# Transportation Data Potpourri in Frisco

TexITE Joint Dallas-Fort Worth Section Meeting
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# Overview

- Signal Performance Measures
- Signal Data Sharing
- Waze Traffic Data
- Closest To Dispatching
- Autonomous Vehicles
- What's Next For Frisco?

# Road Map for SPM

- Detection Requirements for SPM
- Detection Setup Examples
- Detection Standard
- Example – Occupancy on Green
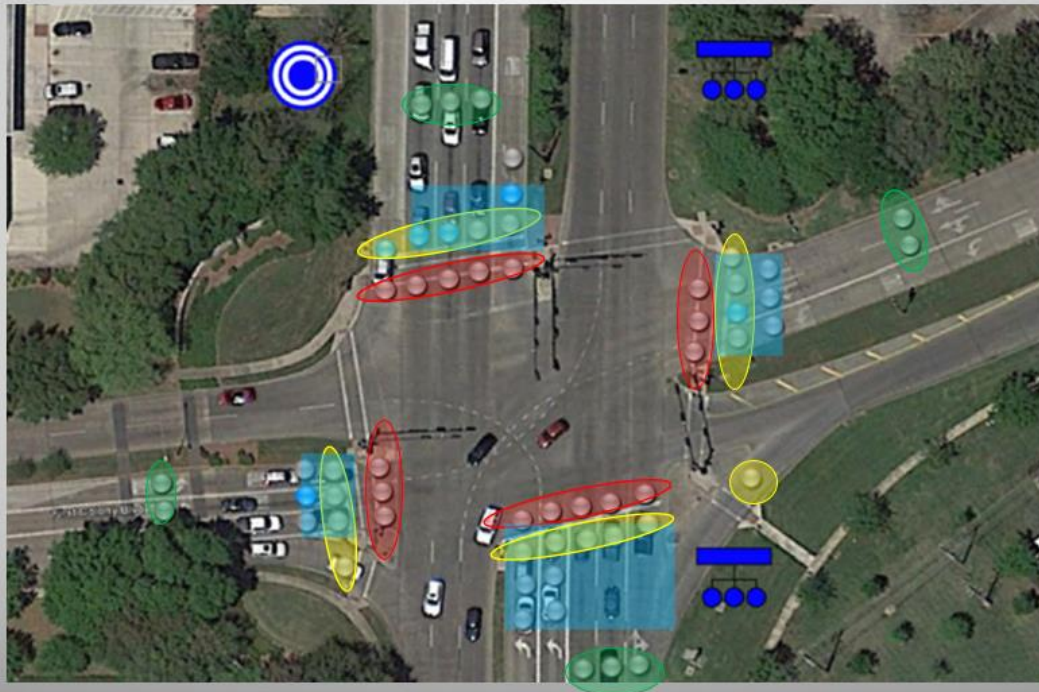- Example – Phase Termination
- Example – Crowd Travel Time

# Detection Requirements

# Detection Requirements

## Trafficware — Signal Performance Measures

## DETECTION REQUIREMENTS

| | Advance Detector | Red Light Monitor (RLM) | Stop Bar Detector | Turning Movement Count (TMC) |
|---|---|---|---|---|
| Approach Delay | ✓ | | | |
| Approach Volume | ✓ | | | |
| Arrivals on Red | ✓ | | | |
| Pedestrian Delay | | | | |
| Preemption Details | | | | |
| Purdue Coordination Diagram | ✓ | | | |
| Purdue Phase Termination | | | | |
| Purdue Split Failure | | | ✓ | |
| Split Monitor | | | | |
| Turning Movement Counts | | | | ✓ |
| Yellow and Red Actuations | | ✓ | | |

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# Detector Requirements

- 11 Standard SPMs
- 4 of 11 with ATC controller
- 3 of 11 with most stop bar detection
- 4 of 11 with setback detection

# Stop Bar Setup - Video

# Stop Bar Setup - RADAR

# Stop Bar - Magnetometers

# Setback Setup - General

- Where to put the setback detection point(s)? Some things to consider:
  - Performance Measures
  - Dilemma Zone Protection
  - Operational Efficiency
  - Adaptive Control Needs

# Setback Setup - General

- Performance Measures
  - Ideal is farther back than the maximum queue length.

- Dilemma Zone Protection
  - 5.5 seconds away 90% stop
  - 2.5 seconds away 10% stop

- Operational Efficiency
  - ~2.5 seconds (varies with speed & zone size)

- Adaptive Control Needs
  - Works with what is best for other considerations

# Setback Setup - General

- Performance Measures
- Dilemma Zone Protection
  - 5.5 seconds away 90% stop
  - 2.5 seconds away 10% stop
- Operational Efficiency
  - ~2.5 seconds (varies with speed & zone size)
- ~~Adaptive Control Needs~~

# Setback Setup - General

- Performance Measures – another detection point could be added

- Dilemma Zone Protection – 3 second extension (gap time)

  - 5.5 seconds away 90% stop
  - 2.5 seconds away 10% stop

- Operational Efficiency – about 2.5 second extension

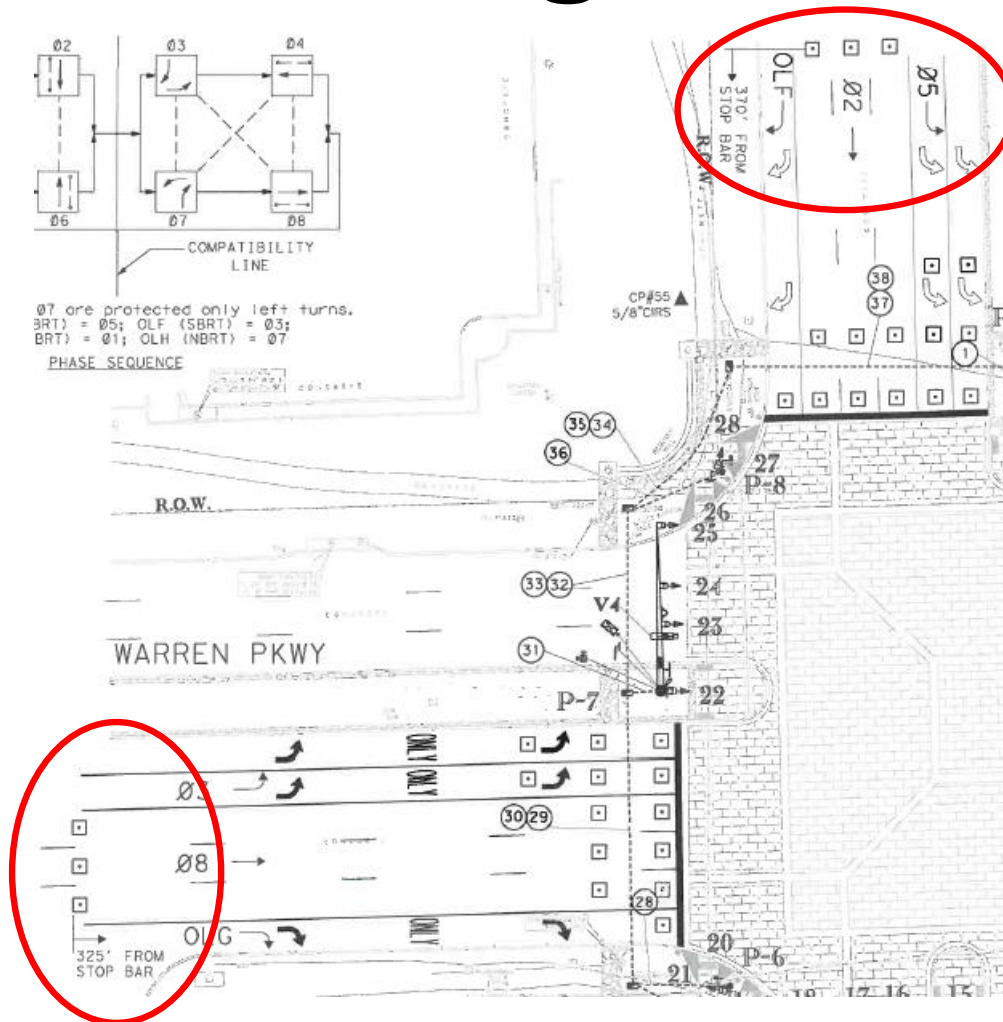- One has to choose between dilemma zone and operational efficiency

# Setback Setup - RADAR

# Setback - Magnetometers

# Detection Standard

- Standard for
  - Standard Intersection
  - Diamond Intersection
  - Box Diamond Intersection

- Detector Inputs
  - Need 128 (8 BUIs) detector inputs.
  - 64 (4 BUIs) is not enough.

