

Preliminary Solution: Increase Maximum Operating Temperature of Davis - Nicholasville 69kv line section 266.8 MCM conductor to 284°F (LTE of 266°F).

Estimated Project Cost: $0.19M

Required IS Date: 6/1/2021



EKPC Transmission Zone

EKPC Transmission Owner Criteria Violation

Problem Statement:

The Plumville - Rectorville 69kV line is overloaded for the loss of the Goddard 138/69KV transformer and Cooper units 1&2.

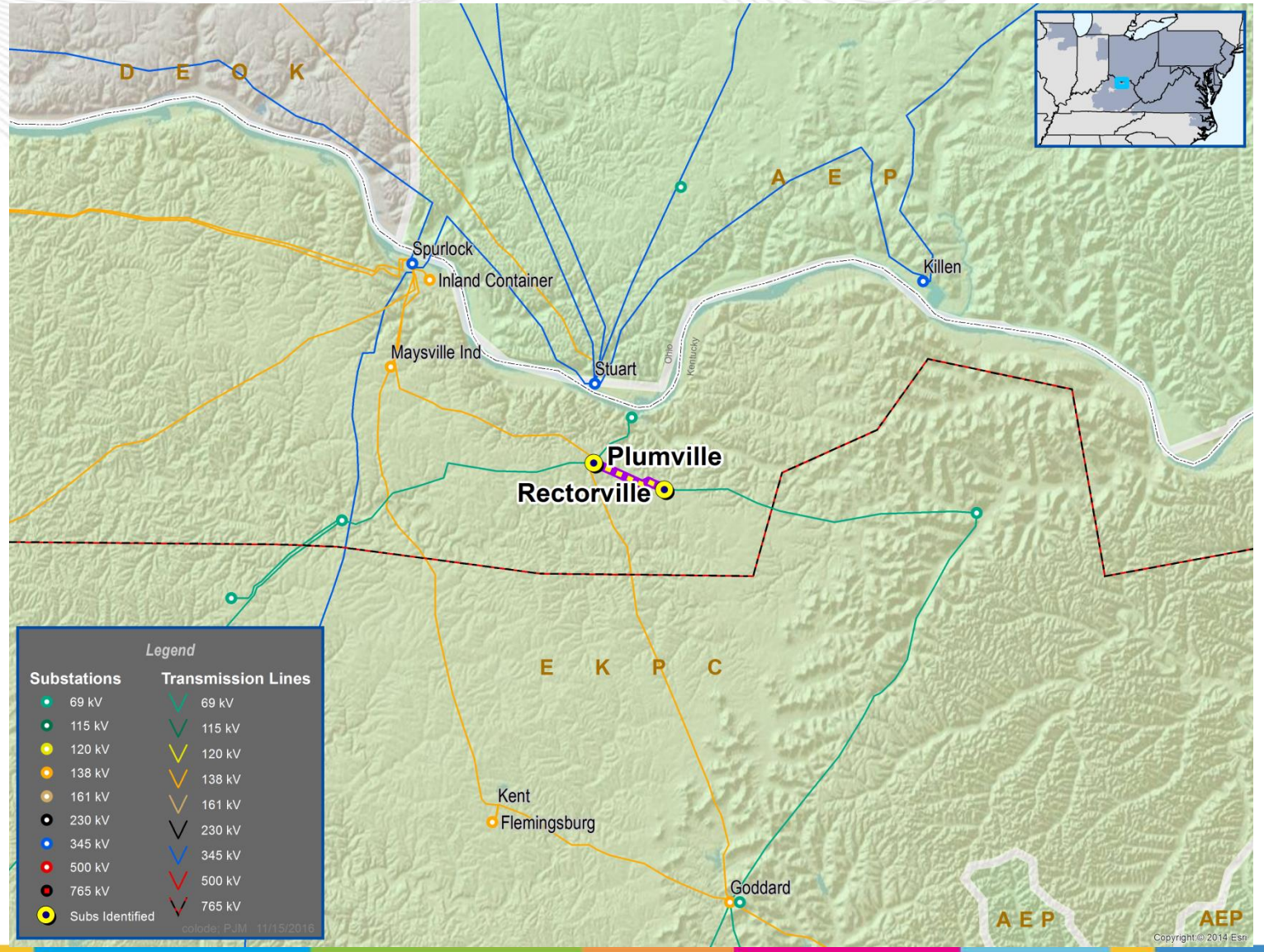
Potential Alternative Solutions Considered:

Rebuild Plumville – Rectorville 69kV line section using 556.5 MCM ACSR/TW (2.9 miles). Estimated Cost: $1.2M

Preliminary Solution: Increase the maximum operating temperature of Plumville - Rectorville 69kV line section 266.8 MCM conductor to 212°F (LTE of 185°F).

Estimated Project Cost: $0.14M

Required IS Date: 6/1/2021



EKPC Transmission Zone

EKPC Transmission Owner Criteria Violation

Problem Statement:

The Davis - Fayette 69kV line is overloaded for the loss of the Baker Lane-Baker Lane 138KV line and Brown unit #3.

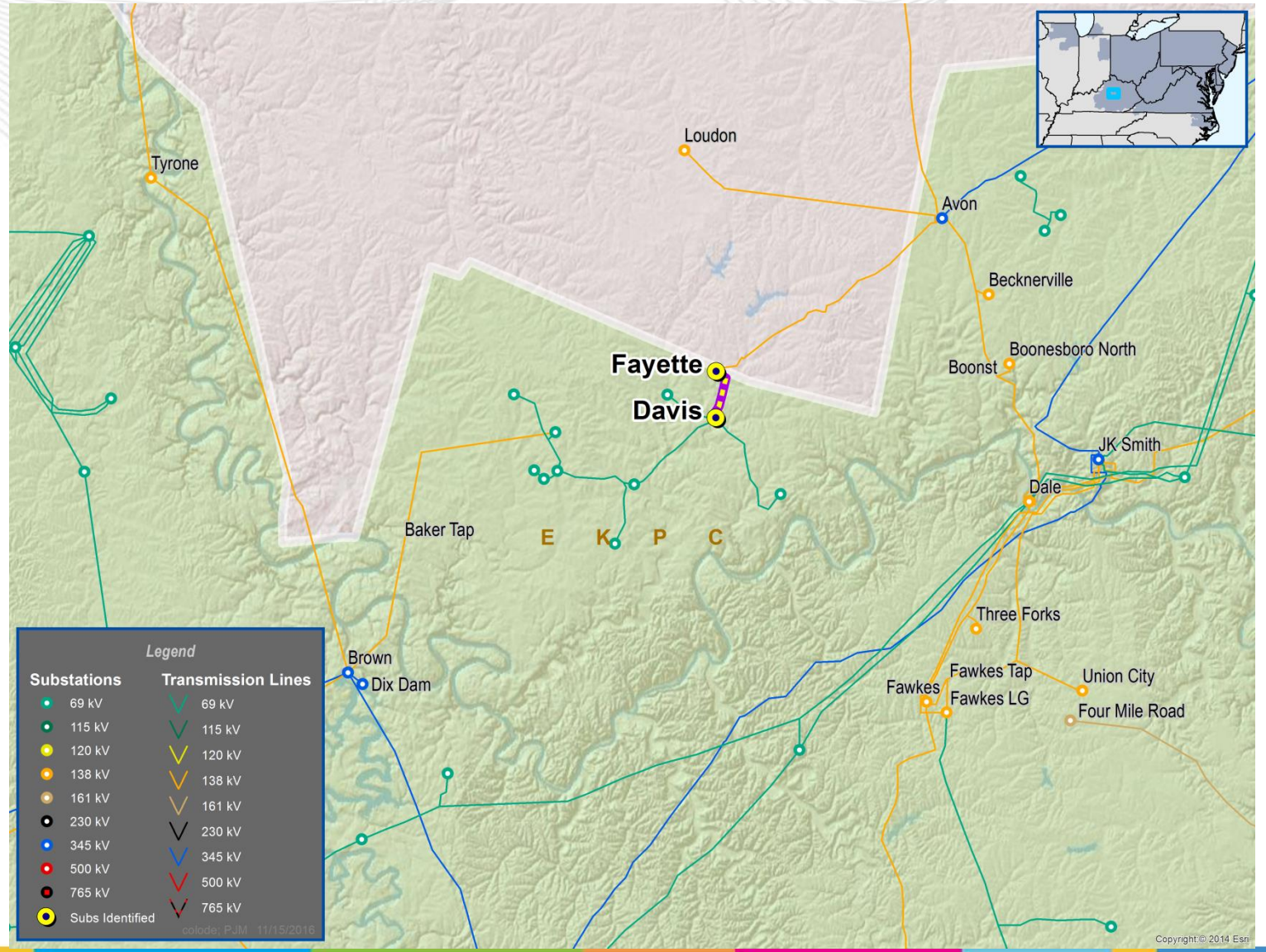
Potential Alternative Solutions Considered:

No other alternatives considered.

Preliminary Solution: Rebuild the Davis - Fayette 69kv line section to 556.5 MCM (3.15 miles)

Estimated Project Cost: $1.3M

Required IS Date: 12/1/2021



EKPC Transmission Zone

EKPC Transmission Owner Criteria Violation

Problem Statement:

The West Berea 138/69kV transformer is overloaded for the loss of the Crooksvil-Fawks 69kV line and Cooper units 1&2.

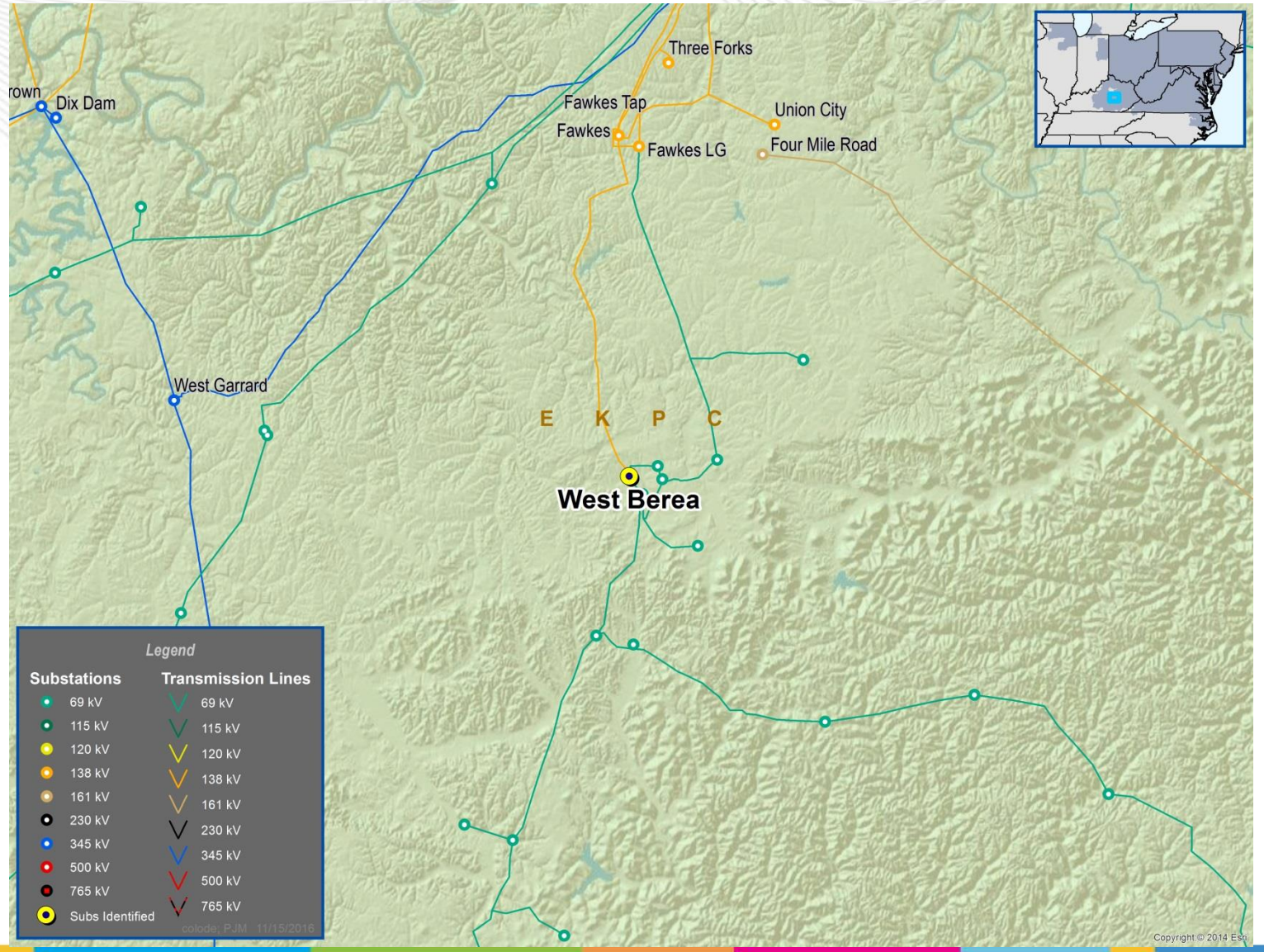
Potential Alternative Solutions Considered:

No other alternatives considered.

Preliminary Solution: Increase overcurrent relay at West Berea 138/69kV to at least 139 MVA Winter LTE

Estimated Project Cost: $0.0M

Required IS Date: 12/1/2021



EKPC Transmission Zone

EKPC Transmission Owner Criteria Violation

Problem Statement:

Low voltage at Williamstown 69kV bus for the loss of the Munk Jct.- Williamstown 69kV line and JK Smith Unit 9.

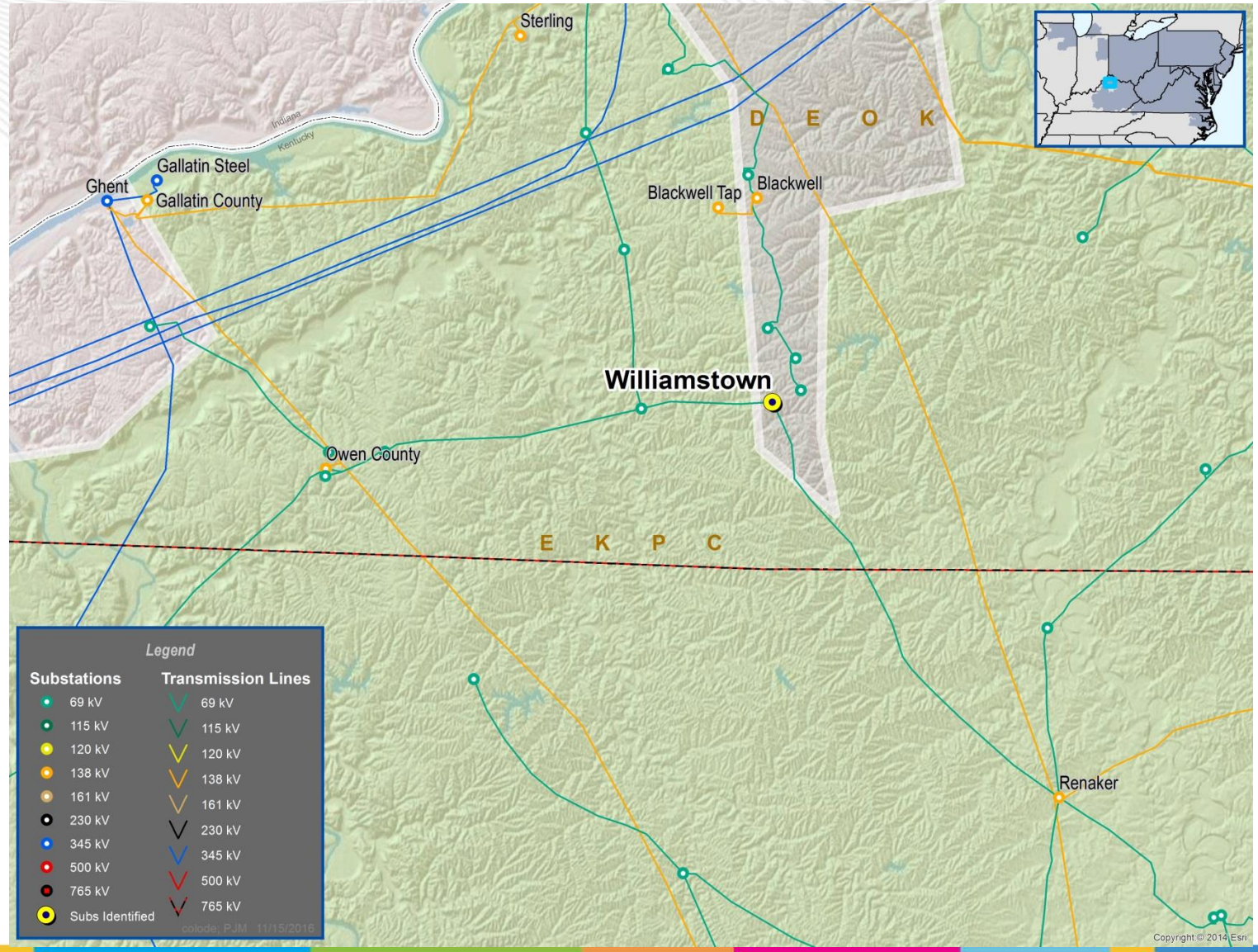
Potential Alternative Solutions Considered:

Build a new 69kV switching station at Munk Junction and construct a new 4.9 mile, 69kV line section using 556.5 MCM ACSR/TW from Munk Junction to Williamstown. Operating the new line normally closed and the existing Munk Junction to Williamstown line normally open. Estimated Cost: $4.95M

Preliminary Solution: Increase Williamstown cap bank to 11.225 MVAR

Estimated Cost: $0.02M

Required IS Date: 12/1/2021



EKPC Transmission Zone

EKPC Transmission Owner Criteria Violation

Problem Statement:

Low voltage at the Deatsville distribution substation during the loss of the Bullitt County-Deatsville Tap 69 KV line section.

Thermal overload of the South Bardstown – West Bardstown Jct. 69kV line during the loss of the Bullitt County 138/69 KV transformer.

Potential Alternative Solutions Considered:

Increasing the capacitor bank size at West Bardstown. Estimated Cost: $0.19M

High temperature upgrade of the South Bardstown –West Bardstown Jct 69 KV line section. Estimated Cost: $0.065M

Other Considerations:

EKPC Reliability Team identified concerns related to the age and condition of this conductor during their conductor assessment. The Reliability Team identified this entire line section as one of the top line sections to be addressed based on condition of the conductor and age of the line.

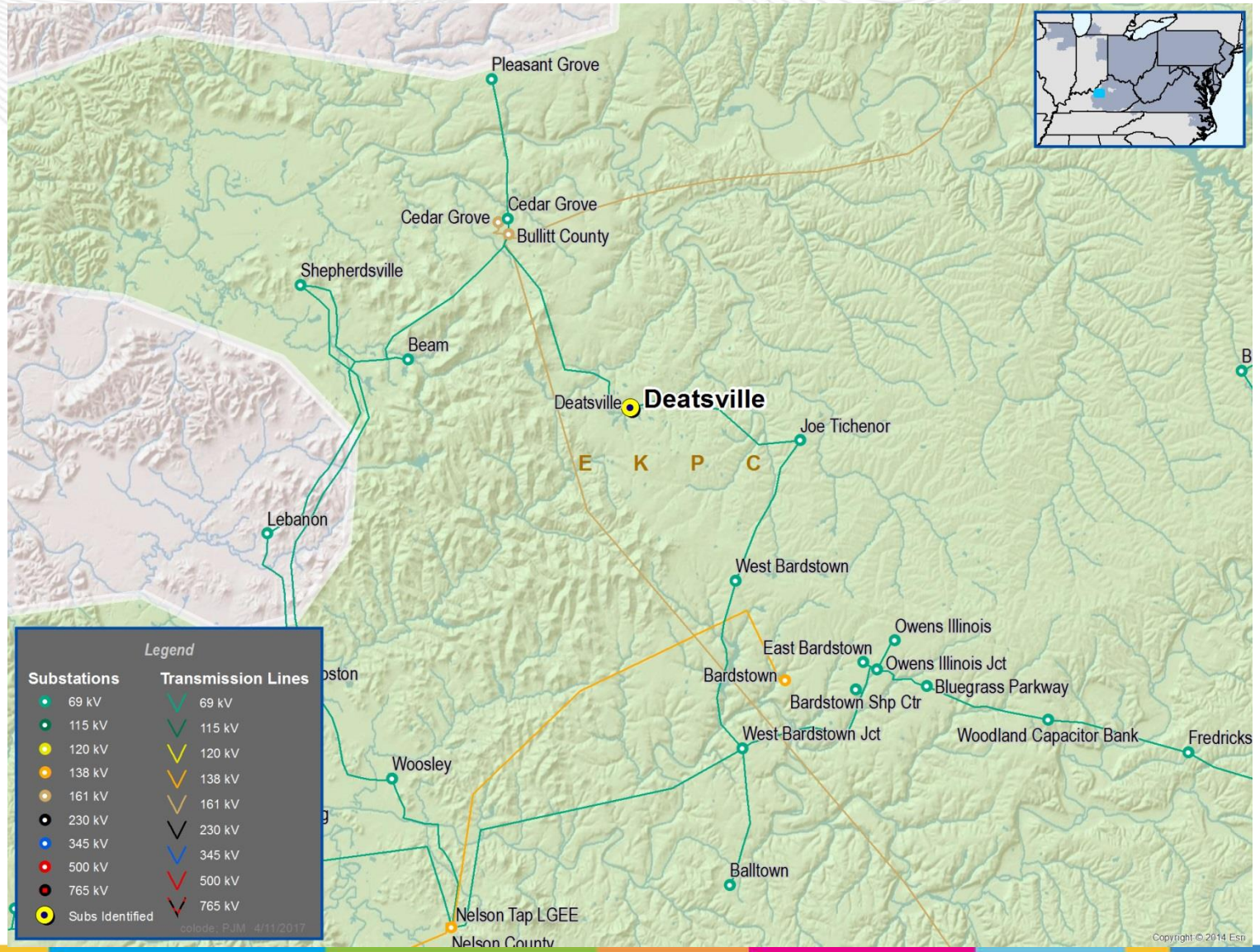
Preliminary Solution:

Re-build the existing (1.5 mile), 1/0 MCM ACSR South Bardstown – West Bardstown Jct. 69kV line using 556.5 MCM ACTW conductor.

Estimated Cost: $1.03M

Required IS Date: 6/1/2017

Projected IS Date: 12/1/2017



Supplemental Projects

Supplemental Project

Problem Statement:

Buckeye Power, on behalf of North Central Electric Cooperative Inc. (NCEC), requested a new Adrian 69kV delivery point to serve load. –Upper Sandusky, OH

Potential Solution:

Install a New 69kV PH/PH switch to connect NCEC to 69kV and new 3-Element Revenue Metering.

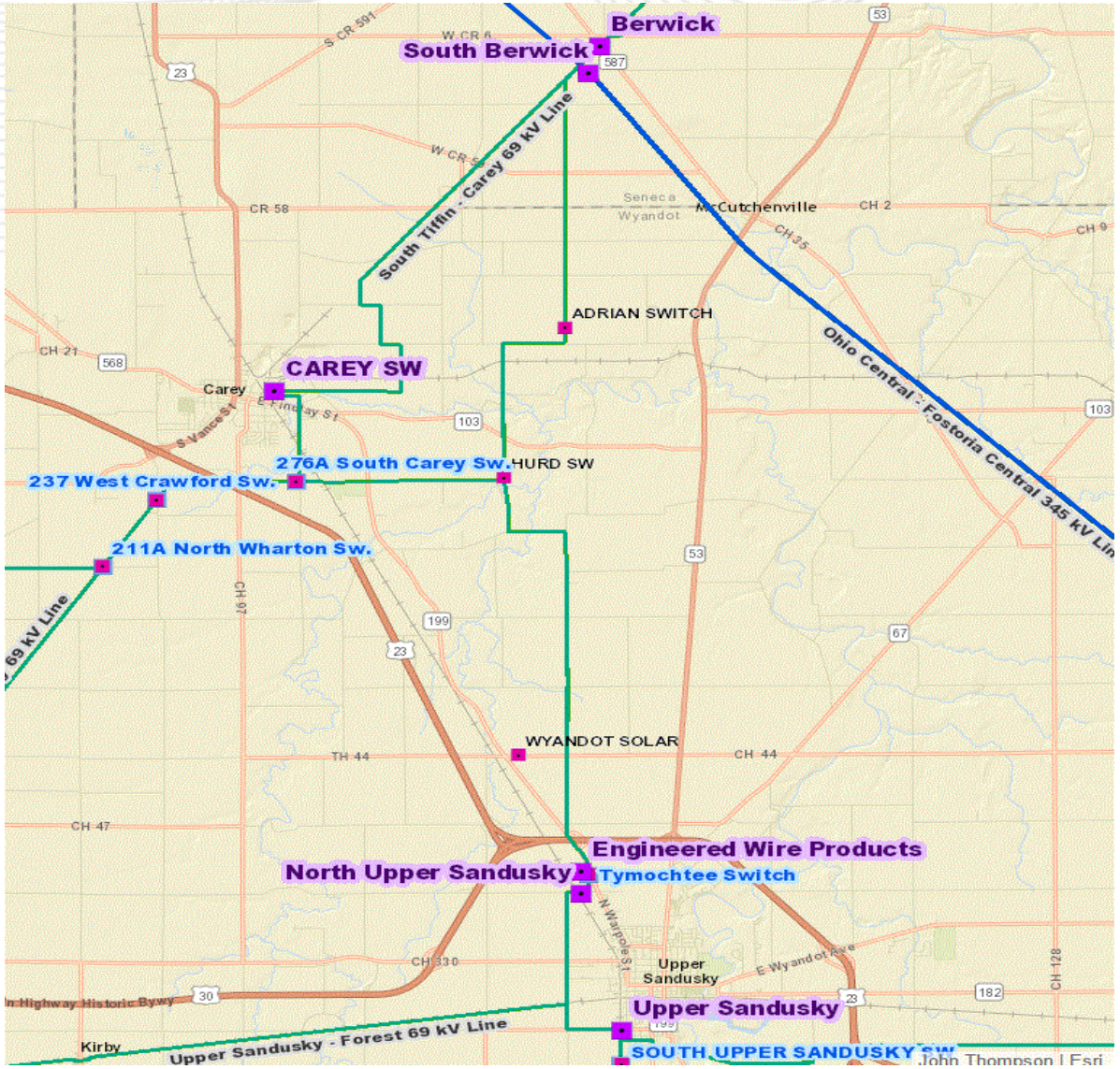
Alternatives:

Tap the Carey Switch – South Berwick 69 kV line to serve the customer. Requires additional line miles to reach the Buckeye delivery point. The AEP cost would be the same, but the co-op cost would increase. Estimated cost: $0.75M

Estimated Cost: $0.75M

Projected IS date: 8/31/2017

Status: Engineering



AEP Transmission Zone

Supplemental Project

Problem Statement:

All breakers included in this project are 3000 A 80kA 2-cycle trip air blast, PK type breakers. AEP is replacing air blast breakers for safety concerns across the AEP system. Air blast breakers in general have become a safety concern due to their catastrophic and violent failures which typically expels sharp pieces of porcelain.

The drivers for these replacements are age, wear, amount of fault operations, and no repair part availability. Circuit breaker C has 102 fault operations, C1 has 23 fault operations, and C2 has 102 fault operations. The recommended value from the manufacturer is 10 fault operations. –Charleston, WV

Potential Solution:

Replace Amos 138kV circuit breaker C, C1, C2, 80kA CBs (2~ trip) with new 3000 A 80kA CBs (3~ trip).

Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $1.7M

Projected IS date: 11/9/2017

Status: Engineering

Supplemental Project

Problem Statement:

Breakers C & D at Chadwick and C at Kenova are 1800 A 27 kA FK-72.5 type and over 40 years old. These are oil breakers that have come more difficult to maintain due to the required oil handling. In general, oil spills occur often during routine maintenance and failures with these types of breakers. Other drivers include PCB content, damage to bushings and number of fault operations exceeding the recommendations of the manufacturer. Chadwick breakers C &D have had 25 and 16 fault operations respectively with breaker C at Kenova recording 32 fault operations. The manufacturer recommended limit for fault operations is 10 for these types of breakers.

Breaker E at Leach and A & B at England Hill are ~~also~~ 1200 A 20 kA CF-48 type oil breakers. Maintenance, as stated above, for oil breakers has become more difficult with age. In addition, these breakers also have bushing damage, some have exceeded the amount of fault operations recommended by the manufacturer and they are all experiencing mechanical breakdown associated with contacts and resistors. Lastly, the latest readings indicate moisture content has been trending unfavorably to higher levels. England Hill breaker B has had 22 fault operations. The manufacturer recommended limit for fault operations is 10 for these types of breakers.

There are currently five overlapping zones of protection at Chadwick station: 138kV Bellefonte line, 138kV Kentucky Electric Steel, 138kV bus differential, transformer #1 differential, and the 69kV bus differential. This setup is prone to misoperations. Installing line breakers on the Bellefonte and Kentucky Electric Steel lines will isolate the line protection from the bus protection, thereby shielding the 138kV Chadwick bus from faults on the nearby 138kV lines. In accordance to AEP guidelines, no more than two protection zones can be combined. Since the 69 kV breakers are being addressed as part of this project, AEP is taking the opportunity to also fix the overlapping zone concern. – KY, OH, WV border

Potential Solution:

At Chadwick 138kV station, install two 138 kV circuit breakers in place of the MOAB switches “V” and “Y”. Replace 69kV circuit breakers C and D with 3000 A 40 kA breakers.

