



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

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

A. CRASH INFORMATION

Location: Intersection of State Routes 30A and State Route 30, Schoharie,
Schoharie County, New York

Vehicle 1: 2001 Ford Excursion "Stretch" Limousine

Operator 1: Prestige Limousine Chauffeur Service

Vehicle 2: 2015 Toyota Highlander

Operator 2: Private citizen

Date: October 6, 2018

Time: Approximately 1:55 p.m. EDT

NTSB #: **HWY19MH001**

HIGHWAY FACTORS GROUP

Robert Squire - Accident Investigator, Group Chairman
NTSB Office of Highway Safety
490 L'Enfant Plaza East, S.W., Washington, DC 20594

Scott Nowalk, P.E.
New York State Department of Transportation
Region 9
Schoharie County/Delaware North Resident Engineer
310 Mineral Springs Road
Cobleskill, NY 12043

B. CRASH SUMMARY

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

C. DETAILS OF THE HIGHWAY FACTORS GROUP INVESTIGATION

The Highway Factors Group for this investigation was convened for the purpose of examining and reviewing the highway environment at the time of this collision, including elements such as roadway alignment, condition, and signage. The group also reviewed documentation related to past major maintenance and rehabilitation projects. In addition to on-scene observations and measurements, data was provided by the New York State Department of Transportation (NYSDOT).

Factual reports prepared by other NTSB investigative groups should be consulted for information related to other areas of the investigation.

1. Collision Description and Location

The initial collision between the Ford limousine and the Toyota Highlander occurred approximately 38 feet off the highway pavement south of the intersection between New York State Route 30 (NY-30) and New York State Route 30A (NY-30A) when the Ford, traveling southbound on NY-30, passed through the intersection without stopping for the posted stop sign and departed the highway where it collided with the parked Toyota. Following the collision with the Toyota, the Ford continued approximately 48 feet southward where it impacted the backslope of a ravine and several trees. The Toyota, which was parked and stationary when struck by the Ford, came to rest about 72 feet south of the area of impact on the opposite side of the ravine.

The Toyota had been parked in a grass-covered field adjacent a paved driveway for the Apple Barrel Country Store, a local business located near the southeast quadrant of the intersection.

The collision area was identified by approximate geographic coordinates of 42.7000957°N (latitude) and -74.3018692°W (longitude). **Figures 1** and **2** provide area views as depicted in Google Maps and Google Earth applications.

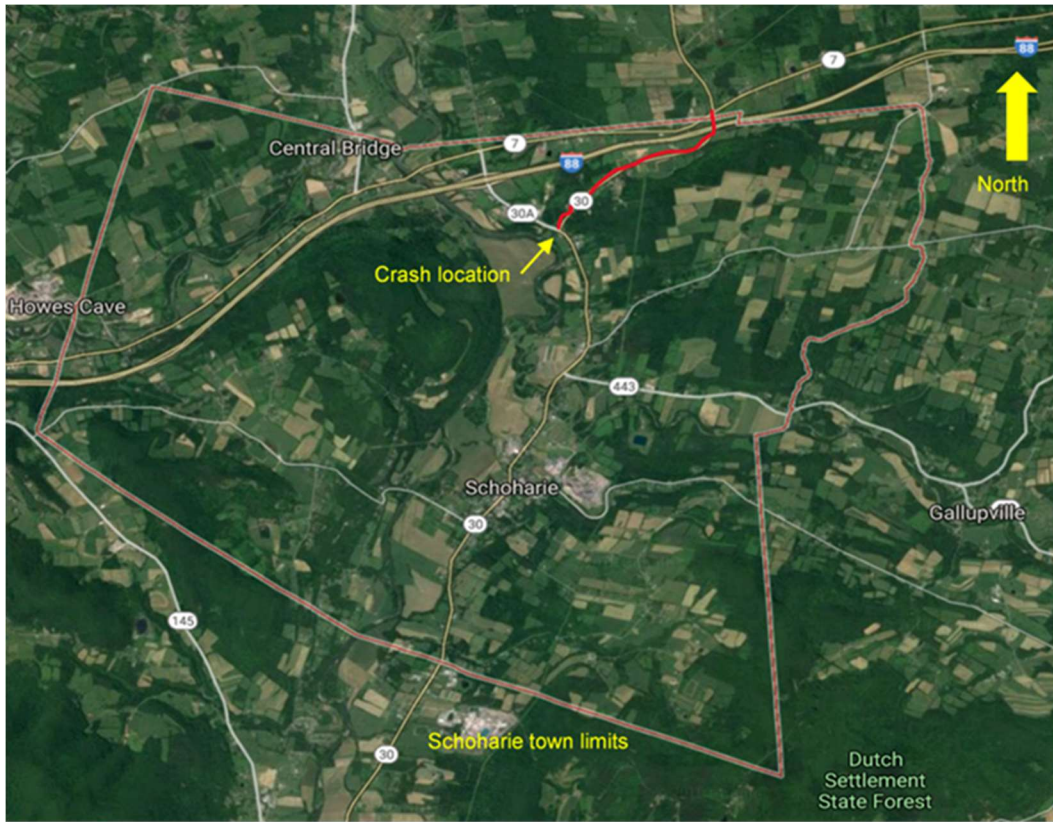


Figure 1: Google Earth image depicting southbound NY-30 route of Ford from NY-7 to crash site relative to Schoharie municipal limits.

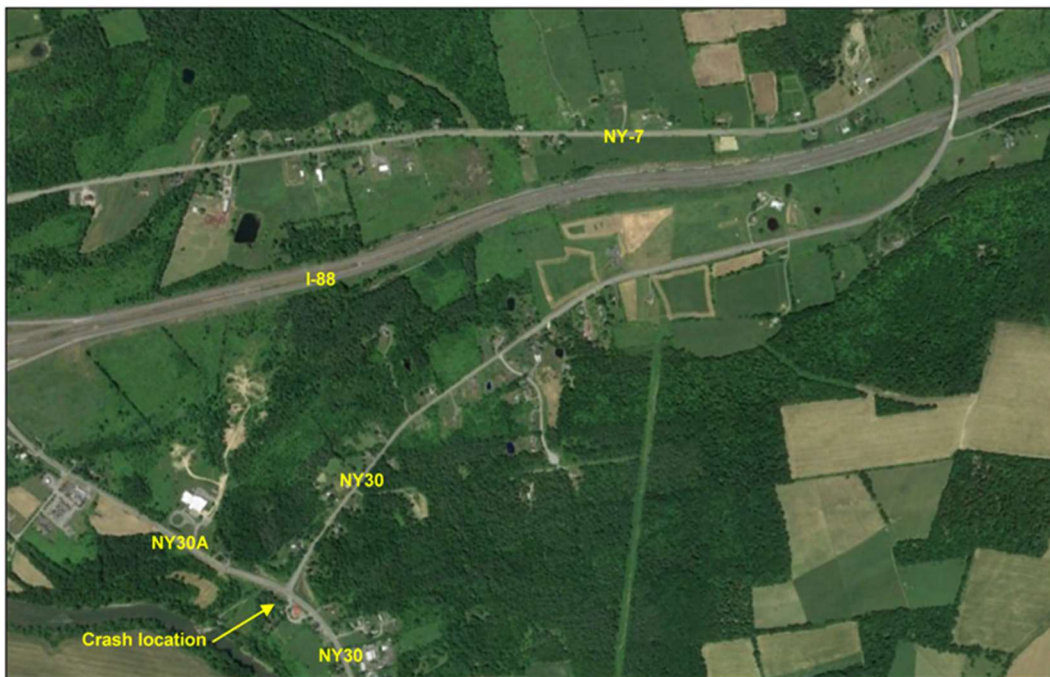


Figure 2: Google Earth image depicting crash location relative to adjacent major highways.

2. Highway Design - General

The Highway Factors Group focused its investigation on the segment of NY-30 between the intersections of NY-7 to the north and NY-30A to the south. Southward from NY-7, NY-30 exhibits primarily a southwestward heading toward the intersection with NY-30A. Along the approximate 1.81-mile segment between the NY-7 and NY-30A intersections, NY-30 exhibits four discernible curves – one rightward curve and three leftward curves. Long tangent segments separate the curves. A discernable descending grade begins approximately 5,420 feet (1.02 miles) north of the NY-30A intersection. Survey data provided by NYSDOT identified portions of the descending grade at between 5% and 11%. Trucks are restricted from traveling south on NY-30 between NY-7 and NY-30A. There are no restrictions in the northbound direction.

NYSDOT identified the functional classification of NY-30 as a rural major collector that is not part of the National Highway or Interstate System. The highway has a design speed of 100 km/h (~62 mph). NY-30 intersects NY-30A at a near right angle from the north. Traffic movement into the intersection is controlled by a stop sign and a painted stop line. The intersection is generally oriented such that NY-30 approaches at an approximate heading of 204° south-southwest. NY-30A ends at the intersection with NY-30 continuing southward along a sweeping curve. The southeastward approach of NY-30A to the intersection exhibits an approximate heading of 108°. NY-30 continues southward from the intersection, exhibiting a heading of approximately 160° south-southeast at the tangent segment following the curve.¹

NYSDOT oversight of the NY-30, NY-30A and NY-7 highways are assigned to Region 9 headquartered in Binghamton, New York. Region 9 includes Schoharie County.

2.1. Historical Data and Major Rehabilitation Projects

Both NY-30 and NY-30A provide primarily south and north travel. A portion of NY-30 within the investigation limits was originally constructed in 1931 with further development in 1940. NY-30 and NY-30A were reconstructed in 1962. In 2011, the intersection at NY-30 and NY-30A was redesigned and rebuilt to its current configuration.² As depicted in **Figure 3**, the original intersection was a “Y” configuration with one leg skewed about 19.5°. The reconstruction plan involved the redesign and reconstruction of about 2,800 feet of NY-30A and NY-30 northwest and southeast of the intersection and about 670 feet of NY-30 north of NY-30A to include the intersection. The intersection was reconstructed to form a “T” type intersection. As noted in the plan, the realignment of the intersection would eliminate non-standard horizontal and vertical geometries in the vicinity of the intersection as well as address the crash rate at the skewed intersection. A crash history analysis conducted in the mid 1990’s concluded that the accident rate for the intersection was more than twice the state average for T-type intersections.

¹ Historic highway planning documents also identify the respective route segments as SH (State Highway) 9298 Oakhill for NY-30 between NY-7 and NY-30A; SH 5086 Gallupville-Vrooman for NY-30 south of the intersection; and SH 5195 Vrooman-Howes Cave for NY-30A west of the intersection.

² See Final Design Report, Transportation Project P.I.N. 9125.5, *Reconstruction Project Intersection of NYS-30/30A and Intersection NYS-30/443, August 2008*. This plan also covered the reconstruction of the intersection of NY-30 and NY-443 (SH 5086) located about 1.5 miles to the south.

