Critical Intersections

A White Paper for Communities in Motion

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COMPASS uses a travel demand model that focuses on regional corridors and travel patterns rather than on specific issues at individual intersections. Certainly the regional corridors are high priorities for investment, but this emphasis does not mean that intersections are not important. In fact, intersections are key to understanding traffic flow on urban roads. This section is intended to highlight the issues and potential approaches in addressing significant intersection problems.

Some terms to understand when considering intersections:

- Entering volumes. The volume of traffic approaching an intersection from each direction.
- Turning movements. How much of the traffic from each direction turns right, left or goes straight through. Left turn movements are the usually the most difficult from a traffic engineering perspective.
- At-grade intersections. Intersections where all the traffic movements occur on the same physical level.
- Grade-separated intersections. Intersections where at least one of the movements occurs above or below another movement.
- Cycle length. The amount of time to complete a complete cycle of a signal, i.e., from the time a light for a certain movement turn green until it turns green again. As traffic volumes increase, this cycle length generally increases.
- Cycle phases. Each phase of a signal cycle relates to permitting specific movements. A very simple two phase signal on a four-legged intersection allows traffic through on one street and then the other street. More complex signal phasing provides for each type of movement—for example a left turn arrow.
- Accident rate and severity. Accidents are usually measured against the volume of entering volumes and often are categorized by fatality, injury or property-damage only.
- Level of service. Twenty years ago, level of service at intersections was simple. The Highway Capacity Manual provided formulas to compute delay at intersections based on the turn movement volumes, the physical design of the intersection, and the existing and nature of traffic signals. Today, level of service can also be computed for pedestrians and bicycles based on features provided at the intersection such as pedestrian islands, curb radii and crosswalk design.

Figure 1: Top ten busiest intersections in Ada County by 2030.

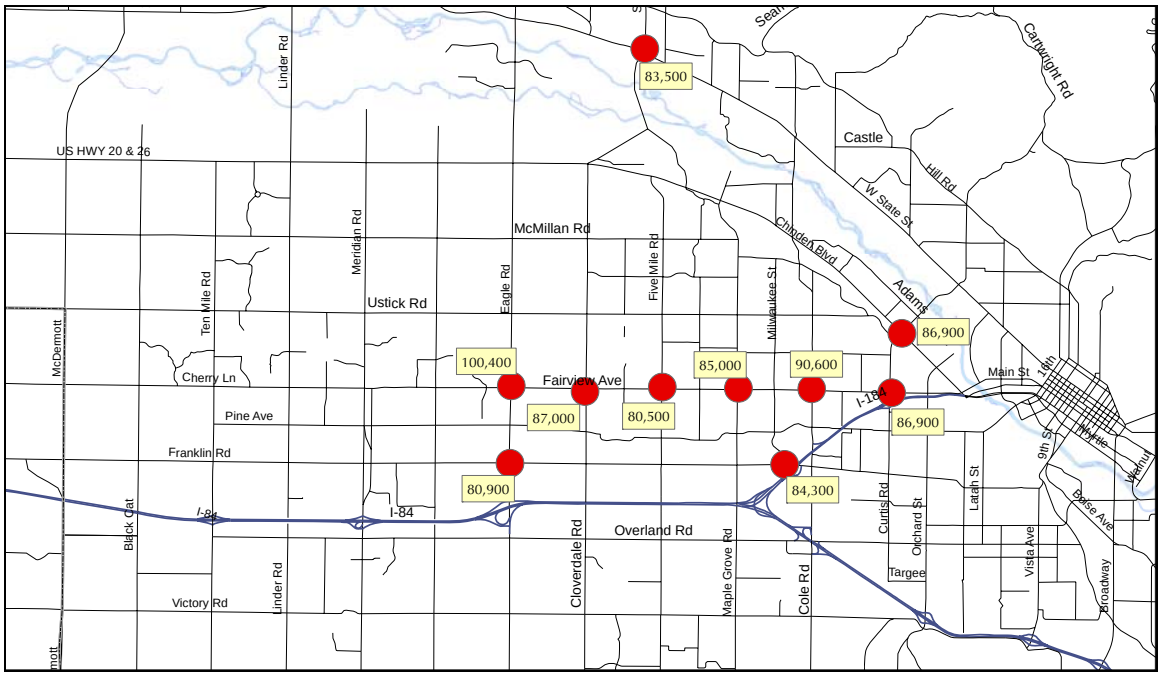
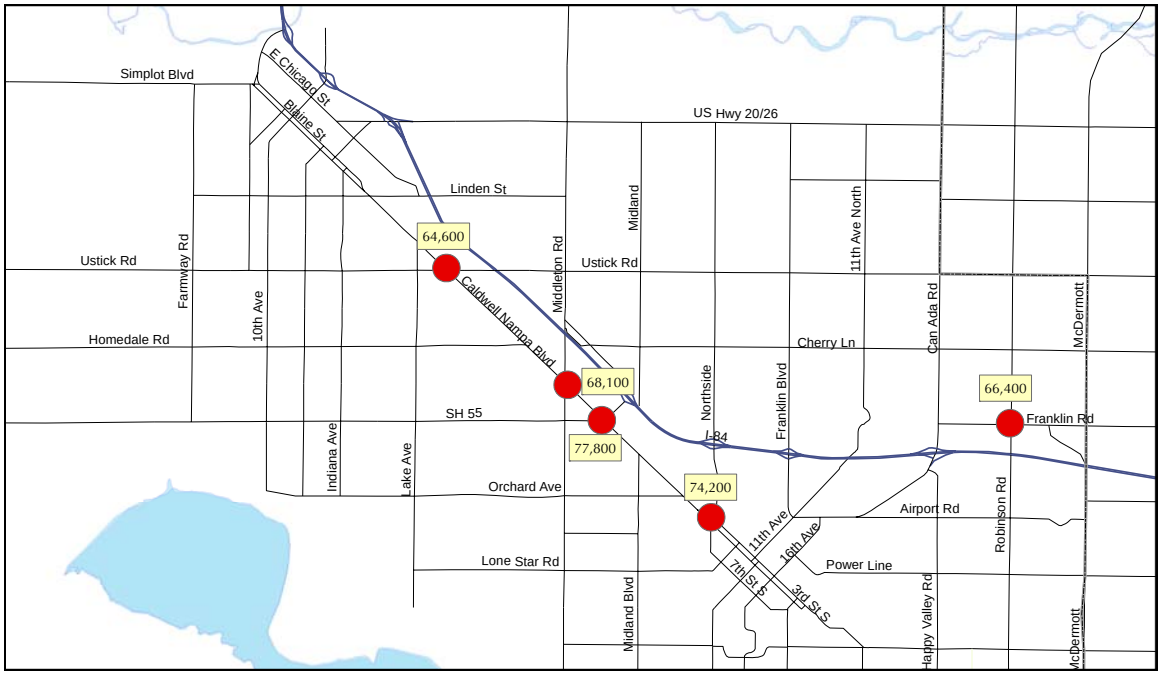


