



**HIGHWAY FACTORS GROUP CHAIRMAN'S  
FACTUAL REPORT**

**Chattanooga, TN**

**HWY17MH009**

(21 pages)

**NATIONAL TRANSPORTATION SAFETY BOARD  
OFFICE OF HIGHWAY SAFETY  
WASHINGTON, D.C.**

**HIGHWAY FACTORS GROUP CHAIRMAN'S  
FACTUAL REPORT**

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**A. CRASH INFORMATION**

Location: 300 block of Talley Road, Chattanooga, Hamilton County, Tennessee  
Vehicle #1: 2008 Thomas Built School Bus  
Operator #1: Durham School Services LP of Warrenville, IL  
Date: November 21, 2016  
Time: Approximately 03:20 p.m. Eastern Standard Time (EST)  
NTSB #: **HWY17MH009**

**B. HIGHWAY FACTORS GROUP**

Dan Walsh, P.E., Senior Highway Factors Investigator, Group Chairman  
NTSB Office of Highway Safety  
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John W. Van Winkle, P.E., City Traffic Engineer  
City of Chattanooga  
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3410 Amnicola Highway  
Chattanooga, TN 37406

Dr. Jeffery Lee McDade, Assistant Superintendent  
Hamilton County Department of Education  
3074 Hickory Valley Road  
Chattanooga, TN 37421

## C. CRASH SUMMARY

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

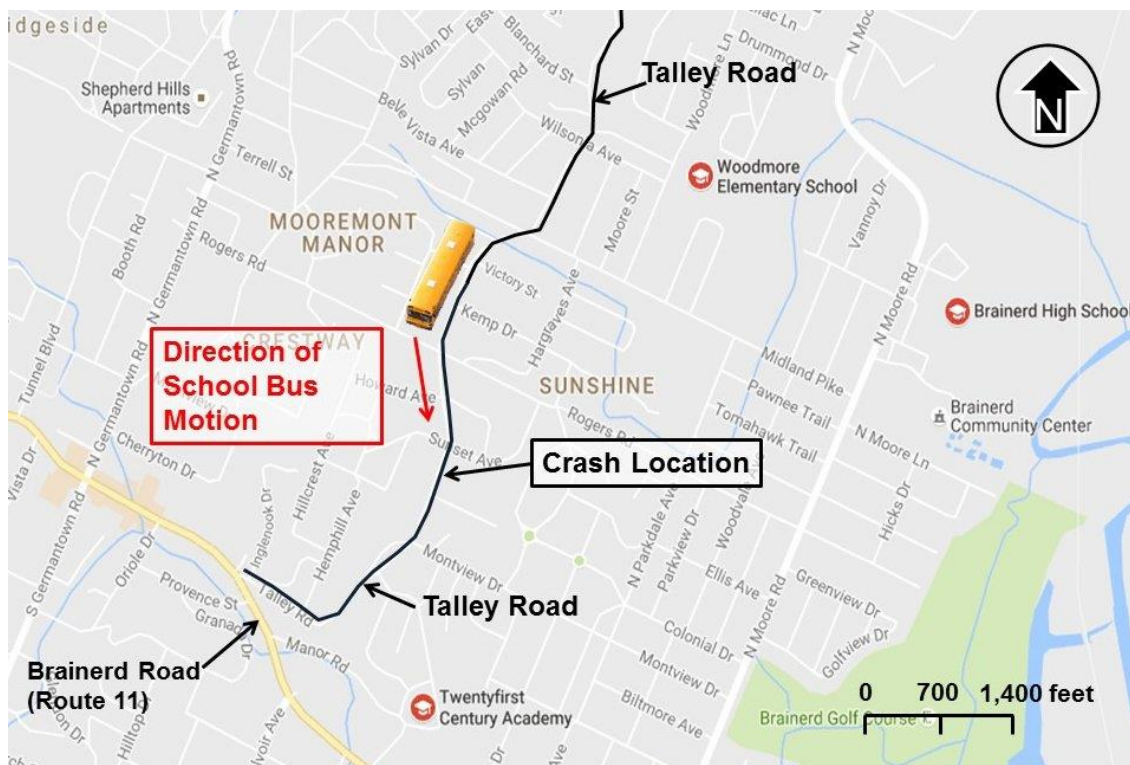
## D. DETAILS OF THE HIGHWAY FACTORS INVESTIGATION

The Highway Factors Factual Report begins with a discussion of the prefatory and other statistical data gathered as it relates to the crash on Talley Road. The report continues with documentation of the roadway characteristics for Talley Road that includes photographs of the tire marks left by the school bus on the grass and right side of Talley Road. The report highlights the distances to the utility pole impact and tree location in relation to the edge of pavement from Talley Road. Lastly, the report provides an extensive research effort to determine how far the school bus driver was off his normal route on the day of the crash and the week preceding the crash.

### 1. Prefatory Data

#### 1.1. Crash Location

The crash occurred in the 300 block of Talley Road in Chattanooga, Hamilton County, Tennessee. **Figure 1** is a crash map that illustrates the crash location was approximately 0.75 miles southwest of Woodmore Elementary School.



**Figure 1** – Crash map (Source: Internet Map of Schools in Hamilton County modified)

## 1.2. Average Daily Traffic Volumes

**Table 1** summarizes the average daily traffic volumes on Talley Road in the vicinity of the crash from 2011 through 2015.

**Table 1** – Average daily traffic volumes on Talley Road

Talley Road	Average Daily Traffic Volumes
2015	2,905
2014	2,637
2013	2,624
2012	2,755
2011	2,449

## 1.3. Traffic and Fatal Accident Summary

**Table 2** summarizes the traffic and fatal accident summary for the entire length of Talley Road from January 2013 through October 2016. The table provides a description of the type of each traffic accident and the number of fatal, injury, and property damage accidents. The total number of traffic accidents is summarized in the table with the corresponding percentage of each type of traffic accident.

**Table 2** – Traffic and fatal accident summary for the entire length of Talley Road

Type	Fatal	Injury	Property Damage	Total	Percentage
Angle	0	3	8	11	21%
Rear End	0	2	7	9	17%
Side-Swipe	0	0	6	6	12%
Fixed Object <sup>1</sup>	0	0	10	10	19%
Other	0	0	1	1	2%
Unknown	0	4	11	15	29%
<b>Total</b>	<b>0</b>	<b>9</b>	<b>43</b>	<b>52</b>	<b>100%</b>

## 2. Roadway Data

### 2.1. Roadway Classification of Talley Road

Talley Road would be considered a local urban street under the American Association of State Highway and Transportation Officials' (AASHTO's) A Policy on Geometric Design of Highways and Streets.<sup>2</sup> AASHTO defines a local urban street as the following:

<sup>1</sup>Fixed objects include utility pole, mail box, embankment rock/stone/concrete, standing tree, fence, and other object.

