Figure 11

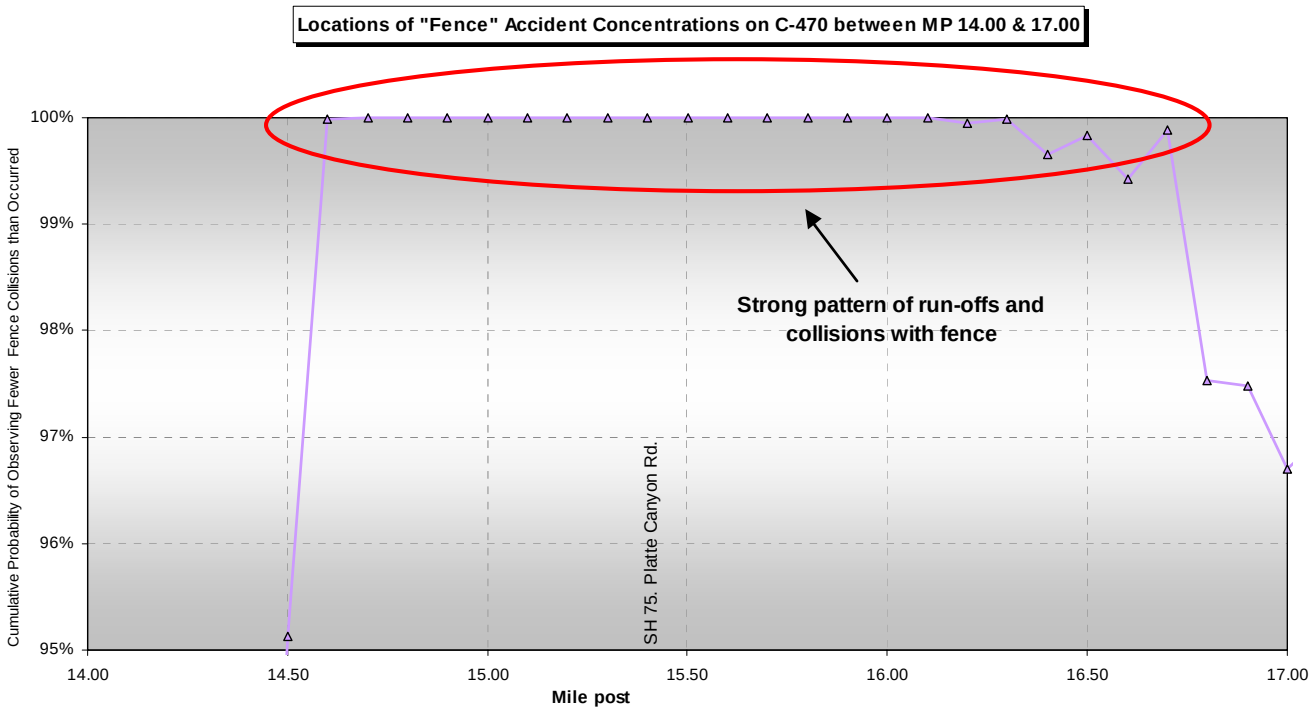


Figure 11 shows locations with high frequencies of collisions with roadside fencing. This well-defined pattern of collisions with off-highway features reflects run-off-road accidents in the vicinity of a curve near MP 15.0. Two of the three fatal accidents in this area involved eastbound vehicles crossing the median. The curve is somewhat isolated by nearly mile-long tangents, a condition sometimes associated with the potential for loss of control at a curve. Consideration may be given to installation of a median barrier such as the cable rail safety fencing, recently installed east of this location, together with outside and median shoulder rumble strips at this curve if not already implemented. The reverse curve between MPs 16 and 17 also records occasional run-off incidents. This curve appears to have a shorter radius than other nearby curves on C-470. Some drivers were not able to negotiate the turns and subsequently lost control resulting in a run off. Crashes at each curve location occurred with good road conditions and lighting. Together with the existing median guardrail, outer and median shoulder rumble strips may further help reduce the occurrence of run-off-road accidents. Geometric and cross sectional changes such as curve flattening or sideslope flattening can also moderate accident frequency and severity here and may be considered during major reconstruction.

Locations with statistically high incidence of rear-end crashes along the C-470 corridor are revealed in the pattern graph of Figure 12. Clearly, crashes of this type can be seen as the major problem on C-470 with extended areas exhibiting rear-end accident patterns. In particular, a strong, continuous pattern of collisions occurs between MP 16.5 and MP 21.5 with lesser concentrations developing near MPs 14.4 and 24.0. Further examination of the wide pattern shows a time of day and directional bias in accident occurrence at various locations. Figure 8 shows the general time variation along the entire study corridor with conspicuous clusters during the morning and afternoon commuting periods. Figures 13 & 14 further break this down directionally, indicating pronounced rear-end accident occurrence during typical morning rush hours (approximately between 5:30 am and 8:30 am) in the eastbound lanes. Similar accident concentration is displayed during the afternoon volume peak (3 pm - 6 pm) in the westbound lanes of this pattern area.

