

**Independent Analysis of
Yellow Signal Timing Issues at
Red Light Camera Approaches
in the City of St. Petersburg**

by
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X. Introduction

This analysis is meant as a supplement to the “Independent Analysis of the City of St. Petersburg Red Light Camera Program” report that was released on September 9, 2013. It is an update and a targeted analysis of several issues related to short yellow signal times at St. Petersburg, Florida traffic intersections that have been equipped with red light cameras.

The topics covered in this analysis are:

1. The effects of lowering yellow signal times
2. Inadequate yellow signal times caused by ignoring the downward grade of an approach
3. An update on the tallies of short yellow light red light camera citations issued to date
4. Changes in the potential citation rejection rate
5. Conclusions

1. Effects of lowering yellow signal time on the Eastbound approach of 38th Ave. N. and 66th St.

The yellow signal time at this approach was lowered from 5.0 seconds to 4.4 seconds. According to testimony by City Staff, the yellow signal had been at 5.0 seconds for over a decade. It was changed on October 4th, 2013.

Red Light Camera Citations:

From October 29th, 2011 until October 3rd, 2013 = 112 straight through citations, 0.159 daily average
 From October 4th, 2013 until October 31st, 2013 = 12 straight through citations, 0.480 daily average

The daily average of straight through red light camera citations has gone **up 302%** since the yellow time was lowered at that approach.

CONTROLLER TIMINGS

LOCATION: 66 STREET & 38 AVENUE N.

PHASE 1. NBLT PHASE 5. SBLT
 PHASE 2. SB PHASE 6. NB
 PHASE 3. EBLT PHASE 7. WBLT
 PHASE 4. WB PHASE 8. EB

EFFECTIVE DATE: 7/31/13

CONTROLLER INTERVAL	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7	PHASE 8
01 INITIAL	5	6	5	15	5	6	5	15
02 PASSAGE	3	3	3	3	3	3	3	3
03 YELLOW	4	5	4	5	4	5	4	5
04 RED CLEARANCE	2	2	2	2	2	2	2	2

Figure 1. Yellow signal times at 38th Ave. N. and 66th St. prior to October 4, 2013

CONTROLLER TIMINGS

LOCATION: 66 STREET & 38 AVENUE N.

PHASE 1. NBLT PHASE 5. SBLT
 PHASE 2. SB PHASE 6. NB
 PHASE 3. EBLT PHASE 7. WBLT
 PHASE 4. WB PHASE 8. EB

EFFECTIVE DATE: 10/4/13

CONTROLLER INTERVAL	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7	PHASE 8
01 INITIAL	5	6	5	15	5	6	5	15
02 PASSAGE	3	3	3	3	3	3	3	3
03 YELLOW	4.8	4.8	4.4	4.4	4.8	4.8	4.4	4.4
04 RED CLEARANCE	2	2	2.4	2.2	2	2	2.4	2.2

Figure 2. Yellow signal times at 38th Ave. N. and 66th St. as of October 4, 2013

2. Effects of inadequate yellow signal time on the Eastbound approach of 1st Ave. S. and 34th St.

The yellow signal time for this approach was calculated by St. Petersburg city staff assuming a 0.0% slope, or grade, when in fact there is a center-line downward grade of 1.661% at 100 feet for this approach(see documentation below).



Figure 3. City staff response to questions about the grade used to calculate yellow times