<sup>2</sup>*A Policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials; 2011 6<sup>th</sup> Edition; page 5-11.

*“The design features of local urban streets are constrained by practical limitations to a greater extent than those of similar roads in rural areas. The two major design controls are (1) the type and extent of urban development, which often limit the available right-of-way, and (2) zoning or regulatory restrictions. Local urban streets serve primarily to provide access to adjacent residential development areas. In such cases, the overriding consideration is to foster a community environment whereas the convenience of the motorist is secondary. Other local urban streets not only provide access to adjacent development but also serve limited through traffic.”*

The characteristics of a local urban street as defined in AASHTO’s A Policy on Geometric Design of Highways and Streets include the following:

- *The design speeds for local urban streets range from 20 to 30 miles per hour (mph) depending on available right-of-way, terrain, likely pedestrian presence, adjacent development, and other area controls.<sup>3</sup>*
- *The width of traveled way on local urban streets should be 10 to 11-feet wide.<sup>4</sup>*
- *The horizontal curves on local urban streets should be a minimum radius of 100 feet and the vertical grades should be less than 15 percent.<sup>5</sup>*
- *The lateral offset to fixed objects on local urban streets without a curb and gutter should be a minimum of 4 feet from the edge of the traveled way.<sup>6</sup>*

## **2.2. Roadway Design**

The cross section for Talley Road in the immediate vicinity of the crash consisted of a southbound and northbound travel lane. Each of the travel lanes was approximately 11-foot wide separated by a solid double yellow line. The total width of the pavement was approximately 22 feet. The right-of-way<sup>7</sup> width for Talley Road was approximately 50 feet.

**Figure 2** illustrates the horizontal curves immediately preceding the crash location. Horizontal curve #1 turned to the left for motorists travelling in the southbound direction of Talley Road and had a radius of 700 feet. Horizontal curve #2 turned to the right for motorists travelling in the southbound direction of Talley Road and had a radius of 352 feet. The horizontal curves were separated by a tangent distance of approximately 500 feet.

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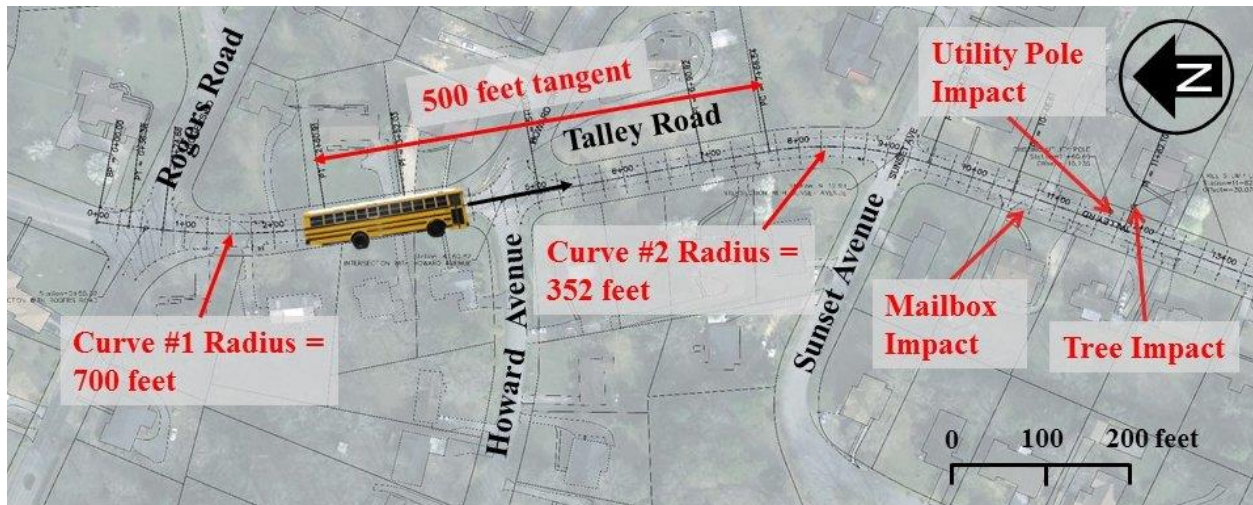
<sup>3</sup>ibid, page 5-11.

<sup>4</sup>ibid, page 5-13.

<sup>5</sup>ibid, page 5-12.

<sup>6</sup>ibid, page 5-20.

<sup>7</sup>The term “right-of-way” is generally understood as the area that is publicly owned in which the roadway is typically centered, but may be offset due to topography, existing utilities, or limited right-of-way width.



**Figure 2** – Horizontal curves immediately preceding the crash location (Source: City of Chattanooga modified)

### 2.3. Direction of Travel

The school bus was traveling in the southbound direction of Talley Road immediately before the crash.

### 2.4. Construction History of Talley Road

The earliest plats show Talley Road to be a platted right-of-way as early as 1921. The last resurfacing of record in the 300 block of Talley Road occurred in 1994 from Brainerd Road to Rogers Road. No roadway improvement projects are currently being planned for the 300 block of Talley Road.

### 2.5. Speed Limit

The posted speed limit for Talley Road was 30 mph. Warning signs existed at various locations along Talley Road to reduce speed to 25 mph and 20 mph in areas of sharp horizontal curvature.