At Leach station, replace 69 kV breaker E with a 3000 A 40 kA breaker.

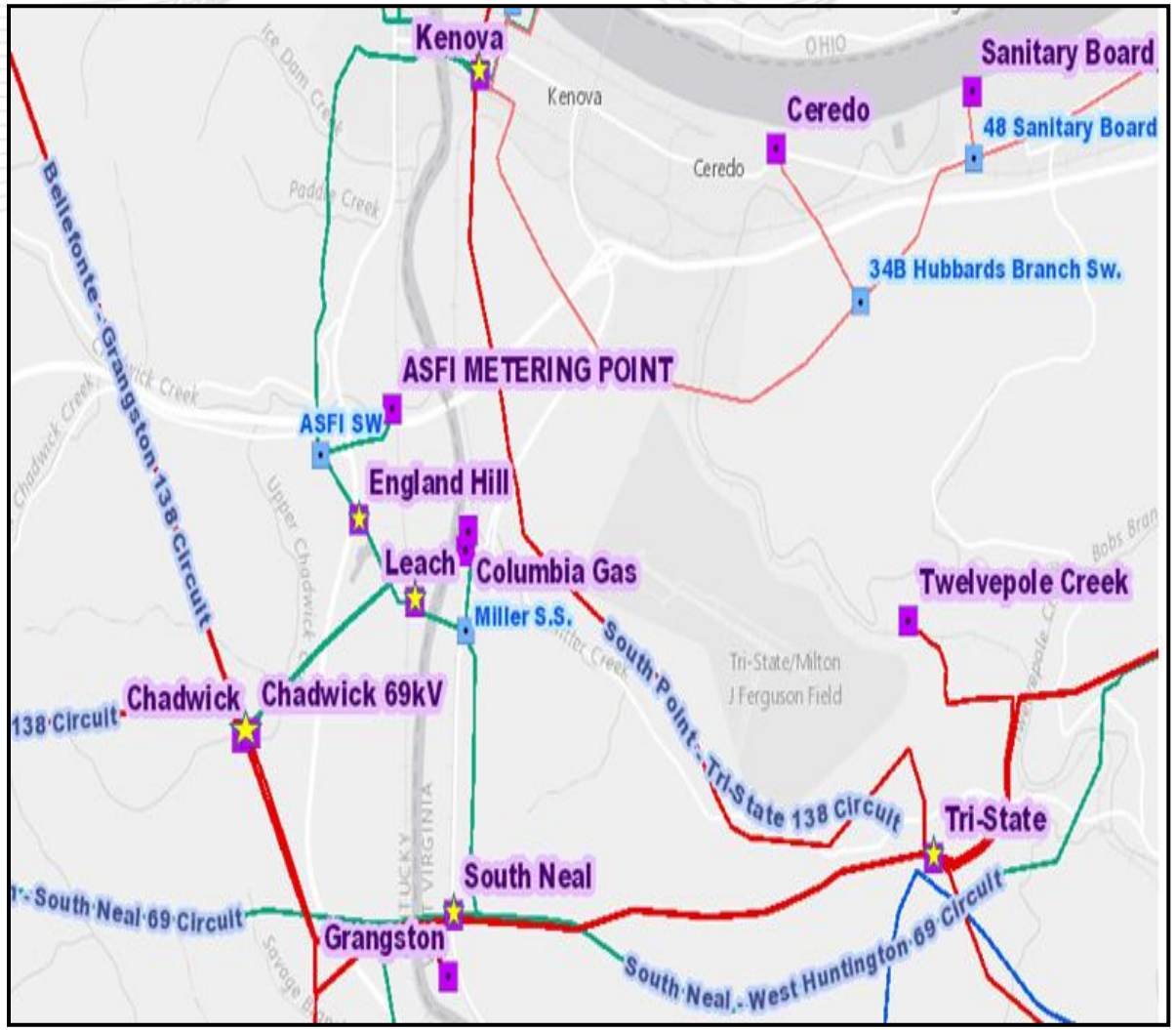
At England Hill, replace 69 kV circuit breakers A and B with 3000 A 40 kA breakers.

At Kenova, replace 69 kV circuit breaker C with a 3000 A 40 kA breaker.

Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $10.94M
Projected IS date: 6/7/2017
Status: Under Construction



AEP Transmission Zone

Supplemental Project

Problem Statement:

Battelle (4.5 MVA load served out of Nautilus station) has requested AEP to upgrade its Transmission service with looped service. Nautilus is currently served radially at 69 kV from Blair station. Looped 69 kV service will be provided to Nautilus and Blair from Trabue station by rebuilding portions of the West-Wilson Road 40 kV radial line to 69 kV and reconnecting to the Trabue-Galloway Road 69 kV line. The remaining portions of 40 kV circuit will be retired, along with West station.

The West-Wilson Road 40 kV radial line was originally constructed in 1953 and has 143 open A conditions along the 12 mile long line. The 40 kV line was built with 2/0 ACSR conductor (22 MVA rating). The radial line makes it difficult to secure outages to perform maintenance as any outage directly affects two industrial customers and an Ohio Power Company Distribution station. –West side of Columbus, OH

Potential Solution:

Retire West 40kV Station and North Galloway 40kV Switch.

Rebuild portions of the West-Wilson Road 40 kV line as 69 kV with 1033 ACSR conductor (125 MVA rating) to match the rest of the 69 kV through path and connect at Nautilus station.

Reconnect the rebuilt portion of the 40kV line to the Trabue-Galloway Road line to create a 69 kV loop through Nautilus and Blair stations.

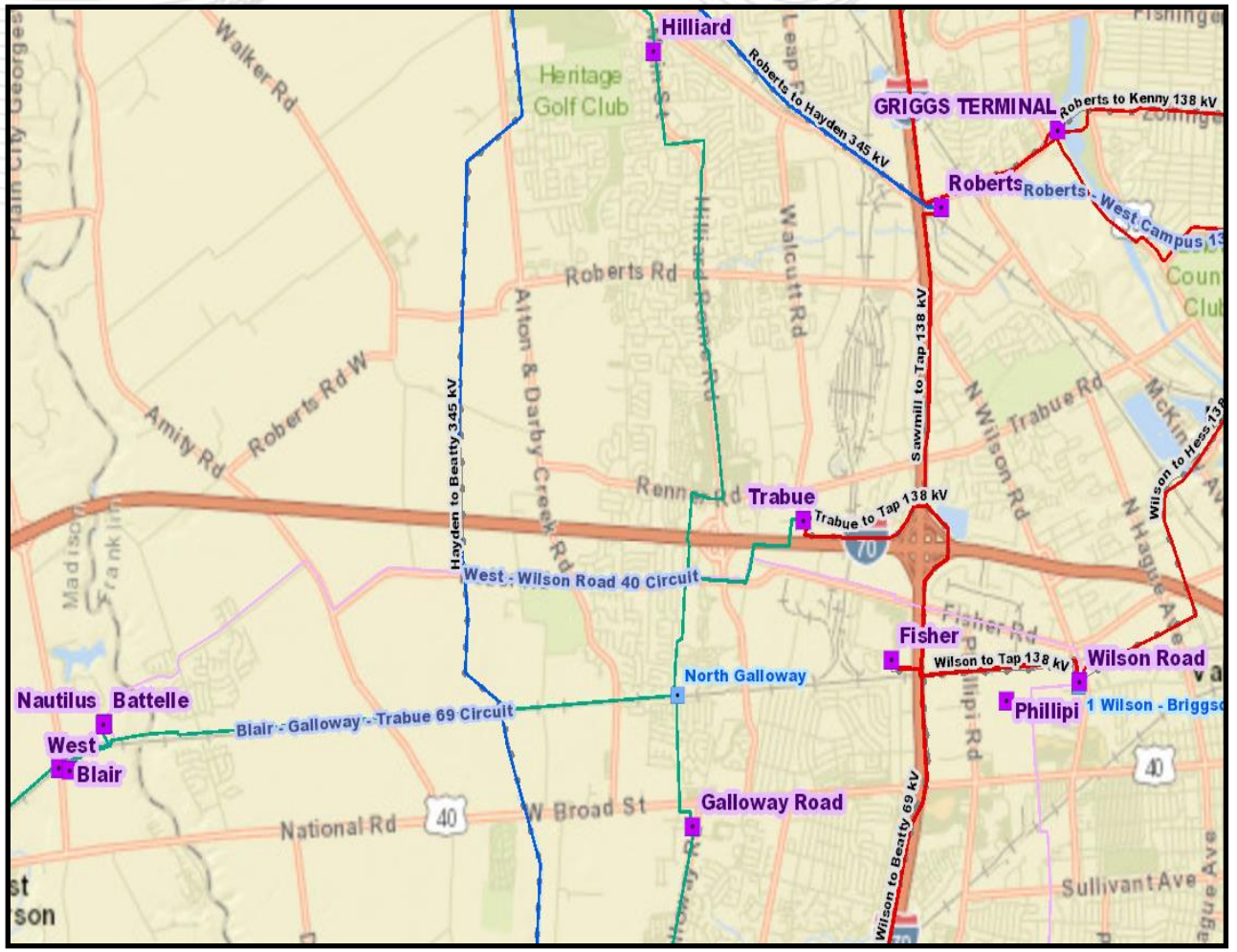
Retire remainder of the West-Wilson Road 40 kV line.

Retire a portion of the Trabue-Galloway Road 40kV line.

Alternatives:

A 138 kV loop between Fisher and Trabue was considered to feed Nautilus station. Due to construction constraints around a river crossing and a portion that would have to be constructed underground, this option was eliminated. Estimated cost: $35M

Estimated Cost: $22.3M
Projected IS date: 12/1/2017
Status: Construction



Supplemental Project

Problem Statement:

The Calcutta-North Wellsville 69kV line was built in 1939 utilizing wood structures with wooden cross-arms & spar-arms. The existing conductors are a mix of 3/0 Copper and 336 ACSR, with brittle copper shield wire (46 MVA rating). Due to the poor condition of the nearly-80-year-old conductors and poles, it is necessary to do a complete line rebuild rather than just a reconductor. This line has been subjected to 9 outages over the past three years and serves two distribution stations (Glenmoor and Calcutta) with over 7,000 customers. In addition to the general deterioration all along this line, there are 43 open A conditions on this 6.4 mile long line, a mix of damaged splices/conductor and broken/rotted poles.– East Liverpool, OH

Potential Solution:

Install New 69kV T-Line exits at North Wellsville 69kV substation and revised relay settings. Rebuild Calcutta-North Wellsville 69kV line section (6.4 miles) with the 1234 ACSR/TW conductor (90 MVA rating, non-conductor limited) to match the rest of the circuit, utilizing mostly single-circuit steel poles. Install ADSS fiber under-build. The first 1.0 mile from North Wellsville is a double-circuit with the North Wellsville-Second Street 69kV line and will be replaced with double circuit steel poles.

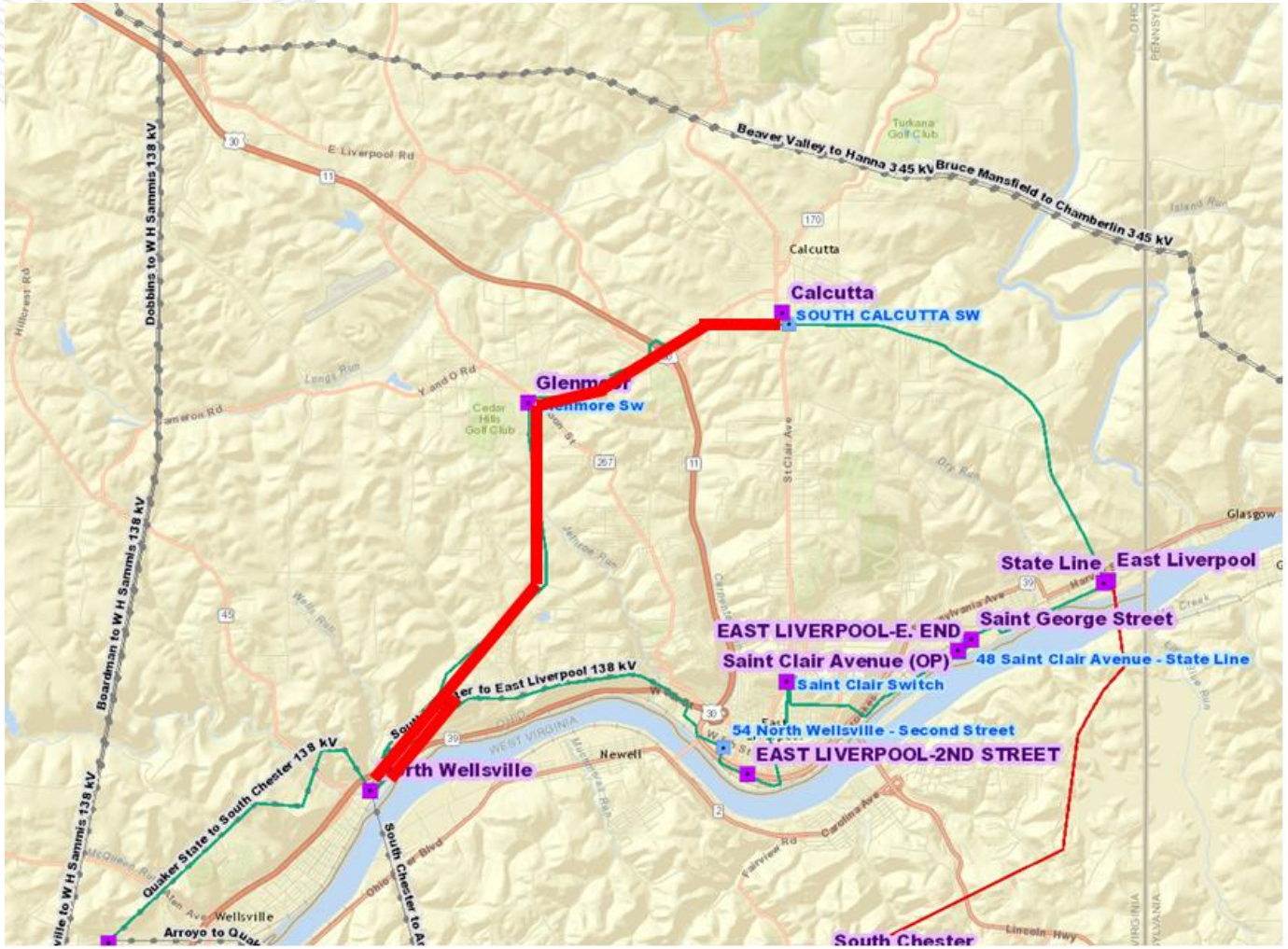
Alternatives:

No viable alternative besides rebuild due to lack of transmission alternates in the area to serve the two distribution stations. Poor conditions exist throughout the entire line and sectionalizing is not projected to reduce customer minutes of interruptions.

Estimated Cost: $6.25M

Projected IS date: 9/1/2017

Status: Construction



Supplemental Project

Problem Statement:

The five breakers at Capitol Hill station are all FK-339 32 kA breakers and use oil as the interrupting medium. The drivers for their replacement are age, repair part availability and bushing damage issues. In general oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. Oil spills are frequent with failures and routine maintenance which is also an environmental hazard. Breaker A has experienced 82 fault operations, breaker D 86 fault operations and breaker F 49 fault operations. The manufacturer's recommended amount is 10 fault operations. – Charleston, WV

Potential Solution:

Replace Capitol Hill 46kV circuit breakers F, A, S, D, & R with new 40kA breakers.

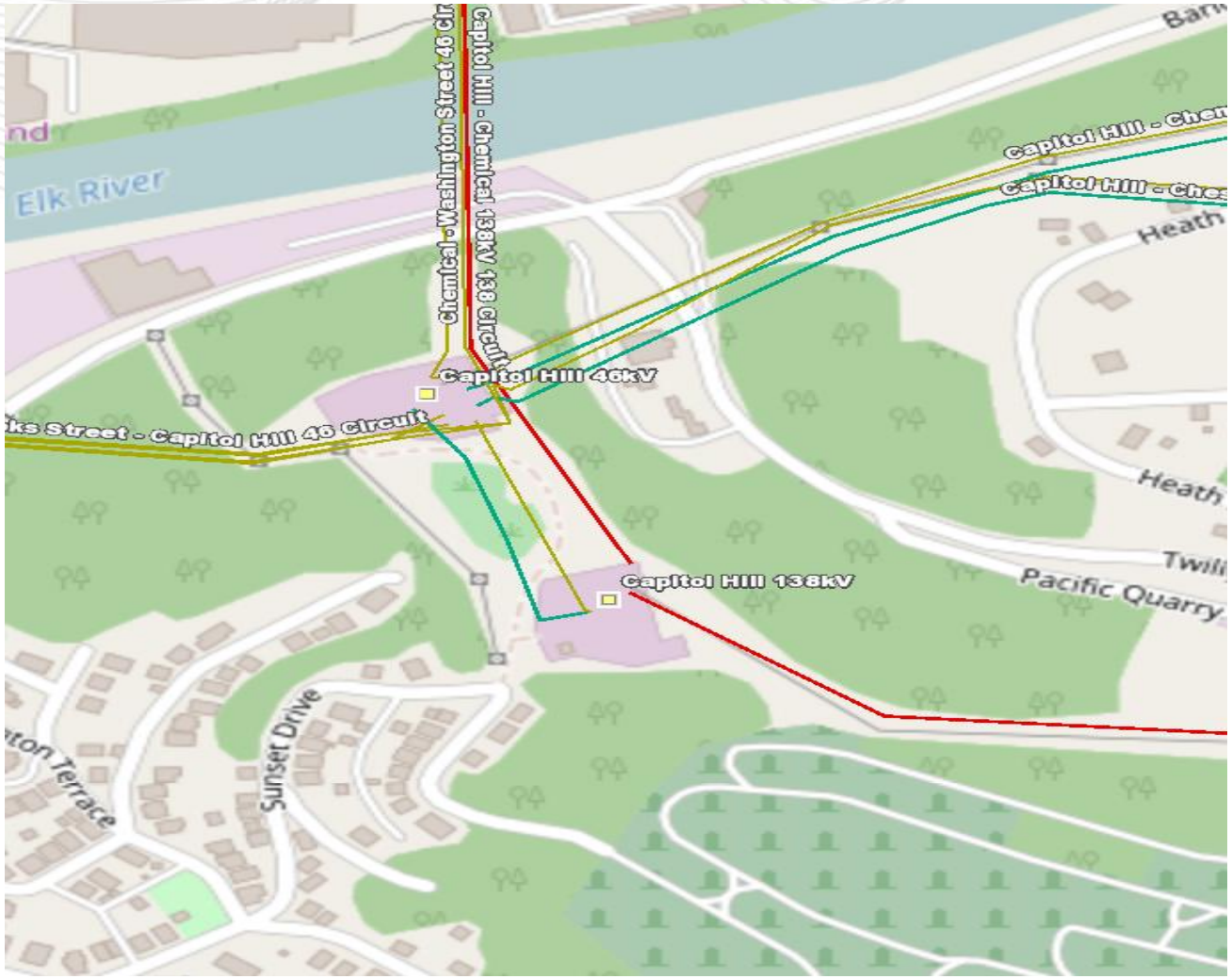
Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $3.81M

Projected IS date: 12/31/2017

Status: Engineering



Supplemental Project

Problem Statement:

The Dover Wire 69kV circuit breaker 'A' is an old GE 'FK' oil-filled breaker installed in 1956. It is a 9kA unit. The breaker is leaking oil and has had many recent maintenance issues. It has also operated through 95 fault operations, exceeding the manufacturer recommendation of 10. The breaker has the following documented conditions: age; bushing problems; unavailability of spare parts; lifetime fault operations count; and high moisture readings. Combined, these justify replacing the breaker.

The breaker disconnects use cap & pin insulators which are prone to failure and are a safety issue.

The station currently has no SCADA functionality. As part of the project, an RTU will be installed and 69kV SCADA controls, which will increase Operations' ability to sectionalize and restore loads in the area. –Dover, OH

Potential Solution:

Replace Dover Wire 69kV 9 kA breaker 'A' with a new 40 kA unit.

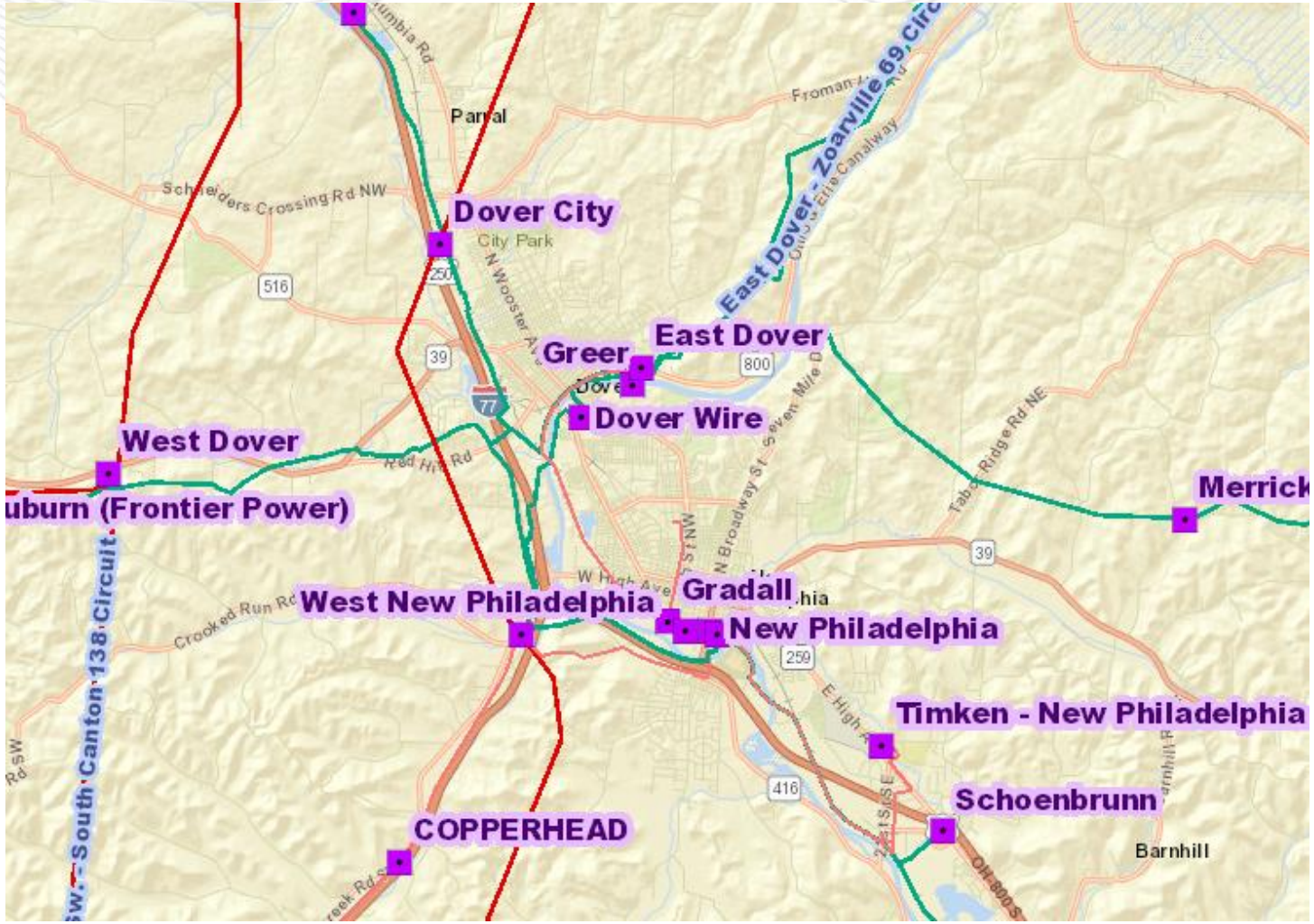
Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $0.63M

Projected IS date: 12/1/2017

Status: Engineering



Supplemental Project

Problem Statement:

There are currently four overlapping zones of protection at East Danville Station: 138kV Monument line, 138kV bus differential, 230kV Bus #2 differential and transformer #4 differential. This arrangement results in poor reliability as multiple elements are tripped resulting in potential consequential load loss. Also, this arrangement reduces the life of breakers by tripping them for events in any of the four protection zones. – Danville, VA

Potential Solution:

East Danville 138kV Station: Replace existing MOAB "V" on East Monument – East Danville 138kV Circuit with a new 3000A 40kA Circuit Breaker

Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $0.95M

Projected IS date: 10/27/2017

Status: Engineering

Supplemental Project

Problem Statement:

At East Monument station, 138 kV circuit breakers A and B are 45.5 kA GEC PK-2B50 type Air Blast breakers that were manufactured in 1979. Air blast breakers are being replaced across the AEP system due to their catastrophic and violent failures. Sharps pieces of porcelain from their bushings are typically expelled from the breakers and can be a potential safety hazard to field personnel. Other factors driving the replacement are age and scarce availability of spare parts. Breaker A has experienced 11 fault operations and breaker B has experienced 10 fault operations. This meets or exceeds the manufacturer's recommended 10 fault operations. – Danville, VA

Potential Solution:

Replace 138 kV Circuit Breakers A and B with new 40 kA Breakers at East Monument 138kV station

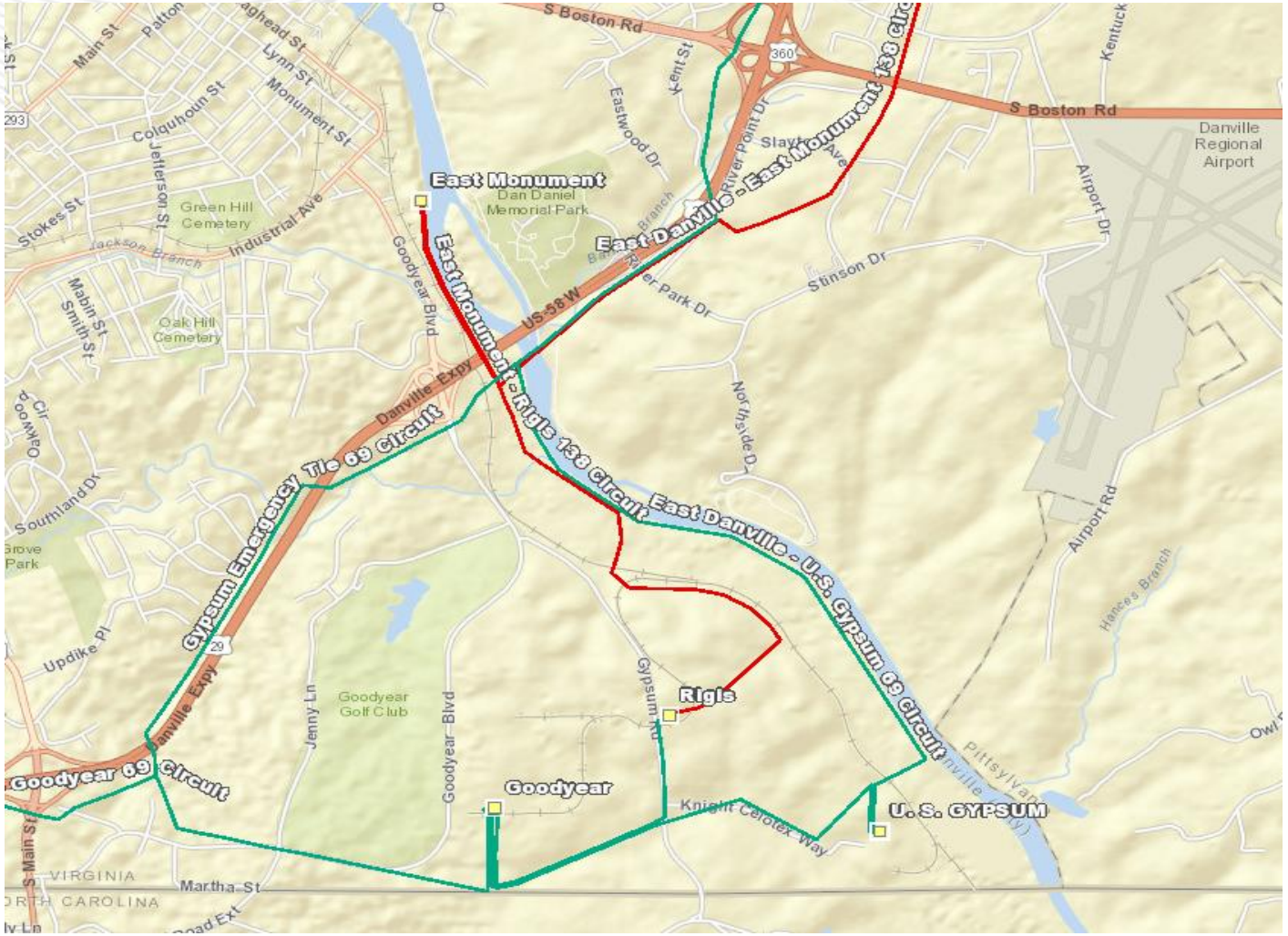
Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $3.0M

Projected IS date: 10/27/2017

Status: Engineering



Supplemental Project

Problem Statement:

The two Georges Run 69kV circuit breakers 'D' and 'E' are 1200 A 16.6 kA GE 'FK' oil breakers made in 1964. The breakers have the following conditions: age; unavailability of spare parts; lifetime fault operations count (40 & 33, compared to a recommended limit of 10); and high moisture readings (35-40 ppm, compared to guidance of 20). Combined, these justify replacing the breakers.

