Summary of Site-Specific Recommendations
For the Intersection Safety Study Public Meeting
December 7, 2006

5.0 A SUMMARY OF SITE-SPECIFIC RECOMMENDATIONS

1. Miller Road and Lennon Road
    - Reduce the yellow interval for Miller Road to 3.6 seconds and increase to 4.3 seconds for Lennon Road.
    - Increase the all-red intervals to 2.6 seconds for Miller Road and to 2.5 seconds for Lennon Road.
    - Provide a raised median over the existing buffer lane on the northeast leg of the intersection with limited provision for left-turn movements.
    - Relocate the stop bars on the northeast and eastbound approaches, as per MMUTCD guidelines.
    - Upgrade existing lane markings on the northeast and eastbound approaches.
    - Provide 11-foot lanes for the northeast-bound approach.
    - Provide a lane designation sign board for the eastbound approach.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at the northwest corner for northeast-bound left-turns.
    - Relocate the existing span-wire installation and include programmable signal head lights.
    - Implement the optimized PM signal timings.
    - Optimize signal timing for AM and off peak hours.

2. Miller Road and SB I-75 and Claude Avenue
    - Increase the yellow interval to 3.6 seconds for the SB I-75 through phase.
    - Increase the all-red intervals to 1.7 seconds for Miller Road phases.
    - Consider moving the stop bars closer to the crosswalks and intersections per MMUTCD guidelines.
    - A stop bar should be provided for northbound Claude Avenue which is not currently present and it should be maintained regularly.
    - Upgrade the existing span-wire configuration at the Miller Road and SB I-75 intersection to a mast-arm signal installation.
    - Install post-mounted traffic signals with a "LEFT" case sign at the northeast corner of the Miller Road and SB I-75 intersection for the Miller Road eastbound left-turns.
    - Implement the optimized PM signal timing.
    - Optimize signal timing for AM and off peak hours.

In addition to the above recommendations, the following lists additional recommended improvements for each option.

Option 1:

- Provide a raised median in the Miller Road left-turn lane.
- Provide an exclusive left-turn only lane for the Miller Road eastbound approach to I-75.
- Lane use left arrow marking with lane use control word "ONLY" should be provided in the eastbound left-turn only lane on Miller Road approaching I-75.
- Redistribute the existing road width to provide 12-foot lanes.

Option 2:

- Widen the road to provide an additional exclusive left-turn lane at the Miller Road eastbound approach.
- Lane use left arrow marking with lane use control word "ONLY" should be provided in pairs for the exclusive eastbound left-turn only lanes on Miller Road.
- Increase the width of the eastbound through lanes at the Miller Road and SB I-75 intersection to 11 feet.

3. Miller Road and NB I-75

- Increase the all-red interval to 2.5 seconds for the Miller Road phases.
- Increase the yellow interval to 3.6 seconds for the NB I-75 through phase.
- Relocate the stop bar on the northbound and westbound approaches, as per MMUTCD guidelines.
- Upgrade the existing span-wire configuration to mast-arm with programmable signal head lights.
- Implement the optimized PM signal timing.
- Optimize signal timing for AM and off peak hours.

4. Miller Road and Austin Parkway

- Increase the yellow interval to 3.6 seconds and the all-red interval to 2.0 seconds for Austin Parkway.
- Provide a through phase with permissive left-turns for N-S Austin Parkway.
- Relocate the stop bar on the westbound Miller Road approach.
- Provide stop bars for the north and southbound approaches of Austin Parkway.
- Provide two sets of left-turn only arrows for the south, west and eastbound approaches.

- Re-stripe the existing lane markings on the south, west and eastbound approaches.
- Provide a solid yellow line demarcation to separate the outgoing and incoming traffic for the northbound approach of Austin Parkway.
- Implement the optimized PM signal timing.
- Optimize the signal timing for AM and off peak hours.

5. Miller Road and Ballenger Highway
   - Reduce the yellow interval for the Miller Road phases to 3.6 seconds and for the Ballenger Highway phases to 4.3 seconds.
   - Increase the all-red intervals to 2.4 seconds for the Miller Road phases and to 1.6 seconds for the Ballenger Highway phases.
   - Provide a split phase for Miller Road.
   - Relocate the stop bars on the north and westbound approaches, as per MMUTCD guidelines.
   - Install stop signs for Miller Road right-turn movements.
   - Upgrade existing lane markings on all approaches to signify exact lane usage.
   - Provide a pavement overlay.
   - Post speed limit signs downstream of the intersection for the eastbound traffic of Miller Road.
   - Install post-mounted traffic signals with a "LEFT" illuminated sign at all the four corners for the left-turning vehicles.
   - Provide an additional exclusive right-turn lane at the northbound Ballenger Highway approach.
   - Upgrade the existing span-wire configuration to a box-span signal installation.
   - Implement the optimized PM signal timing.
   - Optimize the signal timing for AM and off peak hours.

6. Miller Road and Elms Road
   - Reduce the yellow interval for Elms Road to 3.6 seconds and to 3.9 seconds for Miller Road.
   - Increase the all-red interval to 1.8 seconds for Elms Road and to 1.7 seconds for Miller Road.
   - Relocate the stop bar on each approach, as per MMUTCD guidelines, and provide new crosswalks on the north and southbound approaches.
   - Relocate the pedestrian signals.

- Upgrade lane markings on the north, south and eastbound approaches.
- Post speed limit signs downstream of the intersection for all directions of travel. Signs should be posted at locations where they do not currently exist.
- Upgrade the existing span-wire configuration to a mast-arm signal installation.
- Redistribute the existing pavement width to provide an exclusive eastbound right-turn lane.
- Implement the optimized PM signal timing.
- Optimize signal timing for AM and off peak hours.

7. Miller Road and Seymour Road
   - Reduce the yellow interval for the east-west phase to 3.9 seconds and increase the yellow interval for the north-south phase to 5.0 seconds.
   - Increase the all-red interval to 1.5 seconds for Miller Road.
   - Provide a stop bar on the southbound approach.
   - Relocate the stop bar on the east and westbound approaches, as per MMUTCD guidelines.
   - Provide crosswalks on all the approaches.
   - Post speed limit signs downstream of the intersection for all directions of travel. Signs should be posted at locations where they do not currently exist.
   - Provide a westbound left-turn lane using the existing road width.
   - Upgrade the existing span-wire configuration to a mast-arm signal installation.
   - Implement the optimized PM signal timing.
   - Optimize signal timing for AM and off peak hours.

8. Linden Road and Corunna Road (M-21)
   - Reduce the yellow interval for all phases to 4.3 seconds.
   - Increase the all-red intervals to 2.0 seconds for all phases.
   - Upgrade the existing lane markings on the north and southbound approaches.
   - Relocate stop bars for all approaches as per MMUTCD guidelines.
   - Widen Linden Road to provide exclusive right-turn lanes for the north and southbound approaches.
   - Post speed limit signs downstream of the intersection for the east and west directions of travel. Signs should be posted at locations where they do not currently exist.
   - Install post-mounted traffic signals with a "LEFT" illuminated sign at all the corners for all left-turning vehicles.

