Noticed 03/25/26

PUBLIC NOTICE – COMMITTEE OF THE WHOLE

Committee of the Whole will meet Monday March 30, 2026 at 6:00 p.m. in the Auditorium at Lakewood City Hall, 12650 Detroit Ave. The meeting is open to the public.

The meeting will be livestreamed on the City's website.

The agenda is as follows:

Approval of the minutes of the March 16, 2026 Committee of the Whole.

Communication from Planning Department regarding Madison & Hilliard intersection study *(referred to COW 1/20/26)*

Sarah Kepple, Chair
COMMITTEE OF THE WHOLE

PUBLIC COMMENT PROTOCOL
The public is invited to comment on agenda items by submitting a written comment in advance of the meeting using the eComment platform. New users must create an eComment account. Committee Chairs may also accommodate in person public comment.

ADA PROTOCOL
Individuals with disabilities who require accommodations for participation in meetings must request accommodations at least 3 business days ahead of the scheduled meeting. Contact Michelle Nochta at (216) 529-5906 or michelle.nochta@lakewoodoh.gov.

City of Lakewood
Department of Planning
and Development

Angela Byington, Director
David Baas, AICP, Asst. Director

(216) 529-6630
planning@lakewoodoh.gov

January 20, 2026

City Council, City of Lakewood
12650 Detroit Avenue
Lakewood, OH 44107

RE: Madison Ave & Hilliard Road – Safety Analysis Study (Iteris)

Dear President Kepple,
In coordination with the Public Works Department, the enclosed study covering the Madison/Hilliard intersection is provided for reference. The Madison/Hilliard safety analysis study – which considered the main intersection as well as the Carabel and Orchard Grove intersections – was conducted from April to October of 2025 and included:

- Field surveys of the intersection(s) and all current traffic control measures, signals, & operation/cycles;
- Collection/analysis of historic and current traffic data;
- Study of the past five years of accident reports; and
- Study of safety improvement alternatives and determination of subsequent recommendations.

The recommendations outlined by this study include and build upon those provided for this intersection by the Active Transportation & Safe Streets for All (SS4A) Plans.

In consultation with the Traffic Engineer who conducted the study, the City has already implemented several of the study's short-term recommendations this past spring/summer and will continue to work to implement many of the remaining short-term actions during this coming year. Longer-term recommendations – especially changes requiring roadway demolition/construction – will be considered per the City's Complete Streets Ordinance.

It is requested that this study be referred to the appropriate committee for further/more detailed discussion as appropriate.

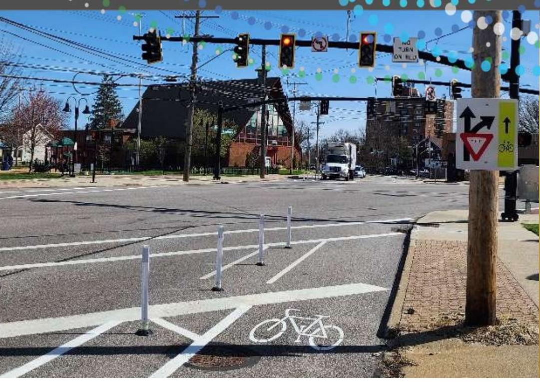
Sincerely,

David Baas, AICP
Assistant Director

Madison Ave & Hilliard Rd/Carabel Ave Safety Analysis Study

Final Version

January 2026



PREPARED FOR:

City of Lakewood
Division of Engineering & Construction
12650 Detroit Avenue
Lakewood, OH 4417

PREPARED BY:

Iteris, Inc
1907 N US 301, Suite 120
Tampa FL 33619

DOCUMENT VERSION CONTROL

DOCUMENT NAME	SUBMITTAL DATE	VERSION NO.
Draft	August 30, 2025	1.0
Draft	September 30, 2025	2.0
Draft Final	October 9, 2025	2.1
Final	January 13, 2026	Final

EXECUTIVE SUMMARY

The City of Lakewood, Ohio, is conducting a safety study at the Madison Ave and Hilliard Rd/Carabel Ave intersection to address crash history, operational issues, and the needs of all travel modes. The study reviews existing conditions, identifies safety deficiencies, and evaluates potential countermeasures and design alternatives for effectiveness, consistency with standards, and feasibility within the current roadway context.

The recommendations are listed as short-term and long-term. Short-term recommendations are those that can be implemented quickly with relatively little expense. Long-term are those that may require geometry improvements and would have a higher cost; but may add a larger benefit overall. Refer to **Figure 21** for a graphic illustrating these recommendations.

Short-term Recommendations

The short-term recommendations include:

1. Protected-only left turns for the eastbound and westbound left turns on Madison Ave
2. Leading Pedestrian Intervals for all directions
3. High visibility crosswalk markings (in place)
4. Green pavement markings and delineation for bike lanes (in place)
5. No turn on red signs (in place)
6. Accessible Pedestrian Signals for all crossings
7. Updates to local intersection safety intervals
8. Signal coordination during STOP
9. Convert Orchard Grove to Right in-Right out

The total cost for implementing the recommended short-term improvements is estimated to be between $13,200 and $19,000. The Accessible Pedestrian Signals (APS) represent the largest single expense but are strongly recommended when using LPIs. If the City installs the equipment, costs are likely to fall toward the lower end of this range.

Long-term Recommendations

The short-term recommendations include:

1. Tight Corner Radii/Reduced Curb Radius, Curb Bulb-Outs, Curb Extensions
2. Automated Pedestrian Detection with Blank-Out Signs, controller features and analytics
3. Flashing Yellow Arrow Operation
4. Add auxiliary signal indications on the right-side signal support

The total cost for implementing the recommended long-term improvements is estimated to be between $176,000 and $486,000. These could be considered for future implementation once the lower-cost options have been in place for a sufficient period. This phased approach allows the initial, more affordable improvements to be tested and evaluated for effectiveness before committing additional resources to higher-cost measures.

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1 INTRODUCTION

1.1 Purpose

The City of Lakewood, Ohio, has initiated a comprehensive safety study focused on the intersection of Madison Ave and Hilliard Rd/Carabel Ave, a critical node in the City's roadway network. The purpose of this study is to evaluate engineering and operational alternatives that will enhance safety and improve traffic operations at this location. The study is being undertaken in response to documented crash history, operational challenges, and the need to better accommodate all modes of travel.

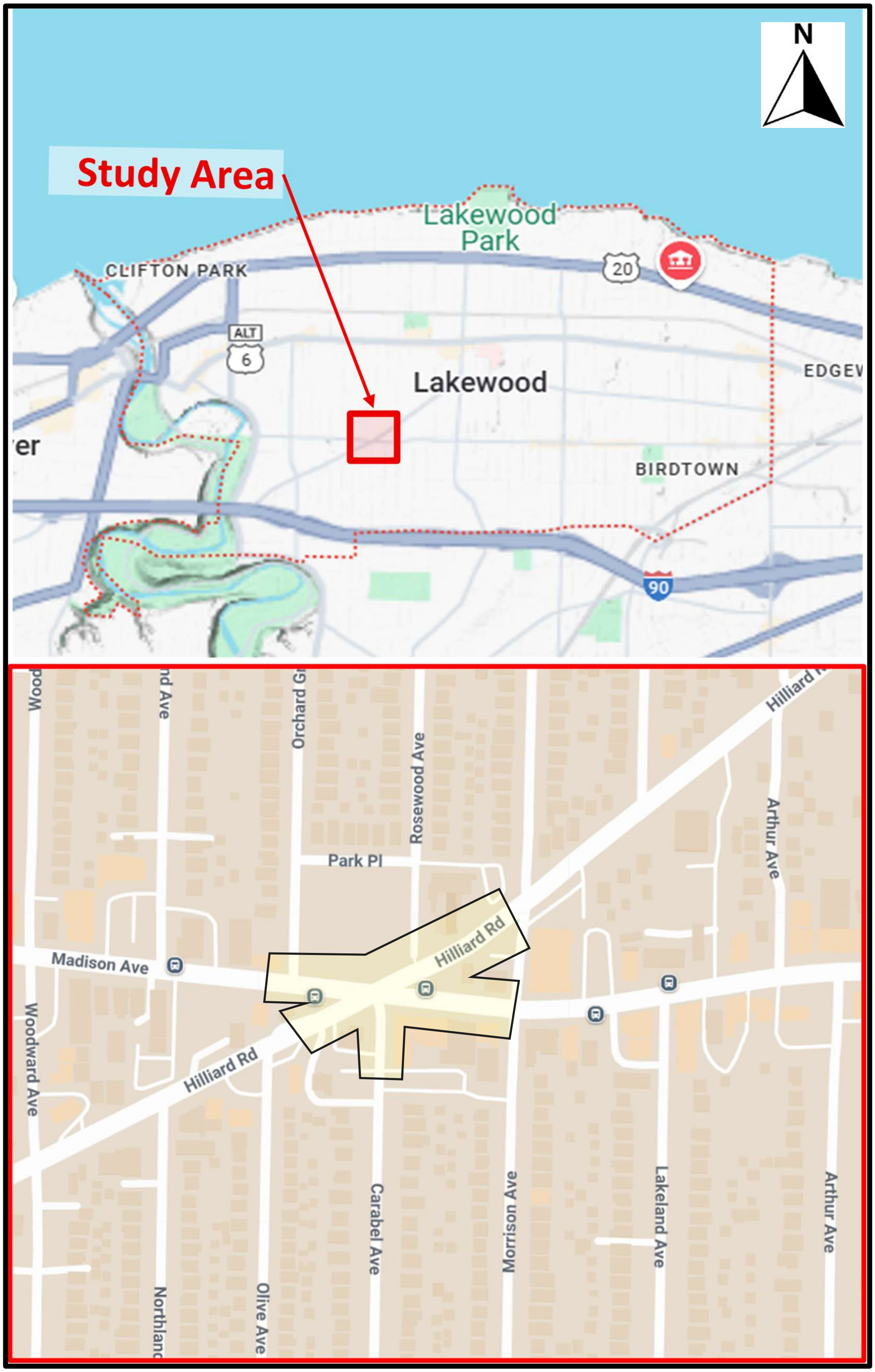
Emphasis is placed on the safety of vulnerable road users, including pedestrians and bicyclists, who are at increased risk of severe injury in collisions. The Madison Ave and Hilliard Rd/Carabel Ave intersection serves a mix of residential, commercial, and transit-related activity, resulting in high levels of pedestrian movement and multimodal interaction. Addressing safety at this location is therefore critical to advancing Lakewood's broader transportation and community development objectives.

The scope of work includes a review of existing crash data and traffic operations, identification of safety deficiencies, and the development and comparison of potential countermeasures and design alternatives. These alternatives will be assessed with respect to their effectiveness in mitigating documented safety concerns, their consistency with applicable design standards and best practices, and their feasibility for implementation within the existing roadway and land use context.

