

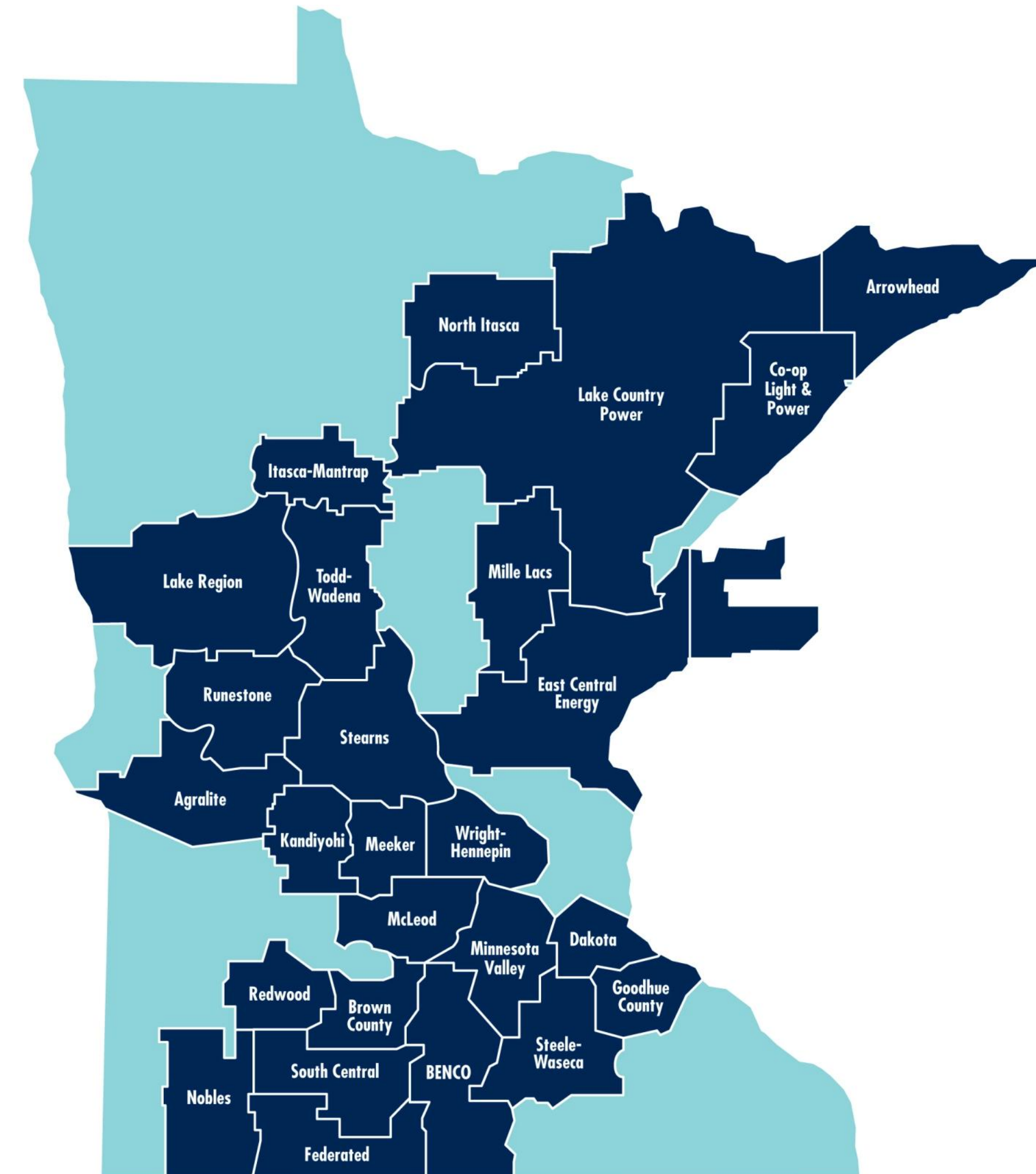
Great River Energy use of Dynamic Line Ratings

A high-voltage power line stretches diagonally across the frame. A large, silver, spherical insulator is attached to the line. To the left, a composite insulator with multiple disc-like segments is visible. The background features a vast landscape with a body of water, distant hills, and industrial structures under a cloudy sky.

