# REVIEW OF POTENTAL TRAFFIC IMPACTS THE MEADOWS AT HAW CREEK 

To: Haw Creek Community Association<br>From: Daniel Findley, PhD, PE \& Chris Cunningham, MSCE, PE<br>Subject: Review of Potential Traffic Impacts of Proposed Development: The Meadows at Haw Creek<br>Date: $\quad$ February 25, 2024

This summary outlines the anticipated traffic impacts of the proposed development, The Meadows at Haw Creek, situated in Haw Creek, North Carolina. Our analysis involved a thorough examination of the site plan (dated January 1, 2024 for Conditional Zoning Submittal) and traffic data collected by the North Carolina Department of Transportation. Additionally, we conducted a comprehensive site visit to New Haw Creek Road and its adjacent network from January 29 to 31, 2024, which included the collection of traffic data.

Throughout our site visit and data collection process, it was evident that the community and two nearby schools have put a lot of focus in developing plans to keep roads in Haw Creek accessible, safe, and open to traffic within the constraints of the current roadway and traffic control designs especially along New Haw Creek Road. Even so, there were some concerns that could use potential mitigation now and into the future as development takes place that are outside of the community's domain. Our team was hired to assess operational and safety concerns still present in the Haw Creek area at five key intersection points. These included intersections near two schools, the primary business hub servicing traffic to and from US70, and two closely spaced intersections near US70 and Crockett Avenue. Crockett Avenue at US70 was the only signalized intersection, with the other four implementing two-way stop control.

Our assessment revealed that each studied intersection was operating efficiently considering the existing traffic control measures, traffic volumes, and roadway infrastructure. However, we observed several areas that could use improvement - particularly in anticipation for the additional traffic generated by the proposed development. A summary of operational and safety concerns at each of the key intersections are summarized below.

## Operations

New Haw Creek Road at Bell Road: Although the Evergreen Community Charter School has implemented staggered pick up times in the PM peak hour, queues were significant and almost backed up into the intersection with New Haw Creek Road. Even more concerning were queues in the AM peak hour which did spill back over $1 / 4$ mile along Bell Road and onto New Haw Creek Church Road's northbound approach. The additional traffic volumes generated from the proposed development would create additional queuing onto New Haw Creek Road that will likely need to be mitigated.

Old Haw Creek Road at Bethesda Road: To help ease traffic concerns at the school entrance into Haw Creek Elementary School from New Haw Creek Road, school traffic management plans, with cooperation from parents, directed traffic into the school from the north by entering
the school off of Bethesda Road from Old Haw Creek Road. Even so, queues spilled back 1800' from the drop off point at school onto Old Haw Creek Road. Traffic parked on the road while waiting for the start of school pickup, effectively blocking the entire eastbound approach of the intersection until the queue cleared.

New Haw Creek Road and US 70 at Crockett Avenue: Given the traffic demands, the existing traffic control being utilized, and close proximity of the two intersections, safety and operations were considered for the two intersections in combination. The unique configuration of the stop/yield-controlled intersection at New Haw Creek Road and Crockett Avenue facilitates substantial ingress and egress to the Haw Creek area to the north. The left turn signal phasing for the eastbound approach of US70 at Crockett Avenue has been optimized, including the utilization of "twice per cycle left" turn phasing from 8:00-8:30 AM to minimize the impact of queued vehicles en route to the two schools in Haw Creek. However, some spillback and blocking issues were noted in the short north-south oriented stem on Crockett Avenue between the two intersections during both peak periods, leading to vehicles spilling into the main intersection at US70 and causing traffic blockages.

## Safety

New Haw Creek Road at Bell Road: Queues spilling back onto New Haw Creek Road from Bell Road block commuting traffic along the mainline movement. This is especially concerning for northbound traffic coming from US70 and nearby neighborhoods which already spill into the roadway during the AM peak. However, the traffic generated from the proposed development, will cause additional spillback of vehicles into the intersection for north and southbound approaches, effectively bringing the intersection to gridlock conditions while left and right turning vehicles queue up. Without proper mitigation, drivers turning from Bell Road from the school will have restricted sight distance in one or both directions while trying to turn onto New Haw Creek Road. In addition, drivers stuck in queues will potentially use the opposing roadway lanes to go around queued traffic, presenting the threat of head on crashes.

Old Haw Creek Road at Bethesda Road: Due to queues spilling back onto Old Haw Creek Road, drivers may decide to drive into oncoming traffic to keep from waiting in excessive queues from parked vehicles. In addition, sight lines are blocked for drivers from nearby driveways which causes significant safety issues during pickup and drop off - especially on the south side of Old Haw Creek Road. As an example, Bethesda United Methodist Church conducts after school programs during the PM peak period which had many drivers utilizing the two driveway entrances adjacent to this intersection. For drivers exiting the parking lot to the east of the church, sight lines are blocked in both directions.

New Haw Creek Road at Beverly Road: Our team identified potential intersection sight distance issues between the southbound through and westbound left movements. The southbound approach leading to the intersection is unimpeded, featuring a notable horizontal curve just before the intersection and descending on a downhill slope. The design speed for this section of road requires an intersection sight distance of $445^{\prime}$; however, only $175^{\prime}$ is currently present. This presents a safety problem that will only be exacerbated with increased traffic from nearby developments.

New Haw Creek Road and US 70 at Crockett Avenue: Spillback of vehicles from the northsouth oriented stem into the intersection of US 70 and Crockett Avenue presents an unintended conflict between westbound through traffic and eastbound left turning vehicles along US70. Although the problem exists today, with increased traffic volumes, queues will be further exacerbated without mitigation thus causing increased potential for safety at this conflict point.

Crash history along roads in the same area on New Haw Creek Road between US 70 and the proposed development was studied over a 5 -year period (November 1, 2018 to October 31, 2023) with 34 crashes reported (source: NCDOT TEAAS). The reported crashes included 3 type B crashes, 3 type C crashes, and 28 property damage only crashes (no fatal or type A crashes were reported during this time period). Prior to this 5 -year time period, a type A (on January 22, 2015) crash occurred south of Arco Road and a fatal (on October 16, 2016) crash occurred near the intersection with Sleepy Hollow Road.