# Detection Standard

**Standard 8**

| | BIU 9 | | | | BIU 10 | | | | BIU 11 | | BIU 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pin | Label - Phase | Source | Func | | Detector | Phase | Source | Func | | Detector | Phase | Detector | Phase |
| **Base** | | | | | **Setbacks** | | | | | **NB Counting** | | **EB Counting** | |
| 1 | NBLT - Ph 1 | field | C, Ext | | 17 | NB Setback (1) | field | C, Ext | | 33 | NB U-Turn | 49 | EB U-Turn |
| 2 | SB - Ph 2 | field | C, Ext | | 18 | NB Setback (2) | field | C, Ext | | 34 | NB LT (1) | 50 | EB LT (1) |
| 3 | EBLT - Ph 3 | field | C, Ext | | 19 | SB Setback (1) | field | C, Ext | | 35 | NB LT (2) | 51 | EB LT (2) |
| 4 | WB - Ph 4 | field | C, Ext | | 20 | SB Setback (2) | field | C, Ext | | 36 | NB Thru (1) | 52 | EB Thru (1) |
| 5 | SBLT - Ph 5 | field | C, Ext | | 21 | EB Setback (1) | field | C, Ext | | 37 | NB Thru (2) | 53 | EB Thru (2) |
| 6 | NB - Ph 6 | field | C, Ext | | 22 | EB Setback (2) | field | C, Ext | | 38 | NB Thru (3) | 54 | EB Thru (3) |
| 7 | WBLT - Ph 7 | field | C, Ext | | 23 | WB Setback (1) | field | C, Ext | | 39 | NB Thru (4) or 2nd NBRT (LL) | 55 | EB Thru (4) or 2nd EBRT (LL) |
| 8 | EB - Ph 8 | field | C, Ext | | 24 | WB Setback (2) | field | C, Ext | | 40 | NBRT (1 or RL) | 56 | EBRT (1 or RL) |
| **RT/Double Cycle** | | | | | **FYA** | | | | | **SB Counting** | | **WB Counting** | |
| 9 | EBRT - Ph 1 or 8 | field | C, Ext | | 25 | FYA - NBLT (Ph 1) | 1 | C, Ext | | 41 | SB U-Turn | 57 | WB U-Turn |
| 10 | SBRT - Ph 3 or 2 | field | C, Ext | | 26 | FYA - NBLT (Ph 9) | 1 | C, Ext | | 42 | SB LT (1) | 58 | WB LT (1) |
| 11 | WBRT - Ph 5 or 4 | field | C, Ext | | 27 | FYA - EBLT (Ph 3) | 3 | C, Ext | | 43 | SB LT (2) | 59 | WB LT (2) |
| 12 | NBRT - Ph 7 or 6 | field | C, Ext | | 28 | FYA - EBLT (Ph 11) | 3 | C, Ext | | 44 | SB Thru (1) | 60 | WB Thru (1) |
| 13 | RT/Double #1 | varies | C, Ext | | 29 | FYA - SBLT (Ph 5) | 5 | C, Ext | | 45 | SB Thru (2) | 61 | WB Thru (2) |
| 14 | RT/Double #2 | varies | C, Ext | | 30 | FYA - SBLT (Ph 13) | 5 | C, Ext | | 46 | SB Thru (3) | 62 | WB Thru (3) |
| 15 | RT/Double #3 | varies | C, Ext | | 31 | FYA - WBLT (Ph 7) | 7 | C, Ext | | 47 | SB Thru (4) or 2nd SBRT (LL) | 63 | WB Thru (4) or 2nd WBRT (LL) |
| 16 | RT/Double #4 | varies | C, Ext | | 32 | FYA - WBLT (Ph 15) | 7 | C, Ext | | 48 | SBRT (1 or RL) | 64 | WBRT (1 or RL) |

# SPM

- SPM presents data in ways not seen but
- How does a point on a chart relate to the traffic conditions?
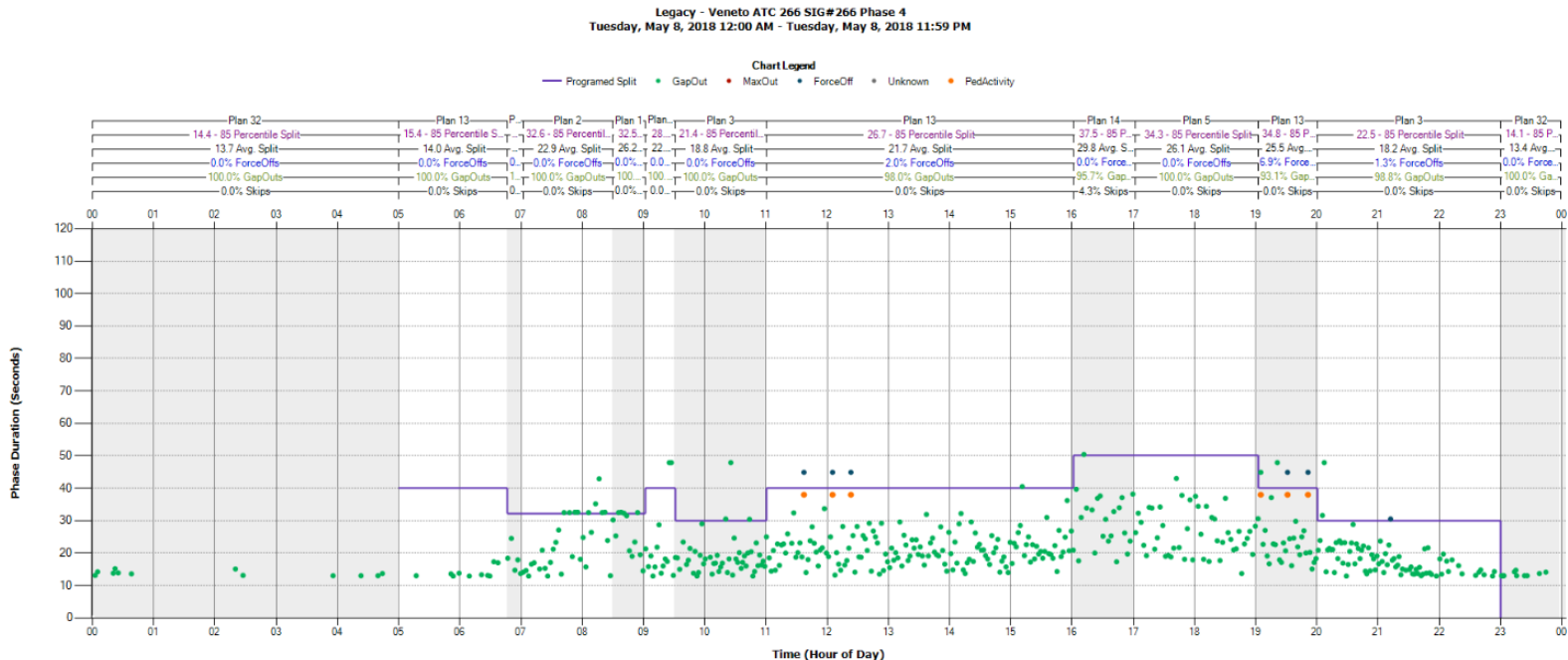
# Purdue Split Failure