### 2.6. Speed and Vehicle Classification Study

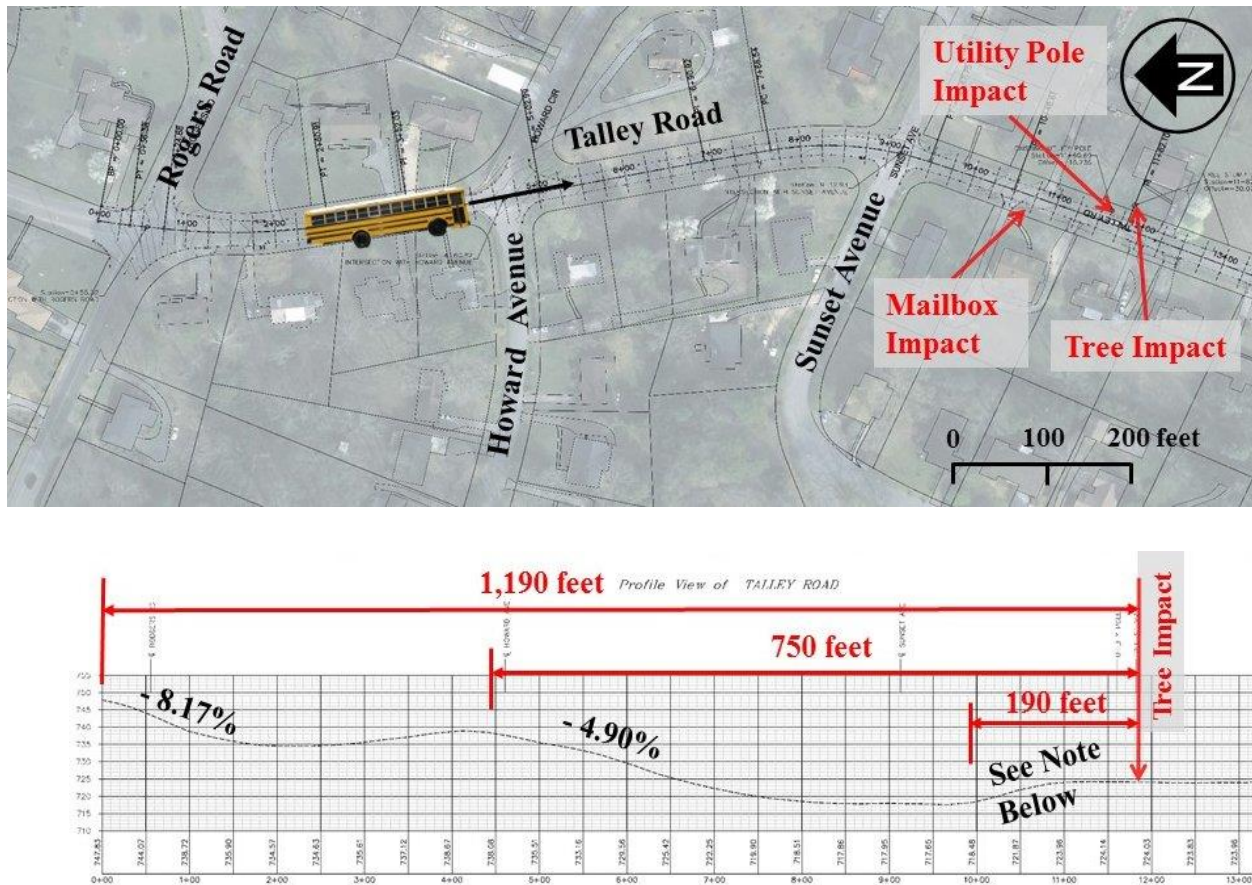
The City of Chattanooga conducted a speed and vehicle classification study in the southbound lane of Talley Road (318 block) on December 1, 2016. The study began on December 1, 2016 at 12:00 a.m. and concluded on December 2, 2016 at 12:00 a.m. lasting a total of 24 hours. The total recorded volume showed 1,588 vehicles passed through the location with a peak volume of 167 vehicles on December 1, 2016 from 5:00 p.m. to 6:00 p.m. and a minimum volume of 7 vehicles on December 1, 2016 from 1:00 a.m. to 2:00 a.m.

The speed study revealed at least half the vehicles were traveling in the 20 – 25 mph range or lower. The average speed for all classified vehicles was 26 mph. The total number of vehicles classified in the study was 1,032 vehicles and most of the vehicles were passenger vehicles.

Passenger vehicles comprised 58 percent of the total classified vehicles (or 594 vehicles); vans and pickups comprised 33 percent (or 341 vehicles); buses and trucks comprised 4 percent (or 43 vehicles); and other vehicles comprised 5 percent (or 54 vehicles).

## 2.7. Vertical Grades

**Figure 3** illustrates the vertical grades immediately preceding the crash location. The top half of the graphic illustrates the plan view of Talley Road and the bottom half of the graphic illustrates the profile view of Talley Road. The vertical grades for Talley Road in the southbound direction of travel consisted of a negative (-) 8.17% downgrade slope located approximately 1,190 feet from the tree impact; a negative (-) 4.9% downgrade slope located approximately 750 feet from the tree impact; and a positive (+) 6.9% upgrade maximum slope (4.3% overall average slope) located approximately 190 feet from the tree impact. The Technical Reconstruction Group Factual Report should be consulted for further information on specific distances and grades as the school bus was traveling southbound on Talley Road approaching the crash location.






Note: 6.9% upgrade maximum slope (4.3% overall average slope).

**Figure 3** – Vertical grades immediately preceding the crash location (Source: City of Chattanooga modified)

## 2.8. Roadway Signing

**Table 3** summarizes the roadway signing in the southbound direction of Talley Road from north of Rogers Road to the crash location. **Table 3** shows the sign type, the Manual on Uniform Traffic Control Devices (MUTCD) code and sign symbol, the condition of the sign, the sign size, and the distance from the sign to the crash location.

**Table 3** – Roadway signing in the southbound direction of Talley Road from north of Rogers Road to the crash location

Sign Type	MUTCD Code	MUTCD Sign Symbol	Condition	Sign Size	Distance to Crash
Intersection Warning	W2-1		Good	30 inch x 30 inch	1,450 feet
Advisory Speed	W13-1 (25)		Good	18 inch x 18 inch	1,450 feet
Speed Limit 30	R2-1		Good	24 inch x 30 inch	445 feet