Similarly, at the intersection of US 70 and New Haw Creek Road/Crockett Avenue over the same 5 -year period, 63 crashes were reported, with a significant portion ( $32 \%$ ) attributed to left-turn movements from US70 onto New Haw Creek Road (source: NCDOT TEAAS). The reported crashes included 6 type B crashes, 14 type C crashes, and 43 property damage only crashes (no fatal or type A crashes were reported during this time period). Approximately $32 \%$ of the crashes occurred from the left-turn movement from US70 to access New Haw Creek Road.

Based on our review of the application and supporting materials, the above-referenced analysis, our training and credentials, and our years of experience, it is our opinion, to a reasonable degree of engineering certainty, that the proposed development will adversely affect the health or safety of persons residing or working along New Haw Creek Road in the vicinity of the proposed Development from a traffic engineering perspective ${ }^{1}$. Notable safety concerns from unaddressed sight distance issues and spillback of traffic into secondary roadway networks will be further intensified by increased development traffic along secondary routes in Haw Creek without mitigation


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## 1. PROJECT OVERVIEW AND EXISTING TRAFFIC VOLUMES

The proposed project will contain 95 units and will be located on 26.29 acres that is divided along both sides of New Haw Creek Road in Haw Creek, North Carolina. As per the Site Plan dated January 1, 2024, the development featured 35 townhome units on the western side of New Haw Creek Road and 60 single-family homes on the eastern side. Based on NCDOT traffic volume records, New Haw Creek Road experienced 5,100 vehicles daily near the Trinity Chapel Road intersection and 6,300 vehicles daily near the Keenan Road intersection (traffic volumes as of 2022). Additionally, US 70 / Tunnel Road (west of the Crockett Avenue intersection) had a traffic volume of 24,500 vehicles per day ( 2022 traffic volumes).


Figure 1. Proposed Development Location along New Haw Creek Road (source: Buncombe County GIS)

## 2. TRIP GENERATION

The proposed land use type and its associated intensity were estimated to result in approximately 847 unadjusted trips per day, with 60 trips during the morning peak hour and 78 trips during the afternoon peak hour (Table 1 ). ${ }^{2}$ While adjustments are typically made to consider potential passby trips (trips from vehicles already in the vicinity of the development) and internal capture (trips generated from within the development), as the proposed development consists solely of residential units, no adjustments are deemed necessary, and the unadjusted trips are equal to the final trips.

According to the NCDOT Traffic Impact Analysis Need Screening / Scoping Request, the projected number of trips generated by the proposed development falls below the NCDOT trip threshold of 3,000 daily trips, thus not mandating a Traffic Impact Analysis automatically. Such an analysis primarily assesses the operational impacts, like levels of delay, on the nearby roadway network. Operational impacts resulting from the trips generated by a proposed development constitute only one aspect of a comprehensive evaluation; the subsequent section delves into critical roadway and access safety components.

[^1]Table 1. Estimated Trips Generated for the Proposed Development (Source: 11 ${ }^{\text {th }}$ Edition of ITE Trip Generation Manual)

| Land Use | Daily Trips | AM Peak Hour Trips | PM Peak Hour Trips |
| :---: | :---: | :---: | :---: |
| Townhomes [35 dwelling units] <br> (ITE Land Use Code 215) | 216 trips $(108$ entering; 108 exiting) | 13 trips (3 entering; 10 exiting) | $\begin{gathered} 17 \text { trips } \\ \text { (10 entering; } \\ 7 \text { exiting) } \end{gathered}$ |
| Single Family <br> [60 dwelling units] <br> (ITE Land Use Code 210) | 631 trips <br> (315 entering; 316 exiting) | 47 trips (12 entering; 35 exiting) | 61 trips (39 entering; 22 exiting) |
| Total | 847 trips | 60 trips | 78 trips |

## 3. TURNING MOVEMENT COUNTS AND QUEUES

We conducted a site visit from January 29 to 31, 2024. The objective was to gather field data and observe general traffic operations and safety. The Appendix includes turning movement counts and maximum queue observations for key intersections and movements during two morning and evening peak periods. Turning movement counts (TMCs) serve two main purposes: a) identifying any key movements that may warrant further investigation or modeling, and b) aiding in the constructing traffic simulation models if concerns about intersection capacity arise, particularly in light of potential future development. Maximum queues were recorded to assess any issues related to spillback ${ }^{3}$ or blockage ${ }^{4}$ at intersections. These queues are also valuable for calibrating simulation models if future traffic modeling becomes necessary. Below is a summary of the findings at each intersection. Please note that each section includes the location of cameras and/or manual data collection points for reference.

### 3.1. New Haw Creek Road at Bell Road

Observations were made at the two-way stop controlled intersection of New Haw Creek Road at Bell Road, located roughly $1 / 4$ mile from Evergreen Community Charter School (ECCS), which serves students from kindergarten through 8th grade. The school allows drop-off of all students before 8:30 AM and staggered pick-up times at 2:50 PM, 3:00 PM, and 3:15 PM to mitigate traffic impacts. It should be noted that ECCS currently accommodates approximately 450 students along with staff. Below is a summary of the observations noted during our visit:

- TMCs: The morning and afternoon peak hours occurred from 7:45-8:45 AM, with a total of 823 vehicles, and from 2:45-3:45 PM, with 698 vehicles. Notably, the afternoon peak hour at this location was different here compared to any other intersection we studied because the majority of work travel coming home to neighborhoods was south of this intersection, while this intersection was highly impacted by ECCS.

[^2]- Queues: As depicted in Figure 2, peak hour queues spilled back from the Evergreen Community Charter School (ECCS) drop off and pick-up location (upper right), causing traffic to queue at the nearby intersection of New Haw Creek Road and Bell Road. In addition, traffic exiting the school drop off location spilled back all the way to the school drop off and pick-up location - particularly in the AM peak hour. The morning peak hour experienced a higher maximum queue length with 64 vehicles ( $1300^{\prime}$ ) compared to the afternoon peak hour with 52 vehicles. While significant queue spillback was consistently observed during all study periods from Evergreen Community Charter School (ECCS), there was only spillback onto New Haw Creek Road during the morning peak. However, queues were typically contained on Bell Road east of New Haw Creek Road during most times.


