

Road Safety Assessment for the Intersection of Olentangy River Road and Linworth Road in Franklin County, Ohio

Final Report
November 2009



U.S. Department
of Transportation
Federal Highway
Administration

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INTRODUCTION

The intersection of Olentangy River Road and Linworth Road, which features an approximate 30° “Y” configuration of two higher volume two-lane suburban roads, has been a safety concern for the Franklin County Engineer’s Office for several years, having consistently appeared among the highest ranked non-signalized intersections for crash rate. In recognition of this crash experience, the county engineer’s office had contracted with a consulting engineer to undertake a safety study and prepare a report describing options for possible improvement. That work was completed in 2007, and the construction of a single-lane roundabout was recommended as the preferred option for addressing the crash experience at this location. Presentation of this proposal in a series of public meetings was met with a mixed response from participating citizens and other interested agencies.

For additional analysis and to address public concerns, the Franklin County Engineer requested an independent safety assessment by a team of disinterested professional engineers. That safety assessment was conducted on August 25th and 26th, 2009 by representatives from the Federal Highway Administration (FHWA) and a FHWA-supported peer-to-peer team for road safety audits.

ASSESSMENT TEAM

The team selected to conduct this review consisted of the following personnel:

- Fred Ranck, PE—Safety Engineer/Manual on Uniform Traffic Control Devices (MUTCD) Team, FHWA Midwest Resource Center
- Joe Glinski—Safety Programs Engineer, FHWA Ohio Division
- Tom McDonald, PE—Safety Circuit Rider, Iowa Local Technical Assistance Program

INITIAL FIELD REVIEWS

On Tuesday, August 25th, the assessment team visited the subject intersection for a nighttime review. The review took place between 8:30 p.m. and 9:30 p.m. Weather conditions were clear and the temperature was 75° F. Light conditions were quite dark.

The intersection was difficult to identify at night with the existing signing and pavement markings. Only the street name signs indicated the existence of an intersection. Nevertheless, pavement markings on both roadways exhibited good visibility, although the raised pavement markings were no longer effective. Even with no illumination, the intersection crash data only listed four crashes occurring in dark conditions. A 48 in. X 48 in. YIELD AHEAD advance warning sign on Linworth Road had excellent conspicuity but was partially obstructed by vegetation. No advance warning signs for the intersection were in place from either direction on Olentangy River Road. An advance horizontal curve warning sign in the southbound direction appeared quite close to the actual curve. No directional guide signing was in place for left-

turning traffic on either roadway, nor was there any indication on southbound Olentangy River Road of the connection permitting right turns onto northbound Linworth Road. The existing left-turn lane on northbound Olentangy River Road does not feature an arrow or ONLY pavement markings in the turn lane. A dashed edge line through the intersection for southbound Olentangy River Road might be beneficial for positive guidance.

On Wednesday, August 26th, a morning peak-hour site review was conducted by the assessment team between 7:00 a.m. and 8:00 a.m. Weather conditions were clear, dry, and approximately 70 ° F. Light conditions were those of dawn. The distance from the Bethel intersection to the south was measured as approximately 0.30 miles. Observed driver behavior approaching the YIELD sign on southbound Linworth Road was found to be highly variable, ranging from a full stop to a pass-through without speed reduction. Most drivers performed satisfactorily, however. It was observed that when drivers stopped for more than a few seconds, an extensive queue of traffic occurred immediately, occasionally extending almost to the Sharon Hill Drive intersection. Few posted speed limit signs were observed during this observation, and this issue was reviewed in more depth later. A large maple and a medium-sized willow tree obstruct the visibility of southbound Olentangy River Road vehicles for southbound Linworth Road drivers approaching the YIELD sign, and this might impact driver behavior at this location. Measured sight distance from the YIELD sign was found to be about 378 ft, which exceeds the 360 ft minimum recommendation of the American Association of State Highway Transportation Officials' (AASHTO) Policy on Geometric Design. The sight distance meets the minimum requirements for 45 mph if the trees were removed. Right-turning drivers onto northbound Linworth Road from southbound Olentangy River Road also have their sight distance obstructed by branches of pine and Siberian elm trees from the YIELD sign position. An existing stop bar for southbound Linworth Road traffic was very worn, and replacement with YIELD symbol markings would be beneficial. Several instances of drivers edging into the Olentangy River Road through lane were observed. A diagrammatic intersection sign along southbound Linworth Road for left-turning vehicles in advance of the intersection might be beneficial as well. Linworth Road was observed to be a Central Ohio Transit Authority (COTA) and school bus route. One pedestrian was observed during this review period.

