UDOT Advance Warning System Timing Worksheet

Worksheet Revision: 4/10/2019 by MDL - **This BLANK FORM can be filled out in field and left in the cabinet**

Signal Number: [ ] Location: [ ] Date: [ ]
Direction: [ ] Initials: [ ]

Field Measurements and Controller Settings

[ ]	Posted Speed Limit, mph
[ ]	85th-Percentile Speed, mph (if known, leave as "0" or blank if unknown)
[ ]	15th-Percentile Speed, mph (if known, leave as "0" or blank if unknown)
[ ]	Distance between stop bar and AWS, ft
[ ]	Advance Warning Sign Lead Flash Time, s Recommended: [ ]
[ ]	Radar offset from AWS pole, ft (positive means farther from stop bar; typically 0 when radar is mounted on AWS pole)
[ ]	Phase passage/vehicle extension time, s (determine using length of detection zone vs. speed)
[ ]	Place an "x" here if approach has Advance Extended Range; leave blank for legacy Advance
[ ]	Maximum distance from radar unit at which vehicles can be detected (typ. up to 600 feet for legacy Advance unit; 900 feet for Extended Range)
[ ]	Lower boundary of Decision Dilemma Zone, s
[ ]	Upper boundary of Decision Dilemma Zone, s (for cars when using legacy Advance)
[ ]	Upper boundary of Decision Dilemma Zone for trucks, s (not used when using legacy Advance)

[ ]	Calculated AWS Design Speed
[ ]	85th-%ile speed used in calculations
[ ]	15th-%ile speed used in calculations

Assumptions

125	Minimum distance from AWS at which it is "legible" (recommend 125 ft, from BYU study)
70	Minimum distance from AWS at which it is "perceivable" (recommend 70 ft, from BYU study)
21	Difference between 15th-%ile speed and 85th-%ile speed (typically +21; used only if 15th-%ile is not directly entered above)
10	Difference between 85th-%ile speed and AWS design speed (positive means design speed is lower than 85th-%ile), mph (typically 10)
3.0	Perception-reaction time, s (typically 3.0)
10.0	Deceleration Rate, ft/s/s (typically 10.0)
600	Range of Legacy Wavetronix Advance, ft (typically 600) - Reduce if aiming shortens effective range
900	Range of Wavetronix Advance Extended Range, ft (typically 900) - Reduce if aiming shortens effective range

Settings in Wavetronix Radar

Channel 1 Type Normal	Channel 1	Discovery Range ≥(ft)	Range (ft)		Speed (mph)		ETA (s)		Notes
			Near	Far	Min	Max	Min	Max	
	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	Trucks (Extended Range), Not Used with legacy Advance
		N/A	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	Cars (Extended Range), All Vehicles with legacy Advance

Notes

UDOT Advance Warning System Design

4/10/2019 by MDL

Use this form to determine the setback of an AWS for a given speed and desired Lead Flash Time.

User Inputs	Outputs	Changeable Assumptions	Intermediate Calculations

	Desired Lead Flash Time, s
	Lesser of 85th-Percentile Speed or Posted Speed Limit, mph
-71	Setback Distance Required
21	Difference between 85th-%ile and 15th-%ile speed, mph (typically 21)
10	Difference between 85th-%ile and AWS Design speed, mph (typically 10)
70	Distance from AWS at which it is perceivable, ft (typically 70)
-21	15th-%ile Speed, mph
-10	AWS Design Speed, mph
0.1	Min ETA, s

Chart of _required setback in ft_ for a given speed and LFT using typical assumptions above

LFT, s	Speed, mph									
	30	35	40	45	50	55	60	65	70	75
2.0	26	58	92	130	170	213	260	309	361	416
2.5	41	76	114	155	199	246	296	349	405	463
3.0	56	95	136	181	229	279	333	389	449	511
3.5	70	113	158	207	258	312	370	430	493	559
4.0	85	131	180	232	287	345	406	470	537	606
4.5	100	150	202	258	317	378	443	510	581	654
5.0	114	168	224	284	346	411	480	551	625	702
5.5	129	186	246	309	375	444	516	591	669	749
6.0	144	205	268	335	405	477	553	631	713	797

Combination	AWS on Approach 1?	AWS on Approach 2?	Left Turn Type Approach 1	Left Turn Type Approach 2	Requirements for an intersection with these parameters:
					Advance Warning System Design - Important considerations to avoid yellow trap
1	Yes	Yes	B	B	Ideally, lead flash time for both approaches should be the same. Consequently, AWS and detection placement should be the same for both approaches. However, if necessary (e.g., because of grade) each AWS can be placed and programmed individually. The result will be a longer red clearance on the approach with the shorter lead flash time.
2	Yes	Yes	A	A	**Lead flash time MUST be the same for both approaches** or yellow trap will result. Consequently, AWS and detection placement should be the same for both approaches.
3	Yes	No	B	B	Ideally, Approach 2 will have a "dummy" lead flash time equal to that of Approach 1, to avoid wasted dwell-red time in one direction at the intersection. Consequently, detection for Approach 2 should be placed the same distance back from the stop-bar as that for Approach 1, even though Approach 2 has no AWS. If detection cannot be placed at this distance, the "dummy" lead flash time for Approach 2 can be reduced or left out, and there will be a longer red clearance time for that approach.
4	Yes	No	A	A	Approach 2 MUST have a "dummy" lead flash time equal to that on Approach 1, to avoid a yellow trap. Detection for Approach 2 MUST be placed the same distance from the stop-bar as that for Approach 1, or detected gaps will be past the stop-bar before signal actually changes.
5	Yes	Yes	B	A	Generally the same as combination 2 above. Lead flash times may be different if absolutely necessary, provided that the lead flash time for Approach 2 is at least as long as that for Approach 1. Otherwise a yellow trap will result.
6	Yes	No	B	A	Generally the same as combination 4 above. Lead flash times may be different if absolutely necessary, provided that the "dummy" lead flash time for Approach 2 is at least as long as the lead flash time for Approach 1. Otherwise a yellow trap will result.
7	Yes	No	A	B	Generally the same as combination 3 above. "Dummy" lead flash time for Approach 2 must not be longer than lead flash time for Approach 1 or yellow trap will result. (A longer "dummy" time would serve no useful purpose, anyway.)

Left Turn Type "A" means that the approach has one of the following left-turn treatments susceptible to yellow trap:
    Permissive-only with Type I head
    Protected/Permissive with Type V head

Left Turn Type "B" means that the approach has one of the following left-turn treatments not susceptible to yellow trap:
    Protected-only (i.e., Type III heads)
    Protected/Permissive with Flashing Yellow Arrow (i.e., Type VI)
    Permissive-only but using Flashing Yellow Arrow (i.e., 3-section without green arrow)
    Approach is one-way, with no opposing traffic lanes
    Left turns are prohibited or physically impossible