



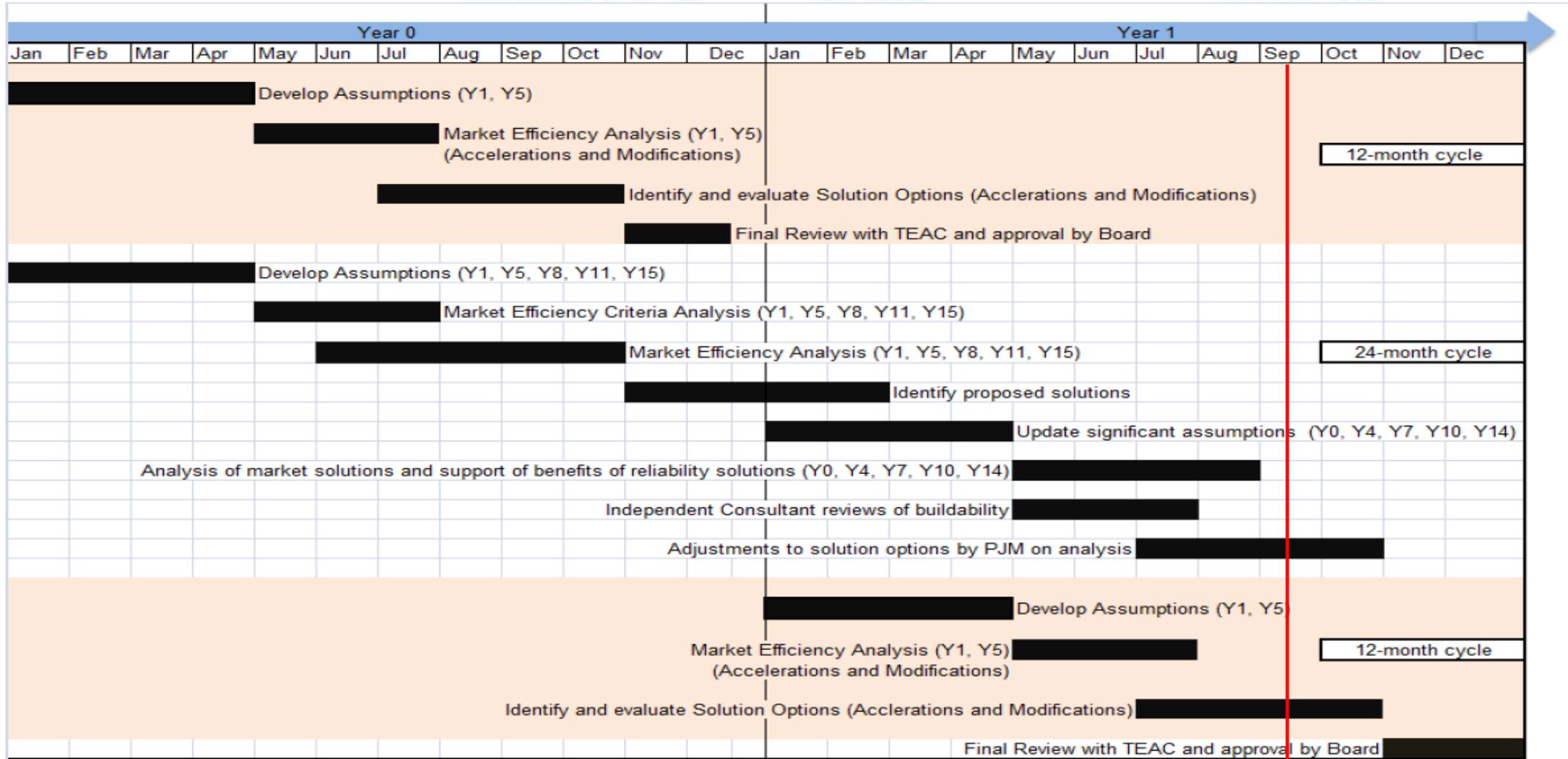
Market Efficiency Update

Transmission Expansion Advisory Committee
September 14, 2017





Where we are - Market Efficiency Timeline





Abbreviated Market Efficiency Proposal Window 2016-2017 Long Term Proposal Window 1A

- Addendum to the 2016-2017 Long Term Proposal Window closed on Feb 2018
 - Will be designated as **2016-2017 Long Term Proposal Window 1A**.
 - Opening on September 14, 2017
 - Closing on September 28, 2017.
 - Solicit proposals to address the Tanners Creek - Dearborn 345 kV thermal constraint, which is a Reliability Pricing Model (RPM) constraint.
- Target facility Tanners Creek - Dearborn 345 kV is the next limiting element in the 2020/2021 RPM Base Residual Auction CETL study for the DEOK LDA*
- All participants of the 2016-2017 Long Term Proposal Window remain eligible to participate.

*After RTEP baseline upgrade b2831 (Upgrade the Tanner Creek - Miami Fort 345 kV circuit) is constructed

- Data is available on the PJM website here:
 - <http://www.pjm.com/planning/rtep-development/expansion-plan-process/ferc-order-1000/rtep-proposal-windows/2016-2017-rtep-long-term-proposal-window.aspx>
- The access requests should be submitted here:
 - <http://www.pjm.com/library/request-access/form-ceii-request.aspx>
 - The request should specify access to MISO and Production Cost Model data as well as the 2016-17 RTEP Long Term Proposal Window data.
 - As a reminder, each individual from the organization who will access the Proposal Window data is required to have CEII clearance with PJM. This is in addition to the organization's CEII clearance.
- Please contact PJM via Proposalwindow-admin@pjm.com with any questions.

Project ID: 201617_PJM_RPM_DEOK

Proposed by: PJM

Proposed Solution:

After the close of the initial Market Efficiency Proposal Window, a low-cost, high-impact upgrade was identified. Replace terminal equipment at Tanners Creek on Tanners Creek - Dearborn 345 kV line.

kV Level: 345 kV

In-Service Cost (\$M): \$1.5, B/C Ratio = 53.13

In-Service Date: 2021

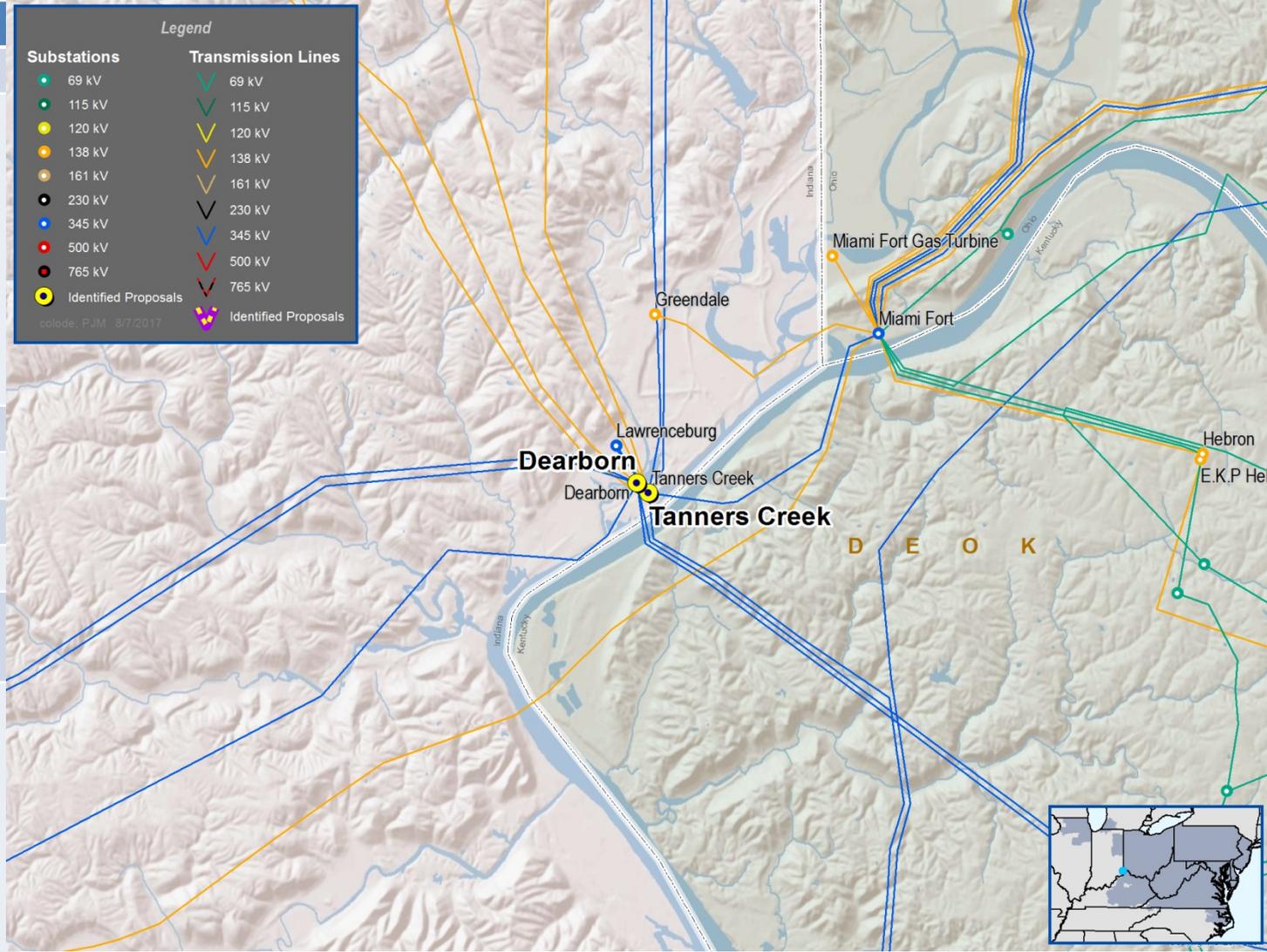
Target Zone: DEOK

ME Constraints:

TANNERS CREEK - MIAMI FORT 345 kV

Notes:

- CETL improvement of 332 MW and very low cost
- Anticipate request for Board approval in Oct 2017 (pending Window 1A outcome)
- Designated Entity: AEP (the local TO)
- Cost Allocation: TBD



2016-2017 Long Term Window

- Market Efficiency Base Case Mid-Cycle Update
 - Base case reposted with updates from stakeholders feedback
 - Olive - Bosserman supplemental project removed from the base case
- Analysis of proposed solutions: Aug 2017 - Dec 2017 (in-progress)
 - RPM and Interregional Projects analysis 90% completed
 - PPL projects analysis in-progress
 - BGE projects will be analyzed after PPL
 - Any high-value low-risk* type projects may be analyzed in parallel with the above
 - All other regional projects will be analyzed last
- Target determination of recommended projects: Feb 2018
 - RPM projects to be recommended at Oct, 2017 Board meeting
 - Interregional, PPL and high-value low-risk projects at Dec, 2017 Board meeting
 - BGE and other projects to be recommended at Feb, 2018 Board meeting

**High-value low-risk projects are generally classified as low cost upgrades, with significant B/C, and with minimum competition.*

- TMI nuclear unit retirement: September 2019
- PPL supplemental project correction: Juniata - Cumberland 230 kV line
- Impedance correction: Conemaugh – Rice – Hunterstown
- NIPSCO retirements: Bailey units to retire in 2018
- AMEREN rating corrections
 - Kincaid – Austin 345 kV line
 - Gifford – Paxton 138 kV line
- Olive – Bosserman 138 kV supplemental project removed from the base case

Interregional Projects

- Benefits to each RTO shall be determined by that RTO using their respective regional process and metrics
- Costs shall be allocated interregional based on pro rata share of benefits, as determined above
- Projects must meet the B/C criteria in each RTO (based on allocated costs) and identified by both RTOs as the best solution to be recommended to each RTOs board
- Use 15 year stream of benefits
- Use average discount rate to move benefits to in service year
 - PJM: 7.4%
 - MISO: 7.1%
 - Average: 7.25%

- **PROMOD simulations:**
 - Base Case with Olive – Bosserman 138 kV Supplemental project
 - Base Case without Olive – Bosserman 138 kV Supplemental project
 - Sensitivity Run: Dune Acre Transformer 345/138 kV closed
- **Analysis completed 90%**
 - Currently performing additional analysis on projects that shifted congestion downstream. This may cause B/C ratio to change, if additional upgrades are required to address congestion created by the project.
- **Coordination with MISO**
 - PJM discussed simulations results with MISO. Factors considered for project selection: congestion driver, PJM and MISO benefits, additional congestion created by the project.
 - Projects that don't show MISO benefits will not be considered for further interregional analysis.
 - PJM to share final results with MISO and vice versa.
 - RTOs jointly select the most beneficial project (if any) and inform stakeholders.



Interregional Projects Results

Project information					Base Runs (Dune Acres Transformer open)				Sensitivity Run Dune Acre Transformer	
					With Olive-Bosserman Dune Acre 345/138 kV open		Without Olive-Bosserman Dune Acre 345/138 kV open		Without Olive-Bosserman Dune Acre 345/138 kV closed	
Project Id	Submitter	Description	Cost (\$M)	Constraint	BC Ratio Lower	NLP	BC Ratio Lower	NLP	BC Ratio Lower	NLP
201617_1-10B	Nextera	Build a new 345/138 kV substation (Rolling Prairie) connecting the following an existing 345 kV line to two existing 138 kV lines.	\$ 19.25	Olive-Bosserman 138 kV	0.28	\$ 7.21	1.71	\$ 44.56	1.29	\$ 33.54
201617_1-12D	AEP NIPSCO	Rebuild the 34.5 kV line between New Carlisle and Silver Lake as 138 kV. Rebuild the Michigan City - Trail Creek-Bosserman 138 kV.	\$ 41.86	Olive-Bosserman 138 kV	1.53	\$ 35.34	1.41	\$ 80.37	0.86	\$ 48.81
201617_1-13H	Transource	Tap the Tanners Creek – Losantville 345 kV line and build a single circuit line to a new 345/138 station (Coyote) next to Wiley.	\$ 71.89	Tanners Creek - Miami Fort 345 kV	0.28	\$ 27.12	0.27	\$ 25.99	0.51	\$ 49.90
201617_1-17B	AEP Exelon	Meadow Lake – Pike Creek 345 kV Double Circuit Greenfield Line and Pike Creek 345kV Station	\$ 197.97	Olive-Bosserman 138 kV	0.29	\$ 78.68	0.36	\$ 96.59	0.29	\$ 76.92
201617_1-18S*	Northeast Transmission Development	Build a 345/138 kV substation ("Coffee Creek") interconnecting Green Acres to Olive 345 kV line and Flint Lake to Luchtman Road 138 kV line.	\$ 17.40	Olive-Bosserman 138 kV	0.54	\$ 12.76	2.39	\$ 56.57	1.76*	\$ 41.68
201617_1-1A**	WPPI	Provide a second New Carlisle-Olive 138 kV circuit. Upgrade substation equipment at New Carlisle and Olive substations.	\$ 2.50	Olive-Bosserman 138 kV	0.17	\$ 0.58	3.75	\$ 12.73	14.35**	\$ 48.75
201617_1-9A	NIPSCO	Reconductor existing NIPSCO line sections between AEP Bosserman and Olive 138 kV substations and between AEP Bosserman and New Carlisle 138 kV substations.	\$ 8.00	Olive-Bosserman 138 kV	0	\$ -	4.84	\$ 52.65	1.60	\$ 17.40
201617_1-9B	NIPSCO	New NIPSCO line section between Thayer and Morrison 138 kV substations.	\$ 42.50	Paxton-Gifford 138 kV	0.13	\$ 7.32	0.33	\$ 18.92	0.87	\$ 50.34

Notes: *201617_1-18S does not fully solve Olive – Bosserman congestion driver.

** WPPI interest in 201617_1-1A is limited to submitting the project description.

If approved this upgrade will be assigned to the incumbent TO (AEP).

Re-evaluation of Approved Market Efficiency Projects (2014/15 RTEP Window)

- Applies to market efficiency projects approved during the 2014/15 RTEP Window
- Using the Market Efficiency Base Case Mid-Cycle Update
- Analysis performed individually, one project at a time
- Reevaluation Study Process
 - Create a new base case by removing/reversing the topology related to the approved market efficiency project
 - Measure the impact of adding back the approved market efficiency project
 - Measure benefits for 15-year period starting with the in-service date
 - For RPM projects also measure the capacity benefits
 - Calculate the new B/C ratios
- Projects must meet the B/C criterion of 1.25

- All projects analyzed so far pass the B/C ratios.
- Baseline project b2728, Loretto – Wilton 345 kV, does not need reevaluation due to new in-service date of 12/31/2017
- Baseline project b2696, Krendale to Shanor Manor 138 kV upgrade, work in-progress