## 2.9. Documentation of tire marks on grass and right side of roadway

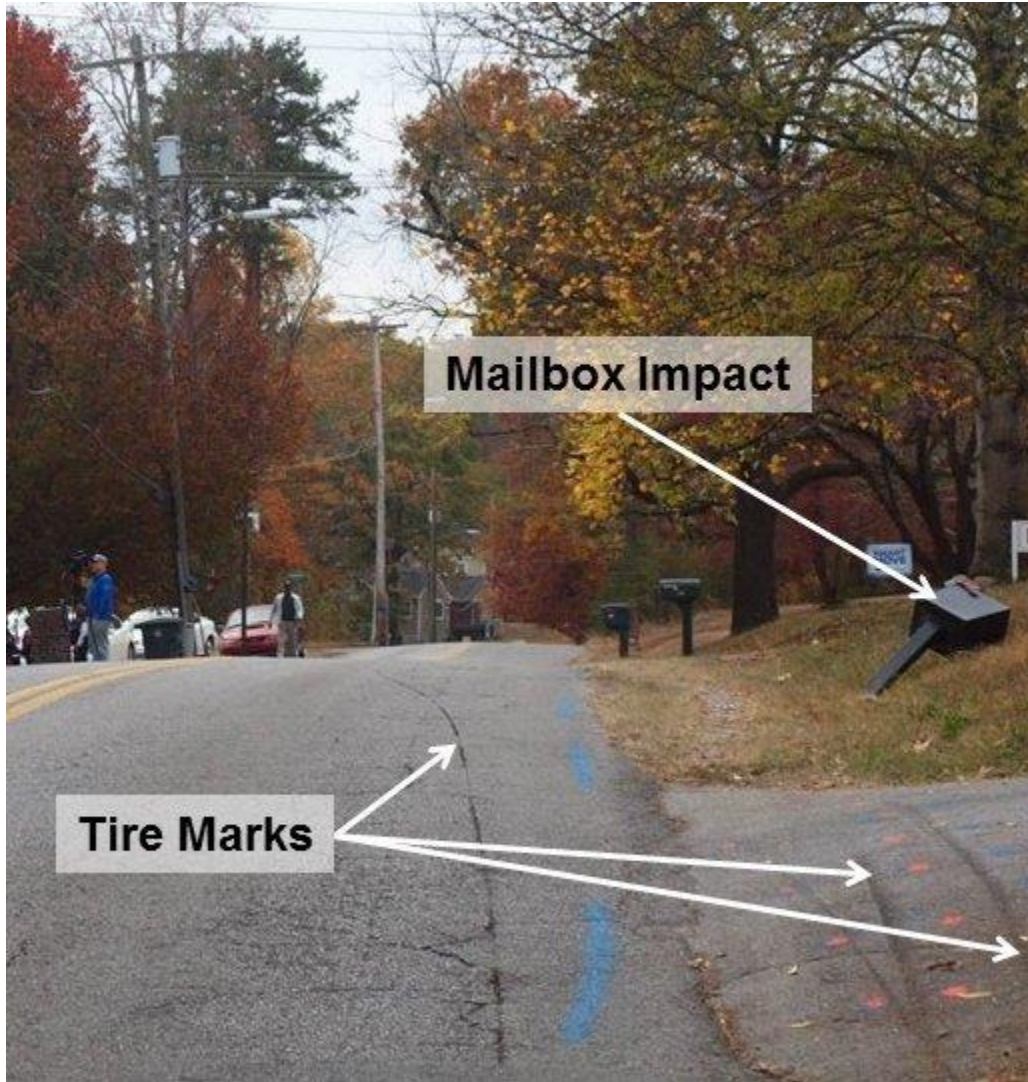
**Highway Photograph 1** illustrates the tire marks left by the school bus on the grass and right side of Talley Road in the southbound direction of travel and the mailbox impact located in the background of the graphic.



**Highway Photograph 1** - Tire marks left by the school bus on the grass and right side of Talley Road in the southbound direction of travel and the mailbox impact located in the background of the graphic

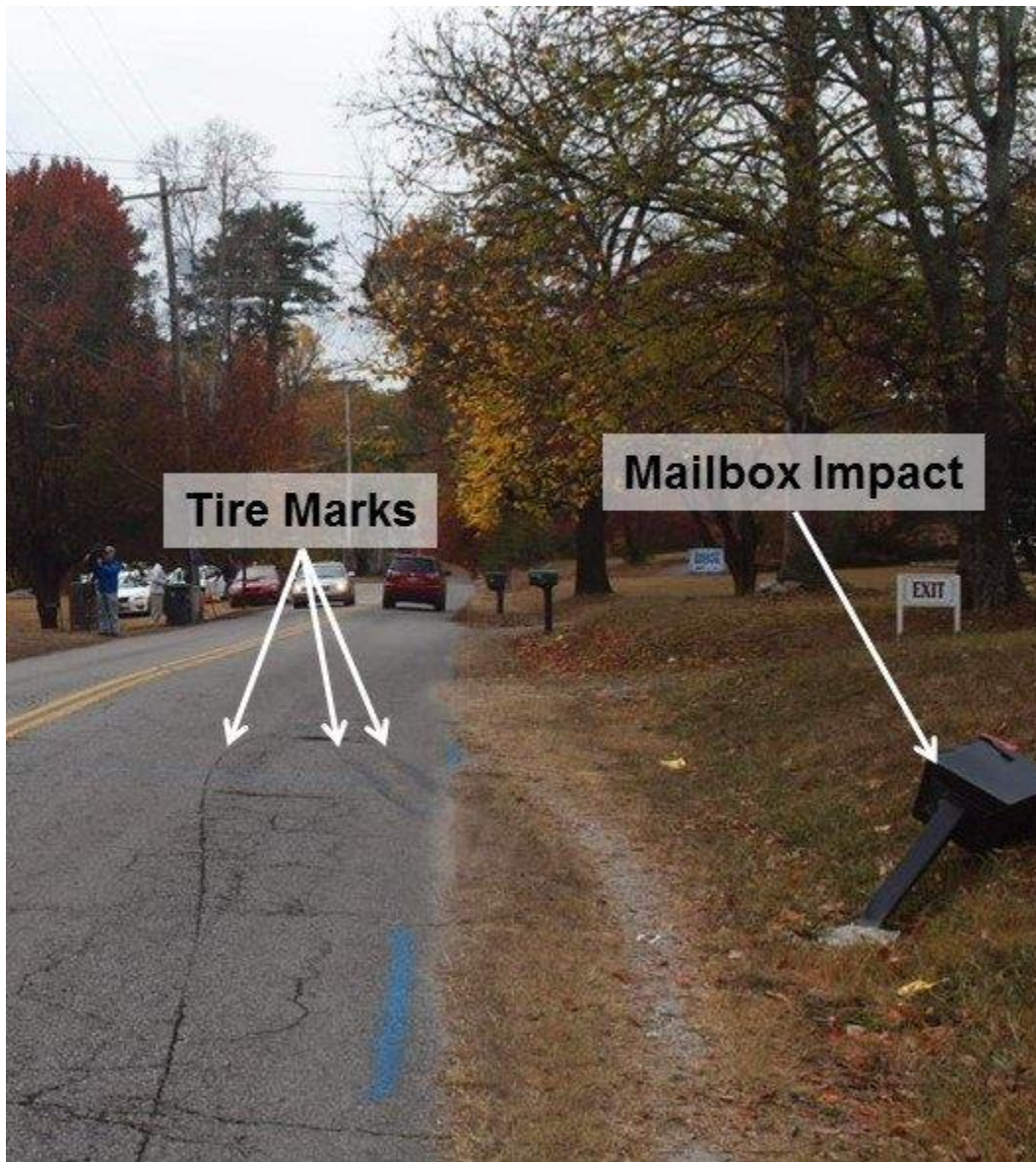
## 2.10. Documentation of damage to mail box

**Highway Photograph 2** illustrates the tire marks left by the school bus on the right side of Talley Road in the southbound direction of travel and the mailbox impact located in the background of the graphic.



