Leveraging Cloud-based Technology for Optimizing Signal Timing & Real-Time Adaptive Control

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The Importance of Measurement

- How well is the signal operating?

  ✓ How do you know?

- Historically we've lacked rich data

  ✓ Volume and Occupancy

  ✓ Floating car studies

- Good data was expensive and time consuming to obtain

- Limited tools for analysis to turn that data into useable information

- Lack of tools to pinpoint sources of problems

National Traffic Signal Report Card 2012	
Management	D
Traffic Signal Operations	C
Signal Timing Practices	C
Traffic Monitoring and Data Collection	F
Maintenance	C
OVERALL	**D+**

Role of SPM

Traffic Adaptive

Traffic Responsive

Coordinated

Fully Actuated

Semi Actuated

Fixed Time

SPM Analytics

"SPMs can be used to manage and optimize all modes of operation, can outperform adaptive control, and is much cheaper and simpler."

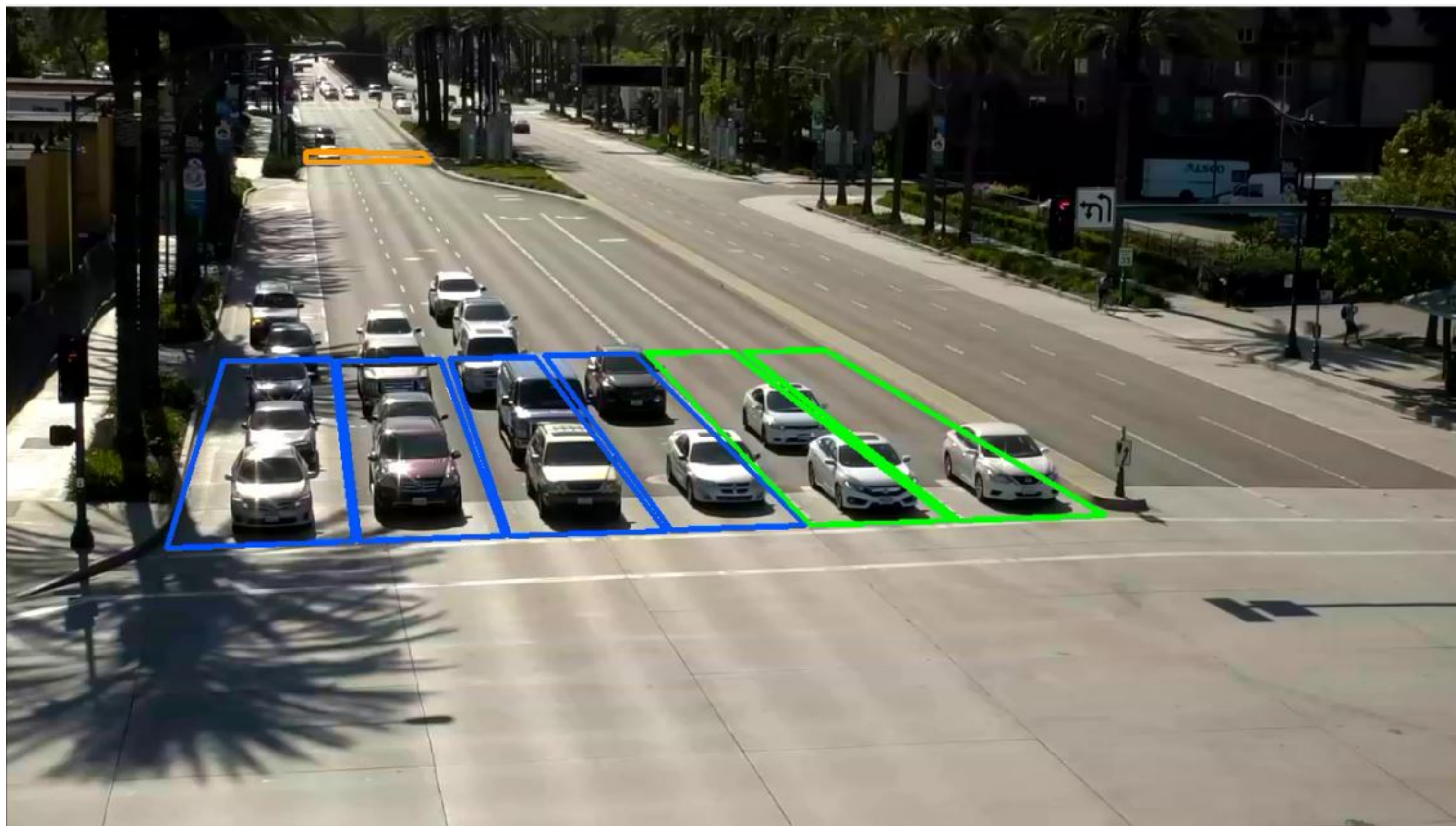Mark Taylor, UDOT