March, 2025

Great River Energy: Who we serve

- ▶ 26 member-owner cooperatives
- ▶ 5,000+ miles of transmission lines
- ▶ 1,500+ miles 115kv and above



GREAT RIVER ENERGY



Dynamic Line Rating Evaluation

- Increased capacity of transmission lines can reduce congestion cost
- Expanding capacity of existing lines could allow GRE to delay more costly work
- Another tool for congestion management
- Doesn't replace need for system upgrades

Heimdall Power Partnership

- Original pilot with one line, four Neurons
- Expanded project on eight additional GRE lines with 52 sensors
- Two additional lines using Virtual Neurons
- MISO Integration



Installation locations

Transmission line

Pleasant Valley – Austin

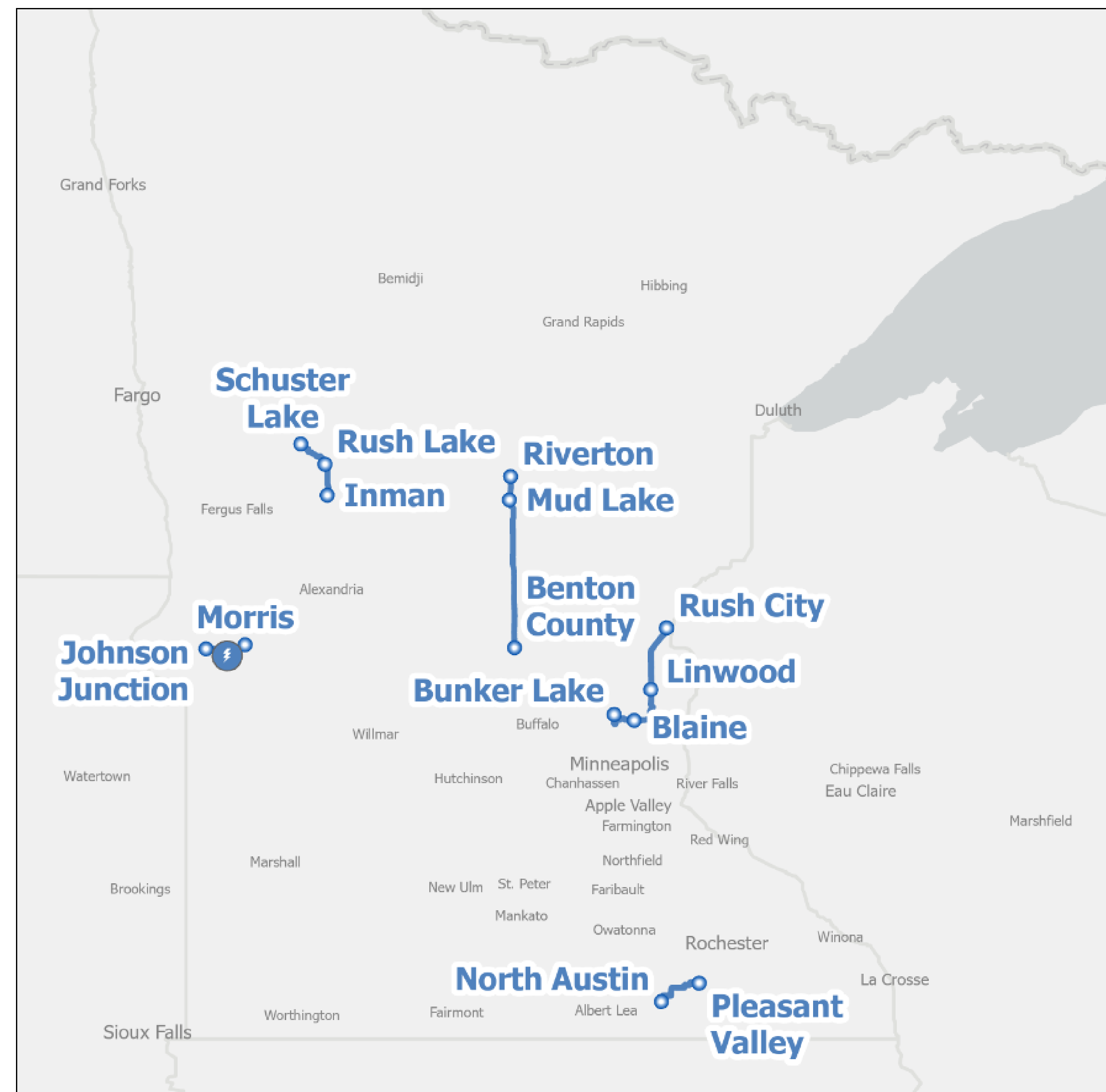
Benton – Mud Lake – Riverton

Inman - Rush Lake – Schuster

Bunker-Blaine-Linwood-Rush City

Johnson Junction – Morris (pilot)