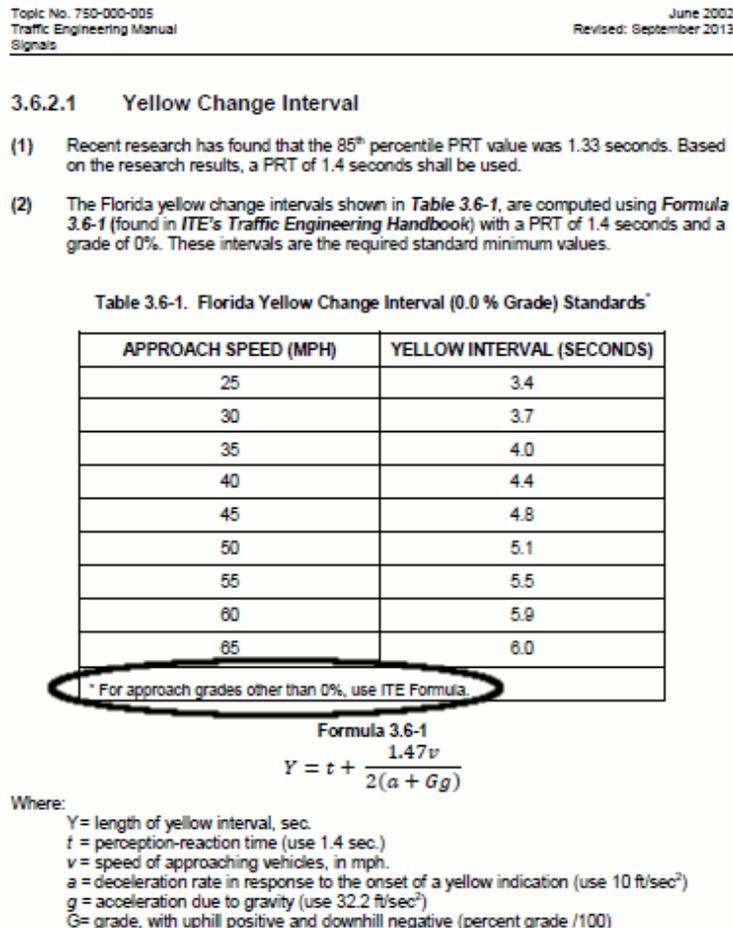


Figure 4. FDOT manual page on yellow signal timing

Florida Department of Transportation

RICK SCOTT
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

ANANTH PRASAD, P.E.
SECRETARY

MEMORANDUM

Date: September 20, 2013
To: District Traffic Operations Engineers, District Maintenance Engineers, District Design Engineers, District Directors of Operations, and District Directors of Production
From: Mark C. Wilson, P.E., State Traffic Operations Engineer *mcw*
Copies: Ananth Prasad, Brian Blanchard, Tom Byron, Duane Brautigam, Tim Lattner, Lora Hollingsworth, and District Secretaries
Subject: Traffic Engineering Manual Section 3.6 Revision - Standardization of Yellow Change and Red Clearance Intervals for Signalized Intersections

Section 3.6 of the Department's *Traffic Engineering Manual (TEM)* Standardization of Yellow Change and Red Clearance Intervals for Signalized Intersections has been revised and is attached.

All new signal installations, intersections with Traffic Infraction Detectors, signal phasing changes, geometric changes affecting the timing or phasing, or corridor re-timing projects must comply with these guidelines immediately upon implementing timing changes.

Intersections with existing Traffic Infraction Detectors must be in compliance with the revisions by December 31, 2013. All other existing signalized intersections on the state highway system must be in compliance by June 30, 2015.

The revisions include:

- Perception/Reaction Time (PRT) to be used is 1.4 seconds
- Minimum yellow change interval is 3.4 seconds
- Round computations up to the nearest 1/10th of a second
- Red clearance interval minimum raised to 2.0 seconds

Also attached are the revised Traffic Infraction Detector Placement and Installation Specifications that the Department is required to develop pursuant to F.S., 316.0776 *Traffic infraction detectors; placement and installation.*

Please forward the documents to the local maintaining agencies in your Districts.

www.dot.state.fl.us

Figure 5. FDOT memorandum on changes to calculating yellow times

CONTROLLER TIMINGS

LOCATION: 34 STREET & 1 AVENUE S.

PHASE 2. NB OLA= SB THRU
 PHASE 3. SBLT
 PHASE 4. EB

EFFECTIVE DATE: 5/17/12

CONTROLLER INTERVAL	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7
01 INITIAL		6	5	10			
02 PASSAGE		3	3	3			
03 YELLOW		4	4	4			
04 RED CLEARANCE		1.5	1.5	1.5			
05 MAXIMUM		??	??	??			

CONTROLLER TIMINGS

LOCATION: 34 STREET & 1 AVENUE S.

PHASE 2. NB OLA= SB THRU
 PHASE 3. SBLT
 PHASE 4. EB

EFFECTIVE DATE: 12/2/13

CONTROLLER INTERVAL	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7
01 INITIAL		6	5	10			
02 PASSAGE		3	3	3			
03 YELLOW		4	4	4.4			
04 RED CLEARANCE		2.1	2	2			
05 MAXIMUM		??	??	??			