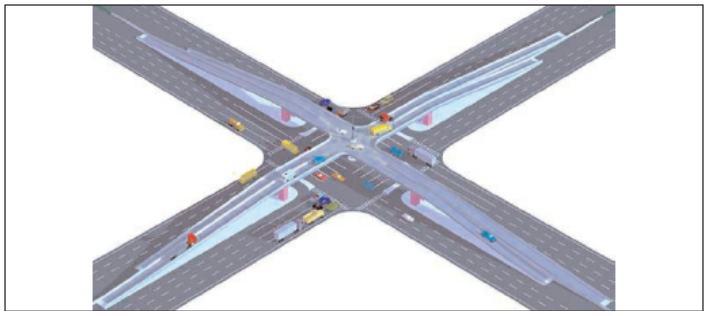
Figure 2: Top five busiest intersections in Canyon County by 2030.



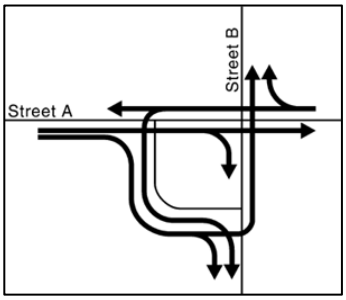
The intersections shown are at-grade intersections. Grade-separated interchanges on I-84 and I-184 may carry high volumes but are less challenging since movements are physically separated. Traffic engineers deal with high levels of intersection volumes in several ways, including:

- Increase the capacity of the intersection by adding more storage for the various traffic movements.
- Separate the movements.
- Reduce or eliminate left-turn movements.
- Improve signal progression to reduce stacking at intersections.

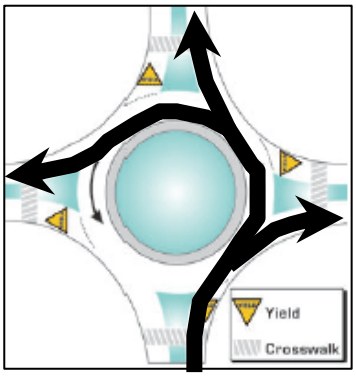
The first approach is the "traditional" one and can be cost-effective to a certain point. Adding separate lanes for right and left turns removes these vehicles from the through lanes, generally the largest percentage of movements. A mixed left-turn/through lane can lose 40% of its capacity and be more prone to rear-end accidents.



The second approach—separating the traffic movements, has often been done by separating the levels of traffic movements vertically. This is expensive in terms of the needed structures and visually intrusive. An example of this is shown with ramps and an above grade intersection for left turns.



More recently, a number of design options have separated traffic movements horizontally. Generally these require drivers to make left turns before or after the main intersection. One example of a "quadrant" intersection is shown here. Vehicles on Street A would need to use a kind of loop in one quadrant to replace a left hand turn.



Reducing or eliminating left turns could be done via simple prohibition, but this is not practical in many situations. A rapidly expanding technique is roundabouts. These require an entering vehicle to go right around a center island and then exit the roundabout via another right turn. Studies have shown the number and severity of accidents to decrease when a roundabout is properly designed.

The bottom line is that the critical intersections shown in the above map will need special design treatments if they are not to become very large parking lots by 2030. Whether grade separation, exotic left-turn treatments, or roundabouts are appropriate are questions that need to be considered--and soon. Or else growth will reduce the options and likelihood of a good solution.