Detection Requirements

No Detection
- Cycle Length
- Green Times
- Percent Ped Calls
- Split Monitor
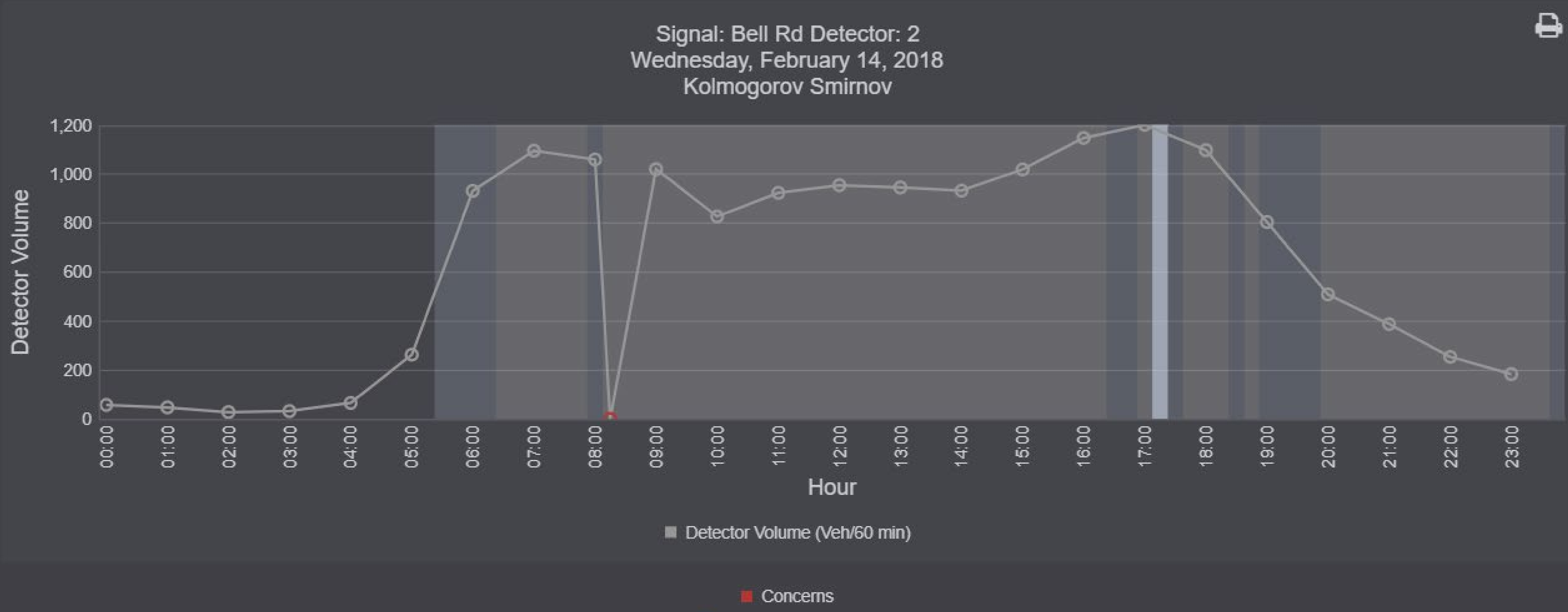- Phase Terminations

Stop Bar
- ROR/GOR
- Split Failures

Advanced
- Purdue Coordination Diagram
- Arrivals on Green
- Flow Rates
- Approach Delay
- Volume/Capacity

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Charts

Date	Detector	Name	P-Value
2/14/2018 8:25:03 AM	2		0

Signal: Bell Rd Detector: 2
Wednesday, February 14, 2018
Kolmogorov Smirnov

■ Detector Volume (Veh/60 min)
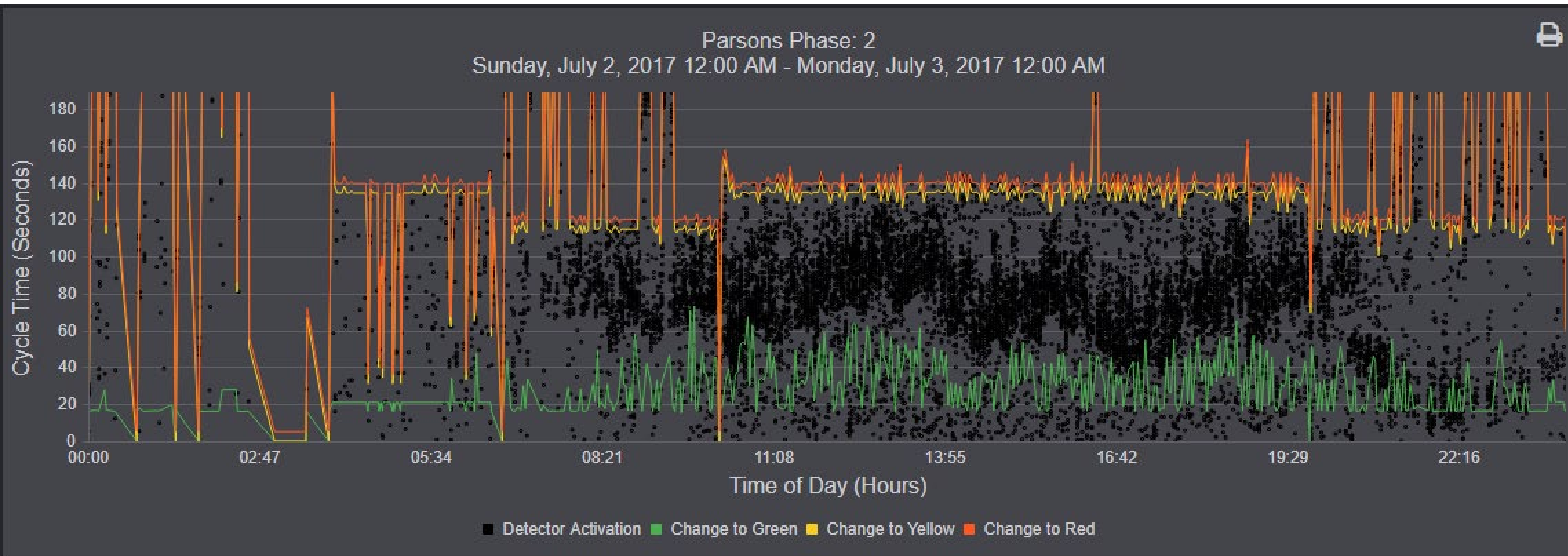
■ Concerns

Controller Compatibility

- Econolite Cobalt: Any Version
- Econolite ASC/3 NEMA, v. 2.50+ and OS 1.14.03+
- Econolite 2070 with 1C CPU Module V. 32.50+

Possible with vendor provided translation utility:
- Intelight Maxtime ver. 1.7.0+
- Peek ATC Greenwave ver. 03.05.0528+
- Trafficware 980ATC ver. 76.10+
- Siemens M50 Linux and M60 ATC
  - ECOM Ver. 3.52+
  - NTCIP Ver. 4.53+
- McCain ATX Omni eX 1.6+
- D4 ver. L-20+