One congestion event per line
estimated cost to GRE: \$3.157M





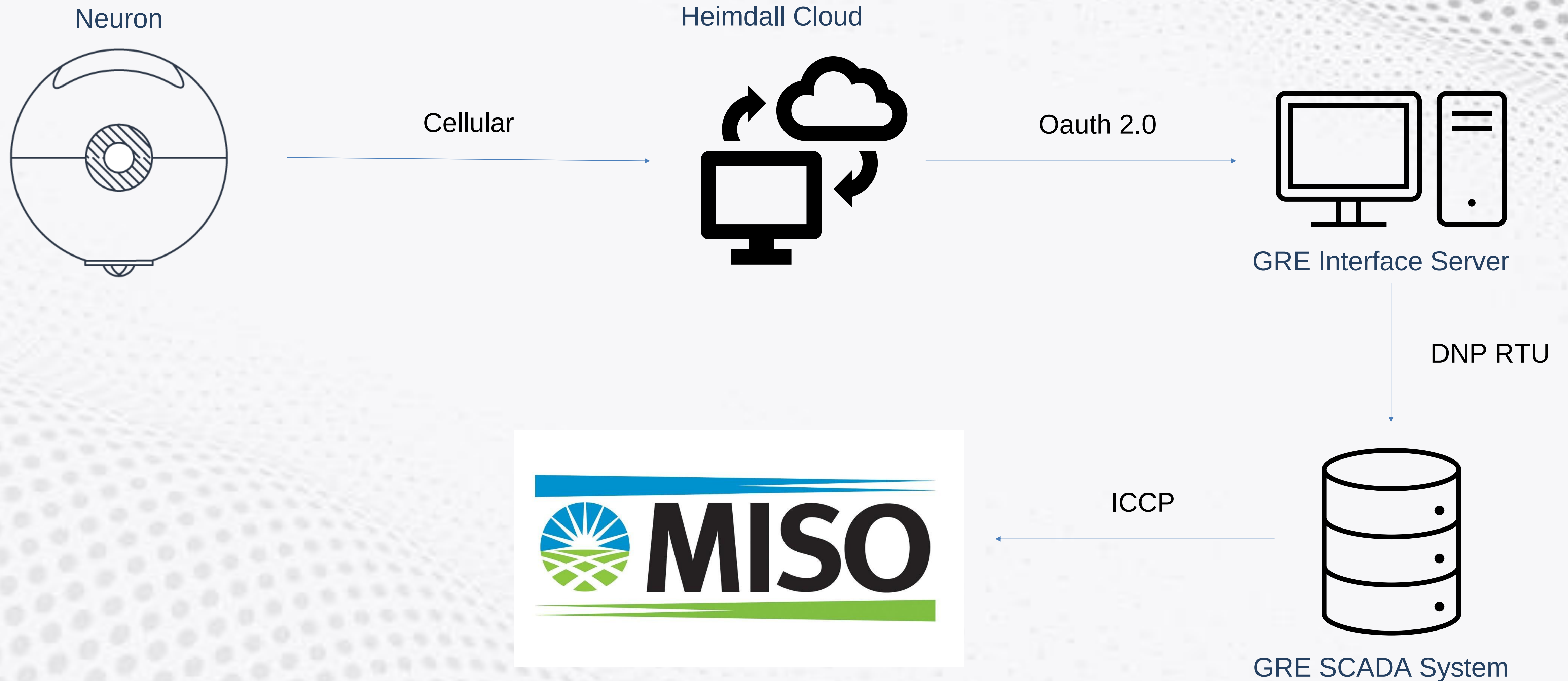
Neuron installations

Neuron installations

- Pilot project installed on live line by GRE field crew
- Majority of additional sensors installed with Heimdall drone
- Two weeks for 40+ Neuron install including a couple weather days
- 115kv and 230kv lines
- Mostly ACSR 795 45/7 Tern



DLR Data Flow



Example Results

Forecast Length (24 hrs) Select data Interval: 5 minutes 95 % Confidence Level Expected load 86.92 MVA Export data