The results of this study will provide the City of Lakewood with a data-driven framework to prioritize safety improvements at Madison Ave and Hilliard Rd/Carabel Ave and advance the City's transportation safety objectives.

Figure 1 on the following page illustrates the study location.

Figure 1 – Study Area – Madison Ave & Hilliard Rd/Carabel Ave



1.2 Existing Geometric Conditions

Madison Ave and Hilliard Rd/Carabel Ave is a five-leg signalized intersection. Madison Ave is an east to west corridor that extends through the entire City. Hilliard Rd is a northeast to southwest corridor that starts in the southwest portion of the City and extends northeast to Franklin Blvd/Warren Rd. Figure 2 is an aerial image of the existing intersection.

Figure 2 – Madison Ave & Hilliard Rd/Carabel Ave Aerial View

The geometry at the intersection is described below.

- Madison Ave Eastbound Approach (refer to **Figure 3**)
    - **Lane 1** (inside): Exclusive left-turn only lane, developed from the upstream two-way left-turn lane (TWLTL), approximately 11’ wide.
    - **Lane 2** (middle): Shared through/right-turn lane, approximately 11’ wide.
    - **Lane 3** (outside): Exclusive bicycle lane, extending to the intersection stop line and is approximately 4’ wide. The bicycle lane is channelized with a solid white line and transitions to a skip line approximately 130’ away from the stop bar.
    - **Lane 4** (curbside): Exclusive on-street parking lane, located to the right of the bicycle lane.
    - The eastbound left turn is a 5-section protected/permissive left turn movement.
    - The approach is signed to prohibit right turns on red.

Figure 3 – Madison Ave Eastbound Approach

- Madison Ave Westbound Approach (refer to **Figure 4**)
  - **Lane 1** (inside): Exclusive left-turn only lane, developed from the upstream two-way left-turn lane (TWLTL), approximately 11' wide.
  - **Lane 2** (middle): Shared through/right-turn lane, approximately 11' wide.
  - **Lane 3** (outside): Exclusive bicycle lane, extending to the intersection stop line and is approximately 4' wide. The bicycle lane is channelized with a solid white line and transitions to a skip line approximately 130' away from the stop bar.
  - **Lane 4** (curbside): Exclusive on-street parking lane, located to the right of the bicycle lane.
  - The westbound left turn is a 5-section protected/permissive left turn movement.
  - The approach is signed to prohibit right turns on red.

Figure 4 – Madison Ave Westbound Approach

- Hilliard Rd Northeast Approach (refer to **Figure 5**)
  - **Lane 1** (inside): Single lane for the through and shared with the right turn movement. Left turn and U-Turn movements are prohibited.
  - **Lane 2** (curbside): A dedicated bicycle lane approximately 4 feet wide, extending to the intersection stop line. It includes a 2-foot painted buffer separating it from the adjacent through/right vehicle lane. Near the intersection, the lane is highlighted with green pavement markings. Flexible delineators have been installed by the City in the buffer lane to provide physical separation between the bike lane and the adjoining travel lanes.
  - The approach is signed to prohibit right turns on red.

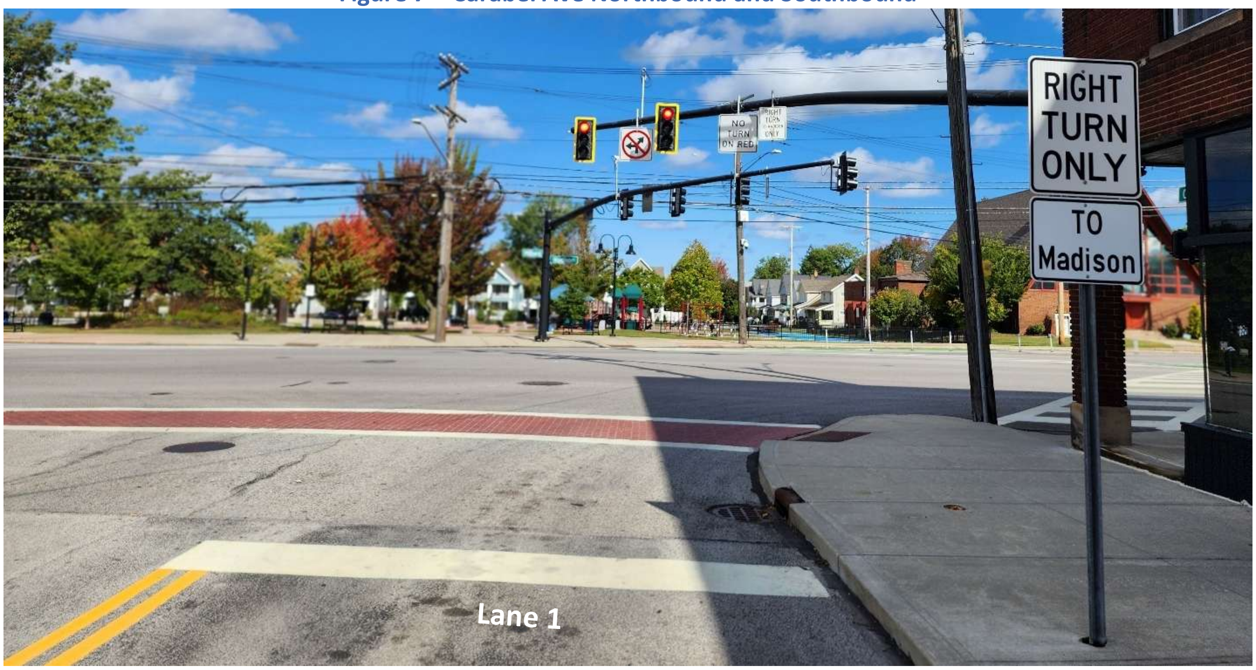
Figure 5 – Hilliard Rd Northeast Approach

- Hilliard Rd Southwest Approach (refer to **Figure 6**)
    - Lane 1 (inside): Single lane for the through and shared with the right turn movement. Left turns and U-Turn movements are prohibited.
    - Lane 2 (curbside): A dedicated bicycle lane approximately 4 feet wide, extending to the intersection stop line. It includes a 2-foot painted buffer separating it from the adjacent through/right vehicle lane. Near the intersection, the lane is highlighted with green pavement markings. Flexible delineators have been installed by the City in the buffer lane to provide physical separation between the bike lane and the adjoining travel lanes.
    - The approach is signed to prohibit right turns on red.

Figure 6 – Hilliard Rd Southwest Approach

- Carabel Ave Northbound Approach and Southbound (refer to **Figure 7**)
  - **Lane 1**: Carabel Ave is a signal lane approach and only allows northbound right turns onto eastbound Madison Ave.
  - The northbound right movement operates during the same phase as the westbound left from Madison to Hilliard Rd/Carabel Ave.
  - The approach is signed to prohibit right turns on red.

Figure 7 – Carabel Ave Northbound and Southbound



2 DATA COLLECTION

2.1 24-Hour Volumes

The 24-hour traffic count data was collected on Madison Ave near Orchard Grove Ave and was obtained from the Ohio Department of Transportation (ODOT) Transportation Information Mapping System (TIMS) at a location near Arthur Ave. These two different 24-hour counts were used to illustrate the various traffic patterns that occur during a typical day on Madison Ave. The weekday Average Daily Traffic (ADT) volume near Orchard Grove is approximately 7,000 vehicles and the ADT for the segment to the near Arthur Ave is approximately 11,400 vehicles. The data and plots are included in the Appendix.

2.2 Turning Movement Counts

Turning movement counts were collected by the Iteris Team at the following intersections:

- Madison Ave & Hilliard Rd/Carabel Ave
- Madison Ave & Orchard Grove Ave

This data is collected to be modeled in the traffic analysis software, Synchro which is utilized to analyze alternatives and to develop signal timings. So, it was important to collect data on dates where volumes were typical since the developed models would be utilized to develop the initial timings.

The full details on turning movement counts are included in the Appendix.

2.3 Traffic Signal Timing and Phasing

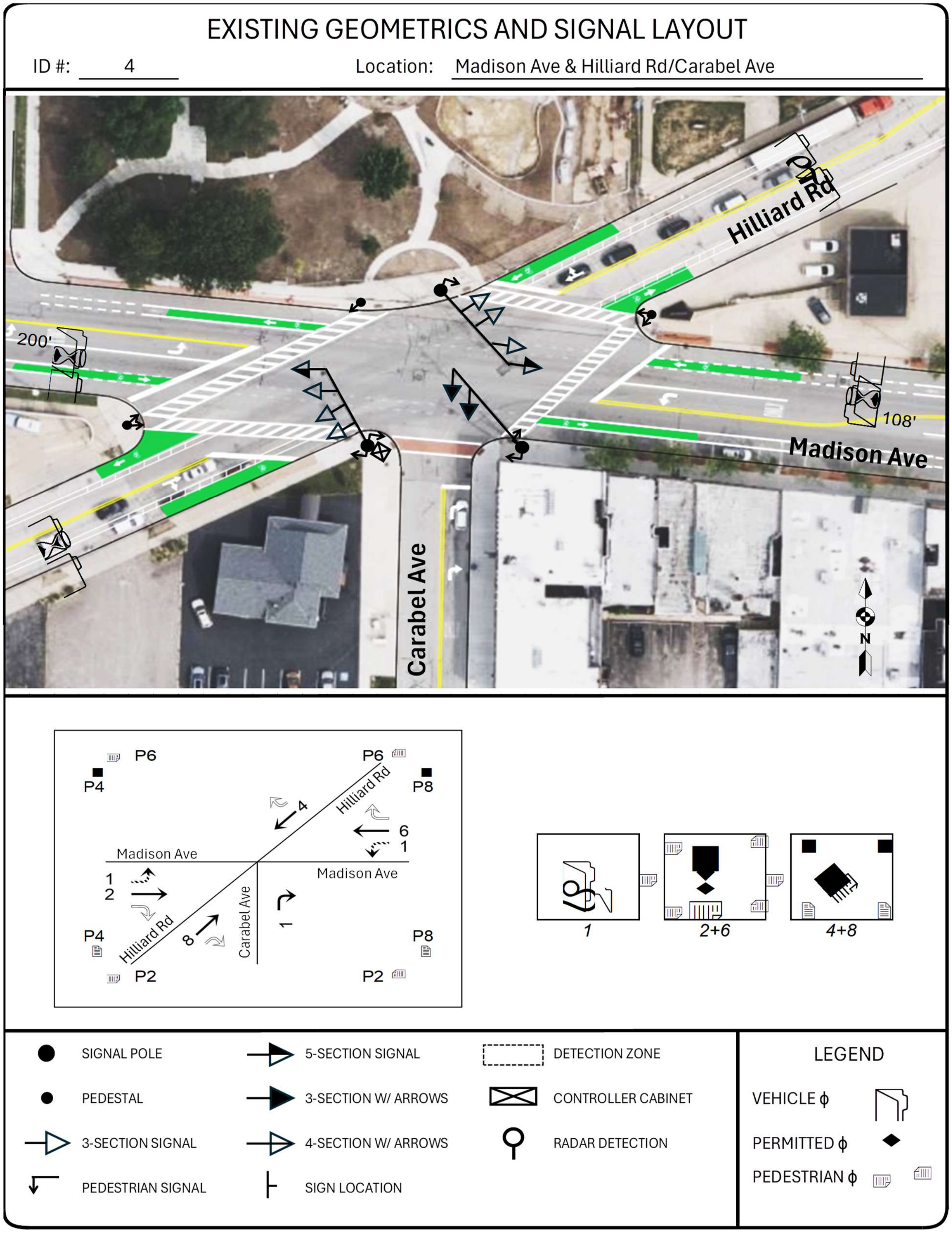
Existing controller data was obtained from the City via an upload from the central platform, Trafficview 32. The intersection is a model 2070E with Wapiti firmware (see **Figure 8**). The existing signal layout and traffic signal phasing is shown in **Figure 9**.