OFFICE MEETING

A meeting was conducted in the Franklin County Engineer's Office on the morning of August 26th to discuss the safety assessment and local agency perspectives and concerns for this intersection. Participating in the meeting were the following personnel:

- Michael Meeks, Franklin County Traffic Engineer
- Cornell Robertson, Franklin County Design Engineer
- Mark Sherman, Franklin County
- Ted Beidler, Franklin County Programming
- Lt. Edward B. DeVennish, City of Columbus Police Department
- Fred Ranck, FHWA
- Joe Glinski, FHWA
- Tom McDonald, Iowa State University

Following introductions, Mike Meeks opened the meeting by describing the history of the proposed improvement of this intersection and the series of public meetings that had been conducted. Olentangy River Road is a former Ohio Department of Transportation (ODOT) roadway and is classified as a minor arterial. Linworth Road is classified as a collector. Posted speed limits are 45 mph in the Franklin County sections of Olentangy River Road and 35 mph on Linworth Road. The speed limits were established using procedures recommended by ODOT. Recent speed studies have verified the validity of the posted limits.

A safety study had been performed by a consultant in 2007 for this intersection, and several options for improvement were considered. The preferred option was the construction of a single-lane roundabout at an estimated cost of \$1.4 million. Safety improvement funding was requested from ODOT, and the project was programmed with an 80/20 state/local cost sharing. A total of two public meetings and four neighborhood meetings had been conducted to acquaint the public with the proposed improvement. However, reaction from the public has been mixed regarding the roundabout proposal.

Franklin County maintains a total of approximately 5,000 unsignalized intersections and about 100 that are controlled with traffic signals. The subject intersection has consistently ranked in the top 10 for crash rate among the unsignalized group. A crash rate of 2.08 crashes per million entering vehicles has been calculated recently for this intersection. An annual total of five to seven crashes have occurred in the intersection over the past several years. The number and rate of crashes is a concern to Franklin County, but Lt. DeVennish indicated that the number would not be considered especially high in the City of Columbus, with much higher traffic volumes in many intersections. Currently, Franklin County has constructed and maintains one roundabout, a multilane facility at the intersection of Morse Road and U.S. 62.

Traffic volume counts had been made by Franklin County for 12 to 13 hour periods, and these data were made available to the assessment team. From these data, it appeared that annual average daily traffic (AADT) is approximately 5,900 vehicles per day (VPD) on Linworth Road and 5,050 VPD on Olentangy River Road north of the intersection. With combined traffic south of the intersection, AADT is about 10,920 VPD. Traffic growth has averaged about 3% to 4% annually in some locations of Franklin County, with selected areas showing up to 18% growth. Assuming an approximate 2% growth in traffic for this intersection, some traffic signal warrants would be met in about five years.

The existing YIELD sign for southbound Linworth Road was installed by ODOT in the 1980s, replacing an existing STOP sign at that location to accommodate high truck volumes generated by a lumber yard to the north. The YIELD sign has remained in place subsequent to the transfer in jurisdiction of Olentangy River Road to Franklin County.

The assessment team described the proposed procedure for the safety review of this intersection and stated that a draft report with recommendations would be developed and transmitted to Mike Meeks within four to six weeks. The report will include suggestions for low-cost interim upgrades that could be implemented pending more permanent improvements.