- The chart versus the real world.
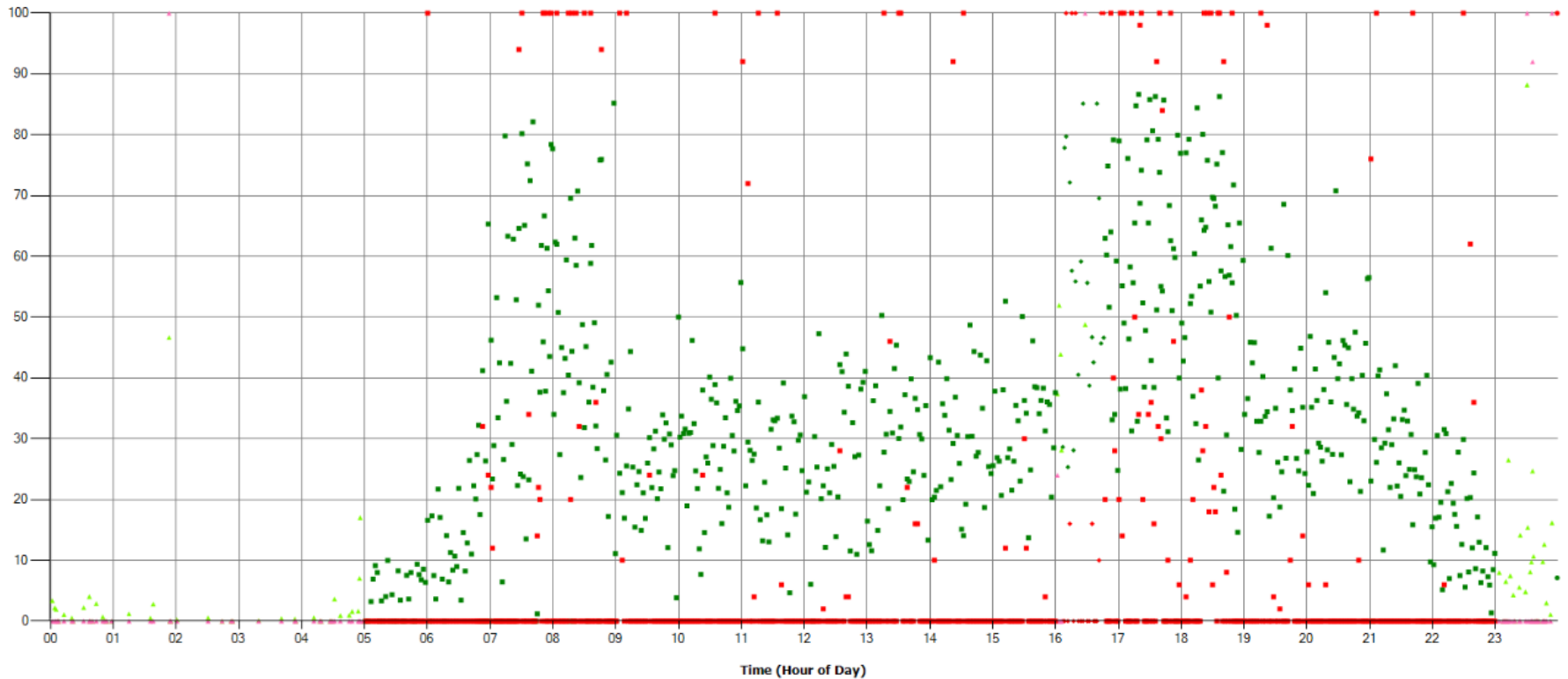- Collected the data for Purdue Split Failure and recorded the approach for a day.
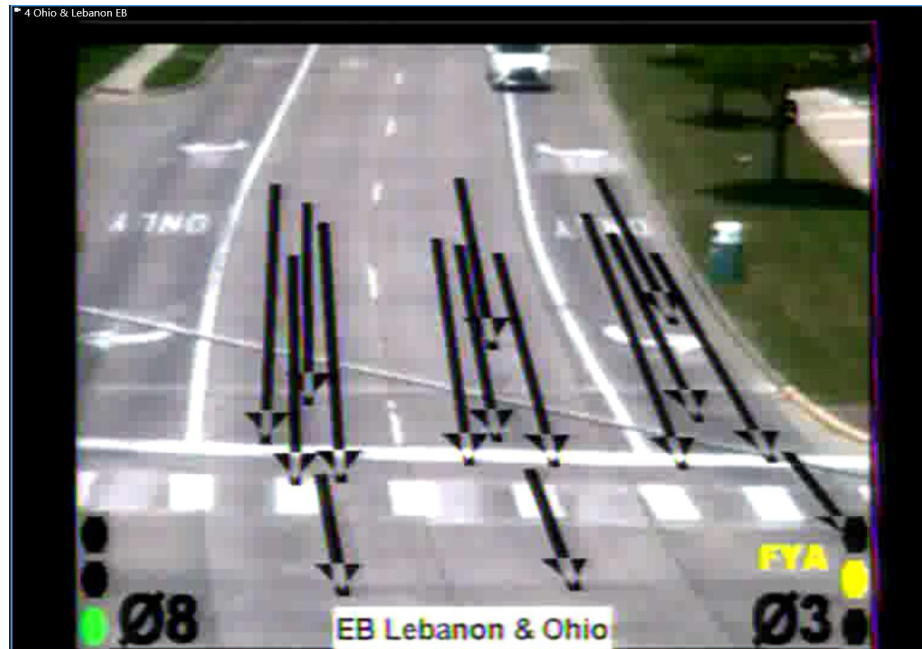
# Purdue Split Failure



Ohio - Lebanon ATC 716 Signal 716 Phase: 8 Eastbound
Tuesday, May 8, 2018 12:00 AM - Tuesday, May 8, 2018 11:59 PM
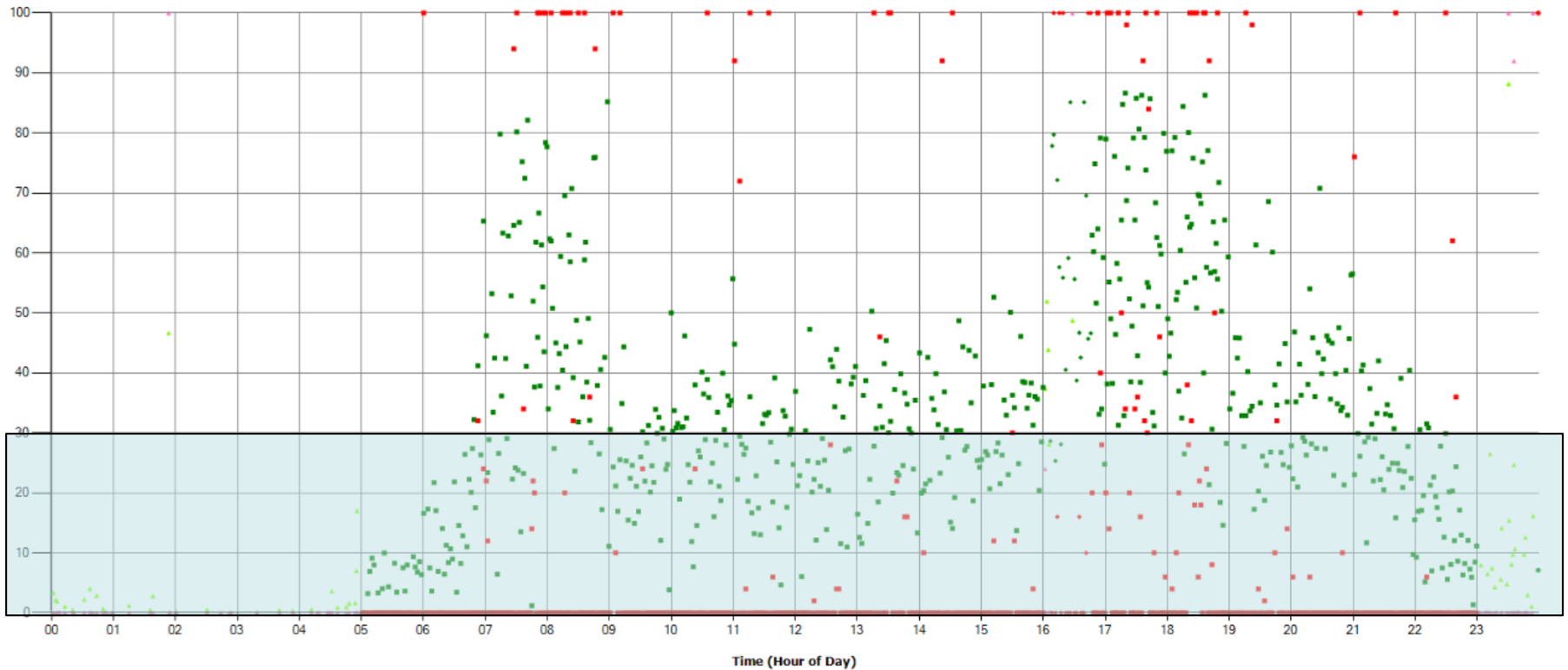
# Purdue Split Failure

- Green dots are the occupancy ratio during the green

- Red dots are the occupancy ratio during the first 5 seconds of the red

# Case 1 – 0 to 30% GOR



Ohio - Lebanon ATC 716 Signal 716 Phase: 8 Eastbound
Tuesday, May 8, 2018 12:00 AM - Tuesday, May 8, 2018 11:59 PM

Time (Hour of Day)

# Case 1 – 0 to 30% GOR

# Case 2 – 30 to 80% GOR



Ohio - Lebanon ATC 716 Signal 716 Phase: 8 Eastbound
Tuesday, May 8, 2018 12:00 AM - Tuesday, May 8, 2018 11:59 PM