Figure 8 – Madison Ave & Hilliard Rd/Carabel Ave (2070 controller Unit)

2.4 Field Notes

Field notes were collected by Iteris staff in April 2025 on various signal and traffic characteristics to assist in model development and alternatives analysis. For each approach, vehicle and pedestrian clearance distances were measured. Vehicle detection was checked, and pedestrian push buttons were tested for proper operation. Field notes and photos can be found in the Appendix.

Figure 9 – Madison Ave & Hilliard Rd/Carabel Ave Signal Layout and Phasing



3 SITE SURVEY

Prior to conducting any analysis, a site survey was performed to observe the signal equipment in the cabinet and operation of the traffic signal as well as the geometric, traffic, and signal timing characteristics of the study area. Observations were conducted in April 2025 to develop an understanding of traffic characteristics and issues in the corridor and determine potential modifications that could improve the intersection safety and operations.

3.1 Existing System Operation

The current intersection operates through central based coordination with adjacent intersections along Madison Ave. Table 1 lists the times and cycle lengths currently operating at the subject intersection.

Table 1 – Madison Ave & Hilliard Rd/Carabel Ave Schedule and Cycle

Period	Days	Times	Function	Cycle
Early Morning	Mon-Fri	12:00 AM to 7:00 AM	20	Free*
AM Peak	Mon-Fri	7:00 AM to 9:00 AM	2	70 sec
Mid-Day Peak	Mon-Fri	9:00 AM to 3:00 PM	2	70 sec
PM Peak	Mon-Fri	3:00 PM to 7:00 PM	3	140 sec
Evening/Night	Mon-Fri	7:00 PM to 12:00 AM	20	Free
Weekend	Sat-Sun	All Day	20	Free

* During Free operation, the intersection does not run with a background cycle, therefore it is not coordinated with the neighboring intersections.

3.2 General Observations

The study intersection of Madison Ave & Hilliard Rd/Carabel Ave is characterized by a skewed angle of approximately 35 degrees between Hilliard Rd and Madison Ave creating a wide footprint. This alignment significantly increases crossing distances for pedestrians, in some cases extending beyond standard thresholds recommended for urban signalized locations. The longer crossing paths elevate pedestrian exposure times and require extended clearance intervals, thereby reducing operational efficiency and safety.

Further compounding these issues, the intersection includes the fifth leg approach to Carabel Ave. The additional approach increases the number of conflict points and overall size of the intersection. For pedestrians, this configuration necessitates multi-stage crossings, potentially requiring individuals to wait through multiple phases to complete a single movement. These conditions are known to reduce compliance with pedestrian signals and increase risk-taking behaviors.

From the vehicular perspective, the skewed alignment and additional approach contribute to nonstandard turning paths, challenging sight lines, and irregular curb radii. These conditions can lead to hesitation, erratic vehicle maneuvers, and reduced driver awareness of pedestrians within crosswalks. The lack of direct, intuitive crossing paths further diminishes pedestrian wayfinding and accessibility, particularly for vulnerable users such as the elderly or visually impaired.

3.3 Multi-Modal Operation

In addition to vehicle traffic, Madison Ave, and the surrounding street network convey travelers using all modes, including transit, walking, and biking. **Figure 10** illustrates these modes of operation along Madison

Ave. As previously noted, a major goal of this signal timing project is to improve the safety and operation for motorists, transit vehicles, pedestrians, and bicyclists.

Figure 10 – Study Area Bus, Bicycle and Pedestrian Activity

3.3.1 Pedestrians

The study area is very inviting to pedestrian activity with the land use mixes near the intersection from commercial, business, restaurants, community, recreational, school, and other attractions. On the northwest corner is Wagar Park. The adjacent land uses to the north and south is primarily residential. Sidewalks exist throughout the study area. Crosswalk pavement markings are currently present on all approaches and are transverse (parallel) white lines (see **Figure 10**).

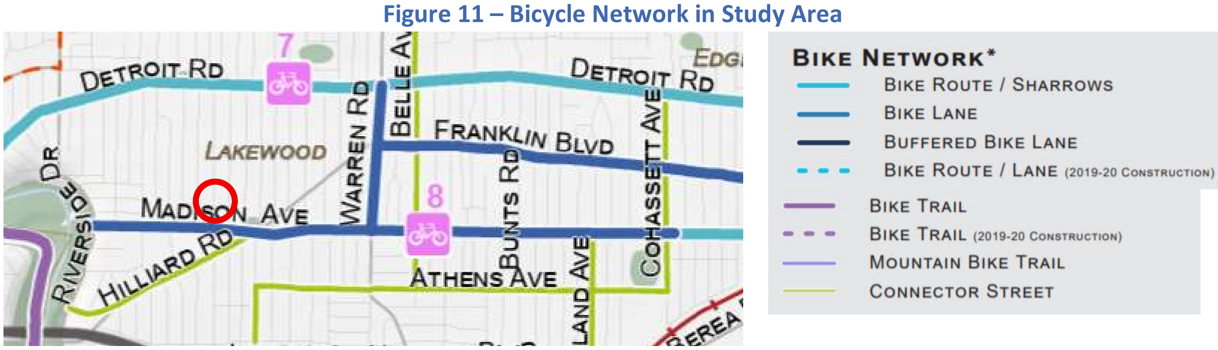
There are several schools near the study area, and there is significant school age pedestrian traffic near the start and end of the school day. The schools that lie within a short walking distance of the intersection:

- Harding Middle School (Grades 6-8) — approximately 0.1 miles away
- Hayes Elementary School (Grades PK-5) — around 0.4 miles away
- Grant Elementary School (Grades PK-5) — about 0.5 miles away
- Lakewood High School (Grades 9-12) — roughly between 0.8 and 1 mile away

3.3.2 Bicycles

As with pedestrians, the study area is conducive to bicycle activity. **Figure 11** illustrates the bicycle network in the study area. To note, the map is out of date as Hilliard Rd in the study arrow includes dedicated, buffered bike lanes. Recently, the City added raised delineators in the buffer area on Hilliard Rd the vicinity of the intersection. In addition, green pavement marking has been added to the bicycle lanes near the intersection.

Figure 11 – Bicycle Network in Study Area



Source: NOACA Bike Map for Cuyahoga County

3.3.3 Transit

In addition to passenger vehicles and pedestrian traffic, the study area is relevant to transit modes. The Greater Cleveland Regional Transit Authority (GCRTA) operates Route 25 along Madison Ave. This route provides service along Madison Avenue in Lakewood with operating hours that extend from early morning until nearly 2 a.m., making it accessible throughout most of the day and night. On weekdays, buses typically arrive every 30 to 60 minutes, with more consistent service during peak travel times and longer waits during off-peak hours. Weekend service follows a similar pattern, maintaining coverage but generally at the lower end of the frequency range. This makes Route 25 a reliable but moderately spaced option for daily commuting and local trips.

Figure 12 illustrate these RTA routes in the study area.

Figure 12 – RTA Route 25 along Madison Ave

Source: GCRTA Service Map

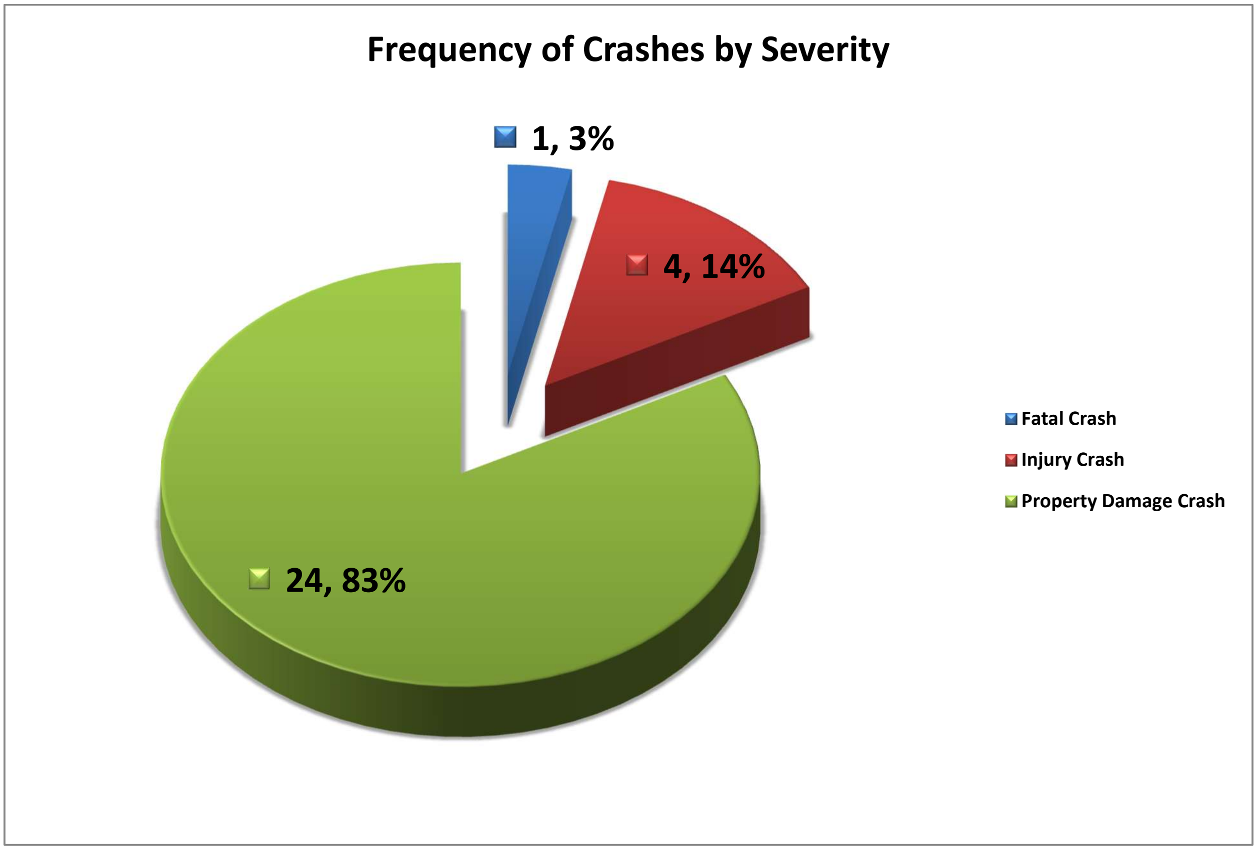
4 CRASH ANALYSIS

An analysis was completed to evaluate the safety history of the intersection based on five (5) years of crash data. The crash analysis includes a summary of crash history by year, type, severity, weather, type, and if alcohol was a contributing factor. The City of Lakewood provided the crash data for the years 2020 through 2024. Detailed raw crash data can be found in the Appendix.