Reevaluation Results

PJM Window Project ID	Baseline#	Type	Area	Constraint	Cost (\$mill)	In-Service Date	B/C 2014/15 Window	BC Reevaluation 2017
201415_1-2A	b2690	Upgrade	PPL/BGE	Safe Harbor to Graceton 230 kV	\$ 1.10	2019	14.4	1.72
201415_1-2B	b2691	Upgrade	ME/PPL	Brunner Island to Yorkana 230 kV	\$ 3.10	2019	22.2	2.84
201415_1-4I	b2697.1-2	Upgrade	AEP	Fieldale to Thornton 138 kV	\$ 0.75	2019	101.2	9.47
201415_1-4J	b2698	Upgrade	AEP	Jacksons Ferry to Cloverdale 765 KV	\$ 0.50	2019	62	46.18
201415_1-9A*	b2743.1-8, b2752.1-7	Greenfield	APS/BGE	AP-South	\$340.60*	2020	2.48	1.30
201415_1-10B	b2693	Upgrade	COMED	Wayne to South Elgin 138 kV	\$ 0.10	2019	6.4	in-progress
201415_1-10J	b2692.1-2	Upgrade	COMED	Cordova to Nelson 345 kV	\$ 24.60	2019	1.9	1.59
201415_1-10D	b2728	Upgrade	COMED	Loretto-Wilton 345 kV (RPM)	\$ 11.50	2019	64.5	New In-Service Date: 12/31/2017
201415_1-11H	b2694	Upgrade	PECO	Peach Bottom 500 kV	\$ 9.70	2019	3	5.70
201415_1-12A	b2689.1-2	Upgrade	DUQ	Dravosburg to West Mifflin 138 kV	\$ 11.18	2018	2	2.63
201415_1-13E	b2695	Upgrade	DPL	Worcester to Ocean Pines (I) 69 kV	\$ 2.40	2019	65.3	10.14
201415_1-18G	b2688.1-3	Upgrade	APS	Taneytown to Carroll 138 kV	\$ 5.20	2019	90.1	8.50
201415_1-18I	b2696	Upgrade	APS/ATSI	Krendale to Shanor Manor 138 kV	\$ 0.60	2019	123.4	78.88
Optimal Caps	b2729	Upgrade	DOM	AP-South	\$ 8.98	2019	15.4	2.16

Note: * 201415_1-9A B/C ratio calculation based on the original cost. Cost of project currently under review and will be updated as necessary.

Milestone	Schedule 2016 - 2017
Proposed RPM projects analysis	Sept – Oct 2017
Proposed projects analysis - Interregional, PPL and high value low cost projects	Sept – Dec 2017
Proposed projects analysis - BGE and other	Oct 2017 – Dec 2017
Acceleration Analysis	Oct – Dec 2017
Final TEAC Review and Board Recommendation	Feb 2018

Appendix A - Interregional Projects Descriptions



AEP/COMED/NIPSCO Interregional Proposals

- **7 Projects:**

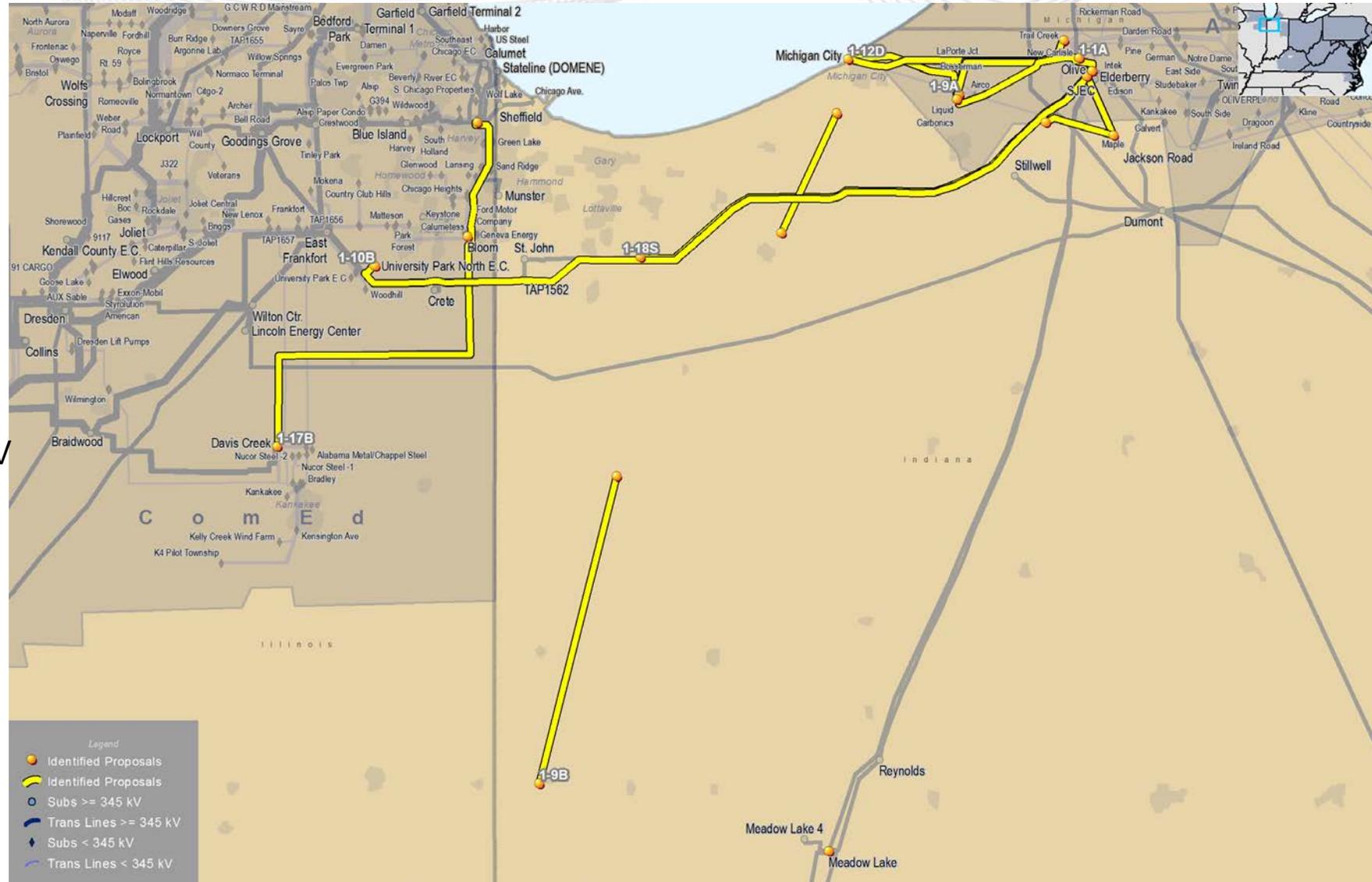
- 1-1A, 1-9A, 1-9B, 1-10B, 1-12D, 1-17B, 1-18S