Figures 6 & 7. Yellow signal times at 34th St. S. and 1st Ave. S. before and after December 2, 2013

The May 2013 Kimley-Horn Yellow signal time report shown below also uses a 0.0% approach grade for calculating yellow signal times. A strange note on their calculations for the Eastbound approach of 1st Ave. S and 34th St. shows that even though they used the same 40 mph speed, they came up with two different calculated minimum yellow signal times:

 **Kimley-Horn and Associates, Inc.** Yellow Change Interval and All Red Clearance Interval Review

This flexibility for setting the intervals for left turn movements indicates that engineering judgment was applied when establishing the existing yellow change interval and all red clearance intervals. Currently, the FDOT District 7 policy is to implement the yellow interval for left turn movements using the adjacent through movement's posted speed. Correspondence with the FDOT District 7 Traffic Operations staff member, Mark Hall, is attached as Appendix C.

The yellow change interval was reviewed at the intersection ~~_____~~ for the 10 intersections that comprise the "Stop on Red" campaign. The approach grades were assumed to be flat. intersection approaches with and without camera enforcement were reviewed to provide a better understanding of the whole intersection, as safety at an entire intersection is the desired outcome instead of only intersection approaches with camera enforcement. Table 1 provides a summary of the yellow change interval using the legal driving speed (posted speed limit).

Figure 8. Kimley-Horn report, page 6 on the PDF(page 4 of the report)

 **Kimley-Horn and Associates, Inc.** Yellow Change Interval and All Red Clearance Interval Review

Table 1 (Continued):
Yellow Change Interval Summary Using the Legal Driving Speed

Intersection	Movement	Legal Driving Speed (mph)	Modified Left Turn Speed (mph)	Existing Yellow Interval (seconds)	Calculated Yellow Interval (w/ legal speed)	Calculated Yellow Interval (w/ modified left turn speed)	Adequate Yellow? (w/ legal speed)
34th Street & 1st Avenue South	NB	35	-	4.0	3.6	-	Yes
	NA (1 st Ave S One-Way)	-	-	-	-	-	-
	SB	35	-	4.0	3.6	-	Yes
	SBL	35	25	4.0	2.6	2.8	Yes
	EB	40	-	4.0	3.9	-	Yes
	EBL	40	-	Permissive Only Lefts			
	NA (1 st Ave S One-Way)	-	-	-	-	-	-
NR	45	-	4.3	4.3	-	Yes	

Figure 9. Kimley-Horn report, page 8 on the PDF(page 6 of the report)

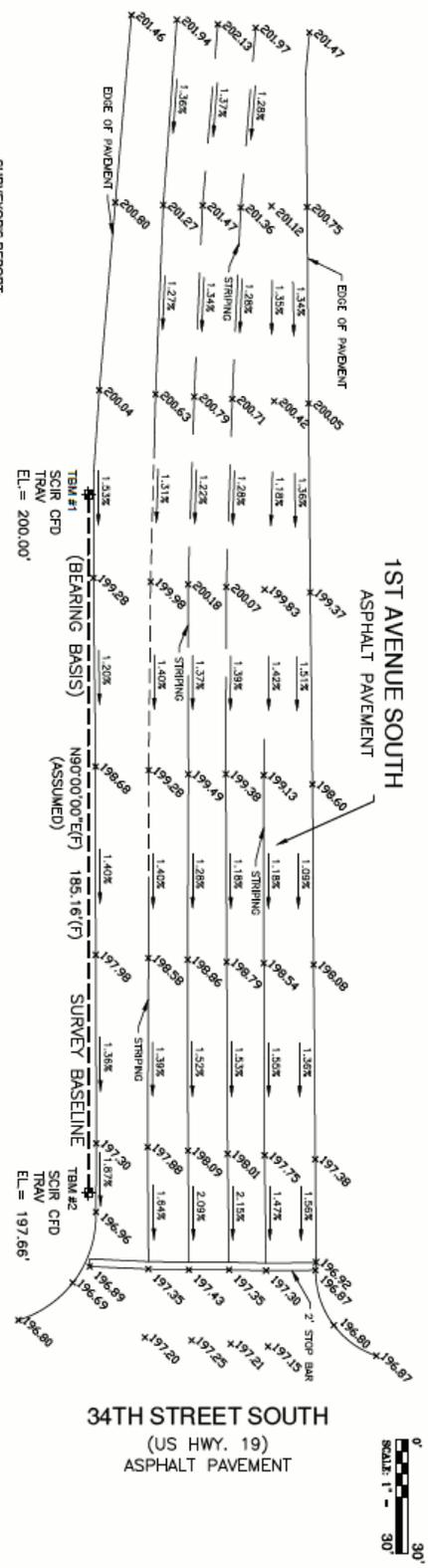
 **Kimley-Horn and Associates, Inc.** Yellow Change Interval and All Red Clearance Interval Review