ADDITIONAL FIELD REVIEWS

Following the office meeting, a field review was made by the assessment team from 12:00 p.m. to 1:00 p.m. Two streets that connect Linworth Road and Olentangy River Road northerly from the subject intersection were examined during this review. The first of these was MeekLynn Drive, an approximately 20 ft wide asphalt-paved residential street. The second was Greenridge Road, which features an approximately 25 ft wide asphalt-paved street with portland cement concrete curb and gutter units through residential areas. Greenridge Road intersects Rocky Rill Road just easterly from Linworth Road at a “T” configuration intersection. Rocky Rill Road is also an asphalt-paved concrete curb and gutter residential street. Neither of these streets would be capable of supporting a high volume of diversion traffic should significant congestion be encountered at the subject intersection.

Use of cell phones by drivers was a common observation during this review, with many holding the phone in the left hand, which hampered the drivers’ ability to look to the left when approaching the YIELD sign on southbound Linworth Road.

Several intersection sight distance measurements were taken for vehicles approaching the intersection:

- For northbound Olentangy River Road, 690 ft to the STOP sign for left turns from Linworth Road
- For southbound Olentangy River Road, 505 ft to the STOP sign for left turns from Linworth Road
- For southbound Linworth Road, 550 ft to a horizontal obstruction and 780 ft to a vertical obstruction from the YIELD sign for left turns from Olentangy River Road.

The AASHTO Policy on Geometric Design recommends minimum intersection sight distances of 360 ft for 45 mph and 250 ft for 35 mph.

No pedestrians were observed during this review.

A final review of the intersection was undertaken by the assessment team from 5:00 p.m. to 6:00 p.m., the approximate afternoon peak-hour period. Fairly heavy northbound traffic was observed south of the subject intersection during this time.

A complete review of posted speed limits was made with the following results:

On Olentangy River Road northbound:

- The initial posted speed limit was 45 mph just north of the Linworth Road intersection.
- 35 mph is posted at the Worthington corporate limits.
- 45 mph is posted just south of the MeekLynn Drive intersection.

- 35 mph is posted just south of U.S. 161 intersection.

On Olentangy River Road southbound:

- 35 mph is posted just south of the U.S. 161 intersection.
- 35 mph is posted at the Worthington corporate limits.
- 35 mph is posted in Worthington.
- 45 mph is posted at the City of Columbus corporate limits, just north of Bethel.

On Linworth Road northbound:

- 35 mph is posted at Sharon Hill Drive.
- 35 mph is posted at Worthington corporate limits.
- 35 mph is posted at Rocky Rill Road.
- 35 mph is posted in the 5700 block.
- 35 mph is posted at the U.S. 161 intersection.

On Linworth Road southbound:

- 35 mph is posted at the U.S. 161 intersection.
- 35 mph is posted across from Beechview.
- 35 mph is posted in the 5700 block.
- 35 mph is posted south of Rocky Rill Road.
- 35 mph is posted south of Kempton Run creek.
- 35 mph is posted at the Franklin County maintenance line.

The peak hour afternoon review did not indicate any major traffic operational problems.

DISCUSSION

Images from all field reviews are included in Appendix A.

The configuration of this intersection, the traffic volumes, the surrounding environment, and crash history combine to present an interesting challenge for a traffic engineer. Several analysis methods are available to assess the need for improvement and to quantify the type of improvements to be recommended. The Franklin County Engineer's Office has compared the historical crash rate at this location to other unsignalized intersections in that jurisdiction and determined a consistently high comparison. Using the ODOT Rate of Return Analysis, Franklin County found that each of six options considered resulted in a positive rate of return on investment. Option F, construction of a roundabout, was selected as the most feasible alternative to the current situation.

Other analysis methods are also available for considering and choosing alternatives. One such approach is contained in the draft edition of the soon-to-be-released Highway Safety Manual (HSM), of which Fred Ranck is a contributing author. Based on regression analyses of crash frequency, crash prediction formulae have been developed to assess crash history at a given location, compared to similar situations. In addition, alternative improvement options can also be analyzed in this manner.