As conveyed in the *Final Design Report, Reconstruction Project Intersection of NYS-30/30A and Intersection NYS-30/443, August 2008*, the NY-30/NY-30A corridor exhibited an overall crash rate of 3.37 million vehicles per kilometer (MVKm) between 1998 and 2001 as compared with a statewide rate of 1.70 MVKm during the same period. The 1998-2001 data conveyed an intersection crash rate of 0.32 million vehicles entering (MEV) as compared with a statewide average of 0.19 MEV. Between 2005 and 2007 the intersection crash rate was reported as 0.38 MEV versus a statewide average of 0.10 MEV.

The horizontal curve passing through the intersection on the northwest and southern legs was also flattened to a 1,434-foot radius. Flattening the curve, along with vertical improvements, was designed to increase the sight distance to above minimum standards. In addition, left turn lanes were added and driveways, both residential and commercial, near the intersection were reconstructed for better definition and conformance with the appropriate driveway standards. Included in the driveway redesign was the relocation of the western driveway to the “Apple Barrel” Country store to intersect with NY-30 across from the new intersection. The northern leg of NY-30 also received wider shoulders. The highway design speed was maintained at 100 km/h, about 62 mph. Abandoned sections of roadway within the project limits were removed and regraded to match the surrounding terrain with the turf reestablished.

The reconstruction plan did note the non-standard grade along the northern leg of NY-30 at the intersection. The design called for a six-percent grade, as opposed to the recommended four-percent but was considered justified because it is a short extension of the existing grade to which the project was matching. The plan stated that while this feature is technically a nonstandard grade, it is at a location where speeds would be lower, is considered an acceptable design in rolling terrain and the inability to achieve standard criteria grade due to the proximity of the intersection. The roadway along NY-30A and NY-30 south of the intersection was raised as much as possible without requiring extensive additional right-of-way takes, relocation of a well, impact to a historic property, and significant driveway modifications. **Figure 3** depicts an image of the Project Map for the intersection before redesign as illustrated in the project Final Design Report, dated 2008. The red dashed line represents the redesigned leg of NY-30 to form the “T” intersection.

NYSDOT provided reconstruction plans, dated December 1977, that provided for the redesign and relocation of the intersection of NY-30 and NY-7 as well approximately 1.13 miles (5,978 feet) of NY-30 south of the intersection (NY-30 relocation).³ The redesign was part of the Interstate-88 construction and involved relocating the NY-30 / NY-7 intersection approximately 2,000 feet further east of its original location. To accommodate the intersection relocation, two curves and a bridge were added to about 5,300 feet of new roadway. Abandoned sections of roadway were removed and regraded to match the surrounding terrain.

NYSDOT reported that the most recent resurfacing of NY-30 between NY-7 and NY-30A took place in 2002 and involved the application of a 1.5-inch asphalt overlay.

³ See *Plans for Constructing the Interstate Route 508 and Reconstructing a Portion of the Oakhill Street, SH 9298*, F.A. project number I-88-1. Note that as-built plans were no longer available.

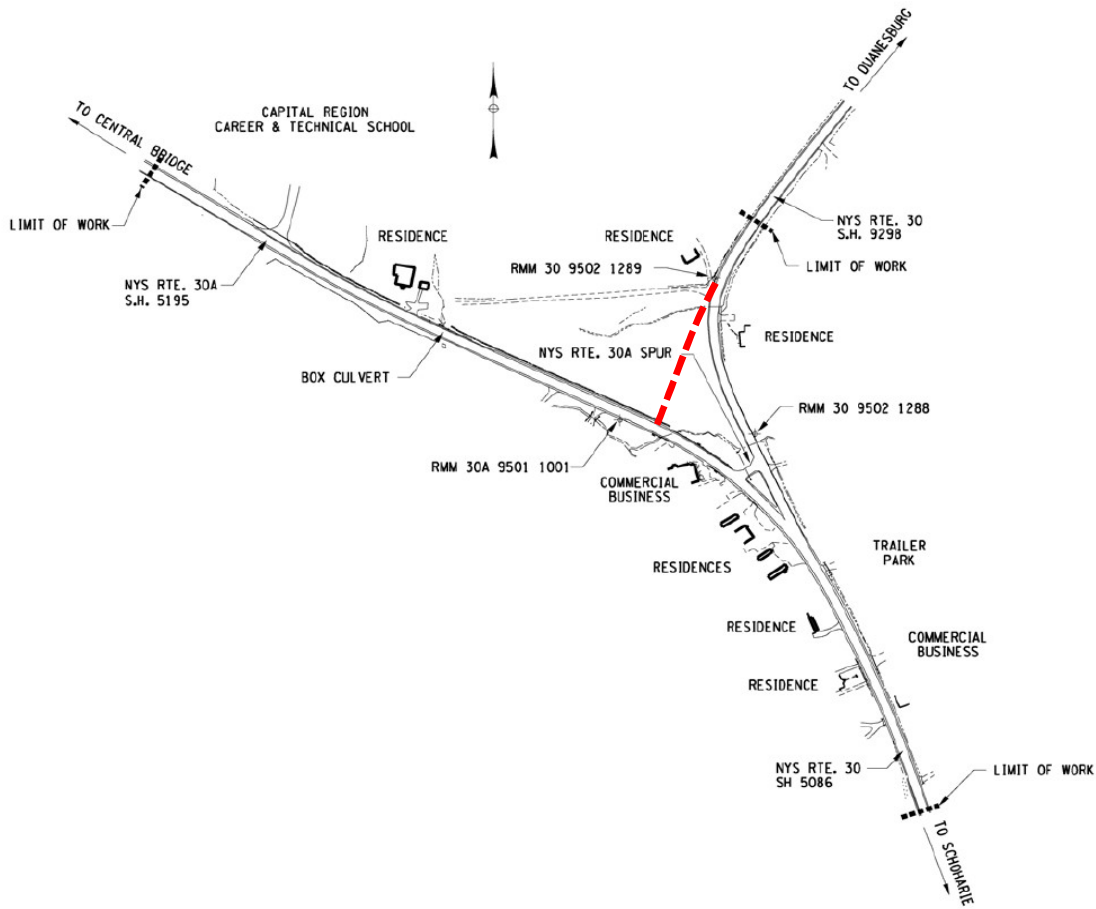


Figure 3: Image of Project Map for NY State Routes 30/30A intersection before redesign as illustrated in the project Final Design Report, PIN 9125.05 (2008). The red dashed line represents the redesigned leg of NY-30 to form the “T” intersection.

3. Highway Design - Typical Section, Alignment and Pavement Delineation

NY-30 is configured as a two-lane highway with one lane of travel in each direction. Shoulder widths vary along the length of the highway considered in this investigation. Highway right-of-way generally ranged from 50 to about 70 feet. On-scene measurements, in corroboration with the NY-30/30A intersection as-built plans and NY-7 relocation design plans were used to identify relevant highway features.

The northern segment of the highway covering approximately 5,300 feet of NY-30 south of the NY-7 intersection featured 12-foot wide travel lanes and 10-foot wide contiguous paved shoulders. Except within curves (and curve transitions) the cross slope of the travel lanes was approximately two-percent. The travel lanes are delineated by yellow (painted) pavement striping configured to designate whether passing is permitted. The shoulder areas were delineated by solid white (painted) pavement striping. The pavement striping measured approximately five and six

inches in width for the yellow and white line markings respectively. In some areas restriping was slightly offset making the striping appear wider. Striping was clearly visible during daylight hours, although it did exhibit wear and intermittent areas of separation due to road surface cracks.⁴

Along this northern portion of NY-30 passing was permitted in certain areas. Just south of the NY-7 intersection, beginning at an estimated 100 feet, broken yellow striping in combination with solid yellow striping permitted passing in the southbound direction of travel. This passing segment terminated on the south side of the I-88 overpass (~845 feet south of NY-7). Extending about 2,100 feet south of this location, two-way passing is permitted as indicated by single, broken yellow striping. About 868 feet south of this segment, passing is permitted in the northbound direction of travel as indicated by broken yellow striping in combination with solid yellow striping. The remainder of the 5,300-foot northern end of the highway features double solid yellow centerline pavement striping. The road surface was dry at the time of the crash.

The approximate 3,568-foot segment of NY-30 between the relocated northern segment referenced in the 1977 Interstate-88 plans and the 670-foot segment referenced in the 2011 NY-30/NY-30A intersection reconstruction, feature 12-foot wide travel lanes, but narrower shoulder areas. Throughout this section of highway, pavement outside the white edge line (shoulder area) ranges in widths between 17 and 46 inches. Except within curves, the lane cross slopes were about two-percent. This segment of the highway exhibited one horizontal curve and the more substantial vertical grades – both of which are discussed in the next section.

In certain areas previous resurfacing overlays measuring one to two inches in height could be seen along the pavement edge. While creating minor pavement edge drops, as depicted in **Figure 4**, no evidence of additional issues was observed. Areas of pavement through this segment exhibited evidence of minor wheel path rutting and surface cracking but no substantial deficiency to the travel surface.

The travel lanes are delineated by solid double yellow (painted) pavement striping except for about 675 feet at the southern end where striping permitted passing in the northbound direction of travel. The remnants of centerline retroreflective raised pavement markers (RPM) were observed covering about 1,200 feet beginning at the end of northbound passing zone, continuing through the horizontal curve and terminating north of the curve. Most of the RPMs were in disrepair and had been painted over by the double-yellow pavement striping. See **Figure 5**.

Striping was clearly visible during daylight hours, although it did exhibit wear and intermittent areas of separation due to road surface cracks.

The southern highway segment included the NY-30/30A intersection. The pavement through this segment exhibited no deficiencies and was well delineated. Lane widths measure between 11.8 and 12 feet, with shoulder pavement width measuring about nine feet with some loss of available width due the installation of guiderails. Except within the horizontal curve (and curve transition), the cross slope of the travel lanes was approximately two-percent. The travel lanes are delineated by double solid yellow (painted) pavement striping designating no passing is permitted. The centerline pavement striping begins about 30.1 feet northward from the intersection center

⁴ Striping visibility and retroreflective characteristics during hours of darkness were not examined.

(about 2.7 feet south of the stop line center). The shoulder area was delineated by solid white (painted) pavement striping. The pavement striping measured approximately five and six inches in width for the yellow and white markings respectively and exhibited no degradation.

Approximately 60-65 feet north of the NY-30A intersection the roadway surface and travel lanes widen to establish the intersection. As measured adjacent the painted stop line, the travel lanes widen to about 34 and 20 feet for the south- and northbound lanes respectively. At the intersection the edge lines arced at a 60-foot radius to merge with the edge lines of the intersecting highway.

A six by six-inch box beam guiderail was installed adjacent the northbound lane of NY-30A and NY-30 (northern side of the roadway). Where the guiderails reached the intersection they were turned (53-foot radius) to continue northward along both sides of NY-30. The guiderails adjacent NY-30 terminated about 357 and 504 feet north of the intersection (center) for the south- and northbound directions of travel respectively. The northbound guiderail had a driveway opening about 320 feet north of the intersection. The guiderails exhibited a vertical height of about 27 inches and were supported by steel I-beam posts anchored in the shoulder asphalt. The location of the guiderail along the shoulder reduced the width available to vehicles to about six feet.