Purdue Coordination Diagram

Parsons Phase: 2
Sunday, July 2, 2017 12:00 AM - Monday, July 3, 2017 12:00 AM

■ Detector Activation ■ Change to Green ■ Change to Yellow ■ Change to Red

Arrivals on Green

McGinnis Ferry @ Medlock Bridge Phase: 2
Wednesday, July 5, 2017 12:00 AM - Thursday, July 6, 2017 12:00 AM
Total Detector Hits = 21304 Total AoG = 13260
AoG for the select period = 62.2%

Arrivals on Green ■ Percent Arrivals on Green ■ Total Vehicles
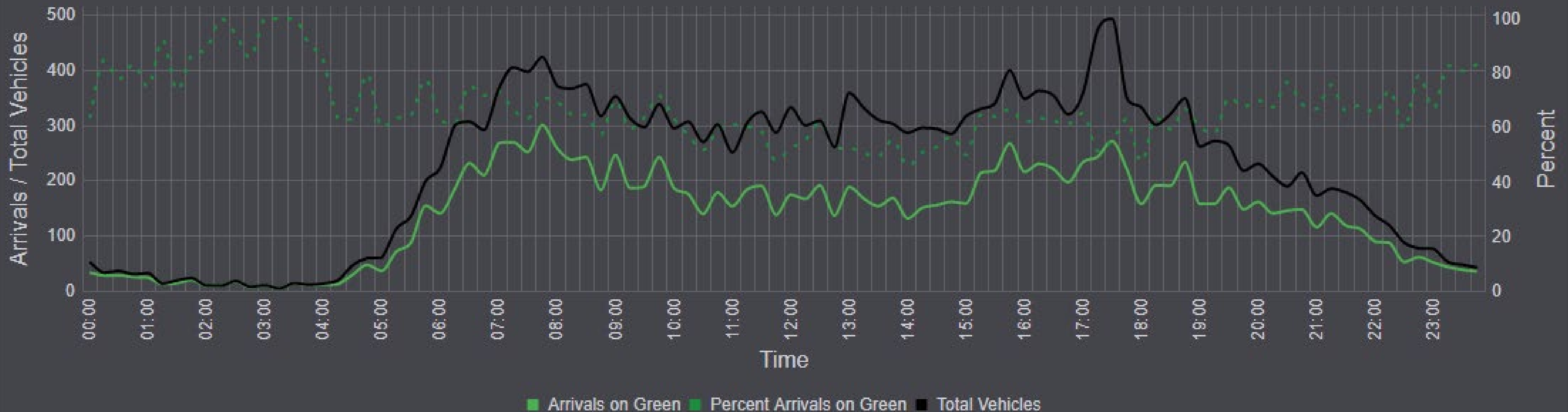
Select signal...

Select Columns

Corridor		Arrivals on Green (avg/day)	Delay (secs/veh)	Delay (secs/hour)	Flow Rate	Volume (avg/day)	Ped Delay (avg/day)	Ped Delay (secs/actuation)	Ped Actuations (avg#/day)	Ped Transitions (avg#/day)	Percent Peds (avg%)	Total Ped Cycles (avg#/day)	Preempts (avg#/day)	Preen Durat (avg secs/
Default Corridor	Range 1	-	-	-	-	-	-	-	-	-	-	-	-	-
	Range 2	-	-	-	-	-	-	-	-	-	-	-	-	-
McGinnis Ferry	Range 1	111597.0	2.1	15184.5	154.6	175781.0	3906.1	56.6	69.0	18.0	1.4	33.0		-
	Range 2	77443.4	3.5	19564.9	122.3	134744.0	2496.7	62.7	39.8	21.6	0.5	19.2		-
Old Alabama Rd	Range 1	87747.0	4.0	23864.5	62.8	143554.0	5840.3	47.9	122.0	56.0	0.7	106.0	2.0	8
	Range 2	114591.8	3.7	28793.2	75.6	187547.4	7261.4	45.3	160.4	83.6	1.6	135.6	7.2	20
Medlock Bridge Road	Range 1	198411.0	2.0	27630.0	102.8	339997.0	16485.8	54.1	305.0	164.0	0.6	58.0	6.0	28
	Range 2	162272.8	2.5	32195.2	106.3	304173.0	18438.1	62.4	295.4	213.6	0.6	61.8	7.6	30