4.1 Crashes by Severity

Crash severity is summarized as being fatal crash, injury crash, or property-damage crash. **Figure 13** illustrates the historical crashes by severity for the intersection.

Figure 13 – Madison Ave & Hilliard Rd Frequency of Crashes by Severity



The severity analysis illustrated the following:

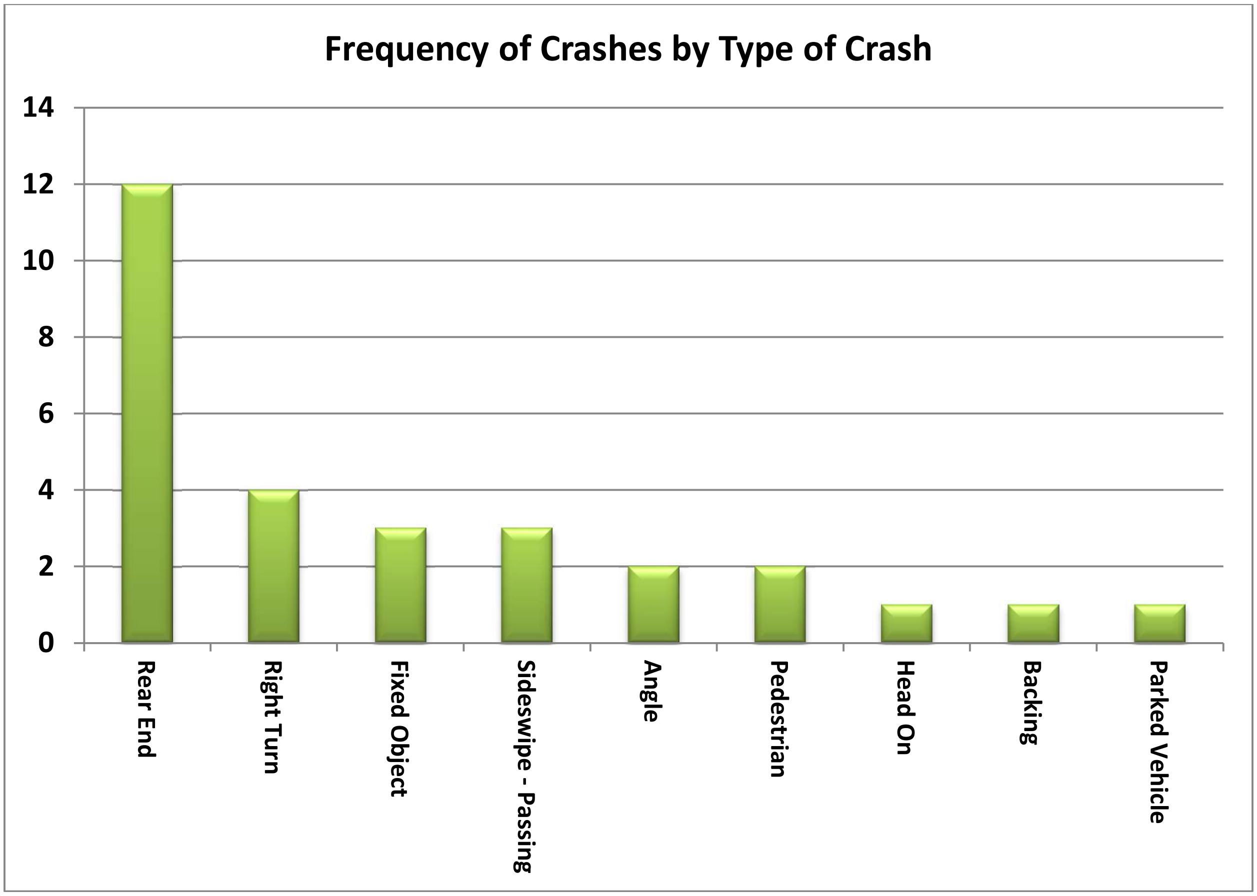
- There was one fatal crash that occurred in 2024.
- Most of the study area corridor crashes are comprised of property damage only crashes, 83 percent of all crashes.
- Injury crashes were the second most common, 14 percent of all crashes.

Two of the serious crashes have raised significant safety concerns. In December 2024, a pedestrian was fatally struck while crossing Madison Avenue near the intersection, leading to criminal charges against the driver who was speeding. In March 2025, a vehicle collided with a bicycle pulling a child trailer carrying two young passengers, who sustained injuries; the driver was cited for failing to yield.

4.2 Crashes by Type

Figure 14 illustrates the historical crashes by type for the intersection.

Figure 14 – Madison Ave & Hilliard Rd Frequency of Crashes by Type



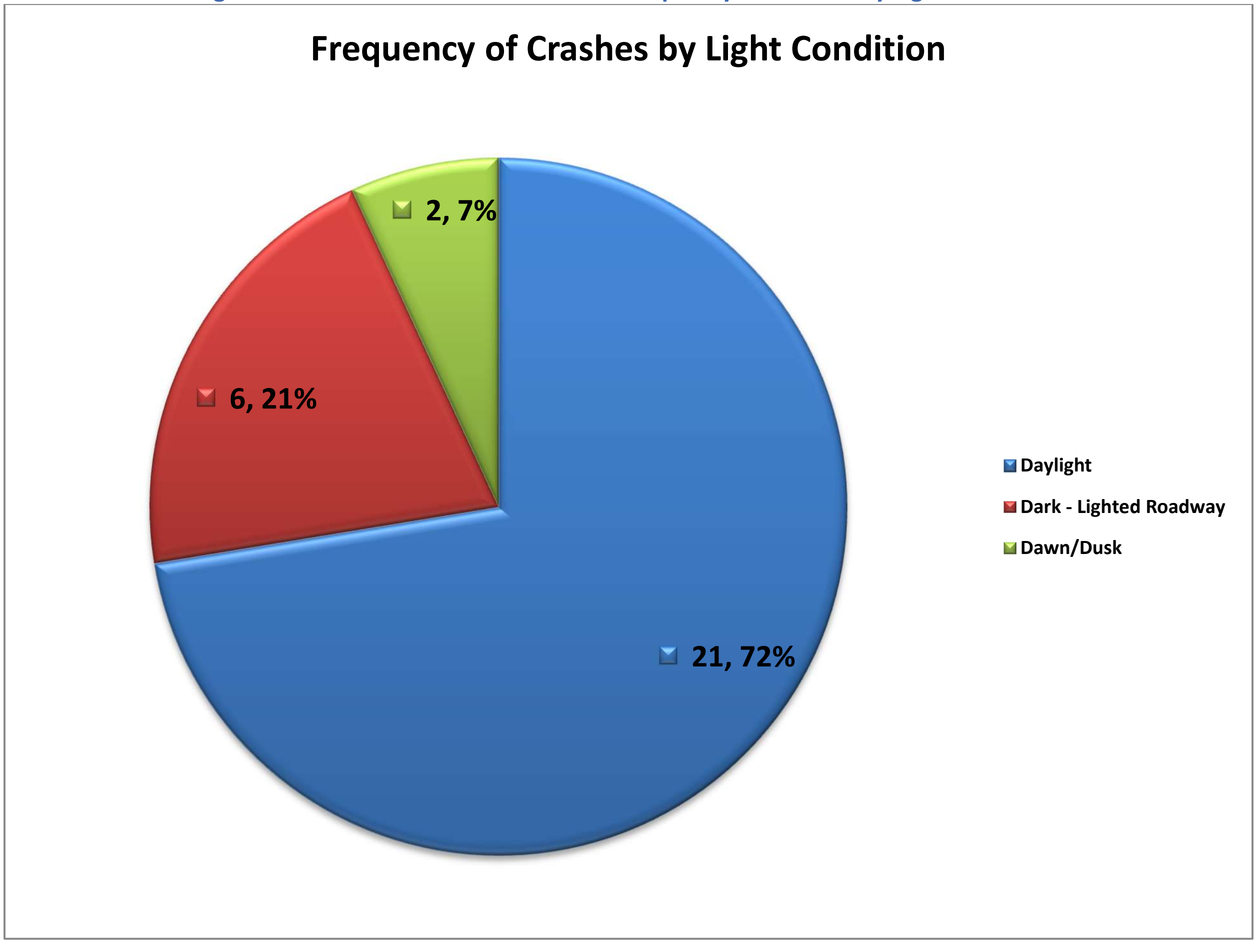
Rear-end crashes represent the largest portion of the crashes (41%), with two right turns at 14%. Rear-end crashes are the most frequent type at signalized intersections, caused by sudden stopping when a indication changes or from following too closely. The right turn crashes could be applicable to the large geometry and vehicles using bicycle lanes for turning. Note that the City has recently taken action to prevent vehicles from using bicycle lanes for right turns.

In summary, the crash analysis indicates that the intersection experienced one fatal crash involving a pedestrian struck by a speeding vehicle, which occurred during nighttime hours. In contrast, the majority of crashes took place during daylight conditions, reflecting typical exposure patterns from higher traffic volumes. The most frequent crash type recorded was rear-end collisions, which is consistent with trends at signalized intersections where frequent stopping and queuing occur.

4.3 Frequency of Crashes by Light Condition

Figure 15 illustrates the historical crashes of crashes by light condition.