**Highway Photograph 2** - Tire marks left by the school bus on the right side of Talley Road in the southbound direction of travel and the mailbox impact located in the background of the graphic

**Highway Photograph 3** illustrates the mailbox impact located in the foreground of the graphic and the tire marks in the southbound lane left by the school bus after the wheels returned to the pavement.



**Highway Photograph 3** - Mailbox impact located in the foreground of the graphic and the tire marks in the southbound lane left by the school bus after the wheels returned to the pavement

## 2.11. Documentation of tire marks left on roadway

**Highway Photograph 4** illustrates the mailbox impact located in the foreground of the graphic and the tire marks in the southbound lane left by the school bus after the wheels returned to the pavement. The Technical Reconstruction Factual Report documents the angle and length of the tire marks in the southbound and northbound lanes prior to the school bus colliding with the utility pole and tree.



**Highway Photograph 4** - Mailbox impact located in the foreground of the graphic and the tire marks in the southbound lane left by the school bus after the wheels returned to the pavement

## 2.12. Distances to impacted utility pole and tree

**Highway Photograph 5** illustrates the utility pole impact and tree location in relation to the edge of pavement for Talley Road. The distance from the utility pole to the edge of pavement was approximately 5 feet. The 25 mph warning sign in the northbound direction of travel was mounted separately from the utility pole and was destroyed as a result of the crash. The distance from the tree location to the edge of pavement was approximately 20 feet.

The diameter of the utility pole was approximately 9 inches and the diameter of the tree was approximately 24 inches.



**Highway Photograph 5** - Utility pole impact and tree location in relation to the edge of pavement for Talley Road (Source: Google Earth Street View modified)

### 3. School Bus Schedule and Drop-off Locations and Times

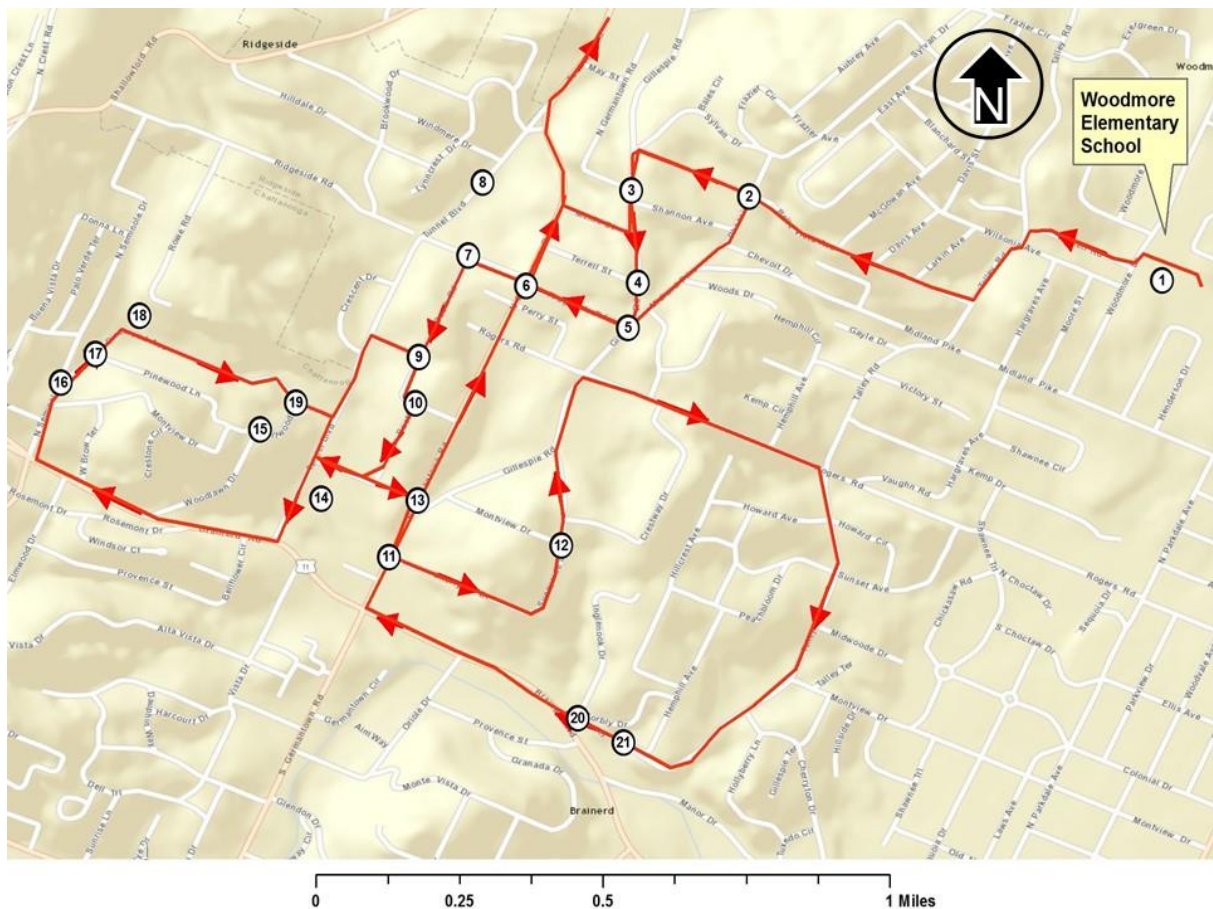
The school bus involved in the crash was transporting student passengers from Woodmore Elementary School. The school bus was identified as bus number 366. **Table 4** summarizes the normal schedule and drop-off locations and times for bus number 366.

**Table 4** – Normal schedule and drop-off locations and times for bus number 366 (Source: Hamilton County Department of Education)

Stop Number	Description of Drop-Off Location	Time at Stop
1	School: Woodmore Elementary Pick-Up	3:00 p.m.
2	Phoenix Ave & Belle Vista Ave	3:08 p.m.
3	Gillespie Road & Shannon Ave	3:09 p.m.
4	Gillespie Road & Terrell St	3:09 p.m.
5	Ridgeside Road & Gillespie Road	3:10 p.m.
6	N Germantown Road & Ridgeside Road	3:11 p.m.
7	Ridgeside Road & Booth Road	3:11 p.m.
8	404 Tunnel Blvd – Shepherd Hills Apts	3:13 p.m.
9	Booth Road & Ridgevale Ave	3:15 p.m.
10	Booth Road & Howard Ave	3:15 p.m.