Figure 2. Queues for key movements at New Haw Creek Road at Bell Road.

### 3.2. Old Haw Creek Road Bethesda Road

The two-way stop controlled intersection of Old Haw Creek Road at Bethesda Road is situated to the northwest of the primary intersection hub of Haw Creek - Beverly Road and New Haw Creek Road. Our team's objective was to assess the impact of queues from Haw Creek Elementary School (HCES); however, turning movement counts were not conducted as the school does not use New Haw Creek Road for entry or exit. It's worth mentioning that HCES built a recent addition based on Google Maps imagery and includes approximately 400 students plus staff ${ }^{6}$. Below is a summary of observations made during our field visit:

- Queues: As depicted in Figure 3, during the PM peak hour, the eastbound right turn queue extended from the south entrance of HCES, reaching a total length of approximately 72

[^3]vehicles (1800 feet). Interestingly, during the AM peak hour on both days of data collection, there was no spillback from Bethesda Road onto Old Haw Creek Road. Drivers exiting the school typically returned to Old Haw Creek Road or New Haw Creek Road, It should be noted that the school directs parents to enter from the north, not allowing direct entry to the school from New Haw Creek Road.


Figure 3. Queues for key movement at Old Haw Creek Road at Bethesda Road.

### 3.3. New Haw Creek Road at Beverly Road

The two-way stop controlled intersection of New Haw Creek Road at Beverly Road is near the center of Haw Creek. When traveling to or from US 70 approximately $1 / 2$ mile in either direction, drivers can opt for Beverly Road or New Haw Creek Road, rendering it a focal point of activity for the community. Consequently, several small businesses are situated in close proximity to this intersection. Below is a summary of observations made during our field visit.

- TMCs: During our observations, the peak hour occurred from 7:30 to 8:30 AM, with a total of 1,138 vehicles, and from $4: 45$ to $5: 45 \mathrm{PM}$, with 815 vehicles. In the morning peak hour, southbound through and left movements by commuting drivers predominated. However, there were also significant volumes of northbound through and westbound right turns, likely from individuals dropping off children at one of the two schools to the north. In the evening peak hour, northbound through and westbound right turn movements were prominent as people returned home from work. There were also high volumes of southbound through and left movements.
- Queues: Illustrated in Figure 4, the PM peak hour queues for westbound traffic were more pronounced with 16 vehicles compared to the AM peak hour, which had 11 queued vehicles. Notably, there were no queues of 10 or more vehicles that lasted longer than a couple of minutes, indicating that blockage of nearby driveway entrances was intermittent.


Figure 4. Queues for key movement at New Haw Creek Road at Beverly Road.

- Additional Consideration: The southbound approach, leading to the intersection is unimpeded, featuring a notable horizontal curve just before the intersection and descending on a downhill slope. Shown in Figure 5, as recent as August 2022, a warning sign was present which advised a speed limit of 20 mph at the intersection for the southbound approach; however, this sign is no longer present. Section 4.3 Sight Distance at Beverly Road with New Haw Creek Road discusses sight distance in more detail.


Figure 5. Speed Warning Sign Heading Southbound towards the intersection of New Haw Creek Road at Beverly Road.

### 3.4. New Haw Creek Road and US 70 at Crockett Avenue

The two-way stop controlled intersection of New Haw Creek Road at Crockett Avenue and the signal-controlled intersection of US70 at Crockett Avenue represent the busiest intersections in Haw Creek. Due to their close proximity, these two intersections are collectively considered when discussing turning movement counts and queues, and future mitigation strategies should be considered with the two intersections in combination. It's worth mentioning that prior engineering efforts to optimize traffic flow have resulted in the westbound left and northbound right movements
at New Haw Creek Road and Crockett Avenue being yield controlled, while all other movements at that intersection are stop controlled. Below is a summary of observations made during our field visit:

- TMCs: During the AM peak hour, occurring from 7:30 to 8:30 AM, there were 2,310 total vehicles at the US70 intersection and 1,085 total vehicles at the New Haw Creek Road intersection. In the PM peak hour, from 4:45 to 5:45 PM, there were 2,511 total vehicles at the US70 intersection and 904 total vehicles at the New Haw Creek Road intersection. In both the AM and PM peak hours, the predominant movements were eastbound and westbound through movements along US70.

Regarding ingress and egress to and from Haw Creek:

- In the AM peak hour, the highest traffic volume for ingress was from eastbound left-turning traffic from US70, followed by northbound right turns onto New Haw Creek Road. The primary egress routes during the AM peak hour were westbound left turns from New Haw Creek Road onto Crockett Avenue, followed by southbound right turns onto US70 heading towards Asheville.
- In the PM peak hour, traffic entering Haw Creek predominantly came from eastbound left turns from US 70, followed by northbound left and right turns at Crockett Avenue and New Haw Creek Road. Exiting traffic from Haw Creek primarily consisted of westbound left-turning vehicles from New Haw Creek Road and right turns at the southbound approach of US70.
- Queues: Four notable locations were monitored for queue spillback as depicted in Figure 6. Along US70, three movements were observed: westbound through, eastbound through, and left turns. The fourth queue monitored by our team was at the southbound approach of US70, primarily fed by a yield-controlled westbound left at New Haw Creek Road and Crockett Avenue.


Figure 6. Queues for key movement at New Haw Creek Road and US70 at Crockett Avenue. Note: Green cars represent left turning vehicle queues. Black cars represent through vehicles.

Among the two through movements on US70, the westbound had a maximum of 18 vehicles per lane in the PM peak hour, while the eastbound through had a maximum of 14 vehicles per lane in the AM peak hour. The queue for the eastbound left turn from US70 was the most significant among the four, with the largest queues occurring during the AM peak hour (21 vehicles). Similarly, the southbound approach at US70, primarily fed by the westbound left turn along New Haw Creek Road at Crockett Avenue, experienced similar queueing during the PM peak hour, with 20 vehicles.