# Case 2 – 30 to 80% GOR

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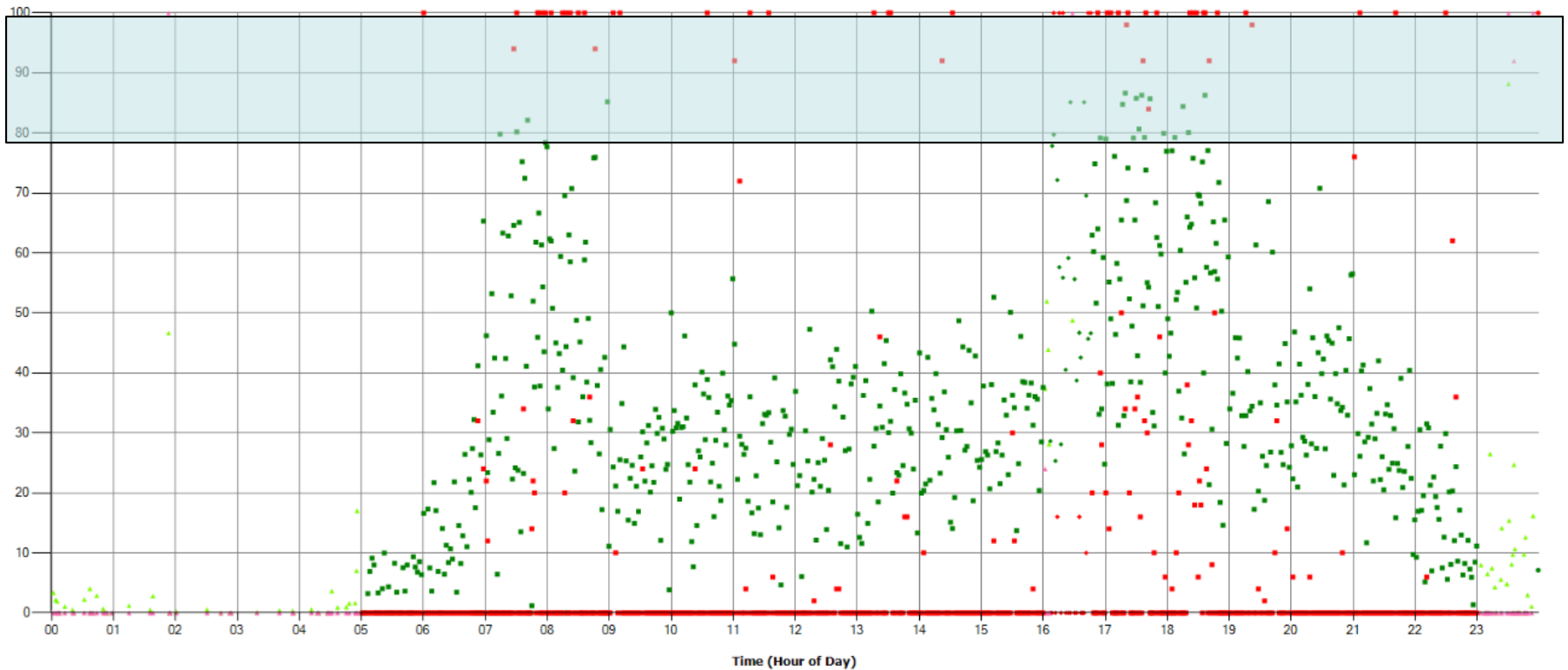


Ohio - Lebanon ATC 716 Signal 716 Phase: 8 Eastbound
Tuesday, May 8, 2018 12:00 AM - Tuesday, May 8, 2018 11:59 PM

Time (Hour of Day)
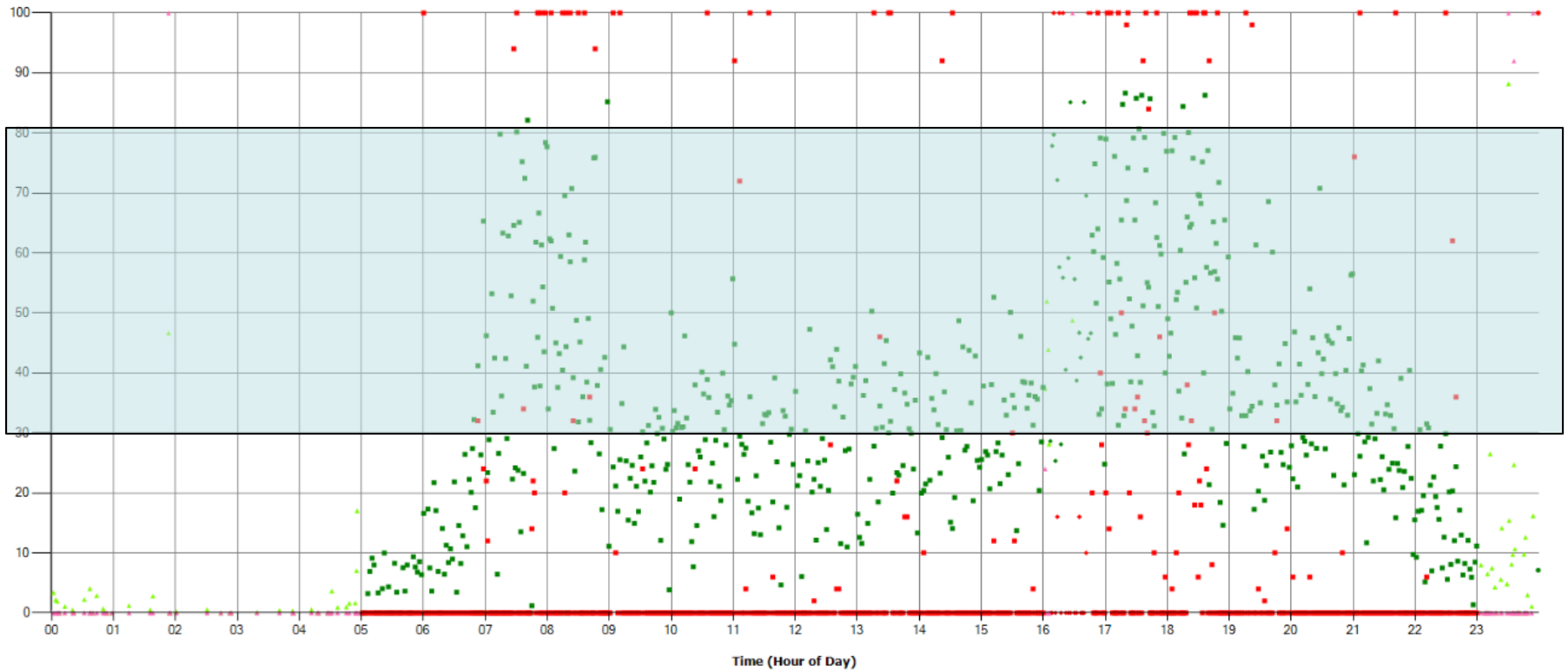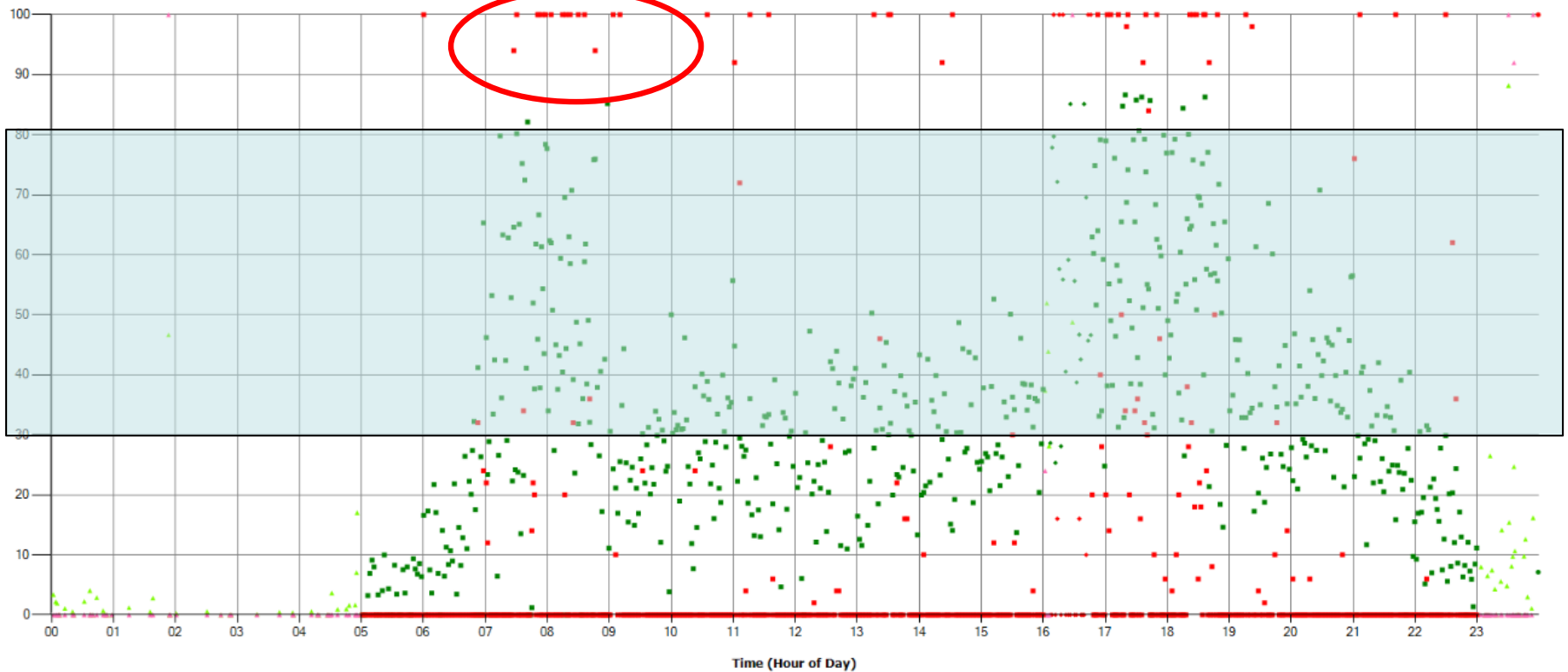
# Case 2 – 30 to 80% GOR
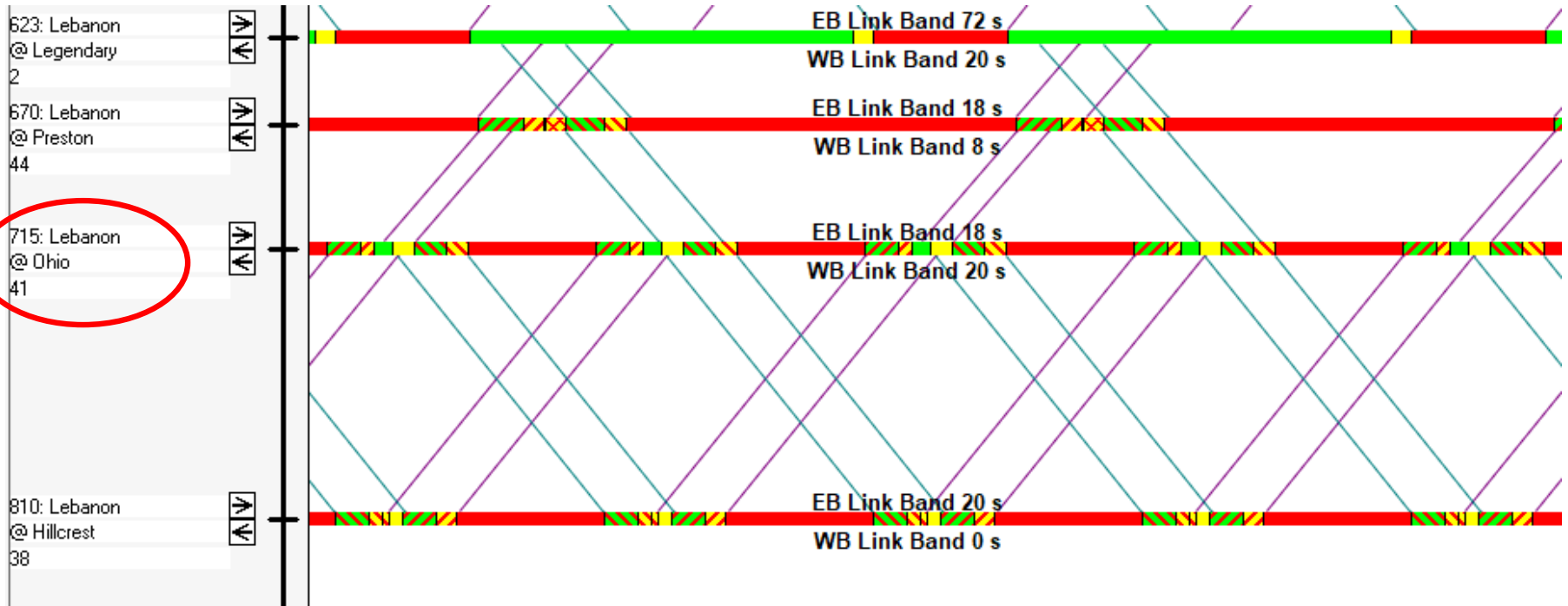
# Case 3 – 80 to 100% GOR