However, due to the multi-level substation yard, it is not feasible to install new breakers and controls. New 69kV motor-operated switches with auto-sectionalizing capability will be installed in place of the breakers; these switches will have SCADA control. Steubenville, OH

Potential Solution:

Georges Run 69kV: Retire and remove the two 69kV line breakers and replace with two 69kV motor-operated switches (with auto-sectionalizing).

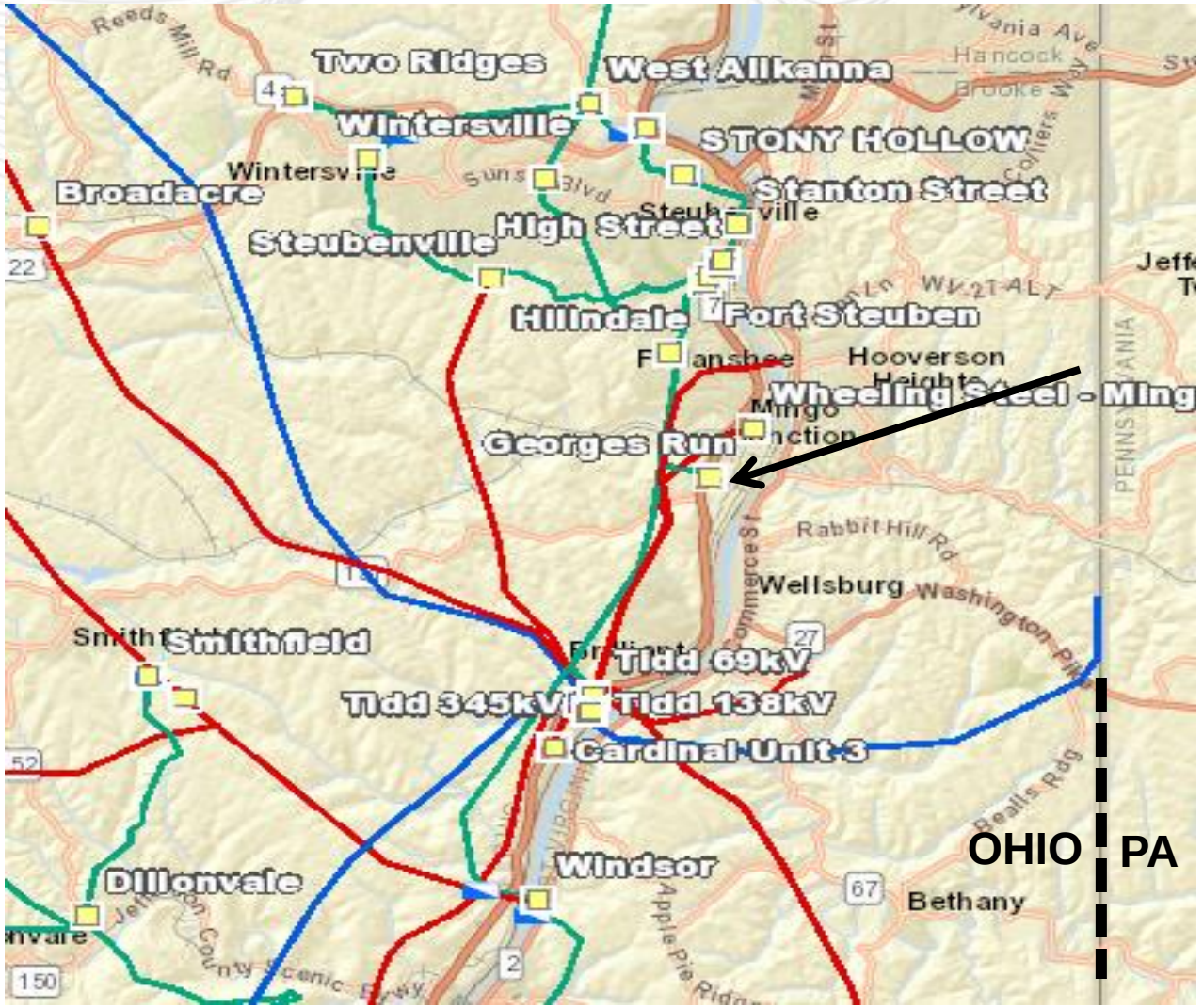
Alternatives:

Replace the problematic oil breakers with new SF6 gas breakers, along with updated relays/control/SCADA. Due to the unique multi-level substation site, this is not feasible on the existing property. Other properties were reviewed in the area for a new, flat substation site, but ultimately weren't pursued. Estimated cost: $1.5M

Estimated Cost: $0.43M

Projected IS date: 12/1/2017

Status: Engineering



Supplemental Project

Problem Statement:

The existing Gravel Pit 34.5/12 kV transformer is 1950's vintage. The Gravel Pit 34.5 kV line was built in the 1950s with 795 AAC conductor (62 MVA rating). Between 2012-2015, 5.4 million customer minutes of interruption (CMI) were recorded at Gravel Pit station due to outages related to the condition of the 4.7 mile radial transmission line. There are 26 open A conditions along the line.

More than 40% of the load at Gravel Pit is not recoverable from / transferable to other sites making rebuilding the existing line impractical. In addition, 34.5 kV system is out of phase with 69 kV and 138 kV networks that results in additional outages when customers have to be transferred to a different source. –South Bend, IN

Potential Solution:

Replace and convert the existing Gravel Pit 34.5/12 kV station with a 138/12 kV station.

Construct two single circuit 138 kV lines (795 ACSR conductor, 251 MVA rating), approximately 6 miles total and tap the Jackson Road – New Carlisle 138 kV line (Edison – Kankakee 138 kV ckt).

Retire the 34.5 kV tap line that at present is utilized to serve Gravel Pit station from the Jackson Road – Kankakee 34.5 kV ckt and retire Gravel Pit station.

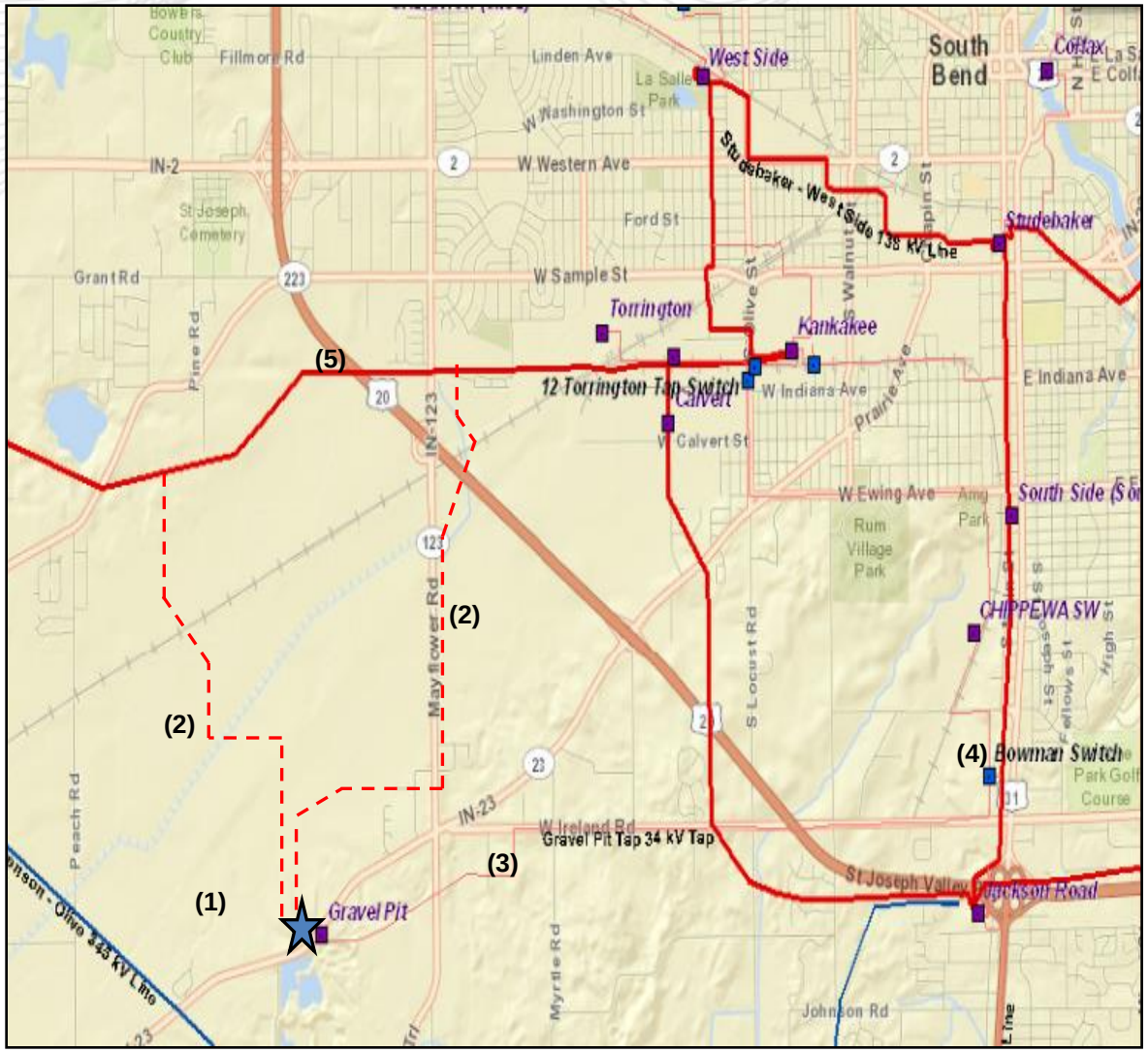
Retire Bowman Creek 34.5 kV switch.

De-energize sections of the Jackson Road – New Carlisle 138 kV line (Edison – Kankakee 138 kV ckt).

Alternatives:

- Rebuild the existing 34.5 kV line tap to Gravel Pit as a double circuit 34.5 kV line. This option would require complete shut down of Gravel Pit station while the line is being rebuilt. A portion of the Gravel Pit load cannot be picked from an alternate source. Therefore, the construction sequence would be complex and involve multiple load drop and pick scenarios when changing sources for the load. Estimated cost: $15M
- Construct the 138 kV in and out from the Jackson Road – Kankakee circuit. While similar in cost, the route for this line would be more difficult to obtain due to area congestion. Estimated cost: $19M

Estimated Cost: $17.24M
Projected IS date: 12/1/2018
Status: Engineering



Supplemental Project

Problem Statement:

Breakers C and D at Layland station are oil breakers built in 1964. The breakers have the following documented conditions: age, bushing damage, scarce availability of spare parts for break and fix scenarios, and number of fault operations. Breaker C has had 402 fault operations and breaker D has had 309 fault operations. The manufacturer's recommended amount is 10 fault operations. In general oil breakers are more difficult to maintain because of the oil handling. Oil spills happen often with failures and routine maintenance which can become an environmental hazard. The existing steel structures were initially installed in 1969 and in poor shape due to rust and wear. For this reason, the 69kV bus will be rebuilt.

There are currently four overlapping zones of protection at Layland 69kV station: McClung 69kV line, 69kV bus differential and 69/12kV transformer differential. This arrangement results in poor reliability as multiple elements are tripped resulting in potential consequential load loss. 69kV Breaker E is being added to the McClung line in order to reduce the number of overlapping zones. –Fayette County, WV

Potential Solution:

Layland 69kV Station: Replace 21 kA circuit breakers C and D with new 40kA CBs. Replace MOAB "X" with a new 40kA CB. Rebuild the 69kV Bus.

Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $2.0M

Projected IS date: 12/29/2017

Status: Engineering

Supplemental Project

Problem Statement:

Marathon Pipe Line LLC has requested 4 MW 69 kV service in Heath, OH off of the Heath – Newark 69 kV circuit (structure #6 Heath – Southgate 69 kV line). They have requested a in service date of March 2017.

In addition to the customer needs, this project will rebuild the small section (<1/4 mile) of line between the new phase-over-phase switch and Heath Station. To coordinate outages, the small section between structures #1 and #7 will be included with the customer project. This section contains five structures with open Category A conditions (Structures 1, 2, 3, 5, 6) constructed with 4/0 copper conductors (54 MVA rating). – Newark, OH

Potential Solution:

Install new 69kV 3-Way phase-over-phase switch with one MOAB towards Newark Station.

Install new 69kV metering outside of the customer station.

Reroute Heath – Newark 69kV circuit to connect the new 69kV phase-over-phase switch and install a 69kV radial line to the customer metering structure.

Rebuild section between the new phase-over-phase switch and Heath Station.

All through-path 69kV will be rebuilt with 556 ACSR Dove conductor (102 MVA rating).

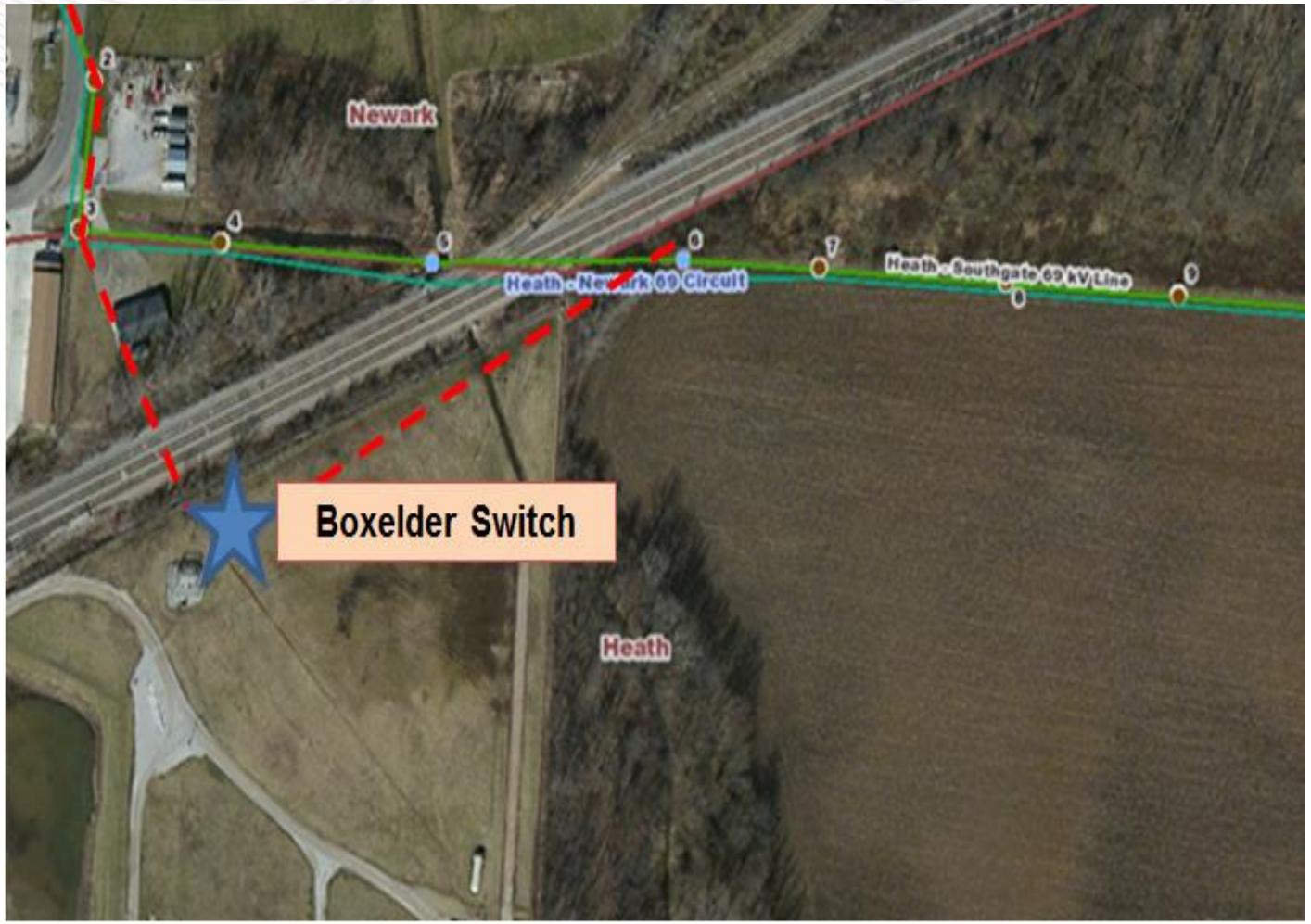
Alternatives:

- Install a new 69kV station with line circuit breakers instead of a phase-over-phase switch to serve the customer. This option was eliminated from contention due to the proximity of the facility to AEP's Heath Station. Estimated cost: $3M
- Construct new line to serve customer directly from Heath station. Space constraints at Heath station don't allow for expansion and new ROW would be required through an already congested corridor to serve the new load. Estimated cost: $2M

Estimated Cost: $1.4M

Projected IS date: 4/25/2017

Status: In Service



AEP Transmission Zone

Supplemental Project

Problem Statement:

Currently, the Miles Avenue 138-12 kV AEP Ohio distribution station is served via a 2-way switch tapping the South Canton-West Canton #2 138 kV line, with a radial feed to Miles Avenue station. The line switch failed and is not currently operable. When work must be done on the 10-mile 138kV circuit, the entire Miles Avenue station must be taken out of service due to the inoperability of the switch. In addition, the property near the switch now has various residential buildings, making switch maintenance or replacement very difficult (located in a backyard, with a pool nearby). For this reason it is necessary to remove the inaccessible switch and instead install 138kV line breakers within the station fence.

In addition, a ground-switch scheme, which trips the entire 138kV circuit for a transformer fault (interruption to 8,700 customers at Miles Ave, Reedurban, Negley and takes out the 138-69 kV source at Reedurban) results in unnecessary fault operation of remote end breakers thus reducing their operational life span.

For the past six years, the switch serving Miles Avenue station has been inoperable, creating various operational challenges for local crews and Transmission dispatchers. In addition, distribution load must be transferred to other stations during these events, which may not be possible year-round. Also, the radial 138kV T-Line tap is difficult to maintain due to the radial feed. There is also no SCADA capability at Miles Ave currently.

This line meets AEP's MPOI (Momentary/Permanent Outage Index) calculation guideline for breaker installations listed in AEP's Customer Connection Requirements document.

For the 2013-16 period, this 138kV circuit had over 640,000 customer-minutes-interrupted (CMI). –Canton, OH

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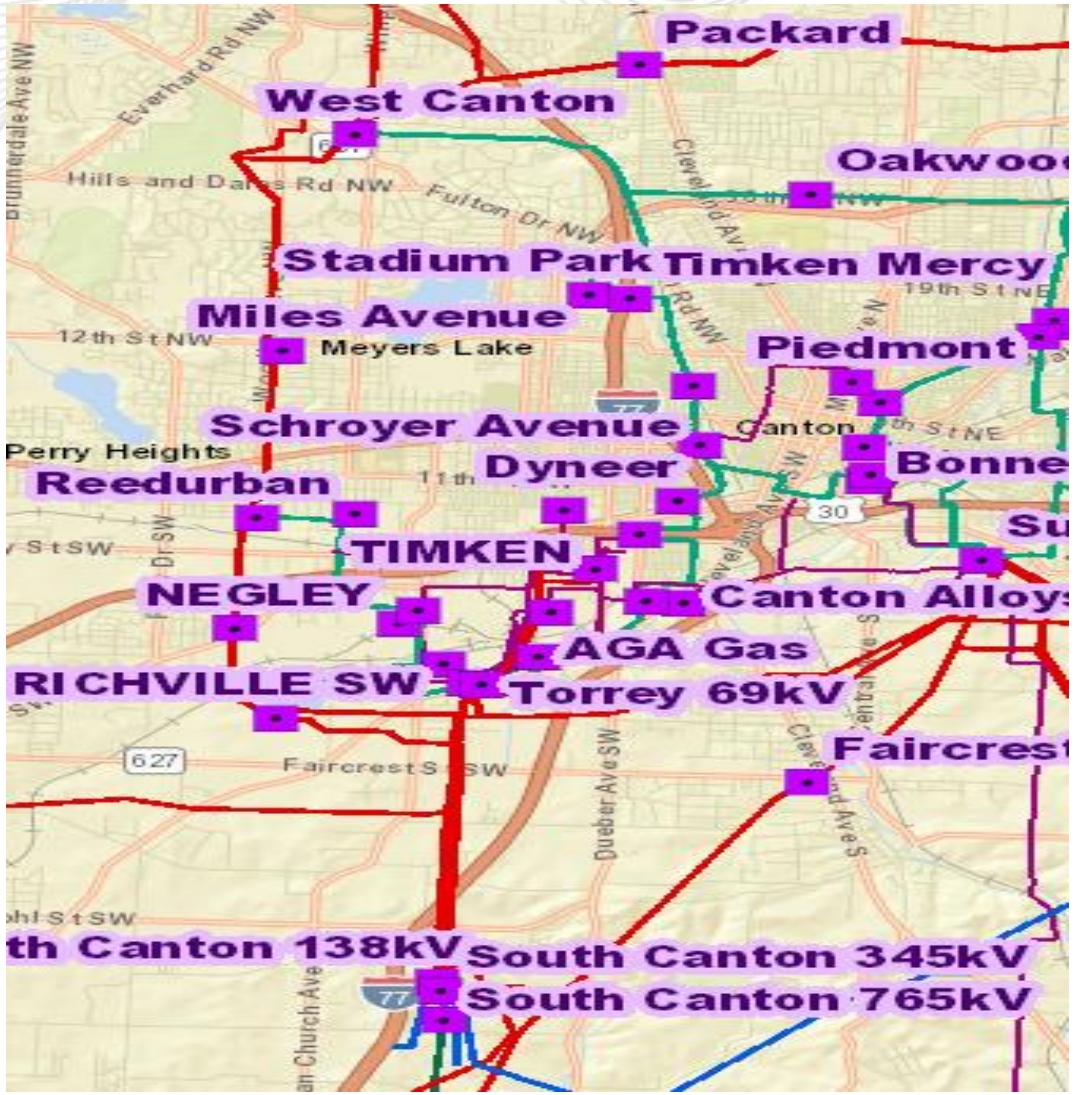

Supplemental Project

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Potential Solution:

Miles Avenue 138kV Station: Install a 138kV bus, 2- 138kV 3000 A 40 kA line breakers (to West Canton & South Canton), new relay panels, and an RTU with SCADA. Remove the ground switching MOAB scheme that places a fault on the line for transformer faults.

South Canton & West Canton 138kV Station: update relay settings accordingly

On the South Canton-West Canton #2 138kV line, remove the inoperable 2-way 138kV line switch. (Note that this is part of a double-circuit towerline.)

Extend a short 138kV double-circuit T-Line loop into Miles Avenue station with 795 ACSR (257 MVA rating, approximately 325 ft.).

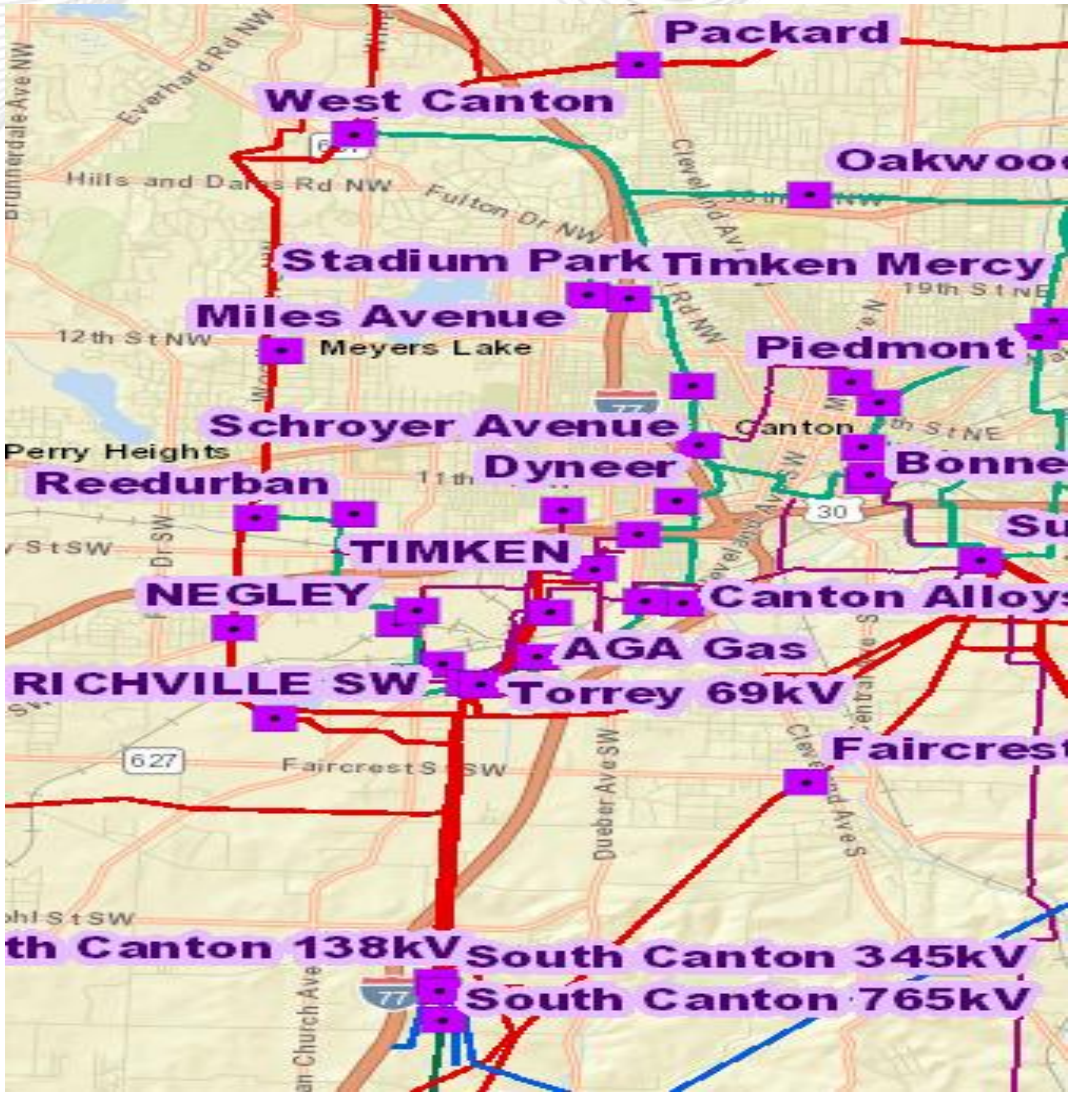
Alternatives:

Purchase the properties near the existing line switch and install a new, easier-to-access 3-way 138kV line switch. This is not practical due to the two homes nearby, which would need to be demolished. In addition, this option would leave a radial 138kV line serving the station, which is a maintenance challenge. The cost of purchasing the houses is not assumed in the estimate. Estimated cost: $1M

Estimated Cost: $2.6M

Projected IS date: 11/1/2017

Status: Engineering



AEP Transmission Zone

Supplemental Project

Problem Statement:

Glen Lyn 138kV Breakers K & J are 1600 A 40 kA type FGK-138-10000 and use oil as the interrupting medium. Circuit Breaker J had 334 fault operations which exceeds the manufacturer's recommended amount of 10 fault operations. These are oil breakers that have come more difficult to maintain due to the required oil handling. Environmental risks are also present due to oil spills resulting from failures and maintenance.

Merrimac 69kV breakers N & M are 1200 A 20 kA CF type oil breakers. The drivers for replacements are amount of fault operations and issues pertaining to bushings. Mechanical issues around the breaker contact's timing and speed have also led to their replacement. These are oil breakers that have come more difficult to maintain due to the required oil handling. Environmental risks are also present due to oil spills resulting from failures and maintenance. Circuit Breaker M has had 52 fault operations, which exceeds to manufacturer's recommended amount of 10 fault operations.

Catawba 69kV Breaker B is a 2000 A 31.5 kA type CGH-50-72.5-31.5 breaker and uses oil as the interrupting medium. Drivers for replacing are amount of fault operations (184 fault operations exceeds manufacturer's recommended amount of 10), no spare part availability, recurrent issues with bushings and increased maintenance. There are only 8 breakers of this type across the AEP system. With break and fix type scenarios spare parts are not readily available.

Cloverdale – Glen Lyn is approximately a 60 mile line with no sectionalizing capabilities. MPOI calculation justifies the need for breakers to be installed at Catawba Station in accordance with AEP's Interconnection Requirements. Matt Funk – Celanese line is approximately 33 miles long with no sectionalizing capabilities. In order to provide sectionalizing along this line 138kV breakers are being installed at North Blacksburg.