## 4. ROADWAY SAFETY

### 4.1. NCDOT Planning Level Safety Score

NCDOT's Planning Level Safety Scoring Data ${ }^{7}$ analysis and map from the 2018 to 2022 timeperiod (Figure 7) indicate that the segment of New Haw Creek Road serving the proposed development primarily falls within the middle category of NCDOT Section Safety Score (33 to 66), as depicted by the yellow line color. Traffic volume serves as a key indicator of exposure for the safety performance of a road. Consequently, the projected increase in vehicles from this proposed development is likely to elevate crash risk and lead to more accidents on New Haw Creek Road.


Figure 7. Planning Level Safety Scoring Data (source: NCDOT).

### 4.2. NCDOT Reported Crash Data

Between US 70 (Tunnel Rd) and the proposed development along New Haw Creek Road for the 5 -year period from November 1, 2018, to October 31, 2023, a total of 34 crashes were reported (source: NCDOT TEAAS). The reported crashes included 3 type B crashes, 3 type C crashes, and 28 property damage only crashes (no fatal or type A crashes were reported during this time

[^4]period)8. These included 3 type B crashes, 3 type C crashes, and 28 property damage only crashes, with no fatal or type A crashes reported during this period. Prior to this timeframe, a type A crash occurred on January 22, 2015, south of Arco Road, and a fatal crash occurred on October 16, 2016, near the intersection with Sleepy Hollow Road.

At the intersection of US 70 (Tunnel Rd) and SR 2032 (New Haw Creek Road)/Crockett Avenue for the same 5 -year period, a total of 63 crashes were reported (source: NCDOT TEAAS). These included 6 type B crashes, 14 type C crashes, and 43 property damage only crashes, with no fatal or type A crashes reported during this timeframe. Is should be noted that approximately $32 \%$ of the crashes occurred during the left-turn movement from US70 to access New Haw Creek Road.

### 4.3. Sight Distance at Beverly Road with New Haw Creek Road

The appropriate type of sight distance to consider at an intersection is referred to as intersection sight distance (ISD). According to AASHTO ${ }^{9}$ (emphasis added) in Section 9.5.1:

Vehicles are assigned the right-of-way at intersections by traffic-control devices or, where no traffic-control devices are present, by the rules of the road. A basic rule of the road, at an intersection where no traffic-control devices are present, requires the vehicle on the left to yield to the vehicle on the right if they arrive at approximately the same time. Sight distance is provided at intersections to allow drivers to perceive the presence of potentially conflicting vehicles. This should occur in sufficient time for a motorist to stop or adjust their speed, as appropriate, to avoid colliding in the intersection. The methods for determining the sight distances needed by drivers approaching intersections are based on the same principles as stopping sight distance, but incorporate modified assumptions based on observed driver behavior at intersections.

According to NCDOT ${ }^{10}$ (emphasis added) in Section 8.4 of the Roadway Design Manual:
Different types of vehicular conflicts can occur at an intersection. These conflicts can be reduced if the intersection design provides adequate sight distances and traffic controls. Sight distance at intersections should allow the driver to detect potential conflicts and provide enough time to stop or adjust speed to avoid the conflict. Proper stopping sight distance is necessary on each leg of an intersection for intersection operation.

[^5]According to AASHTO ${ }^{11}$ (emphasis added) in Section 9.5.3.2.1 (as referred to by NCDOT and as applicable to the driveway access for the proposed development as a stop-controlled intersection with left-turns for egress):

Departure sight triangles for traffic approaching from either the right or the left, like those shown in Figure 9-17, should be provided for left turns from the minor road onto the major road for all stop-controlled approaches. The length of the leg of the departure sight triangle along the major road in both directions, shown as distance b in Figure 9-17, is the recommended intersection sight distance for Case B1.

The vertex (decision point) of the departure sight triangle on the minor road should be $14.5 \mathrm{ft}[4.4 \mathrm{~m}]$ from the edge of the major-road traveled way. This represents the typical position of the minor-road driver's eye when a vehicle is stopped relatively close to the major road. Field observations of vehicle stopping positions found that, where needed, drivers will stop with the front of their vehicle $6.5 \mathrm{ft}[2.0 \mathrm{~m}]$ or less from the edge of the major-road traveled way. Measurements of passenger cars indicate that the distance from the front of the vehicle to the driver's eye for the current U.S. passenger car population is nearly always 8 ft [ 2.4 m ] or less (21). Where practical, it is desirable to increase the distance from the edge of the major-road traveled way to the vertex of the clear sight triangle from 14.5 to 18 ft [ 4.4 m to 5.4 m ]. This increase allows 10 ft [ 3.0 m ] from the edge of the major-road traveled way to the front of the stopped vehicle, providing a larger sight triangle. The length of the sight triangle along the minor road (distance a in Figure $9-17)$ is the sum of the distance from the major road plus $1 / 2$ lane width for vehicles approaching from the left, or 11/2 lane widths for vehicles approaching from the right.

New Haw Creek Road has a posted speed limited of 35 MPH with an assumed design speed of 40 MPH $^{12}$. According to AASHTO ${ }^{13}$ in Table 9-7 of Section 9.5.3.2.1 (as referred to by NCDOT and as applicable to the driveway access for the proposed development as a stop-controlled intersection with left turns for egress), the appropriate design intersection sight distance for a 40 MPH design speed roadway is 445 feet. Therefore, for a vehicle turning left from Beverly Road onto New Haw Creek Road, the intersection sight distance is 445 feet.