Figure 15 – Madison Ave & Hilliard Rd Frequency of Crashes by Light Condition

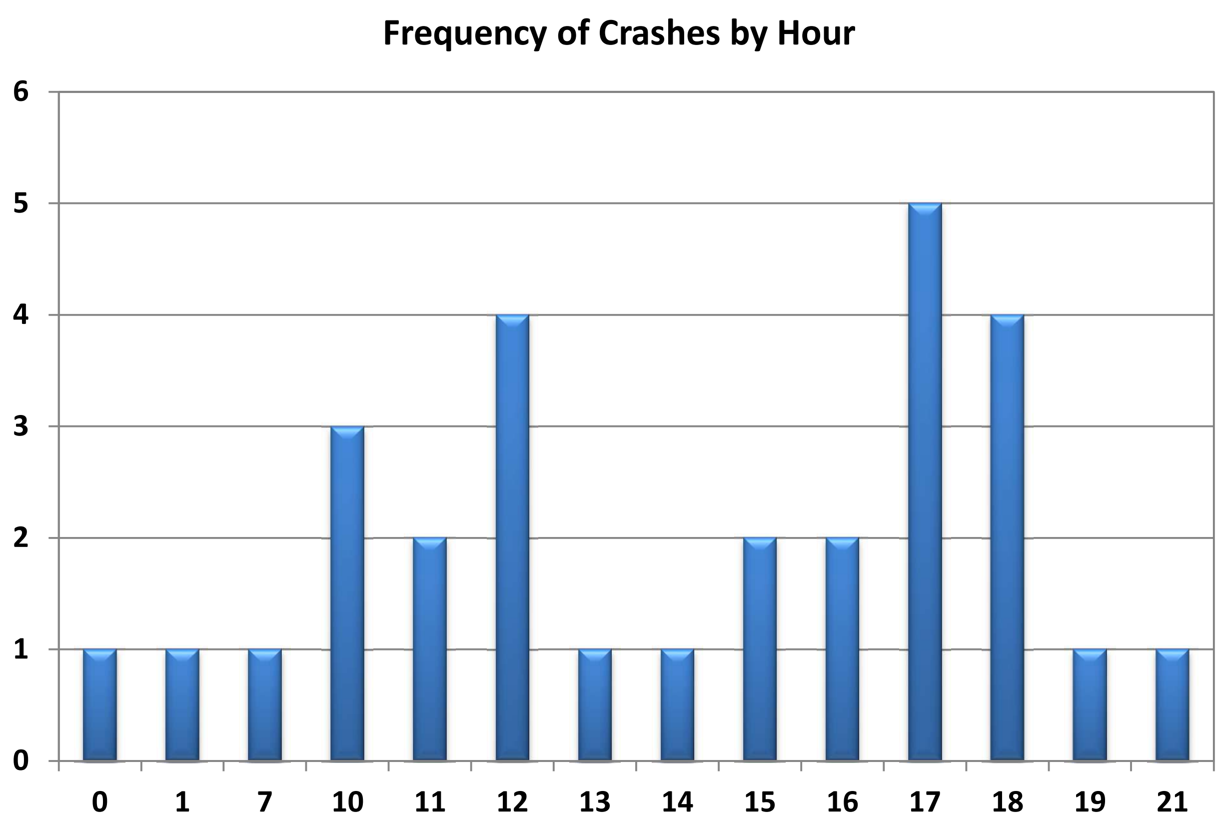


Analysis shows that 72% of crashes occur during daytime hours, which is not uncommon given that traffic volumes are significantly higher during this period. The fatal accident did occur during dark (lighted) roadway conditions with wet pavement.

4.4 Frequency of Crashes by Hour

Figure 15 illustrates the historical crashes of crashes by hour of the day.

Figure 16 – Madison Ave & Hilliard Rd Frequency of Crashes by Hour of the Day



Crash data by time of day shows a clear concentration during daylight and early evening hours. Crash frequency began to rise mid-morning, with three crashes at 10 a.m. and two at 11 a.m., peaking around midday with four crashes at noon. Afternoon activity remained steady, with one to two crashes reported each hour between 1 p.m. and 4 p.m. The highest frequency occurred at 5 p.m. with five crashes, followed by four crashes at 6 p.m. After 7 p.m., only sporadic incidents were recorded, with one crash each at 7 p.m. and 9 p.m. Overall, the majority of crashes occurred between late morning and early evening, coinciding with peak traffic volumes.

5 TRAFFIC OPERATIONS ANALYSIS

5.1 Model Development

Synchro models were developed for the existing conditions to represent the weekday AM Peak, Mid-day Peak and PM Peak hours. Once volumes, existing geometries and signal timings were validated, these were input into the model to develop base existing conditions.

5.2 Intersection Performance Measures

Operations analysis were conducted using the traffic models for each of the periods with existing signal timings. This analysis established a benchmark by which traffic operations with implemented signal timings are compared to potential alternatives.

Synchro was used to determine the delay (in seconds per vehicle) for each lane group as well as the delay and level of service (LOS) for the intersection. The intersection capacity utilization (ICU) and LOS were also determined for each intersection. The delay, LOS, and ICU for each intersection can be found in the Synchro reports found in the Appendix.

In general, intersections may experience an increase in overall intersection delay when 1) the cycle length is significantly adjusted from its optimal cycle length to provide coordination, 2) green times are allocated with the objective of providing maximum progression on the major street, or 3) vehicle and pedestrian change and clearance times are increased.

Table 2 below, summarizes the existing delay and level of service (LOS) for Madison Ave & Hilliard Rd-Carabel Ave.

Table 2 – Madison Ave & Hilliard Rd-Carabel Ave Existing Conditions Delay and LOS

Measure	AM Peak	Mid-Day Peak	PM Peak
Delay (sec/veh)	22	20	39
LOS	C	C	D

These results will be used to compare with recommended solutions to see how this impacts traffic operations.

6 ALTERNATIVES ANALYSIS

6.1 Introduction

The following section presents an evaluation of potential safety improvement alternatives for the signalized intersection of Madison Avenue and Hilliard Road. Each alternative was developed to address identified safety concerns, with particular emphasis on enhancing conditions for vulnerable road users such as pedestrians and bicyclists, while maintaining efficient vehicular operations. The analysis considers the operational effectiveness, safety benefits, feasibility, and potential impacts of each alternative. Alternatives that do not sufficiently meet the project objectives are documented for transparency, while the recommended alternative(s) are advanced for further consideration.

To facilitate a clear and consistent evaluation, the alternatives are organized into three categories: traffic signal operations and upgrades, geometric, delineation, and signing treatments, and safety technologies. This framework provides a logical structure for comparing improvements that focus on signal phasing and coordination, roadway configuration and visibility, and the application of innovative safety measures.

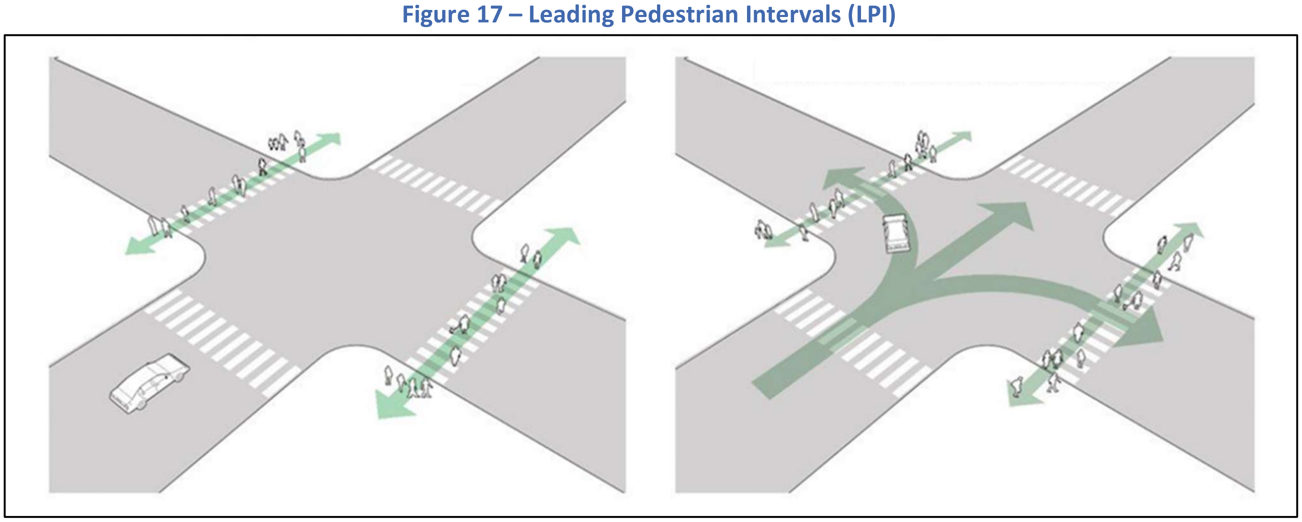
6.2 Traffic Signal Operations and Upgrades

This category evaluates improvements to the existing signal system that could enhance both safety and operational efficiency. Potential strategies include adjustments to signal phasing and timing to reduce conflicts, implementation of leading pedestrian intervals (LPIs) to provide pedestrians a head start before turning vehicles, and consideration of protected-only left turn phasing to mitigate angle crashes. Additional upgrades such as signal coordination, adaptive timing, or updated controller hardware are also assessed to determine their feasibility in improving overall intersection safety and efficiency.

6.2.1 Leading Pedestrian Interval Crossing Madison Ave

A Leading Pedestrian Interval (LPI) is a traffic signal timing feature that gives pedestrians a head start, usually 3 to 7 seconds, to enter the crosswalk before vehicles get a green light for turning movements. This makes pedestrians more visible to drivers before vehicles start moving. It reduces conflicts with turning traffic (especially right turns on green)and improves safety at busy intersections or those with high pedestrian volumes. An LPI is activated during the “Walk” phase, but before the parallel vehicle phase turns green. These are most effective where turning traffic often fails to yield and can reduce pedestrian-vehicle collisions by up to ~60% in certain settings.

Figure 17 – Leading Pedestrian Intervals (LPI)



This is an easy and effective update for the pedestrians crossing Madison Ave as the left turns from Hilliard Rd are prohibited. For pedestrians crossing Hilliard Rd, there can be issue with the operation when the conflicting left turns include a permitted phase, as the currently do. If using an LPI for pedestrians across Hilliard Rd (East-West), the left turn operation would need to be modified. The problem is during the transition from the left turn arrow to the circular green indication. The left turn indication may bring up the green indication while the green indication for the through movements is delayed. This is confusing for drivers and not recommended. Possible solutions include: 1) Implementation of a FYA; 2) changing the left turns to Protected Only; 3) Changing the left turns to lagging lefts; 4) Prohibiting the left turn movements.

The existing controller has an advanced walk feature that behaves exactly like an LPI and this can be implemented immediately. The one consideration is that it will delay the adjacent through movements, so timing will need to be adjusted to account for this to prevent unnecessary delay. This will be done via this project and fine-tuned during the Madison Ave STOP. Accessible Pedestrian Signals (APS) are highly recommended when using LPI (see below).

This treatment is recommended as it is low cost and can be handled in a short time frame.

6.2.2 Signal Retiming and Coordination

During the signal timing process, the clearance (safety) intervals will be updated to current standards. This is to include the pedestrian walk and flashing don't walk intervals, along with vehicular yellow and red clearance intervals.