Ground switch MOABs complicate the protection scheme and reduce the life of circuit breakers as they introduce a line fault so the breakers can see a transformer fault. These ground switch MOABs are being replaced with circuit switchers on transformers at Catawba (XF1 and XF2) and N. Blacksburg (XF1 and XF2) to improve operational flexibility. Fiber/relaying upgrades are being installed on lines to replace existing pilot wire that has been cut out. – Blacksburg, VA

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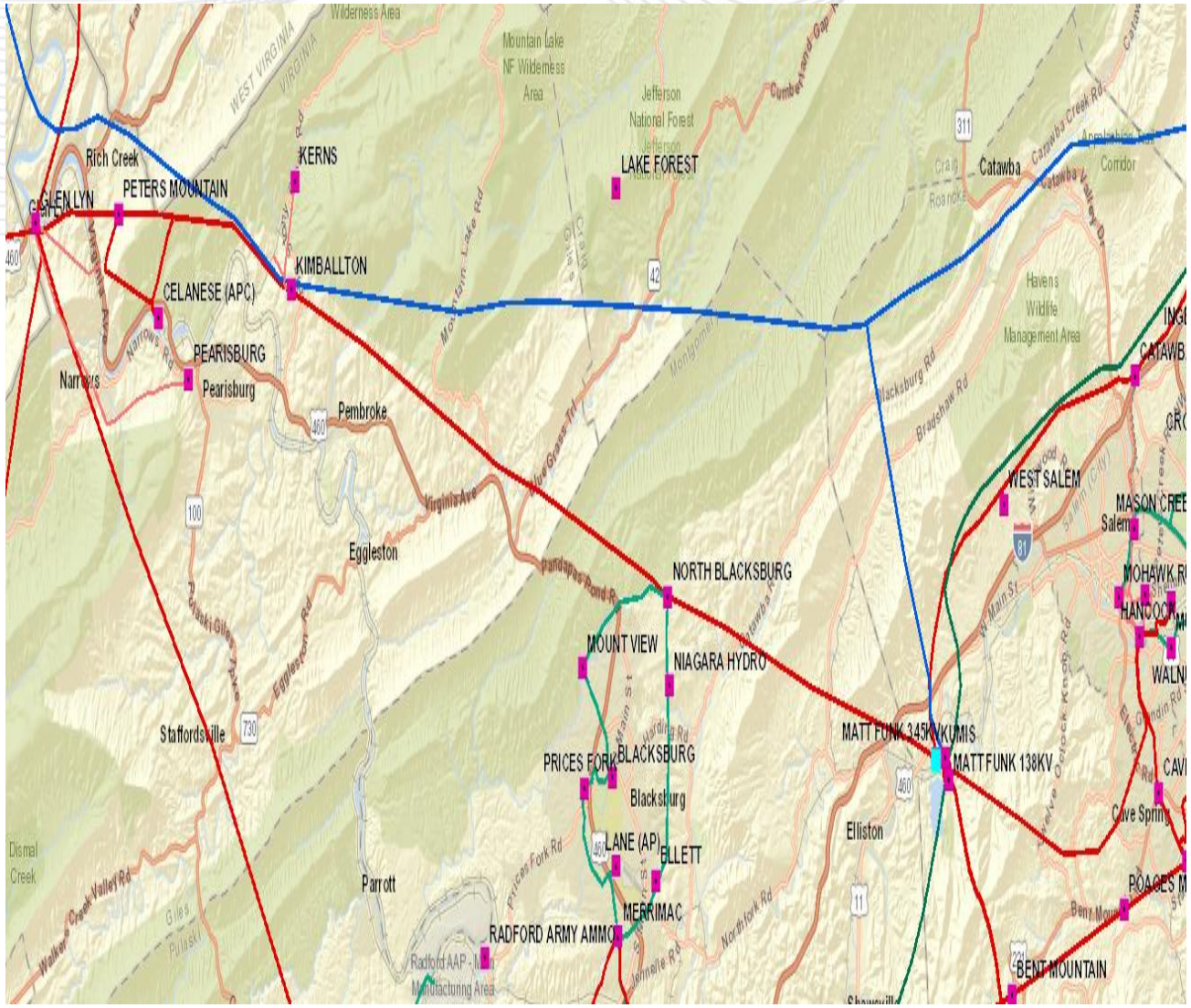

Supplemental Project

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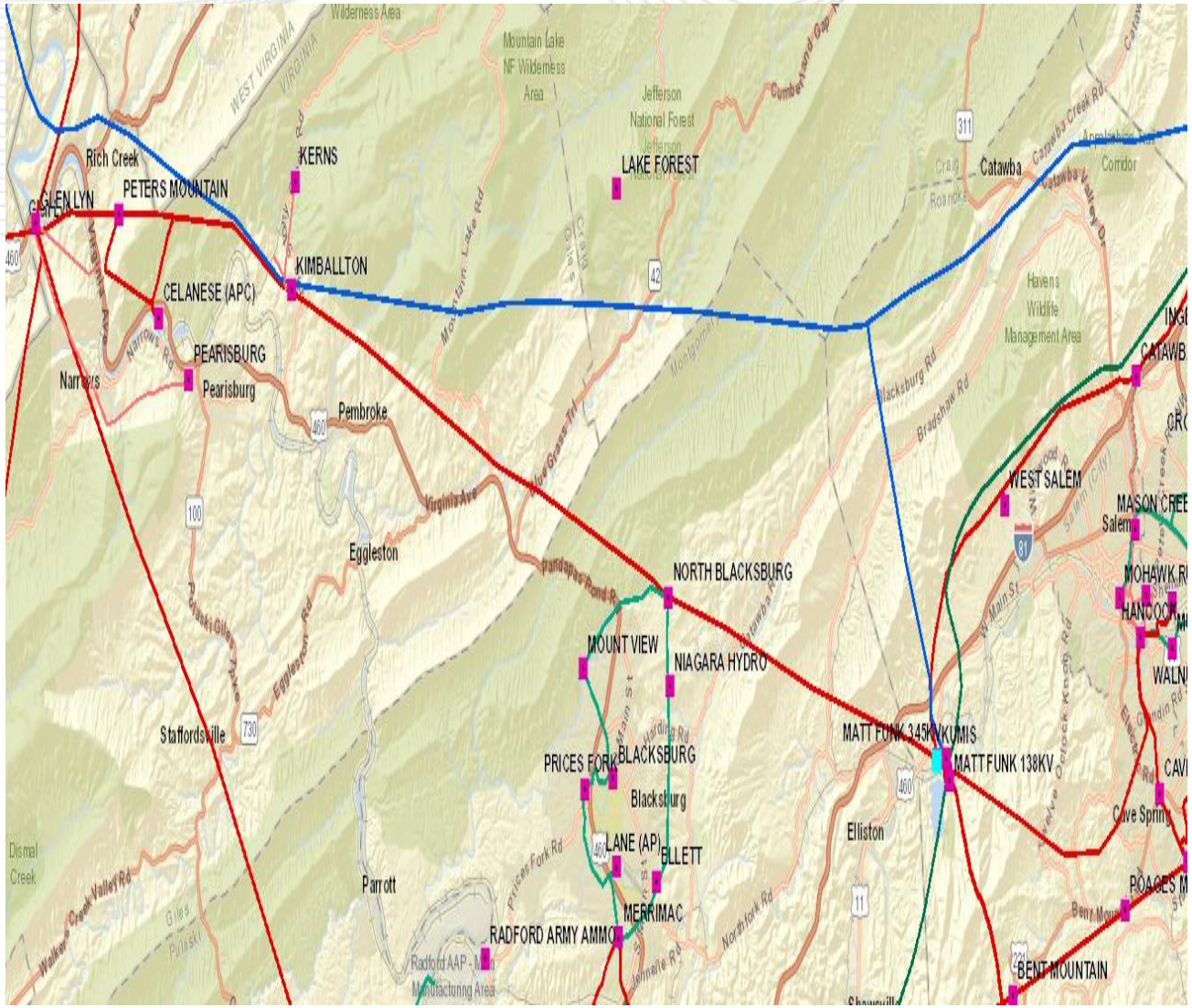
Potential Solution:

North Blacksburg – Matt Funk 138kV line relaying/fiber
North Blacksburg – Celanese 138kV line relaying
Glen Lyn – Catawba – Cloverdale 138kV line relaying/fiber
Glen Lyn – Peters MT. 138kV relaying/fiber
North Blacksburg – Lane 69kV relaying/fiber
North Blacksburg – Blacksburg 69kV relaying/fiber
Lane – Merrimac 69kV relaying/fiber
Merrimac – North Blacksburg 69kV relaying/fiber
North Blacksburg Station: Install 3000 A 40 kA 138kV CBs and switchers on the transformers
Glen Lyn 138kV Station: Replace two 138kV CBs with 3000 A 40 kA breakers.
Merrimac 69kV Station: Replace two 69kV CBs with 3000 A 40 kA breakers.
Catawba 138kV Station: Install two 3000 A 40 kA 138kV CBs, two 138kV switchers on the transformers, and three 3000 A 40 kA 69kV CBs

Alternatives:

- Rebuild Cloverdale – Glen Lyn 138kV double circuit line (59.36 miles). Estimated cost: $130M
- Add a second static to the Cloverdale – Glen Lyn 138kV double circuit line (59.36 miles). Majority of the towers along the line are 1940s and would need to be replaced to withstand the added weight. Outage constraints along the line would not be feasible due to the length. This project would only address the anticipated fault operations and would just defer the replacement of the circuit breakers for a few years. Conceptual Estimated Cost: ~$120M

Estimated Cost: $37.5M
Projected IS date: 6/1/2018
Status: Construction



Supplemental Project

Problem Statement:

Tidd: 138kV breaker D1 is a 1600 A 50 kA 1960's vintage GE 'ATB' air-blast breaker that has shown signs of failure. It has a severe gas leak, which requires gas to be balanced every other day, and gas additions bi-weekly. This breaker has the following documented conditions: age, unavailability of spare parts, high number of fault interruptions (18, whereas the recommended lifetime limit is 10). – Brilliant, OH

Potential Solution:

Replace Tidd 138kV breaker D1 with a new 3000A/63kA breaker to match the other breakers at the station.

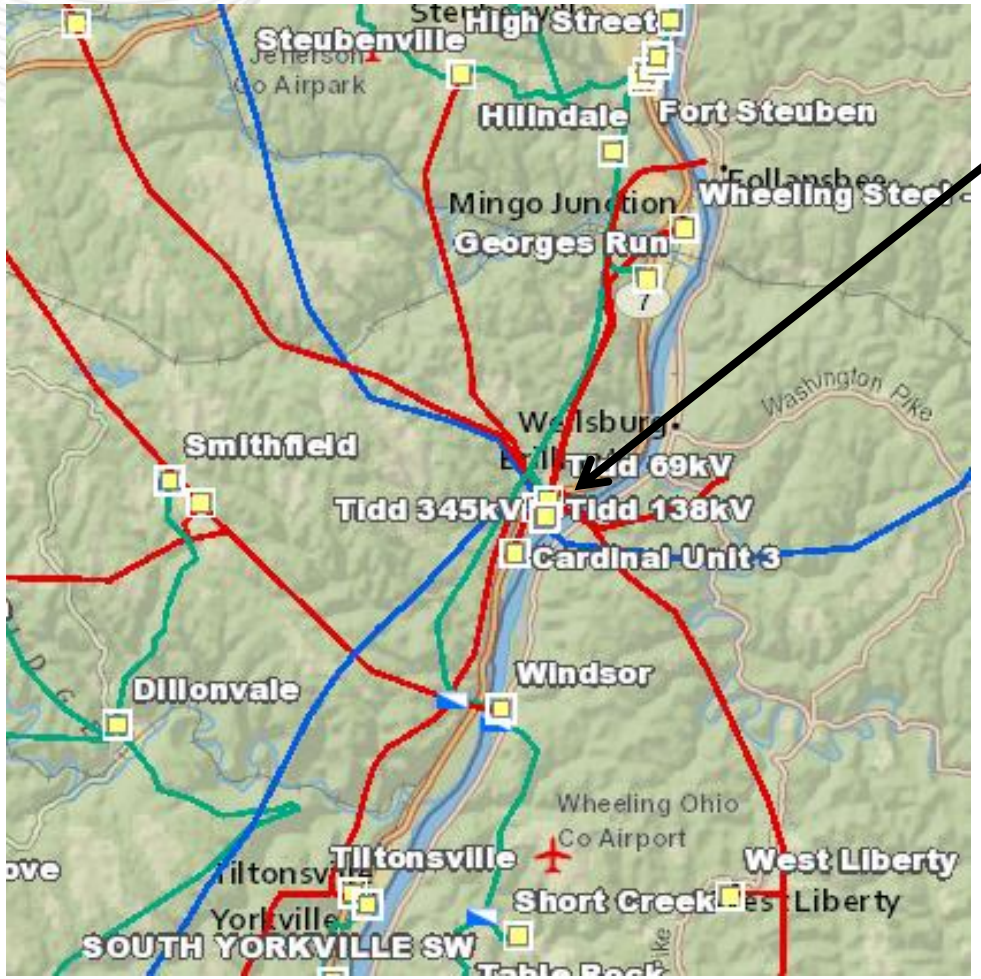
Alternatives:

No good transmission alternative.

Estimated Cost: $0.261M

Projected IS date: 4/20/2017

Status: In Service



Tidd Substation (Jefferson County, OH)

Supplemental Project

Problem Statement:

The existing Robison Park 600 MVA 345/138 kV transformer was manufactured in 1968 and has issues with oil leaks, leading to the need for additional maintenance outages. – Fort Wayne, IN

Potential Solution:

Replace Robison Park 345/138 kV Transformer #5 and associated equipment with a 675 MVA transformer.

Alternatives:

No additional cost effective alternatives were identified.

Estimated Cost: $4.5M
Projected IS date: 12/31/2017
Status: Engineering

Supplemental Project

Problem Statement:

The existing 8 mile, 69 kV line section between Phillips Tap and Kendallville was constructed in 1957 using wood pole structures with 4/0 ACSR conductor (50 MVA rating). There are 270 open A conditions on this line, including rotten cross-arms, burnt/broken insulators, and loose/broken conductor hardware. The Albion-Kendallville 69 kV circuit has experienced over a million customer minutes of interruption in the past three years. – Fort Wayne, IN

Potential Solution:

Rebuild approximately 8 miles of 69 kV line between Albion and Kendallville stations (starting at structure 32) using 795 ACSR conductor (128 MVA rating) on the existing circuit centerline.

Alternatives:

Rebuild the existing 69 kV line in the clear was an option considered, but was eliminated due to the increased cost of acquiring additional ROW and the additional impact to local landowners, environment and community. Estimated cost: $12M

Estimated Cost: $7.625M

Projected IS date: 6/1/2018

Status: Engineering

Supplemental Project

Problem Statement:
69 kV breakers A, B, and C at East Lancaster are McGraw-Edison, CF-type oil filled breakers manufactured in 1962, 1964 and 1965. Oil filled breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. Breakers B has had 337 fault operations and breaker C has had 88 fault operations. The manufacturer recommendation is 10 for this type of breaker. Breakers A, B and C have the following documented conditions: PCB content, fault operation exceeding manufacturer life expectancy, availability of spare parts, bushing damage, and age. – Lancaster, OH

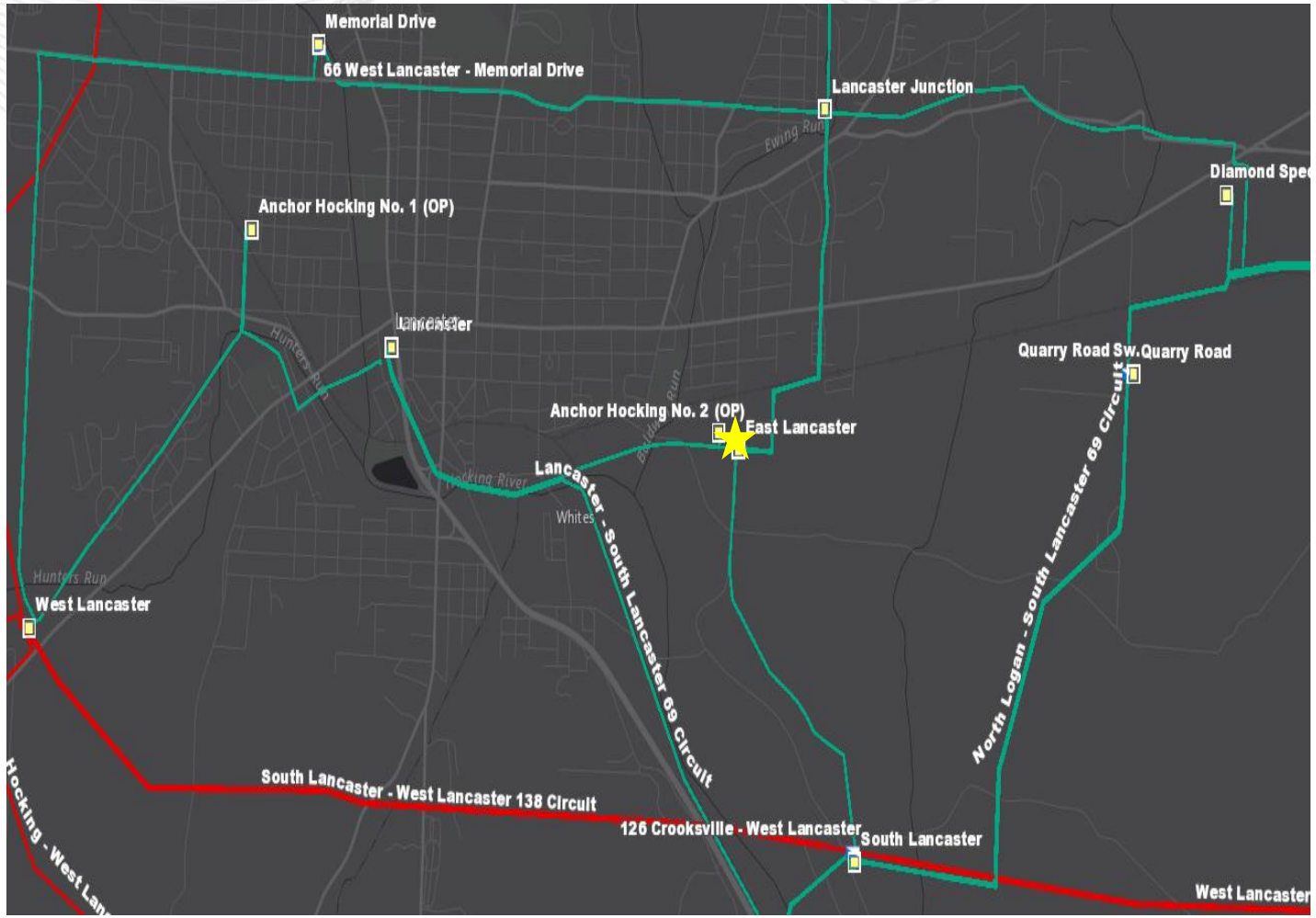
Potential Solution:
Replace East Lancaster 69 kV breakers A (21 kA), B (21 kA), and C (29 kA) with new 40 kA units.

Alternatives:
No good cost effective alternatives were identified.

Estimated Cost: $1.236M

Projected IS date: 12/1/2017

Status: Engineering



Supplemental Project

Problem Statement:

69 kV breakers B, C, and D at South Lancaster station are all McGraw-Edison, CF-type oil filled breakers manufactured in 1969. Oil filled breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. Breaker B has had 125 fault operations over its lifetime. Breaker C has had 56 fault operations over its lifetime. Breaker D has had 76 fault operations over its lifetime. The manufacturer recommendation is 10 operations for this breaker type. Breakers B, C and D have the following documented conditions: high moisture readings, fault operation exceeding manufacturer life expectancy, bushing maintenance issues, and age. – Lancaster, OH

Potential Solution:

Replace the South Lancaster 69 kV 21 kA circuit breakers B, C and D with new 40 kA units.

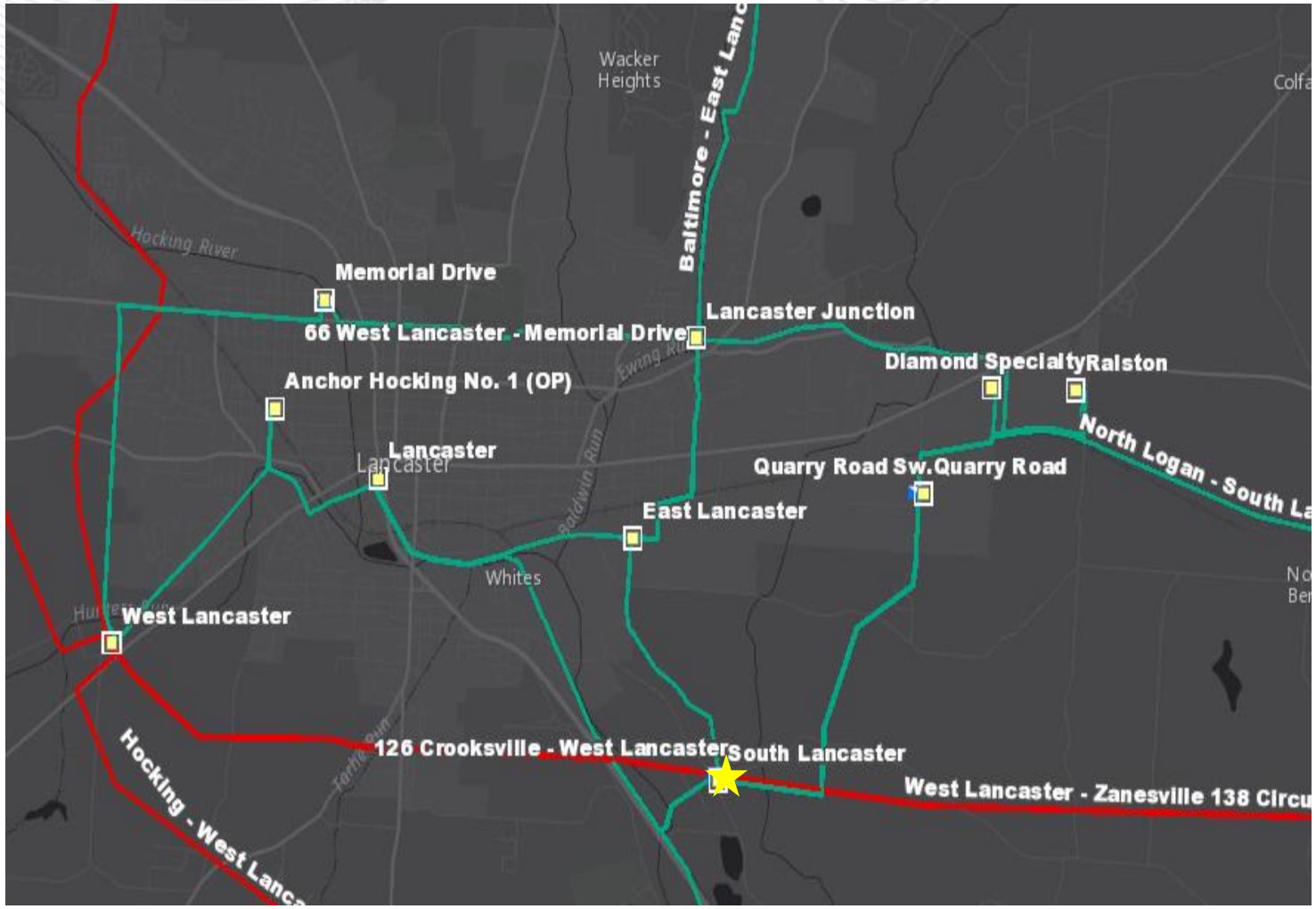
Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $1.8M

Projected IS date: 6/30/2017

Status: Engineering



Supplemental Project

Problem Statement:

The transmission lines owned by Century Aluminum serve two other customers. In order to maintain service to these customers, it is necessary to purchase these transmission facilities. –Ravenswood, WV

Potential Solution:

Purchase Transmission lines owned by Century Aluminum, which has shut down. Century Aluminum has retired and planned to scrap the lines.

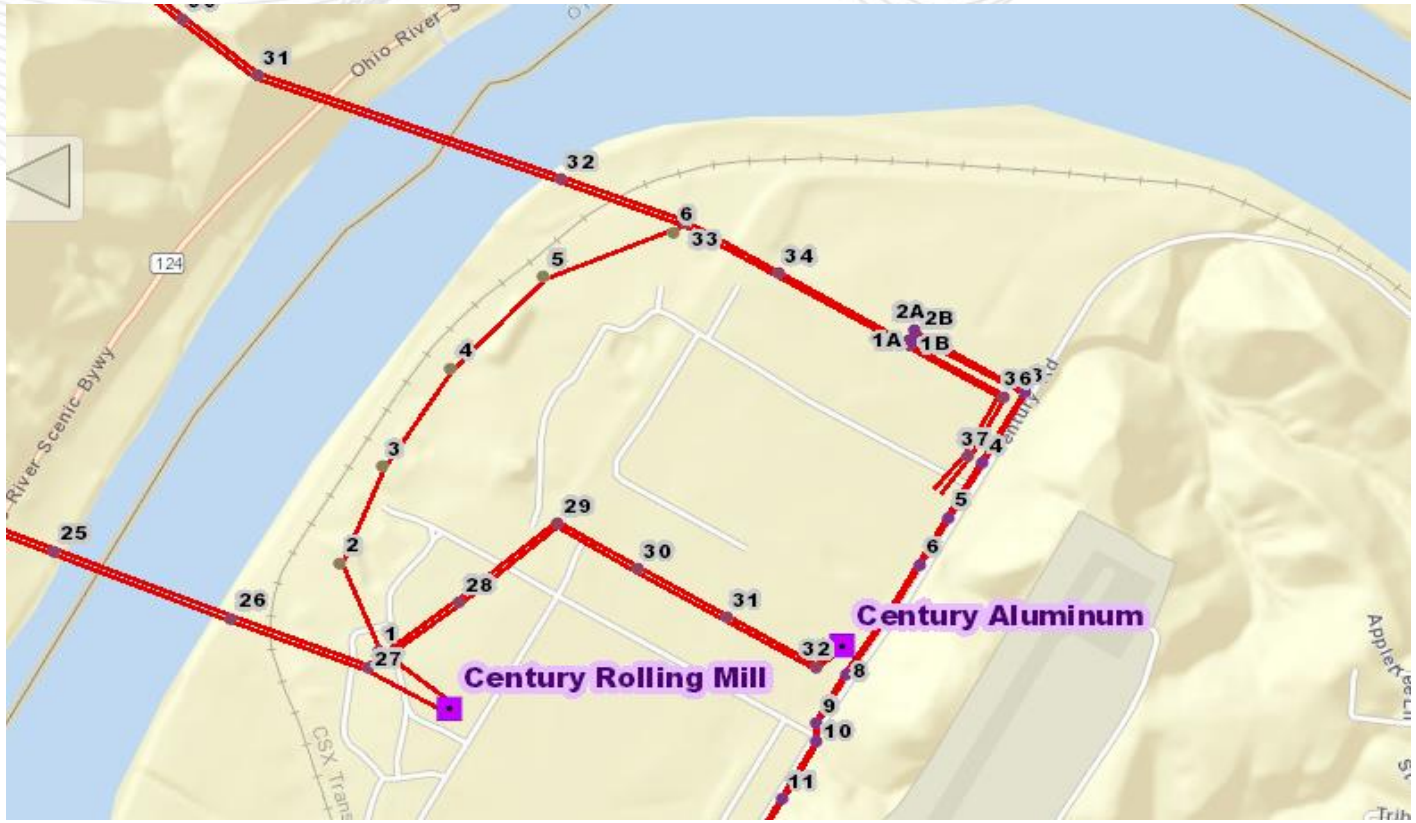
Alternatives:

Construct new transmission lines to customers. This plan was rejected due the length of time to get a permit across the Ohio River and the cost. Estimated Cost: $10M

Estimated Cost: $5.215M

Projected IS date: 3/31/2018

Status: Engineering



Supplemental Project

Problem Statement:

The City of Fort Wayne has scheduled a tunnel boring project to last 4-5 years, with the peak load scheduled to be in-service for two years and a reduced load in service for an additional 2-3 years. The projected load (4 MVA peak, 2 MVA reduced) and voltage requirements are such that the existing nearby distribution station, Water Pollution, cannot serve the temporary load due to limited transformer capacity; therefore, the city has asked for 12 kV delivery voltage. This results in the need for a dedicated skid station that will be installed and utilized for the entire period of the City's project. –Fort Wayne, IN

Potential Solution:

Install a temporary 34.5/12 kV skid station to be served by tapping the existing Lakeside-Water Pollution 34.5 kV circuit just west of the existing Water Pollution station.