- Upgrade the existing span-wire configuration to a box-span signal installation.
- Implement the optimized PM signal timing.
- Optimize AM and off peak signal timings.

9. S. Linden Road and W. Court Street
   - Reduce the yellow interval for all phases to 4.3 seconds.
   - Increase the all-red intervals to 1.6 seconds for all through phases.
   - Provide a protected left-turn phase for Linden Road.
   - Relocate the stop bar on all approaches, as per MMUTCD guidelines.
   - Upgrade existing lane markings on all approaches.
   - Install post-mounted traffic signals with a "LEFT" illuminated sign at the northwest and southeast corners for north and southbound left-turns.
   - Upgrade the existing span-wire configuration to a box-span wire signal installation.
   - Provide a center lane only sign with a left-turn arrow across both Linden Road approaches.
   - Redistribute the lane widths with the existing pavement width.
   - Implement the optimized PM signal timing.
   - Optimize the signal timing for AM and off peak hours.

10. Lahring Road and Torrey Road
    - Post a "Stop Ahead" warning sign along eastbound Lahring Road in advance of the cross street.
    - Re-stripe the pavement markings for southbound Torrey Road and eastbound Lahring Road.
    - Post speed limit signs downstream of the intersection for all directions of travel. Signs should be posted at locations where they do not currently exist.
    - Provide a stop bar for the eastbound Lahring Road approach.
    - Provide a solid line demarcation at the eastbound Lahring Road approach.

11. W 12th Street and Van Slyke Road
    - Reduce the yellow interval for all phases to 4.3 seconds.
    - Include all-red intervals of 1.6 seconds for W 12th Street and Van Slyke Road.
    - Relocate the stop bar on all the approaches, as per MMUTCD guidelines.
    - An additional speed limit sign should be posted downstream of the intersection for the eastbound and southbound traffic.

- Implement the optimized PM signal timing.
- Optimize signal timing for AM and Off-peak hours.
- Upgrade the existing pavement marking for all the approaches.
- Install a post-mounted traffic signal for northbound right-turns synchronized with the intersection signals.

12. Bristol Road and Fenton Road
    - Reduce the yellow interval for east-west phases to 3.9 seconds and for north-south phases to 3.6 seconds.
    - Increase the all-red intervals to 2.5 seconds for Fenton Road and to 1.9 seconds for Bristol Road.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for north-south and east-west left-turns.
    - Provide lag protected left-turn phases for Bristol Road and Fenton Road.
    - Relocate the stop bar on the east and westbound approaches, as per MMUTCD guidelines.
    - Upgrade the existing span-wire configuration to a box-span signal installation.
    - Post an additional speed limit sign downstream of the intersection for the eastbound traffic.
    - Implement the optimized PM signal timings.
    - Optimize signal timing for AM and off peak hours.

13. W. Bristol Road and Van Slyke Road
    - Reduce the yellow interval to 4.3 seconds for east-west phases and to 3.6 seconds for north-south phases.
    - Increase the all-red intervals to 2.0 seconds for Van Slyke Road and to 1.7 seconds for W Bristol Road.
    - Post speed limit signs downstream of the intersection for all directions of travel. Signs should be posted at locations where they do not currently exist.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for north-south and east-west left-turning vehicles.
    - Provide an exclusive right-turn lane at the southbound approach of Van Slyke Road.
    - Provide a southbound split phase for Van Slyke Road.
    - Relocate the stop bar and cross-walk on the north, east and westbound approaches, as per MMUTCD guidelines.

- Upgrade the existing lane markings on all approaches.
- Upgrade the existing span-wire configuration to a box-span signal installation.
- Implement the optimized PM signal timing.
- Optimize signal timing for AM and Off-peak hours.

14. E. Bristol Road and Camden Avenue
    - Post a "Stop Ahead" warning sign along Camden Avenue in advance of the intersection.
    - Post a speed limit sign downstream of the intersection for the westbound traffic of E. Bristol Road.
    - Change the existing lane widths of the southbound approach of Camden Avenue to accommodate proposed right-turn only and left-turn only lanes.
    - Relocate the cross-walk to match up with the existing sidewalk.
    - Relocate the stop bar on the southbound approach as per MMUTCD.
    - A semi-actuated signal may be installed based on the peak hour warrant only.

15. W. Atherton Road and Fenton Road
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Increase the all-red intervals to 1.9 seconds for each phase.
    - Post speed limit signs downstream of the intersection for north and westbound traffic. Signs should be posted at locations where they do not currently exist.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for north-south and east-west left-turns.
    - Provide protected left-turn phases for W Atherton Road and Fenton Road.
    - Provide an additional shared through and right-turn lane at the north and southbound Fenton Road approaches.
    - Relocate the stop bar on the north and southbound approaches, as per MMUTCD guidelines.
    - Upgrade the existing span-wire configuration to a box-span signal installation.
    - Implement the optimized PM signal timing.
    - Optimize signal timing for AM and off-peak hours.

16. Lapeer Road and State Road (M-15)
    - Increase the all-red intervals to 2.1 seconds for Lapeer Road.
    - Upgrade existing lane markings on the northbound approach.

- Post speed limit signs downstream of the intersection for the north and south directions of travel. Signs should be posted at locations where they do not currently exist.
- Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for north-south and east-west left-turns.
- Upgrade the existing span-wire configuration to a box-span signal installation.
- Install a raised median at each approach.
- Implement the optimized P.M. signal timings.
- Optimize signal timing for A.M. and off-peak hours.

17. Lapeer Road and S. Vassar Road
    - A "Stop Ahead" warning sign should be placed along S Vassar Road for both approaches in advance of the intersection.
    - Relocate the stop bars for S Vassar Road as per MMUTCD guidelines
    - Relocate the stop signs on the north and southbound approaches.

18. Richfield Road and N Genesee Road
    - Reduce the yellow interval to 3.9 seconds for the Richfield Road phases and to 4.3 seconds for the Genesee Road phases.
    - Increase the all-red interval to 1.4 seconds for the Richfield Road phases and to 1.3 seconds for the Genesee Road phases.
    - Provide a lag protected left turn phase for Genesee Road and eliminate the split phase.
    - Relocate stop bars at all approaches as per MMUTCD guidelines.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for left-turns.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation.
    - Pavement markings should be re-striped for increasing driver awareness.
    - Implement the optimized P.M. signal timing.
    - Optimize signal timing for A.M. and off-peak hours.

19. E Hill Road and S Saginaw Road
    - Reduce yellow interval for the E Hill Road phases to 4.7 seconds and for the S Saginaw Road phases to 4.3 seconds.
    - Provide an all-red interval of 1.6 seconds for the E Hill Road phases and 1.7 seconds for the S Saginaw Road phases.
    - Provide permissive left-turn phases before protected left-turn phases.