The existing signal operates with currently acceptable pedestrian FDW times, however, adding in LPI as previously mention can greatly improve operation. New timing parameters will be developed for this project, along with adjacent intersections during the planned retiming of Madison Ave under the Signal Timing Optimization Project (STOP).

Under the existing timing, the cycle at Madison and Hilliard is relatively long at 140 seconds during the PM Peak. This can create excess waiting time for pedestrians that may become non-compliant. It may be possible to reduce the cycle length but this needs to be done wholistically and will be considered during the STOP project.

This is a recommended strategy and basic timing parameters (Walk, FDW, Yellow and Red Clear) are included as part of this project. A wholistic approach with adjacent intersections will be performed with the Madison STOP project.

6.2.3 Pedestrian Countdown Signals

The pedestrian countdown indication displays the remaining time to cross and helps pedestrians make safer crossing decisions. They do show slight safety improvements (about 5 to 10%) and do boost compliance.

Countdown indications are currently present.

6.2.4 Accessible Pedestrian Signals

An Accessible Pedestrian Indication (API) is a crosswalk signal feature that provides non-visual cues—such as audible tones, speech messages, or vibrotactile feedback—to help people with vision or hearing impairments know when and where to cross.
Key points:

- Activated by pressing the pedestrian pushbutton.
- Often includes a locator tone to help find the button.
- Gives a distinct walk indication (tone, speech, or vibration) when it’s safe to start crossing.

- May include countdown or orientation cues during the crossing phase.
- Required in many places under ADA guidelines when new signals are installed or majorly upgraded.

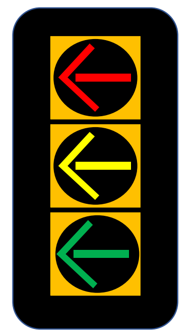
In addition to the key points to the right, can provide clear verbal notification for pedestrians to "wait" during non-walk intervals, thereby increasing compliance.

Implementation at the subject location is likely feasible, however, would want to have a follow-up discussion with the signal shop for unforeseen issues (i.e., wiring or structural concerns).
If LPI is implemented as recommended above, APS is highly desirable for visually impaired individuals as they use verbal cues from adjacent vehicles to know when the walk indication is on if there is no APS.

In general, this would be moderate cost provided additional structural items are not required, but this is not anticipated. APS is recommended, in particular with the addition of LPI.

6.2.5 Protected Only Left Turn Phasing

Protected left turn operation would replace the existing 5-section signal indication thereby eliminating the left turn conflict with pedestrians crossing Hilliard Rd. This has been shown to reduce pedestrian crashes.



The FYA has more advantages, however, this is a fix that is more well known, at least in the City. It does create extra delay, and could create non-compliance as left turns have to wait for a green arrow and cannot proceed, even when they can clearly see no oncoming traffic.

This is a relatively low cost alternative and a straight forward swap of the existing 5-second indications with the 3-section protected only. FYA is more desirable, however, this is an option if additional investigation shows the FYA to be unfeasible.

6.2.6 Flashing Yellow Arrows (FYA)

A Flashing Yellow Arrow allows permissive left turns while still highlighting the need to yield to oncoming traffic and pedestrians. It has been widely adopted as a safer alternative to the traditional circular green indication for permissive left turns.
For pedestrian safety, the permissive (green ball) indication can be omitted whenever the pedestrian push button is activated, thereby greatly enhancing safety for pedestrian/left turn conflicts.

The FYA has been widely adopted and even encouraged by agencies across the United States. ODOT has embraced the use of the FYA and more information can be found here, https://www.transportation.ohio.gov/programs/tsmo/signals/flashing-yellow-arrow.
The FYA indication would allow for the operation of an LPI for pedestrians crossing Hilliard Rd.

The cost of the FYA at the subject location should be moderate to high. The structure is capable of centering the new indication over the left turn lanes. However, the cabinet and controller would likely need to be updated.

If further investigation shows the installation of the FYA is possible without major changes, this type of operation is highly desirable for the reasons already stated.

6.2.7 Exclusive Pedestrian Phasing

An exclusive pedestrian phase is a traffic signal operation where all vehicle movements are stopped, and pedestrians are given a dedicated phase to cross in any direction, including diagonally. This design eliminates conflicts with turning vehicles, improving safety and comfort for pedestrians, particularly in areas with high foot traffic such as downtowns or transit hubs. While it enhances pedestrian safety, it can also increase delays for vehicles and lengthen overall signal cycle times, which may result in longer pedestrian wait times as well.

As noted, the exclusive pedestrian phase (also known as a Barnes Dance or Pedestrian Scramble) is a dedicated phase with all directions of pedestrians moving at one time. Given the size of the subject intersection, this would create significant amounts of extra delay and longer cycles. In cases like this, pedestrian compliance is show to drop.

Low cost given the current equipment could handle this type of operation. Not recommended due to the high added delay and reduced compliance.

6.2.8 Prohibit Left Turn Movement on Madison

The left turns from Hilliard to Madison are already excluded effectively eliminating the conflict with left turns and pedestrians crossing Madison. In addition, left turns from Madison to Hilliard Rd could be restricted thereby eliminating the ped/left turn conflict.

For this location, alternative routes need to be determined. It is anticipated that there would be non-compliant left turns creating additional unforeseen issues. In addition, no good alternatives for these left turns exist.

Low cost with timing changes and signing. Additional cost to reroute left turn vehicles may be necessary.

Prohibiting the EB and WB left turns is not recommended. Other alternatives such as a FYA and/or a protected only left turn would be more feasible.

6.3 Geometric, Delineation, and Signing Treatments

This category focuses on physical and visual modifications to the intersection that could improve clarity and reduce conflict points for all users. Potential alternatives include curb extensions to shorten pedestrian crossing distances, high-visibility crosswalk markings to increase driver awareness, and adjustments to lane striping or channelization to provide better separation between modes of travel. Enhanced signing, such as advance warning signs or oversized street name signs, may also be considered to improve driver recognition and compliance. These treatments are aimed at improving visibility, reducing uncertainty, and reinforcing proper user behavior at the intersection.

6.3.1 Delineation between vehicular lane and bike lane

Adding delineation between an exclusive bike lane and an adjacent vehicle lane provides several important safety and operational benefits. Physical or visual separation—such as pavement markings, buffers, flex posts, or curbs—creates a clearer boundary between modes of travel, which reduces encroachment of vehicles into the bike lane and lowers the risk of sideswipe or “dooring” crashes. Delineation also improves the predictability of movements for both drivers and cyclists, helping each group better anticipate where the other will be. From a comfort perspective, cyclists feel more protected from traffic, which can encourage more people to ride, including less experienced riders. For drivers, clear delineation helps organize the roadway and minimizes sudden weaving or swerving. In addition, when buffer space or vertical elements are used, they can calm vehicle speeds and contribute to a safer overall corridor for all road users.

The City has implemented delineation between the vehicle and bike lanes. While green bike lanes improve visibility and safety, they also come with some disadvantages. The colored pavement can be more expensive to install and maintain than standard markings, particularly in areas with heavy traffic wear, snow removal, or frequent resurfacing needs. If not maintained, fading or patchy color can reduce effectiveness and even create confusion. In some cases, drivers may still encroach into the lane despite the markings, meaning the treatment works best when paired with physical separation or enforcement. Additionally, in wet conditions, some surface treatments can become slick if not applied with proper materials. Finally, overuse of green pavement may reduce its impact, as drivers may become desensitized to the markings if applied too broadly instead of focusing on key conflict zones.

6.3.2 Green Bike Lanes

Green bike lanes are sections of roadway where a bicycle lane is highlighted with bright green pavement markings, either as solid fill or dashed patterns, to make the bike facility more visible to all road users. The color is used consistently to emphasize areas of potential conflict, such as intersections, driveways, or merging zones, where vehicles may cross or enter the bike lane. These improve safety by making bicycle facilities more visible and clearly defining the space reserved for cyclists. The bold color draws driver attention, particularly at conflict points such as intersections, driveways, and merge areas, where vehicles are more likely to cross into the bike lane. This increased visibility helps remind drivers to yield and watch for cyclists, while also providing riders with a clear, predictable path through complex areas. By reinforcing that the space is dedicated to bicycles, green bike lanes reduce encroachment, discourage illegal parking, and promote safer interactions between drivers and cyclists.

6.3.3 No Turn on Red

A No Turn on Red (NTOR) indication helps reduce conflicts at intersections by eliminating situations where drivers attempt to turn right on red while pedestrians are crossing or while cyclists are traveling through on a green signal. By requiring vehicles to remain stopped until they receive a green indication, NTOR removes the need for drivers to judge gaps in conflicting traffic and pedestrians, which is often done hastily and can lead to failure to yield. This improves safety for vulnerable road users, particularly at locations with high pedestrian volumes, school zones, or areas with limited visibility. It also reduces conflicts with left-turning vehicles on the opposite approach, since right-turning drivers are not simultaneously entering the intersection from a stop. While it can add some delay for motorists, NTOR is a simple, low-cost measure that enhances safety and predictability at intersections.

6.3.4 Auxiliary Right Side Signal Indications

An auxiliary right side signal indication is installed on the right side upright of the traffic signal structure. Large trucks often block the view of the overhead signal indications and these auxiliary signals help improve visibility for these locations. Figure 18 illustrates the approximate location of a proposed auxiliary right side signal indication. These indications at this location could be misleading for opposing directions due to the skewed angle between Madison Ave and Hilliard Rd. These are not recommended for the short-term, but in the long term if signal structures are updated, these could be installed on near-side upright poles that would not be visible to the other approaches.