Table 2 (Continued):
Yellow Change Interval Summary Using the 85th Percentile Speed

Intersection	Movement	Rounded 85 th Percentile Speed (mph)	Legal Driving Speed (mph)	Existing Yellow Interval (seconds)	Calculated Yellow Interval (w/ 85 th % speed)	Adequate Yellow? (w/ 85 th % speed)	
34th Street & 1st Avenue South	NB	38	35	4.0	3.8	Yes	
	NA (1 st Ave S One-Way)	-	-	-	-	-	
	SB	35	35	4.0	3.6	Yes	
	SBL	33	35	4.0	3.5	Yes	
	EB	40	40	4.0	4.0	Yes	
	EBL	36	40	Permissive Only Lefts			
	NA (1 st Ave S is One-Way EB)	-	-	-	-	-	
NR	37	45	4.3	3.8	Yes		

Figure 10. Kimley-Horn report, page 11 on the PDF(page 9 of the report)

ELEVATION
 (7) FIELD
 (7) PROFESSIONAL SURVEYOR &
 REG. NO. 12345
 NAME JOHN D. SURVEYOR
 SEC. SECTION 15
 TOWNSHIP 30N-04W
 RANGE 15W



SURVEYOR'S REPORT:

1. THE PURPOSE OF THIS TOPOGRAPHIC SURVEY IS TO SHOW THE SLOPE AND DIRECTIONS OF FALL FOR A PORTION OF 1ST AVENUE SOUTH LYING WEST OF 34TH STREET SOUTH (US HWY. 19), ST. PETERSBURG, FLORIDA.
2. THE BASIS OF BEARING UTILIZED FOR THIS TOPOGRAPHIC SURVEY IS BASED ON THE SURVEY BASELINE HAVING AN ASSUMED BEARING OF N90°00'00"E.
3. THE ACCURACY STANDARD USED FOR THIS SURVEY, AS CLASSIFIED IN THE MINIMUM TECHNICAL STANDARDS (S-1-17 FAC), IS "COMMERCIAL/HIGH RISK". THE MINIMUM RELATIVE DISTANCE ACCURACY FOR THIS TYPE OF SURVEY IS 1 FOOT IN 10,000 FEET. THIS SURVEY EXCEEDS THIS STANDARD.
4. SURVEY MAP AND REPORT OR THE COPIES THEREOF ARE NOT VALID WITHOUT THE SIGNATURE AND THE ORIGINAL RAISED SEAL OF A FLORIDA LICENSED SURVEYOR AND MAPPER. ADDITIONS OR DELETIONS TO SURVEY MAPS OR REPORTS BY OTHER THAN THE SIGNING PARTY OR PARTIES IS PROHIBITED.
5. RE-USE OF THIS SURVEY FOR PURPOSES OTHER THAN WHICH IT WAS INTENDED, WITHOUT WRITTEN VERIFICATION, WILL BE AT THE RE-USERS SOLE RISK AND WITHOUT LIABILITY TO THE SURVEYOR. NOTHING HEREIN SHALL BE CONSTRUED TO GIVE ANY RIGHTS OR BENEFITS TO ANYONE OTHER THAN THOSE TO WHOM CERTIFIED.
6. THIS SURVEY IS NOT INTENDED TO SHOW THE LOCATION OR EXISTENCE OF ANY JURISDICTIONAL, HAZARDOUS OR ENVIRONMENTALLY SENSITIVE AREAS.
7. SHOWN ANYWHERE ON THIS SURVEY, THE WORD "CERTIFY" IS UNDERSTOOD TO BE AN EXPRESSION OF A PROFESSIONAL OPINION BASED UPON THE SURVEYOR'S BEST KNOWLEDGE, INFORMATION AND BELIEF, AND THAT IT THUS CONSTITUTES NEITHER A GUARANTEE NOR A WARRANTY.
8. ELEVATIONS HEREON ARE BASED ON AN ASSUMED DATUM OF 200.00' FOR TBM #1.
9. CONTROL ELEVATIONS FOR THIS SURVEY ARE BASED ON A LEVEL LOOP USING DIFFERENTIAL LEVELING TECHNIQUES. THE CLOSURE ACHIEVED IN THIS SURVEY EXCEEDS THE MINIMUM ACCURACY REQUIREMENT CALCULATED AT A MAXIMUM MIS-CLOSURE OF 0.050 FEET.
10. THIS SURVEY IS BASED ON U.S. SURVEY FEET.