11	Cherryton Dr & N Germantown Road	3:16 p.m.
12	Montview Dr & Sunnyside Dr	3:18 p.m.
13	N Germantown Road & Montview Dr	3:21 p.m.
14	Montview Apartments	3:22 p.m.
15	Dellwood Pl & Woodlawn Dr	3:23 p.m.
16	Pinewood Ave & N Seminole Dr	3:25 p.m.
17	Pinewood Ave & Pinewood Terrace Lane	3:25 p.m.
18	3301 Pinewood Ave – Pinewood Trace Apts	3:26 p.m.
19	Pinewood Ave & Dellwood Pl	3:27 p.m.
20	Corbly Dr & Inglebrook Dr & Talley Rd	3:29 p.m.
21	99 Talley Road	3:31 p.m.

**Figure 4** illustrates the general route for bus number 366 based on the normal schedule and 3 p.m. drop-off locations as shown in **Table 4**. **Figure 4** illustrates the driver of the school bus maintained his normal route with only slight modifications from Monday, November 14, 2016 through Thursday, November 17, 2016. The graphic was developed using data from software technology called Zonar. Durham School Services uses the Zonar software technology to assist with GPS tracking, payroll, and for completing pre-trip vehicle inspections.

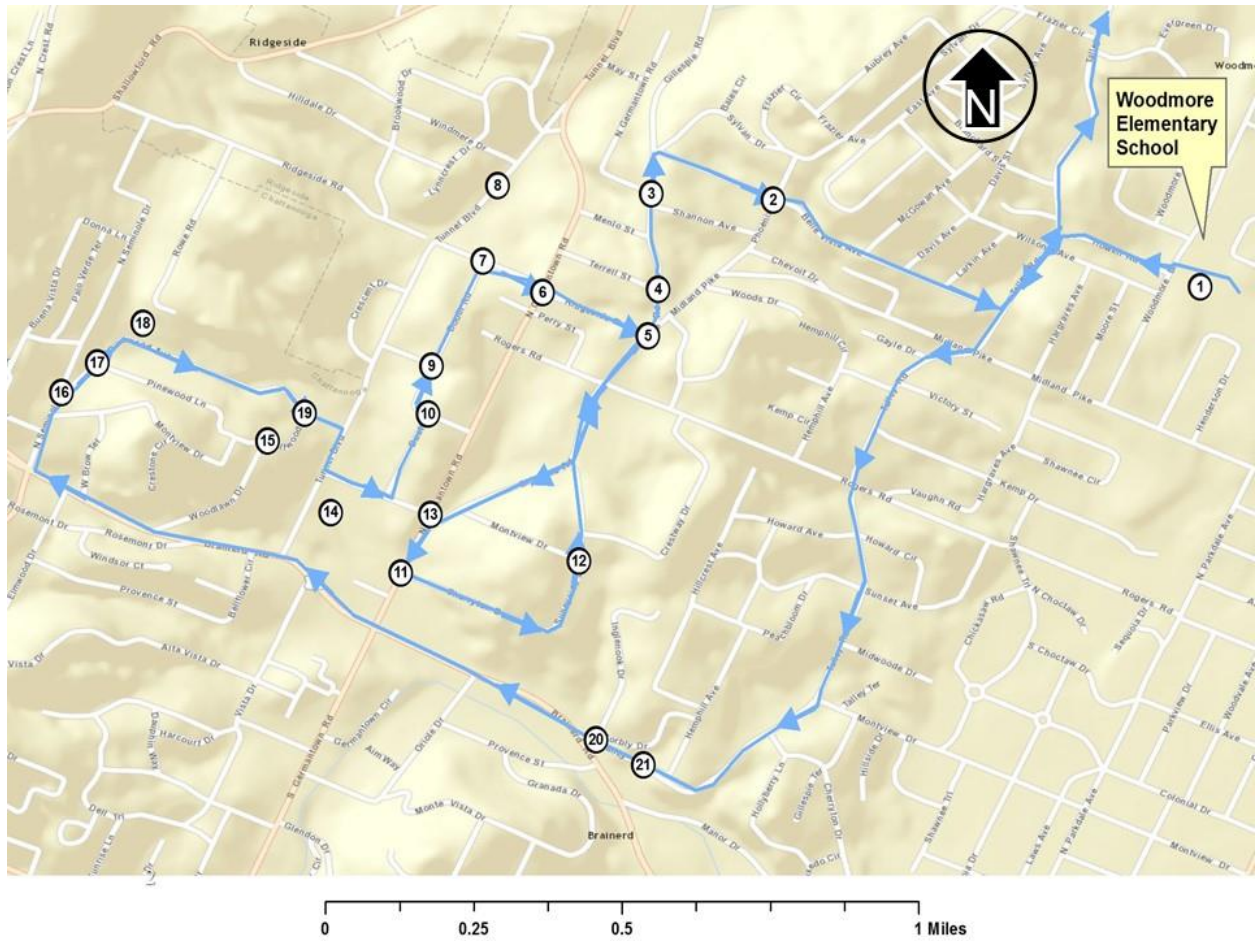


**Figure 4** – Driver of the school bus maintained his normal route with only slight modifications from Monday, November 14, 2016 through Thursday, November 17, 2016

**Table 5** and **Figure 5** illustrate the driver of the school bus deviated from his normal route on Friday, November 18, 2016 and almost reversed the order of his normal schedule and drop-off locations.