- **Cost:**

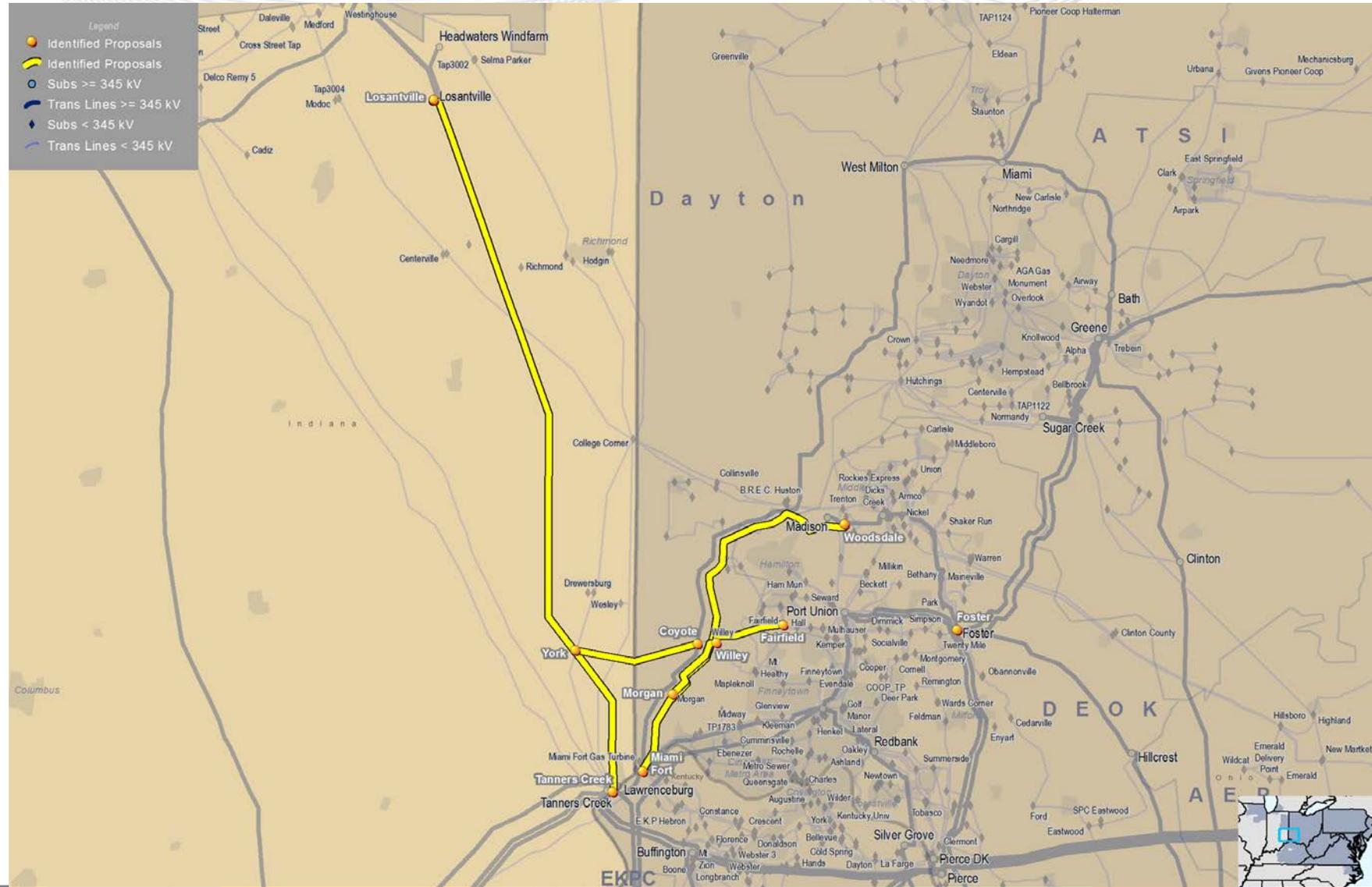
- From \$1.00 M to \$197.97 M

- **ME Constraints:**

- BOSSERMAN - OLIVE 138 kV
- PAXTON - GIFFORD 138 kV



- **1 Project:**
 - 1-13H
- **Cost:**
 - \$71.88 M
- **ME Constraint:**
 - TANNERS CREEK - MIAMI FORT 345 kV
- **2020/2021 RPM BRA Results**
 - DEOK LDA binding with Tanners Creek - Miami Fort 345KV as limiting CETL constraint



Project ID: 201617_1-1A

Proposed by: WPPI

Proposed Solution: Interregional
 Provide a second New Carlisle-Olive 138 kV circuit. Upgrade substation equipment at New Carlisle and Olive substations.

kV Level: 138 kV

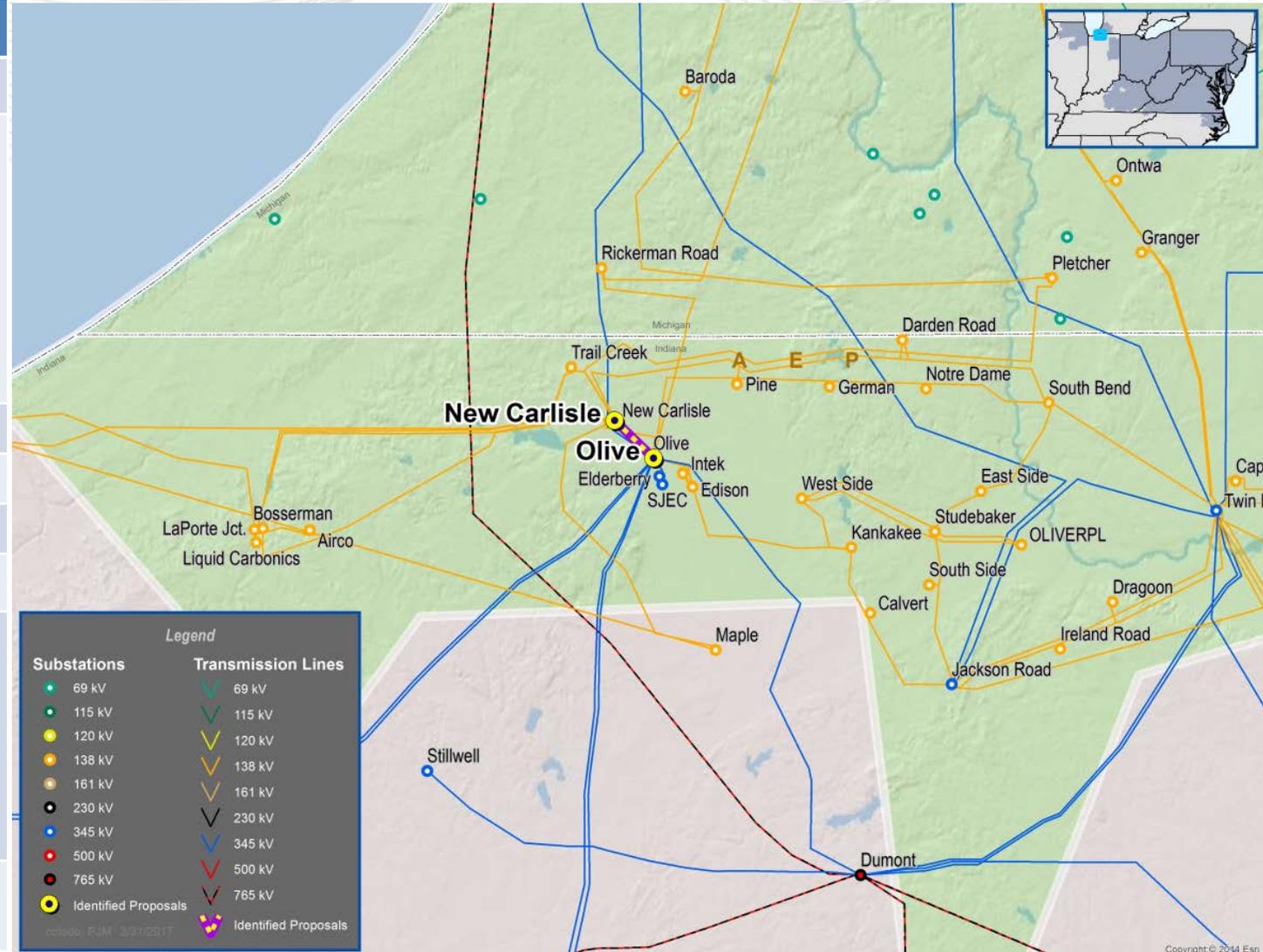
In-Service Cost (\$M): \$2.5

In-Service Date: 2019

Target Zone: AEP

ME Constraints:
 OLIVE - BOSSERMAN 138 kV

Notes:



Project ID: NIPSCO 1-9A

Proposed by: NIPSCO

Proposed Solution: Interregional Reconductor existing NIPSCO line section between AEP Bosserman and Olive 138 kV substations. Reconductor existing NIPSCO line section between AEP Bosserman and New Carlisle 138 kV substations.