Monitoring Forecast

179.0 MVA

15 m rating

179.0 MVA

Intra-Hour DLR

179.0 MVA

DLR T +1

10:00 - 11:00

179.0 MVA

DLR T +2

11:00 - 12:00

179.0 MVA

DLR T +3

12:00 - 13:00

179.0 MVA

DLR T +4

13:00 - 14:00

173.1 MVA

DLR T +5

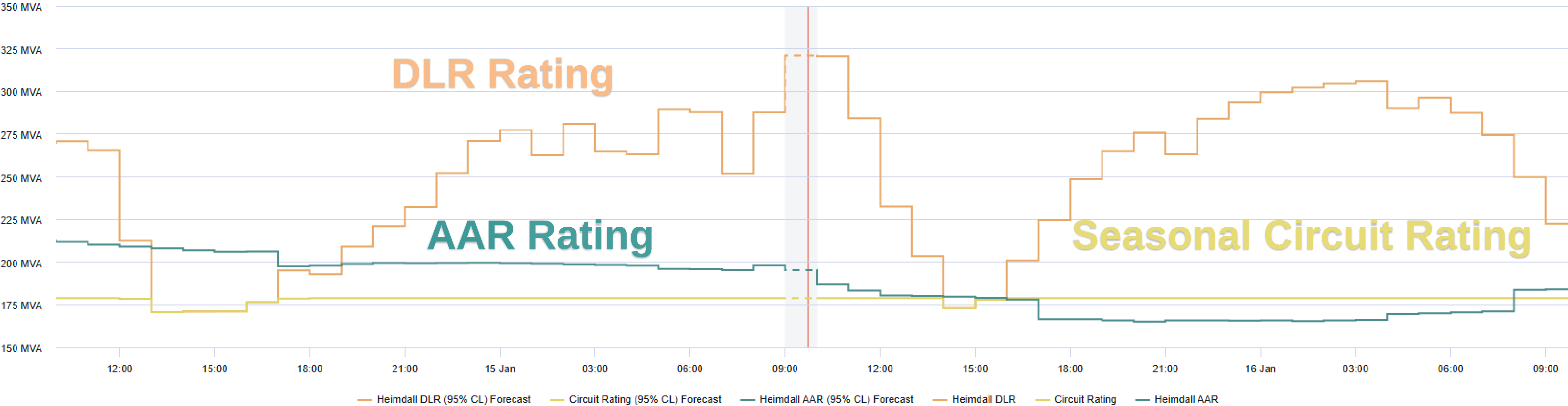
14:00 - 15:00

178.1 MVA

DLR T +6

15:00 - 16:00

JJ-Morris (AG-MJ Line) 72 hrs 48 hrs 24 hrs 12 hrs 6 hrs Intra-hour DLR



Pilot Line 12 Month Results

Key Capacity Metrics

28.82%

Average Line Utilization

+5.61%

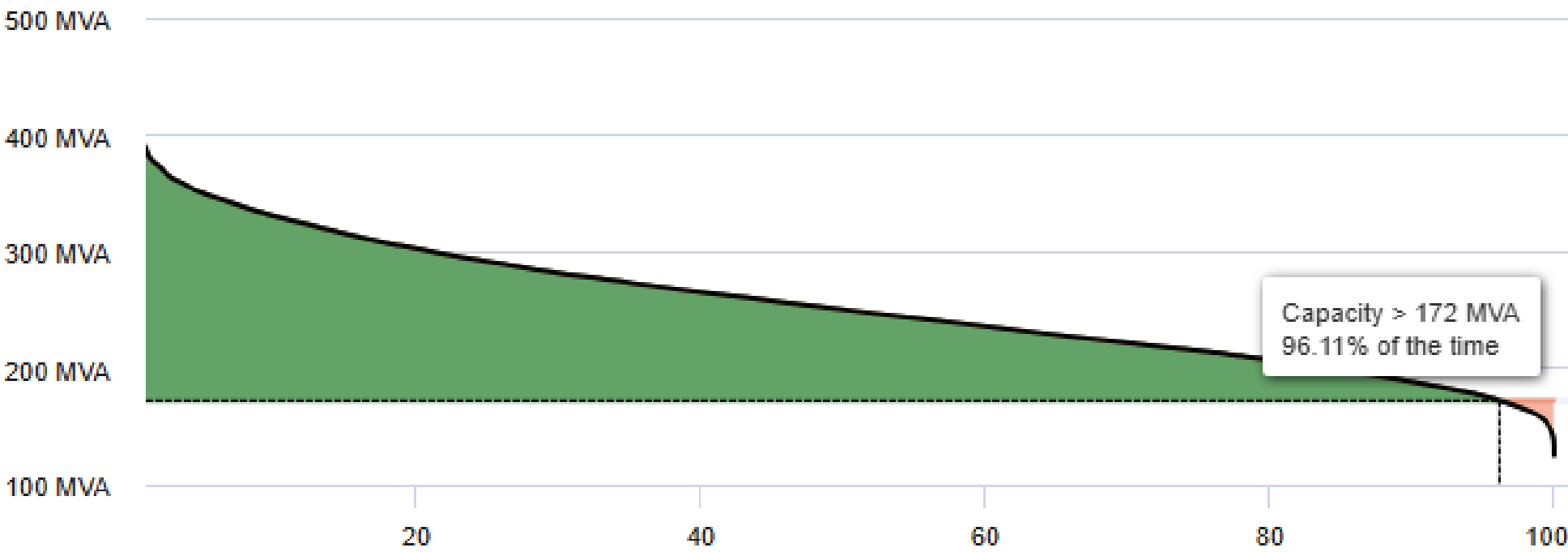
Capacity with AAR (Average)

+48.37%

Capacity with Heimdal DLR (Average)