SYMBOL LEGEND	
⊕	TEMPORARY BENCHMARK
⊕	PERMANENT BENCHMARK
⊕	SPOT ELEVATION

CERTIFIED TO:
 FENITEL, INC.

WORK ORDER NO.	2013-1745
FIELD DATE	12-24-2013
DRAWN: D.H.	
SCALE:	1" = 30'
SHEET NO.:	1 of 1

Figure 11. Elevation and approach grade survey conducted on the Eastbound approach of 1st Ave. S. and 34th St. by local Traffic Engineering firm Deuel & Associates of Clearwater, FL.

Below is a spreadsheet calculation of the minimum yellow signal times for the Eastbound approach of 1st Ave. S and 34th St. given several different grades as measured from several different distances from the stop bar. Also included on the last row of the table is a 0.0% slope calculation:

YELLOW SIGNAL FORMULA CALCULATION (Eastbound approach 34th St. & 1st Ave S.)

rounded up (in seconds)	yellow time	Perception time (sec)	Speed (mph)	Decelera- tion	Accl. (gravity)	Grade (slope)	Distance (feet)
4.6	4.542368534	1.4	40	10	32.2	-0.02	33 feet
4.6	4.514924174	1.4	40	10	32.2	-0.01744	82 feet
4.6	4.506128815	1.4	40	10	32.2	-0.01661	100 feet
4.5	4.496857701	1.4	40	10	32.2	-0.01573	131 feet
4.5	4.490358942	1.4	40	10	32.2	-0.01511	182 feet
4.5	4.494233948	1.4	40	10	32.2	-0.01548	217 feet
4.5	4.482221724	1.4	40	10	32.2	-0.01433	282 feet
4.4	4.34	1.4	40	10	32.2	0	NO SLOPE

distance(ft)	0	33	82	131	182	217	282
elevation(ft)	197.43	198.09	198.86	199.49	200.18	200.79	201.47

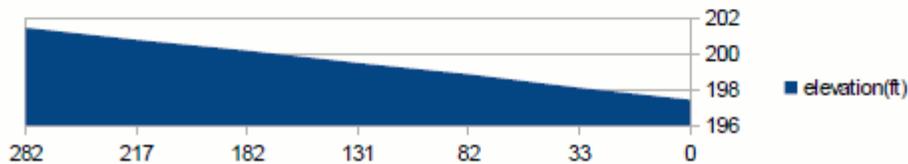


Figure 12. Yellow signal time calculation with elevations and grades

At this measured downward slope level(1.661%), the calculated minimum yellow signal time should be 4.51 seconds. According to the September 20th, 2013 FDOT memorandum on changes in yellow signal time calculations(shown above, Figure 5), all yellow signal times should be rounded UP to the nearest 1/10th of a second. This would mean the proper current yellow signal time at this approach should be 4.6 seconds, instead of the currently set 4.4 seconds. Also, prior to December 2nd, 2013, this yellow signal was set to 4.0 seconds, but it should have been set to 4.2 seconds if the true downward slope had been used in the calculation.

The effect of this short yellow signal time was that 778 citations were issued for people that ran the red light 0.2 seconds or less into the red. Those citations have a total cost of over \$122,000.00.

3. Updated Short Yellow tallies for the first two years of the red light camera program.

The estimate given in early 2013 of 1,645 improperly short yellow signal time red light camera citations was based upon the incomplete and inaccurate yellow signal time tables included in the December 2012 red light camera update report released by the St. Petersburg Traffic and Parking Department. The numbers have been updated to reflect more accurate yellow signal times as well as the several left turn yellow signals that had previously been set to shorter yellow times than their straight through phases.