On October 10, 2018, the segment of NY-30 between the I-88 overpass and NY-7 was repaved as part of an ongoing repaving project for NY-7. While this segment of highway was examined and photographed before the repaving, lane width measurements were not taken.

The posted speed limit on NY-30 between NY-30A and NY-7 is 55 miles per hour. The posted speed limit on NY-30A north of the intersection and NY-30 south of the intersection is 50 miles per hour.



Figure 4: Photograph depicting an example of pavement edge and edge line condition. View is looking southward.



Figure 5: Example of degraded centerline retroreflective raised pavement marker.

3.1. Highway Alignment

Following the crash NYSDOT conducted a centerline survey of NY-30 beginning at center of the NY-30/30A intersection extending northward about 6,741.42 feet, which covered the highway to the top of the substantial vertical grade. Data for the remaining 2,827.2 feet of NY-30 to the NY-7 intersection were derived from highway plans provided by NYSDOT. The NYSDOT survey and existing highway plans documented the points of curvature and intersections for the various horizontal and vertical curves and provided accurate horizontal curve measurements and vertical grade elevation and slope. Travel lane cross slopes were not surveyed, although on-scene measurements were taken at various locations that corroborated the highway design plans. Measurements cited in the subsequent sections are referenced to the centers of the respective intersection unless otherwise stated.

3.1.1. Horizontal Alignment

Traveling south from the NY-7 intersection, NY-30 exhibits four horizontal curves – one rightward and three leftward.

The first curve (C_1) is a sweeping 1,432-foot radius, 4° rightward curve that begins about 117 feet south of NY-7 and continues for 2,358 feet. Spiral segments 210 feet in length transition the tangent segments to the curve. In the southbound direction, the roadway exhibits a heading change of about 86° from an initial heading of 169° south to a new heading of 255° west-southwest.

The second curve (C_2) is a 2,004-foot radius, 2.9° leftward curve 784-feet in length. This curve follows a 2,077-foot tangent segment. In the southbound direction, the roadway exhibits a heading change of about 23° from an initial heading of 255° west-southwest to a new heading of 232° southwest. As measured at the site, the southbound travel lane exhibits a maximum cross slope of six-percent while the northbound lane exhibited about 3.5-percent.

The third curve (C_3) is a 1,641-foot radius, 3.5° leftward curve 458-feet in length. This curve follows an 1,861-foot tangent segment. In the southbound direction, the roadway exhibits a heading change of about 16° from an initial heading of 232° southwest to a new heading of 216° southwest. As measured at the site, the southbound travel lane exhibits a maximum cross slope of six-percent.

The fourth curve (C_4) is a 3,000-foot radius, 1.9° leftward curve 626-feet in length. This curve follows a 1,119-foot tangent segment. In the southbound direction, the roadway exhibits a heading change of about 12° from an initial heading of 216° southwest to a new heading of 204° southwest. As measured at the site, the southbound travel lane exhibits a cross slope between six and four-percent. This curve preceded a 168-foot tangent segment that met the NY-30A intersection.

Table 1 provides a summary of the horizontal points of curvature as measured south and north from the NY-7 and NY-30A intersections. **Figure 6** depicts a Google Earth image illustrating the highway curve locations as referenced in above text and Table 1.

Table 1: Summary of horizontal alignment points of curvature and distances.

Horizontal alignment north to south	Curve radius (feet)	Segment Length (feet)	Cumulative distance to onset of horizontal segment relative to intersection	
			South from NY-7 Intersection (feet)	North from NY-30/30A Intersection (feet)
Tangent		117	0	9451
Curve C ₁ (right)	1432	2358	117	7093
Tangent		2077	2475	5016
Curve C ₂ (left)	2004	784	4552	4232
Tangent		1861	5336	2371
Curve C ₃ (left)	1641	458	7197	1913
Tangent		1119	7655	794
Curve C ₄ (left)	3000	626	8774	168
Tangent		168	9400	0

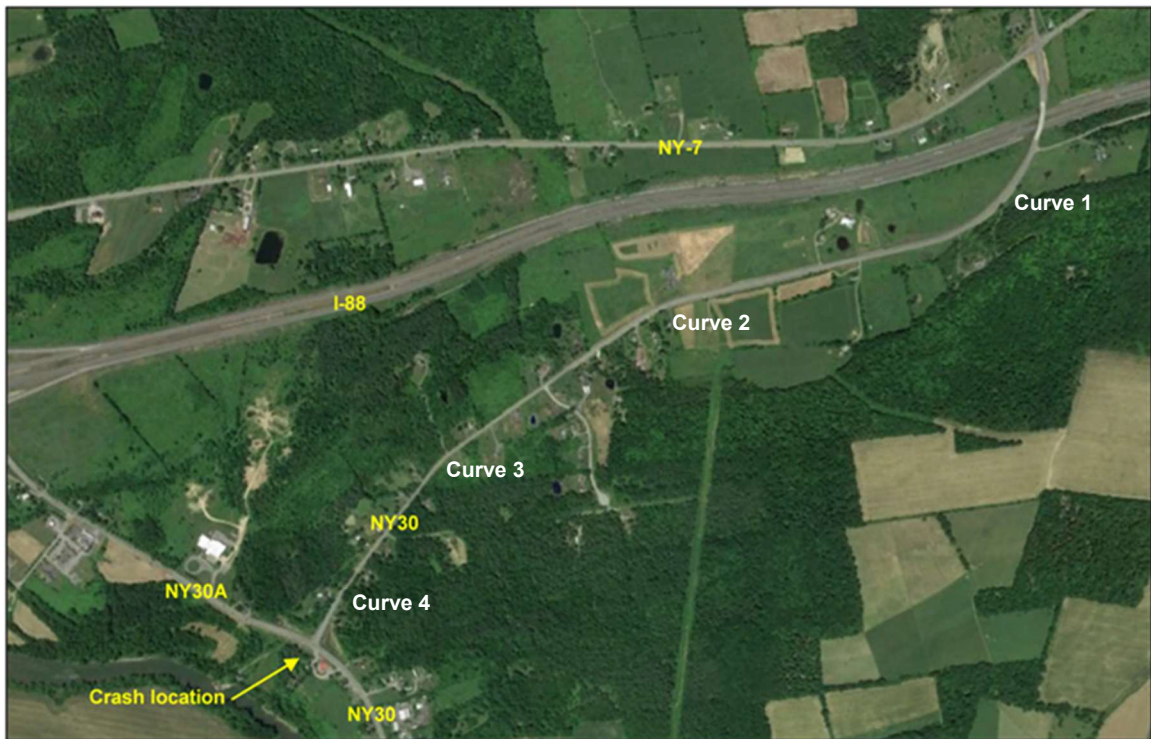


Figure 6: Google Earth image depicting location of highway curves as referenced in descriptive text and Table 1.

3.2. Vertical Alignment

Along the 1.81-mile stretch of roadway between the intersections of NY-7 and NY-30A, NY-30 exhibits 13 changes in vertical grade. The total change in elevation as measured by NYSDOT survey and GPS is about 573 feet.

The vertical slopes ranged from less than one-percent to 11.35%. Southbound from NY-7 the roadway exhibits an initial downgrade of 2.95%. The downward slope then varies between 1.34% and 5.00% then decreases to less than one-percent about 2,478 feet south of NY-7 and continuing for about 1,670 feet.

About 4,148 feet south of the NY-7 intersection the vertical slope increases. In the southbound direction the downgrade increases to a maximum of 11.35% before decreasing to less than six-percent about 1,135 feet before the NY-30A intersection. The final 174 feet leading to the intersection exhibits a 1.82% downgrade.

At the intersection, NY-30/30A lies along a 1,434-foot radius horizontal curve. The downward grade of less than two-percent exhibited along the southbound approach of NY-30 to the intersection transitions into the cross slope of this curve. This cross slope appeared to continue to the opposite side of the roadway.

Table 2 provides a summary of the vertical points of curvature as measured south and north from the NY-7 and NY-30A intersections. The distances convey the starting point for the grade segment relative to the referenced intersection and the total length of each segment. **Table 3** summarizes the integration of both the horizontal and vertical alignments.

Table 2: Summary of vertical alignment points of curvature and distances.

Vertical Grade – Percent (North to South)	Segment Length (feet)	Cumulative distance to onset of vertical grade segment relative to intersection	
		South from NY-7 Intersection (feet)	North from NY-30/30A Intersection (feet)
2.95	478		9090
1.34	800	478	8290
5.00	1200	1278	7090
0.93	1670	2478	5420
9.80	1421	4148	3999
7.20	570	5569	3429
11.28	498	6139	2931
9.64	439	6637	2492
7.71	262	7076	2230
11.35	281	7338	1949
8.63	814	7619	1135
5.92	961	8433	174
1.82	174	9394	

The asphalt driveway for the Apple Barrel Country Store intersects with the NY-30/30A at a right angle on the south side, opposite the NY-30 northern leg to the intersection. The western edge of the driveway is offset from the NY-30 centerline such that the driveway is in line with the northbound lane of NY-30.⁵ The driveway opening exhibits a width of about 46 feet and curves southeastward from the intersection with the highway. **Figure 7** depicts an sUAS overhead view of the intersection as provided by the New York State Police.

⁵ The 2011 intersection reconstruction plans indicate that the driveway was to begin about 24 feet east of the intersection center and be about 23.6 feet wide.

Table 3: Summary of combined horizontal and vertical alignment data.