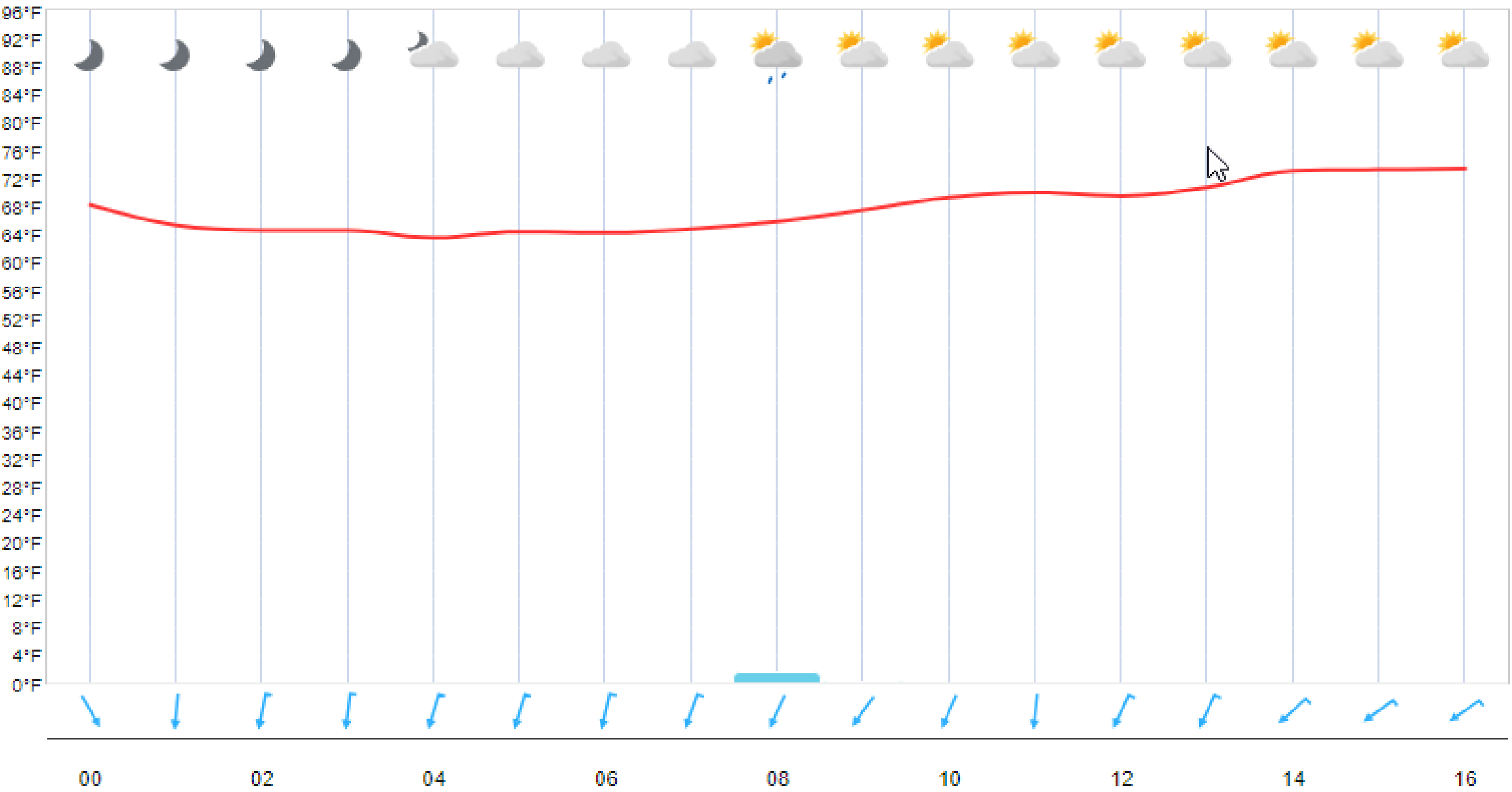
Line DLR

Duration Curve



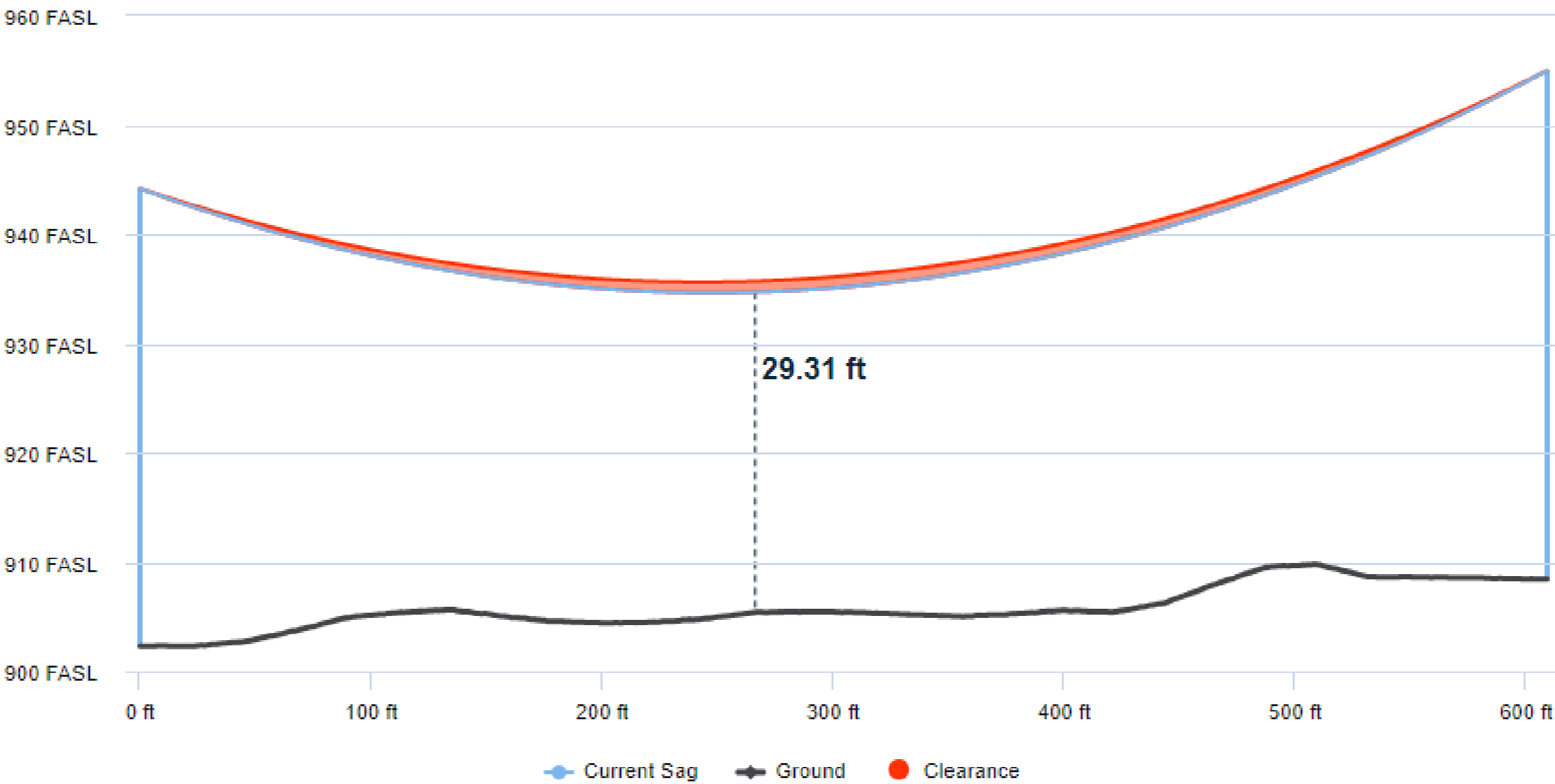
Meteogram