kV Level: 138 kV

In-Service Cost (\$M): \$8.00

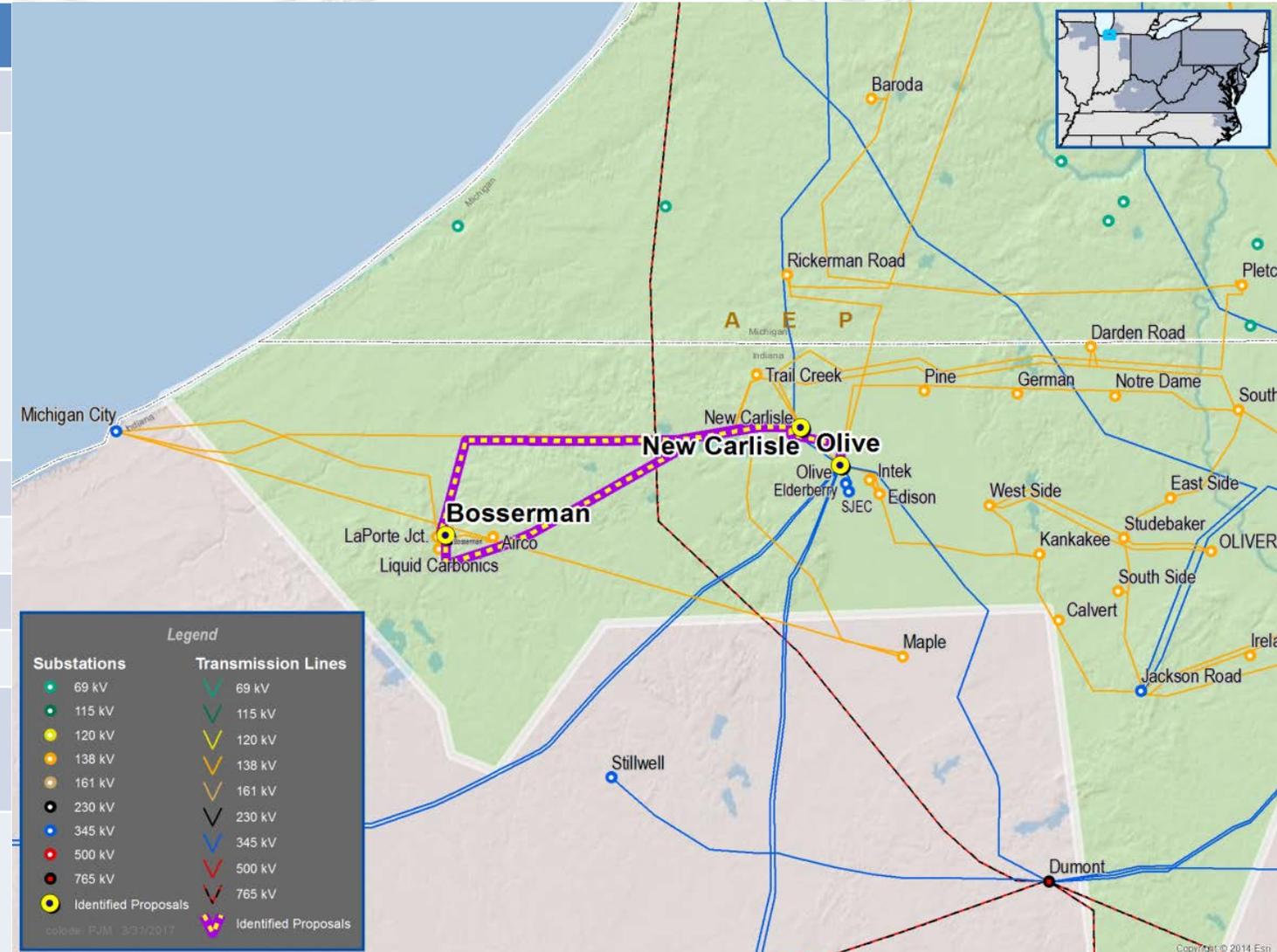
In-Service Date: 2019

Target Zone: AEP NIPSCO

ME Constraints:

OLIVE - BOSSERMAN 138 kV

Notes:



Project ID: 201617_1-9B

Proposed by: NIPSCO

Proposed Solution: Greenfield, Interregional
 New NIPSCO line section between Thayer and Morrison 138 kV substations.

kV Level: 138 kV

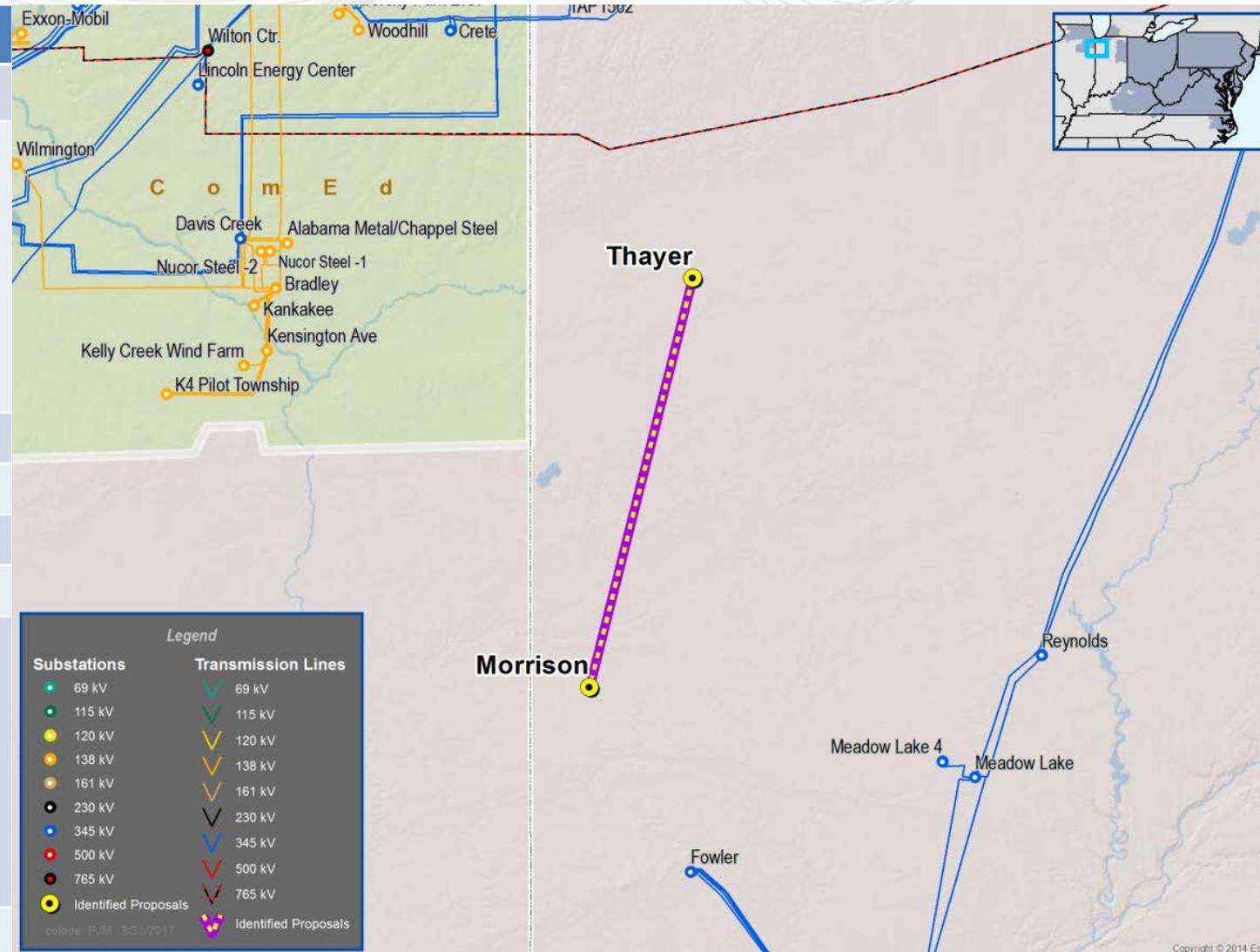
In-Service Cost (\$M): \$42.50

In-Service Date: 2022

Target Zone: AML ComEd NIPSCO

ME Constraints:
 PAXTON - GIFFORD 138 kV

Notes:



Project ID: 201617_1-10B

Proposed by: Nextera

Proposed Solution: Greenfield, Interregional
 Cut the University Park - Olive 345 kV and tie into a new 345/138 kV substation (Rolling Prairie). Cut the Maple - New Carlisle 138 kV and Maple - LNG 138 kV lines and tie into the new substation.