Feature	Horizontal tangent length	Horizontal curve length Feet	Horizontal curve radius	Vertical alignment Percent grade	Feature length	Distance from NY-7 Intersection Feet	Distance from NY-30A intersection	
Intersection	117			-2.95			9568	
Begin tangent segment at intersection						0	9568	
Point of curve C₁		2358	1432	-1.34		117	9451	
Vertical grade change	800				478	9090		
<i>Overpass end</i>	289.5				555.45	9012.55		
<i>Overpass end</i>				844.95	8723.05			
Vertical grade change				-5.00	1200	1278	8290	
Point of curve C₁						2475	7093	
Vertical grade change	2077			-0.93	1670	2478	7090	
Vertical grade change				-9.80	1421	4148	5420	
Point of curve C₂		784	2004			4552	5016	
Point of curve C₂							5336	4232
Vertical grade change	1861			-7.20	570	5569	3999	
Vertical grade change				-11.28	498	6139	3429	
Vertical grade change				-9.64	439	6637	2931	
Vertical grade change				-7.71	262	7076	2492	
Point of curve C₃		458	1641			7197	2371	
Vertical grade change					-11.35	281	7338	2230
Vertical grade change					-8.63	814	7619	1949
Point of curve C₃							7655	1913
Vertical grade change	1119			-5.92	961	8433	1135	
Point of curve C₄		626	3000			8774	794	
Vertical grade change					-1.82	174	9394	174
Point of curve C₄							9400	168
Intersection	168					9568	0	

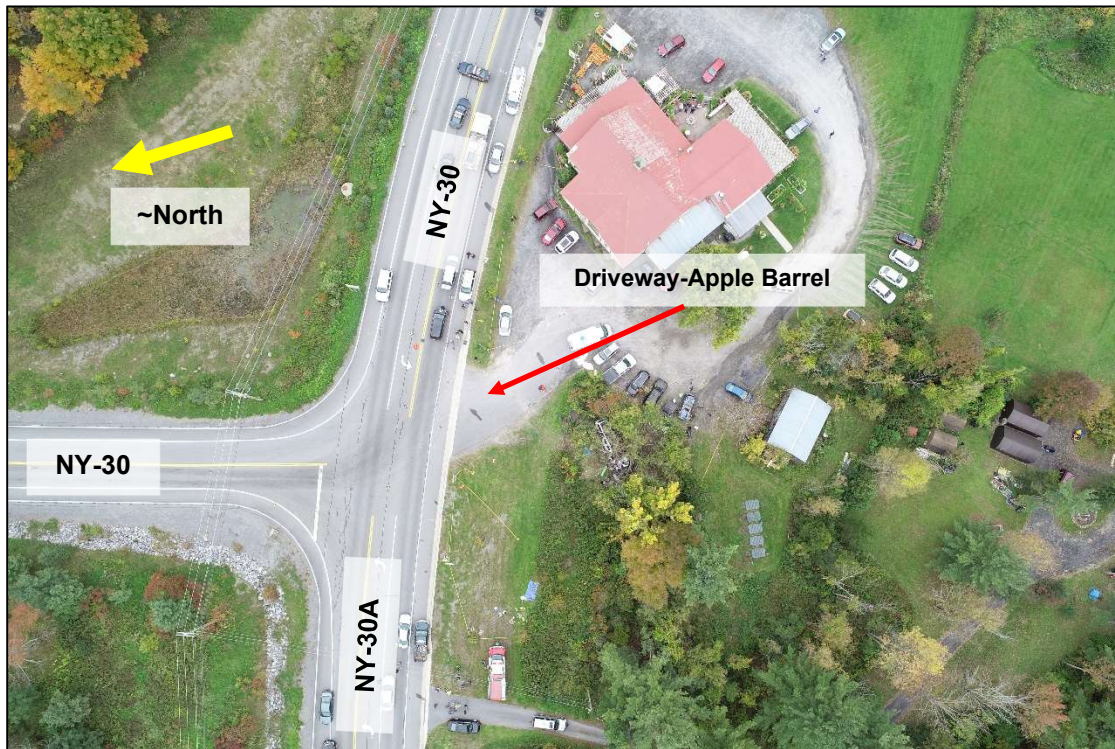


Figure 7: sUAS image depicting an overhead view of NY-30/30A intersection and intersection of Apple Barrel Country Store driveway. Source: New York State Police.

4. Highway Signage and Traffic Control

This section will primarily discuss the highway signage and traffic control installed along southbound NY-30, the route traveled by the Ford. Roadside devices such as roadside route reference markers and route signage will not be discussed. The Manual on Uniform Traffic Control Devices (MUTCD) provides standards and guidance for the installation of traffic control devices and may be referenced for additional details.⁶

4.1. Intersection Traffic Control

The NY-30/NY-7 intersection features flashing Intersection Control Beacons with two horizontal, single-face beacons supported by span wires facing each of the four approaches (also see MUTCD Section 4L.02). Traffic on NY-7 face a flashing circular yellow signal while traffic on NY-30 face a flashing red circular signal. Traffic approaching on NY-30 also face a stop sign.

Southbound NY-30 at the NY-30/30A intersection faces a stop sign (MUTCD - R1-1). The sign face is oversized measuring 36 by 36 inches was increased above the typical 30 by 30-inch to improve conspicuity. The bottom edge of the sign measured about 6.3 feet above the road surface. The sign is setback about 18.3 from the intersection stop line (51.1 feet from the intersection

⁶ As referenced in the MUTCD Section 2A.05, Classification of Signs - Regulatory signs give notice of traffic laws or regulations, while Warning signs give notice of a situation that might not be readily apparent .

center) and 9.5 feet outside the roadway edge line, opposite the guiderail. The sign exhibited no deficiencies.

A 24-inch wide white painted stop line extended across the south bound lane. The line was setback about 32.8 feet from the intersection center (about 15 feet from the intersecting roadway travel lane).

4.2. Signage

Table 4 summarizes the regulatory and warning signage posted along southbound NY-30 between the NY-7 and NY-30/30A intersections. The table cites the respective type, the MUTCD designation, size and approximate distance of each sign from the intersection stop sign. The mounting height of each sign ranged between about 6.2 and seven feet and were located between approximately 10 to 12 feet off the right side of the travel lane.

Southbound roadway sign summary:

- **Stop Ahead (W3-1)**

This is an advance warning sign that was located approximately 481 feet before the stop sign and 6.5 feet off the roadway pavement. An identical sign precedes the northbound stop sign at the NY-7 intersection about 480 feet before that stop sign.

- **Reduced Speed Limit Ahead "50" (W3-5)**

This is a single sign located approximately 914 feet before the stop sign and 8,603 south of the NY-7 intersection. The sign referenced the change in posted speed limit after entering the extension of NY-30 or NY-30A past the stop sign.

- **Intersection Warning with "Driveways" plaque (W2-2/W8-5P)**

This is a single sign located approximately 1,134 feet before the stop sign and 8,383 south of the NY-7 intersection. The supplemental plaque (W8-5P) mounted below the warning sign references residential driveways that may be partially obscured due to the horizontal alignment of the roadway. This warning sign precedes curve C₄, the final curve before the NY-30/30A intersection. Site observations revealed that the stop sign is visible from this location.

- **Curve Warning with speed advisory plaque (W1-2/W13-1P)**

This horizontal alignment sign is the second of two in the southbound direction. This sign is located approximately 3,005 feet before the stop sign and 6,512 south of the NY-7 intersection. The supplemental plaque (W13-1P) mounted below the warning sign references an advisory speed reduction to 50 mph. This warning sign indicates a left curve and precedes curve C₃ by about 685 feet. While curve C₃ exhibits a large radius (1,641 feet) and satisfactory super elevation, two changes in vertical grade lie within this curve.

Table 4: Traffic control signage summary for southbound NY-30 between the intersections of NY-7 and NY-30/30A. Distance column represents the relative distance between the referenced sign and the stop sign posted at the intersection.

Sign Type	MTUDC Designation	Description	Dimension (inches)	Image	Distance from Intersection Stop Sign
Two-direction arrow	W1-7	Intersection warning	48 x 24		
Stop sign	R1-1		36 x 36		0
Stop Ahead sign	W3-1		30 x 30		481
Reduced Speed Limit Ahead	W3-5	"Speed Limit 50"	36 x 36		914
Intersection Warning with "Driveways" plaque	W2-2		30 x 30		1134
	W8-5P	"Driveways" advisory plaque	24 x 18		
Curve warning with speed advisory plaque	W1-2		30 x 30		3005
	W13-1P	Advisory plaque "50 MPH"	18 x 18		
Curve warning	W1-2	No advisory plaque	30 x 30		5889
Speed limit	R2-1	"55 MPH"	30 x 30		5039
Hill warning sign 2 with advisory plaque	W7-1		30 x 30		3447 6394 6694
	W7-3aP	Advisory plaque "1 MILE" "½ MILE"	18 x 24		
Road Narrows	W5-1		30 x 30		4139
No Trucks	R5-2	7 signs	30 x 30		

- **Hill warning sign with supplemental plaque (W7-1/W7-3aP)**

This is the third vertical grade warning sign along the southbound route. This sign also featured the supplemental plaque (W7-3aP) bearing the terms “½ mile” indicating that the descending grade continued for this distance. Additionally, this sign exhibited the remnants of a conspicuity enhancement in the form of a flag staff at the top of the sign. This sign was located approximately 3,447 feet before the stop sign and 6,070 south of the NY-7 intersection. Additionally, this sign is located approximately 1,922 feet south of the onset of the more substantial grade, although about 69 feet before the grade change from seven to 11 percent.

- **Road Narrows (W5-1)**

This is a warning sign located approximately 4,139 feet north of the NY30/30A stop sign and 5,378 feet south of the NY-7 intersection. This sign is positioned before the terminus of the wide shoulders that were installed during the relocation of NY-30 and the NY-7 intersection in the late 1970’s.

- **Speed Limit “55” (R2-1)**

This is the sole speed limit sign (55 MPH) on southbound NY-30 and is located approximately 5,039 feet north of the NY-30/30A intersection stop sign and 4,478 feet south of the NY-7 intersection.

- **Curve Warning (W1-2)**

The first left curve warning sign in the southbound direction. This sign was located approximately 5,889 feet north of the NY-30/30A intersection and 3,628 feet south of the NY-7 intersection. This sign was positioned about 924 feet in advance of curve C₂.

- **Hill warning sign with advisory plaque (W7-1/W7-3aP)**

Before the onset of the more significant downgrade portion of the highway, two hill warning signs with distance advisory “1 mile” plaques (W7-3aP) are installed 300 feet apart. The sign nearest the NY-30/30A intersection was approximately 6,394 feet to the north of that intersection and 3,123 feet south of the NY-7 intersection. The second sign was located approximately 6,694 feet to the north and 2,823 feet south of the respective intersections. Additionally, this northern-most sign exhibited the remnants of a conspicuity enhancement in the form of two flag staffs at the top of the sign. Both signs were posted along the 0.93% downgrade and approximately 1,025 and 1,325 feet in advance of the onset of the next steeper (9.8%) downgrade.

- **No Trucks (R5-2)**

As previously noted, southbound NY-30 between the intersections restricted truck traffic. A total of six “No Trucks” signs were posted on NY-30 facing southbound

within approximately 150 to 370 feet south of the NY-7 intersection with a seventh single sign located on the right roadside about 2,000 feet south of the intersection. As a conspicuity enhancement, signs were placed on both sides of the highway (doubling-up) and featured two fluorescent, diamond-shaped markers at the top of each sign (excluding the seventh sign). Additionally, “No Trucks” signs are posted on NY-7 preceding the NY-30 intersection to alert motorists of the southbound NY-30 restrictions.

As defined by New York Vehicle and Traffic Law, the term “truck” is found in §158 and means “Every motor vehicle designed, used, or maintained primarily for the transportation of property”.

NYSDOT provided the following timeline regarding the application of the truck restrictions:

- 4/15/13: An order is signed for an 18-ton weight restriction on NY-30 southbound to prohibit large trucks but allow smaller delivery trucks and school busses.
- 1/15/15: An order is signed for a 5-ton weight restriction to prohibit any truck that uses air brakes as they are the most common vehicles to lose braking ability. Residency crews update the signs to reflect the order.
- 2/22/15: To avoid confusion, an order is written by DOT to restrict all trucks on NY-30 southbound. Residency crews update the signs to reflect the order.