Weather data provided by Meteomatics



Span Model PR-294-PR-295

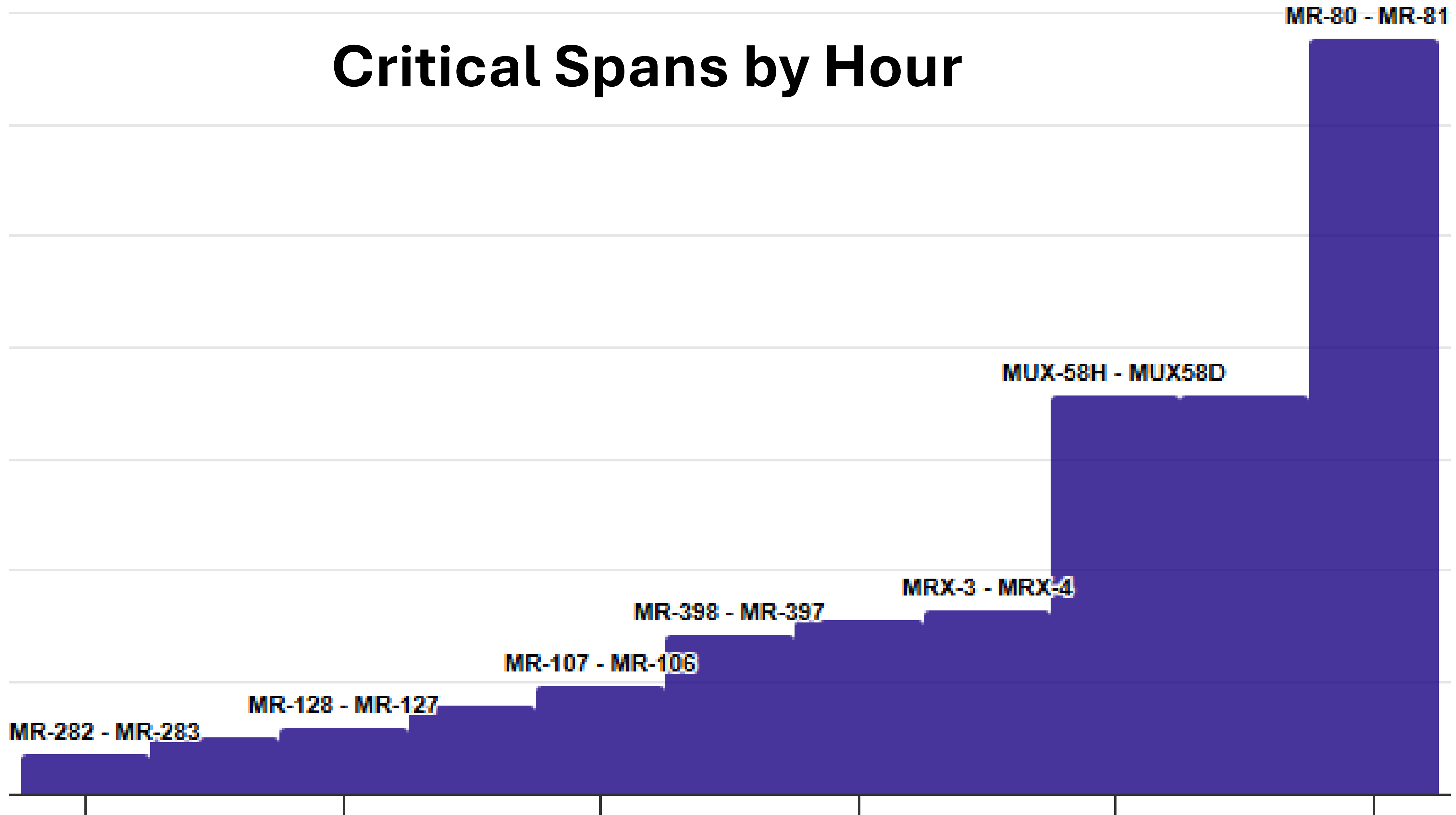
Time Series ⓘ



Critical Spans by Hour