Ohio - Lebanon ATC 716 Signal 716 Phase: 8 Eastbound
Tuesday, May 8, 2018 12:00 AM - Tuesday, May 8, 2018 11:59 PM

# Case 3 – 80 to 100% GOR

# Use Case for GOR

- Changed from coordinated to free



Ohio - Lebanon ATC 716 Signal 716 Phase: 8 Eastbound
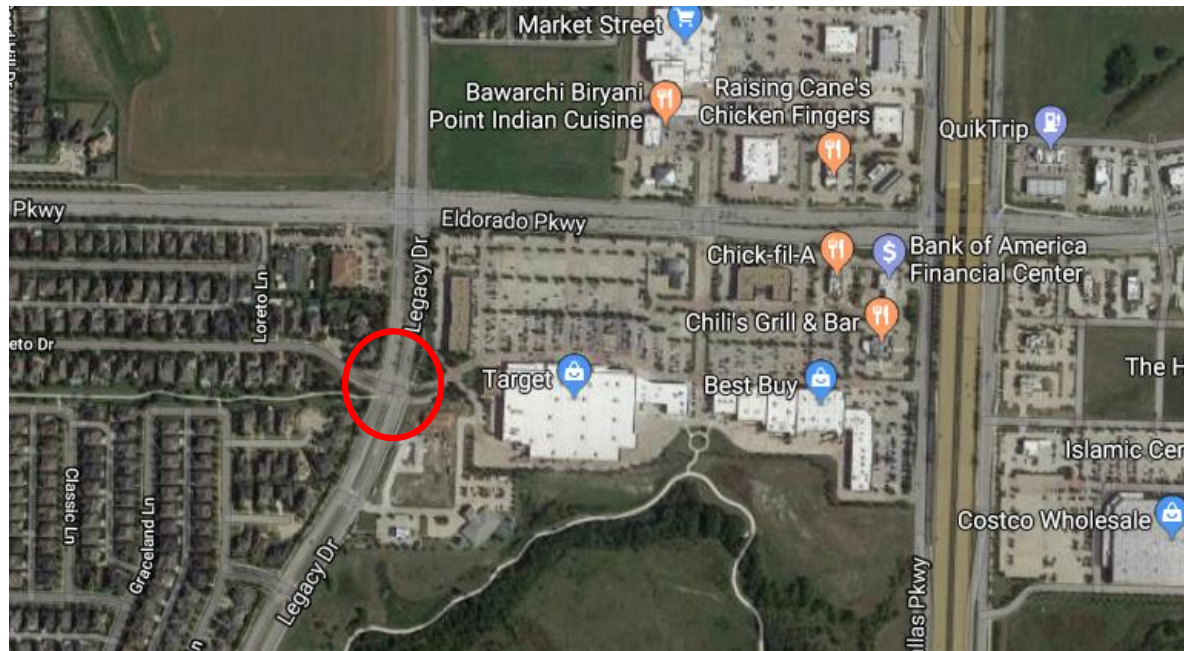Tuesday, May 8, 2018 12:00 AM - Tuesday, May 8, 2018 11:59 PM
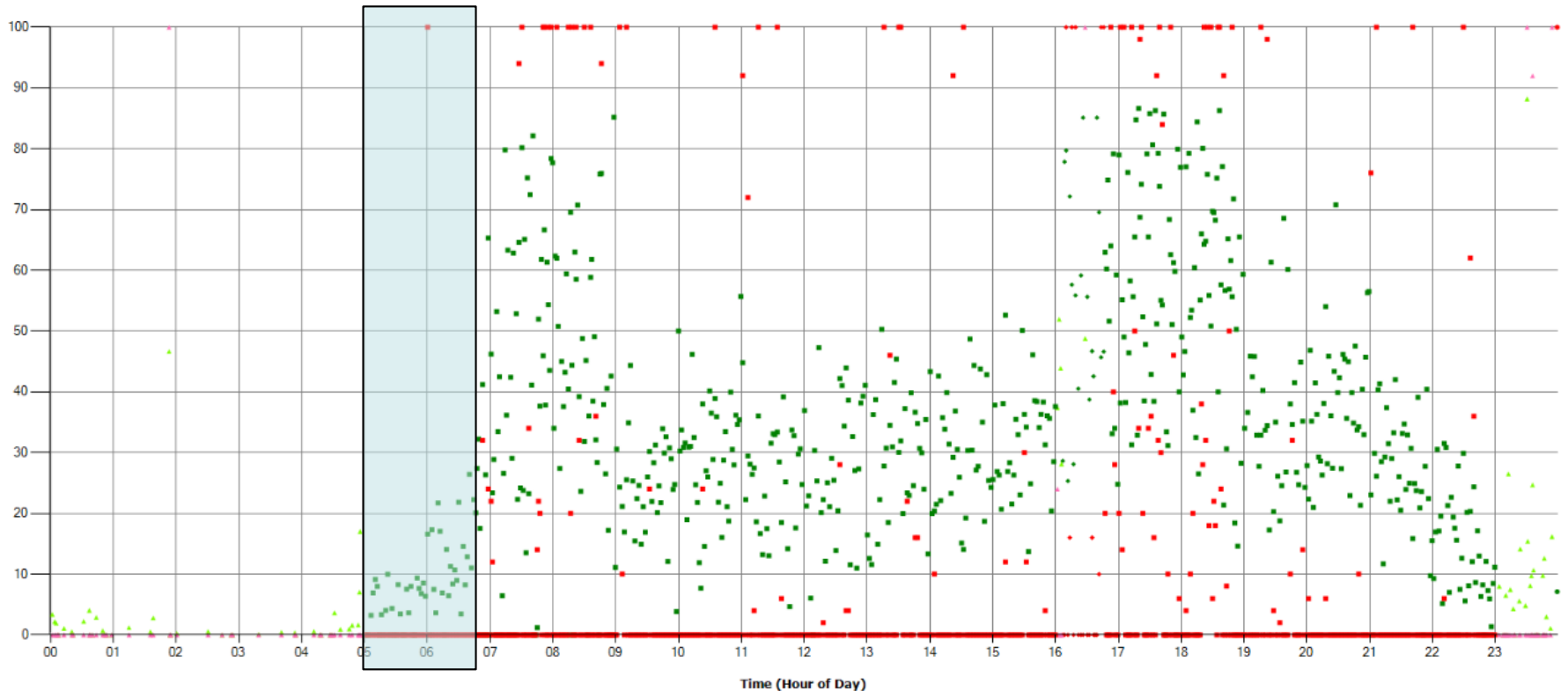
# Use Case for GOR
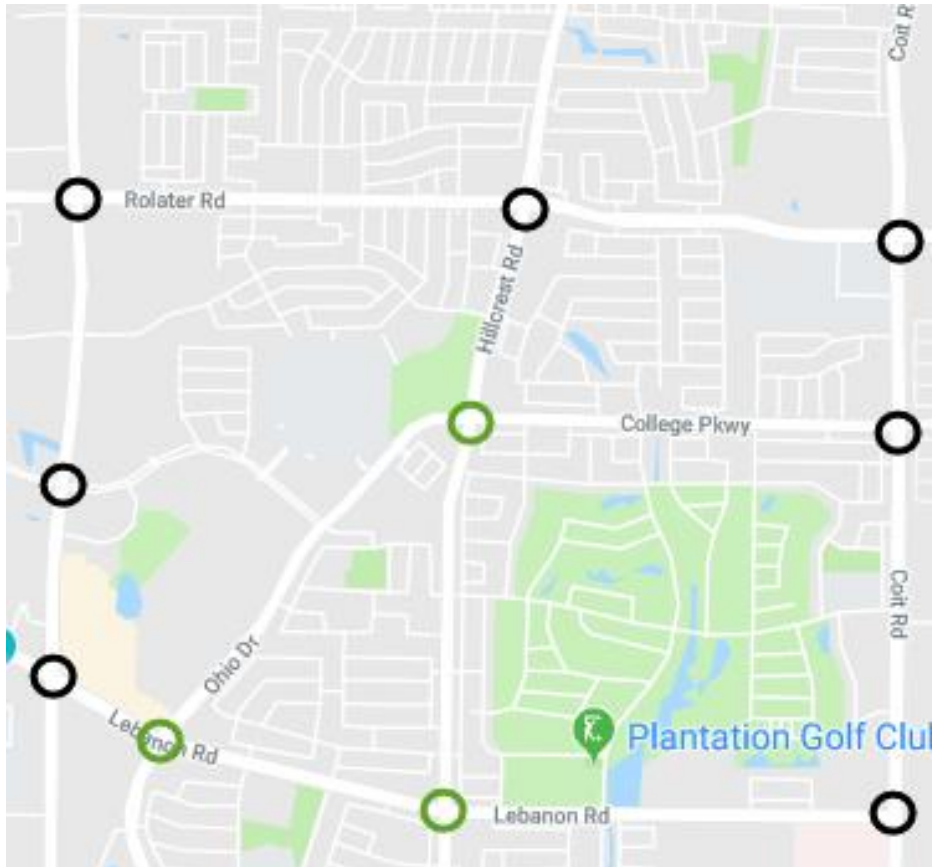


