

October 8, 2002

CHOOSING INTERSECTION CONTROL

A few years ago a State Department of Transportation asked me to develop a practical procedure for determining the feasibility of roundabout installation. This DOT periodically receives requests for the installation of roundabouts and it was felt that the development of a formal, technically-sound procedure for evaluating these requests would be of value. As the study progressed, it became apparent to me that the most useful evaluation procedure would address all forms of intersection control, not just roundabouts. The evaluation procedure that I ultimately developed is depicted in Figure 1. You may find this procedure useful for your jurisdiction.

In order to determine the "best" form of control for a given intersection, the first question that needs to be answered is: "Does the intersection meet traffic signal warrants?" Since, in most cases, an agency will not install a traffic signal unless it meets the major numerical warrant (warrant 1, condition A or B) or the crash experience warrant (warrant 7), the question can be made more specific: "Does the intersection meet warrant 1 or 7?" The remaining warrants may be applicable in certain instances and their use needs to be decided upon on a case-by-case basis.

IF THE INTERSECTION MEETS SIGNAL WARRANTS:

If one of the signal warrants is met, then the next question to answer is: "Will installation of a signal hurt coordination?" This can sometimes be determined through casual field observation. For example, if the intersection is more than one-half mile from the next signalized intersection or if is in the middle of a residential neighborhood, then the answer to this question is probably "no". However, if it is located along a coordinated arterial or in close proximity to another signal, then an evaluation of time-space diagrams will probably be needed to answer this question definitively.

If the installation of a signal will not hurt coordinated flow, yet the signal is not desired (it will be costly, it will be ugly, the neighbors oppose it, the local agency doesn't want the cost of maintaining it, signal proliferation is frowned upon, etc.), then the next question to answer is "Does the intersection meet the all-way STOP warrant?" If it meets the all-way STOP warrant (and there is a good chance it will since it met signal warrants) then we need to decide if intersection volumes are too high to make all-way STOP control (AWSC) feasible.

I developed the graph shown in Figure 2 by analyzing a typical intersection of two 2-lane roads using various volume combinations. Analyses were done by running the SIDRA computer program using these various volume combinations and either a roundabout configuration, AWSC, 2 phase signal control with no main street left turn lanes, or 2 phase signal control with main street left turn lanes. As the graph shows, the delay associated with AWSC goes up dramatically as the sum of the entering volumes exceeds 1400. Consequently, if the sum of the entering volumes at an intersection are greater than 1400 then a higher-capacity solution (such as a roundabout or signal) will be needed. This gives rise to the next question: "Is the sum of the entering volumes during the peak hour greater than 1400?"

If the answer to this question is "no" then either AWSC or a roundabout will work. However, if the answer is "yes", then we need to decide if intersection volumes are too high to make roundabout installation feasible. This is done by performing a detailed operational analysis using the SIDRA computer program. If SIDRA determines that the 95th percentile queue length on any approach is 15 vehicles or greater, then a roundabout is not considered feasible and a signal is needed, otherwise

a roundabout can be installed. The 15 vehicle value is merely a reasonable value; it is not based on any analytical derivation. If agency personnel consider this value to be either too large or too small from a public acceptance standpoint, it could be varied accordingly.

IF THE INTERSECTION DOES NOT MEET SIGNAL WARRANTS:

If none of the signal warrants are met, then the next question to answer is: "Does a two-way stop control (TWSC) analysis of peak hour volumes produce level of service F?" If the answer to this question is "no", then the following question is asked: "Have there been 5 or greater left turn or angle accidents at the intersection during the past year?" If the answer to this question is also "no" then, unless there is a main street speeding problem that needs to be dealt with, TWSC is the preferred means of control.

If we **don't** have LOS F conditions, if there are not 5 or more accidents of the right type, and if there is a main street speeding problem, then TWSC along with road narrowing techniques should be tried. Road narrowing techniques include the use of chicanes (geometric lane shifts), bulbs (planters and other curbed obstructions), speed humps (not bumps), striping (to narrow the lane widths), or the establishment of on-street parking (where feasible). Increased enforcement is another way to reduce a speeding problem; however, the effectiveness of increased enforcement in terms of longevity is less in comparison to these more permanent techniques. If road narrowing techniques do not control the main street speeding problem or, if for some reason, their use is not desirable, then we are back to deciding between AWSC and a roundabout.