Dimensioning hours

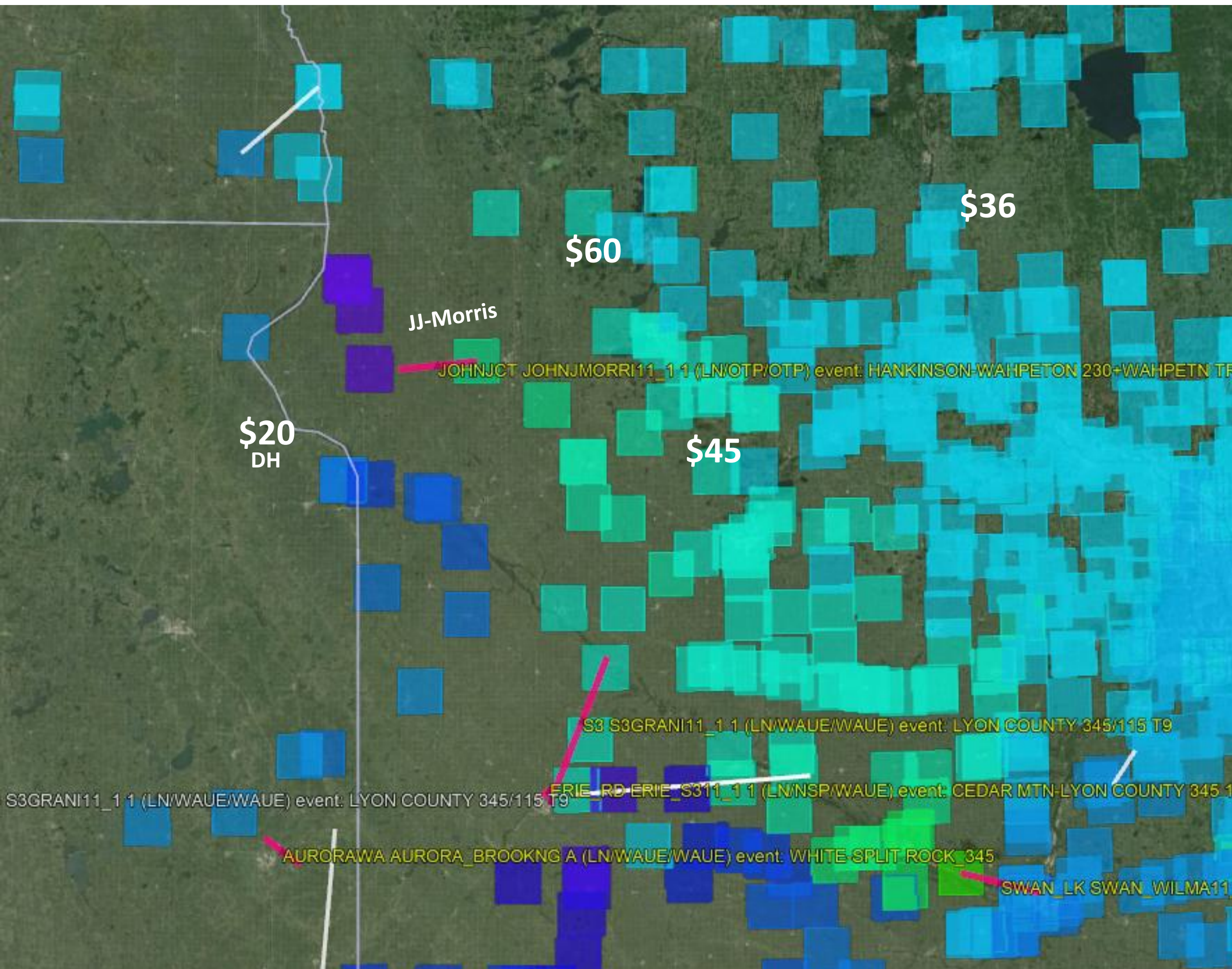
700 hrs
600 hrs
500 hrs
400 hrs
300 hrs
200 hrs
100 hrs
0 hrs