Using this method, the following results were obtained using current traffic volumes:

- Three-leg approach to an intersection with stop control at the “T” leg: 3.3 crashes per year
- Three-leg approach to a signal (not warranted by current volumes): 1.7 crashes per year
- Three-leg approach to a roundabout: 1.36 crashes per year

Note that the HSM currently does not present a formula for analyzing a three-leg approach to a yield-controlled intersection.

With a record of 5 to 7 crashes annually, the subject intersection has consistently performed worse than any of the options presented above, and thus crashes should be reduced by any option selected. The remaining issue becomes how much funding is justified to accomplish a crash reduction.

CRASH DATA

Crash data were provided to the assessment team by Franklin County. The data indicated a consistent crash pattern at the intersection, with predominately rear-end collisions on southbound Linworth Road approaching the YIELD sign at the Olentangy River Road intersection.

In the period of 2003 through 2005, 30 crashes were reported at the intersection, 24 of which (80%) were rear-end collisions near the YIELD sign on southbound Linworth Road. For the period of 2006 through 2008, 19 crashes were recorded, 16 (67%) of which were rear-end at the YIELD sign. Most crashes were property damage only (PDO), but 14 injuries were recorded in the 2003–2005 period, and 5 were noted in 2006–2008. No fatalities were recorded at the intersection in either of these periods. Almost all crashes occurred in daylight conditions, and a fairly consistent pattern was noted for day of week, although no crashes were recorded on Sunday. Dry pavement conditions were noted for most crashes, although some occurred with a wet pavement surface. In terms of time of day for crashes, a peak occurred during morning rush hour, and again a slight peak occurred over the lunch hour. This would be consistent with observations of traffic patterns and driver performance made by the assessment team.

Copies of selected crash summaries are included in Appendix B.

SUGGESTED OPTIONS

Based on site observations, analysis of the available crash data, and discussion with Franklin County staff, the assessment team offers these suggestions. The first set of options was discussed in the 2007 safety study and presented at public meetings, and the second set of options was proposed by the team.

Safety Study Options

- **Upgrade existing signing and pavement markings and trim vegetation to improve visibility.** The assessment team concluded this is a viable option for consideration, and more extensive low-cost improvements will be discussed below.
- **Replace YIELD sign on southbound Linworth Road with a STOP sign.** The team would not recommend this option because driver performance most likely would not improve perceptibly and a STOP sign would result in queue build-up during morning rush hour on southbound Linworth Road, as observed by the team.
- **Construct a merging lane for southbound Linworth Road traffic.** This option would relocate the conflict point further from the intersection and likely result in sideswipe crashes replacing many rear-end crashes. The investment cost of this option would probably not be justified by the results.
- **Reconstruct the intersection to provide a 90° connection to Olentangy River Road and install a STOP sign for southbound Linworth Road.** This could be a viable option, although the investment cost would be high and a resulting queue build-up at the STOP sign would occur. Another disadvantage to this option is the fact that, once the high cost of this investment is made, installation of signalization would be the only option left for Franklin County if unsatisfactory performance of STOP sign control results.
- **Reconstruct the intersection to provide a 90° connection to Olentangy River Road and install traffic signals.** Again, the cost of this improvement would be quite significant with little expected improvement in crash performance. In addition, traffic delay and potential rear-end crashes could likely result on Olentangy River Road and Linworth Road. Delays at the intersection on these two roads could result in diversionary traffic using the residential streets described earlier to travel between Linworth Road and Olentangy River Road.
- **Construct a roundabout.** If Franklin County elects to make a significant improvement at this location to address crash history and improve traffic flow during rush hour periods, construction of a single-lane roundabout would be the option recommended by the assessment team. Roundabouts have consistently resulted in crash reduction when compared to signalization.