Although heavy truck braking capability was cited in the implementation timeline, citizen complaints regarding truck noise, including engine or exhaust brakes, and general safety were frequently cited - as referenced in the *Reconstruction Project Intersection of NYS-30/30A and Intersection NYS-30/443, August 2008* that provided justification for the NY-30/30A intersection redesign. In response to citizen requests for a complete truck ban on NY-30 between NY-7 and NY-30A NYSDOT concluded that the accident data did not warrant a complete restriction.⁷

- **Two-Direction Arrow (W1-7)**

This sign was located on the opposite side of the NY-30/30A intersection facing the southbound traffic. Located approximately 60 feet from the stop line, this sign alerted southbound traffic that a turn to the right or left is required at the intersection.

⁷ NYSDOT conveyed that accident data between January 2003 and December 2007 were analyzed.

4.3. Highway Lighting

Supplemental lighting is not installed along NY-30. This collision occurred during daylight hours.

5. Intersection Stopping Sight Distance and General Intersection Sight Line

The NY-30/30A intersection redesign plans specified a highway design speed of 100 km/h, about 62 mph, and a stopping sight distance of 185 meters, about 607 feet. As defined in the AASHTO A Policy on Geometric Design of Highways and Streets, stopping sight distance (SSD) is the sum of (1) the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant the brakes are applied, and (2) the distance needed to stop the vehicle from the instant the brake application begins.⁸ While the standard set forth in the state plan referenced the intersection redesign, it conformed with the AASHTO recommendation for SSD. Although the SSD was not evaluated along the entire NY-30 route south of NY-7, observations concluded that it likely prevailed.⁹

Chapter 9.5 of the AASHTO A Policy on Geometric Design of Highways and Streets conveys that stopping sight distance should be preserved on intersection approaches. The policy recommends that all drivers should have an unobstructed view of the intersection and all traffic control devices. Observations made along the southbound approach to the intersection confirmed that the SSD specified in the plan was preserved.¹⁰ Beginning at least 730 feet north of the intersection, the entire intersection could be viewed, except for a portion of the southeast corner due to some low hanging roadside vegetation. At 660 feet, which was still more than the recommended SSD, the entire intersection and all traffic control devices were visible from the southbound travel lane, as depicted in **Figure 8**.

Overall, observations along the southbound travel lane revealed that all the intersection traffic control devices – stop ahead sign and stop sign – began to come into simultaneous view about 1,125 feet before the stop sign. Within 1,015 feet of the stop sign, view of these signs was unaffected by roadside vegetation. While the intersection approach sight line and view of signage met AASHTO recommendations, roadside foliage, primarily low tree branches, did present partial signage obstruction from greater distances.

As there was no stopping action by the southbound vehicle, the intersection sight distance triangle was not evaluated. General observations of the intersection raised no concerns.

⁸ AASHTO (American Association of State Highway and Transportation Officials) A Policy on Geometric Design of Highways and Streets recommends an average eye height of 7.6 feet for truck drivers. A target height of 2.0 feet is recommended for stopping and decision sight distances, while 3.5 feet is recommended for passing and intersection sight distances.

⁹ AASHTO recommends an increase of the SSD from 185 meters to 194 and 207 meters (~636 and 679 feet) on downgrades of 3-9%.

¹⁰ NTSB investigators conducted observations and acquired site data during the days of October 9 and 10, 2018.



Figure 8: Photograph depicting the approach view of NY-30/30A intersection from the southbound travel lane about 660 feet before the intersection.

6. Highway Traffic Volume and Speed

A 2016 study provided NYSDOT reported the Annual Average Daily Traffic (AADT) volume on NY-30 north of NY-30A. The AADT was 650 for northbound and 707 vehicles per day for southbound.

Regarding the 85th percentile speed¹¹ traveled by vehicles on NY-30, NYSDOT provided data from studies in 2016 and 2018. The 2016 study was based on 72-hour observation, although the observation site was located at the north end of the NY-30 segment, just south of the NY-7 intersection. That study identified the 85th percentile speed at 45.3 mph in the northbound direction and 43.1 mph in the southbound direction with no speeds reported above 55 mph.

The 2018 study comprised a one-hour observation period at a location on NY-30 just north of NY-30A intersection. The study reported the 85th percentile speed at 58 mph. While the study concluded that a total of 28% of vehicles (30% in the southbound direction) exceeded the posted speed limit, the highest speed range reported was 66-67 mph by one vehicle.

¹¹ The 85th percentile speed is the speed that 85% of the traffic does not exceed (85% vehicles travel at or below this speed).

NYSDOT also provided vehicle classification data from the 2016 72-hour study. The results are summarized in **Table 5**. At the time of the study the truck restriction for southbound NY-30 had been established. As exhibited in the table, more than 70% of the vehicle traveling on NY-30 were automobiles.

Table 5: 2016 Vehicle classification summary.

Vehicle Classification – 2016 Study		
Vehicle Type	Northbound Direction	Southbound Direction
Motorcycle	17 (2.5%)	15 (2%)
Auto (includes trailer)	480 (70.5%)	561 (75.2%)
Pickup, Van, Motorhome	142 (20.9%)	156 (20.9%)
Bus	5 (0.7%)	1 (0.1%)
2 Axle - 6 tire	31 (4.6%)	13 (1.7%)
3 Axle	2 (0.3%)	
4+ Axle – 1 unit is truck	3 (0.4%)	
5+ Axle – Double	1 (0.1%)	

7. Highway Crash History

NYSDOT provided a 5-year crash history covering a one-mile radius around the NY-30/30A intersection (**Figure 9**). The history covered January 2013 through October 2018. During this period a total of 196 crashes were tallied, with about 31% classified as non-reportable. As conveyed by NYSDOT *“accidents are classified as either reportable or non-reportable. All accidents involving either a death, personal injury or if the reported property damage to any single motor vehicle meets a threshold of at least one thousand dollars will be considered a reportable accident. Reportable accidents always have event, vehicle and contributing factor information. Non-reportable accidents usually have only a limited amount of event information coded by DMV. The only event information captured by DMV for a typical non-reportable accident is location (reference marker and intersection number) and date. There usually is no vehicle or contributing factor data for non-reportable accidents. However, vehicle and contributing factor records can exist for nonreportable accidents, but all the data fields will contain code values of not entered or not available.*

Within the one-mile radius of the intersection, of the total crashes, no fatalities were reported. A total of 39 (20%) involved injury with four (4) of those reported as serious. A total of 132 (67%) were single vehicle crashes with 56 (29%) involving an animal strike. A total of 60 crashes (31%) involved two vehicles while four (2%) involved three vehicles.

The one-mile crash history radius included not only the descending grade on NY-30 and the NY-30/30A intersection, but also a 1.5-mile segment of I-88 and 1.1-mile segment of NY-7. Of the total crashes, 76 (39%) were reported on I-88 or a ramp associated with the interstate, while eight (8) crashes reported NY-7 as the primary roadway. Three (3) of the total crashes were reported on a secondary roadway. Seven (7) crash records cited no primary or cross-street roadway location while an additional 11 reports contained no cross-street reference. Of the remaining crash reports that referenced NY-30 and NY-30A as the primary roadways, 42 (21%) occurred on NY-

30 and 60 on NY-30A, with 22 of those having occurred along the segment between NY-7 and I-88.

To more concisely narrow down crashes that occurred at the NY-30/NY-30A intersection, the Universal Transverse Mercator (UTM) coordinates provided with the data were used to physically locate each crash. A total of four (4) crashes were indicated as having occurred at the NY-30/30A intersection, although only one (1) was specifically coded as an intersection crash. Two of those crashes were coded as stop sign violations although only one exhibits data suggesting the at-fault vehicle failed to yield while making a left turn from southbound NY-30. The second crash was identified as a nonreportable, non-collision crash where a single vehicle reported a mechanical issue. The third intersection crash exhibits coding that suggests a failure to yield during a left turn from the intersecting highway – NY-30A. The fourth intersection crash involved a deer strike. Three of the four intersection crashes occurred during daylight with one of those during rain. The deer strike occurred during darkness in dry weather.

North of the intersection on NY-30, a total of seven (7) crashes, all single vehicle, were reported. One (1) crash was reported as involving a pedestrian with an injury and property damage, five (5) were indicated as “non-reportable” and one (1) as a property damage collision. Four collisions involved an animal, while two (2) involved a single vehicle that impacted a ditch or embankment while traveling on snow or ice. Of the seven crashes on NY-30 north of the intersection the location of the one nearest the intersection was about 1,070 feet north. The average distance separating the other crash locations was in excess of 500 feet.

The remaining 31 reported crashes on NY-30 occurred south of the intersection. The UTM coordinates depicted one crash that apparently occurred in the parking lot of the Apple Barrel Country store. That crash was depicted as being on the south side of the building with the data indicating that a backing vehicle struck a parked vehicle. It had not been recorded as a parking lot related crash. The data did not indicate any reported crashes being associated with the driveway or access to the Apple Barrel Country Store property.