Overview | Map | Metrics | Compare | **Optimization** | Detector Concerns

Demo, USA
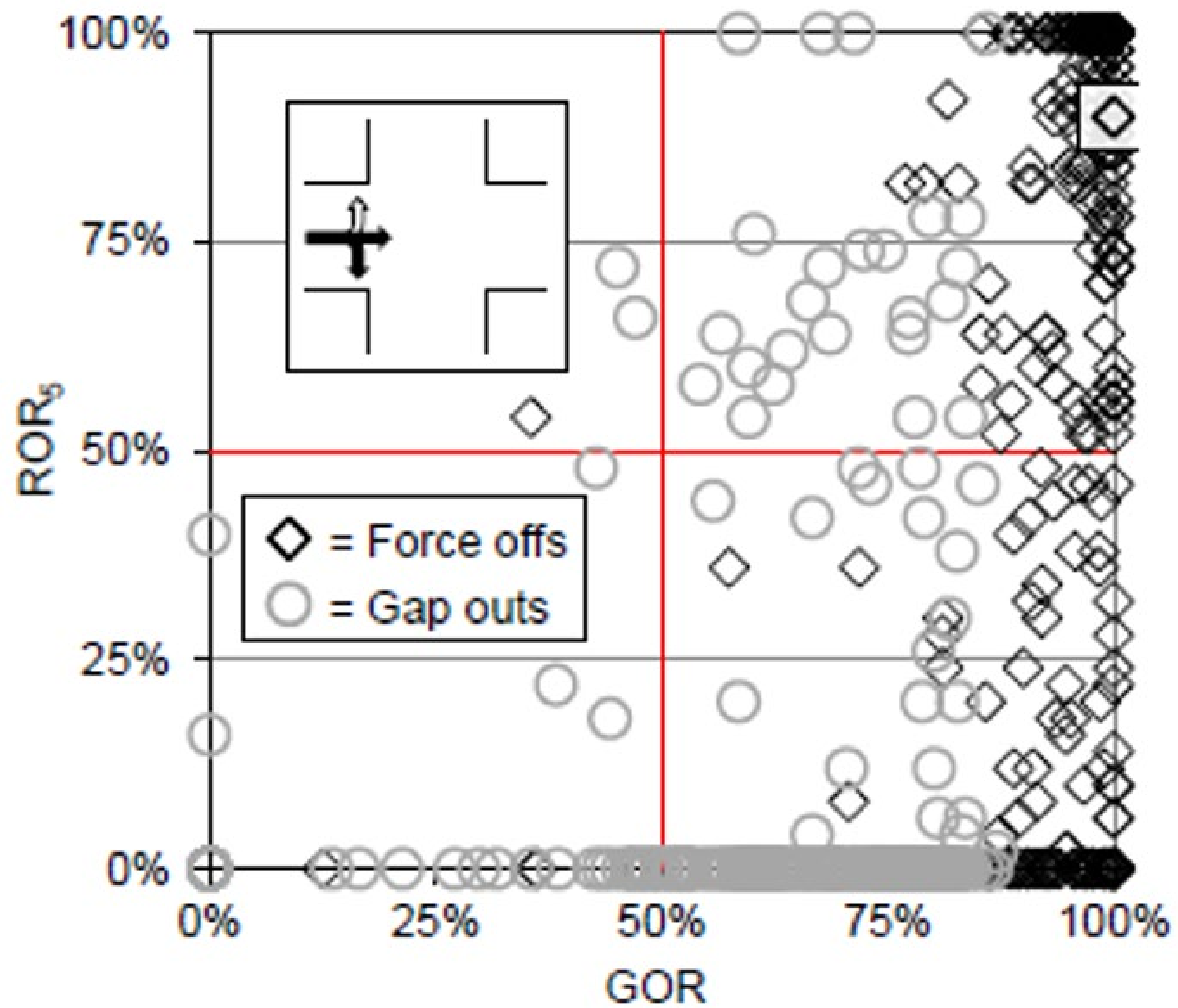
Optimizations❓

Corridor Details

Pattern Optimizer

Corridor	Enabled	Latest Run	Analysis Period	Latest Action	Green Time / Direction	Average Delay		
						Initial	Predicted	Outcome
Jones Bridge Road	No	--	--	⊘				
McGinnis Ferry	No	**May 06, 2018 09:00 PM**	Apr 29, 2018 - May 05, 2018	⊘				
Medlock Bridge Optimization	No	**Jun 12, 2018 11:47 AM**	Jun 11, 2018 - Jun 12, 2018	📋 Jun 12, 2018 11:47 AM	Programmed / Southbound Programmed / Northbound	0:00:20 0:00:13	0:00:15 ↓25% 0:00:12 ↓8%	-- --
Medlock Bridge Optimization South	Yes	**Sep 15, 2019 09:00 PM**	Sep 08, 2019 - Sep 14, 2019	📋! Sep 15, 2019 09:00 PM				
Medlock Bridge Road	No	**May 06, 2018 09:00 PM**	Apr 29, 2018 - May 05, 2018	⊘				
Old Alabama Rd	No	**May 06, 2018 09:00 PM**	Apr 29, 2018 - May 05, 2018	⊘				
Single Intersection Test	No	--	--	⊘				

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Pattern Optimizer - Medlock Bridge Optimization[?]

Plan Generated On: Jun 12, 2018 11:47 AM

Analysis Period: Jun 11, 2018 - Jun 12, 2018

Configured: O, C, S   View Details

All Patterns

Pattern	Latest Action	Green Time / Direction	Average Delay	
			Initial	Predicted
Pattern 22	📋 Jun 12, 2018 11:47 AM	Programmed / Southbound Programmed / Northbound	0:00:11 0:00:10	0:00:11 0% 0:00:06 ↓40%
Pattern 25	📋 Jun 12, 2018 11:47 AM	Programmed / Southbound Programmed / Northbound	0:00:14 0:00:15	0:00:12 ↓14% 0:00:13 ↓13%
Pattern 27	📋 Jun 12, 2018 11:47 AM	Programmed / Southbound Programmed / Northbound	0:00:24 0:00:09	0:00:17 ↓29% 0:00:08 ↓11%
Pattern 28	📋 Jun 12, 2018 11:47 AM	Programmed / Southbound Programmed / Northbound	0:00:47 0:00:25	0:00:19 ↓60% 0:00:36 ↑44%
Pattern 29	📋 Jun 12, 2018 11:47 AM	Programmed / Southbound Programmed / Northbound	0:00:26 0:00:14	0:00:21 ↓19% 0:00:18 ↑29%

Signal Details

	Green Time / Direction	Average Delay	
		Initial	Predicted
Wilson Rd Pattern: 25	Programmed /	--	--
	Programmed /	0:00:17	0:00:14 ↓18%
	Actual /	--	--
	Actual /	0:00:01	--

Setting	Initial		Recommended
Offset	77		32
Cycle Length	140		135
Sequence/Splits	Ø1 Ø2 C Ø4 15 83 42 Ø5 Ø6 C Ø7 Ø8 15 83 21 21		Ø1 Ø2 C Ø4 14 87 34 Ø5 Ø6 C Ø7 Ø8 14 87 15 19