Safety Assessment Team Options

The assessment team suggests the following interim options for consideration by the Franklin County Engineer's Office:

Low-cost safety improvements consisting of the following:

- Increase the size of the existing YIELD sign for southbound Linworth Road.
- Review the location of existing advance warning signs for compliance with Table 2C-4 of the 2009 MUTCD.
- Install advance intersection warning signs as needed on all approaches to the intersection.
- Specify fluorescent yellow high-reflectivity sheeting for all warning signs.
- Upgrade all pavement markings and install arrows and/or ONLY symbols in the left-turn lane for northbound Olentangy River Road.
- Install a dotted pavement edge line through the intersection for southbound Olentangy River Road.
- Check the location of posted speed limit signs and reposition as needed to better meet driver needs and expectations. Consider additional speed limit signing along southbound Olentangy River Road approaching the intersection.
- Install stop bars and YIELD symbol pavement markings at all appropriate existing traffic control device locations in the intersection. Mill markings into the pavement surface to extend longevity.
- Remove the existing large maple tree on the north side of the intersection that hampers driver sight distance from the YIELD sign on southbound Linworth Road.
- Negotiate with the property owner for trimming or removal of other trees that hamper visibility on the property just northerly from the intersection, including a weeping willow, a Siberian elm, and pine trees.
- Consider the installation of a single roadway lamp in the grassy median of the intersection to enhance nighttime visibility.

These options are intended to improve driver recognition and performance at the intersection, potentially reducing crashes for a minimal investment of funds.

In addition to the low-cost improvements listed above, other improvements can include replacing the existing YIELD sign on southbound Linworth Road with a STOP sign and installing a STOP sign for southbound Olentangy River Road. Additionally, use larger, 36 in. STOP signs, possibly on each side of the approaches, and enhance the approaches with fluorescent yellow warning plaques that advise “Oncoming Traffic Does Not Stop.” Appropriate advance stop warning signs can also be added on both southbound approaches. This option would eliminate the driver confusion and indecision at the existing YIELD sign, but the option would also result in additional delay for southbound Olentangy River Road traffic. However, the concern of local residents for excess vehicle speed would be addressed.

Another option would be to pave over the existing island in the intersection and construct a low-cost “T” connection from Olentangy River Road to Linworth Road. The connection would need to be enhanced with significant positive guidance using temporary curbing, tubular markers, and pavement markings. Lighting the intersection with a single roadway lamp would also be suggested.

The “T” connection alternative would be similar to an option described in the safety study but would be constructed within existing right-of-way at a much lower cost. Installing the stop condition on Olentangy River Road also varies from the safety study option but would seem to favor the major traffic movement, at least during the critical morning rush hour. In addition, this improvement could be easily replaced when more extensive improvements are warranted.

If a major long-term solution for this intersection is desired by Franklin County, the assessment team would recommend a single-lane roundabout at this location. Using Franklin County traffic projections, signalization might meet at least one warrant in about 5–7 years. In lieu of reconstruction of the intersection with the probable addition of turning lanes and installation of traffic signals, a roundabout would better fit desired community aesthetics, serve as an entrance into the residential area, and not result in traffic queue build-ups during morning and afternoon peak travel periods.

It is suggested as a minimum that the low-cost improvements described in the options above be undertaken immediately so that the impacts can be assessed before proceeding with more costly long-term solutions.

APPENDIX A. IMAGES FROM SITE VISITS



Figure A.1. Potential traffic conflicts during morning peak traffic period



Figure A.2. Transit vehicle in intersection



Figure A.3. Speed limit sign on northbound Linworth Road



Figure A.4. Advance YIELD sign on southbound Linworth Road, hampered by vegetation



Figure A.5. Pavement markings on southbound Linworth Road



Figure A.6. Use of left-turn storage lane from northbound Olentangy River Road



Figure A.7. View of intersection from southerly approach on Olentangy River Road with left-turn storage lane



Figure A.8. Queue build-up on southbound Linworth Road during morning peak period traffic



Figure A.9. View of southbound Olentangy River Road from southbound Linworth Road, hampered by trees