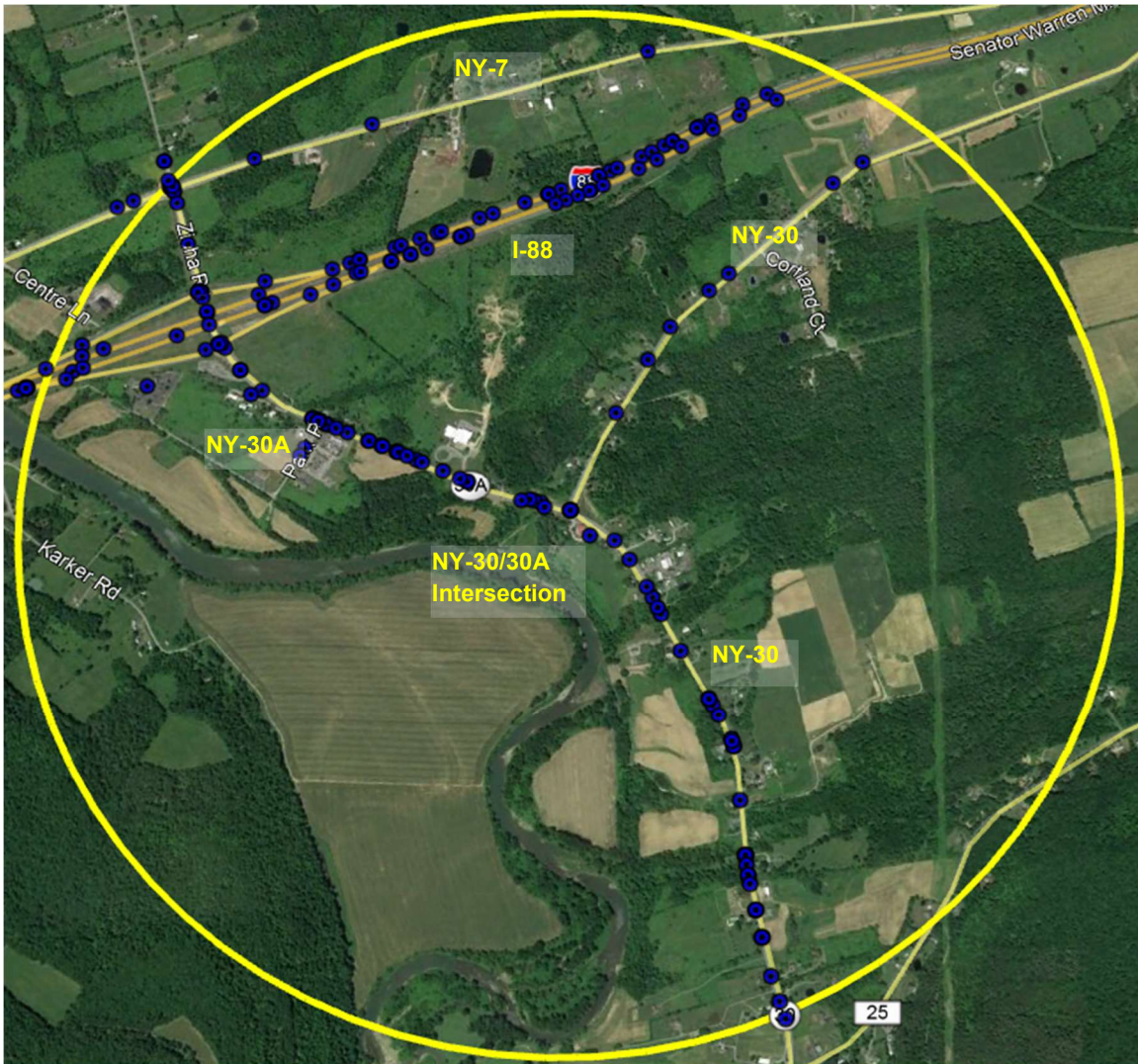


Figure 9: Historical crash locations reported by NYSDOT within a one-mile radius of the NY-30/30A intersection for 2013-2018. Multiple crashes at a single location may be covered by a single icon.

D. REFERENCES

- A Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials, 2018 – 7th Edition
- Manual on Uniform Traffic Control devices for Streets and Highways, U.S. Department of Transportation, Federal Highway Administration, 2009

E. DOCKET MATERIAL

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

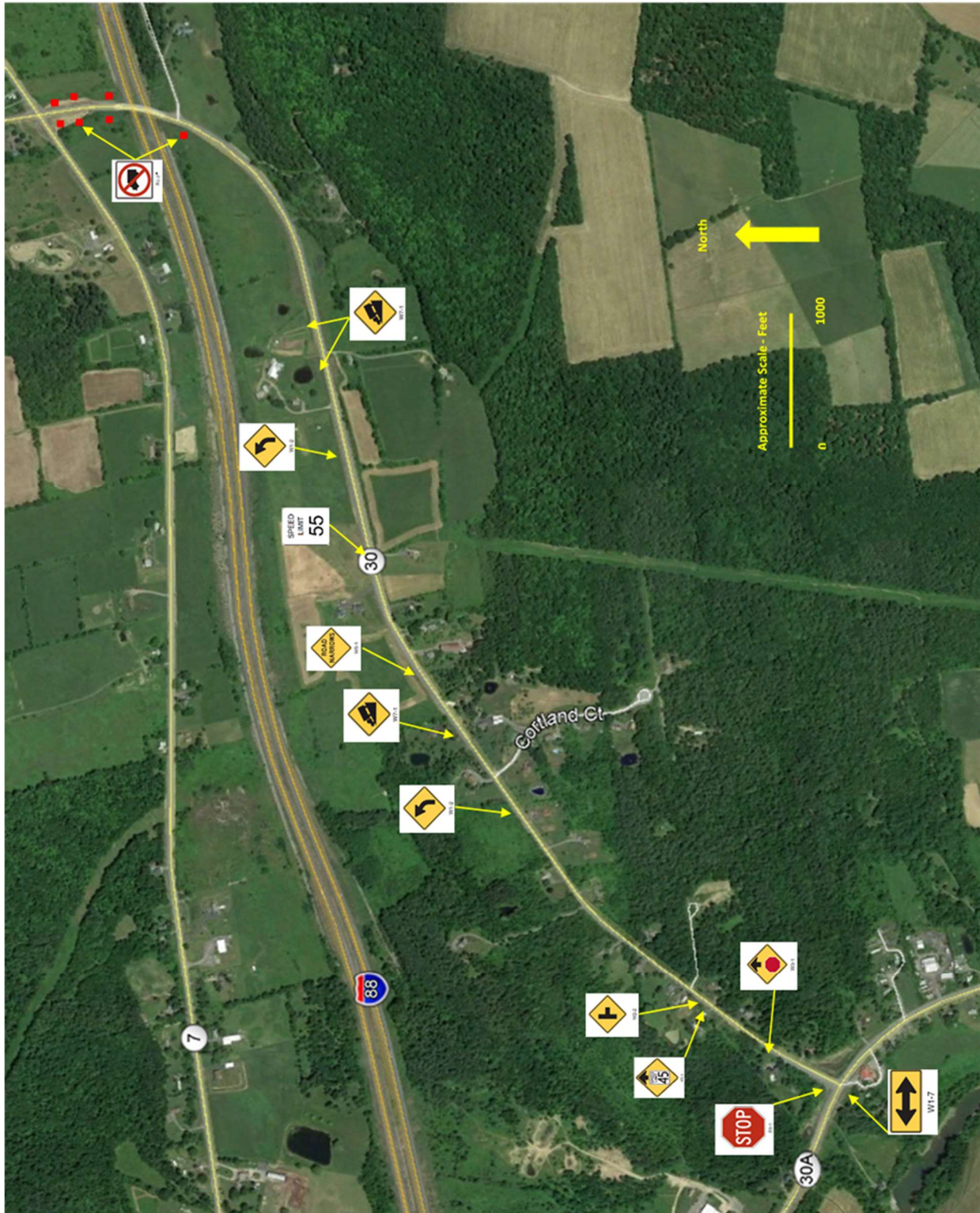
LIST OF ATTACHMENTS

- Relevant sections of the Final Design Report, Transportation Project P.I.N. 9125.5, *Reconstruction Project Intersection of NYS-30/30A and Intersection NYS-30/443, August 2008.*
- Relevant sections of the *Plans for Constructing the Interstate Route 508 and Reconstructing a Portion of the Oakhill Street, SH 9298, F.A. project number I-88-1.*
- Relevant sections of the plans for *Highway Intersection Improvements NYS Routes 30/30A & 30/443, November 2009*
- Centerline survey data prepared by NYSDOT.
- NYSDOT crash data, *QRA Accident Severity Study* and *Verbal Description* summary.
- NYSDOT data for 85th percentile speed, AADT and vehicle classification for NY-30.

END OF REPORT

Robert Squire - Highway Accident Investigator

Appendix A: Signage depicted southbound direction of travel along NY-30 between NY-7 and NY-30A.



Appendix B: Select photographs depicting southbound direction of travel along NY-30 between NY-7 and NY-30A.



Southbound view along NY-30 through Curve #1 approaching the I-88 overpass. One of the six “No Trucks” is also visible.



Southbound view after exiting Curve #1 into the tangent segment. The signs indicated by yellow arrows include the first and second “Hill” warning signs (#1 and #2) and the “Curve” warning sign (#3).



Southbound approach to Curve #2 and onset of descending grade. Speed limit sign (55 MPH) is also depicted.



Southbound view toward tangent segment following Curve #2. Signs depicted include "Road Narrows" (#1) and the third "Hill" warning sign (#2).



Southbound view along tangent segment approaching curve #3. Image also depicts “Curve” warning sign with reduced speed advisory plaque (50 MPH).



Southbound view of tangent segment following Curve #3 and approaching Curve #4. The signs indicated by yellow arrows include the “Intersection” warning with “Driveways” advisory plaque (#1) and the “Reduced Speed Limit Ahead”, 50-MPH (#2).



Southbound view approaching Curve #4. Visible signage includes the “Intersection” warning sign, the “Reduced Speed Limit Ahead” sign (#1), and the “Stop Ahead) sign (#2).



Southbound view approaching Curve #4 and tangent to leading to the NY-30/NY-30A intersection. Visible signs include the “Stop Ahead” sign and intersection “Stop” sign (#1).

Appendix C: MUTCD Select Sections

Select sections from the FHWA Manual on Traffic Control Devices are provided below for additional reference.

Section 2A.03 Standardization of Application

Support:

01 It is recognized that urban traffic conditions differ from those in rural environments, and in many instances signs are applied and located differently. Where pertinent and practical, this Manual sets forth separate recommendations for urban and rural conditions.

Guidance:

02 Signs should be used only where justified by engineering judgment or studies, as provided in [Section 1A.09](#).

03 Results from traffic engineering studies of physical and traffic factors should indicate the locations where signs are deemed necessary or desirable.

04 Roadway geometric design and sign application should be coordinated so that signing can be effectively placed to give the road user any necessary regulatory, warning, guidance, and other information.

Standard:

05 Each standard sign shall be displayed only for the specific purpose as prescribed in this Manual. Determination of the particular signs to be applied to a specific condition shall be made in accordance with the provisions set forth in [Part 2](#). Before any new highway, private road open to public travel (see definition in [Section 1A.13](#)), detour, or temporary route is opened to public travel, all necessary signs shall be in place. Signs required by road conditions or restrictions shall be removed when those conditions cease to exist, or the restrictions are withdrawn.

Section 2A.04 Excessive Use of Signs

Guidance:

01 Regulatory and warning signs should be used conservatively because these signs, if used to excess, tend to lose their effectiveness. If used, route signs and directional guide signs should be used frequently because their use promotes efficient operations by keeping road users informed of their location.

Section 2A.05 Classification of Signs

Standard:

01 Signs shall be defined by their function as follows:

- A. Regulatory signs give notice of traffic laws or regulations.
- B. Warning signs give notice of a situation that might not be readily apparent.

- C. Guide signs show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information.