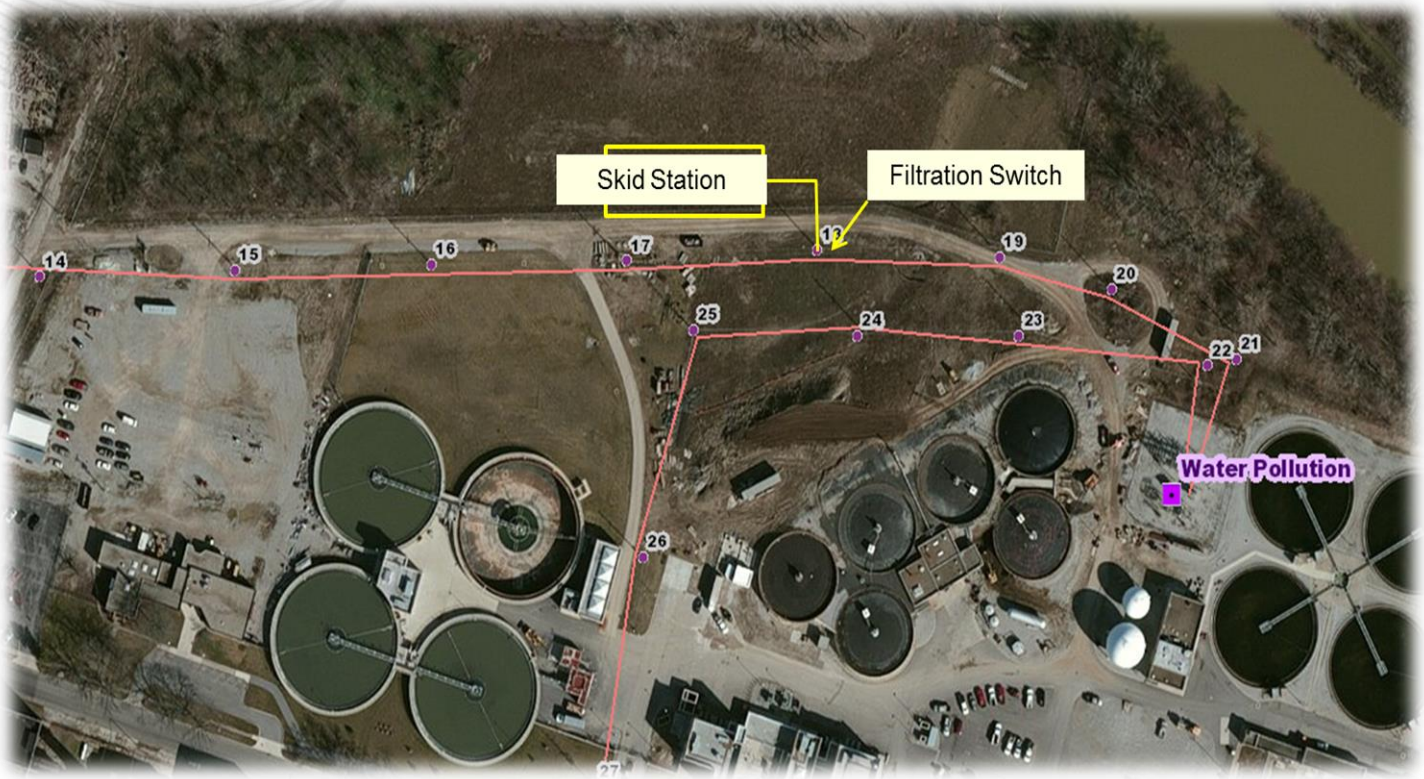
Alternatives:

Due to the temporary nature of the load, no viable alternatives were considered.

Estimated Cost: $0.8M

Projected IS date: 7/25/2017

Status: Construction



Supplemental Project

Problem Statement:

Duck Creek currently only has manually-operated line switches with no fault-interrupting or sectionalizing capability. Installing a new breaker will enhance operational flexibility for this remote part of the AEP system, by better isolating the 138kV system after faults, and allowing system dispatchers to remotely sectionalize the system. In addition, the station currently lacks an RTU, which will be installed as part of the project, with SCADA indication & control on the 138kV equipment. Installing additional 138kV line MOAB switches instead of a breaker does not reduce the FOI calculation below the AEP requirement; therefore a breaker is justified in this instance.

The breaker installation will also serve to improve reliability to AEP's Mill Creek distribution station, due to the fact that a fault on Mill Creek-Willow Island 138kV currently takes out two Mill Creek distribution transformers tapped off the line (#1 & #3, for a summer peak of 26 MVA). The Duck Creek breaker will significantly reduce the miles of exposure for a 138kV line fault east of Mill Creek station.

The Duck Creek distribution station east of Marietta, Ohio is currently a tap of the Mill Creek-Willow Island 138kV tie-line with FirstEnergy, which is a 13-mile line from Ohio to West Virginia. Duck Creek is a large load center (22 MVA summer peak), serving over 2,000 AEP Ohio customers. Due to historically poor reliability in the greater-Marietta area, an official MOU was signed by AEP Transmission, AEP Ohio, Washington Electric Co-op and Buckeye Power to create a 138kV transmission area plan and retire the 23kV system over the next decade. As part of the overall plan, the circuit breaker installation at Duck Creek will improve reliability to AEP distribution customers by reducing the impact of transmission line faults. -- Marietta, OH

Potential Solution:

Duck Creek: At AEP Ohio's 138-12kV distribution station, install a new 3000 A 40 kA 138kV breaker (toward Willow Island). This is currently a tap of the Mill Creek-Willow Island 138kV tie-line with FirstEnergy (soon to be Mill Creek-Belmont).

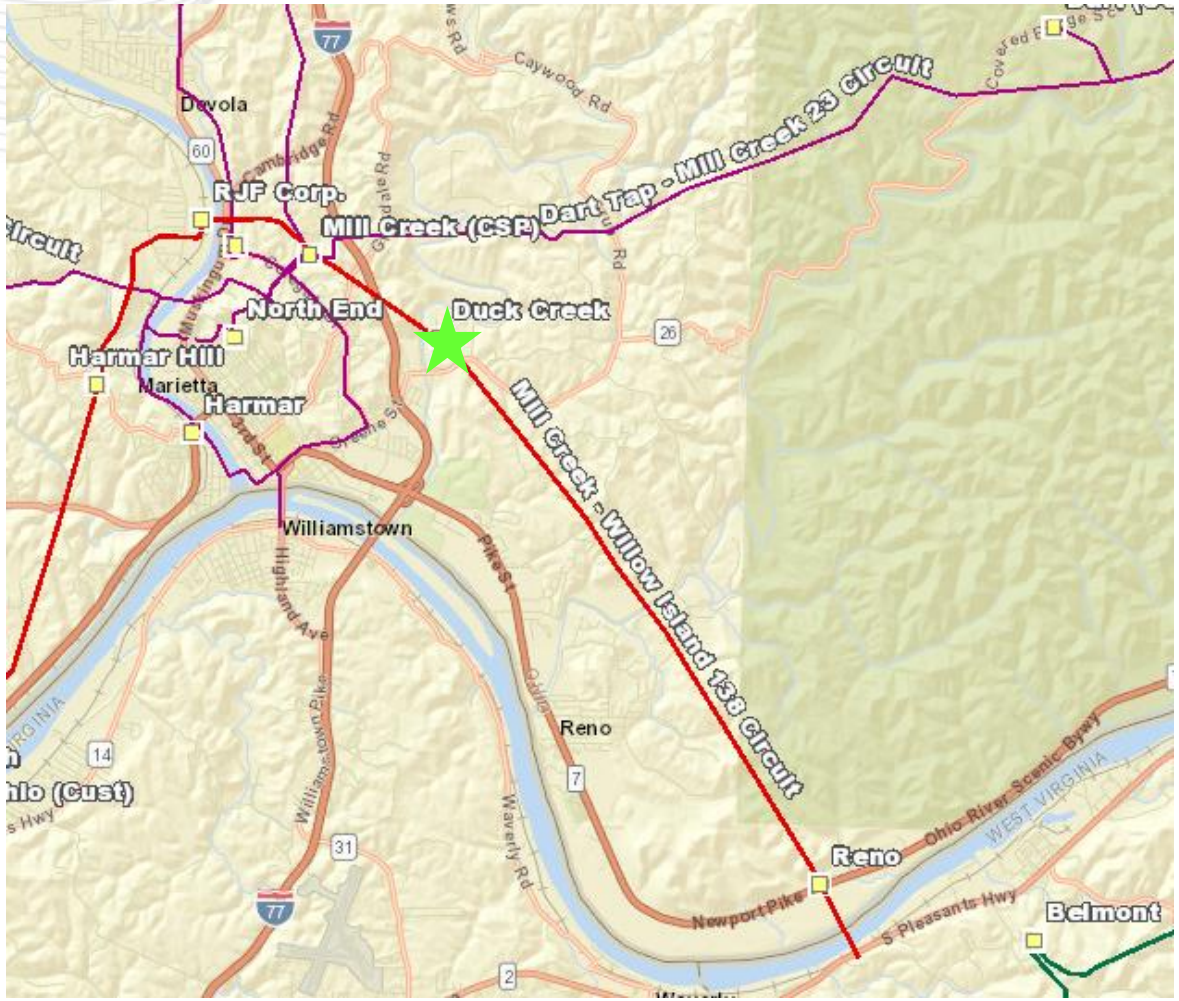
Alternatives:

Install two 138kV line breakers at Duck Creek, rather than just one. This would have been a further improvement in reliability, by preventing the station from going out of service for a line fault toward Mill Creek. However, based on the load served and shorter distance, and considering costs and site limitations, a single breaker installation was deemed sufficient. A less-expensive motor-operated switch will be installed toward Mill Creek instead. Estimated cost: $2M

Estimated Cost: $0.8M

Projected IS date: 12/1/2017

Status: Engineering



Supplemental Project

Problem Statement:

The Heath – Southgate line section was built in 1916 with wooden structures and 4/0 copper conductors (54 MVA rating). It has 37 open A conditions on this 2.7 mile long line. Between 2013 -2016 the circuit has had 3 permanent outages attributed to defective cross arms and rotten poles. –Newark, OH

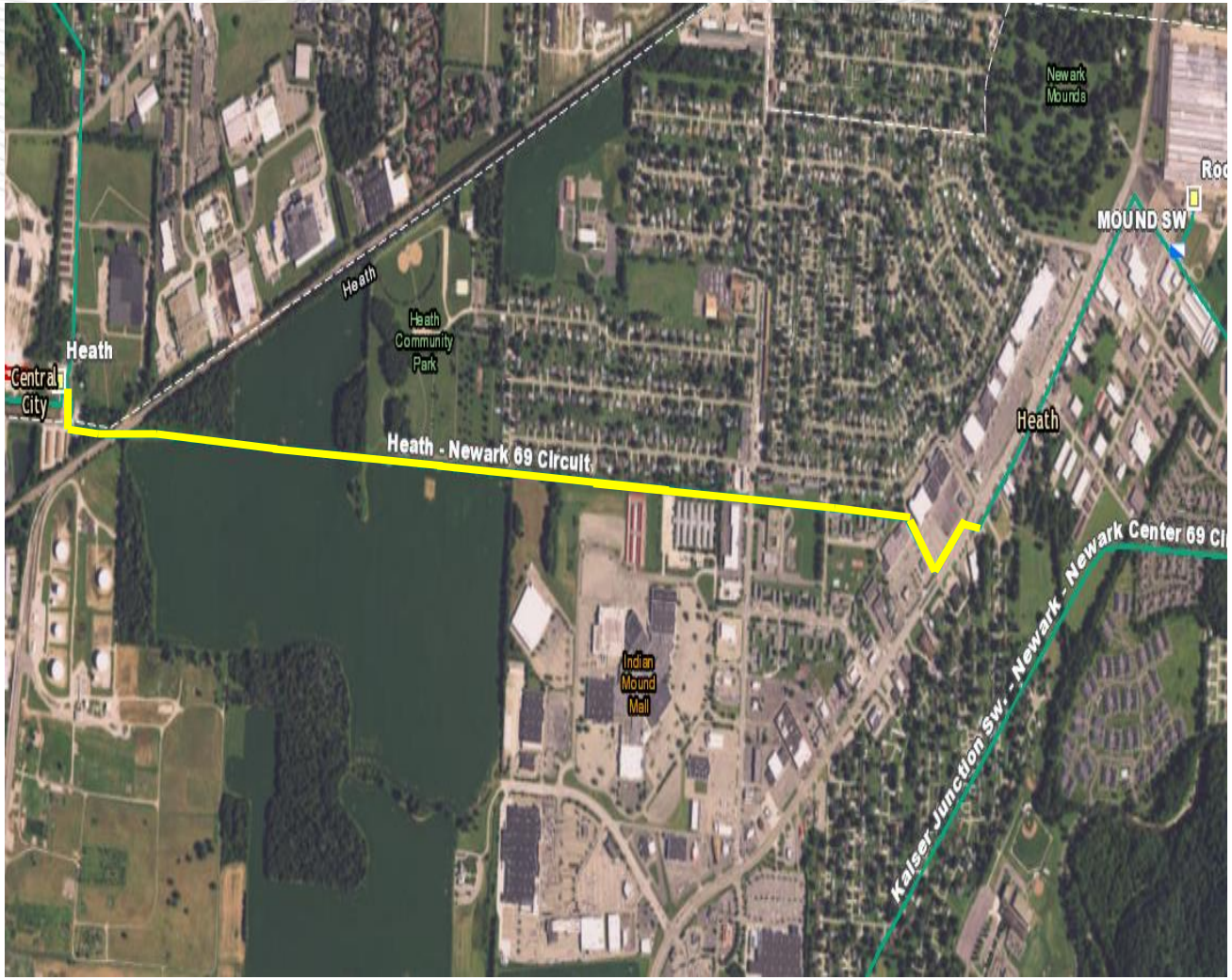
Potential Solution:

Rebuild 2.71 miles of Heath- Southgate 69 kV 4/0 copper conductor with 556 ACSR conductor (102 MVA rating). The customer project associated with the Marathon-Heath proposal has rebuilt the first section of this line.

Alternatives:

- Rebuilding in the clear off center line was an option considered. However, this was more expensive due to increased ROW requirements. Estimated cost: $3M

Estimated Cost: $1.9M
Projected IS date: 12/1/2017
Status: Engineering



AEP Transmission Zone

Supplemental Project

Problem Statement:

The Hocking – Poston 138 kV line was built in 1949 utilizing wooded H-Frame structures with 636 ACSR conductor (223 MVA rating) that are showing signs of severe deterioration. The circuit has accumulated a total of 170 thousand customer minutes of interruption over the past three years. In addition, it has 44 open A conditions along the 16 mile line which are due to rot, structure damage, and broken cross arms. –Athens, OH

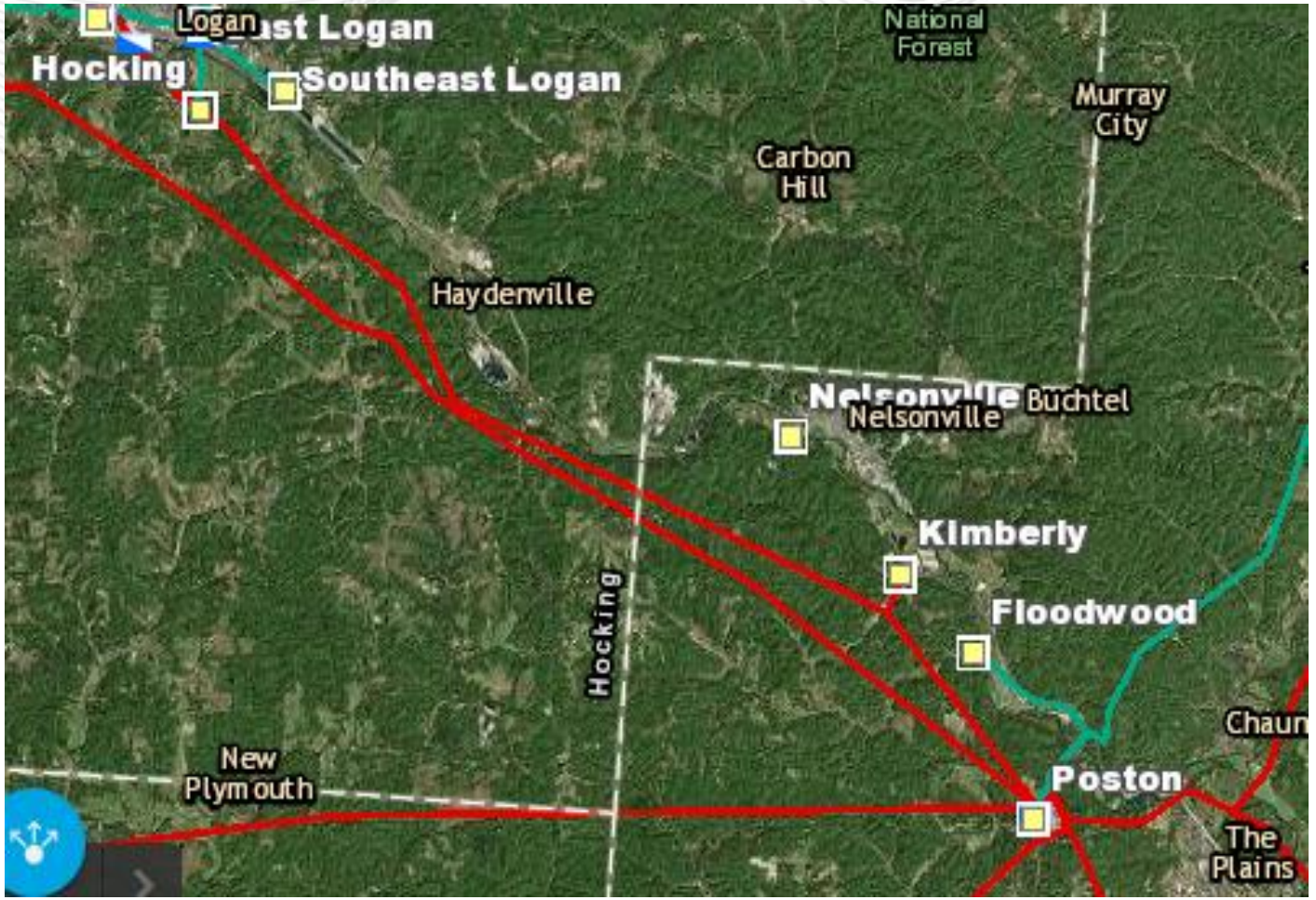
Potential Solution:

Rebuild 16.62 miles of the Hocking-Poston 138 kV line with 1033 ACSR (296 MVA rating) on steel poles.

Alternatives:

Rebuilding this line in the clear. This option was eliminated due to cost and the impact it would cause on the Wayne National Park, through which it would need to be built if moved off centerline. Estimated cost: $34M

Estimated Cost: $17.1M
Projected IS date: 12/1/2017
Status: Engineering



Supplemental Project

Problem Statement:

Jackson Road – Lapaz/Marshall 34.5 kV ckt has 269 open conditions and is approximately 13 miles long. The majority of the line was built in the 1950s and is wood pole construction with 4/0 Copper and 336 ACSR conductor (27 MVA rating). 5.5 million customer minutes of interruption have been recorded at Lapaz and Quinn stations between 2010-2015.

At present Lapaz and Quinn stations are on a radial feed with partial emergency back up available through Marshall (NIPSCO's) station. The transformer size at Marshall prohibits the desired operational flexibility by limiting the periods when the Lapaz and Quinn loads can be fully served out of Marshall. Under this project, Lapaz and Quinn load is being converted to a looped 69 kV service.

Indiana and Michigan Power Company (IMPCO) has requested that Quinn and Lapaz stations be converted to 69 kV. –South Bend, IN

Potential Solution:

Replace 138/34.5 kV transformer with a 138/69-34.5 kV transformer, replace 34.5 kV circuit breaker F, and add a new 69 kV breaker at Jackson Road station.

Rebuild and convert ~13 miles of 34.5 kV line between Jackson Road and Marshall (NIPSCO) to 69 kV utilizing 556 ACSR conductor (102 MVA rating).

Convert Quinn to 69 kV

Construct Vintage 69 kV station to replace Lapaz

Install 69 kV tie line metering at Marshall station

Alternatives:

- Establish a 69 kV transmission line path between Jackson Road – Quinn – Lapaz – Gravel Pit stations by rebuilding the existing 34.5 kV lines and constructing greenfield facilities to complete the loop back to Jackson Road. Estimated cost: $73M

Estimated Cost: $32M
Projected IS date: 12/1/2018
Status: Engineering

Supplemental Project

Problem Statement:

A customer requested 138 kV transmission service adjacent to the existing Jug Street Station property. The projected load for this single customer is 190 MVA. Additionally, there is currently 26 MVA of load served by AEP Ohio and another 3 MVA of load served by a local co-op out of this station. AEP Ohio has space for a total of four 50 MVA transformers to serve future load. The co-op has space for two 20 MVA transformers. A separate PJM project (s1191) will introduce a new 138 kV source at Jug Street to serve this load.

Expanding Jug Street Station into a ring bus design will be beneficial for Operations as the existing 138 kV circuit breakers require an outage of the transmission line when maintenance is necessary. Additionally, the new 190 MVA load will be served via five individual transformers along with the existing load at the station. The ring bus design eliminates the potential of losing all load at the station for a breaker failure scenario.
– New Albany, OH

Potential Solution:

Jug Street 138 kV Station will be expanded and modified into a two ring bus configuration to serve up to five additional 50 MVA, 138/34.5 kV customer transformers.

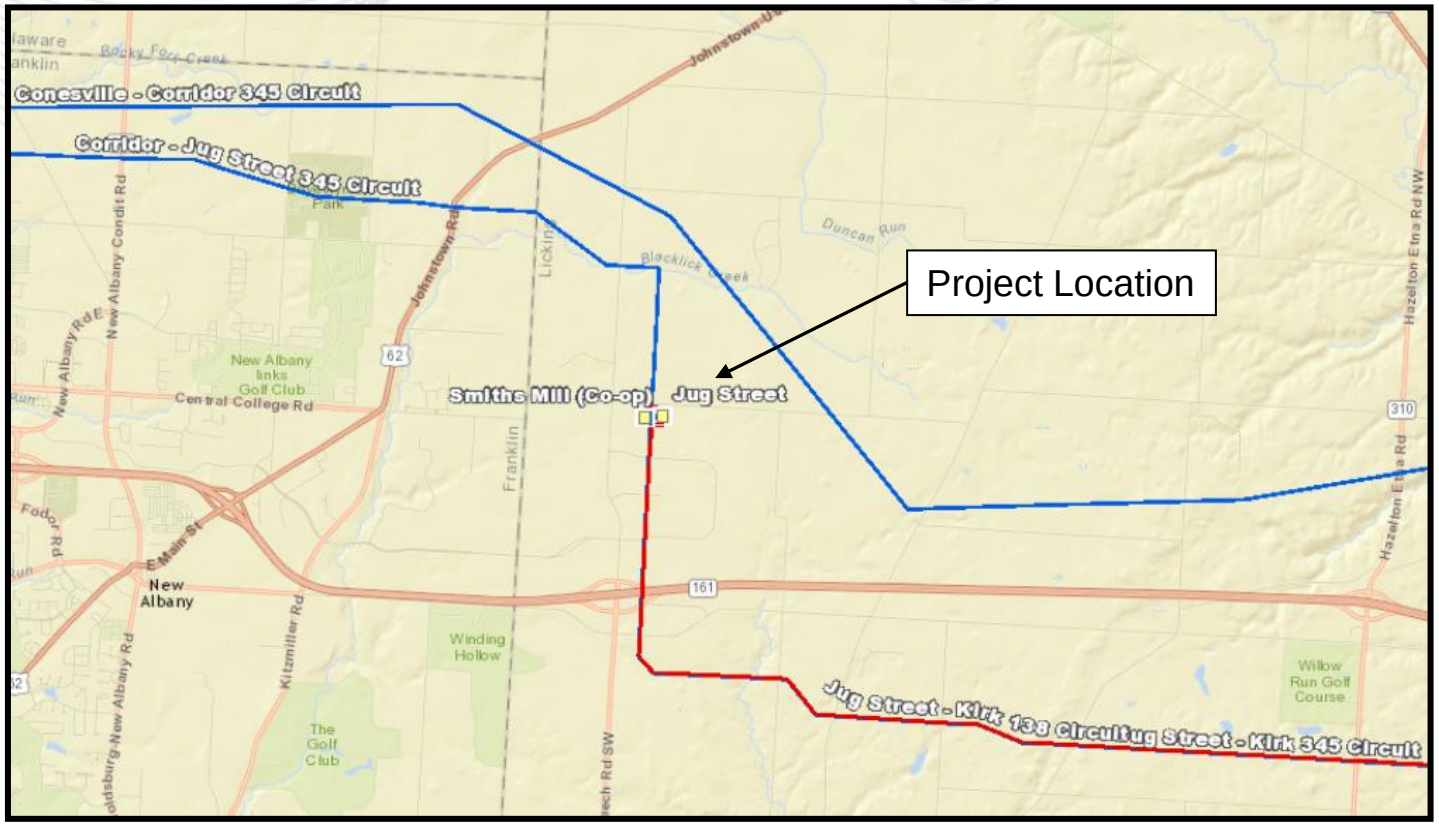
Alternatives:

Establishing a new 345/138 kV station in the area to connect the customer rather than expanding Jug Street Station. Estimated transmission cost: $15M.

Estimated Cost: $9.1M

Projected IS date: 6/1/2017

Status: In service



Supplemental Project

Problem Statement:

At Kankakee station, the 34.5kV Circuit Breakers H, I, F & D are all 1200 A 25 kA oil type (FK) breakers manufactured in 1955. Oil filled breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. Breaker D has had 108 fault operations and breaker I has had 16 fault operations. The manufacturer recommendation is 10 for this type of breaker. The breakers have the following documented conditions: age, wear, PCB content, maintenance issues, and no repair part availability.

138/34.5kV 70 MVA transformer #1 at Kankakee, manufactured in 1955, will be replaced because of breakdown in dielectric strength (insulation system), short circuit strength (winding short circuit strength breakdown due to magnitude of short circuit fault events), oil quality issues, and accessory problems (bushings, pumps, etc.). – South Bend, IN

Potential Solution:

Replace existing Kankakee transformer #1 with a 138/69/34.5 kV 130 MVA transformer.

Replace 34.5 kV circuit breakers H, I, D and F with new 1200A 25kA circuit breakers along with associated equipment and protection.

Alternatives:

No additional cost effective alternatives were identified

Estimated Cost: $5.0M
Projected IS date: 12/1/2017
Status: Engineering

AEP Transmission Zone

Supplemental Project

Problem Statement:

Virginia Tech Electric Service (VTES) requested an additional 69 kV delivery point via two new transformers from AEP at Lane station. – Blacksburg, VA

Potential Solution:

Relocate the Lane-Merrimac 69 kV line to accommodate the Lane station expansion.

Expand Lane Station to establish a second Virginia Tech Electric Service (VTES) 69 kV delivery point.

Install one 3000 A 40 kA 69 kV circuit breaker and associated equipment.

Motorize an existing 69 kV switch and system protection equipment.

Add 2-12 kV metering to the new transformers to be added by VTES.

Alternatives:

No viable transmission alternatives were identified due to the length and siting challenges of building through campus and Blacksburg.

Estimated Cost: $2.356M

Projected IS date: 4/1/2018

Status: Engineering

Supplemental Project

Problem Statement:

The current location of Northwest Elkhart is very space constrained and has structures dating back to 1966. Circuit breakers A, B and J were manufactured in 1960 and are oil filled breakers. Oil filled breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. The breakers have the following documented conditions: age, wear, PCB content, maintenance issues, and no repair part availability.

The transformers are in poor condition due to dielectric strength breakdown (insulation) and decreased short circuit strength (through fault events). –Elkhart, IN

Potential Solution:

Rebuild the 34 kV facility currently located at the Northwest Elkhart station, to be renamed to “Mackey” station.

Retire the existing Northwest Elkhart station.

Retire the line that was previously serving Miles Lab.

Retire the remaining equipment at Miles Lab station that was left after the customer went out of service a couple of years ago.

Build a new 34.5kV line with 795 AAC (62 MVA rating) from Mackey station to re-terminate the Concord 34.5 kV line, bypassing the retired Miles Lab line.

Alternatives:

Rebuilding the 34.5kV Northwest Elkhart Station on the same site has space constraints and would require lengthy outages as equipment was replaced in place. Estimated cost: $4M

Estimated Cost: $3.256M
Projected IS date: 12/15/2017
Status: Engineering

Supplemental Project

Problem Statement:

BREC has requested AEP retire the AEP-owned Waterloo hard tap, which currently serves the BREC-owned Elliot Station, and re-establish service at a new station called New Marshfield, which will be owned by Buckeye, via the new AEP-owned Mineral switch.

When the Elk – Poston 138 kV circuit trips from service, outages occur at Bolin's Mills and Waterloo stations. This load cannot be transferred to any nearby stations to get picked up in case of an outage. Thus, by placing MOABs at the new Mineral switch, the 138 kV source will keep Bollins Mill and Mineral in service, as well as provide the following benefits:

- By having MOABs with supervisory control the circuit could sectionalize and provide TDC a location for the fault, which would reduce time spent troubleshooting and customer outage duration.
- MOABs would greatly improve AEP's ability to perform maintenance because we would not need to rely on BREC to transfer load or take an outage.
- Currently, AEP must rely on BREC to isolate Waterloo for any line work. In an emergency condition it can take several hours for BREC personnel to be on-site to perform switching operations. The MOAB will eliminate the need for BREC to isolate their load.

–Athens, OH

Potential Solution:

Install new 138 kV phase over phase switch ("Mineral") to connect the BREC ("New Marshfield") delivery point.