- Relocate stop bars as per MMUTCD guidelines.
- Re-stripe pavement markings on all approaches as an annual maintenance program.
- Post speed limit signs downstream of the intersection for north and southbound Saginaw Road. Signs should be posted at locations where they do not currently exist.
- Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for north-south and east-west left-turns.
- Upgrade the existing span-wire configuration to a mast-arm signal installation.
- Implement the optimized P.M. signal timing.
- Optimize signal timing for A.M. and off peak hours.

20. E Hill Road and S Dort Highway
    - Reduce the yellow interval for all phases to 4.3 seconds.
    - Increase the all-red intervals to 1.8 seconds for all phases.
    - Relocate all stop bars as per MMUTCD guidelines.
    - Provide a crosswalk for the northbound approach.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for all left-turn movements.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation.
    - Implement the optimized P.M. signal timing.
    - Optimize signal timing for A.M. and Off-peak hours.

21. E. Hill Road and Center Road
    - Reduce the yellow interval to 4.7 seconds for the E. Hill Road phases and to 4.3 seconds for the Center Road phase.
    - Provide exclusive left-turn lanes for all approaches.
    - Provide a protected east-west left-turn phase.
    - Provide an 18-foot shared through/right-turn lane for each approach.
    - Provide an 18-foot receiving lane for south, east, and westbound through traffic and a 16-foot receiving lane for northbound traffic.
    - Relocate stop bars as per MMUTCD guidelines.
    - Upgrade the lane markings to signify exact lane usage.
    - Re-stripe pavement markings as part of an annual maintenance program.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for north-south and east-west left-turns.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation.

- Optimize signal timing for AM and off-peak hours.
- Implement the optimized PM signal timings.

22. S. Saginaw Road and S. Dort Highway
    - Reduce the yellow interval for all phases to 4.3 seconds.
    - Increase the all-red intervals for all phases to 2.5 seconds.
    - Relocate the stop bars on all approaches, as per MMUTCD guidelines.
    - Provide 12-inch thick paint lines for crosswalks and stop bars.
    - Upgrade existing lane markings on the north, east and westbound approaches.
    - Realign the existing span-wire configuration and replace the existing signal heads with programmable signal heads.
    - Optimize signal timing for AM and off-peak hours.
    - Implement the optimized PM signal timings.

23. N. Saginaw Street and E. Fifth Avenue
    - Reduce the yellow interval to 3.6 seconds for E. Fifth Avenue and to 3.5 seconds for N. Saginaw Street.
    - Increase the all-red intervals to 2.3 seconds for E. Fifth Avenue and to 2.2 seconds for N. Saginaw Street
    - Relocate the stop bar for each approach, as per MMUTCD guidelines.
    - Post speed limit signs downstream of the intersection for the east, west and southbound approaches.
    - Redistribute the lane widths for the eastbound and southbound approaches using the existing pavement width.
    - Provide two sets of lane use arrow markings with lane use control word "ONLY" at the eastbound approach of E. Fifth Avenue to prevent entrapment.
    - Upgrade the existing span-wire configuration to a box-span signal installation.
    - Optimize signal timing for AM and off-peak hours.
    - Implement the optimized PM signal timings.

24. N. Saginaw Street and E. Pierson Road
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Include all-red intervals of 2.1 seconds for N. Saginaw Street and 2.3 seconds for E. Pierson Road.

- Install post-mounted traffic signals with a "LEFT" illuminated sign on all corners for left-turns.
- Upgrade the existing span-wire configuration to a box-span signal installation.
- Relocate the stop bars for the west and eastbound approaches of E. Pierson Road. Also, relocate the cross-walk for the westbound E. Pierson Road approach.
- Post a speed limit sign downstream of the intersection for the southbound traffic.
- Provide two sets of lane use arrow markings with lane use control word "ONLY" on all approaches to prevent entrapment.
- Optimize signal timing for AM and off-peak hours.
- Implement the optimized PM signal timings.

25. N. Saginaw Street and Mt. Morris Street
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Increase the all-red intervals to 2.5 seconds for N Saginaw Street and 1.9 seconds for Mt. Morris Street.
    - Provide a dedicated left-turn lane at the eastbound approach of Mt. Morris Street instead of a shared through and left-turn lane.
    - Post speed limit signs downstream of the intersection for all the approaches.
    - Provide two sets of lane use arrow markings with lane use control word "ONLY" on the eastbound, westbound and northbound approaches to prevent entrapment.
    - Change the span-wire installation of signal heads to a mast-arm supported signal installation.
    - Relocate the stop bar for the southbound N. Saginaw Street as per MMUTCD regulations.
    - Optimize signal timing for AM and off-peak hours.
    - Implement the optimized PM signal timings.

26. S. Saginaw Street and E. Grand Blanc Road
    - Increase the all-red interval to 2.5 seconds for Grand Blanc Road.
    - Reduce the all-red interval to 1.6 seconds for S. Saginaw Street.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at the northwest and southeast corners for north and southbound left-turns.
    - Upgrade the existing span-wire configuration to a box-span signal installation.
    - Relocate the stop bar for the northbound and southbound S. Saginaw Street as per MMUTCD regulations.

- Install a "No Turn on Red" sign at the Grand Blanc Road eastbound approach.
- Optimize signal timing for AM and off-peak hours.
- Implement the optimized PM signal timings.

27. S. Saginaw Street and E. Reid Road/ Old Bridge Road
    - Increase the yellow interval to 3.6 seconds for S. Saginaw Street.
    - Increase the all-red interval to 2.5 seconds for E. Reid Road/Old Bridge Road.
    - Decrease the all-red interval to 1.9 seconds for S. Saginaw Street.
    - Relocate the stop bars for the southbound and northbound approaches of S. Saginaw Street and the westbound approach of Old Bridge Road.
    - Realign the crosswalks for the northbound and southbound S. Saginaw Street approaches.
    - Upgrade the existing span-wire configuration to a box-span signal installation.
    - Provide lane arrow markings in sets of two with the lane use control word "ONLY" for the westbound and eastbound approaches to prevent entrapment and to help road users select the appropriate lane in advance of reaching the stop bar.
    - Optimize signal timing for AM and off-peak hours.
    - Implement the optimized PM signal timings.

28. Dupont Street and W Pasadena Avenue
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Increase the all-red intervals to 1.8 seconds for Dupont Street and 1.9 seconds for W. Pasadena Avenue.
    - Provide protected left-turn phases for Dupont Street and W. Pasadena Avenue.
    - Redistribute the lane width evenly over eastbound W. Pasadena Avenue.
    - Provide exclusive left-turn lanes.
    - Provide stop bars and crosswalks on all the approaches, as per MMUTCD guidelines.
    - Upgrade the existing lane markings at all approaches.
    - Post a speed limit sign downstream of the intersection for northbound traffic.
    - Upgrade the existing span-wire configuration to a mast-arm supported signal installation.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for left-turns.
    - Optimize signal timings for AM and off-peak hours.
    - Implement the optimized PM signal timings.