Programmed Green Time

Phase 6
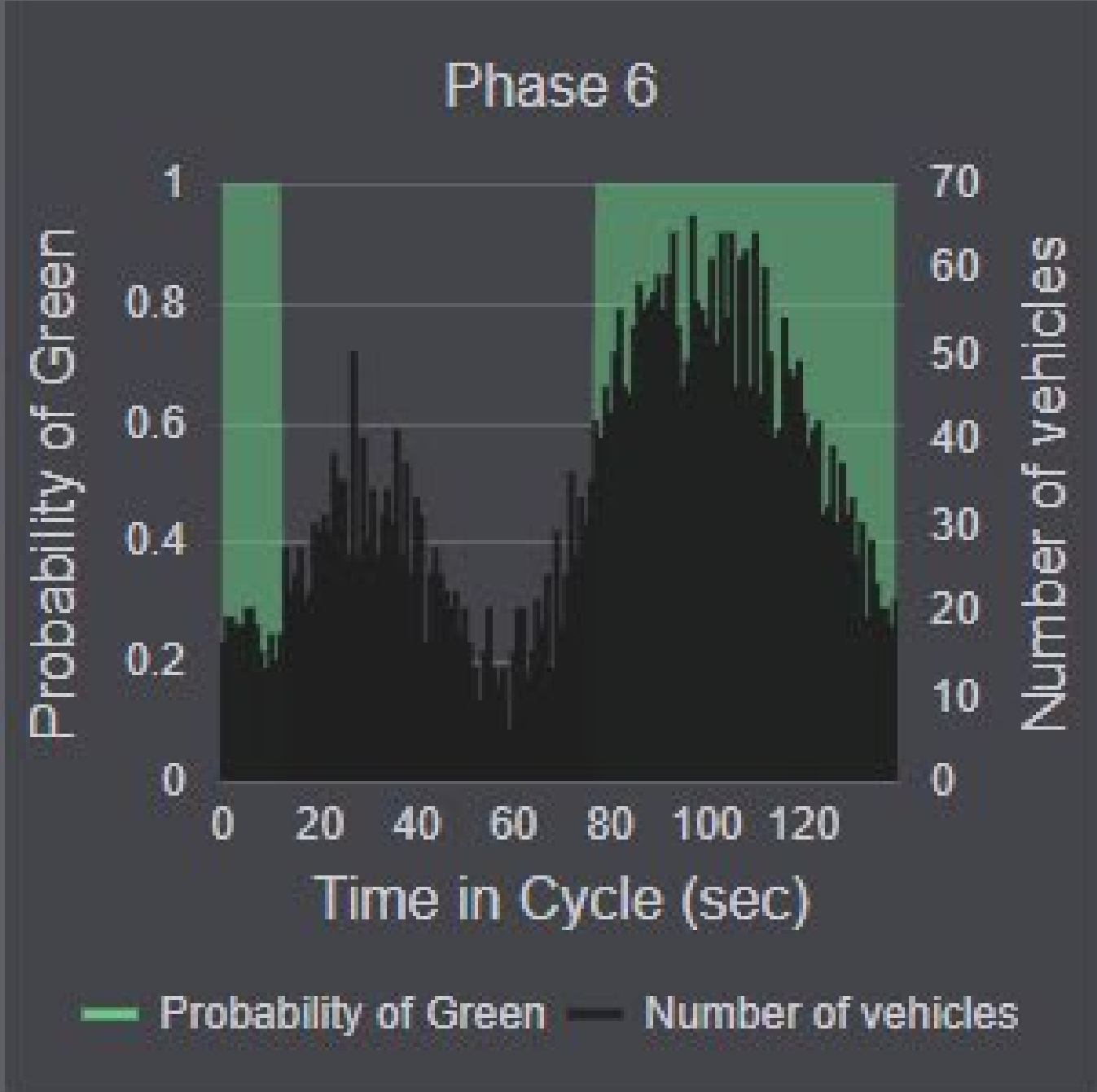

Phase 6