Figure 12

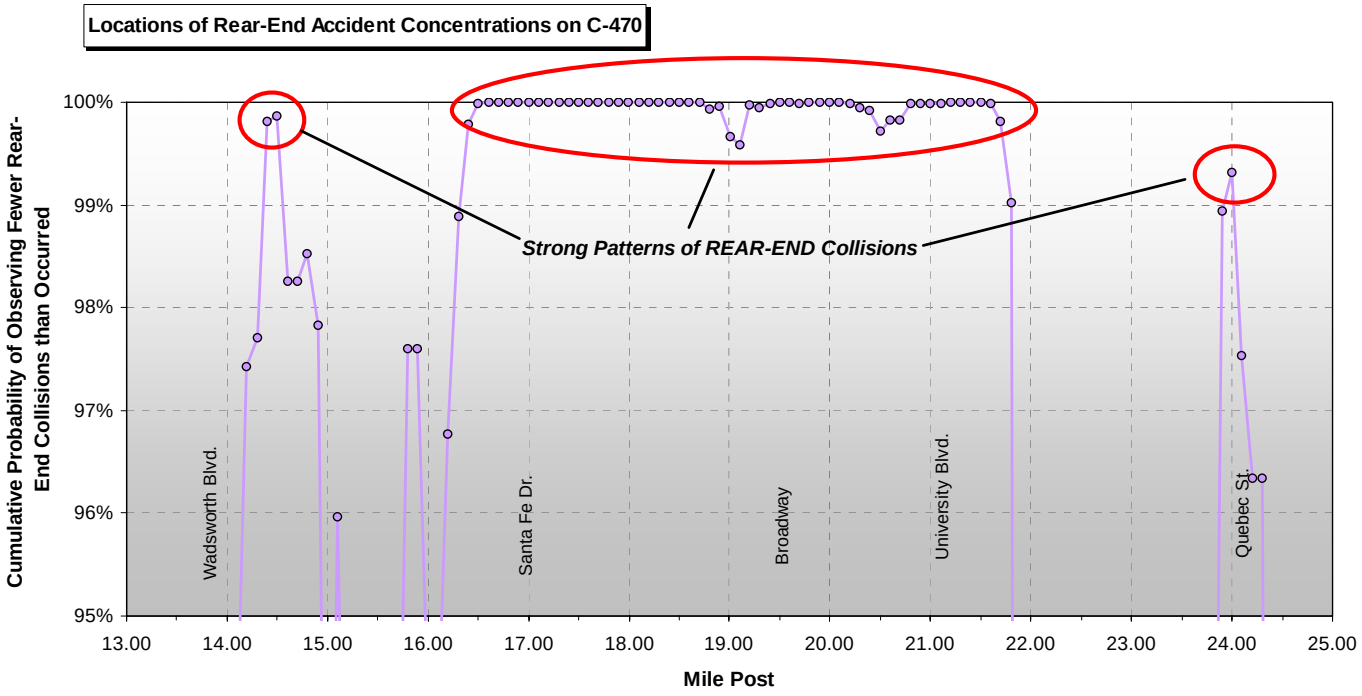


Figure 13

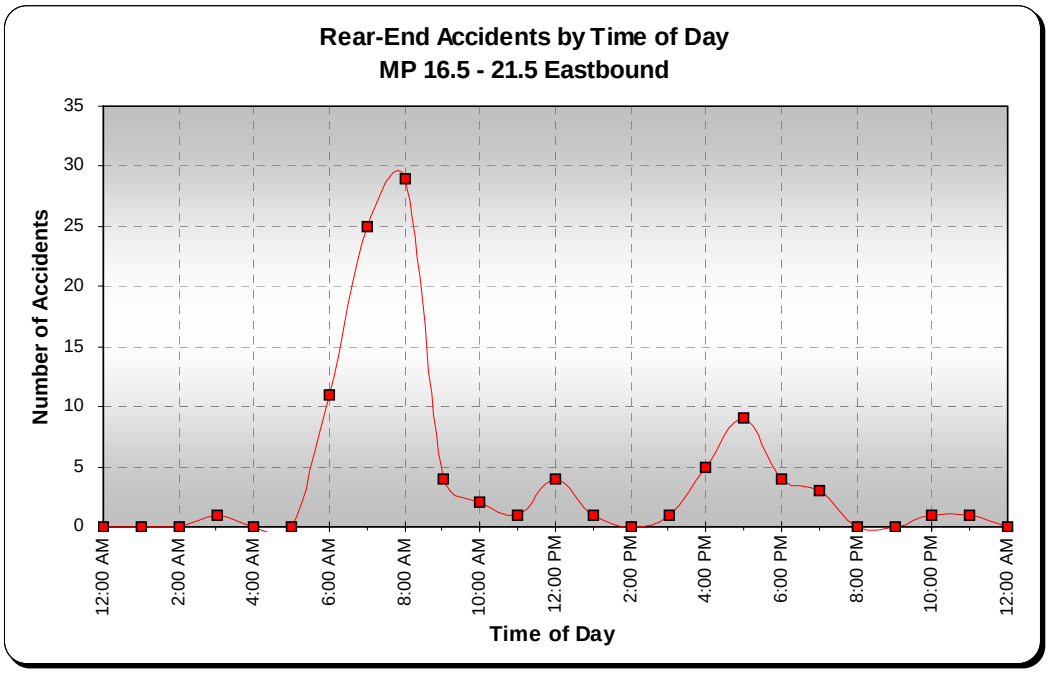
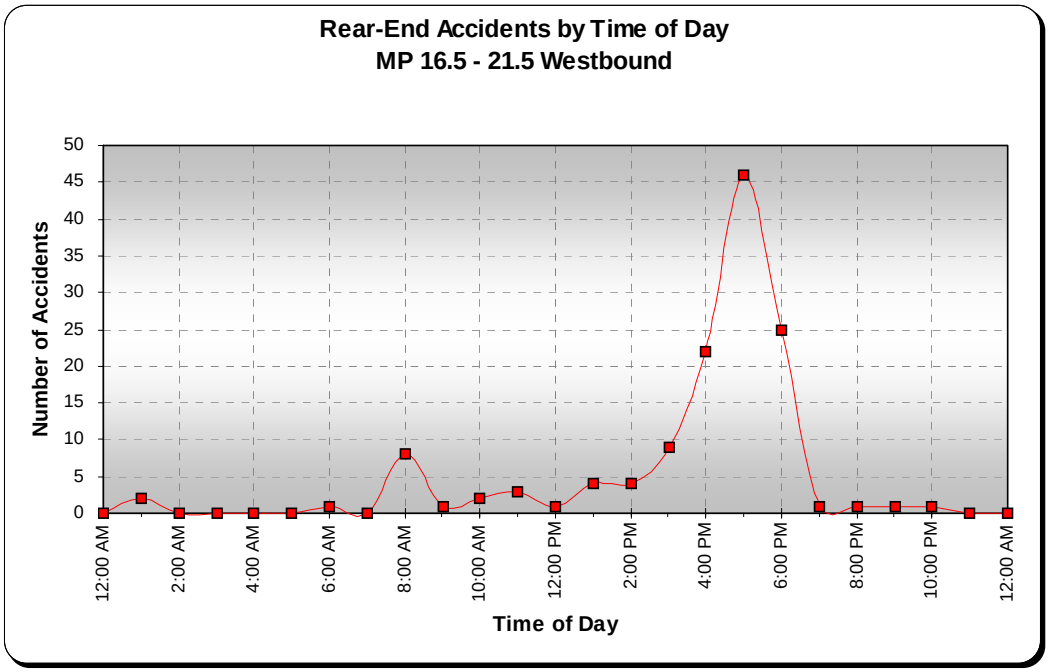


Figure 14



Examining the rear end accidents in the pattern area by direction, minor clusters predictably develop in the area of interchange ramp merge-diverge zones. In the *eastbound* direction, minor rear-end accident concentration is noted at the following locations among others:

Wadsworth on-ramp to eastbound C-470, am peak
Santa Fe on-ramp to eastbound C-470, am peak
Lucent Blvd. on-ramp to eastbound C-470, am peak
Broadway on-ramp to eastbound C-470, various times
University Blvd. on-ramp to eastbound C-470, am peak

Rear-end accident concentration in the *westbound* lanes are noted at the following:

A broad area in the vicinity of Santa Fe interchange (MP 16.6-17.5), pm peak
University Blvd. interchange area (MP 20.9-21.3), mid-day to pm peak
MP 22.95-23.1, downgrade near bridge, pm peak
Quebec interchange off ramp & on ramp merge areas to westbound C-470, pm peak

An increase in rear-end accident frequency is typical during high ADT periods. Added traffic capacity will be the most effective improvement in reducing these congestion-related accidents. Additionally, providing on-ramp acceleration lanes as long as practical at interchanges may help minimize speed reduction and disruption to through traffic lanes. In some instances, the parallel type acceleration lane may create less disturbance in the mainline traffic flow as well. At several of the above locations (westbound in the Santa Fe interchange area, westbound from 22.95-23.1 and near the University Blvd. Interchange) downhill grades make slowing or stopping for unexpected traffic congestion even more difficult. Again, providing extended ramp lanes in these areas to segregate slowing traffic may marginally help reduce the incidence of rear-end collisions.