29. EB Robert T Longway Boulevard and NB Chavez Drive
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Include all-red intervals of 1.6 seconds for EB Robert T Longway Boulevard and 1.4 seconds for NB Chavez Drive.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation with 12-inch signal head lights.
    - Redistribute the lane widths using the existing pavement width.
    - Provide pavement markings at the northbound and eastbound approaches.
    - Re-stripe pavement markings on all approaches.
    - Install pedestrian signals.
    - Optimize signal timings for AM and off-peak hours.
    - Implement the optimized PM signal timings.

30. WB Robert T Longway Boulevard and NB Chavez Drive
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Include all-red intervals of 1.8 seconds for WB Robert T Longway Boulevard and 1.7 seconds for NB Chavez Drive.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation with 12-inch signal head lights.
    - Redistribute the lane widths using the existing pavement width.
    - Provide pavement markings at the northbound and westbound approaches for the through lanes.
    - Re-stripe pavement markings on all approaches.
    - Install pedestrian signals.
    - Optimize signal timings for AM and off-peak hours.
    - Implement the optimized PM signal timings.

31. EB Robert T Longway Boulevard and SB Chavez Drive
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Increase the all-red intervals to 1.9 seconds for EB Robert T Longway Boulevard and 1.8 seconds for SB Chavez Drive.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation with 12-inch signal head lights.
    - Redistribute the lane widths using the existing pavement width.

- Provide pavement markings at the eastbound and southbound approaches for the through lanes.
- Re-stripe pavement markings on all approaches.
- Install a speed limit sign downstream of the intersection for the southbound direction.
- Install pedestrian signals.
- Optimize the signal timings for the AM and off peak hours.
- Implement the optimized PM signal timings.

32. WB Robert T Longway Boulevard and SB Chavez Drive
    - Reduce the yellow interval for all phases to 3.6 seconds.
    - Include all-red intervals of 1.7 seconds for each phase.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation with 12-inch signal head lights.
    - Relocate the stop bar on each approach, as per MMUTCD guidelines.
    - Redistribute the lane widths using the existing pavement width.
    - Provide pavement markings at the westbound and southbound approaches.
    - Re-stripe pavement markings on all approaches.
    - Install a speed limit sign downstream of the intersection for the westbound direction.
    - Install pedestrian signals.
    - Optimize the signal timings for the AM and off peak hours.
    - Implement the optimized PM signal timings.

33. NB Chavez Drive and Second Street
    - Reduce the yellow interval for the eastbound phase to 3.5 seconds and to 3.6 seconds for the northbound phase.
    - Include all-red intervals of 1.7 seconds for Second Street and 1.6 seconds for NB Chavez Drive.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation.
    - Relocate the pedestrian signals closer to the crosswalks.
    - Provide pavement markings at the northbound approach.
    - Optimize the signal timings for the AM and off peak hours.
    - Implement the optimized PM signal timings.

34. SB Chavez Drive and Second Street

- Reduce the yellow interval for the eastbound phase to 3.5 seconds and to 3.6 seconds for the southbound phase.
- Include all-red intervals of 2.2 seconds for Second Street and 1.6 seconds for SB Chavez Drive.
- Upgrade the existing span-wire configuration to a mast-arm signal installation.
- Post speed limit signs downstream of the intersection for the southbound direction of travel.
- Provide pavement markings at the southbound approach.
- Optimize the signal timings for the AM and off peak hours.
- Implement the optimized PM signal timings.

35. NB Grand Traverse Street and W. Atherton Road

- Reduce the yellow intervals for all phases to 3.6 seconds.
- Include all-red intervals of 1.7 seconds for all phases.
- Upgrade the existing span-wire configuration to a mast-arm signal installation.
- Relocate the stop bars and crosswalk on the north and eastbound approaches, as per MMUTCD guidelines.
- Provide a stop bar and crosswalk for the westbound approach.
- An additional speed limit sign should be posted downstream of the intersection for the westbound Atherton Road traffic.
- Provide "Do Not Enter" signs on both sides of the road at the southbound approach.
- Install pedestrian crossing signals at the northeast, southeast and southwest corners of the intersection.
- Upgrade the existing pavement markings across the northbound, eastbound and westbound approaches.
- Redistribute the lane widths evenly for the westbound Atherton Road.
- Optimize the signal timings for the AM and off peak hours.
- Implement the optimized PM signal timings.

36. SB Grand Traverse Street and W. Atherton Road

- Reduce the yellow interval for all phases to 3.6 seconds.
- Include all-red intervals of 1.7 seconds for SB Grand Traverse Street and 1.9 seconds for W Atherton Road.
- Upgrade the existing span-wire configuration to a mast-arm signal installation.

- Relocate the stop bar and crosswalks on the eastbound, westbound and southbound approaches, as per MMUTCD guidelines.
- Post speed limit signs downstream of the intersection for the eastbound, westbound and southbound traffic.
- Install pedestrian crossing signals at each corner except southeast.
- Upgrade existing pavement markings across all approaches.
- Redistribute the lane widths evenly for the westbound Atherton Road approach.
- Optimize the signal timings for the AM and off peak hours.
- Implement the optimized PM signal timings.

37. Beecher Road and Calkins Road
    - Reduce the yellow interval for all phases to 4.3 seconds.
    - Change the span-wire installation of signal heads to a mast-arm signal installation.
    - Provide a solid line demarcation along northbound Calkins Road to indicate the separation of the dedicated left-turn and right-turn movements.
    - Provide two sets of lane use arrow markings with lane use control word "only" at the northbound Calkins Road approach to prevent entrapment.
    - Install post-mounted right-turn signals synchronized with the intersection signals for the northbound approach of Calkins Road.
    - Optimize the signal timings for the AM and off peak hours.
    - Implement the optimized PM signal timings.

38. S. Ballenger Highway and Beecher Road
    - Reduce the yellow interval to 3.9 seconds for Beecher Road and 3.6 seconds for Ballenger Highway.
    - Increase the all-red intervals to 1.8 seconds for Beecher Road and to 2.3 seconds for Ballenger Highway.
    - Relocate the stop bars and crosswalks on the east, north and southbound approaches, as per MMUTCD guidelines, and provide a stop bar on the westbound approach and crosswalks on the south and westbound approaches.
    - Upgrade existing lane markings on all the approaches.
    - Provide pedestrian crossing traffic signals across all approaches.
    - Post a yield traffic sign for northbound traffic turning right onto Beecher Road.
    - Post speed limit signs downstream of the intersection for all directions of travel. Signs should be posted at locations where they do not currently exist.

- Install post-mounted traffic signals with a "LEFT" illuminated sign for all left-turns.
- Reverse the order of signal phasing to provide the protected left-turn phase after the through phase.
- Optimize the signal timings for the AM and off-peak hours.
- Implement optimized PM signal timings.