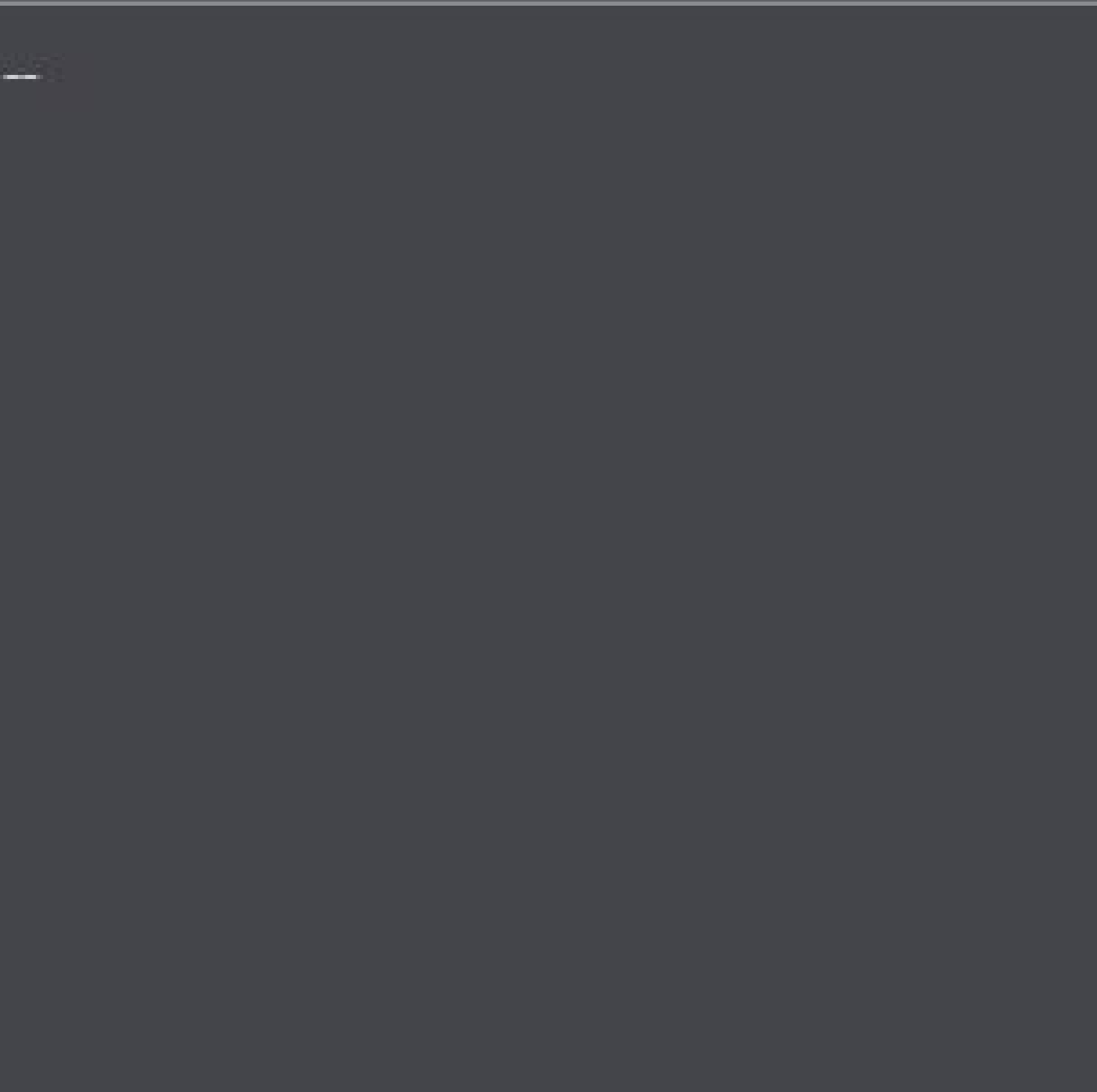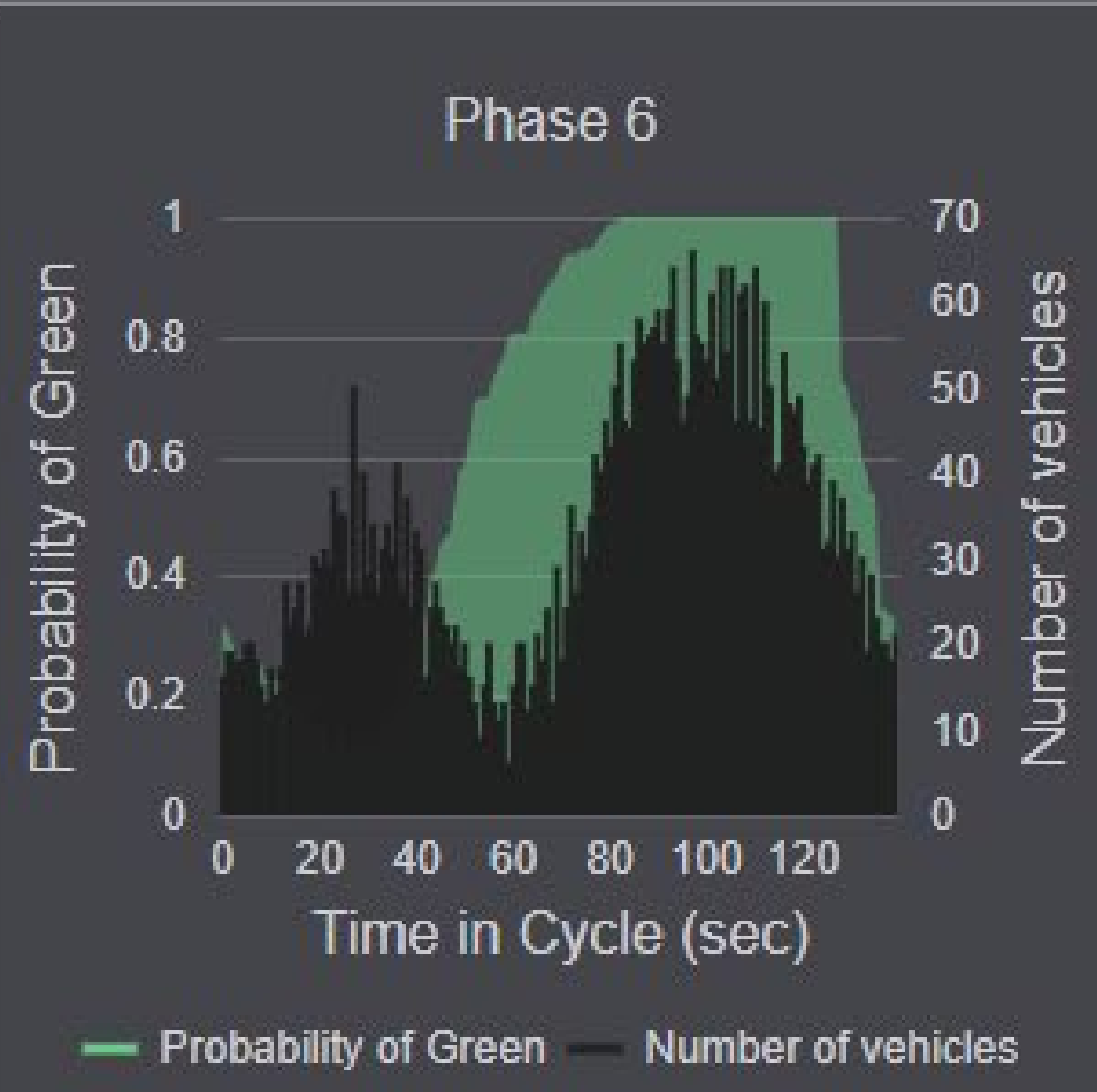**Actual Green Time**