[^6]Table 9-7. Design Intersection Sight Distance-Case B1, Left Turn from Stop

| U.S. Customary |  |  |  |
| :---: | :---: | :---: | :---: |
|  | Stopping Sight Distance (ft) | Intersection Sight Distance for Passenger Cars |  |
|  |  | Calculated <br> (ft) | Design (ft) |
| 15 | 80 | 165.4 | 170 |
| 20 | 115 | 220.5 | 225 |
| 25 | 155 | 275.6 | 280 |
| 30 | 200 | 330.8 | 335 |
| 35 | 250 | 385.9 | 390 |
| 40 | 305 | 441.0 | 445 |
| 45 | 360 | 496.1 | 500 |
| 50 | 425 | 551.3 | 555 |
| 55 | 495 | 606.4 | 610 |
| 60 | 570 | 661.5 | 665 |
| 65 | 645 | 716.6 | 720 |
| 70 | 730 | 771.8 | 775 |
| 75 | 820 | 826.9 | 830 |
| 80 | 910 | 882.0 | 885 |


| Metric |  |  |  |
| :---: | :---: | :---: | :---: |
| Design <br> Speed <br> $(\mathrm{km} / \mathrm{h})$ | Stopping <br> Sight <br> Distance <br> $(\mathrm{m})$ | Intersection Sight <br> Distance for <br> Passenger Cars |  |
|  | Calculated <br> $(\mathrm{m})$ | Design <br> $(\mathrm{m})$ |  |
| 20 | 20 | 41.7 | 45 |
| 30 | 35 | 62.6 | 65 |
| 40 | 50 | 83.4 | 85 |
| 50 | 65 | 104.3 | 105 |
| 60 | 85 | 125.1 | 130 |
| 70 | 105 | 146.0 | 150 |
| 80 | 130 | 166.8 | 170 |
| 90 | 160 | 187.7 | 190 |
| 100 | 185 | 208.5 | 210 |
| 110 | 220 | 229.4 | 230 |
| 120 | 250 | 250.2 | 255 |
| 130 | 285 | 271.1 | 275 |

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane
highway with no median and grades 3 percent or less. For other conditions, the time gap
should be adjusted and the sight distance recalculated.

According to AASHTO ${ }^{14}$ (emphasis added) in Section 9.5.2.3, the appropriate height of the driver's eye and object to be seen is 3.5 feet:

The determination of whether an object constitutes a sight obstruction should consider both the horizontal and vertical alignment of both intersecting roadways, as well as the height and position of the object. In making this determination, it should be assumed that the driver's eye is $3.50 \mathrm{ft}[1.08 \mathrm{~m}]$ above the roadway surface and that the object to be seen is 3.50 ft [ 1.08 m ] above the surface of the intersecting road.

Figure 8 illustrates the intersection sight distance of 445 feet along New Haw Creek Road, along with the vertex (decision point) of the departure sight triangle on the minor road, positioned 14.5 feet from the edge of the major-road traveled way. These elements are connected to depict the area that should remain free of obstructions. However, based on our field estimates, existing buildings, vegetation, and terrain limit the available sight distance for drivers turning left onto New Haw Creek Road to approximately 175 feet.

Figure 9 provides a view to the northeast along New Haw Creek Road from the intersection with Beverly Road. Additionally, Figure 10 displays the approach to Beverly Road along New Haw Creek Road for a distance of approximately 200 feet from the intersection, while Figure 11 showcases the same approach for a distance of approximately 100 feet from the intersection.

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Figure 8. Intersection Sight Distance along New Haw Creek Road for a Left-Turning Vehicle from Beverly Road


Figure 9. View to the Northeast along New Haw Creek Road from the intersection with Beverly Road


Figure 10. View of Approach to Beverly Road Traveling to Southeast along New Haw Creek Road (approximately 200 feet from the intersection)


Figure 11. View of Approach to Beverly Road Traveling to Southeast along New Haw Creek Road (approximately 100 feet from the intersection)
5. APPENDIX: TRAFFIC VOLUME COUNTS AND QUEUES