39. S. Ballenger Highway and W. Court Street
    - Reduce the yellow interval to 3.6 seconds for S Ballenger Highway and 3.9 seconds for W Court Street.
    - Increase the all-red intervals to 1.7 seconds for S Ballenger Highway and to 1.9 seconds for W Court Street.
    - Provide a protected left-turn phase for W Court Street.
    - Re-designate existing lane markings at eastbound and westbound approaches.
    - Relocate the stop bar on all approaches, as per MMUTCD guidelines.
    - Upgrade the existing pavement markings on east, west and northbound approach.
    - Post speed limit signs downstream of the intersection for northbound traffic. Signs should be posted at locations where they do not currently exist.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at the northeast and southwest corners for eastbound and westbound left-turns.
    - Upgrade the existing span-wire configuration to a box-span signal installation.
    - Optimize the signal timings for the AM and off peak hours.
    - Implement optimized PM signal timings.

40. N. Center Road and E. Court Street
    - Reduce the yellow interval to 4.3 seconds for N. Center Road and to 3.9 seconds for E. Court Street.
    - Increase the all-red intervals to 1.6 seconds for N. Center Road and to 1.9 seconds for E. Court Street.
    - Relocate the stop bar on the southbound approach of N. Center Street.
    - Post a speed limit sign downstream of the intersection for the westbound traffic.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all the corners of the intersection for all left-turn movements.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation.
    - Provide a raised median in the northbound and southbound left-turn lane of N. Center Street.

- Provide two sets of arrow markings with lane use control word "only" for the southbound and eastbound approaches to prevent entrapment and to help road users select the appropriate lane in advance of reaching the stop bar.
- Optimize the signal timings for the AM and off peak hours.
- Implement the optimized PM signal timings.

41. N. Belsay Road and E. Potter Road
    - Install advance warning signs indicating "Stop Ahead" along E Potter Road.
    - Post speed limit signs downstream of the intersection for all directions of travel. Signs should be posted at locations where they do not currently exist.
    - Relocate stop bars on the east and westbound approaches of E Potter Road.
    - Provide stop bars for the north and southbound approaches of N Belsay Road.
    - Upgrade pavement marking on all approaches.

42. S. Belsay Road and Lapeer Road
    - Reduce the yellow interval to 3.6 seconds for the S Belsay Road phases and to 4.3 seconds for the Lapeer Road phases.
    - Increase the all-red interval to 1.5 seconds for the S Belsay Road phases.
    - Provide exclusive left-turn lanes for all approaches.
    - Provide protected left-turn phases for S Belsay Road and Lapeer Road.
    - Relocate the stop bars on all approaches, as per MMUTCD guidelines.
    - Upgrade lane markings to signify exact lane usage.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at all corners for north-south and east-west left-turns.
    - Implement the optimized PM peak signal timing.
    - Optimize the signal timings for the AM and off peak hours.

43. Owen Road and Silver Parkway
    - Reduce the yellow interval to 3.9 seconds for the Owen Road phases and to 3.6 seconds for the Silver Parkway phase.
    - Increase the all-red intervals to 1.7 seconds for the Owen Road phases and to 1.8 seconds for the Silver Parkway phase.
    - Eliminate the EB Owen Road split phase.
    - Change the NB and SB Silver Parkway split phases to one through phase.

- Relocate the stop bar on the east and southbound approaches, as per MMUTCD guidelines.
- Upgrade existing lane markings on the east, south and westbound approaches.
- Post speed limit signs downstream of the intersection for east and westbound traffic. Signs should be posted at locations where they do not currently exist.
- Upgrade the existing span-wire configuration to a mast-arm signal installation.
- Install post-mounted traffic signals with a "LEFT" illuminated sign at the northeast and southwest corners for east and westbound left-turns.
- Implement the optimized PM peak signal timing.
- Optimize signal timings for the AM and off peak hours.

44. Owen Road and Donaldson Drive
    - Increase the yellow interval to 3.9 seconds for the Owen Road phase.
    - Increase the all-red interval to 2.3 seconds for the Donaldson Drive phase.
    - Relocate the stop bar on all approaches, as per MMUTCD guidelines, and provide new crosswalks on all the approaches.
    - Upgrade existing lane markings on the northbound and westbound approaches.
    - Post a speed limit sign downstream of the intersection for westbound traffic.
    - Install post-mounted traffic signals with a "LEFT" illuminated sign at the northwest and southwest corners for north and westbound left-turns.
    - Upgrade the existing span-wire configuration to a mast-arm signal installation accompanied with perforated back plates.
    - Implement the optimized PM signal timings.
    - Optimize the signal timing for the AM and off peak hours.

45. State Road (M-15) and Green Road
    - Post speed limit signs downstream of the intersection for both the east-west and north-south directions of traffic of M-15 (South State Road) and Green Road.
    - Change the existing dirt road at the westbound approach of Green Road to a paved road for strengthening the road surface.
    - Provide stop bars for guiding the east and westbound traffic of Green Road.
    - Provide "Stop Ahead" warning signs along Green Road.

46. State Road (M-15) and Flint Street
    - Relocate the stop bars on all approaches as per MMUTCD guidelines.

- Upgrade the existing span-wire configuration to a mast-arm signal installation.
- Post speed limit signs downstream of the intersection for all directions of travel. These signs should be posted at locations where they do no currently exist.
- Upgrade existing lane markings on the north, east and westbound approaches.
- Implement the optimized PM signal timing.
- Optimize the signal timing for AM and off peak hours.

47. State Road (M-15) and W. Hegel Road
    - Increase the yellow interval for the north-south phases to 4.3 seconds.
    - Increase the all-red intervals to 2.2 seconds for W Hegel Road and 1.3 seconds for M-15.
    - Upgrade the existing span-wire configuration to a box-span signal installation.
    - Post speed limit signs downstream of the intersection. Signs should be posted at locations where they do not currently exist.
    - Relocate the stop bar on all approaches, as per MMUTCD guidelines.
    - Provide pavement markings at all the approaches.
    - Provide a northbound split phase for M-15.
    - Implement the optimized PM signal timing.
    - Optimize the signal timing for AM and off peak hours.

48. State Road (M-15) and E. Hegel Road (Dutch Road)
    - Post "Stop Ahead" warning signs along E. Hegel Road/Dutch Road in advance of M-15.
    - Post a speed limit sign downstream of the intersection for the westbound traffic of E. Hegel Road/Dutch Road.
    - Re-stripe existing lane markings on all approaches.
    - Provide a stop bar for the north, south, and eastbound approaches.
    - Relocate the stop bar on the westbound approach, as per MMUTCD guidelines.

6.0 DETAILED INTERSECTION ANALYSIS

Detailed analyses of the 49 selected intersections (Section 6.2 contains two intersections) were performed as a part of this study. The detailed analyses includes a critical review of the physical and traffic characteristics of the roadway including Average Daily Traffic volumes (ADT) based on data obtained from the Genesee County Road Commission and peak hour traffic data collected by the WSU-TRG staff as a part of this study. In addition, details on traffic control

deficiencies, recommended improvements, and operational evaluations are provided for each of the study intersections.