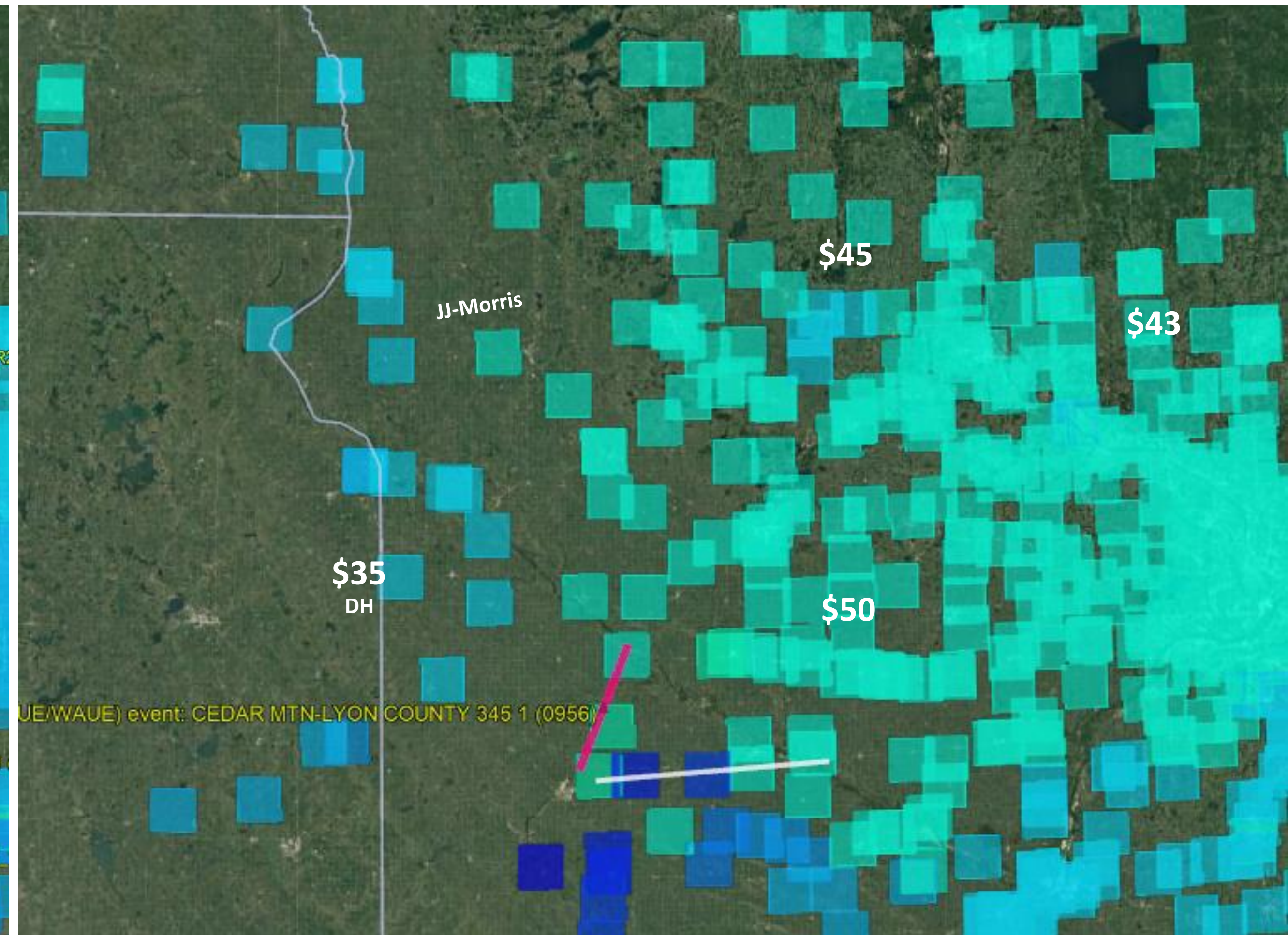
Constraint Event July 2024

Friday 3 pm

Day-ahead market (binding)



Real-time market (not binding)





DLR Next Steps

- Integration between Heimdall and GRE EMS SCADA system via virtual DNP RTU
- Added to MISO model for ratings and passing values to MISO via ICCP
- Working with MISO to verify their use of DLR ratings
- Project underway for AAR using EMS system