—

Phase 6
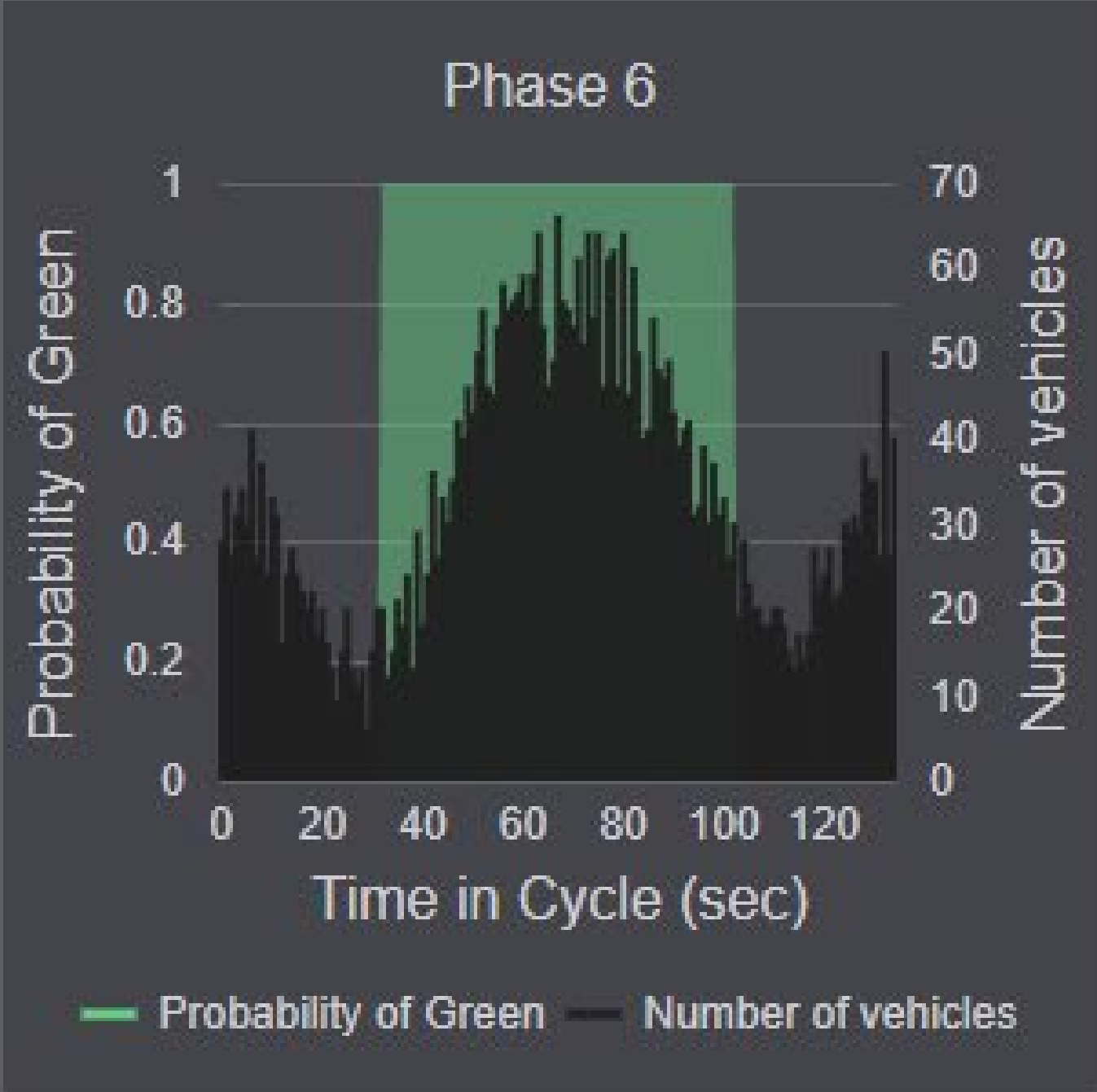
Edaptive!