Physical Characteristics

As a part of this study, a field survey was conducted for each intersection. The field survey included visiting the intersection sites, developing condition diagrams, taking photographs in order to capture the existing lane use and other potential physical characteristics in the vicinity of the intersections, and assessing the existing traffic control devices. The existing condition diagrams and photographs of the intersection approaches are provided later in this section for the study intersections.

Traffic Volumes

PM peak period traffic count data were collected for each intersection from 4:00 to 6:00 PM on typical weekdays between November of 2005 and June of 2006. An analysis of daily traffic volumes at key locations indicated the highest traffic volumes occurred during the PM peak period. Traffic volume diagrams including the PM peak hour turning movement counts have been prepared for each intersection and are provided later in this report.

Crash Analysis

Two-years of site-specific traffic crash data (2003 and 2004) were analyzed as a part of this study to identify safety deficiencies and to develop countermeasures. Crash information was obtained from the UD-10 crash reports obtained from the Michigan State Police. Crash data summaries and collision diagrams were prepared for each intersection for the two-year study period. Collision diagrams for the years, 2003 and 2004, are provided in this study.

The collision diagrams were analyzed to determine predominant crash patterns for each intersection. Crash types can be indicative of inadequacies at individual intersections. Rear-end crashes at a signalized intersection are generally related to excessive speeds, poor visibility of signal heads, signal timing deficiencies, excessive pedestrian crossings, unexpected stopping of vehicles, presence of driveways in close proximity, and slippery surfaces on the roadways.

Right-angle crashes at signalized intersections are generally related to an inadequate clearance interval, poor visibility of signal heads, unexpected stopping of vehicles and lack of driver information. Left-turn head-on crashes are generally related to excessive speed, an inadequate

clearance interval, inadequate gaps in the opposing traffic stream and inadequate signal timing for left-turning movements. Sideswipe crashes are generally related to excessive speed, unexpected lane changing, low visibility of signal heads and inadequate pavement markings.

Safety Deficiencies and Recommended Improvements

Based on the crash analysis, safety deficiencies for each of the selected 48 intersections have been identified as well as recommended improvements. The recommended improvements include engineering measures and behavioral measures such as public awareness campaigns, enforcement and education initiatives. A summary of some of the countermeasures recommended as a part of this study include the following:

Engineering Countermeasures

- Signal timing and phasing modifications including:
    - Modifying cycle lengths along the major corridor of Miller Road to be consistent and the same (or half) in order to facilitate signal coordination and progression. Currently, various cycle lengths are operated at the intersections along these corridors.
    - Calculating clearance intervals (yellow and all-red intervals) according to MDOT's guidelines and the Institute of Transportation Engineers (ITE) recommended practice. In many instances the yellow intervals included in the existing signal timing plans exceeded the values recommended by ITE and MDOT, while all-red intervals were either excluded from the existing timings or were too short. Excessive yellow intervals may encourage some motorists to proceed through the intersection, even if they had sufficient time and distance to stop comfortably. Rear-end crashes often result due to the unexpected stopping of some motorists, while others intend to travel through the intersection during the signal change interval. The lack of or insufficient length of all-red intervals in traffic signal timing may not provide enough time for drivers to clear the intersection before opposing traffic receives a green signal indication. All-red intervals should be provided and should have a sufficient duration which allows vehicles to traverse through the intersection safely. Lack of all-red intervals may lead to a high frequency of left-turn head-on, angle and injury crashes.
    - Install exclusive left-turn phases at locations with high left-turn volumes and a predominance of left-turn head-on crashes.

- Provide protected only left-turn phasing at locations where an existing permitted/protected left-turn phase exists, but still experiences a high number of left-turn head-on crashes.

- Geometric modifications including the installation of additional turning lanes and receiving lanes. Also, redistributing lane widths to provide 12-foot lanes.
- Signage modifications including the installation of overhead lane designation signs to reduce driver confusion, particularly for the significant amount of tourists or recreational travelers.
- Installation of traffic signs including 'No Turn on Red' signs, speed limit signs downstream of the intersections, and others where appropriate.
- Routine maintenance of pavement markings.
- Relocation of stop bars and crosswalks closer to the intersection, as per MUTCD guidelines.
- Installation of raised islands in the center lane for left-turns to mitigate driveway conflicts in close proximity to the intersection.

Operational Evaluation

Level of service (LOS) analyses for the existing and improved traffic conditions for the PM peak hour were performed for the 48 intersections. According to the most recent edition of the Highway Capacity Manual, level of service is a qualitative measure describing operational conditions of a traffic stream or intersection. Level of service ranges from A to F; with LOS A being the best. LOS D is generally considered to be acceptable for the peak hour operations. Table 6.1 and Table 6.2 present the criteria for defining the various levels of service for unsignalized and signalized intersections.

Table 6.1. Level of Service Criteria (Unsignalized Intersection)

Level of Service	Average Stopped Vehicle Delay (seconds)
A	≤10
B	>10 and ≤ 15
C	>15 and ≤ 25
D	>25 and ≤ 35
E	>35 and ≤ 50
F	> 50

Note: LOS "D" is considered acceptable in urban/suburban areas.

Table 6.2. Level of Service Criteria (Signalized Intersection)

Level of Service	Average Stopped Delay/Vehicle (seconds)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

Note: LOS "D" is considered acceptable in urban/suburban areas.

The results of the level of service analyses are summarized for each intersection in this section. The HCM LOS results for each intersection is summarized in Table 6.3.

Table 6.3. Level of Service Analysis for the Studied Intersections

Intersection	Level of Service (LOS) of Existing Conditions		Level of Service (LOS) with Proposed Improvements	
	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)	LOS
Linden Road and Corunna Road	335.2	F	38.7	D
Linden Road and Court Street	13.5	B	20.0	B
Miller Road and Austin Parkway	21.9	C	15.4	B
Miller Road and SB I-75 – Option 1	20.9	C	26.2	C
Miller Road and SB I-75 – Option 2	20.9	C	19.9	B
Miller Road and Claude Avenue – Option 1	45.2	E	27.6	D
Miller Road and Claude Avenue – Option 2	45.2	E	45.2	E
Miller Road and NB I-75	29.5	C	28.7	C
Miller Road and Lennon Road	7.6	A	10.5	B
Miller Road and Ballenger Highway	36.9	D	35.4	D
Miller Road and Elms Road	13.4	B	16.9	B

Note: LOS "D" is considered acceptable in urban/suburban areas.

Table 6.3. Level of Service Analysis for the Studied Intersections (cont.)