Figure A.10. View of intersection from SB Linworth Road

APPENDIX B. CRASH MAPS

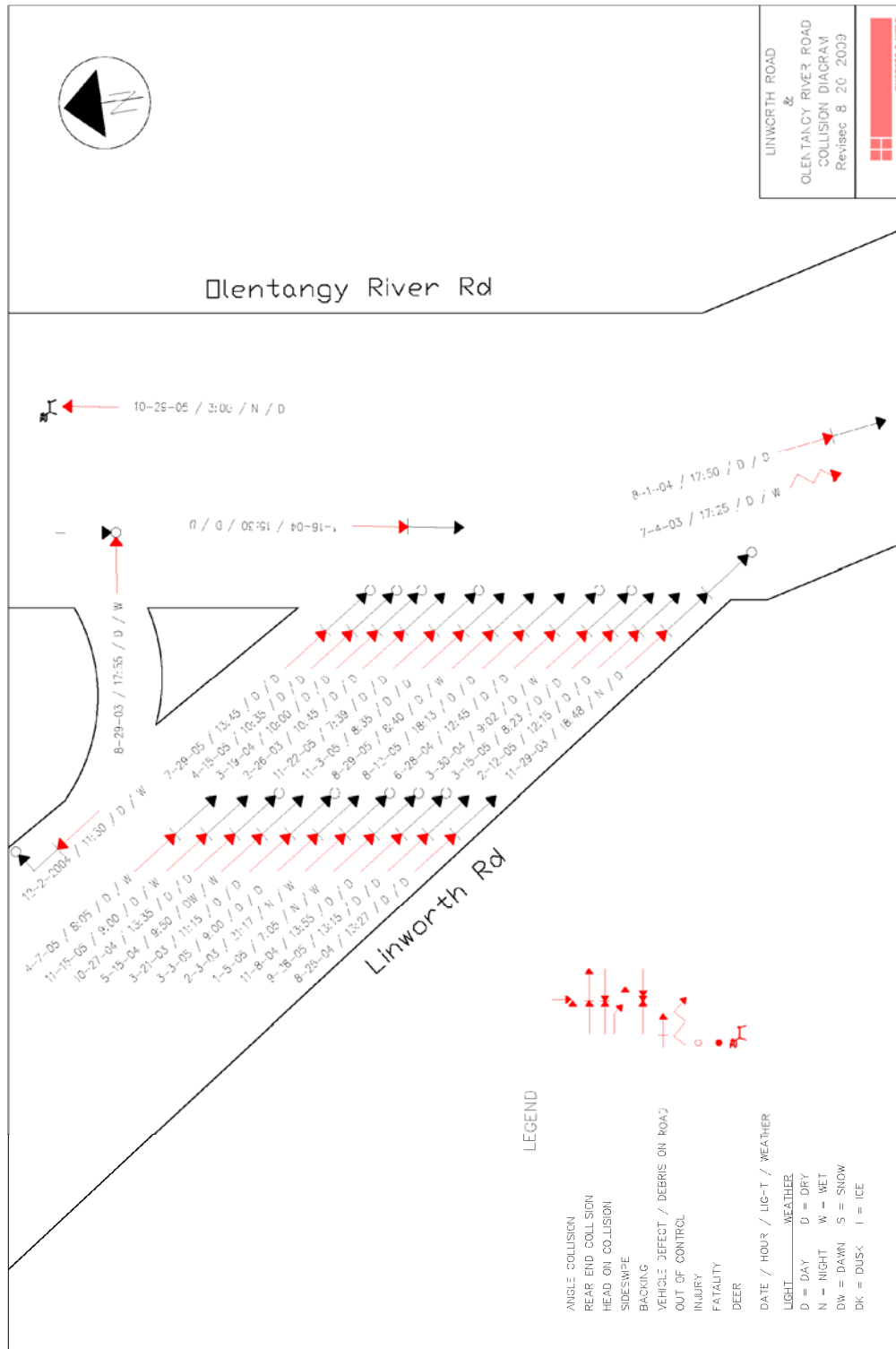