- Can we optimize cycle by cycle? YES!
- Requirements: Network; Detection; Hi-res controller
- Release real-time control to SPM system…
- …but, retain understanding of how system trying to operate
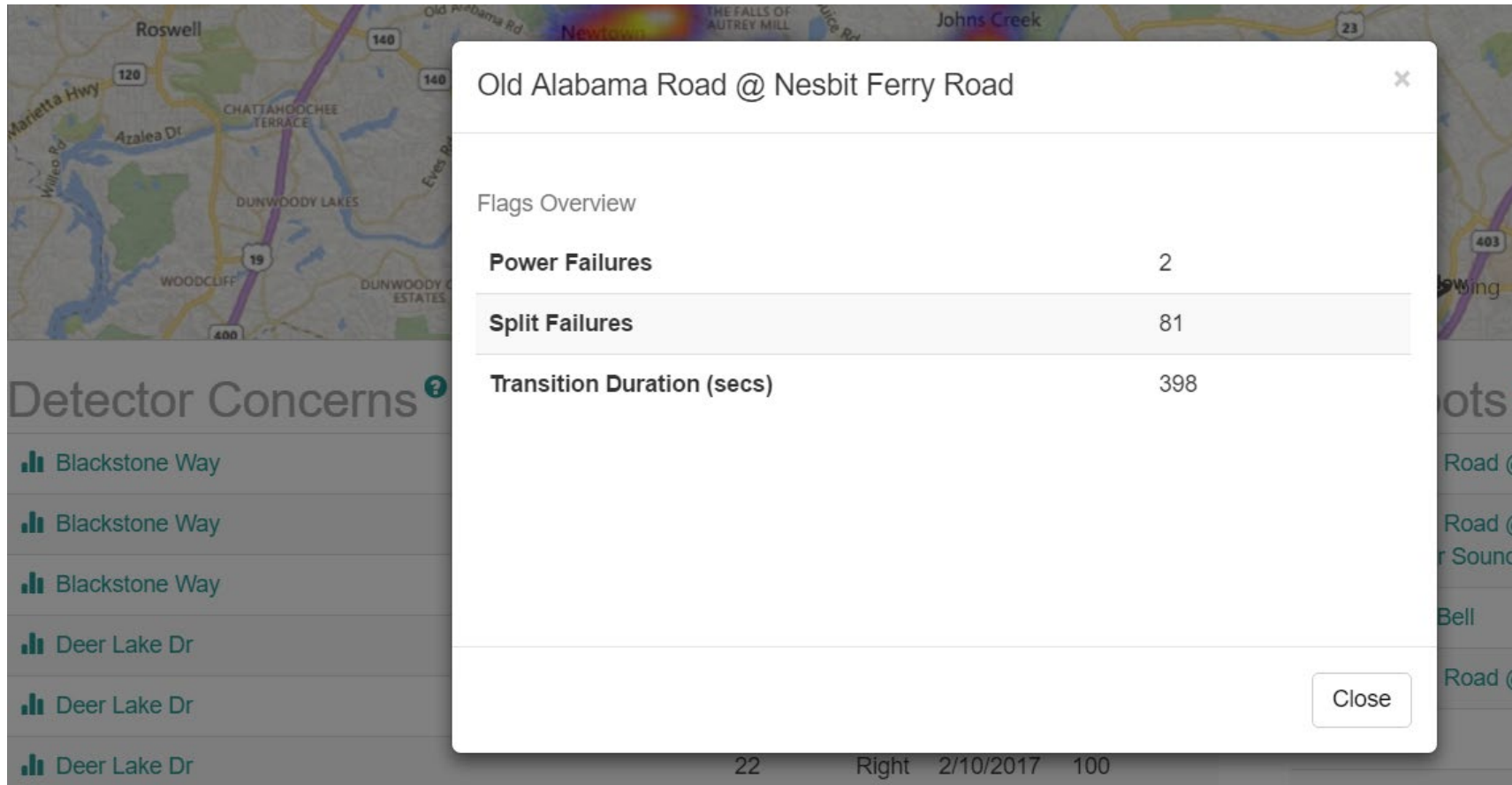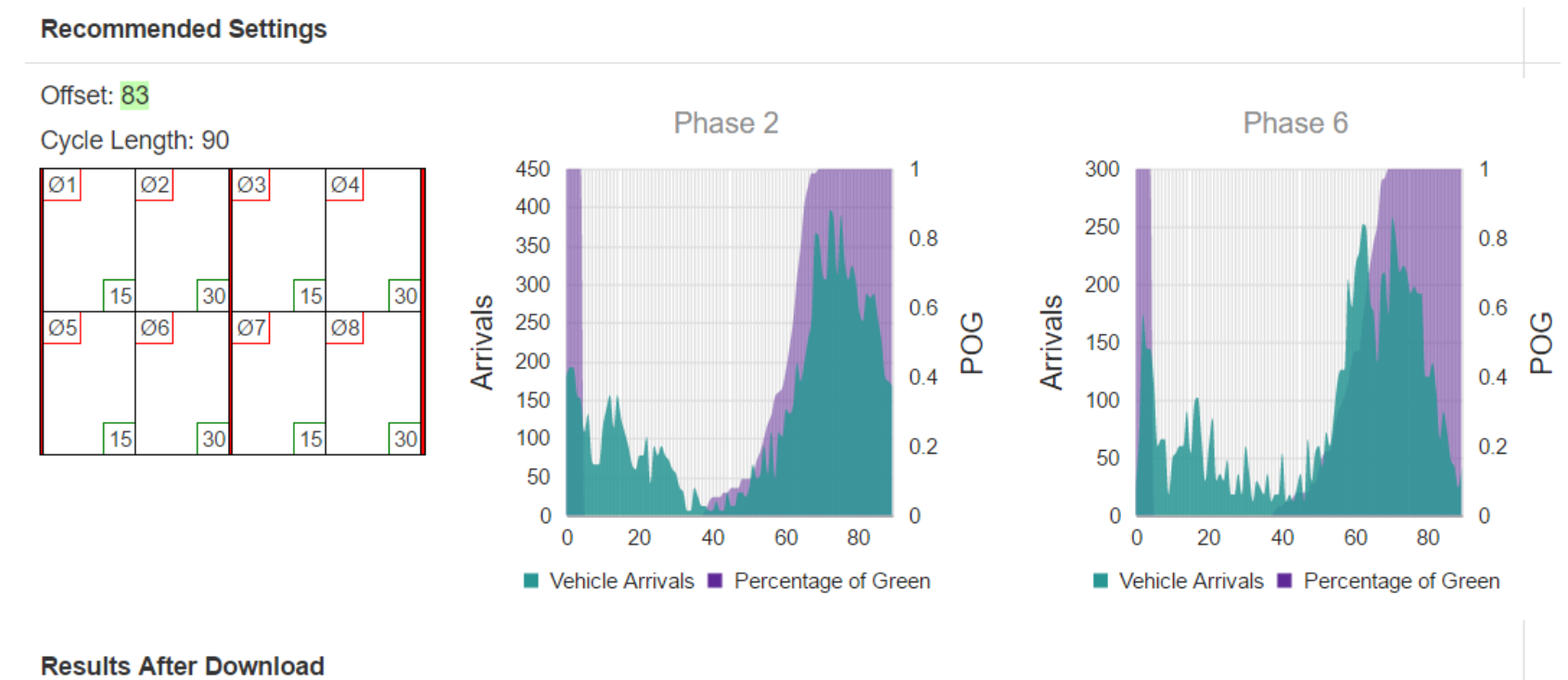
Evolution of Optimization

Reactive

"I had to wait 5 minutes for the light to change!"

Proactive

There are abnormally high spilt failures at Old Alabama and Nesbit Ferry road

Automated Recommendations

Update phase 2&6 split times to 22 seconds and 4&8 to 15 seconds to reduce split failures

Key Takeaways

- Don't invest in any controller that is not hi-res capable!

- SPM = Hi-resolution Controller Data

- SPM optimizations → Different than traditional adaptive

- Edaptive: SPM technology; optimizes; arterial

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