Intersection	Level of Service (LOS) of Existing Conditions		Level of Service (LOS) with Proposed Improvements	
	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)	LOS
Miller Road and Seymour Road	10.8	B	15.8	B
Bristol Road and Fenton Road	65.6	E	30.2	C
Bristol Road and Van Slyke Road	61.1	E	29.5	C
Bristol Road and Camden	28.4	D	22.2	C
Fenton Road and Atherton Road	15.4	B	29.5	D
Lapeer Road and State Road	55.1	E	33.3	C
Lapeer Road and S Vassar Road	21.5	C	21.5	C
Lahring Road and Torrey Road	25.6	D	25.6	D
Genesee Road and Richfield Road	35.4	D	29.6	C
Hill Road and Saginaw Road	37.3	D	34.9	C
Hill Road and Dort Highway	28.6	C	28.3	C
Hill Road and Center Road	15.9	B	24.8	C
Saginaw Road and Dort Highway	19.7	B	19.5	B
Saginaw Street and Fifth Avenue	13.5	B	23.0	C
Saginaw Street and Pierson Road	26.3	C	26.9	C
Saginaw Street and Mt. Morris Street	24.8	C	23.8	C
Saginaw Street and Grand Blanc Road	39.1	D	29.3	C
Saginaw Street and Reid/Bridge Road	14.2	B	19.2	B
Calkins Road and Beecher Road	12.4	B	14.1	B
EB Robert T Longway and NB Cesar Chavez Drive	12.4	B	12.6	B
WB Robert T Longway and NB Cesar Chavez Drive	19.6	B	13.7	B
EB Robert T Longway and SB Cesar Chavez Drive	19.7	B	17.8	B
WB Robert T Longway and SB Cesar Chavez Drive	12.0	B	12.0	B
NB Cesar Chavez Drive and Second Street	10.6	B	11.3	B

Note: LOS "D" is considered acceptable in urban/suburban areas.

Table 6.3. Level of Service Analysis for the Studied Intersections (cont.)

Intersection	Level of Service (LOS) of Existing Conditions		Level of Service (LOS) with Proposed Improvements	
	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)	LOS
SB Cesar Chavez Drive and Second Street	10.1	B	11.0	B
NB Grand Traverse Street and W Atherton Road	11.6	B	11.2	B
SB Grand Traverse Street and W Atherton Road	14.4	B	9.8	A
Dupont Street and Pasadena Avenue	12.1	B	31.3	C
Ballenger Highway and Beecher Road	31.5	C	29.2	C
Ballenger Highway and Court Street	16.1	B	22.4	C
N Center Road and E Court Street	41.5	D	33.3	C
Van Slyke Road and Twelfth Street	79.4	E	19.5	B
Lapeer Road and Belsay Road	15.0	B	29.2	C
N Belsay and E Potter	26.0	D	26.0	D
Silver Parkway and Owen Road	60.1	E	34.5	C
Owen Road and Donaldson Drive	62.8	E	18.0	B
M-15 (S State Road) and Green Road	36.2	E	36.2	E
M-15 (State Road) and Flint Street	19.4	B	19.6	B
M-15 (State Road) and W Hegel/Erie Road	11.9	B	17.5	B
M-15 (State Road) and E Hegel/Dutch Road	31.6	D	31.6	D

Note: LOS "D" is considered acceptable in urban/suburban areas.

The majority of the intersections currently operate well at LOS C or better during the PM peak hour, and in general, capacity problems are not an issue. A level of service analysis was also performed for the study intersections which incorporated the proposed improvements. This analysis indicated that at a majority of the intersections, better levels of service were achieved with the improvements, as compared to the existing conditions.

Behavioral Countermeasures

A crash analysis was performed for the 48 study intersections to quantify the number of crashes involving driver behavior problems, such as driving under the influence of alcohol, drivers not wearing their seatbelts and crashes involving speeding and/or red light running. The crash frequency information was obtained by querying the MSP's Statewide Traffic Crash Database for the years 2001, 2002, 2003 and 2004, as shown in Table 6.4.

In general, the number of crashes involving driver behavior issues has a relatively low frequency for a given intersection during a given year.

Table 6.4. Crashes Related to Driver Behavioral Issues

Description	Intersection Name	Total Crashes for Four Years of Data Combined (2001, 2002, 2003 and 2004)			
		Alcohol-Related Crashes	Crashes Involving Unbelted Drivers	Speeding Crashes	Red Light Running Crashes
Miller Road Corridor	Miller Road and Lennon Road	1	4	4	4
	Miller Road and SB I-75	3	2	0	0
	Miller Road and NB I-75	4	4	1	2
	Miller Road and Austin Parkway	1	0	2	7
	Miller Road and Ballenger Highway	3	2	4	10
Miscellaneous Intersections	Linden Road and Corunna Road	7	6	9	9
	Linden Road and Court Street	3	5	1	19
	Miller Road and Claude Avenue	1	1	0	0
	Miller Road and Elms Road	2	2	0	5
	Miller Road and Seymour Road	0	0	4	0
	Lahring Road and Torrey Road	1	1	0	0
	Bristol Road and Fenton Road	3	2	5	9
	Bristol Road and Van Slyke Road	2	4	0	7
	Bristol Road and Camden Avenue	2	0	0	0
	Fenton Road and Atherton Road	7	0	6	13

Represents intersections with a crash frequency of four or more

* Includes more than one intersection

Table 6.4. Crashes Related to Driver Behavioral Issues (cont.)

Description	Intersection Name	Total Crashes for Four Years of Data Combined (2001, 2002, 2003 and 2004)			
		Alcohol-Related Crashes	Crashes Involving Unbelted Drivers	Speeding Crashes	Red Light Running Crashes
Miscellaneous Intersections	Lapeer Road and State Road	3	1	3	6
	Lapeer Road and Vassar Road	2	0	0	1
	Genesee Road and Richfield Road	2	1	3	3
	Hill Road and Saginaw Road	2	0	0	2
	Hill Road and Dort Highway	3	2	1	7
	Hill Road and Center Road	1	0	1	5
	Saginaw Road and Dort Highway	7	1	1	4
	Saginaw Street and Fifth Avenue	3	8	1	12
	Saginaw Street and Pierson Road	6	4	5	12
	Saginaw Street and Mt. Morris Street	1	3	0	1
	Saginaw Street and Grand Blanc Road	0	0	1	2
	Saginaw Street and Reid/Bridge Road	0	2	0	1
	Calkins Road and Beecher Road	1	0	0	0
	Robert T. Longway and Cesar Chavez Drive*	8	4	4	84
	Cesar Chavez Drive and Second Street*	1	2	0	38
	Grand Traverse Street and Atherton Road*	6	3	1	36
	Dupont Street and Pasadena Avenue	6	5	2	17
	Ballenger Highway and Beecher Road	6	1	3	6
	Ballenger Highway and Court Street	1	1	2	12
	Center Road and Court Street	5	2	3	5
	Van Slyke Road and Twelfth Street	3	2	2	2
	Potter Road and Belsay Road	2	0	0	1
	Lapeer Road and Belsay Road	3	2	0	4
	Silver Parkway and Owen Road	7	1	0	1
	Owen Road and Donaldson Drive	2	2	2	3
	M-15 (State Road) and Flint Street	1	0	0	11
	M-15 (State Road) and Green Road	0	0	0	0
	M-15 (State Road) and Hegel/Erie Road*	0	0	1	0
	TOTALS	**122**	**80**	**72**	**361**