- Green is Free
- Black is Coordinated

# Phase Termination

- The chart versus the real world.
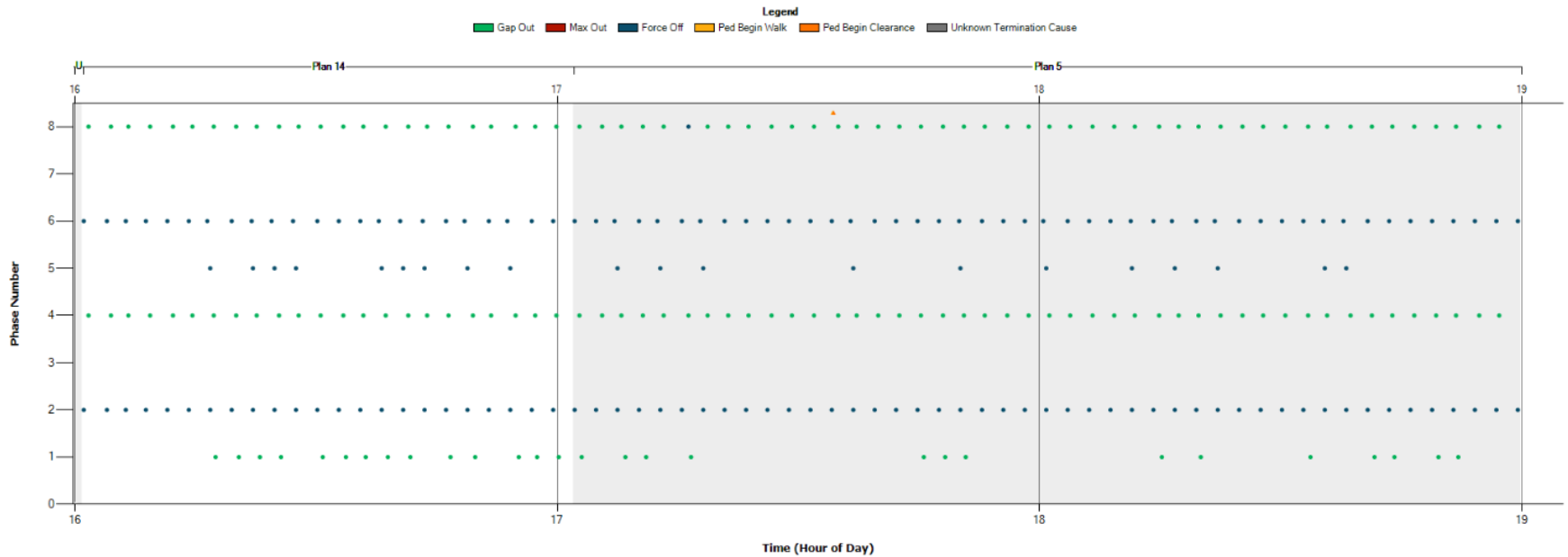- Collected the data for Purdue Split Failure and recorded the approach.

# Phase Termination



Legacy - Veneto ATC 266 Signal 266
Wednesday, May 9, 2018 4:00 PM - Wednesday, May 9, 2018 7:00 PM

Currently showing Force-Offs, Max-Outs and Gap-Outs with a consecutive occurrence of 1 or more.
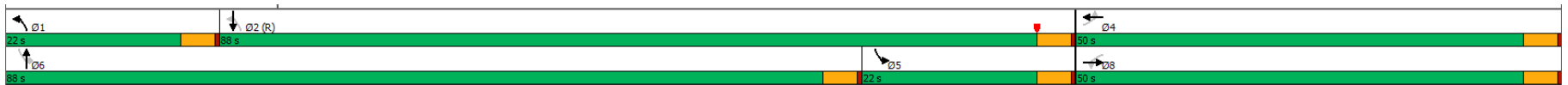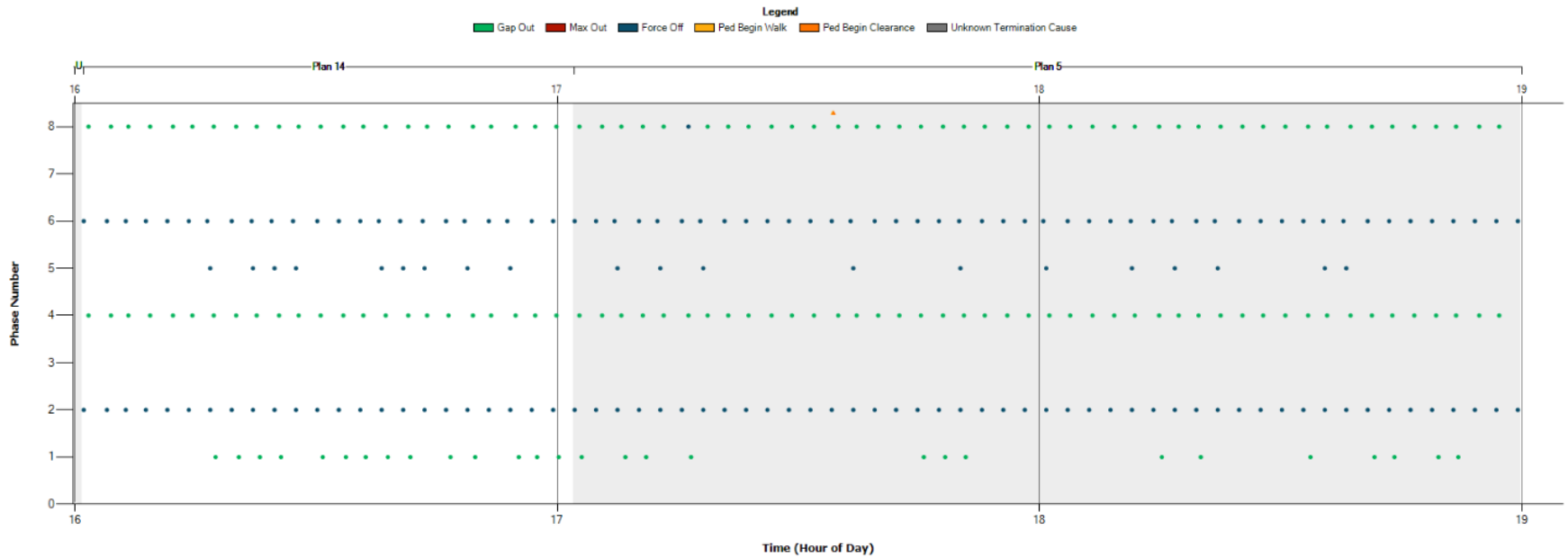Pedestrian events are never filtered