kV Level: 138 kV

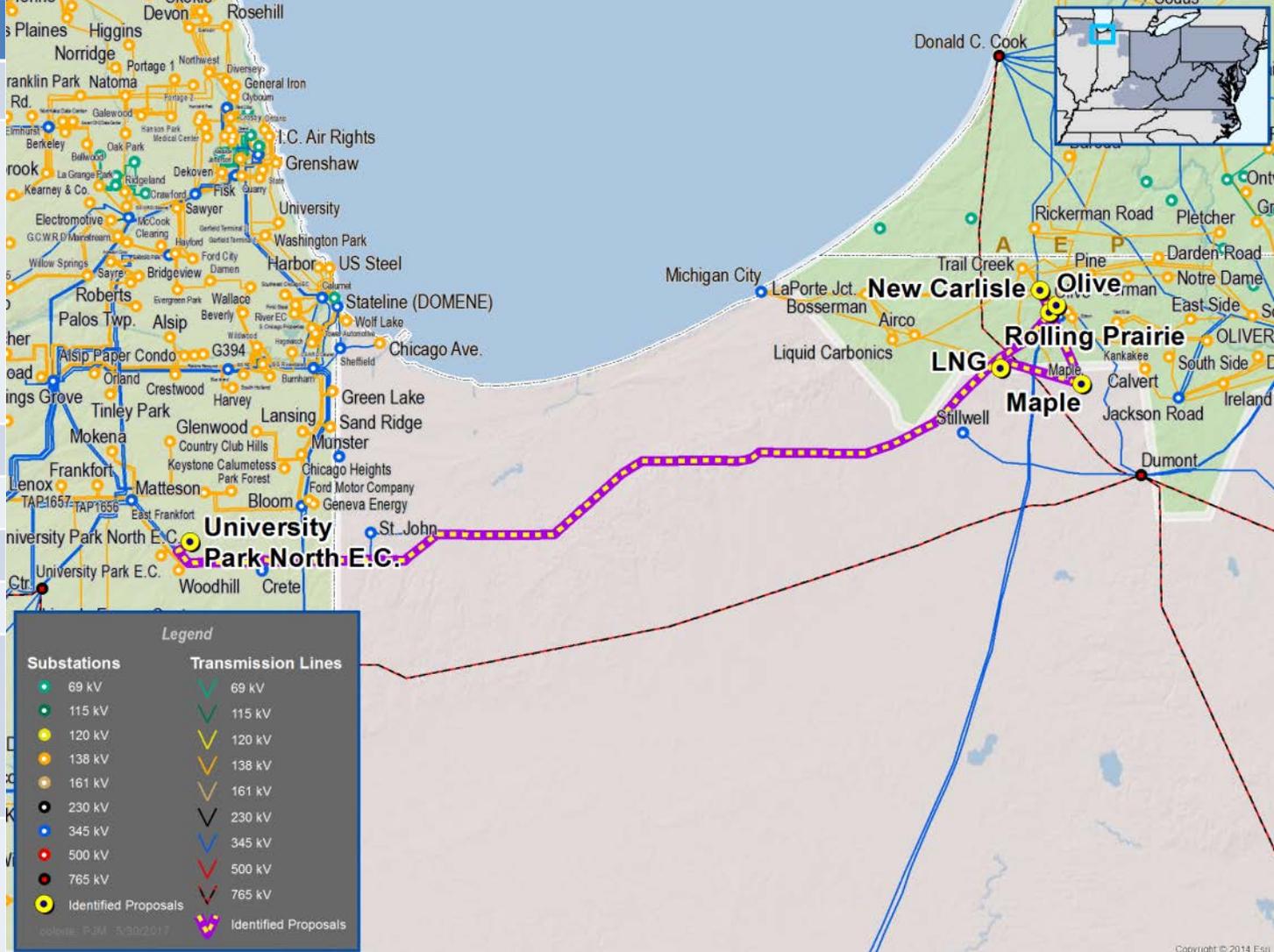
In-Service Cost (\$M): \$19.2

In-Service Date: 2021

Target Zone: AEP

ME Constraints:
 BOSSERMAN - OLIVE 138 kV

Notes:



Project ID: 201617_1-12D

Proposed by: AEP NIPSCO

Proposed Solution: Interregional

Terminate Olive-Bosserman 138 kV line at New Carlisle.
 Rebuild the 34.5 kV line between New Carlisle and Silver Lake as double circuit 138 kV, operating one circuit as 34.5 kV while extending the other at 138 kV with a new circuit to Liquid Carbonics. Establish an Olive-Liquid Carbonics-Bosserman 138 kV line. Rebuild the Michigan City-Trail Creek-Bosserman 138 kV.

kV Level: 138 kV

In-Service Cost (\$M): \$41.86

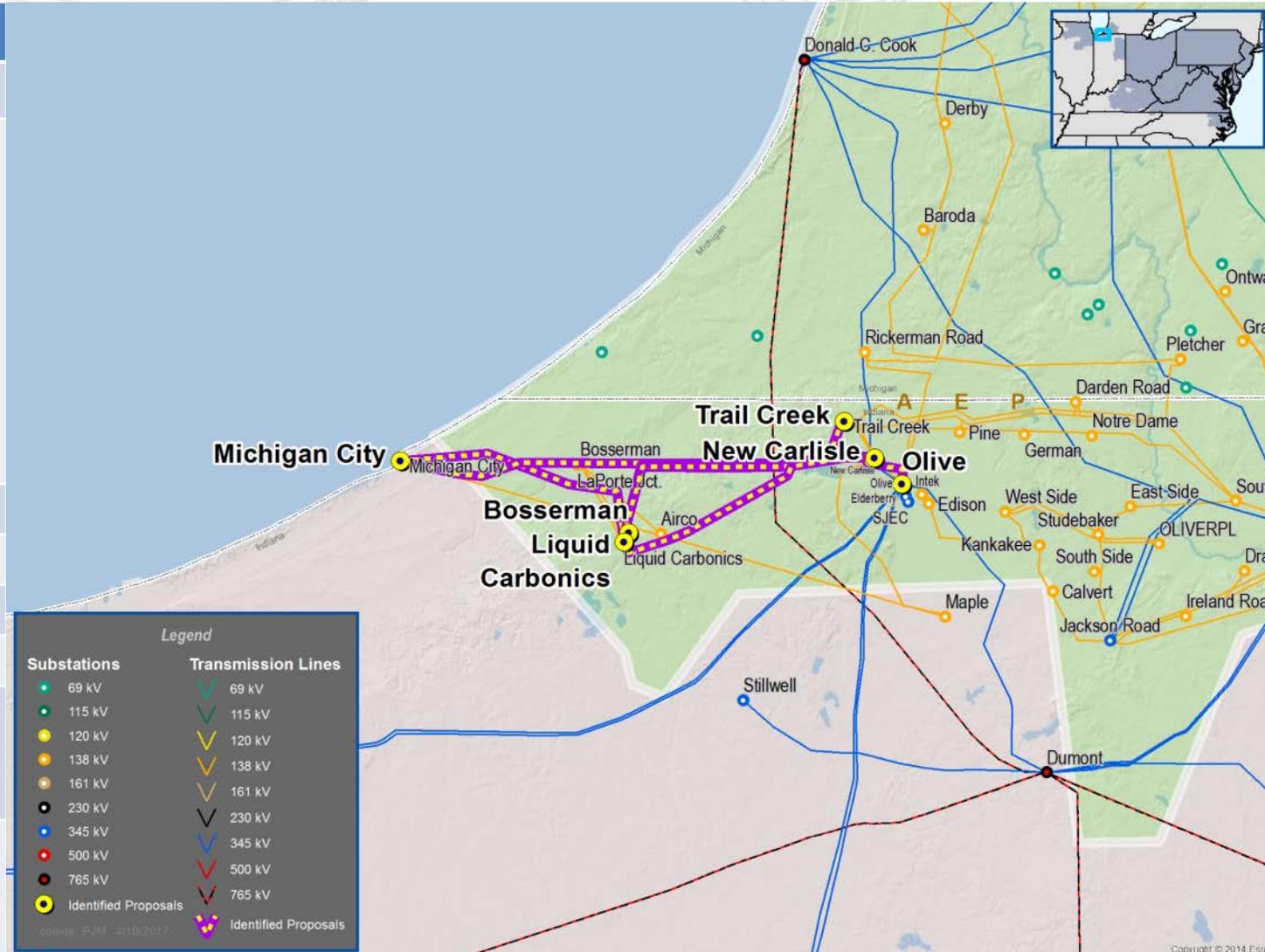
In-Service Date: 2021

Target Zone: AEP

ME Constraints:

OLIVE - BOSSERMAN 138 kV

Notes:



Project ID: 201617_1-13H

Proposed by: Transource

Proposed Solution: Greenfield, Interregional
 Tap the Tanners Creek - Losantville 345 kV line and build a new 345 kV switchyard (York). Tap the Miami Fort - Woodsdale 345 kV line and build a new 345/138 kV substation (Coyote) next to Wiley 138kV switchyard. Build a new 345 kV line between York and Coyote stations. Expand Wiley 138 kV switchyard by tying the Coyote 345/138 kV transformer into the Wiley 138 kV yard. Loop the Morgan-Fairfield 138 kV line into Wiley 138 kV station. Install a new 345/138 kV transformer at Foster substation.