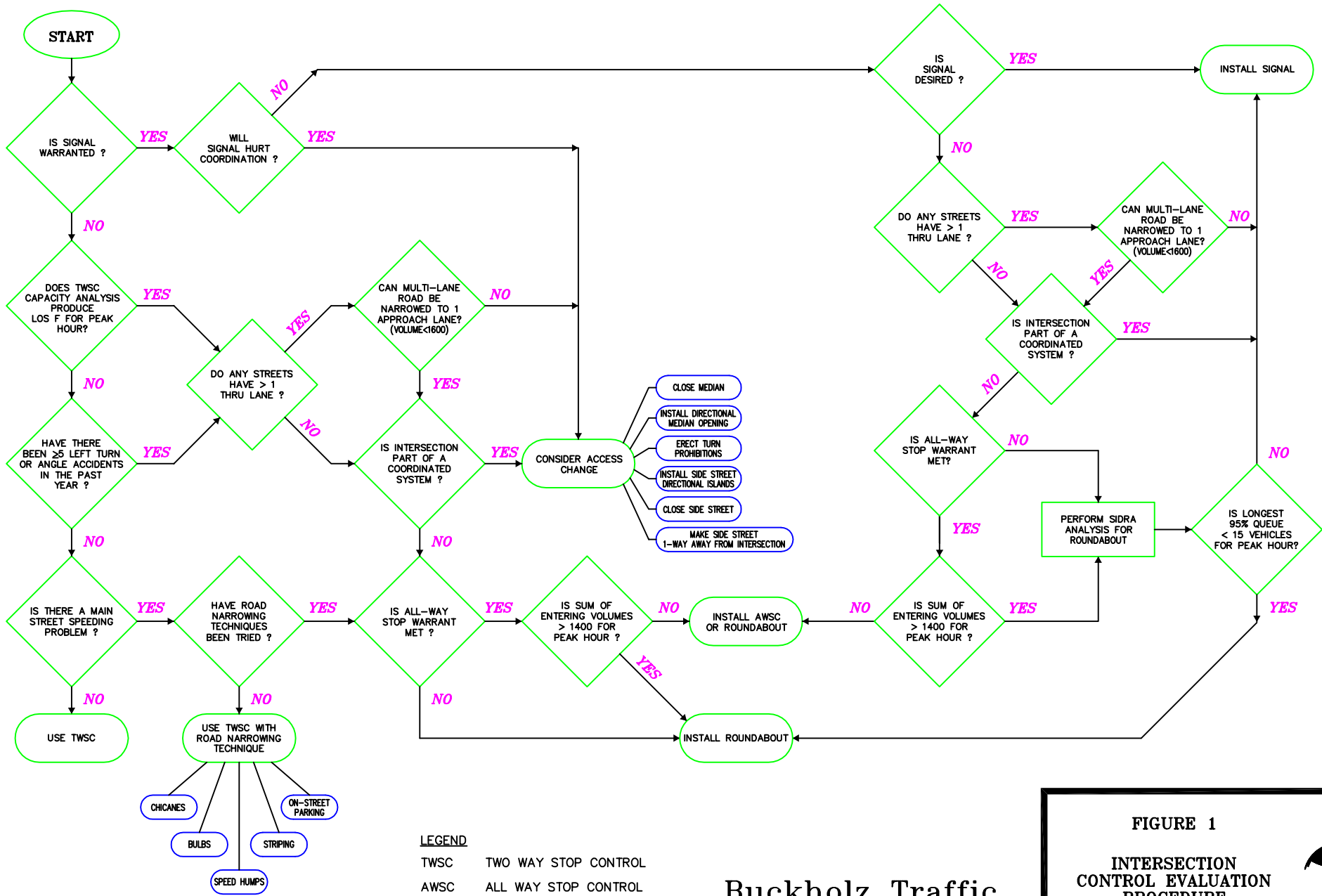
If we **do** have LOS F conditions for TWSC, or if there are 5 or more accidents of the right type, then TWSC is not a good solution. In this case, the first question that needs to be answered is "Do any of the intersecting streets have more than 1 thru lane?" The use of AWSC or a roundabout under multi-lane conditions requires much more driver judgment than when 2 lane roads are involved.

If multi-lane roads are involved then, either all multi-lane approaches must be narrowed down to one lane prior to the intersection (which is feasible if the hourly approach volume is less than about 1600) or AWSC and roundabouts must be ruled-out as infeasible. If AWSC or roundabouts are deemed infeasible, then access changes (such as closing the median, installing a directional median opening, erecting turn prohibitions, closing the side street, or converting the side street to 1-way operation) should be considered.

If there are no multi-lane roads, or if the multi-lane road can be successfully narrowed, then the next question becomes: "Is the intersection part of a coordinated system?" That is, "Is the intersection in the middle of a coordinated series of signals or is it in close proximity to the end of such a system (within about 1000 feet)?" If the intersection is part of a coordinated system then we do not want to interrupt the flow by installing a roundabout or all-way STOP. Access changes would then be the preferred solution. However, if signal coordination is not an issue then the next question to answer is "Does the intersection meet the all-way STOP warrant?" If it does not meet the all-way STOP warrant then a roundabout is the solution. If it does meet the all-way STOP warrant, then we still need to decide if intersection volumes are too high to make AWSC feasible. Once again, we use 1400 vehicles as the cut-off point with a roundabout being required if the sum of the entering volumes exceeds this value and either a roundabout or AWSC being acceptable if the sum of the entering volumes is less than this value.

It should be kept in mind that, when we are talking about roundabouts, we mean "true" roundabouts, not traffic circles or rotaries. Only true roundabouts exhibit the desired operational characteristics that make them an attractive alternative to STOP or signal control at certain intersections.

It should also be kept in mind that the above discussion assumes that the intersection under study is currently unsignalized. If this is not the case, the same procedure can still be applied but some of the questions will need to be phrased a bit differently.



LEGEND
 TWSC TWO WAY STOP CONTROL
 AWSC ALL WAY STOP CONTROL

Buckholz Traffic

FIGURE 1
INTERSECTION CONTROL EVALUATION PROCEDURE