Represents intersections with a crash frequency of four or more

* Includes more than one intersection

Alcohol-Related Crashes

As shown in Table 6.4 (page 63), a total of 122 crashes occurred at the 48 study intersections involving drivers who were driving under the influence of alcohol during the four-year study period. The following 11 study intersections experienced four or more alcohol-related crashes in the four year analysis period and would be candidate locations for **enforcement programs**:

- Miller Road and NB I-75 (4 crashes in four-year analysis period)
- Linden Road and Corunna Road (7 crashes in four-year analysis period)
- Fenton Road and Atherton Road (7 crashes in four-year analysis period)
- Saginaw Road and Dort Highway (7 crashes in four-year analysis period)
- Saginaw Street and Pierson Road (6 crashes in four-year analysis period)
- Robert T Longway and Cesar Chavez Drive (8 crashes in four-year analysis period)
- Grand Traverse Street and Atherton Road (6 crashes in four-year analysis period)
- Dupont Street and Pasadena Avenue (6 crashes in four-year analysis period)
- Ballenger Highway and Beecher Road (6 crashes in four-year analysis period)
- Center Road and Court Street (5 crashes in four-year analysis period)
- Silver Parkway and Owen Road (7 crashes in four-year analysis period)

Unbelted Crashes

As shown in Table 6.4 (page 63), a total of 80 crashes involving unbelted drivers occurred at the 48 study intersections during the four-year study period. The following nine study intersections experienced four or more crashes involving unbelted drivers in the four year analysis period and would be candidate locations for **enforcement programs.**

- Miller Road and Lennon Road (4 crashes in four-year analysis period)
- Miller Road and NB I-75 (4 crashes in four-year analysis period)
- Linden Road and Corunna Road (6 crashes in four-year analysis period)

- Linden Road and Court Street (5 crashes in four-year analysis period)
- Bristol Road and Van Slyke Road (4 crashes in four-year analysis period)
- Saginaw Street and Fifth Avenue (8 crashes in four-year analysis period)
- Saginaw Street and Pierson Road (4 crashes in four-year analysis period)
- Robert T.Longway and Cesar Chavez Drive (4 crashes in four-year analysis period)
- Dupont Street and Pasadena Avenue (5 crashes in four-year analysis period)

It should be noted that the number of crashes involving drivers who were not wearing their seat belt at the time of the crash has been following a decreasing trend until 2003 and somewhat increased in Genesee County during 2004. As shown in Section 2.5, Figure 2.11, there were a total of 411 crashes in the entire county involving unbelted drivers in the year 2002, while in 1999 this crash frequency was 1,322 which is a reduction of 69 percent. In comparing 2003 data we find that it has increased to a crash frequency of 489, which is an increase of 19 percent from 2002. It is recommended that public awareness campaigns and enforcement programs be continued in this area.

Speeding-Related Crashes

As shown in Table 6.4 (page 63), a total of 72 speeding-related crashes occurred at the 48 study intersections during the four-year study period. The following eight study intersections experienced four or more speeding-related crashes in the four year analysis period and would be candidate locations for **enforcement programs**:

- Miller Road and Lennon Road (4 crashes in four-year analysis period)
- Miller Road and Ballenger Highway (4 crashes in four-year analysis period)
- Linden Road and Corunna Road (9 crashes in four-year analysis period)
- Miller Road and Seymour Road (4 crashes in four-year analysis period)
- Bristol Road and Fenton Road (5 crashes in four-year analysis period)

- Fenton Road and Atherton Road (6 crashes in four-year analysis period)
- Saginaw Street and Pierson Road (5 crashes in four-year analysis period)
- Robert T.Longway and Cesar Chavez Drive (4 crashes in four-year analysis period)

Midblock spot-speed studies were conducted as a part of this study on Miller Road . The results of the spot-speed studies are shown in Table 6.5.

Table 6.5. Results of Midblock Spot-Speed Studies at Selected Locations

Location	Speed Limit (mph)	Mean Speed (mph)	Standard Deviation	85th Percentile Speed (mph)
WB Miller Road (between Lennon Road and Linden Road)	45	37.8	6.9	41.4
EB Miller Road (between Lennon Road and Linden Road)	45	35.1	6.3	37.2
WB Miller Road (near Genesee Valley Shopping Area)	45	38.5	5.6	41.4
EB Miller Road (near Genesee Valley Shopping Area)	45	39.2	6.1	42.3

The results of the spot-speed studies indicate that the 85th percentile speeds do not exceed the posted speed limit at any of the spot-speed study locations. Excessive speeding does not seem to be a substantial issue on Miller Road between Lennon Road and Linden Road since the 85th percentile speed does not exceed the posted speed limit.

Red Light Running Crashes

As shown in Table 6.4 (page 63), a total of 361 crashes occurred at the 48 study intersections during the four-year study period which were related to red light running. The following 11 intersections experienced 10 or more red light running crashes in the four-year analysis period:

- Miller Road and Ballenger Highway (10 crashes in four-year analysis period)
- Linden Road and Court Street (19 crashes in four-year analysis period)
- Fenton Road and Atherton Road (13 crashes in four-year analysis period)
- Saginaw Street and Fifth Avenue (12 crashes in four-year analysis period)
- Saginaw Street and Pierson Road (12 crashes in four-year analysis period)
- Robert T.Longway and Cesar Chavez Drive (84 crashes in four-year analysis period)
- Cesar Chavez Drive and Second Street (38 crashes in four-year analysis period)
- Grand Traverse Street and Atherton Road (36 crashes in four-year analysis period)
- Dupont Street and Pasadena Avenue (17 crashes in four-year analysis period)
- Ballenger Highway and Court Street (12 crashes in four-year analysis period)
- State Road and Flint Street (11 crashes in four-year analysis period)

The recommended engineering countermeasures (modifying the traffic signals' yellow and all-red intervals) are expected to alleviate some of the red light running created by drivers who did not intend to run the red light, but may have been caught in a 'dilemma zone' when approaching the intersection during a yellow light. In order to alleviate problems with red light running, due to aggressive driving behavior, it is recommended to provide increased enforcement at the above-noted locations. It should be noted that it might be risky for police officers to cite offenders for red light running, based on traditional enforcement techniques, as they must follow them through the red light. However, there are some new technologies, which are currently being tested that allow police officers to safely observe red light runners downstream of the intersection.

Another method to discourage red light running would be to participate in a national **public awareness campaign**. The Federal Highway Administration sponsors an annual event entitled "Stop on Red" Week to discourage such behavior. More information can be found on the internet at http://safety.fhwa.dot.gov/fourthlevel/pro_res_srlr_week.htm. This type of campaign could impact red light running throughout the entire county.

The detailed analyses of the 48 study intersections are described in the following subsections. Each intersection includes a critical review of the physical and traffic characteristics of the roadway. The related condition, collision, and volume diagrams as well as capacity analyses are included. Finally, recommended improvements based on the existing characteristics are also given based on each individual intersection.