Figure B.1. Collision diagram, 2003–2005

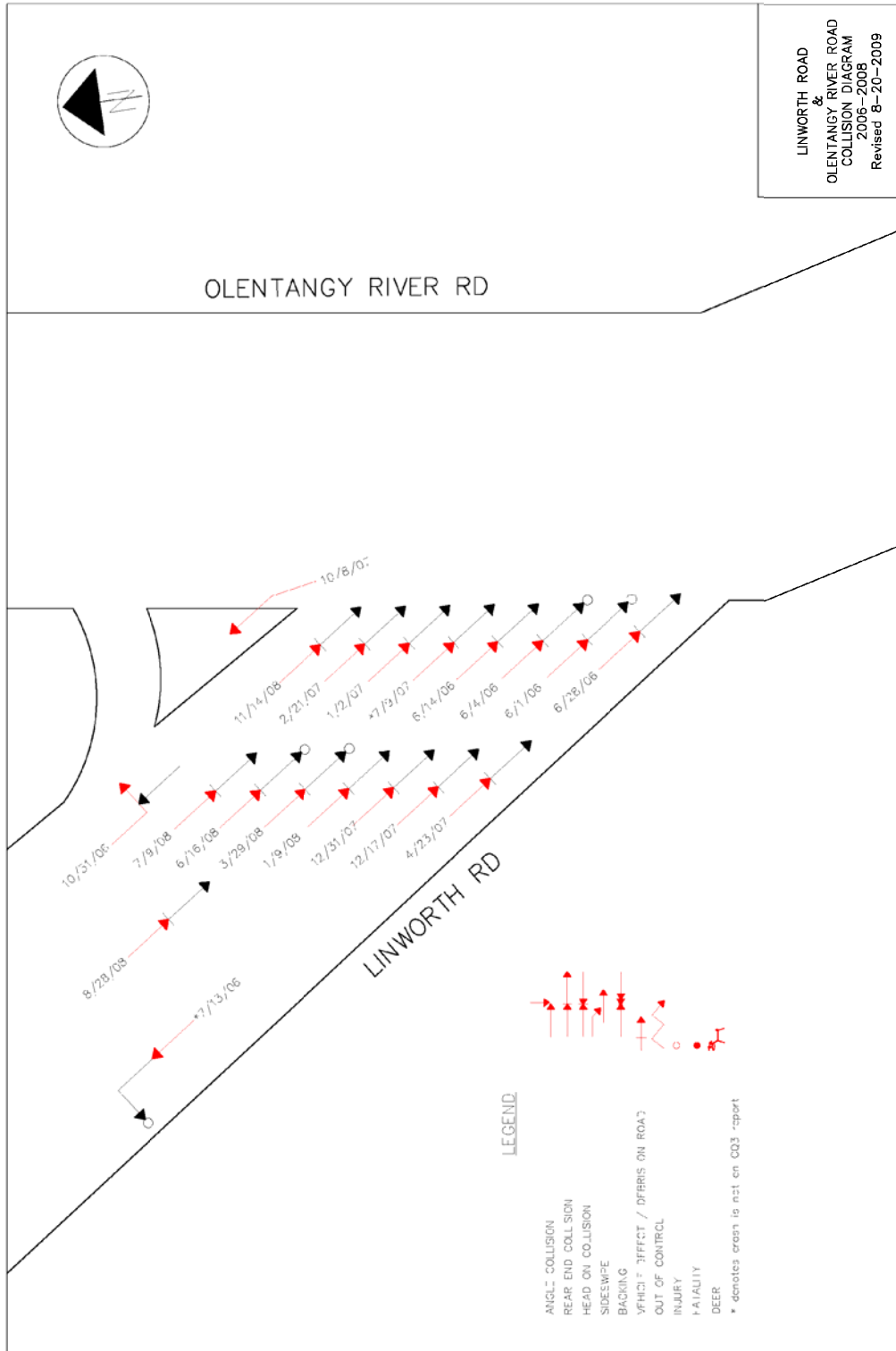


Figure B.2. Collision diagram, 2006-2008