| New Haw Creek Rd @ Beverly Rd |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Date: January 29-31, 2024 |  |  |  | Weather: Sunny (Overcast on 1/31) |  |  |  |  |  | EB/WB: Miller Rd/Beverly Rd |  |  |  |  | NB/SB: New Haw Creek Rd |  |
| Time Period |  | Traffic Counts |  |  |  |  |  |  |  |  |  |  |  |  | Major Mvmt <br> Queues (vehs) <br> WB | Notes |
|  |  | EB |  |  | WB |  |  | NB |  |  | SB |  |  | Total |  |  |
|  |  | L | T | R | L | T | R | L | T | R | L | T | R |  |  |  |
| $\underset{N}{N}$NNNNInNN | 16:30-16:45 | 0 | 1 | 2 | 15 | 0 | 31 | 3 | 39 | 8 | 24 | 33 | 0 | 156 | 13 |  |
|  | 16:46-17:00 | 0 | 2 | 1 | 15 | 1 | 47 | 0 | 34 | 13 | 20 | 32 | 0 | 165 |  |  |
|  | 17:01-17:15 | 0 | 3 | 2 | 7 | 1 | 42 | 1 | 47 | 11 | 16 | 41 | 1 | 172 |  |  |
|  | 17:16-17:30 | 0 | 0 | 1 | 9 | 1 | 48 | 0 | 53 | 18 | 22 | 35 | 0 | 187 |  |  |
|  | 17:31-17:45 | 0 | 0 | 0 | 13 | 0 | 40 | 1 | 39 | 16 | 25 | 28 | 0 | 162 |  |  |
|  | 17:46-18:00 | 0 | 0 | 2 | 13 | 0 | 27 | 1 | 38 | 10 | 15 | 21 | 0 | 127 |  |  |
|  | 18:01-18:15 | 0 | 0 | 0 | 8 | 1 | 30 | 0 | 35 | 19 | 15 | 20 | 0 | 128 |  |  |
|  | 18:16-18:30 | 0 | 1 | 2 | 12 | 1 | 20 | 1 | 31 | 6 | 17 | 25 | 0 | 116 |  |  |
|  | 07:00-07:15 | 0 | 0 | 0 | 4 | 0 | 6 | 0 | 11 | 5 | 16 | 29 | 0 | 71 | 11 |  |
|  | 07:16-07:30 | 0 | 0 | 0 | 7 | 0 | 15 | 0 | 34 | 10 | 21 | 32 | 0 | 119 |  |  |
|  | 07:31-07:45 | 0 | 0 | 2 | 27 | 0 | 25 | 0 | 19 | 17 | 44 | 115 | 1 | 250 |  |  |
|  | 07:46-08:00 | 0 | 0 | 0 | 22 | 0 | 38 | 0 | 49 | 8 | 57 | 98 | 0 | 272 |  |  |
|  | 08:01-08:15 | 0 | 0 | 4 | 6 | 0 | 53 | 0 | 113 | 12 | 38 | 99 | 0 | 325 |  |  |
|  | 08:16-08:30 | 0 | 0 | 1 | 10 | 2 | 33 | 3 | 80 | 9 | 45 | 106 | 1 | 290 |  |  |
|  | 08:31-08:45 | 0 | 1 | 1 | 10 | 0 | 17 | 2 | 25 | 7 | 34 | 83 | 0 | 180 |  |  |
|  | 08:46-09:00 | 0 | 0 | 0 | 4 | 1 | 19 | 1 | 25 | 14 | 19 | 30 | 0 | 113 |  |  |
|  | 16:30-16:45 | 1 | 0 | 0 | 9 | 0 | 36 | 0 | 41 | 11 | 8 | 12 | 0 | 118 | 16 |  |
|  | 16:46-17:00 | 0 | 1 | 2 | 7 | 1 | 44 | 1 | 47 | 16 | 34 | 48 | 0 | 201 |  |  |
|  | 17:01-17:15 | 0 | 2 | 4 | 15 | 1 | 49 | 0 | 48 | 17 | 21 | 44 | 0 | 201 |  |  |
|  | 17:16-17:30 | 0 | 1 | 1 | 22 | 0 | 34 | 0 | 57 | 12 | 29 | 63 | 0 | 219 |  |  |
|  | 17:31-17:45 | 0 | 0 | 1 | 15 | 0 | 45 | 1 | 53 | 9 | 30 | 40 | 0 | 194 |  |  |
|  | 17:46-18:00 | 0 | 2 | 1 | 10 | 2 | 40 | 2 | 44 | 19 | 25 | 27 | 0 | 172 |  |  |
|  | 18:01-18:15 | 0 | 0 | 2 | 11 | 1 | 28 | 0 | 31 | 2 | 21 | 19 | 0 | 115 |  |  |
|  | 18:16-18:30 | 0 | 0 | 1 | 8 | 0 | 27 | 0 | 31 | 11 | 14 | 26 | 0 | 118 |  |  |
|  | 07:00-07:15 | 0 | 0 | 0 | 5 | 0 | 6 | 0 | 13 | 7 | 12 | 30 | 0 | 73 | 8 |  |
|  | 07:16-07:30 | 0 | 1 | 0 | 8 | 0 | 14 | 1 | 38 | 10 | 20 | 40 | 0 | 132 |  |  |
|  | 07:31-07:45 | 0 | 1 | 2 | 28 | 0 | 16 | 1 | 21 | 10 | 51 | 108 | 0 | 238 |  |  |
|  | 07:46-08:00 | 0 | 1 | 1 | 14 | 1 | 49 | 1 | 60 | 15 | 61 | 104 | 0 | 307 |  |  |
|  | 08:01-08:15 | 1 | 0 | 2 | 6 | 0 | 51 | 0 | 111 | 7 | 41 | 88 | 0 | 307 |  |  |
|  | 08:16-08:30 | 0 | 0 | 1 | 7 | 0 | 37 | 1 | 78 | 12 | 32 | 117 | 1 | 286 |  |  |
|  | 08:31-08:45 | 0 | 0 | 0 | 9 | 0 | 22 | 2 | 23 | 17 | 38 | 78 | 0 | 189 |  |  |
|  | 08:46-09:00 | 0 | 1 | 1 | 16 | 0 | 16 | 8 | 19 | 14 | 26 | 41 | 0 | 142 |  |  |
| Note |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |


| New Haw Creek Rd @ Crocket Avenue |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Date: January 29-31, 2024 |  |  | Weather: Sunny (Overcast on 1/31) |  |  |  |  | EB/WB: New Haw Creek Rd |  | NB: Crockett Rd |
| Time Period |  | EB |  |  |  |  |  |  | Major Mvmt <br> Queues (vehs) <br> WB | Notes |
|  |  | WB | NB |  | Total |  |  |
|  |  | T | R | L |  | T | L | R |  |  |
| NNNNNInNN | 16:30-16:45 |  |  | 3 | 25 | 54 | 4 | 5 | 70 | 161 | 8 |  |
|  | 16:46-17:00 | 0 | 13 | 63 | 2 | 36 | 62 | 176 |  |  |  |
|  | 17:01-17:15 | 1 | 24 | 55 | 2 | 44 | 75 | 201 |  |  |  |
|  | 17:16-17:30 | 1 | 22 | 51 | 2 | 38 | 84 | 198 |  |  |  |
|  | 17:31-17:45 | 0 | 19 | 46 | 0 | 30 | 70 | 165 |  |  |  |
|  | 17:46-18:00 | 2 | 31 | 40 | 1 | 26 | 67 | 167 |  |  |  |
|  | 18:01-18:15 | 1 | 21 | 46 | 1 | 28 | 55 | 152 |  |  |  |
|  | 18:16-18:30 | 0 | 17 | 42 | 2 | 30 | 57 | 148 |  |  |  |
|  | 07:00-07:15 | 0 | 20 | 47 | 0 | 4 | 14 | 85 | 20 |  |  |
|  | 07:16-07:30 | 1 | 25 | 58 | 0 | 6 | 55 | 145 |  |  |  |
|  | 07:31-07:45 | 1 | 39 | 131 | 0 | 11 | 78 | 260 |  |  |  |
|  | 07:46-08:00 | 1 | 37 | 125 | 1 | 12 | 93 | 269 |  |  |  |
|  | 08:01-08:15 | 1 | 24 | 126 | 2 | 9 | 122 | 284 |  | queue spillback from US70 |  |
|  | 08:16-08:30 | 0 | 26 | 141 | 0 | 10 | 84 | 261 |  |  |  |
|  | 08:31-08:45 | 0 | 34 | 121 | 1 | 26 | 42 | 224 |  |  |  |
|  | 08:46-09:00 | 0 | 34 | 78 | 1 | 14 | 44 | 171 |  |  |  |
|  | 16:30-16:45 | 2 | 37 | 42 | 1 | 36 | 63 | 181 | 12 |  |  |
|  | 16:46-17:00 | 0 | 33 | 66 | 0 | 44 | 70 | 213 |  |  |  |
|  | 17:01-17:15 | 1 | 35 | 76 | 1 | 35 | 85 | 233 |  |  |  |
|  | 17:16-17:30 | 2 | 33 | 84 | 5 | 40 | 91 | 255 |  |  |  |
|  | 17:31-17:45 | 0 | 15 | 68 | 5 | 35 | 80 | 203 |  |  |  |
|  | 17:46-18:00 | 0 | 33 | 47 | 1 | 40 | 81 | 202 |  |  |  |
|  | 18:01-18:15 | 0 | 23 | 40 | 0 | 34 | 51 | 148 |  |  |  |
|  | 18:16-18:30 | 0 | 19 | 41 | 2 | 32 | 56 | 150 |  |  |  |
|  | 07:00-07:15 | 0 | 21 | 49 | 0 | 6 | 23 | 99 | 25 |  |  |
|  | 07:16-07:30 | 1 | 26 | 57 | 1 | 13 | 55 | 153 |  |  |  |
|  | 07:31-07:45 | 1 | 31 | 125 | 1 | 8 | 70 | 236 |  |  |  |
|  | 07:46-08:00 | 2 | 43 | 137 | 2 | 14 | 101 | 299 |  |  |  |
|  | 08:01-08:15 | 1 | 27 | 128 | 1 | 12 | 120 | 289 |  | long queue spillback from US70 |  |
|  | 08:16-08:30 | 2 | 26 | 138 | 1 | 13 | 81 | 261 |  |  |  |
|  | 08:31-08:45 | 2 | 32 | 116 | 0 | 12 | 42 | 204 |  |  |  |
|  | 08:46-09:00 | 1 | 23 | 79 | 0 | 16 | 55 | 174 |  |  |  |