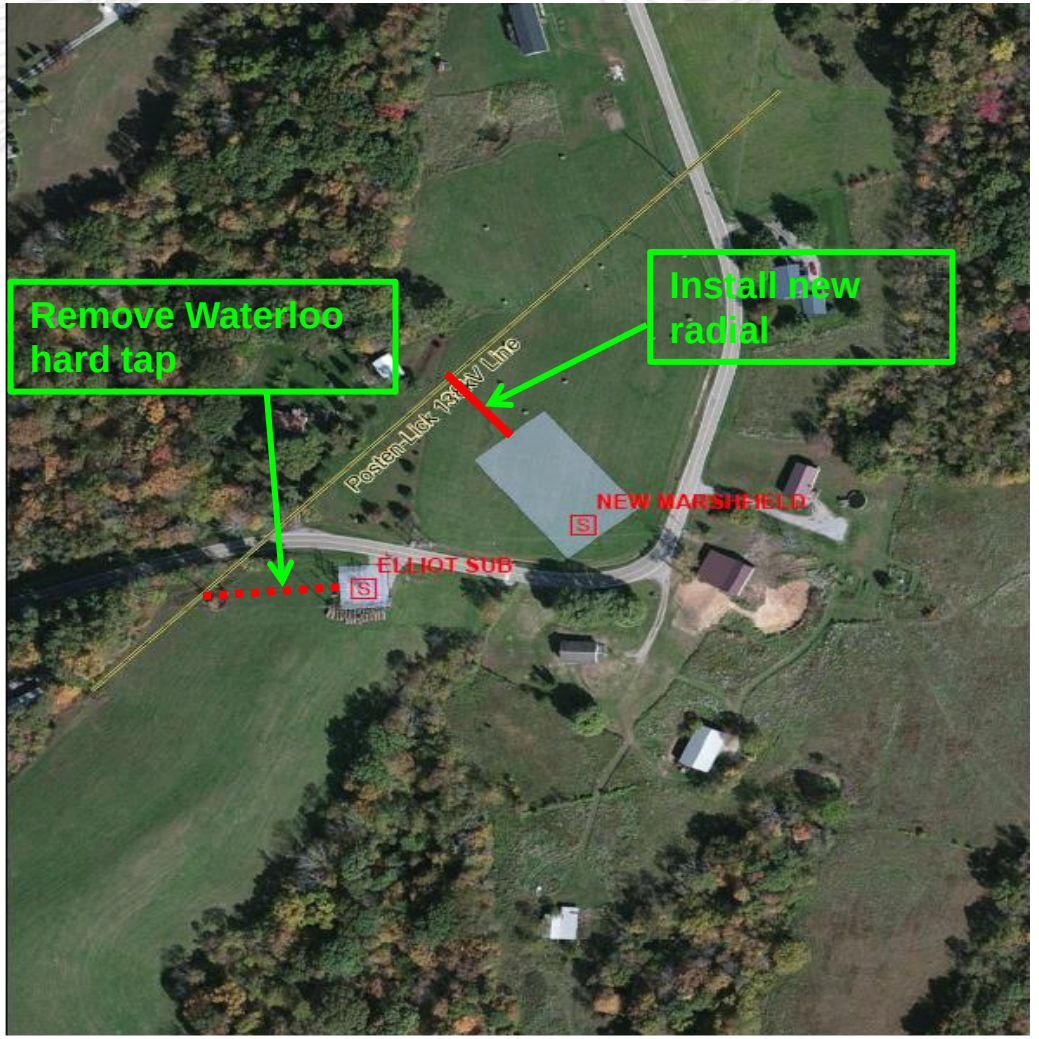
Construct a new 50-foot span between the new Mineral Switch structure and New Marshfield.

Remove Waterloo (Elliot Station) radial hard tap.

Alternatives:

Not Installing MOABs would save $400,000 on the project cost. However, due to the remote nature of this circuit and the inability of Buckeye to back feed their stations/customers, AEP determined that MOABs are justified.

Estimated Cost: $0.9M
Projected IS date: 9/26/2017
Status: Scoping



Supplemental Project

Problem Statement:

The 138kV circuit breakers L, B and M at New Carlisle 138kV substation are all 3000 A 40 kA air blast type PK model. Air breakers tend to fail violently and their porcelain bushings disperse particles into the surrounding area, which is a safety concern. Breakers B has had 45 fault operations, breaker L has had 30 fault operations, and breaker M has had 12 fault operations. The manufacturer recommendation is 10 for this type of breaker. Factors leading to the replacement of these three breakers are age, repair part availability, and safety concerns. – South Bend, IN

Potential Solution:

Replace existing 138kV CB B, M and L at New Carlisle with 3000A 63kA circuit breakers along with associated equipment and protection to match other breakers at the station.

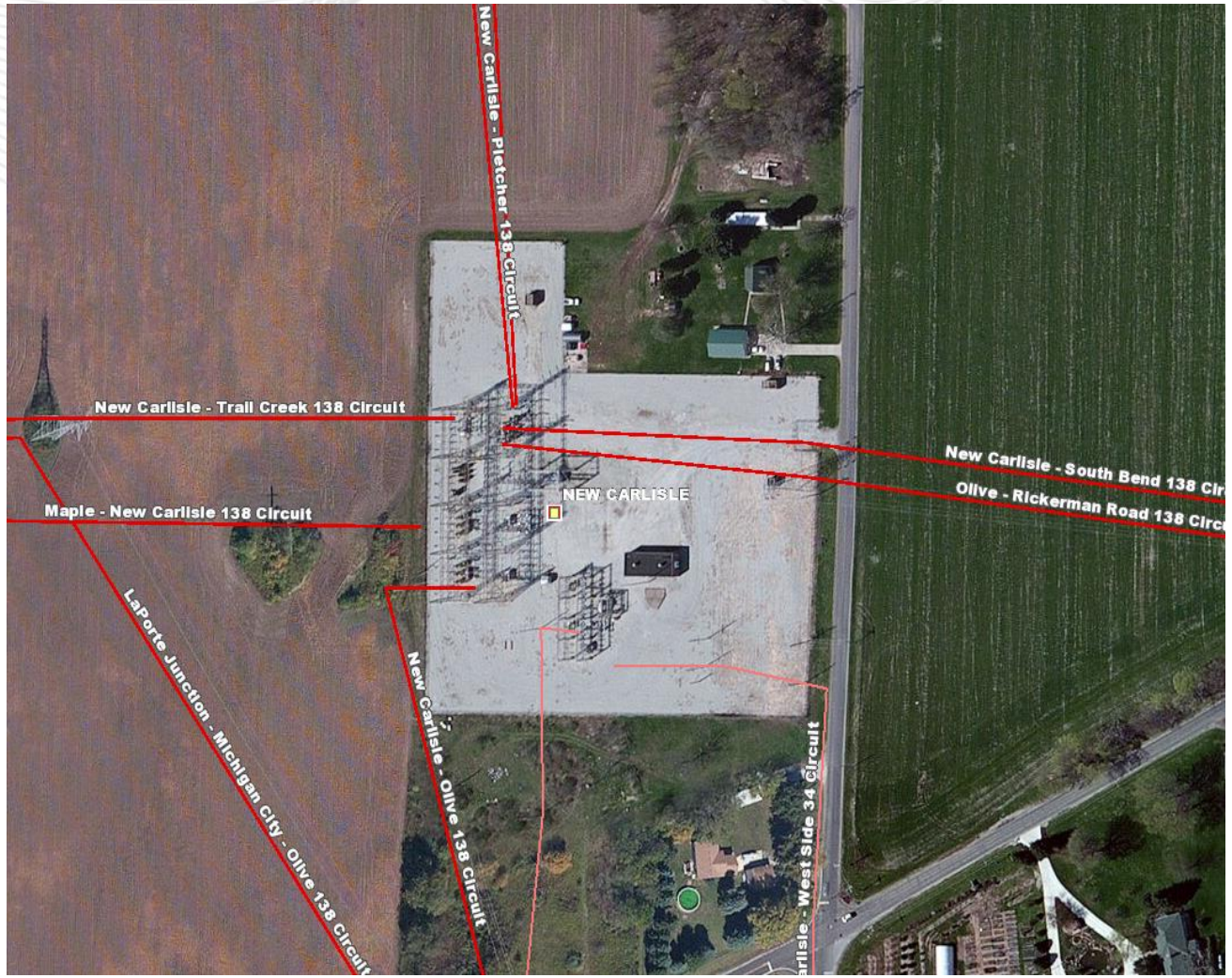
Alternatives:

No additional cost effective alternatives were identified

Estimated Cost: $2.3M

Projected IS date: 12/1/2017

Status: Scoping



AEP Transmission Zone

Supplemental Project

Problem Statement:

An AEP Ohio customer served out of North Lexington station approached AEP Transmission in 2016 to relocate their delivery point to 69 kV due to the nature of their load, which is very sensitive to any type of power outage. The existing 138 kV delivery point is on a 38 mile long line with no existing sectionalizing capability. Only 2 MW of load is transferable when the 138 kV line is out of service. Currently, there is 24 MVA of load served from North Lexington at peak. Therefore, AEP Transmission recommended a plan to install breakers at North Lexington station to keep the station transformer in service for a line outage. – Mansfield, OH

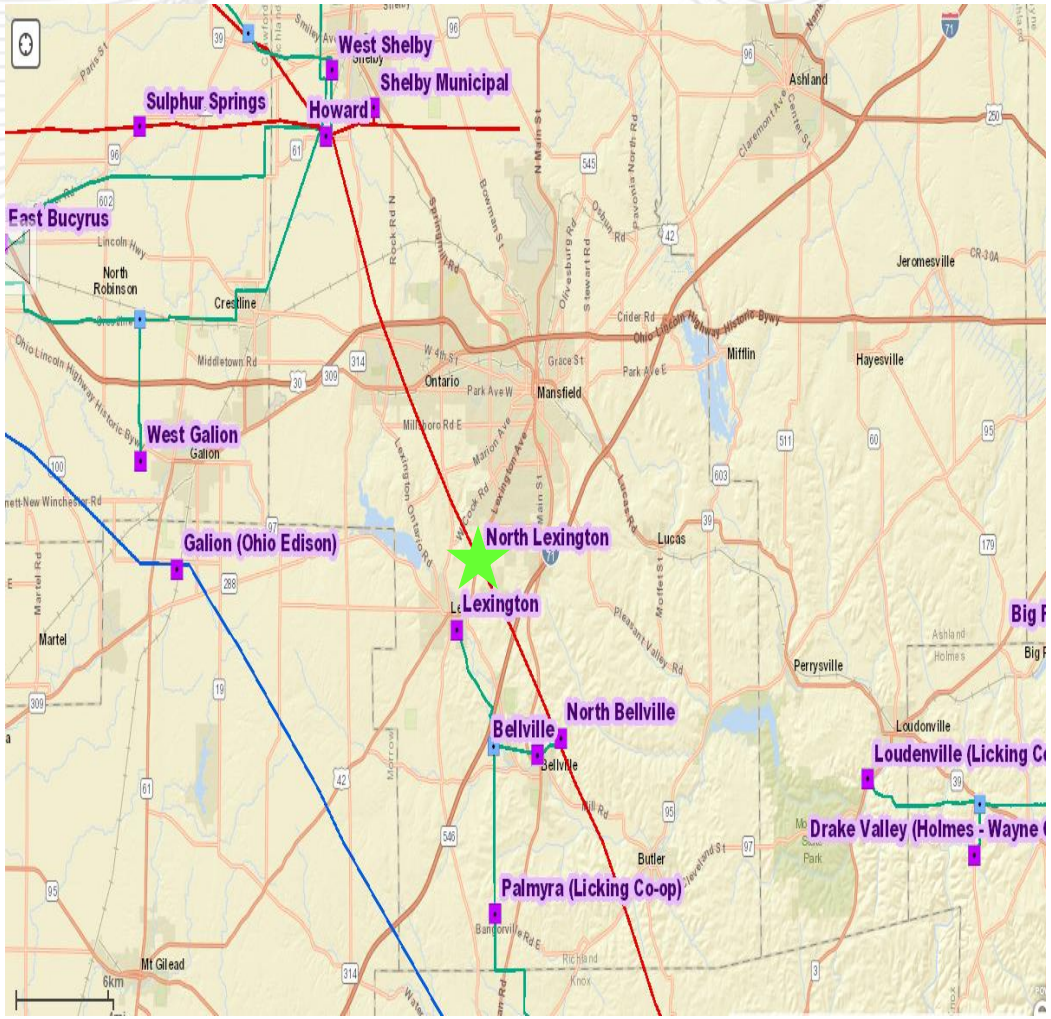
Potential Solution:

Install two 138 kV 3000 A 40 kA circuit breakers at North Lexington 138kV station.

Alternatives:

- Serve the customer from the 69 kV as originally requested. This option requires new lines, station upgrades, and line upgrades due to thermal violations and is much more expensive than installing the breakers. Estimated cost: $14M
- Rebuild the 138 kV line between Howard and Academia. While this may help eliminate some of the outages due to line condition, the customer served out of North Lexington would still lose service for any fault on the line. Estimated cost: $50M

Estimated Cost: $2.214M
Projected IS date: 5/31/2017
Status: In Service



AEP Transmission Zone

Supplemental Project

Previously Presented in TEAC on April 13th,2017

Problem Statement:

The LaPorte Junction - New Carlisle 34.5 kV circuit has a vintage from 1930s and is wood pole construction with 4/0 Copper conductor (27 MVA rating). Between 2010-2015, ~2 million customer minutes of interruption (CMI) were recorded at Silver Lakes station.

There are 183 open conditions, 95 of which are A conditions on the ~20 mile long line.

Indiana and Michigan Power Company has requested to convert Silver Lake and Springville to 138 kV operation. – La Porte, IN

Potential Solution:

Construct two 138/12 kV distribution stations, Bootjack and Marquette, to replace Silver Lake 34.5 kV and Springville 69 kV stations.

Cut the existing Olive – Bosserman line into New Carlisle station.

Rebuild sections of the LaPorte Junction-New Carlisle/New Buffalo 34.5 kV line to 138 kV to establish Bootjack-Olive 138 kV circuit utilizing 795 ACSR conductor (251 MVA rating).

Install a three way phase over phase switch, called Kuchar, near Liquid Carbonics station and construct a new 138 kV line between Bootjack and Kuchar.

Construct a 138 kV extension to Marquette station by tapping the Bosserman-Liquid Carbonics 138 kV line utilizing 795 ACSR conductor (251 MVA rating).

Alternatives:

Rebuild ~20 mile long New Carlisle – LaPorte Junction 34.5 kV utilizing existing line ROW corridor. This alternative was not selected because it did not provide the operational flexibility & efficiency and customer service benefits provided by the preferred option. Estimated cost: ~$32M

Estimated Cost: $36.786M
Projected IS date: 12/1/2019
Status: Scoping

Supplemental Project

Problem Statement:

There are five overlapping zones of protection (138 kV lines, 138/12 kV transformer, 138/69/34.5 kV transformer, 34.5 kV bus and lines) at Shawnee Road station. Additionally, installation of the proposed breakers addresses legacy hybrid IED/EM Mux transfer trip protection schemes which are very difficult to maintain and have shown a history of failure on the AEP system. These transfer trip schemes are difficult to maintain or replace in kind due to the fact that multiple line outages are needed.– Wapakoneta, OH

Potential Solution:

At Shawnee Road 138kV station, install 40 kA circuit breakers A, B & C on the branches to Southwest Lima and Junction Switch and on the high side of Transformer #2 and a circuit switcher on Transformer #1.

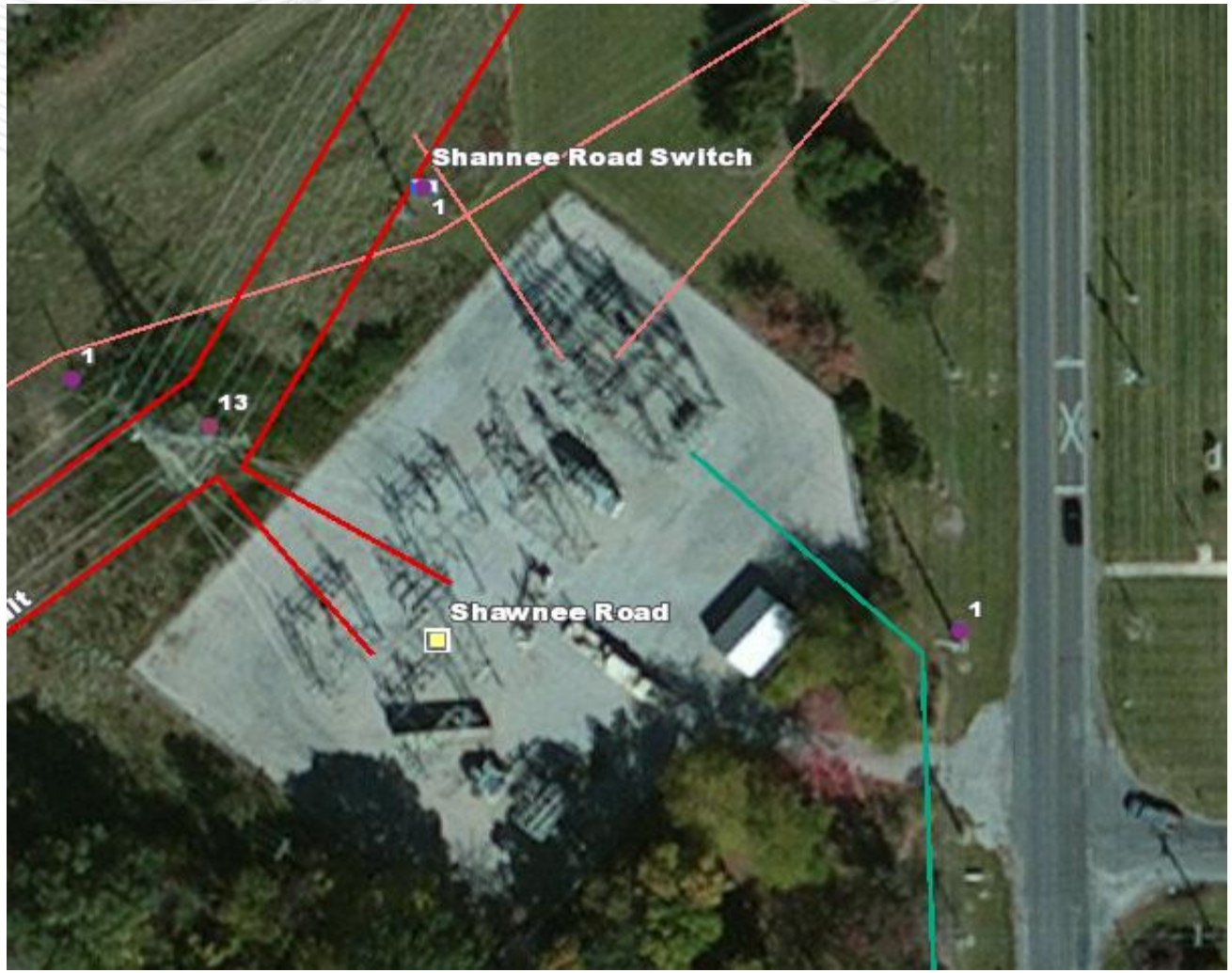
Alternatives:

No additional cost effective alternatives were identified.

Estimated Cost: $1.609M

Projected IS date: 11/1/2017

Status: Engineering



Supplemental Project

Problem Statement:

Karl Road 138kV CBs 104, 105, 102 & 101 are all 1200 A 20 kA oil breakers with 105 being an FK type and the other three being AHE's. The drivers to replace are age (1963), number of fault operations suffered, bushing damage and lack of repair parts for break and fix scenarios. These are the only 3 AHE type breakers in the eastern AEP footprint.

Clinton 138kV CBs 102, 108, 104, 107, and 105 are 2000 A 40 kA oil filled 145GMA type breakers. There are only 8 remaining GMA's in the entire AEP system, including these five at Clinton. Additional drivers for replacement include age, bushing damage, and lack of available repair parts.

Morse Road 138kV CBs 110, 101, 109, 102, and 108 are 1600 A 42 kA oil filled ALP-60 type breakers. All these breakers have the following documented conditions: age, bushing damage, and lack of repair parts available.

In general, oil breakers have become more difficult to maintain due to the oil handling. Oil spills occur frequent with failures and routine maintenance which can become an environmental concern.

Existing protection at Morse is very difficult to coordinate properly due the complexity of the system, number of lines coming in, old relaying schemes, and three terminal line configurations affecting the station. This project will eliminate a three terminal line just outside of Morse station. A 3 terminal line exposes Karl, Genoa, and Morse stations to unnecessary outage risk as well as relay miscoordination risk.

Karl Station has three 84 MVA 138/13.8 kV Distribution Transformers serving approximately 125 MVA of load. This load is non-transferrable, so is unable to be picked up by alternate sources for outages to the sources serving Karl Road. – East side Columbus, OH

Potential Solution:

Add 3-138kV 3000 A 63 kA CB's at Karl Road to create a ring bus and cut in the other side of the existing double circuit tower line.

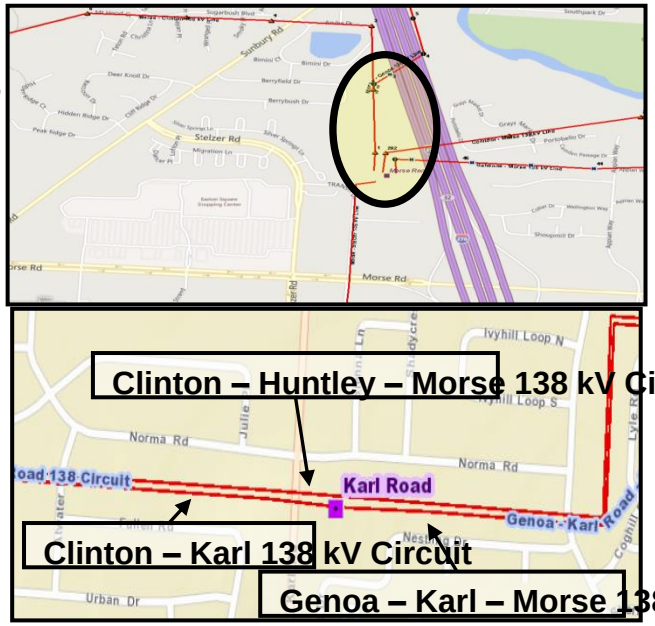
Replace CB's at Karl Road, Morse Road, and Clinton stations with 3000 A 63 kA circuit breakers.

Note: Additional breaker replacements at Morse Road and Clinton stations were previously reviewed as baseline projects b2821 and b2822.

Alternatives:

No good transmission alternatives were identified. New construction in the area is difficult to execute due to the urban nature of the area.

Estimated Cost: $14.5M
Projected IS date: 12/31/2019
Status: Engineering



AEP Transmission Zone

Supplemental Project

Problem Statement:

New Carlisle – West Side 34.5 kV circuit has experienced 202,942 customer minutes of interruption between 2013-2015. Construction of this new station will reduce customer outages by breaking the existing New Carlisle-West Side circuit into two segments, New Carlisle-Tulip Road and Tulip Road-West Side.

Scrap Metal Services (customer) is served via a hard tap. Every time scheduled/non-scheduled maintenance is taken on the New Carlisle – West Side 34.5 kV circuit, the customer is forced out of service. Tulip Road station addresses this situation.

Two retail customers are served via the New Carlisle – West Side 34.5 kV circuit through two delivery points (Smilax Switch and the other via a hard tap) that are in close proximity (4 spans) to each other. Construction of Tulip Road station will consolidate the two delivery points and simplify grid connectivity.

A MOAB is recommended between the New Carlisle & Tulip Road and Lydick & Tulip Road sections per the AEP MPOI/FOI calculation. However, this circuit already has two MOABs in series at Lydick. Two additional MOABs at Tulip Road will result in four total MOABs in series, which is not recommend as that introduces relay coordination complications, potentially resulting in misoperations. Therefore, instead of two additional MOABs at Tulip Road, installation of one circuit breaker is recommended. – South Bend, IN

Potential Solution:

Construct a new 34.5 kV Tulip Road station.

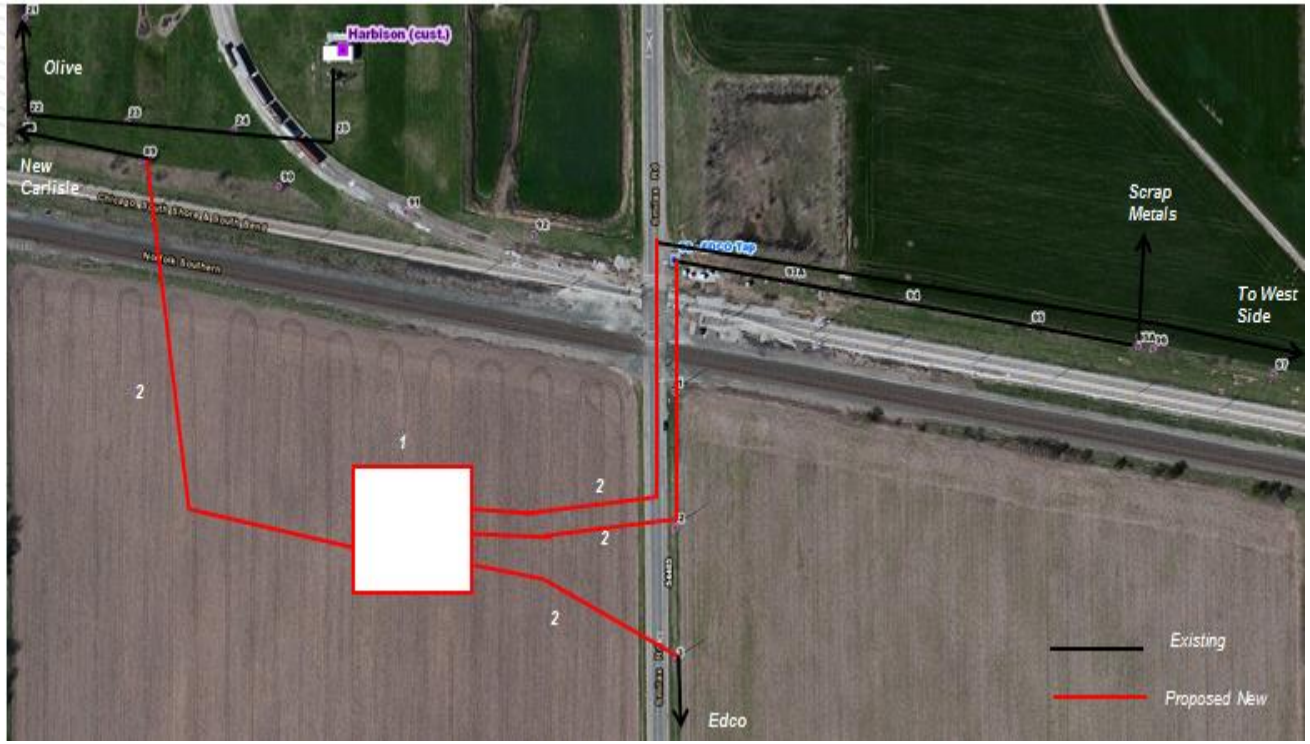
Terminate New Carlisle, West Side, Scrap Metals, and Edco lines into the new station.

Install one circuit breaker at Tulip Road on the West Side line exit.

Alternatives:

Rebuild the New Carlisle – West Side 34.5 kV line, approximately 13 miles. This is not expected to reduce the number of CMI. Estimated cost: $16M

Estimated Cost: $7.48M
Projected IS date: 12/1/2017
Status: Engineering



Supplemental Project

Problem Statement:

The existing 65 mile, 138 kV double circuit line between Twin Branch and Robison Park was constructed in 1926 using lattice towers with 397 ACSR conductor (167 MVA rating). There are 686 open conditions on this line, including burnt/broken insulators, loose/broken conductor strands, damaged conductor hardware and corroded shield wire. –Fort Wayne and South Bend, IN

Potential Solution:

Rebuild approximately 65 miles of 138 kV double circuit tower line between Twin Branch and Robison Park stations using 795 ACSR overhead conductor (251 MVA rating).

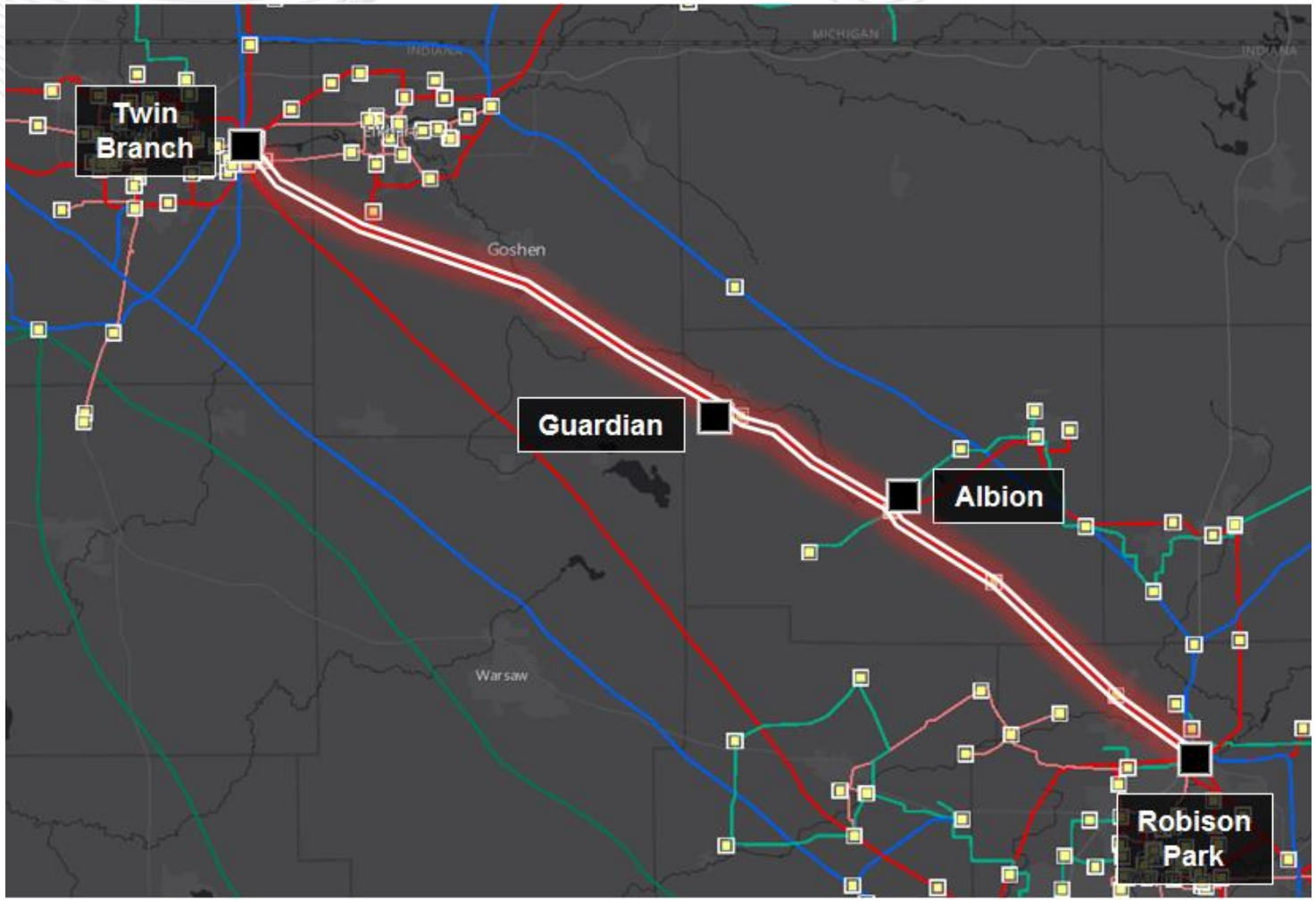
Alternatives:

Rebuilding the existing 65 mile, 138 kV line asset in the clear was an option considered, but was eliminated due to the increased cost of acquiring additional ROW and the additional impact to local landowners, environment and community. Estimated cost: $130M

Estimated Cost: $98.7M

Projected IS date: 6/1/2020

Status: Scoping



Supplemental Project

Problem Statement:

The 34.5kV circuit breakers A,G,E & F at West Side, three of which are 2000 A 36 kA type FK-38-36000 and the remaining one is a 1200 A 25 kA FK-439-34.5-1500, were manufactured in 1971 and 1953. All use oil as the interrupting medium. Oil filled breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. Breaker A has had 61 fault operations, breaker E has had 68 fault operations and breaker G has had 16 fault operations. The manufacturer recommendation is 10 for this type of breaker. These breakers have the following documented conditions: age, high moisture readings, fault operation exceeding manufacturer life recommendation, and bushing maintenance issues. – West side of South Bend, IN

Potential Solution:

Replace West Side existing 34.5kV breakers A, F, E and G with new 3000A 40KA circuit breakers along with associated equipment and protection.