Figure 18 – Auxiliary Right Side Signal Indication

6.3.5 High-Visibility Crosswalks

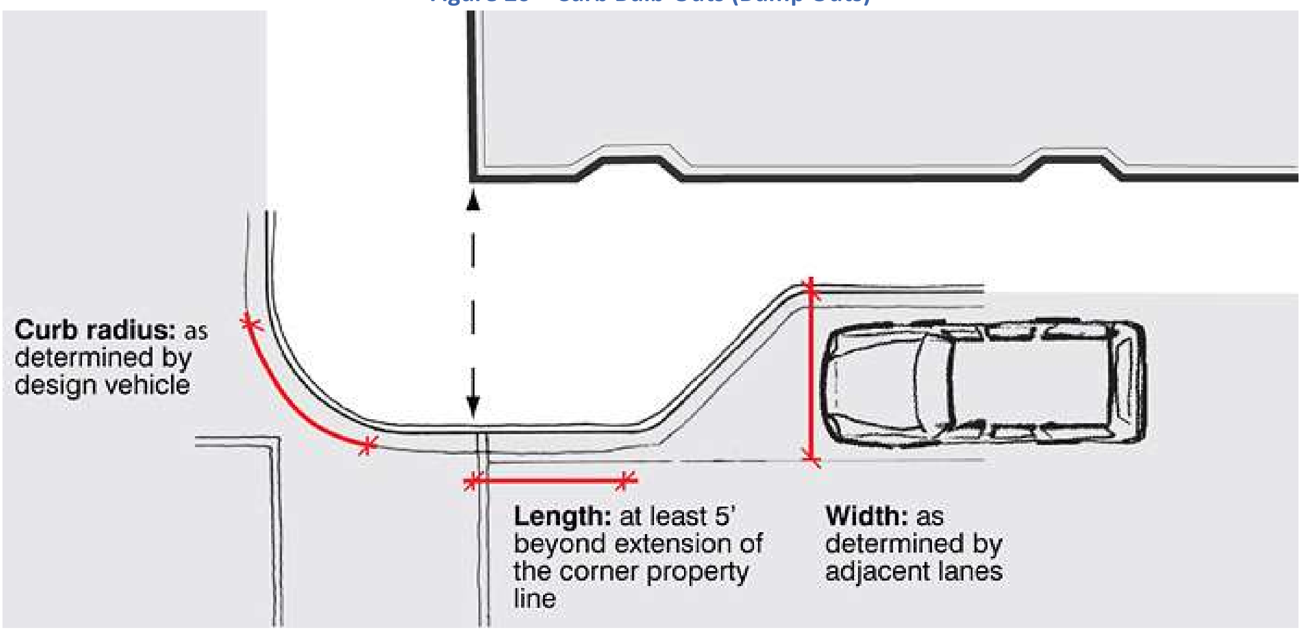
High-visibility crosswalks use bold pavement markings—such as continental (bar) or ladder-style striping—that are more prominent to approaching drivers than standard parallel lines. These markings enhance pedestrian safety by increasing driver awareness of crossing activity, improving yielding compliance, and providing clearer guidance for pedestrians on where to cross. Research has demonstrated that high-visibility crosswalks can reduce pedestrian crashes at uncontrolled locations by up to 40 percent, making them a proven, cost-effective countermeasure for improving safety for vulnerable road users.

Figure 19 – High Visibility Crosswalk

6.3.6 Tight Corner Radii/Reduced Curb Radius, Curb Bulb-Outs, Curb Extensions

Using tight corner radii (reduced curb radius) at intersections provides several safety and operational benefits, especially for pedestrians and cyclists. A smaller curb radius requires turning vehicles to slow down, reducing the likelihood and severity of crashes. It shortens pedestrian crossing distances, meaning people spend less time exposed in the roadway. The tighter geometry also improves sight lines between drivers and pedestrians, since vehicles make turns at sharper angles and drivers are more likely to face crosswalk users directly. In addition, reduced radii create opportunities to expand sidewalk space, add curb extensions, or incorporate stormwater features. While very large trucks and buses may require accommodations at certain locations, overall, tighter curb radii are a proven design strategy to calm vehicle speeds, improve yielding behavior, and enhance safety for vulnerable road users.

Figure 20 – Curb Bulb-Outs (Bump Outs)



6.3.7 Lighting Enahancements

Lighting enhancements include focused lighting at or near crosswalks to increase visibility of pedestrians and night, which is a high crash time for pedestrians.

A nighttime survey should be completed at this location during nighttime hours. Consideration for more directed illumination should be considered. Dynamic detection of pedestrians would add additional benefit to illuminate crosswalks when pedestrians are present. The are a relatively low cost solution, assuming additional structures are not necessary.

6.3.8 Raised Crosswalks

A raised crosswalk at a signalized intersection is a pedestrian crossing built at a slightly higher elevation—typically level with the adjacent sidewalks—so that vehicles must travel over a ramp when crossing it. This treatment essentially combines the function of a speed table with a marked crosswalk. These improve safety by slowing vehicle speeds, increasing pedestrian visibility, and making crossings more accessible. Because the crosswalk is elevated to sidewalk level, drivers are required to decelerate as they pass over it, which reduces both the likelihood and severity of crashes. The elevation also positions pedestrians more prominently in a driver's line of sight, helping to improve yielding behavior. In addition, the level surface eliminates the need for pedestrians, wheelchair users, or people pushing strollers to step down into the roadway, creating a shorter, more comfortable, and accessible crossing. Together, these features enhance pedestrian priority and make intersections safer and more user-friendly.

While raised crosswalks enhance safety and accessibility, they also have some drawbacks that need consideration. The vertical deflection can slow emergency vehicles, buses, and trucks, making them less suitable for primary response or freight routes. They may also increase maintenance needs, complicate snow removal, and create drainage challenges if not designed properly. In addition, the ramps can generate noise from larger vehicles and may cause driver discomfort at higher speeds. Ensuring compliance with accessibility standards is also essential. For these reasons, raised crosswalks are best suited for lower-speed streets with high pedestrian activity, where their safety benefits outweigh potential operational and maintenance concerns.

High cost of installation and maintenance. Due to the disadvantages, this is not a recommended solution.

6.3.9 Convert Orchard Grove Ave to Right In-Right out

The T-intersection of Madison Avenue and Orchard Grove Avenue, which currently permits all turning movements, will be modified to a right-in/right-out configuration. With this change, left turns and through movements across Madison Avenue will no longer be allowed, reducing conflict points and helping traffic move more efficiently. The modification is intended to improve safety along Madison Avenue while still providing convenient access for right-turning vehicles. This change is also necessary because the eastbound left turn at Madison Avenue and Hilliard Road will be converted to a protected-only movement, which is expected to create vehicle queues that would otherwise extend back into the Orchard Grove intersection.

6.3.10 Roundabout

A roundabout is a circular intersection where traffic flows counterclockwise around a central island. Vehicles entering must yield to traffic already in the circle, which reduces conflict points compared to traditional intersections.

A roundabout can offer both positive and negative advantages depending on its design, location, and users. On the positive side, roundabouts improve safety by reducing severe crashes, lowering vehicle speeds, and eliminating traditional stop-and-go delays. They also keep traffic flowing smoothly and can be more cost-effective to operate than signalized intersections since they do not require electricity for signals. However, roundabouts also have drawbacks, such as requiring more space than a standard intersection, which may not be feasible in dense urban areas. They can be confusing for unfamiliar drivers, and large vehicles, cyclists, or pedestrians may face challenges navigating them if not properly designed.

A roundabout is not recommended at this location due to several constraints and concerns. The high cost of construction, combined with the limited available right-of-way, makes implementation impractical. In addition, the presence of pedestrians and bicycles presents further challenges, as accommodating them safely within a roundabout requires additional design features that may not be feasible in the space provided. These factors make alternative improvements more suitable for this intersection.

6.4 Safety Technologies

This category considers the application of technology-based countermeasures designed to enhance safety beyond conventional geometric and operational improvements. Examples include pedestrian detection systems that adjust signal timing when pedestrians are present, red-light enforcement cameras to reduce signal violations, and driver feedback signs to encourage speed compliance. Emerging technologies, such as vehicle-to-infrastructure (V2I) communication tools, may also be evaluated for their potential to improve safety outcomes as part of a longer-term strategy.

6.4.1 Automated Pedestrian Detection

Automated pedestrian detection systems are technologies installed at intersections or midblock crossings that use sensors to detect when pedestrians are present and adjust traffic signal operations accordingly. Instead of relying solely on pedestrians pressing a push button, these systems employ tools such as infrared sensors, thermal imaging, microwave radar, or video analytics to identify people waiting to cross or still within the crosswalk. These improve safety and convenience by recognizing when pedestrians are present and adjusting signal timing to accommodate them. They can extend the WALK or clearance interval if someone is still crossing, reducing conflicts with vehicles and lowering crash risk. By removing the need to press a button, these systems make crossings more accessible for people with disabilities, children, or those carrying items. They also encourage compliance, since pedestrians know they will be detected automatically, and can improve traffic efficiency by skipping pedestrian phases when no one is present. Overall, they create safer, more reliable, and user-friendly crossings.

There can be high benefits to including these technologies to the subject intersection. This could be a stand-alone system that could illuminate the crosswalks and activate blank-out signs indicating the presence of pedestrians.

Additional higher tech systems could modify the signal timing, such as increasing the pedestrian walk/FDW and the opposing movement red clearance times.

6.4.2 Dynamic Warning Signals

Electronic signs that activate when pedestrians are present (e.g., “Yield to Pedestrians When Flashing”). These are often triggered by radar, infrared or video detection. This is a subset of the above technology

6.4.3 V2I or V2X technologies

Vehicle-to-Infrastructure (V2I) technologies for pedestrian safety at signalized intersections use wireless communication between connected vehicles and roadside equipment (like traffic signals) to help reduce conflicts with pedestrians. In these systems, the traffic signal controller communicates real-time information—such as signal phase status, pedestrian crossing activity, or the presence of vulnerable road users—to vehicles equipped with V2I technology.

6.4.4 Real Time Analytics

Real-time analytics for pedestrian safety at signalized intersections involve the use of advanced sensors, cameras, and data-processing systems to monitor conditions at an intersection and provide immediate insights that can improve safety. These systems analyze live data—such as pedestrian movements, vehicle speeds, turning patterns, and near-miss events—to detect potential conflicts between pedestrians and vehicles as they happen. These help improve pedestrian safety by continuously monitoring conditions and identifying potential conflicts between vehicles and people as they occur. Using sensors and data processing, these systems can extend WALK or clearance intervals when pedestrians are still in the crosswalk, adjust signal timing to reduce turning conflicts, and even flag unsafe driver or pedestrian behavior. Beyond immediate interventions, they also provide valuable data on pedestrian volumes, wait times, and near-miss events, allowing agencies to proactively address safety issues before crashes happen. This shift from reactive to proactive management makes intersections safer, more responsive, and more efficient for all users.

6.5 Proposed Intersection Performance

The proposed recommendations include several changes that may affect intersection performance. To evaluate these impacts, an operational analysis was conducted to confirm that delay, level of service (LOS), and queue lengths remain within acceptable limits. Capacity-related considerations include:

- Implementing Leading Pedestrian Intervals, which will slightly delay adjacent through movements.
- Converting the eastbound and westbound left turns on Madison Avenue to protected-only phasing, which will reduce capacity for those movements.
- Maintaining existing "No Turn on Red" restrictions, which will not add further operational impacts.
- Updating local safety intervals (e.g., yellow and red clearance times, pedestrian walk and flashing don't walk intervals), which may influence operations.
- Enhancing signal coordination during STOP, which can improve overall performance.
- Shifting to protected-only left turns on Madison Avenue, which will increase queues and lead to the recommendation for right-in/right-out access at Orchard Grove Avenue.

Table 3 shows the existing versus proposed overall delay and LOS measures.