**Table 5** – Driver of the school bus deviated from his normal route on Friday, November 18, 2016

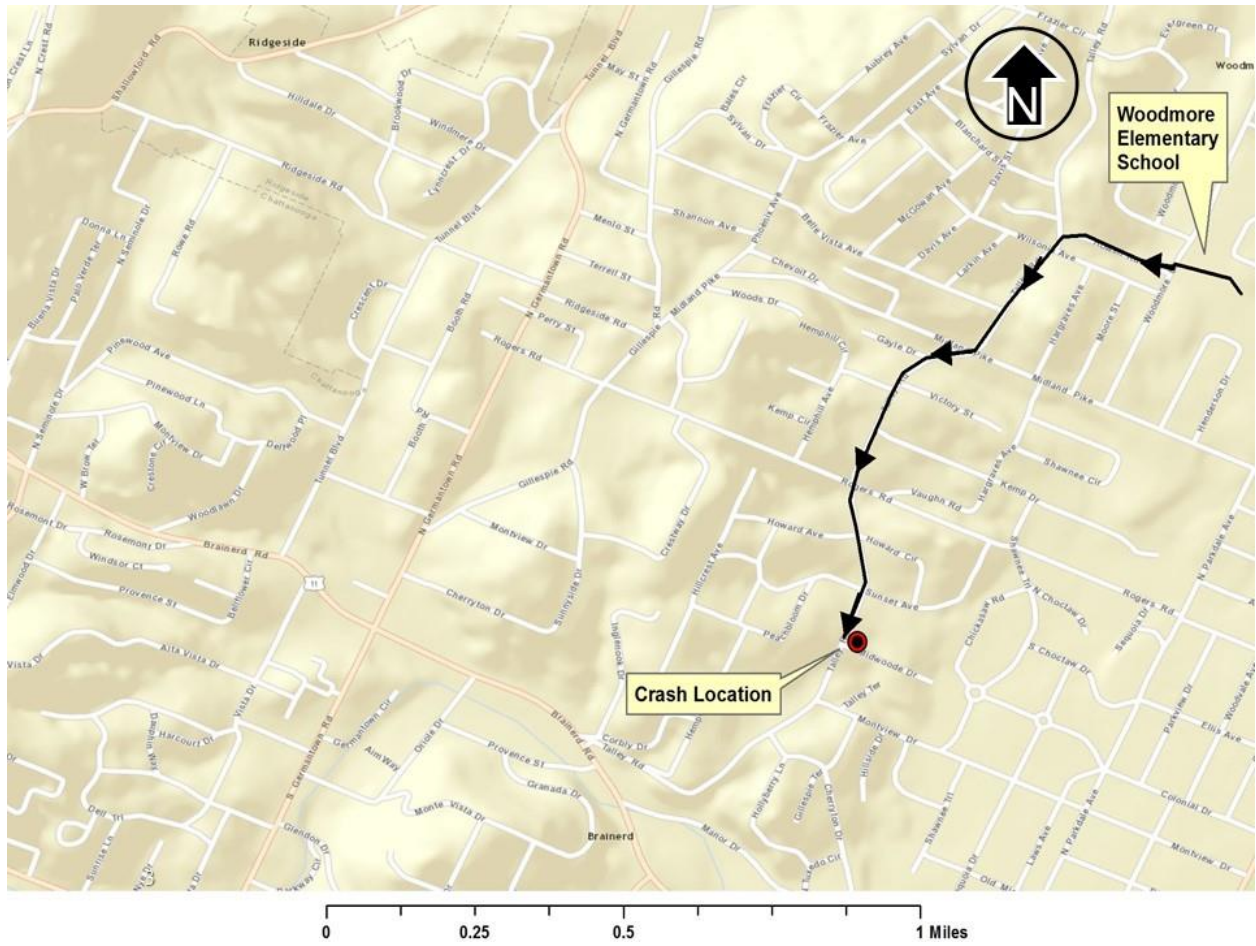
<b>Stop Number</b>	<b>Description of Drop-Off Location</b>
1	School: Woodmore Elementary Pick-Up
21	99 Talley Road
20	Corbly Dr & Inglenook Dr & Talley Rd
16	Pinewood Ave & N Seminole Dr
17	Pinewood Ave & Pinewood Terrace Lane
18	3301 Pinewood Ave – Pinewood Trace Apts
19	Pinewood Ave & Dellwood Pl
15	Dellwood Pl & Woodlawn Dr
14	Montview Apartments
10	Booth Road & Howard Ave
9	Booth Road & Ridgevale Ave
7	Ridgeside Road & Booth Road
8	404 Tunnel Blvd – Shepherd Hills Apts
6	N Germantown Road & Ridgeside Road
5	Ridgeside Road & Gillespie Road
13	N Germantown Road & Montview Dr
11	Cherryton Dr & N Germantown Road
12	Montview Dr & Sunnyside Dr
4	Gillespie Road & Terrell St
3	Gillespie Road & Shannon Ave
2	Phoenix Ave & Belle Vista Ave