kV Level: 138/345 kV

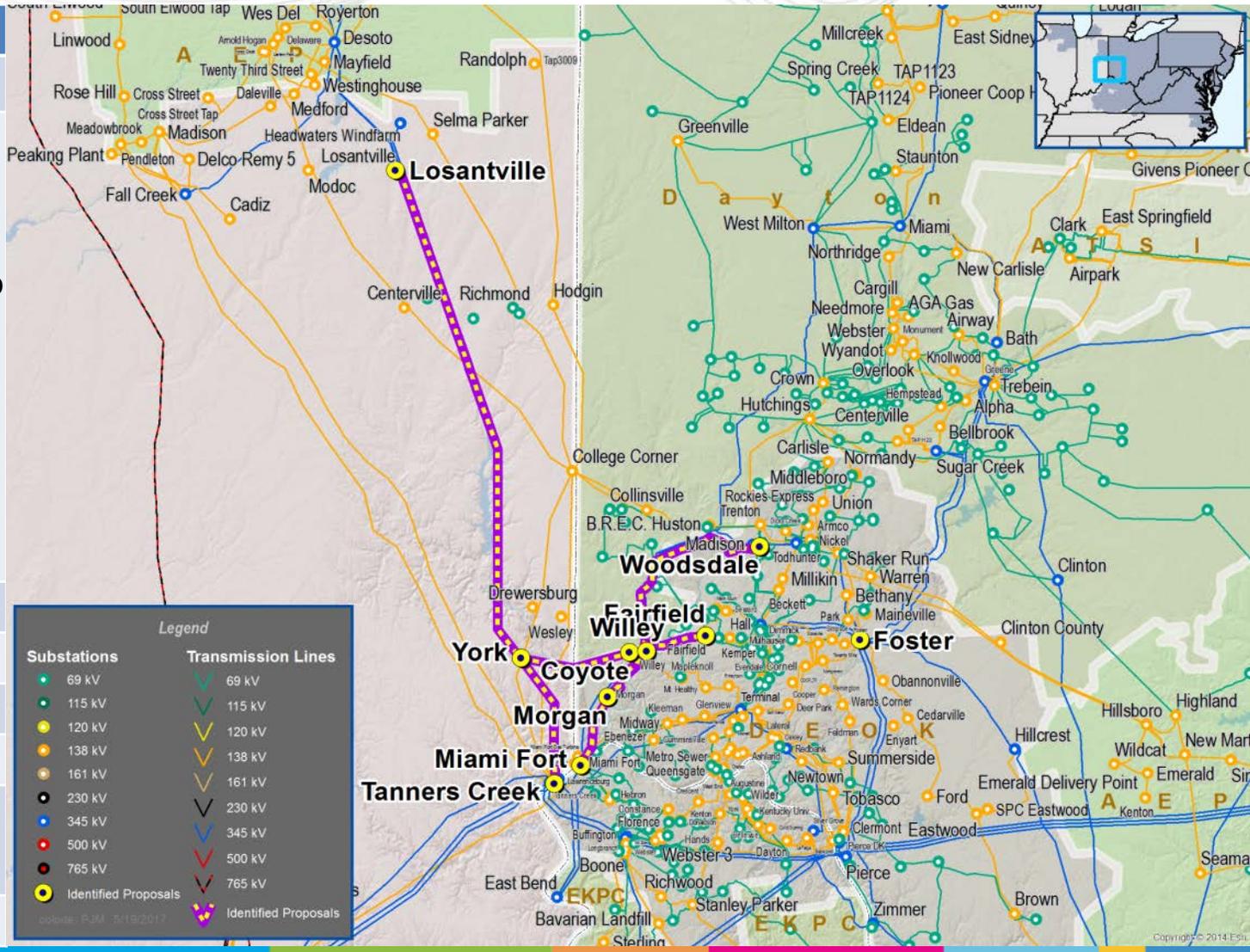
In-Service Cost (\$M): \$71.89

In-Service Date: 2021

Target Zone: DEOK

ME Constraints:
 TANNERS CREEK - MIAMI FORT 345 kV

Notes:



Project ID: 201617_1-17B

Proposed by: AEP Exelon

Proposed Solution: Greenfield, Interregional
 Build a new 345 kV switchyard (Pike Creek). Build a new Meadow Lake - Pike Creek 345 kV double circuit line. Loop the Bloom - Davis Creek 345 kV line and Burnham - Davis Creek 345 kV line into Pike Creek switchyard.

kV Level: 345 kV

In-Service Cost (\$M): \$197.97

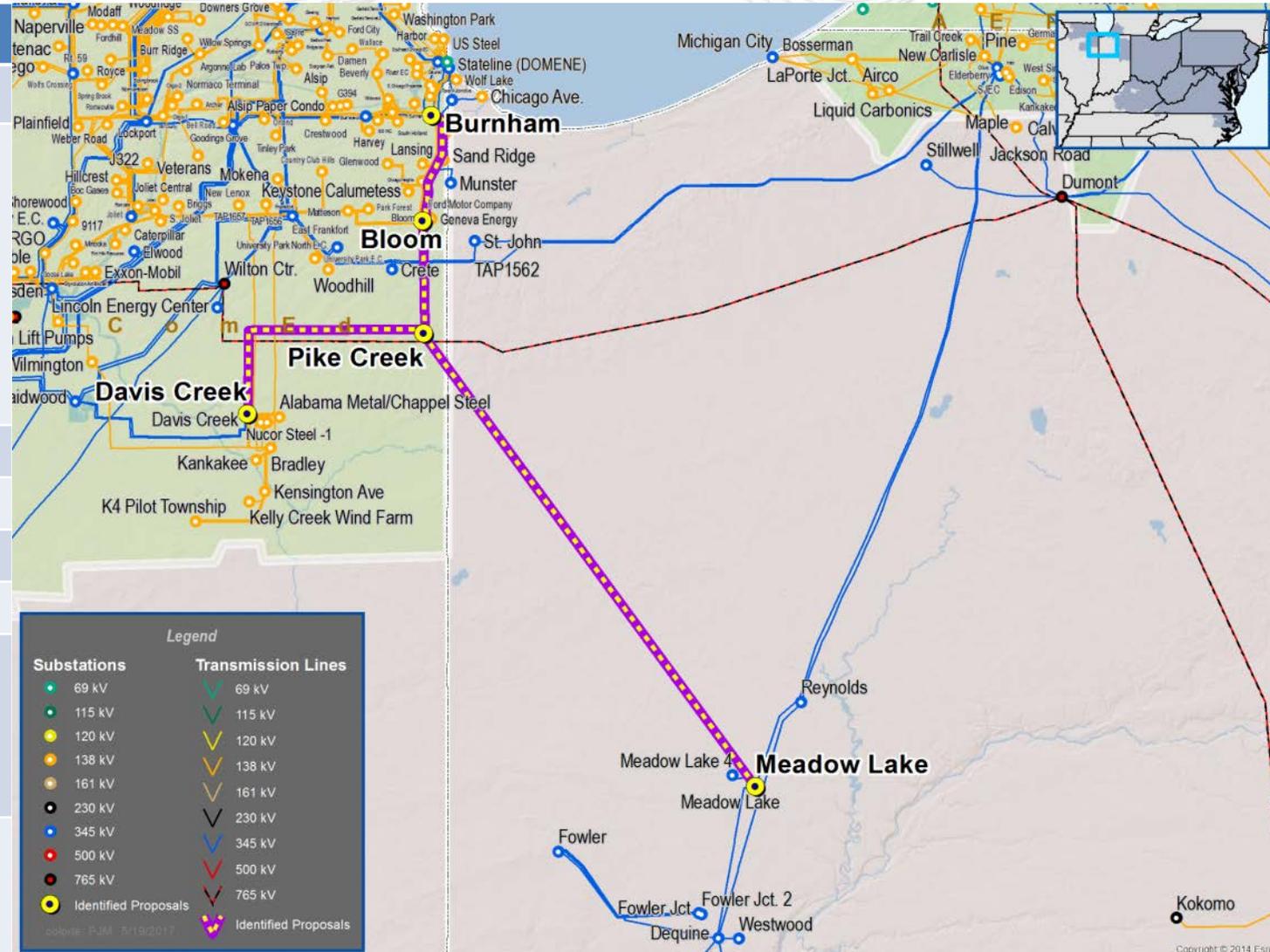
In-Service Date: 2021

Target Zone: ComEd

ME Constraints:

OLIVE - BOSSERMAN 138 kV + RPM Benefits

Notes:



Project ID: 201617_1-18S

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield, Interregional
 Tap the Green Acres - Olive 345 kV line and build a new 345/138 kV substation (Coffee Creek). Loop the Flint Lake to Luchtman Road 138 kV line into Coffee Creek.