Support:

02 Object markers are defined in [Section 2C.63](#).

Section 2A.15 Enhanced Conspicuity for Standard Signs

Option:

01 Based upon engineering judgment, where the improvement of the conspicuity of a standard regulatory, warning, or guide sign is desired, any of the following methods may be used, as appropriate, to enhance the sign's conspicuity (see [Figure 2A-1](#)):

[Figure 2A-1](#) Examples of Enhanced Conspicuity for Signs

- A. Increasing the size of a standard regulatory, warning, or guide sign.
- B. Doubling-up of a standard regulatory, warning, or guide sign by adding a second identical sign on the left-hand side of the roadway.
- C. Adding a solid yellow or fluorescent yellow rectangular "header panel" above a standard regulatory sign. A legend of "NOTICE," "STATE LAW," or other appropriate text may be added in black letters within the header panel for a period of time determined by engineering judgment.
- D. Adding a NEW plaque (see [Section 2C.62](#)) above a new standard regulatory or warning sign, for a period of time determined by engineering judgment, to call attention to the new sign.
- E. Adding one or more red or orange flags (cloth or retroreflective sheeting) above a standard regulatory or warning sign, with the flags oriented so as to be at 45 degrees to the vertical.
- F. Adding a solid yellow, a solid fluorescent yellow, or a diagonally striped black and yellow (or black and fluorescent yellow) strip of retroreflective sheeting at least 3 inches wide around the perimeter of a standard warning sign. This may be accomplished by affixing the standard warning sign on a background that is 6 inches larger than the size of the standard warning sign.
- G. Adding a warning beacon (see [Section 4L.03](#)) to a standard regulatory (other than a STOP or a Speed Limit sign), warning, or guide sign.
- H. Adding a speed limit sign beacon (see [Section 4L.04](#)) to a standard Speed Limit sign.



- I. Adding a stop beacon (see [Section 4L.05](#)) to a STOP sign.
- J. Adding light emitting diode (LED) units within the symbol or legend of a sign or border of a standard regulatory, warning, or guide sign, as provided in [Section 2A.07](#).
- K. Adding a strip of retroreflective material to the sign support in compliance with the provisions of [Section 2A.21](#).
- L. Using other methods that are specifically allowed for certain signs as described elsewhere in this Manual.

Support:

02 Sign conspicuity improvements can also be achieved by removing non-essential and illegal signs from the right-of-way (see [Section 1A.08](#)), and by relocating signs to provide better spacing.

Standard:

03 The NEW plaque (see [Section 2C.62](#)) shall not be used alone.

04 Strobe lights shall not be used to enhance the conspicuity of highway signs.

Section 2A.16 Standardization of Location

Support:

01 Standardization of position cannot always be attained in practice. Examples of heights and lateral locations of signs for typical installations are illustrated in [Figure 2A-2](#), and examples of locations for some typical signs at intersections are illustrated in [Figures 2A-3](#) and [2A-4](#).

02 Examples of advance signing on an intersection approach are illustrated in [Figure 2A-4](#). Chapters 2B, 2C, and 2D contain provisions regarding the application of regulatory, warning, and guide signs, respectively.

Standard:

03 Signs requiring separate decisions by the road user shall be spaced sufficiently far apart for the appropriate decisions to be made. One of the factors considered when determining the appropriate spacing shall be the posted or 85th-percentile speed.

Guidance:

04 Signs should be located on the right-hand side of the roadway where they are easily recognized and understood by road users. Signs in other locations should be considered only as supplementary to signs in the normal locations, except as otherwise provided in this Manual.

05 Signs should be individually installed on separate posts or mountings except where:

- A. One sign supplements another;
- B. Route or directional signs are grouped to clarify information to motorists;

C. *Regulatory signs that do not conflict with each other are grouped, such as turn prohibition signs posted with one way signs or a parking regulation sign posted with a speed limit sign; or*

D. *Street name signs are posted with a stop or yield sign.*

06 *Signs should be located so that they:*

A. *Are outside the clear zone unless placed on a breakaway or yielding support (see [Section 2A.19](#)),*

B. *Optimize nighttime visibility,*

C. *Minimize the effects of mud splatter and debris,*

D. *Do not obscure each other,*

E. *Do not obscure the sight distance to approaching vehicles on the major street for drivers who are stopped on minor-street approaches, and*

F. *Are not hidden from view.*

Support:

07 The clear zone is the total roadside border area, starting at the edge of the traveled way, available for use by errant vehicles. The width of the clear zone is dependent upon traffic volumes, speeds, and roadside geometry. Additional information can be found in AASHTO's "Roadside Design Guide" (see [Section 1A.11](#)).

Guidance:

08 *With the increase in traffic volumes and the desire to provide road users regulatory, warning, and guidance information, an order of priority for sign installation should be established.*

Support:

09 An order of priority is especially critical where space is limited for sign installation and there is a demand for several different types of signs. Overloading road users with too much information is not desirable.

Guidance:

10 *Because regulatory and warning information is more critical to the road user than guidance information, regulatory and warning signing whose location is critical should be displayed rather than guide signing in cases where conflicts occur. Community wayfinding and acknowledgment guide signs should have a lower priority as to placement than other guide signs. Information of a less critical nature should be moved to less critical locations or omitted.*

Option:

11 Under some circumstances, such as on curves to the right, signs may be placed on median islands or on the left-hand side of the road. A supplementary sign located on the left-hand side

of the roadway may be used on a multi-lane road where traffic in a lane to the right might obstruct the view to the right.

Guidance:

12 *In urban areas where crosswalks exist, signs should not be placed within 4 feet in advance of the crosswalk (see Drawing D in [Figure 2A-3](#)).*

Section 2A.18 Mounting Height

Standard:

01 The provisions of this Section shall apply unless specifically stated otherwise for a particular sign or object marker elsewhere in this Manual.

Support:

02 The mounting height requirements for object markers are provided in Chapter 2C.

03 In addition to the provisions of this Section, information affecting the minimum mounting height of signs as a function of crash performance can be found in AASHTO's "Roadside Design Guide" (see [Section 1A.11](#)).

Standard:

04 The minimum height, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement, of signs installed at the side of the road in rural areas shall be 5 feet (see [Figure 2A-2](#)).

05 The minimum height, measured vertically from the bottom of the sign to the top of the curb, or in the absence of curb, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, of signs installed at the side of the road in business, commercial, or residential areas where parking or pedestrian movements are likely to occur, or where the view of the sign might be obstructed, shall be 7 feet (see [Figure 2A-2](#)).

Option:

06 The height to the bottom of a secondary sign mounted below another sign may be 1 foot less than the height specified in [Paragraphs 4](#) and [5](#).

Standard:

07 The minimum height, measured vertically from the bottom of the sign to the sidewalk, of signs installed above sidewalks shall be 7 feet.

08 If the bottom of a secondary sign that is mounted below another sign is mounted lower than 7 feet above a pedestrian sidewalk or pathway (see [Section 6D.02](#)), the secondary sign shall not project more than 4 inches into the pedestrian facility.

Option:

09 Signs that are placed 30 feet or more from the edge of the traveled way may be installed with

a minimum height of 5 feet, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement.

Standard:

10 Directional signs on freeways and expressways shall be installed with a minimum height of 7 feet, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement. All route signs, warning signs, and regulatory signs on freeways and expressways shall be installed with a minimum height of 7 feet, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement. If a secondary sign is mounted below another sign on a freeway or expressway, the major sign shall be installed with a minimum height of 8 feet and the secondary sign shall be installed with a minimum height of 5 feet, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement.

11 Where large signs having an area exceeding 50 square feet are installed on multiple breakaway posts, the clearance from the ground to the bottom of the sign shall be at least 7 feet.

Option:

12 A route sign assembly consisting of a route sign and auxiliary signs (see [Section 2D.31](#)) may be treated as a single sign for the purposes of this Section.

13 The mounting height may be adjusted when supports are located near the edge of the right-of-way on a steep backslope in order to avoid the sometimes less desirable alternative of placing the sign closer to the roadway.

Standard:

14 Overhead signs shall provide a vertical clearance of not less than 17 feet to the sign, light fixture, or sign bridge over the entire width of the pavement and shoulders except where the structure on which the overhead signs are to be mounted or other structures along the roadway near the sign structure have a lesser vertical clearance.

Option:

15 If the vertical clearance of other structures along the roadway near the sign structure is less than 16 feet, the vertical clearance to an overhead sign structure or support may be as low as 1 foot higher than the vertical clearance of the other structures in order to improve the visibility of the overhead signs.

16 In special cases it may be necessary to reduce the clearance to overhead signs because of substandard dimensions in tunnels and other major structures such as double-deck bridges.

Support:

17 [Figure 2A-2](#) illustrates some examples of the mounting height requirements contained in this Section.

Section 2A.19 Lateral Offset

Standard:

01 For overhead sign supports, the minimum lateral offset from the edge of the shoulder (or if no shoulder exists, from the edge of the pavement) to the near edge of overhead sign supports (cantilever or sign bridges) shall be 6 feet. Overhead sign supports shall have a barrier or crash cushion to shield them if they are within the clear zone.

02 Post-mounted sign and object marker supports shall be crashworthy (breakaway, yielding, or shielded with a longitudinal barrier or crash cushion) if within the clear zone.

Guidance:

03 For post-mounted signs, the minimum lateral offset should be 12 feet from the edge of the traveled way. If a shoulder wider than 6 feet exists, the minimum lateral offset for post-mounted signs should be 6 feet from the edge of the shoulder.

Support:

04 The minimum lateral offset requirements for object markers are provided in Chapter 2C.

05 The minimum lateral offset is intended to keep trucks and cars that use the shoulders from striking the signs or supports.

Guidance:

06 All supports should be located as far as practical from the edge of the shoulder. Advantage should be taken to place signs behind existing roadside barriers, on over-crossing structures, or other locations that minimize the exposure of the traffic to sign supports.

Option:

07 Where permitted, signs may be placed on existing supports used for other purposes, such as highway traffic signal supports, highway lighting supports, and utility poles.

Standard:

08 If signs are placed on existing supports, they shall meet other placement criteria contained in this Manual.

Option:

09 Lesser lateral offsets may be used on connecting roadways or ramps at interchanges, but not less than 6 feet from the edge of the traveled way.

10 On conventional roads in areas where it is impractical to locate a sign with the lateral offset prescribed by this Section, a lateral offset of at least 2 feet may be used.

11 A lateral offset of at least 1 foot from the face of the curb may be used in business, commercial or residential areas where sidewalk width is limited or where existing poles are close to the curb.

Guidance:

12 *Overhead sign supports and post-mounted sign and object marker supports should not intrude into the usable width of a sidewalk or other pedestrian facility.*

Support:

13 [Figures 2A-2](#) and [2A-3](#) illustrate some examples of the lateral offset requirements contained in this Section.

Chapter 2C. Warning Signs And Object Markers

Section 2C.01 Function of Warning Signs

Support:

01 Warning signs call attention to unexpected conditions on or adjacent to a highway, street, or private roads open to public travel and to situations that might not be readily apparent to road users. Warning signs alert road users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operations.

Section 2C.02 Application of Warning Signs

Standard:

01 The use of warning signs shall be based on an engineering study or on engineering judgment.

Guidance:

02 *The use of warning signs should be kept to a minimum as the unnecessary use of warning signs tends to breed disrespect for all signs. In situations where the condition or activity is seasonal or temporary, the warning sign should be removed or covered when the condition or activity does not exist.*

Option:

03 Consistent with the provisions of Chapter 2L, changeable message signs may be used to display a warning message.

04 Consistent with the provisions of Chapter 4L, a Warning Beacon may be used in combination with a standard warning sign.