**Legend**
Gap Out   Max Out   Force Off   Ped Begin Walk   Ped Begin Clearance   Unknown Termination Cause
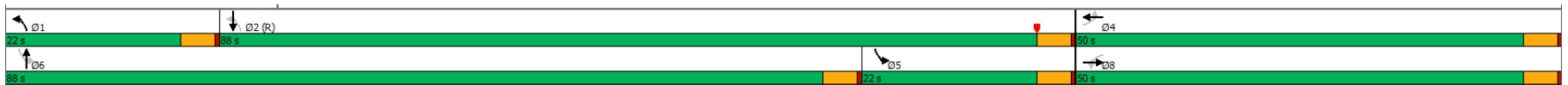
# Phase Termination



Legacy - Veneto ATC 266 Signal 266
Wednesday, May 9, 2018 4:00 PM - Wednesday, May 9, 2018 7:00 PM

Currently showing Force-Offs, Max-Outs and Gap-Outs with a consecutive occurrence of 1 or more.
Pedestrian events are never filtered

**Legend**
Gap Out   Max Out   Force Off   Ped Begin Walk   Ped Begin Clearance   Unknown Termination Cause
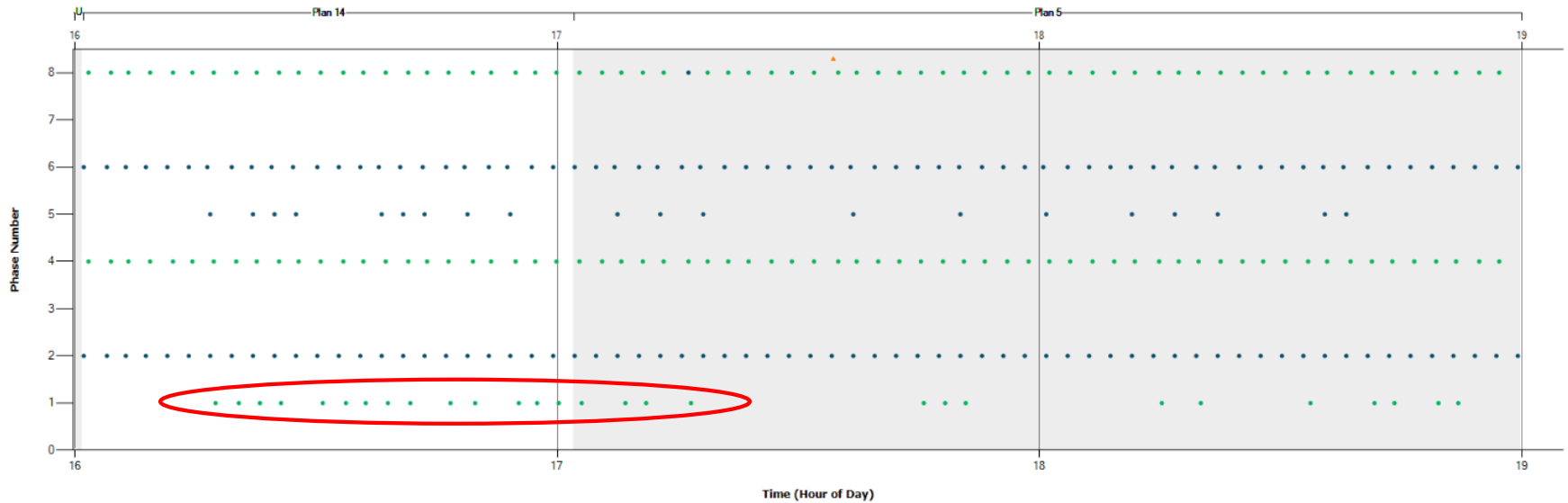
# Phase Termination



Legacy - Veneto ATC 266 Signal 266
Wednesday, May 9, 2018 4:00 PM - Wednesday, May 9, 2018 7:00 PM

Currently showing Force-Offs, Max-Outs and Gap-Outs with a consecutive occurrence of 1 or more.
Pedestrian events are never filtered

**Legend**
Gap Out ■ Max Out ■ Force Off ■ Ped Begin Walk ■ Ped Begin Clearance ■ Unknown Termination Cause

# Left Turn Cycle 1
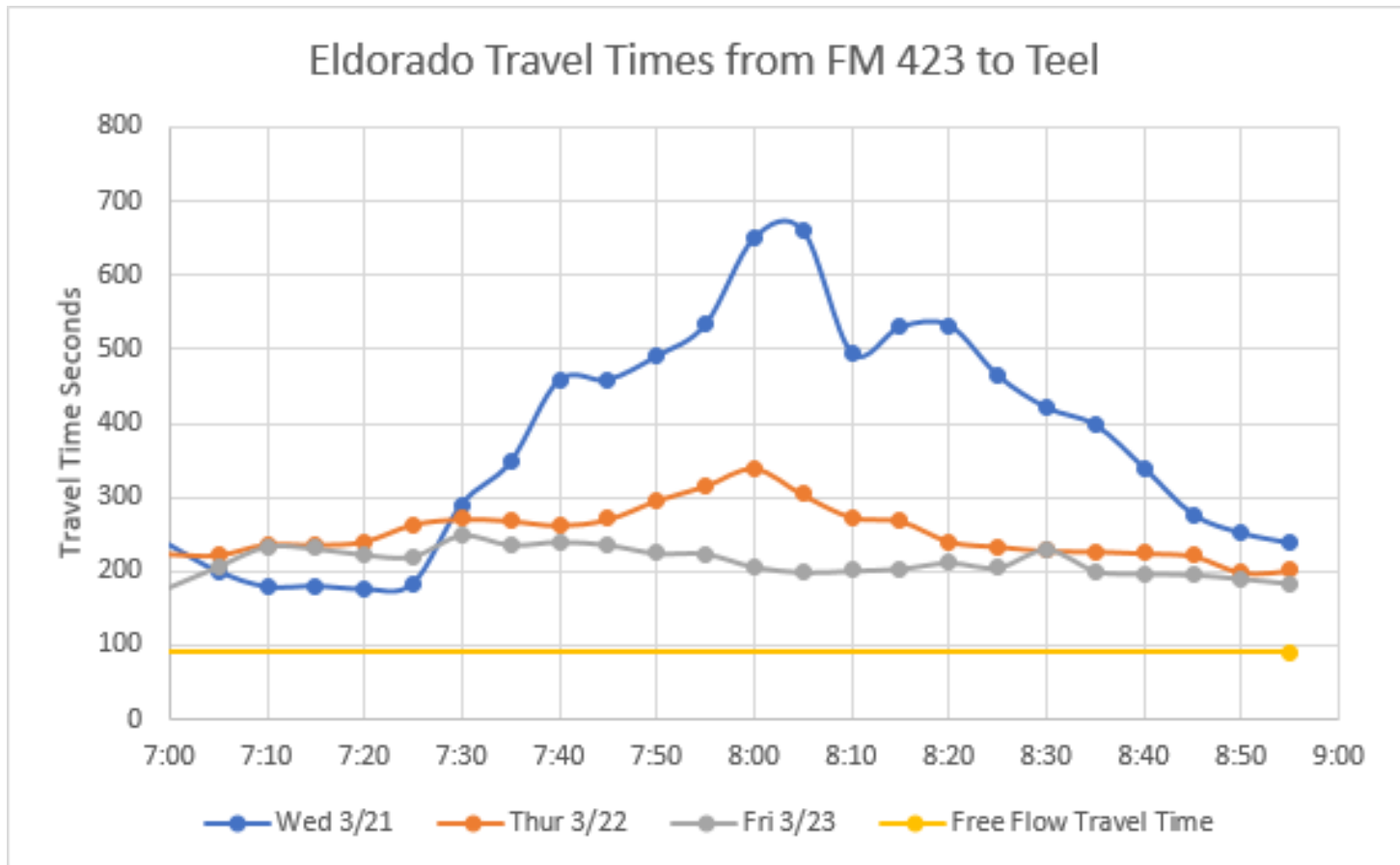
# Left Turn Cycle 2

# Crowd Source Travel Time

- Received an email – 10 minute backup, horrible.