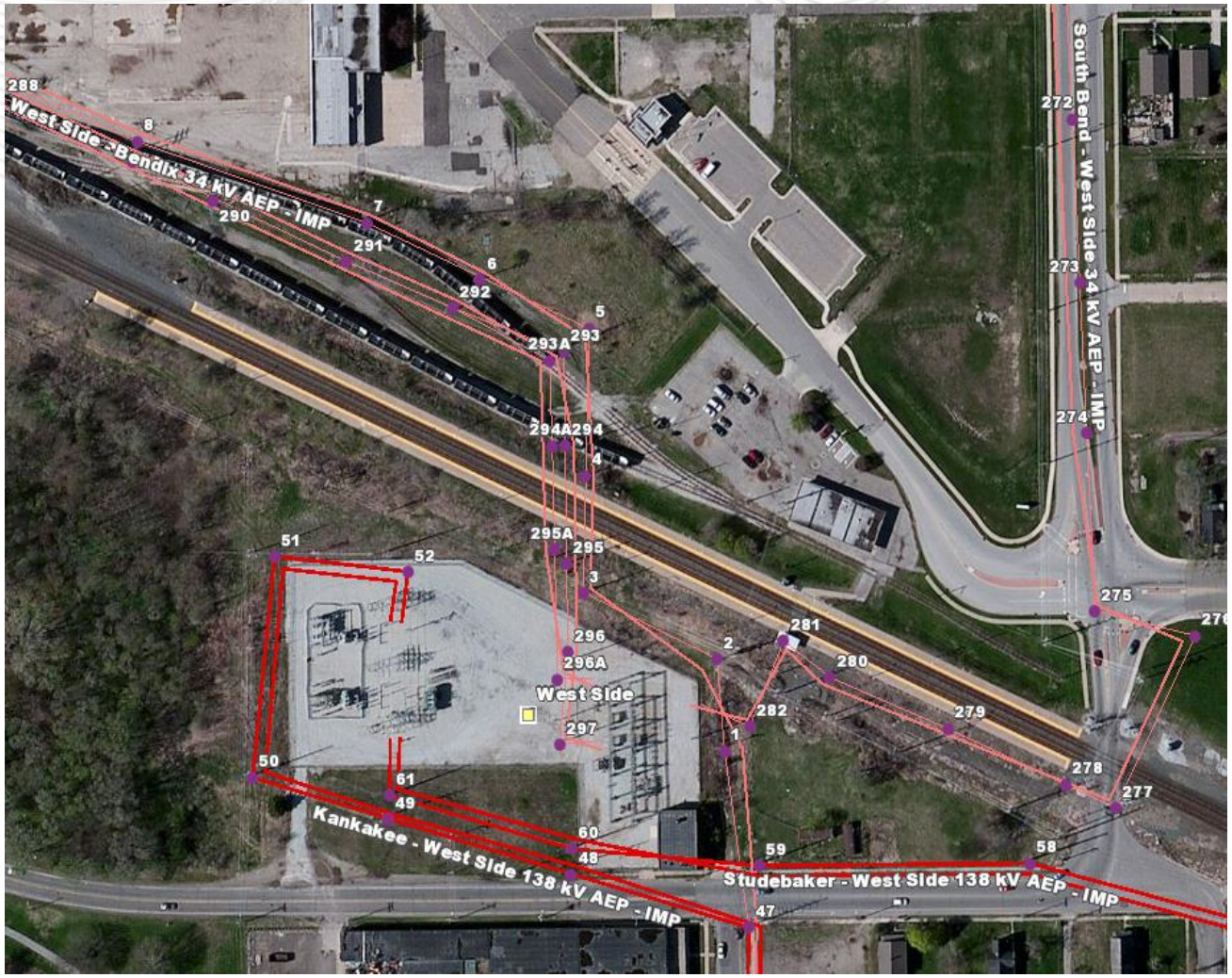
Alternatives:

No additional cost effective alternatives were identified.

Estimated Cost: $3.088M

Projected IS date: 10/2/2017

Status: Engineering



Supplemental Project

Problem Statement:

MK Morse has requested to convert their existing 3.8 MW, 12kV delivery point to 69kV to improve their electric reliability. A fully executed Letter of Commitment (LOC), Letter of Credit (LC), and Contribution In Aid of Construction (CIAC) has been secured from MK Morse. –Canton, OH

Potential Solution:

Install new 69kV PH/PH switch to connect MK Morse to Cherry Avenue – Sunnyside 69kV circuit , 2-MOABs on the through-path with full SCADA control, and New 69kV customer metering.

Cut existing Cherry Avenue – Sunnyside 69kV circuit to accommodate new 69kV PH/PH switch, Re-route Sunnyside – Torrey 23kV circuit to go underneath 69kV tap to customer station. Supplement existing easements to support new switch location and 23kV re-route.

Alternatives:

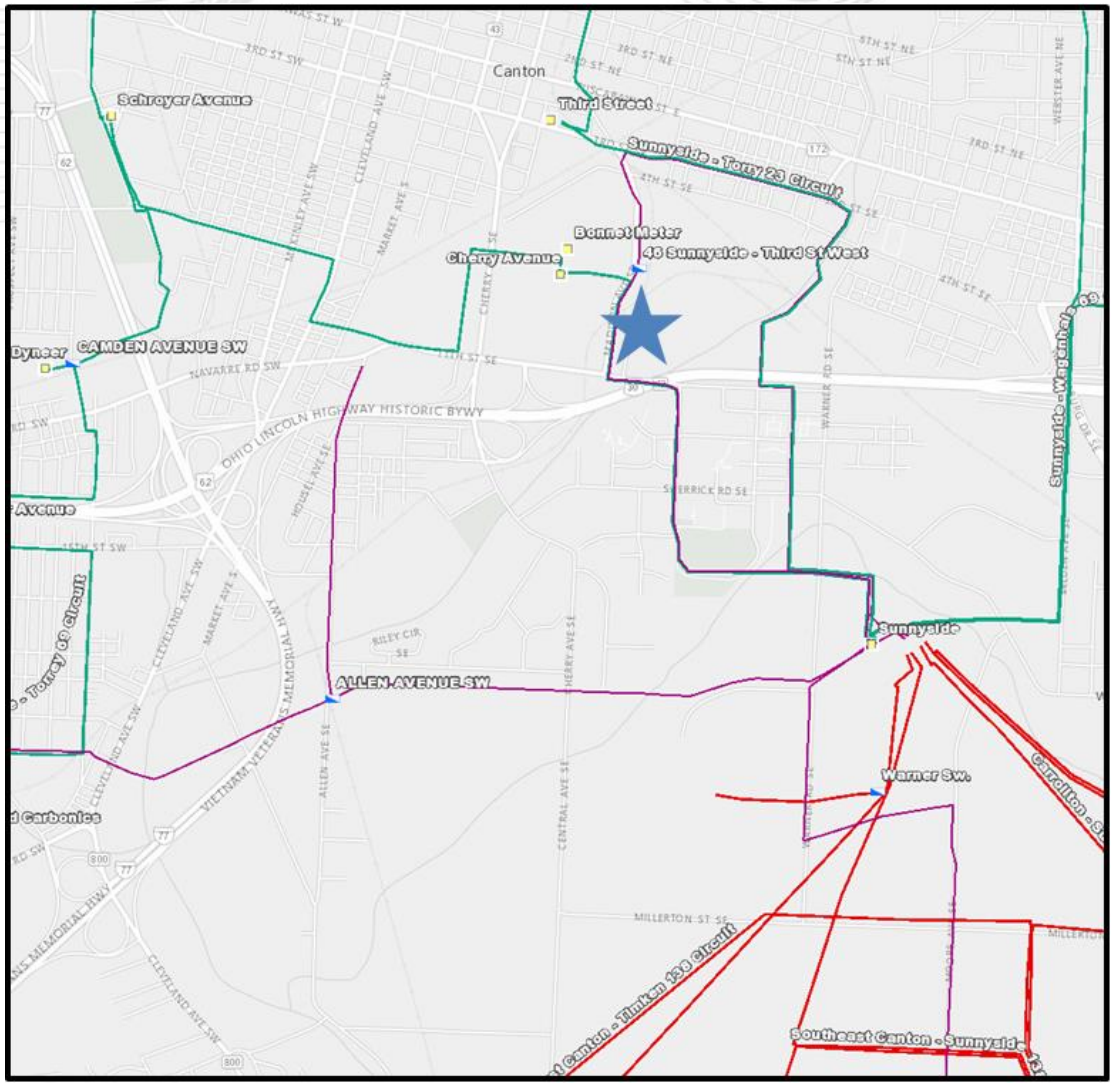
Connect customer to 23kV circuit instead of 69kV:The 23kV circuit is actually closer to the customer and would eliminate a couple of line structures, however there were minimal cost savings and minimal boosts in reliability from their existing 12kV service, because the line is already constructed to 69kV standards. Furthermore, AEP is looking to eventually retire or convert the 23kV network in the Canton Area.

Alternate Cost: $511,181 ($50k less than 69kV service)

Estimated Cost: $0.561M

Projected IS date: 10/1/2017

Status: Engineering



ComEd Transmission Zone

Supplemental Project

Problem Statement :
Distribution station Veterans currently has one 138/12 kV transformer and is fed from a single 138 kV line.
Projected load growth in the area from new warehouse construction and residential growth along I355.
Existing station is projected to be over its allowable loading in 2018.
A second138/12 kV transformer will be installed in 2018, requiring a second transmission feed.

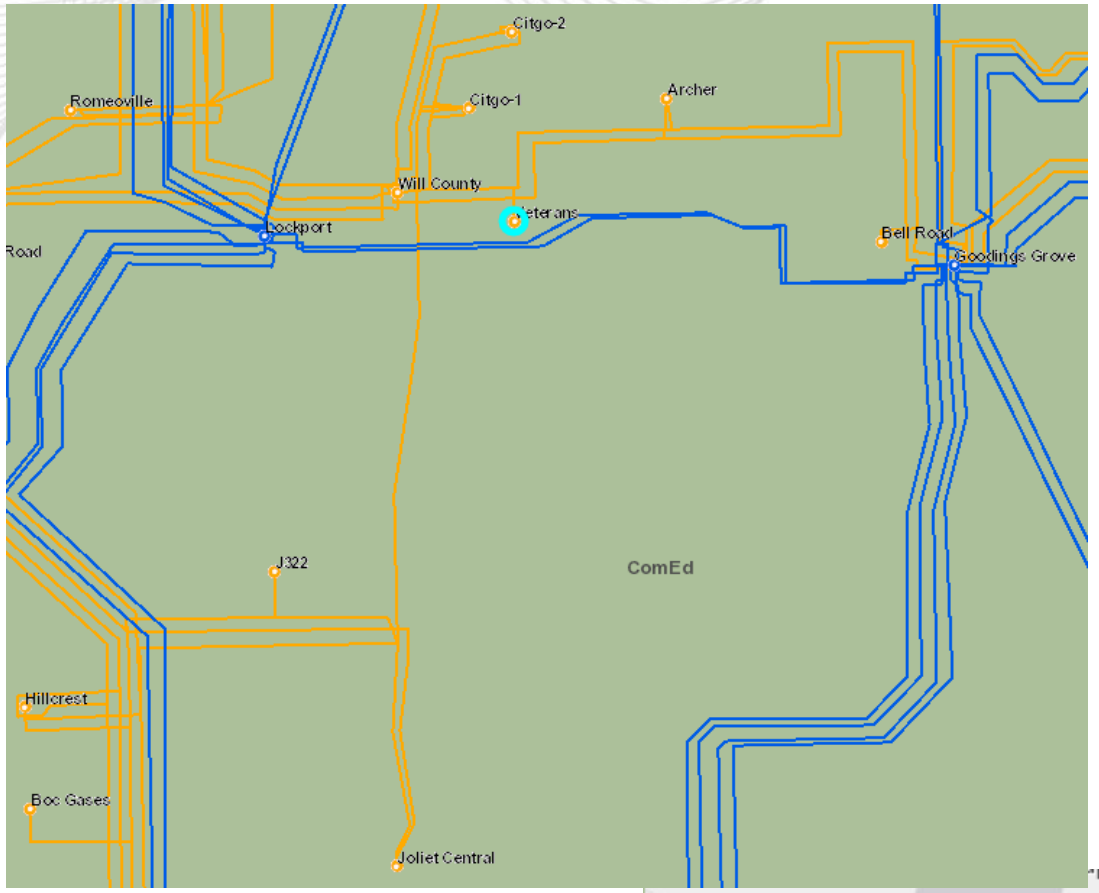
Potential Solutions:
Tap existing 138 kV line 1808 (Will County – Goodings Grove) and extend for 4.6 miles on existing towers

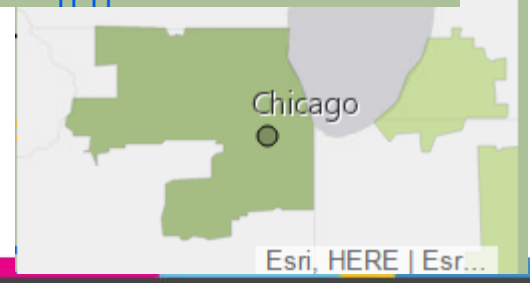
Alternatives:
Install 345/138 kV substation to the south and extend new 138 kV line 3 miles --Requires new right of way and property to build substation
Tap 138 kV line to the West, extend new line 5.5 miles --Requires new right of way

Estimated Cost: $0M

Project IS Date: 6/1/2018

Status: Engineering & Construction





ComEd Transmission Zone

Supplemental Project

Problem Statement :

Load is growing rapidly in Elk Grove Village area due to several new data center customers.

108 MW connecting to 34 kV distribution

Tonne station is projected to be overloaded in 2018

Potential Solutions:

Expand Itasca138 kV bus and install new 34 kV terminal at Itasca substation.

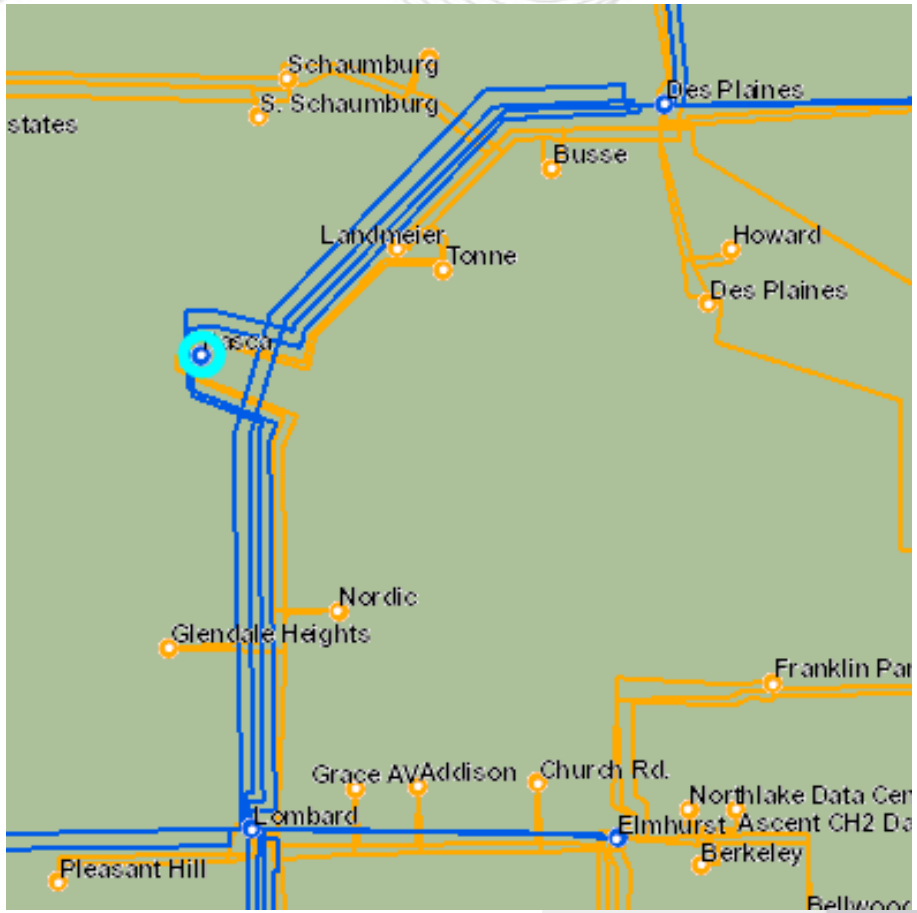
Alternatives:

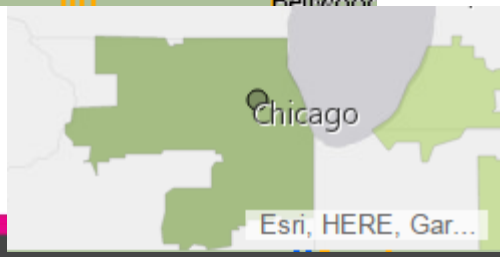
Build new substation.--Requires new property

Estimated Cost: $0M

Projected IS Date: 6/1/2018

Status: Engineering & Construction





ComEd Transmission Zone

Supplemental Project

Problem Statement:
138 kV Line 7421 (Kewanee – Toulon) has 18 NERC Alert potential violations.

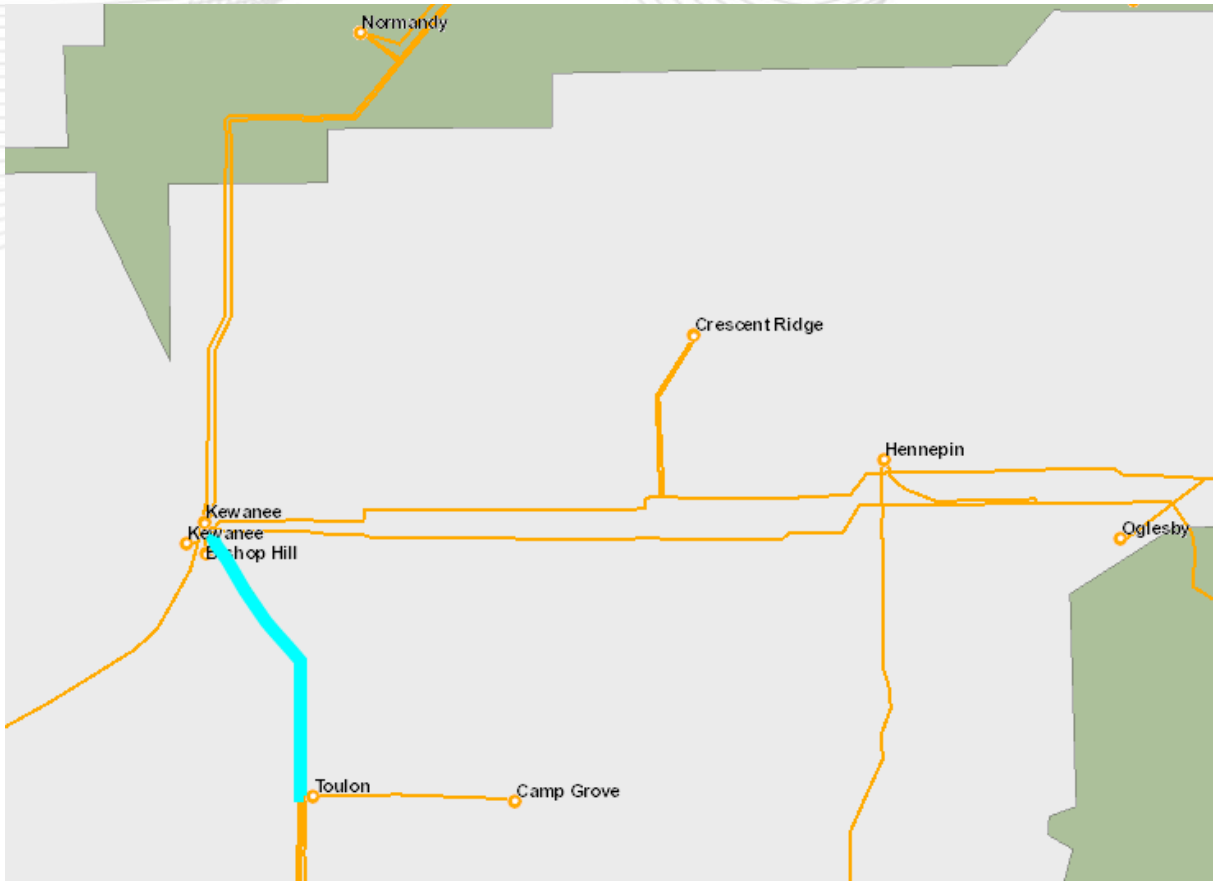
Potential Solutions:
Reconductor 0.3 miles of the 138 kV Line 7421 (Kewanee – Toulon), replace 3 structures, install 3 dead-ends, replace insulators

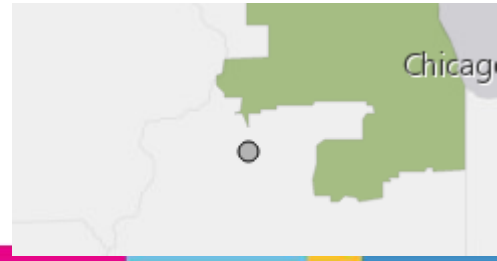
Alternatives:
Reconductor 14.2 miles ($10M)

Estimated Cost: $2.4M

Projected IS Date: 12/31/2018

Status: Engineering & Construction





ComEd Transmission Zone

Supplemental Project

Problem Statement :

138 kV Line 13304 (Rock Falls – Normandy) is wood H frame construction dating from 1950 and has been identified for replacement due to deteriorated condition.

Potential Solutions:

Rebuild the 138 kV Line 13304 (Rock Falls – Normandy) 11 miles of wood H frame construction with steel poles.

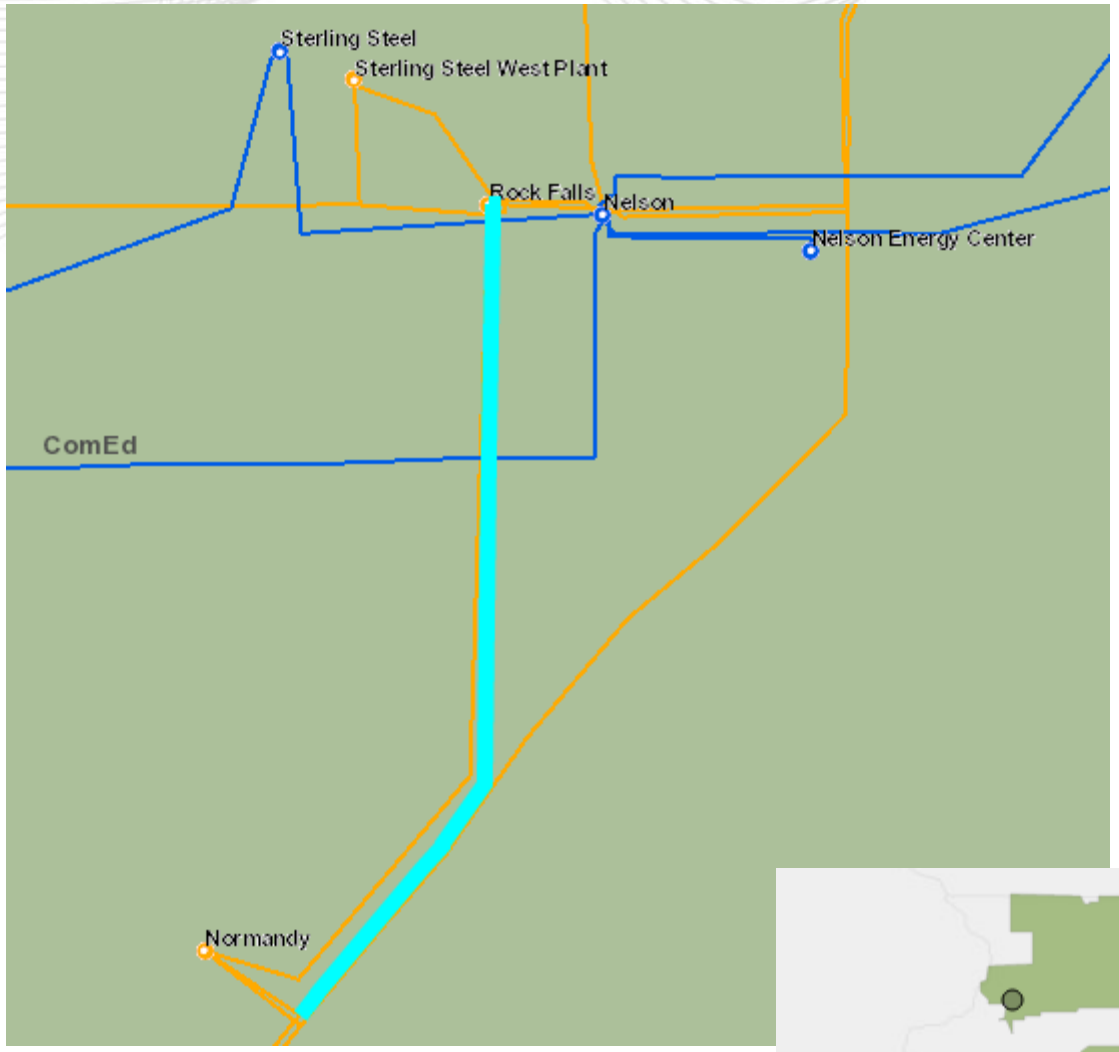
Alternatives:

no other alternatives considered

Estimated Cost: $13.2M

Projected IS date: 12/31/2018

Status: Engineering & Construction



DEOK Transmission Zone

Supplemental Project

Problem Statement:

The Ford-Sharonville substation is supplied by a 69kV radial feeder that is tapped off of a feeder from Port Union to Evendale. An alternate 69kV radial feeder to Ford-Sharonville is tapped off a feeder from Allen to Wyscarver. The Port Union Evendale radial feeder is aged and in deteriorating condition. The Allen Wyscarver radial feeder has inadequate capacity.

Driver: Equipment Condition, Operational Flexibility

Potential Solutions:

Rebuild and reconfigure the Ford-Sharonville 69kV feeder into two separate feeds, a feeder straight from Port Union to Ford-Sharonville and a feeder straight from Evendale to Ford-Sharonville to be used in a primary and secondary feed arrangement.