| US 70 @ Crockett Avenue |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Date: January 29-31, 2024 |  |  |  | Weather: Sunny (Overcast on 1/31) |  |  |  |  | EB/WB: US 70 |  |  |  |  |  | NB/SB: Crockett |  |  |  |
| Time Period |  | Traffic Counts |  |  |  |  |  |  |  |  |  |  |  |  | Major Mvmt Queues (vehs) |  |  | Notes |
|  |  | EB |  |  | WB |  |  | NB |  |  | SB |  |  | Total |  |  |  |  |
|  |  | L | T | R | L | T | R | L | T | R | L | T | R |  | EBL | EBT | WBT |  |
| NNNNZInNN | 16:30-16:45 | 80 | 161 | 2 | 4 | 175 | 2 | 6 | 4 | 4 | 8 | 2 | 60 | 508 | 19 | 11 | 15 |  |
|  | 16:46-17:00 | 89 | 159 | 7 | 0 | 224 | 8 | 8 | 5 | 2 | 8 | 3 | 72 | 585 |  |  |  |  |
|  | 17:01-17:15 | 131 | 232 | 1 | 9 | 236 | 13 | 7 | 4 | 3 | 6 | 1 | 65 | 708 |  |  |  |  |
|  | 17:16-17:30 | 87 | 160 | 0 | 5 | 129 | 7 | 11 | 2 | 3 | 4 | 0 | 64 | 472 |  |  |  |  |
|  | 17:31-17:45 | 92 | 181 | 3 | 5 | 160 | 11 | 13 | 6 | 6 | 7 | 4 | 60 | 548 |  |  |  |  |
|  | 17:46-18:00 | 90 | 145 | 4 | 2 | 142 | 8 | 13 | 2 | 6 | 11 | 0 | 59 | 482 |  |  |  |  |
|  | 18:01-18:15 | 90 | 158 | 2 | 0 | 166 | 3 | 7 | 4 | 3 | 4 | 2 | 58 | 497 |  |  |  |  |
|  | 18:16-18:30 | 68 | 158 | 0 | 2 | 159 | 8 | 4 | 5 | 0 | 3 | 3 | 55 | 465 |  |  |  |  |
| $\begin{aligned} & \text { N } \\ & \text { N } \\ & \text { N } \\ & \text { O} \\ & \text { N} \\ & \text { N } \\ & \text { त्N } \end{aligned}$ | 07:00-07:15 | 15 | 85 | 0 | 0 | 79 | 2 | 0 | 0 | 1 | 4 | 1 | 60 | 247 | 21 | 7 | 17 |  |
|  | 07:16-07:30 | 62 | 126 | 1 | 0 | 93 | 3 | 6 | 1 | 3 | 7 | 1 | 78 | 381 |  |  |  |  |
|  | 07:31-07:45 | 79 | 148 | 2 | 0 | 167 | 8 | 4 | 2 | 1 | 4 | 0 | 168 | 583 |  |  |  |  |
|  | 07:46-08:00 | 103 | 119 | 1 | 0 | 221 | 3 | 6 | 3 | 3 | 7 | 5 | 152 | 623 |  |  |  | spill back from T-intx to north into intx |
|  | 08:01-08:15 | 116 | 121 | 1 | 0 | 162 | 1 | 6 | 4 | 0 | 6 | 2 | 128 | 547 |  |  |  | serve twice per cycle EB left |
|  | 08:16-08:30 | 89 | 113 | 0 | 2 | 172 | 3 | 7 | 4 | 2 | 6 | 1 | 158 | 557 |  |  |  | serve twice per cycle EB left |
|  | 08:31-08:45 | 59 | 147 | 4 | 1 | 158 | 5 | 8 | 8 | 0 | 8 | 5 | 136 | 539 |  |  |  |  |
|  | 08:46-09:00 | 46 | 134 | 5 | 2 | 210 | 2 | 8 | 2 | 3 | 8 | 2 | 98 | 520 |  |  |  |  |
|  | 16:30-16:45 | 88 | 196 | 8 | 3 | 225 | 11 | 9 | 9 | 5 | 14 | 1 | 70 | 639 | 17 | 12 | 18 |  |
|  | 16:46-17:00 | 82 | 175 | 1 | 0 | 226 | 14 | 1 | 4 | 2 | 6 | 1 | 81 | 593 |  |  |  | spill back from T-intx to north into intx |
|  | 17:01-17:15 | 102 | 176 | 2 | 4 | 181 | 8 | 7 | 8 | 1 | 7 | 7 | 98 | 601 |  |  |  | spill back from T-intx to north into intx |
|  | 17:16-17:30 | 124 | 223 | 6 | 2 | 185 | 5 | 5 | 5 | 5 | 7 | 1 | 110 | 678 |  |  |  |  |
|  | 17:31-17:45 | 92 | 166 | 2 | 1 | 204 | 9 | 8 | 5 | 4 | 1 | 4 | 72 | 568 |  |  |  |  |
|  | 17:46-18:00 | 99 | 143 | 6 | 3 | 155 | 5 | 12 | 7 | 7 | 6 | 3 | 71 | 517 |  |  |  |  |
|  | 18:01-18:15 | 64 | 131 | 3 | 3 | 179 | 10 | 8 | 3 | 4 | 5 | 4 | 57 | 471 |  |  |  |  |
|  | 18:16-18:30 | 75 | 145 | 2 | 3 | 144 | 6 | 14 | 6 | 1 | 3 | 0 | 54 | 453 |  |  |  |  |
|  | 07:00-07:15 | 29 | 89 | 2 | 1 | 86 | 1 | 1 | 2 | 0 | 3 | 1 | 65 | 280 | 17 | 14 | 15 |  |
|  | 07:16-07:30 | 66 | 144 | 1 | 0 | 106 | 3 | 2 | 0 | 5 | 8 | 1 | 73 | 409 |  |  |  |  |
|  | 07:31-07:45 | 71 | 109 | 4 | 0 | 129 | 6 | 3 | 2 | 0 | 6 | 1 | 130 | 461 |  |  |  |  |
|  | 07:46-08:00 | 104 | 143 | 1 | 0 | 180 | 4 | 11 | 4 | 4 | 11 | 3 | 161 | 626 |  |  |  |  |
|  | 08:01-08:15 | 126 | 146 | 4 | 0 | 165 | 4 | 1 | 2 | 0 | 6 | 3 | 148 | 605 |  |  |  | serve twice per cycle EB left |
|  | 08:16-08:30 | 82 | 131 | 6 | 0 | 161 | 2 | 5 | 2 | 6 | 4 | 3 | 154 | 556 |  |  |  | serve twice per cycle EB left |
|  | 08:31-08:45 | 46 | 114 | 4 | 1 | 152 | 8 | 3 | 0 | 3 | 13 | 3 | 141 | 488 |  |  |  |  |
|  | 08:46-09:00 | 69 | 138 | 5 | 3 | 155 | 2 | 8 | 2 | 1 | 7 | 3 | 89 | 482 |  |  |  |  |
| Note | EBL is a major | onflic | with | EBT | ch | downh | grad |  |  |  |  |  |  |  |  |  |  |  |