kV Level: 138/345 kV

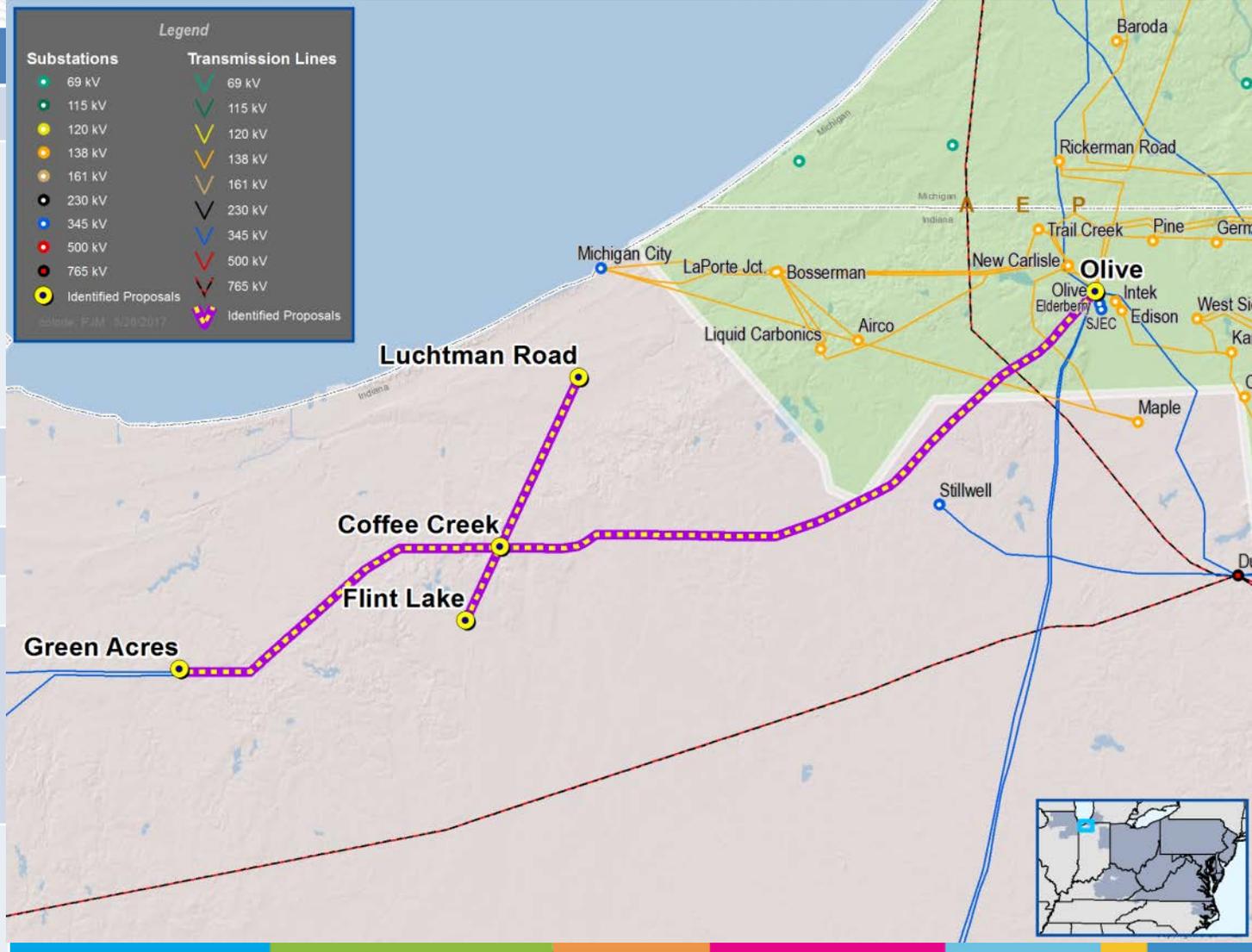
In-Service Cost (\$M): \$17.4

In-Service Date: 2021

Target Zone: AEP

ME Constraints:
 OLIVE - BOSSERMAN 138 kV

Notes:



Appendix B - AEP Supplemental Project Olive – Bosserman 138 kV

- AEP has planned a supplemental project that impacts the Olive – Bosserman market efficiency constraint
- Supplemental projects are:
 - Not needed for reliability criteria, market efficiency, or operational performance
 - Funded wholly by Transmission Owner
 - No PJM approval needed
- This supplemental project is NOT included in the mid-cycle update of the Market Efficiency base case.

Supplemental Project: Olive-Bosserman 138 kV
Previously Presented at 4/13/2017 TEAC and 4/21/2017 Western SRTEAC

Problem Statement/Driver:

The LaPorte Junction - New Carlisle 34.5 kV circuit has a vintage from 1930s and is wood pole construction. 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 category 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.

This project would also resolve congestion on the Olive-Bosserman 138 kV identified during MISO-PJM JOA market efficiency studies in addition to addressing the a potential overload identified on this facility during the PJM 2021 RTEP. It was submitted (without the new distribution station additions) to the PJM reliability and market efficiency windows.

Recommended Solution:

Construct two 138/12 kV distribution stations, Bootjack and Marquette, to replace Silver Lake 34.5 kV and Springville 69 kV stations. (S1279.1)

Cut the existing Olive – Bosserman line into New Carlisle station. (S1279.2)

Rebuild sections of the LaPorte Junction-New Carlisle/New Buffalo 34.5 kV line to 138 kV to establish Bootjack-Olive 138 kV circuit. (S1279.3)

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. (S1279.4)

Construct a 138 kV extension to Marquette station by tapping the Bosserman-Liquid Carbonics 138 kV line. (S1279.5)

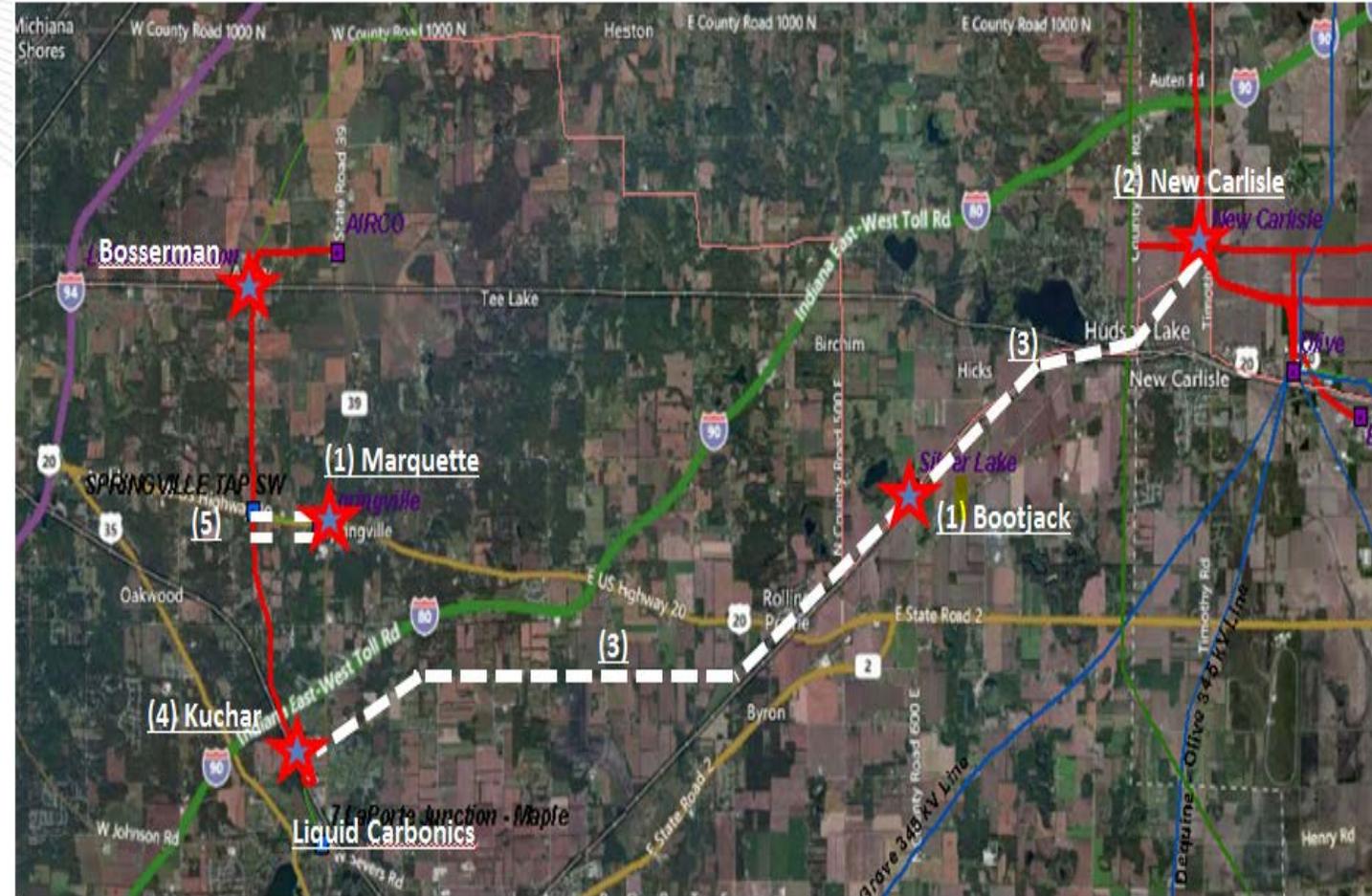
Alternatives:

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

Cost Estimate: \$36.786M

Projected IS date: 12/1/2019

Status: Conceptual



- Revision History
 - V1 – 9/8/2017 – Original Version Posted to PJM.com
 - V2 – 9/12/2017 – Slide 17 corrections
 - 9A in-service date from 2021 to 2020
 - added note regarding 9A cost review