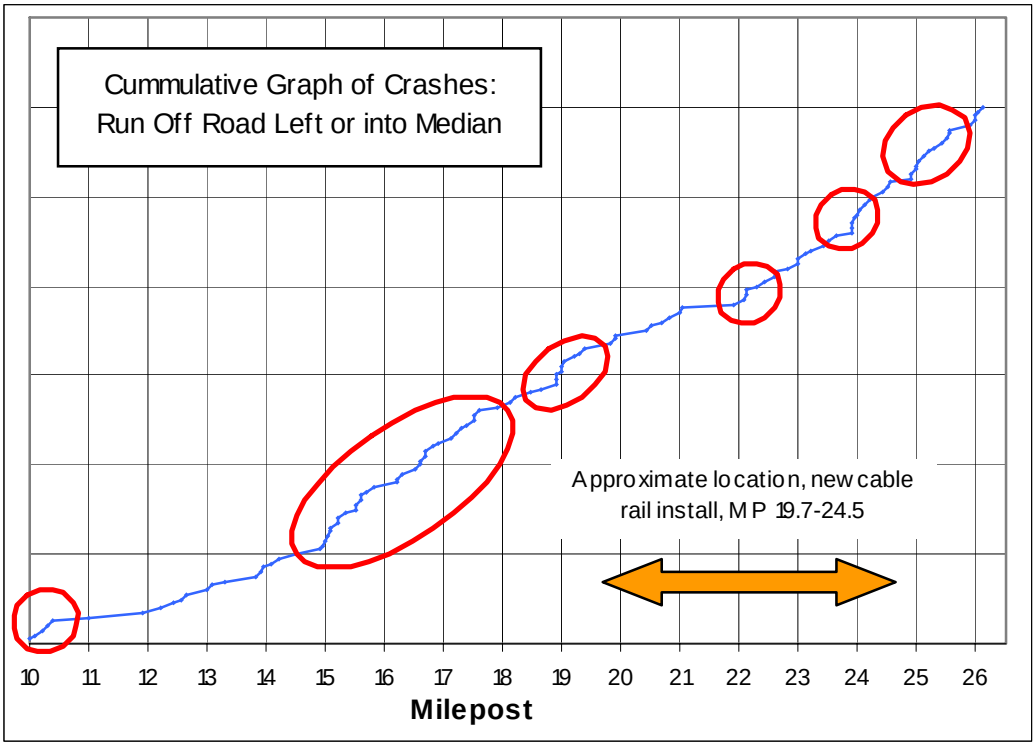
Additional minor collision patterns and clusters are noted within the study corridor. Only 3 or 4 accidents over several years, however, constitute some of these clusters. In other cases, the accidents making up the type pattern vary sufficiently in circumstance and exact location such that common, cost effective countermeasures are not available.

Corridor-Wide Collision Observations

Collisions with delineator posts are statistically over-represented among the overall accident count. This accident type is a consequence of control loss and, ultimately, running-off-the-road. The highway segments from MP 18.5 to 19.5 and MPs 23 to 24.5 exhibit a slightly higher incidence of this crash type. We note that some of these loss-of-control incidents result from the sudden maneuvering required when drivers traveling at highway speeds encounter unexpected slow-moving or stationary, congested traffic. Again, by reducing general congestion, capacity improvement in the form of widening is expected to reduce the frequency of this type of crash. In other collisions with delineator posts we note the accident was initiated by irregular lane changes. The use of durable pavement marking materials or inlaid striping methods may marginally reduce this accident type.

Over the corridor as a whole, it appears that C-470 records a lower percentage of vehicle collisions with median barrier compared to other similar highways while the percentage of median crossovers and crashes in the opposing lanes is slightly high. Additionally, the percentage of head-on and opposing direction sideswipe collisions is at or slightly above statewide averages for this highway type. These conditions suggest that installation of additional median barrier may be an effective safety improvement. Figures 15 & 16 (a & b) graphically depicts the locations where vehicles have run off the road to the left side and/or into the median.

Figure 15



In Figure 15, the circled areas identify isolated locations with slightly increased frequencies of median incursion or crossovers. The Region has recently installed median cable rail from MP 19.7 - 24.5. This type of median barrier is expected to improve safety significantly along this segment.

In conjunction with major widening or other large-scale improvements undertaken in the future, planners may consider additional median barrier installation following review of the accident reduction performance of this latest cable rail project.

Figure 16a specifically indicates locations of those crashes involving run-off the left roadside

Figure 16a