[^0]:    ${ }^{1}$ The opinions contained in this report are based on facts and data that is widely accepted and utilized within the traffic engineering field and the product of principles and methods that have been tested, peer reviewed and published, have a known or potential error rate, have established standards and controls related to their application, and are generally accepted within the traffic engineering community.

[^1]:    ${ }^{2}$ This estimate of trips was developed using industry established practices to apply the proposed land uses defined in the site plan with trip generation estimates from the ITE Trip Generation Manual.

[^2]:    ${ }^{3}$ Spillback refers to vehicular demand that exceed a predefined storage threshold for vehicles. Examples include traffic that "spills" out of a left or right turn storage lane or traffic that "spills" into upstream intersections due to capacity constraints downstream.
    ${ }^{4}$ Blockage refers to vehicular demand that interferes with the ability of traffic to enter the desired lane. Examples include long queues that block left or right turn storage lanes or even driveway entrances.
    ${ }^{5}$ North Carolina School Report Cards. Available online at https://ncreports.ondemand.sas.com/src/school?school=11A000\&year=2019\&lng=en\&home lea=110LEA

[^3]:    ${ }^{6}$ Haw Creek Elementary School webpage found at https://hces.buncombeschools.org/o/hces/page/our-school

[^4]:    ${ }^{7}$ Per NCDOT: Section Scoring: Points for highway section projects are scored based on three components: 1) Class Density Ratio - The crash density of the study area versus the average crash density of similar facilities; 2) Severity Index; and 3) Critical Crash Rate Ratio - The actual crash rate for the study area versus the critical crash rate. The points from the three safety score components are added, and then the sum is divided by three. Areas with higher scores are considered to have the poorer highway safety performance. (Source: NCDOT)

[^5]:    ${ }^{8}$ According to the North Carolina DMV-349 Crash Report Instruction Manual, crash types are defined by the most severe injury to a person involved in the crash as follows:

    - Killed - Deaths, which occur within 12 months after the crash.
    - A injury type (disabling) - Injury obviously serious enough to prevent the person injured from performing his normal activities for at least one day beyond the day of the collision. Massive loss of blood, broken bone, unconsciousness of more than momentary duration are examples.
    - B injury type (evident) - Obvious injury, other than killed or disabling, which is evident at the scene. Bruises, swelling, limping, soreness, are examples. Class B injury would not necessarily prevent the person from carrying on his normal activities.
    - C injury type (possible) - No visible injury, but person complains of pain, or has been momentarily unconscious.
    ${ }^{9}$ American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. $7^{\text {th }}$ Edition. 2018
    ${ }^{10}$ North Carolina Department of Transportation. Roadway Design Manual. May 2023.

[^6]:    ${ }^{11}$ American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. $7^{\text {th }}$ Edition. 2018.

    12 The design speed of a roadway is commonly assumed to be five miles per hour above the posted speed limit.
    ${ }^{13}$ American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. $7^{\text {th }}$ Edition. 2018.

[^7]:    ${ }^{14}$ American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. $7^{\text {th }}$ Edition. 2018.