**Figure 5** – Driver of the school bus deviated from his normal route on Friday, November 18, 2016

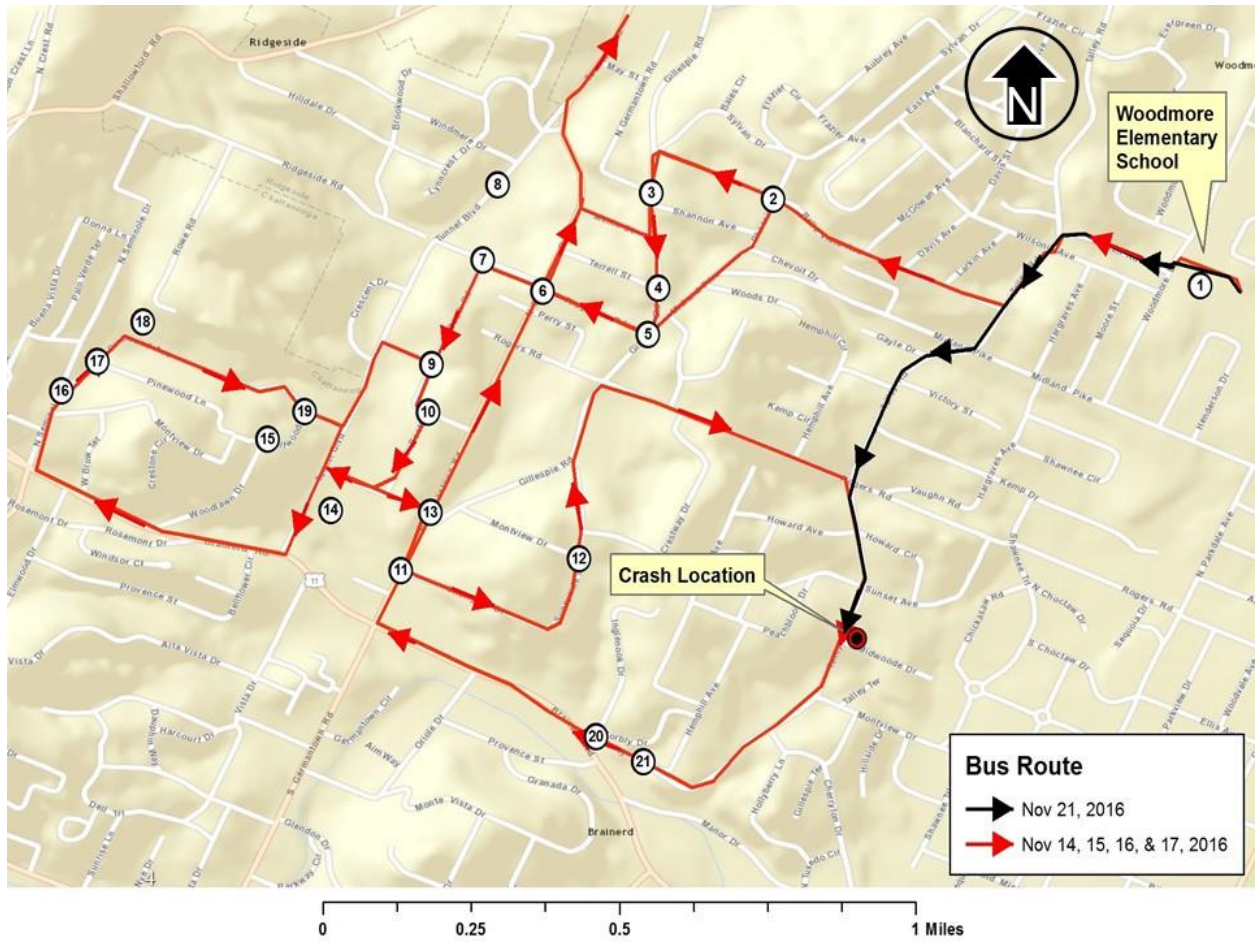


**Figure 6** illustrates the driver of the school bus deviated from his normal route on Monday, November 21, 2016, the day of the crash.



**Figure 6** – Driver of the school bus deviated from his normal route on Monday, November 21, 2016, the day of the crash

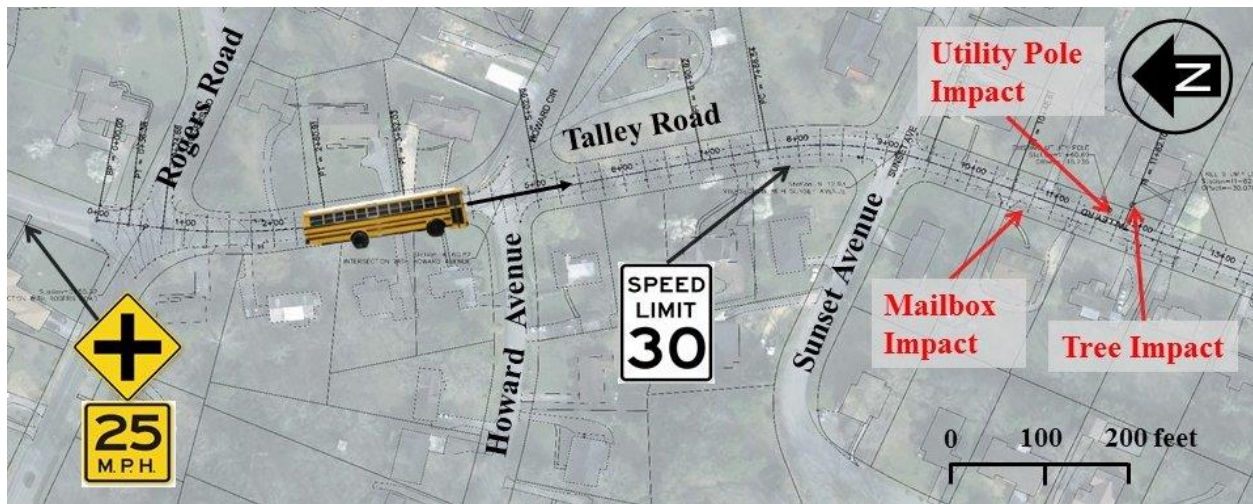
**Figure 7** illustrates a comparison of the route the driver took on the day of the crash Monday, November, 21, 2016 to his normal route.



**Figure 7** – Comparison of the route the driver took on the day of the crash Monday, November, 21, 2016 to his normal route

#### 4. Research and Testing

The City of Chattanooga performed a survey of Talley Road on December 7, 2016 for a distance of 1,300 feet prior to the crash location. The survey maps are used extensively throughout the Highway Factors Factual Report. **Figure 8** illustrates the survey of Talley Road. The graphic illustrates the roadway signing in the southbound direction of Talley Road prior to the crash location including the mailbox, utility pole, and tree impact. The 30 mph speed limit sign was located approximately 445 feet prior to the crash location. The 25 mph advisory warning and intersection symbol was located approximately 1,450 feet prior to the crash location on the same post.



**Figure 8** – Survey of Talley Road (Source: City of Chattanooga modified)

#### E. DOCKET MATERIAL

The following attachments and photographs are included in the docket for this investigation:

##### LIST OF ATTACHMENTS

Highway Factors Attachment 1 – Survey of Talley Road performed by the City of Chattanooga

Highway Factors Attachment 2 – Talley Road Sign List performed by the City of Chattanooga

Highway Factors Attachment 3 – Speed and Vehicle Classification Study for Talley Road performed by the City of Chattanooga

Highway Factors Attachment 4 – Normal Schedule of Pick-Up / Drop-Off Locations and Times for Bus Number 366 (Accident School Bus)

### LIST OF PHOTOGRAPHS

- Highway Photograph 1 – Tire marks left by the school bus on the grass and right side of Talley Road in the southbound direction of travel and the mailbox impact located in the background of the graphic
- Highway Photograph 2 – Tire marks left by the school bus on the right side of Talley Road in the southbound direction of travel and the mailbox impact located in the background of the graphic
- Highway Photograph 3 – Mailbox impact located in the foreground of the graphic and the tire marks in the southbound lane left by the school bus after the wheels returned to the pavement
- Highway Photograph 4 – Mailbox impact located in the foreground of the graphic and the tire marks in the southbound lane left by the school bus after the wheels returned to the pavement
- Highway Photograph 5 – Utility pole impact and tree location in relation to the edge of pavement for Talley Road (Source: Google Earth Street View modified)
- Highway Photograph 6 – View of Talley Road looking in the southbound direction approximately 1,300 feet prior to the crash location illustrating the downgrade slope of 8.17 percent
- Highway Photograph 7 – View of Talley Road looking in the southbound direction approximately 800 feet prior to the crash location illustrating the downgrade slope of 4.92 percent
- Highway Photograph 8 – View of Talley Road looking in the southbound direction approximately 500 feet prior to the crash location illustrating the horizontal curve to the right
- Highway Photograph 9 – View of Talley Road looking in the southbound direction approximately 150 feet prior to the crash location illustrating the upgrade slope of 6.78 percent
- Highway Photograph 10 – View of Talley Road looking in the southbound direction illustrating the tire marks left by the school bus prior to striking the utility pole
- Highway Photograph 11 – View of the damaged utility pole after the crash
- Highway Photograph 12 – View of the final rest of the school bus wrapped around the tree

Highway Photograph 13 – View of the post-crash scene looking to the north illustrating the area in which the tree was removed in the foreground of the graphic and a new utility pole was installed in the background of the graphic

END OF REPORT

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Dan Walsh, P.E.  
Senior Highway Factors Investigator