- Watched traffic and made a signal timing change.  Added 10 seconds of green.
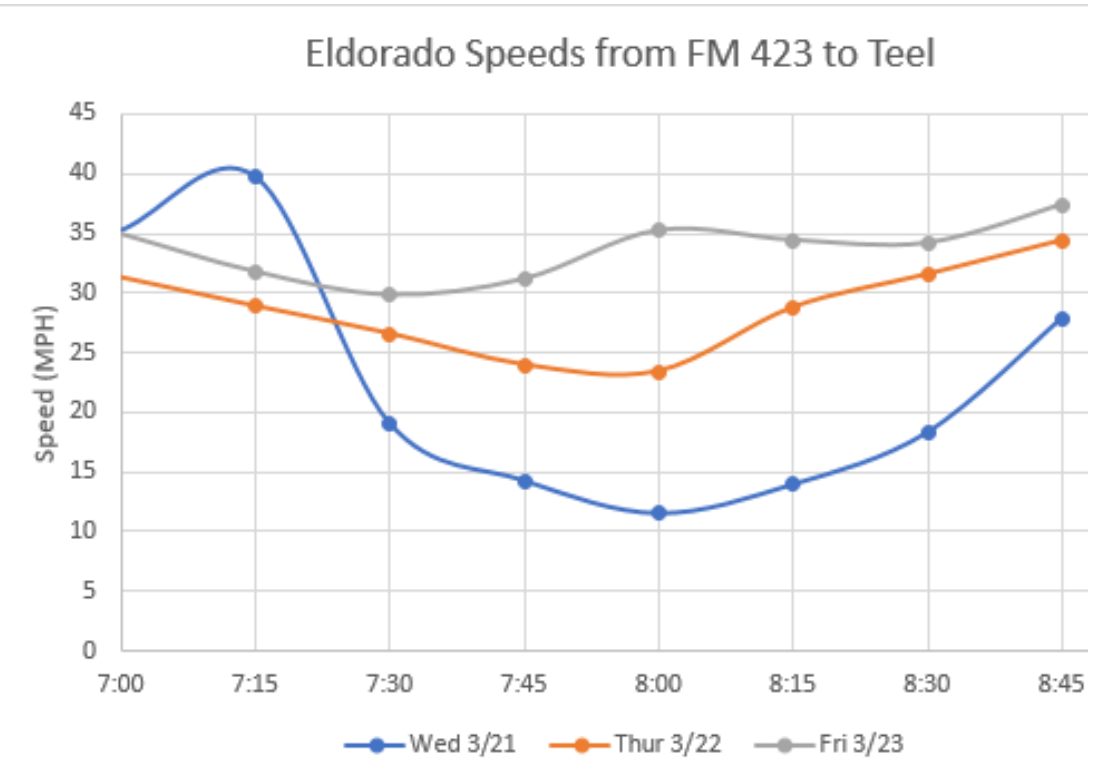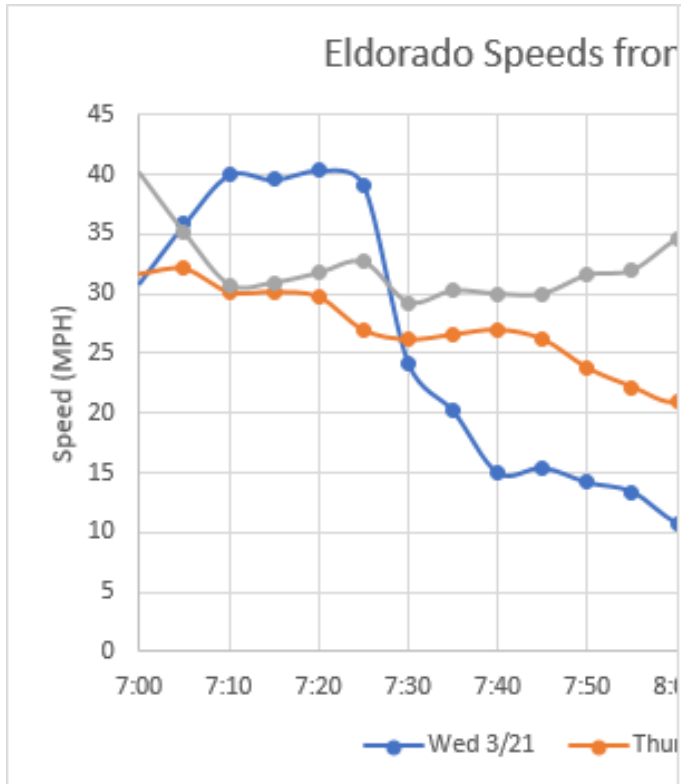  - Did I make the right change?
  - Did I change enough?

# Crowd Source Travel Time

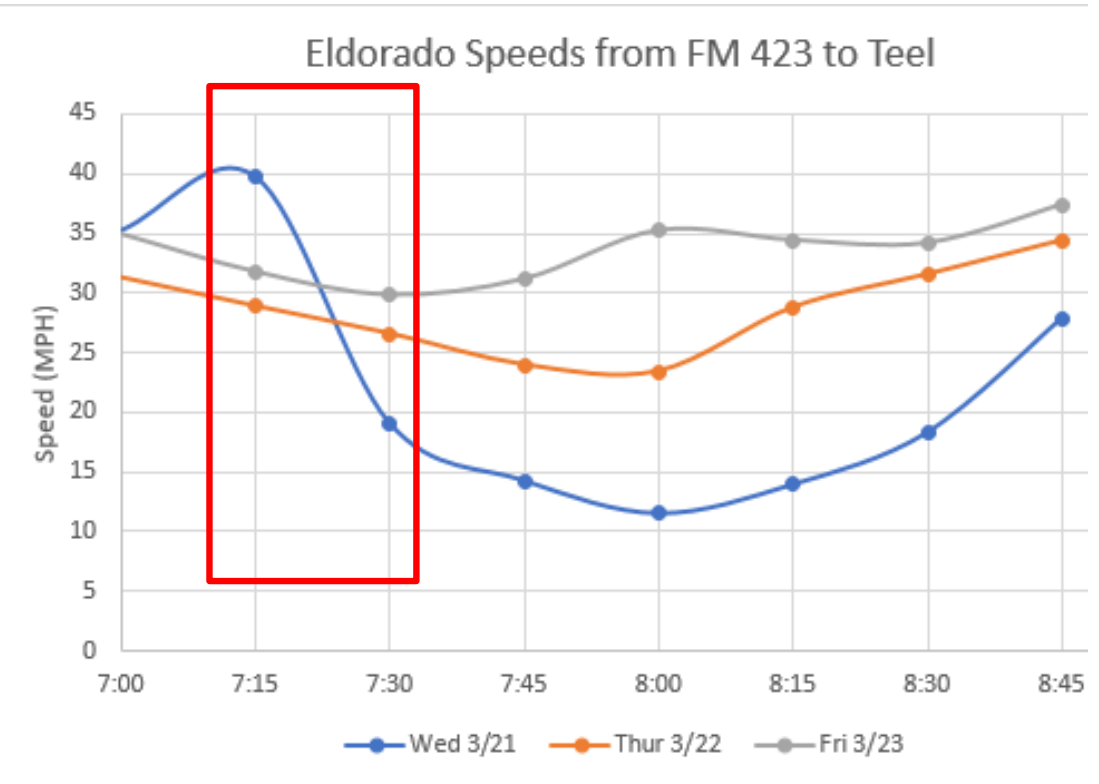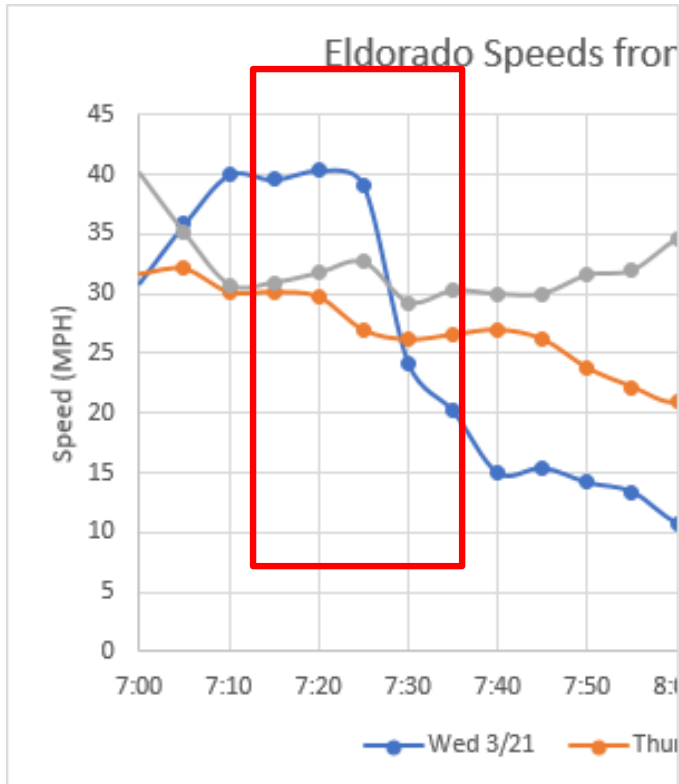- Blue – Before, Orange – During, Gray - After

# Crowd Source Travel Time

- 5 minute versus 15 minute data

# Crowd Source Travel Time

- 5 minute versus 15 minute data.

# Machine Learning

- Determine what in the SPM data indicates a problem. We need to gain experience.

- Machine Learning – user provides feed back to the SPM module.

  - Yes that was a traffic signal problem or
  - No that was not a traffic signal problem.

- From SPM (manual) to ATSPM (automated)

  - Data analytics that provide a "top 10 list" of problems, which are actually problems
  - Don't need false alarms

# Contact

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