Table 3 – Madison Ave & Hilliard Rd-Carabel Ave Existing vs Proposed Conditions Delay and LOS

	AM Peak		Mid-Day Peak		PM Peak	
Measure	Existing	Proposed	Existing	Proposed	Existing	Proposed
Delay (sec/veh)	22	45	20	44	39	46
LOS	C	D	C	D	D	D

The table indicates that overall intersection delay and LOS will increase; however, both measures remain within the acceptable LOS D threshold. The primary contributor to this increase is the conversion of eastbound and westbound left turns to protected-only operation. The Leading Pedestrian Interval contributes minimally to overall delay. Collectively, the protected-only left turns and Leading Pedestrian Intervals yield substantial safety improvements at relatively low implementation cost.

7 RECOMMENDATIONS

The recommendations are listed as short-term and long-term. Short-term recommendations are those that can be implemented quickly with relatively little expense. Long-term are those that may require geometry improvements and would have a higher cost; but may add a larger benefit overall. Refer to **Figure 21** for a graphic illustrating these recommendations.

Short-Term Recommendations

Alternative	Advantages	Approximate Cost (Additional)
Protected-only left turns for the eastbound and westbound left turns on Madison Ave.	Converting to protected-only left turns improves safety by removing conflicts with opposing traffic and pedestrians, reduces severe crashes, and simplifies driver decisions, though it may increase delay.	$1,200 - $2,000 To install 2 new 3-section left turn indications
Leading Pedestrian Intervals for all directions	A Leading Pedestrian Interval (LPI) enhances safety by giving pedestrians a brief head start before vehicles move, improving visibility, reducing crashes, and offering a low-cost way to prioritize walking at intersections.	$0 Existing equipment is capable of and to be implemented under STOP
High visibility crosswalk markings (in place)	High-visibility crosswalk markings improve pedestrian safety by making crossings more noticeable to drivers, increasing yielding behavior, and enhancing comfort and confidence for people walking.	$0 Already implemented under another project
Green pavement markings and delineation for bike lanes (in place)	Green bike lanes with flex post separation improve cyclist safety and visibility, discourage vehicle encroachment, and provide a low-cost, flexible way to create a more comfortable and predictable biking environment.	$0 Already implemented under another project
No turn on red signs (in place)	No Turn on Red signs improve safety by reducing conflicts with pedestrians and cyclists, lowering crash risk, and preventing vehicles from blocking crosswalks or sightlines.	$0 Already implemented under another project
Accessible Pedestrian Signals	Accessible pedestrian signals enhance safety and independence for people with vision or hearing impairments by providing audible and tactile cues, ensuring equitable and ADA-compliant crossings.	$8,000 – $12,000 To install 10 APS buttons
Updates to local intersection safety intervals	Updating yellow, red, walk, and flashing don't walk intervals improves safety for drivers and pedestrians, reduces crashes, and ensures compliance with current standards.	$0 Included in STOP
Signal coordination during STOP	Signal coordination enhances safety by reducing red-light running, rear-end crashes, and speeding while creating more predictable traffic flow for drivers and pedestrians.	$0 Included in STOP

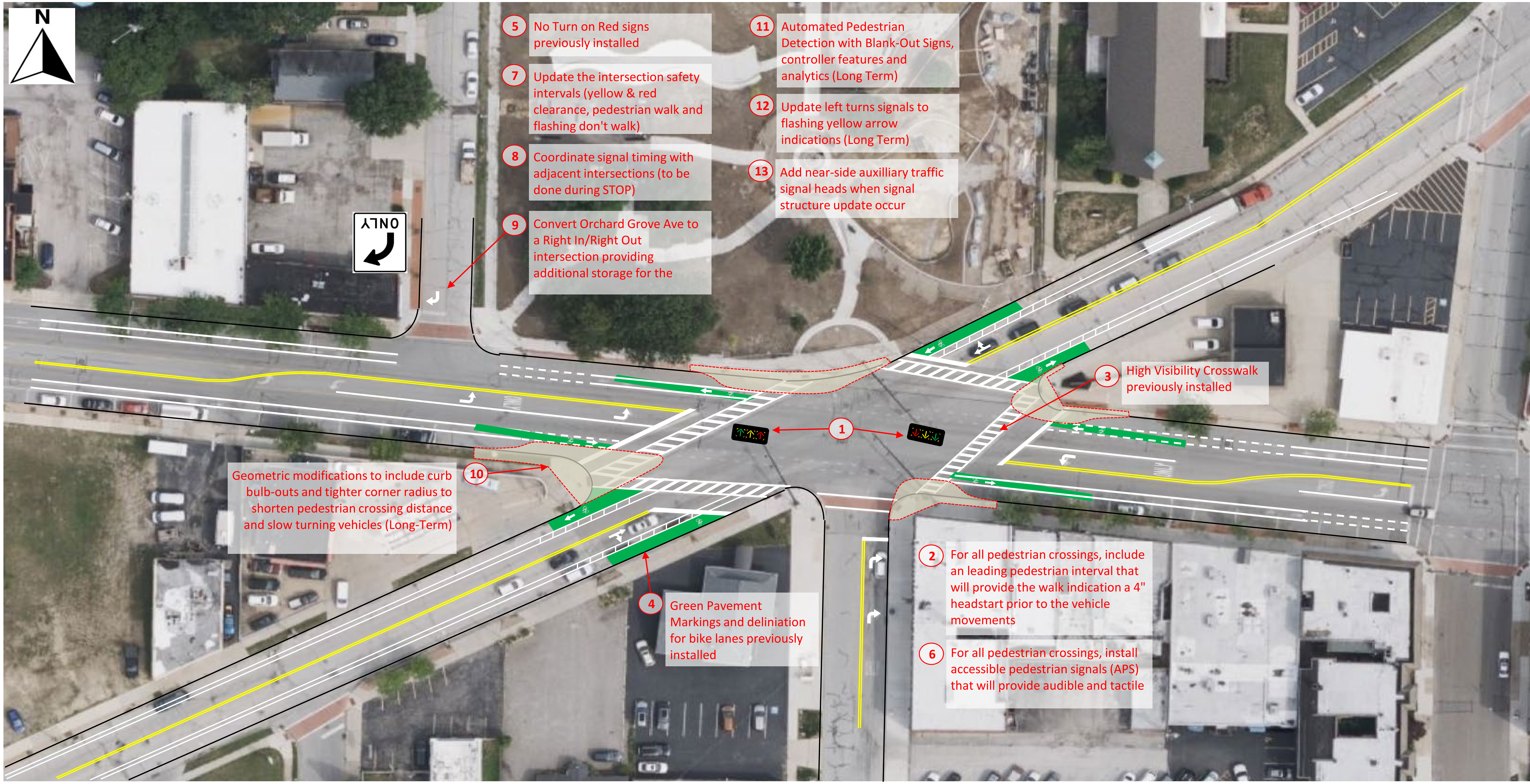
Alternative	Advantages	Approximate Cost (Additional)
Convert Orchard Grove to Right in-Right out	Converting an unsignalized intersection to right-in/right-out reduces conflict points, improves safety, mitigates queue spillback into nearby signals, and simplifies driver and pedestrian interactions.	$2,000 - $5,000 Cost to provide pavement markings and signs

The total cost for implementing the recommended short-term improvements is estimated to be between $13,200 and $19,000. The Accessible Pedestrian Signals (APS) represent the largest single expense but are strongly recommended when using LPIs. If the City installs the equipment, costs are likely to fall toward the lower end of this range.

Long-Term Recommendations

Alternative	Advantages	Approximate Cost (Additional)
Tight Corner Radii/Reduced Curb Radius, Curb Bulb-Outs, Curb Extensions	Tight corner radii, curb bulb-outs, and curb extensions all improve pedestrian safety and comfort by slowing turning vehicles, shortening crossing distances, and improving visibility between drivers and pedestrians. They also calm traffic, create space for amenities or green infrastructure, and make crossings more predictable. Overall, they enhance walkability and safety at intersections and midblock crossings.	$150,000 - $300,000 Curb extensions and tighter corner radii can be costly—typically tens of thousands of dollars per corner—because of curb, drainage, and utility work.
Automated Pedestrian Detection with Blank-Out Signs, controller features and analytics	Automated pedestrian detection with blank-out signs, advanced controllers, and analytics improve safety and efficiency by activating warnings only when needed, adjusting signal timing in real time, and reducing unnecessary delays. They also provide valuable pedestrian counts and safety data to guide planning and performance monitoring.	$20,000 - $80,000 The cost can vary based on the full feature and equipment needs.
Flashing Yellow Arrow Operation	Flashing Yellow Arrow operation improves safety and reduces confusion compared to green ball permissive for left turns, while also reducing crashes and delays. It gives agencies more flexibility to balance protected and permissive turns, adapts by time of day, and supports better traffic flow and pedestrian safety.	$2,000 - $100,000 Cost can be low if existing structures are suitable, much higher costs if structures need to be replaced.
Add auxiliary signal indications on the right-side signal support	Large trucks often block the view of the overhead signal indications and these auxiliary signals would help improve visibility for these locations.	$4,000 - $6,000 Cost to install 4 signal indications

The total cost for implementing the recommended long-term improvements is estimated to be between $176,000 and $486,000. These could be considered for future implementation once the lower-cost options have been in place for a sufficient period of time. This phased approach allows the initial, more affordable improvements to be tested and evaluated for effectiveness before committing additional resources to higher-cost measures.



Short-Term Recommendations:

1 Convert Protected/Permissive left turn indications on Madison to Protected-Only
2 Include a Leading Pedestrian Interval (LPI) for all pedestrian indications
3 Add High Visibilty Crosswalk marking (previously done)
4 Add Green Pavement markings and deliniation for bike lanes (previously done)
5 No turn on red signs (in place)
6 Accessible Pedestrian Signals
7 Updates to local intersection safety intervals
8 Signal coordination during STOP
9 Convert Orchard Grove to Right in-Right out

Long-Term Recommendations:

10 Tight Corner Radii/Reduced Curb Radius, Curb Bulb-Outs, Curb Extensions
11 Automated Pedestrian Detection with Blank-Out Signs, controller features and analytics
12 Flashing Yellow Arrow Operation
13 Auxillary Near-side Signals on Uprights

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Figure 21
Summary of Short-Term and Long-Term Recommendations for Madison Ave & Hilliard Rd/Carabel Ave Intersection

8 APPENDIX

The Appendix documents are electronic only and can be found at the following SharePoint site:

https://iterisinc1.sharepoint.com/sites/CS-Ext-ODOT/Shared%20Documents/Forms/AllItems.aspx?id=%2Fsites%2FCS%2DExt%2DODOT%2FShared%20Documents%2FLakewood%2FMadison%20Ave%20%26%20Hilliard%20Rd%20Study&viewid=d11af16f%2Dd4e7%2D48b1%2D8d76%2Df621be62458f

Documents included on the website:

A. 7-day, 24-hour directional volume counts
B. Turning movement counts
C. Crash Data
D. Timing Data
E. Photographs and Field Notes
F. Synchro models and Reports

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