The 778 short yellow citations at 1st Ave. S. & 34th St. mentioned above, combine with the recalculated 247 short yellow citations from other intersections gives a total of 1,025 red light camera citations that were issued only because the yellow light was improperly short. These citations have a total cost of over \$161,000.00 through the first two years of the program. (table below for per-camera totals. Per citation details are also available for download).

LOC ID	volume	speed	approach	yellow time			short citations		
				Before	After	change	total	refund	
STP01	19250	35	NB 34TH ST N @ 1ST AVE N	4.0	4.0	0	0	0	
			left turn	4.0	4.0	0	0	0	
STP04	20250	40	SB 34TH ST N @ 38TH AVE N	4.0	4.4	0.4	1	0	
			left turn	4.0	4.4	0.4	3	1	
STP05	13896	40	EB 38TH AVE N @ 34TH ST N	4.0	4.4	0.4	0	0	
			left turn	4.0	4.4	0.4	3	1	
STP06	13896	40	WB 38TH AVE N @ 34TH ST N	4.0	4.4	0.4	0	0	
			left turn	4.0	4.4	0.4	22	2	
STP07	17000	40	NB 4TH ST N @ GANDY BLVD N	4.5	4.5	0	4	0	
			left turn	4.5	4.5	0	1	0	
STP08	21850	45	EB GANDY BLVD N @ 4TH ST N	4.5	4.8	0.3	0	0	
			left turn	4.5	4.8	0.3	0	0	
STP26	11500	40	SB 4TH ST N @ GANDY BLVD N	4.5	4.5	0	48	2	
			left turn	4.5	4.5	0	0	0	
STP12	19250	35	SB 34TH ST S @ 1ST AVE S	4.0	4.0	0	3	0	
			left turn	4.0	4.0	0	0	0	
STP13	10304	40	EB 1ST AVE S @ 34TH ST S	4.0	4.4	0.4	2127	778	
STP14	12427	35	EB 22ND AVE N @ 4TH ST N	4.0	4.0	0	0	0	
			left turn	4.0	4.0	0	0	0	
STP15	14500	35	NB 4TH ST N @ 22ND AVE N	4.0	4.0	0	0	0	
			left turn	4.0	4.0	0	0	0	
STP16	14500	40	SB 4TH ST N @ 22ND AVE N	4.0	4.0	0	0	0	
			left turn	4.0	4.0	0	0	0	
STP17	20750	45	NB 66TH ST N @ 22ND AVE N	4.3	4.8	0.5	19	4	
			left turn	4.3	4.8	0.5	0	0	
STP18	22250	45	SB 66TH ST N @ 22ND AVE N	4.3	4.8	0.5	110	15	
			left turn	4.0	4.8	0.8	0	0	
STP19	13500	40	SB 34 ST S @ 22ND AVE S	4.3	4.8	0.5	87	24	
			left turn	4.0	4.8	0.8	12	1	
STP27	13500	40	NB 34TH ST S @ 22ND AVE S	4.3	4.8	0.5	228	41	
			left turn	4.0	4.8	0.8	79	10	
STP20	16750	45	NB 4TH ST N @ 54TH AVE N	4.3	4.8	0.5	1	0	
			left turn	4.0	4.8	0.8	0	0	
STP21	16750	45	SB 4TH ST N @ 54TH AVE N	4.3	4.8	0.5	1	0	
			left turn	4.0	4.8	0.8	0	0	
STP22	22250	45	SB 66TH ST N @ 38TH AVE N	5.0	4.8	-0.2	9	7	
			left turn	4.0	4.8	0.8	117	8	
STP23	10713	40	EB 38TH AVE N @ 66TH ST N	5.0	4.4	-0.6	343	8	
			left turn	4.0	4.4	0.4	2	1	
STP24	20750	45	NB 66TH ST N @ TYRONE BLVD N	4.3	4.8	0.5	122	22	
			left turn	4.0	4.8	0.8	330	43	
STP25	15000	45	EB TYRONE BLVD N @ 66TH ST N	4.3	4.8	0.5	314	49	
			left turn	4.0	4.8	0.8	116	10	
							4100	1025	

Figure 13. Short yellow signal red light camera citations table

4. Changes in the Potential Citation Rejection Rate.

In order to get a better overall understanding of why the number of citations issued over time is going down, it is also important to look at the police review(potential citation) rejection rate. From the beginning of the red light camera program the rejection rate has stayed at a fairly consistent rate, averaging around 46%. But, starting with potential violations in the month of September of 2013, the rejection rate has jumped up significantly. The rejection rate of the October 2013 potential violations stands at 61.1%, and is a significant source of the reduction in citations issued compared to earlier months in the year. In fact, as potential violations sent from ATS went up from September to October, the number of citations issued actually went down(as shown in the bottom chart, Figure 15).