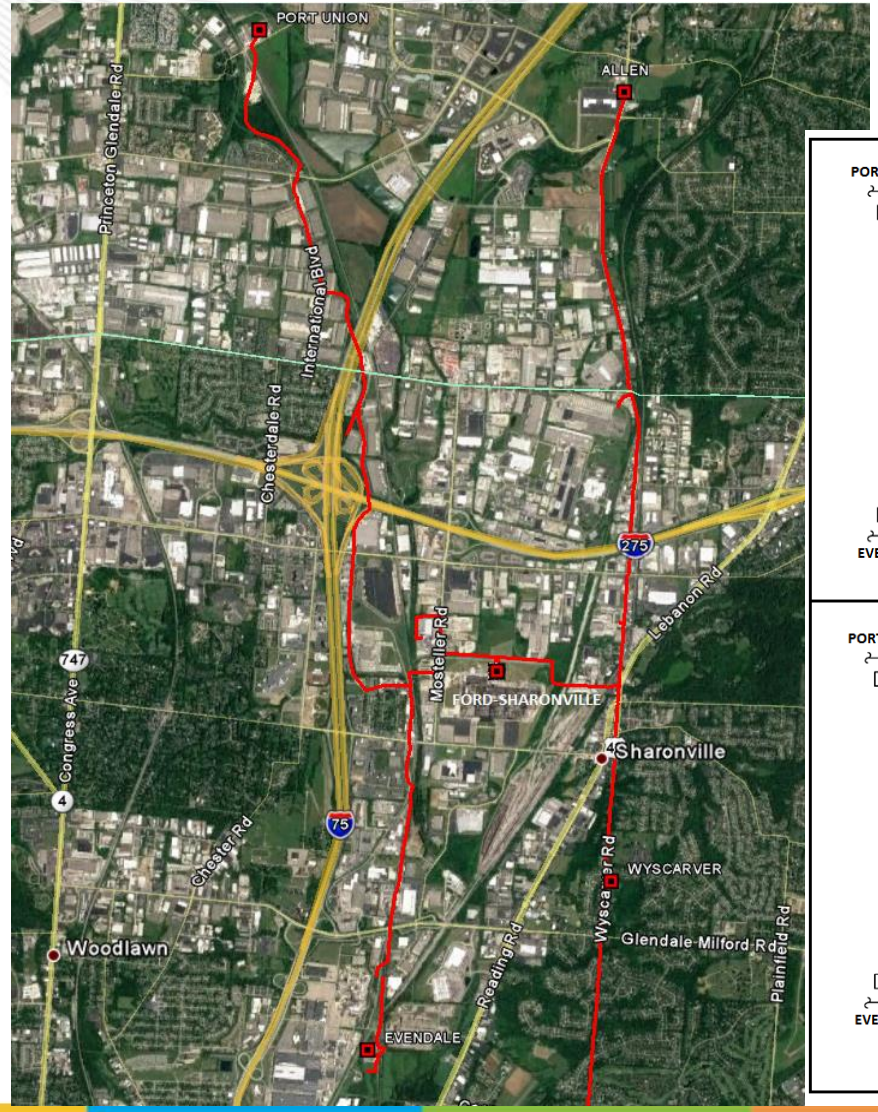
Potential Solutions:

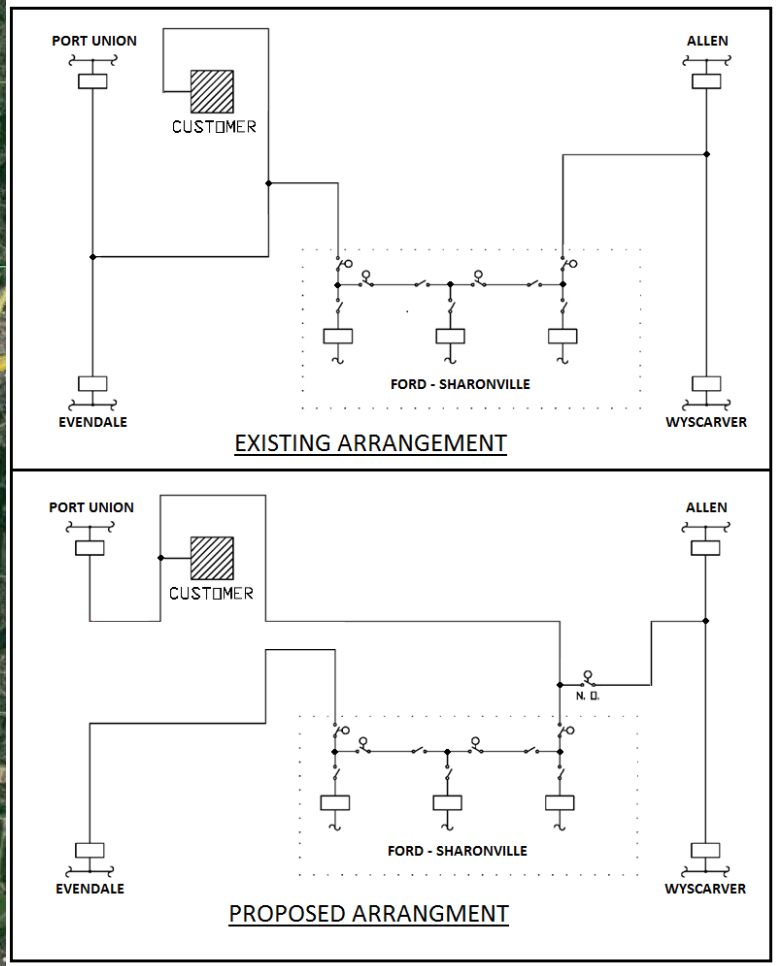
Rebuild the longer alternate feed (Feeder B).

Estimated Cost: $1.31M

Projected IS Date: 6/30/2018

Status: Planning





DEOK Transmission Zone

Supplemental Project

Problem Statement:

Miami Fort Unit 6 was retired June 2015. The GSU and connecting infrastructure needs to be removed

Driver: Other, retirement.

Potential Solutions:

Remove Miami Fort Unit 6 GSU, aux transformer, and associated equipment.

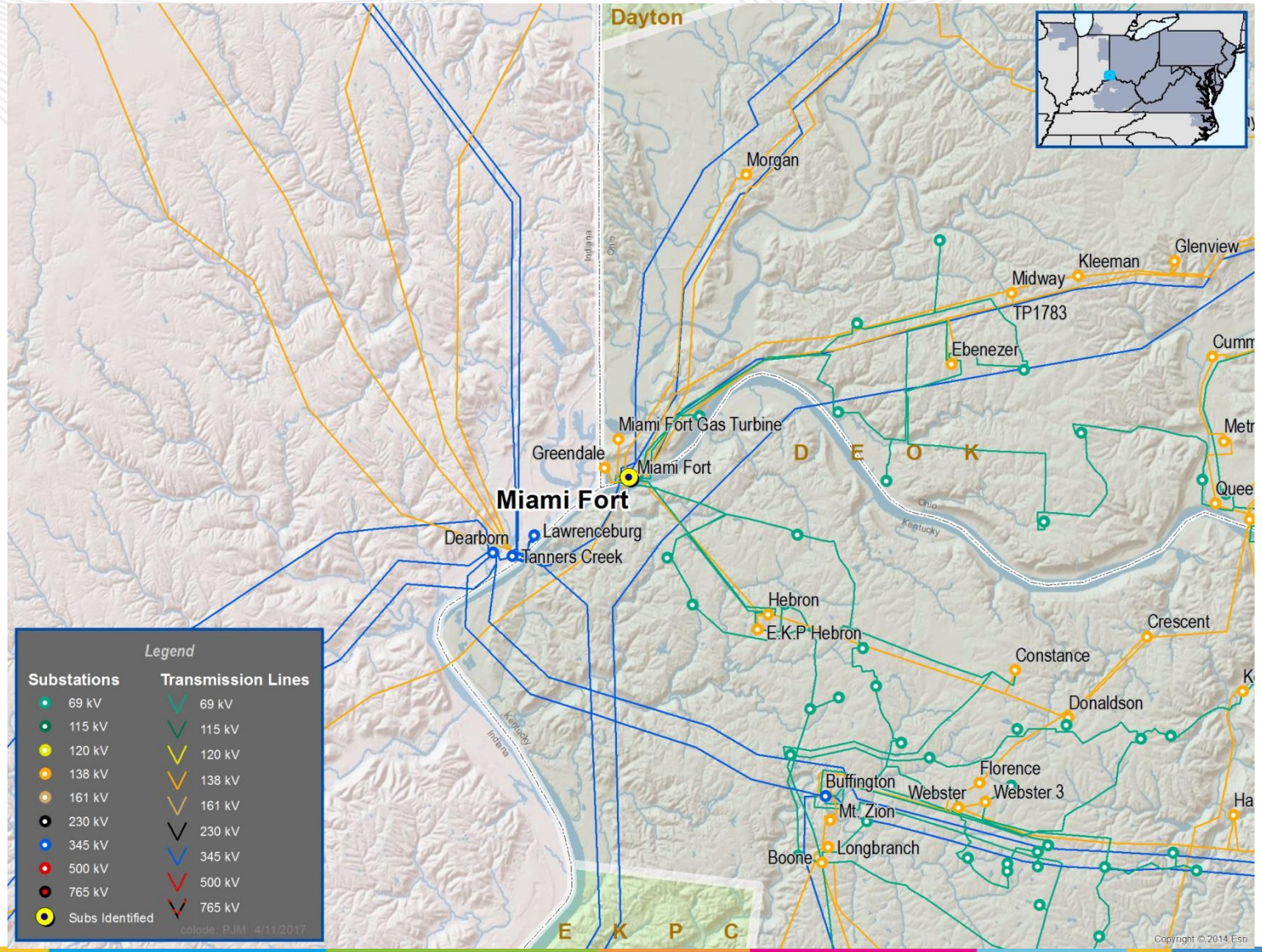
Alternatives:

No good cost effective alternatives were identified.

Estimated Cost: $0.44M

Projected IS Date: 12/31/2018

Status: Planning



DEOK Transmission Zone

Supplemental Project

Problem Statement:

Mitchell 138/69/33kV Transformer #3, the connected 69kV oil filled circuit breaker, and cap and pin insulators are in deteriorating condition and obsolete.

Driver: Equipment Condition, Performance and Risk

Potential Solutions:

Install a138/69kV transformer and a138/13kV transformer at Mitchell 138kV substation. Replace related circuit breaker and insulators.

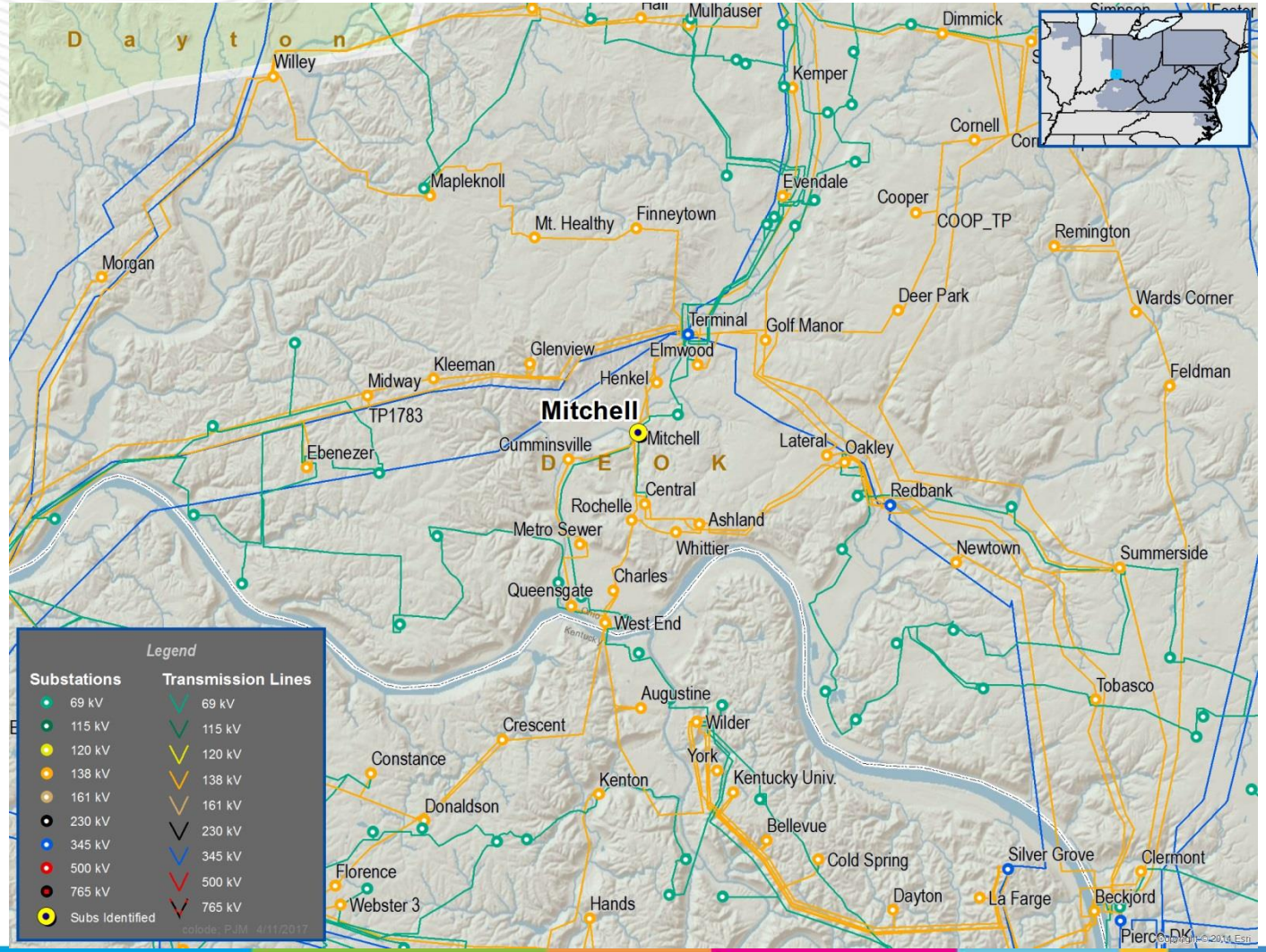
Alternatives:

No good cost effective alternatives were identified.

Estimated Costs: $5.52M

Project IS Date: 6/30/2018

Status: Planning



DEOK Transmission Zone

Supplemental Project

Problem Statement:
Critical customer has only one feed.
Driver: Customer Service

Potential Solutions:

The 69kV feeder between Trenton and the customer has two parallel sets of conductors joined at the customer property. The new configuration will separate the conductors at the customer property, extending the first set around the customer's property and connecting them to an auto-throw-over switch. The second set of conductors will connect to the other side of the auto-throw-over switch and then be tapped into another feeder near Trenton to be used as a secondary feed.

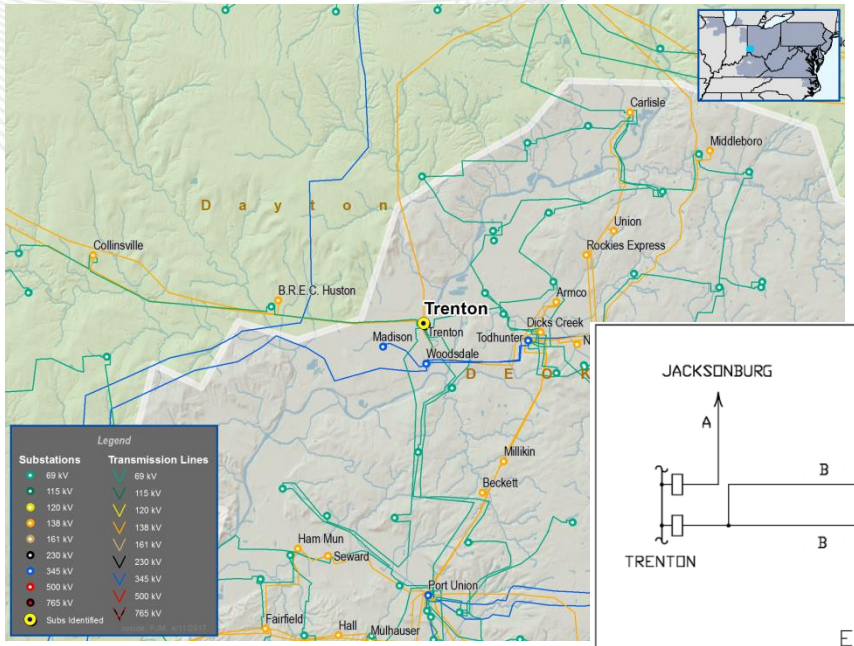
Alternatives:

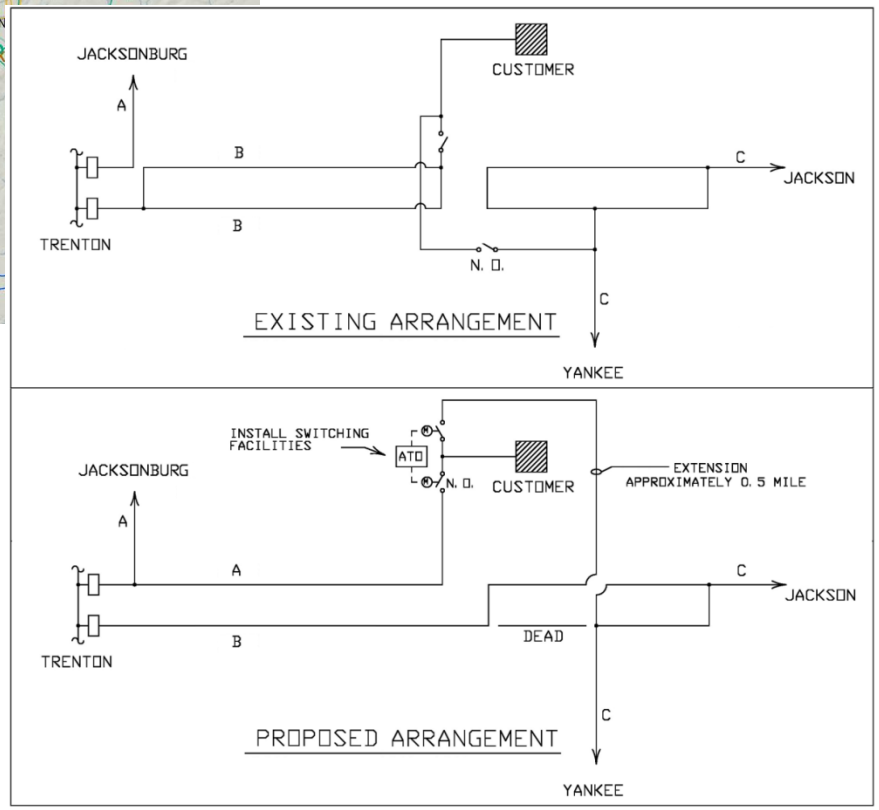
Extend bus and add breaker at Trenton 69kV substation with new feeder to customer.

Estimated Costs: $2.18M

Projected IS Date: 6/30/2018

Status: Planning





DEOK Transmission Zone

Supplemental Project

Problem Statement:

The Wards Corner-Feldman 138kV feeder is highly loaded; Prevents planned service outages.

Driver: Operational Flexibility

Potential Solutions:

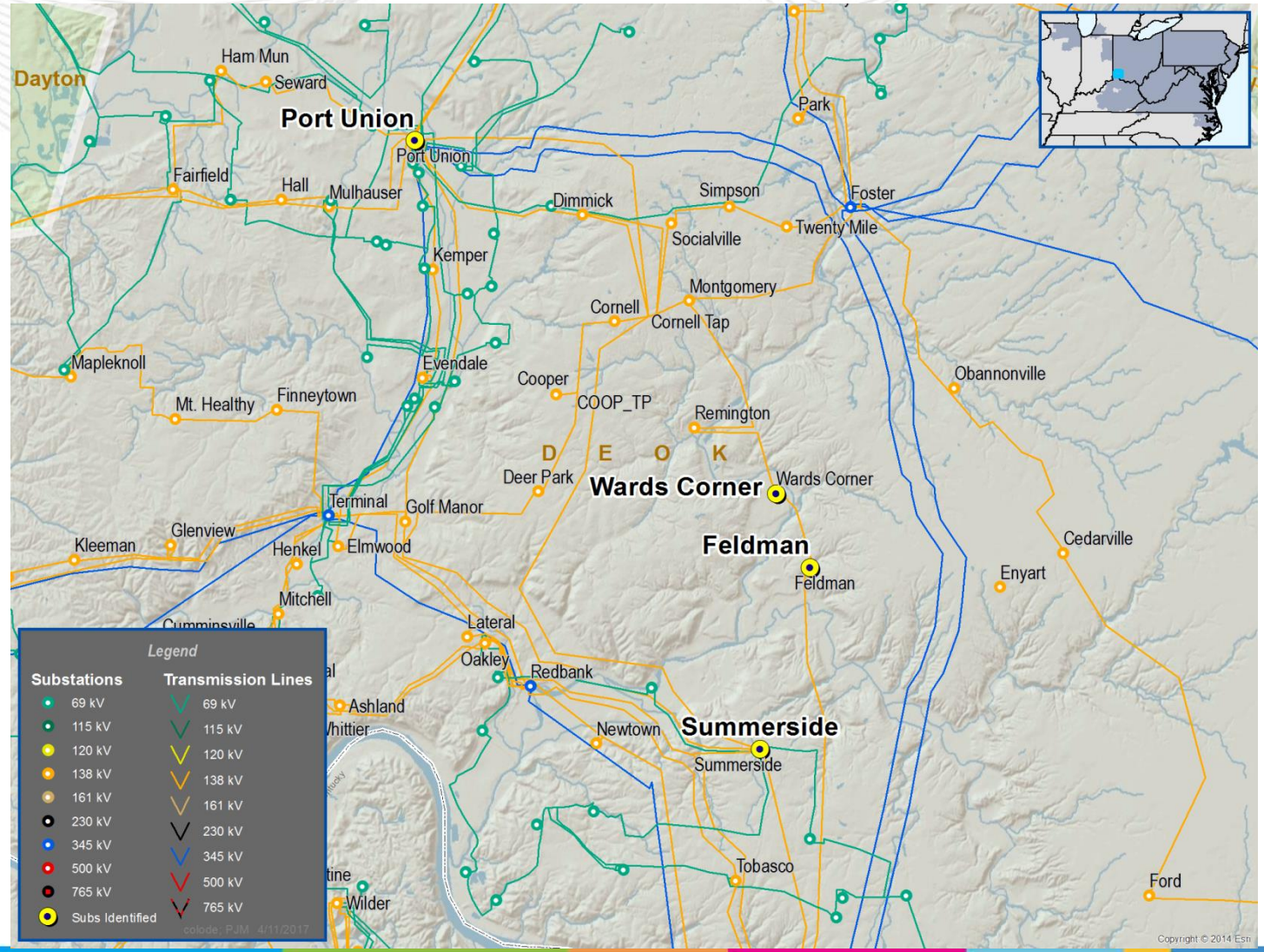
Disconnect the Remington-Wards Corner-Feldman 138kV feeder at Wards Corner. Refeed Wards Corner with Port Union-Summerside 138kV feeder. Both on shared tower at Wards Corner.

Alternatives: Reconductor Feldman-Wards Corner 138kV line

Estimated Cost: $0.992M

Projected IS Date: 12/31/2019

Status: Planning



EKPC Transmission Zone

Supplemental Project- S0916 Scope change

S0916 Old Scope:

- Retire the Hilda 18.37 MVAR capacitor bank and move to Big Woods
- Project IS Date: 6/1/2017
- Estimated cost: $0.35M

New Scope:

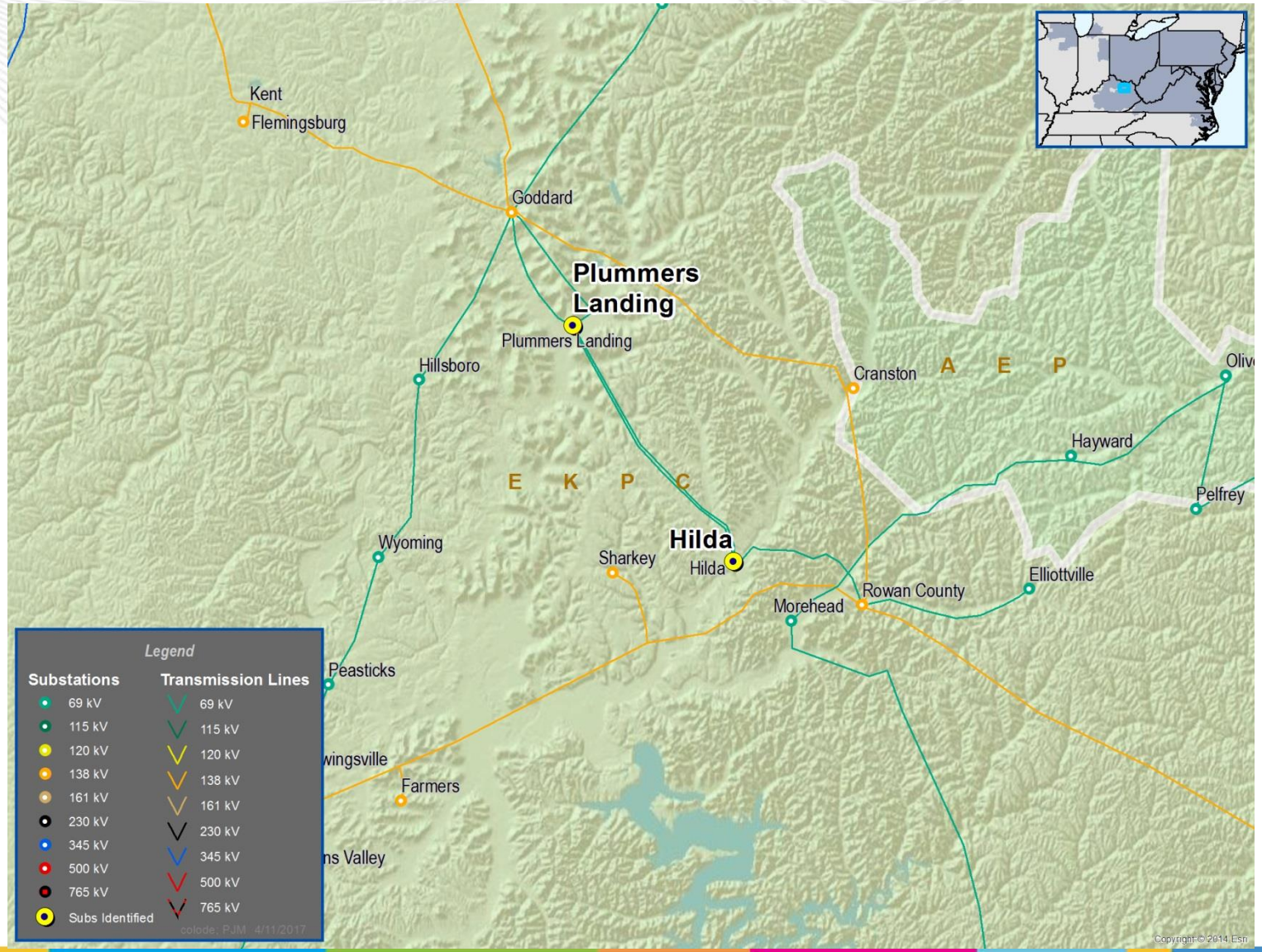
- Retire the Hilda 18.37 MVAR capacitor bank. Move the retired Hilda bank to Plummers Landing distribution substation and resize to 12.245 MVAR.
- Project IS Date: 12/1/2018
- Estimated cost: $0.35M

Reason for scope change:

- A nearby industrial customer has experienced transient voltage during the operation of the existing Hilda capacitor bank. EKPC had planned to relocate this cap bank to the Big Woods distribution substation, which is 4.75 miles away from the industrial customer, to buffer the transient experienced. However, upon discussions with our Member System distribution cooperative it has been determined that a larger buffer would be preferred. EKPC now plans to relocate the Hilda Capacitor Bank to Plummer's Landing distribution station, which is 4.71 miles (total of 9.46 miles) further from the industrial customer to provide an even greater buffer.

Alternative Considered: Move capacitor to Big Woods ($0.35M)

Status: Engineering/Procurement



Questions?

Email: RTEP@pjm.com

Revision History

4/14/2017 – Original version posted to PJM.com

4/18/2017 – Slide#83 (original number): updated map and problem statement;

– Slides #85 (original number): updated Estimated cost update

– Slides #72 (original number): Removed; duplicate with Slide #53

– Slides #38 (original number): Update the solution description

– Slides #61 (original number): Update the Estimated Cost

– Slides #7 (original number): In problem statement, change Caldwell to Chatfield

– Slides #71 (original number): Removed, the scope is covered in Slide#35

– Slides #3 (original number): New Map

– Slides #49 (original number): Updated Projected IS date

– Add Slides #28: Leon-Ripley project

4/19/2017 – Slides #29, #30, #33: Added Estimated Cost for Alternatives

– Slides #31, #33: Updated the Preliminary Solution description

Revision History

– Slides #29, #30, #33: Added Estimated Cost for Alternatives

– Slides #31, #33, #34: Updated the Preliminary Solution description

– Slides #87: Corrected a typo in new scope

4/24/2017 – Slides #16, #22, #57: Updated maps

– Slides #69: Updated the Estimated Cost

– All Slides for AEP zone: Added the city or county location for the projects

6/12/2017 –Original Slides #4-6, #8-14, #17-20 , #23, #27, #38 -50, #53 -77: Updated the content on one or multiple items including Problem Statement, Alternatives, Preliminary Solution, Status, and maps

– Original Slides #7: Expanded to two slides (7&8) with content update

– Original Slides #15: Expanded to two slides (16, 17&18) with content update

– Original Slides #21: Expanded to two slides (24&25) with content update, split the whole project into baseline and supplemental

– Original Slides #24: Expanded to two slides (28&29) with content update

Revision History

- Original Slides #25: Expanded to two slides (30&31) with content update
- Original Slides #26: Expanded to two slides (32&33) with content update
- Original Slides #28: Expanded to two slides (35&36) with content update
- Original Slides #36: Deleted. Combined with baseline slides 15-16
- Original Slides #37: Deleted. Combined with baseline slides 7-8
- Original Slides #51: Expanded to two slides (59&60) with content update
- Original Slides #52: Expanded to two slides (61&62) with content update