"Presented for Review" vs. "Citations Issued" Rejection Rate

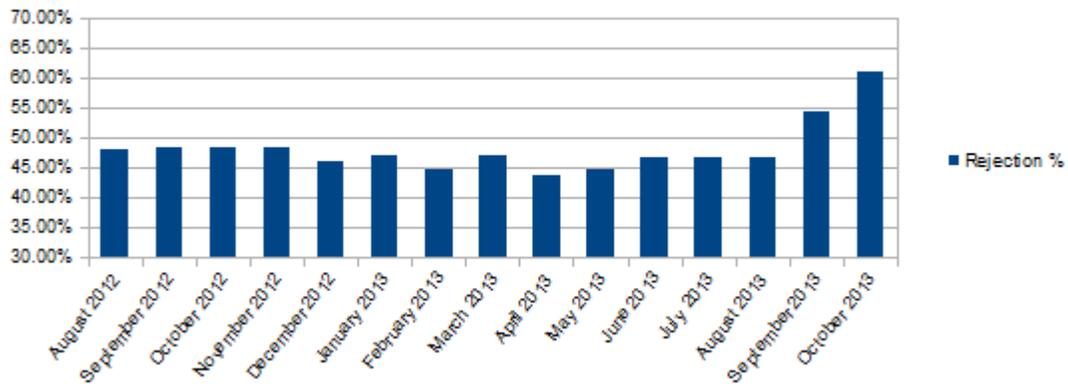


Figure 14. Potential citations rejection rate monthly chart

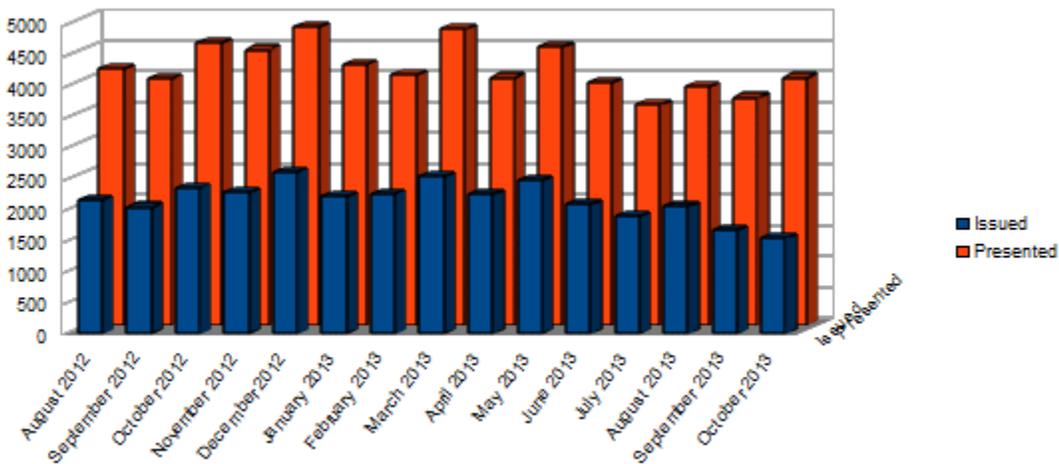


Figure 15. Potential citations and issued citations monthly chart

5. Conclusions

After over a year of preparation for red light cameras, and another two years of red light cameras operating, there are still significant problems with yellow signal timing in the City of St. Petersburg that need to be corrected. Lowering yellow signal times has been shown to significantly increase red light camera citations, and ignoring the downward grade of intersection approaches as demonstrated here, shows that yellow signal times still need to be raised further at some intersection approaches just to be at the minimum level of what they are supposed to be.

The issuance of red light camera citations under these short yellow light conditions makes the red light camera program, and the City of St. Petersburg both look bad.

In order to maintain a fair red light camera program, and show that the City holds itself up to the same level of perfection that it holds the drivers on it's streets to, these documented short yellow citations should be refunded in full, and the short yellow conditions that lead to them should be corrected as soon as possible.