Support:

05 The categories of warning signs are shown in [Table 2C-1](#).

06 Warning signs provided in this Manual cover most of the conditions that are likely to be encountered. Additional warning signs for low-volume roads (as defined in [Section 5A.01](#)), temporary traffic control zones, school areas, grade crossings, and bicycle facilities are discussed in [Parts 5](#) through 10, respectively.

07 [Section 1A.09](#) contains information regarding the assistance that is available to jurisdictions that do not have engineers on their staffs who are trained and/or experienced in traffic control devices.

Section 2C.03 Design of Warning Signs

Standard:

01 Except as provided in [Paragraph 2](#) or unless specifically designated otherwise, all warning signs shall be diamond-shaped (square with one diagonal vertical) with a black legend and border on a yellow background. Warning signs shall be designed in accordance with the sizes, shapes, colors, and legends contained in the "Standard Highway Signs and Markings" book (see [Section 1A.11](#)).

Option:

02 A warning sign that is larger than the size shown in the Oversized column in [Table 2C-2](#) for that particular sign may be diamond-shaped or may be rectangular or square in shape.

03 Except for symbols on warning signs, minor modifications may be made to the design provided that the essential appearance characteristics are met. Modifications may be made to the symbols shown on combined horizontal alignment/intersection signs (see [Section 2C.11](#)) and intersection warning signs (see [Section 2C.46](#)) in order to approximate the geometric configuration of the intersecting roadway(s).

04 Word message warning signs other than those provided in this Manual may be developed and installed by State and local highway agencies.

05 Warning signs regarding conditions associated with pedestrians, bicyclists, and playgrounds may have a black legend and border on a yellow or fluorescent yellow-green background.

Standard:

06 Warning signs regarding conditions associated with school buses and schools and their related supplemental plaques shall have a black legend and border on a fluorescent yellow-green background (see [Section 7B.07](#)).

Section 2C.04 Size of Warning Signs

Standard:

01 Except as provided in [Section 2A.11](#), the sizes for warning signs shall be as shown in [Table 2C-2](#).

Support:

02 [Section 2A.11](#) contains information regarding the applicability of the various columns in [Table 2C-2](#).

Standard:

03 Except as provided in [Paragraph 5](#), the minimum size for all diamond-shaped warning signs facing traffic on a multi-lane conventional road where the posted speed limit is higher than 35 mph shall be 36 x 36 inches.

04 The minimum size for supplemental warning plaques that are not included in [Table 2C-2](#) shall be as shown in [Table 2C-3](#).

Table 2C-3. Minimum Size of Supplemental Warning Plaques

Size of Warning Sign	Size of Supplemental Plaque			
	Rectangular			Square
	1 Line	2 Lines	Arrow	
24 x 24	24 x 12	24 x 18	24 x 12	18 x 18
30 x 30				
36 x 36	30 x 18	30 x 24	30 x 18	24 x 24
48 x 48				

Notes:

1. Larger supplemental plaques may be used when appropriate
2. Dimensions in inches are shown as width x height

Option:

05 If a diamond-shaped warning sign is placed on the left-hand side of a multi-lane roadway to supplement the installation of the same warning sign on the right-hand side of the roadway, the minimum size identified in the Single Lane column in [Table 2C-2](#) may be used.

06 Signs and plaques larger than those shown in [Tables 2C-2](#) and [2C-3](#) may be used (see [Section 2A.11](#)).

Guidance:

07 *The minimum size for all diamond-shaped warning signs facing traffic on exit and entrance ramps should be the size identified in [Table 2C-2](#) for the mainline roadway classification*

(Expressway or Freeway). If a minimum size is not provided in the Freeway Column, the Expressway size should be used. If a minimum size is not provided in the Freeway or the Expressway Column, the Oversized size should be used.

Section 2C.05 Placement of Warning Signs

Support:

01 For information on placement of warning signs, see [Sections 2A.16](#) to [2A.21](#).

02 The time needed for detection, recognition, decision, and reaction is called the Perception-Response Time (PRT). [Table 2C-4](#) is provided as an aid for determining warning sign location. The distances shown in [Table 2C-4](#) can be adjusted for roadway features, other signing, and to improve visibility.

Table 2C-4. Guidelines for Advance Placement of Warning Signs

Posted or 85th-Percentile Speed	Advance Placement Distance ¹								
	Condition A: Speed reduction and lane changing in heavy traffic ²	Condition B: Deceleration to the listed advisory speed (mph) for the condition							
		0 ³	10 ⁴	20 ⁴	30 ⁴	40 ⁴	50 ⁴	60 ⁴	70 ⁴
20 mph	225 ft	100 ft ⁶	N/A ⁵	—	—	—	—	—	—
25 mph	325 ft	100 ft ⁶	N/A ⁵	N/A ⁵	—	—	—	—	—
30 mph	460 ft	100 ft ⁶	N/A ⁵	N/A ⁵	—	—	—	—	—
35 mph	565 ft	100 ft ⁶	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—	—
40 mph	670 ft	125 ft	100 ft ⁶	100 ft ⁶	N/A ⁵	—	—	—	—
45 mph	775 ft	175 ft	125 ft	100 ft ⁶	100 ft ⁶	N/A ⁵	—	—	—
50 mph	885 ft	250 ft	200 ft	175 ft	125 ft	100 ft ⁶	—	—	—
55 mph	990 ft	325 ft	275 ft	225 ft	200 ft	125 ft	N/A ⁵	—	—
60 mph	1,100 ft	400 ft	350 ft	325 ft	275 ft	200 ft	100 ft ⁶	—	—
65 mph	1,200 ft	475 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft ⁶	—
70 mph	1,250 ft	550 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—
75 mph	1,350 ft	650 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft ⁶

1. The distances are adjusted for a sign legibility distance of 180 feet for Condition A. The distances for Condition B have been adjusted for a sign legibility distance of 250 feet, which is appropriate for an alignment warning symbol sign. For Conditions A and B, warning signs with less than 6-inch legend or more than four words, a minimum of 100

feet should be added to the advance placement distance to provide adequate legibility of the warning sign.

2. Typical conditions are locations where the road user must use extra time to adjust speed and change lanes in heavy traffic because of a complex driving situation. Typical signs are Merge and Right Lane Ends. The distances are determined by providing the driver a PRT of 14.0 to 14.5 seconds for vehicle maneuvers (2005 AASHTO Policy, Exhibit 3-3, Decision Sight Distance, Avoidance Maneuver E) minus the legibility distance of 180 feet for the appropriate sign.
3. Typical condition is the warning of a potential stop situation. Typical signs are Stop Ahead, Yield Ahead, Signal Ahead, and Intersection Warning signs. The distances are based on the 2005 AASHTO Policy, Exhibit 3-1, Stopping Sight Distance, providing a PRT of 2.5 seconds, a deceleration rate of 11.2 feet/second², minus the sign legibility distance of 180 feet.
4. Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are Turn, Curve, Reverse Turn, or Reverse Curve. The distance is determined by providing a 2.5 second PRT, a vehicle deceleration rate of 10 feet/second², minus the sign legibility distance of 250 feet.
5. No suggested distances are provided for these speeds, as the placement location is dependent on site conditions and other signing. An alignment warning sign may be placed anywhere from the point of curvature up to 100 feet in advance of the curve. However, the alignment warning sign should be installed in advance of the curve and at least 100 feet from any other signs.
6. The minimum advance placement distance is listed as 100 feet to provide adequate spacing between signs.

Guidance:

03 Warning signs should be placed so that they provide an adequate PRT. The distances contained in [Table 2C-4](#) are for guidance purposes and should be applied with engineering judgment. Warning signs should not be placed too far in advance of the condition, such that drivers might tend to forget the warning because of other driving distractions, especially in urban areas.

04 Minimum spacing between warning signs with different messages should be based on the estimated PRT for driver comprehension of and reaction to the second sign.

05 The effectiveness of the placement of warning signs should be periodically evaluated under both day and night conditions.

Option:

06 Warning signs that advise road users about conditions that are not related to a specific location, such as Deer Crossing or SOFT SHOULDER, may be installed in an appropriate location, based on engineering judgment, since they are not covered in [Table 2C-4](#).

Section 2C.06 Horizontal Alignment Warning Signs

Support:

01 A variety of horizontal alignment warning signs (see [Figure 2C-1](#)), pavement markings (see Chapter 3B), and delineation (see Chapter 3F) can be used to advise motorists of a change in the roadway alignment. Uniform application of these traffic control devices with respect to the amount of change in the roadway alignment conveys a consistent message establishing driver expectancy and promoting effective roadway operations. The design and application of horizontal alignment warning signs to meet those requirements are addressed in [Sections 2C.06](#) through [2C.15](#).

[Figure 2C-1](#) Horizontal Alignment Signs and Plaques

Standard:

02 In advance of horizontal curves on freeways, on expressways, and on roadways with more than 1,000 AADT that are functionally classified as arterials or collectors, horizontal alignment warning signs shall be used in accordance with [Table 2C-5](#) based on the speed differential between the roadway's posted or statutory speed limit or 85th-percentile speed, whichever is higher, or the prevailing speed on the approach to the curve, and the horizontal curve's advisory speed.



Table 2C-5. Horizontal Alignment Sign Selection

Type of Horizontal Alignment Sign	Difference Between Speed Limit and Advisory Speed				
	5 mph	10 mph	15 mph	20 mph	25 mph or more
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W1-10) (see Section 2C.07 to determine which sign to use)	Recommended	Required	Required	Required	Required
Advisory Speed Plaque (W13-1P)	Recommended	Required	Required	Required	Required
Chevrons (W1-8) and/or One Direction Large Arrow (W1-6)	Optional	Recommended	Required	Required	Required
Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp	Optional	Optional	Recommended	Required	Required

Note: Required means that the sign and/or plaque shall be used, recommended means that the sign and/or plaque should be used, and optional means that the sign and/or plaque may be used.

See [Section 2C.06](#) for roadways with less than 1,000 AADT.

Option:

03 Horizontal Alignment Warning signs may also be used on other roadways or on arterial and collector roadways with less than 1,000 AADT based on engineering judgment.

Section 2C.07 Horizontal Alignment Signs (W1-1 through W1-5, W1-11, W1-15)

Standard:

01 If [Table 2C-5](#) indicates that a horizontal alignment sign (see [Figure 2C-1](#)) is required, recommended, or allowed, the sign installed in advance of the curve shall be a Curve (W1-2) sign unless a different sign is recommended or allowed by the provisions of this Section.

02 A Turn (W1-1) sign shall be used instead of a Curve sign in advance of curves that have advisory speeds of 30 mph or less (see [Figure 2C-2](#)).

[Figure 2C-2](#) Example of Warning Signs for a Turn

Guidance:

03 Where there are two changes in roadway alignment in opposite directions that are separated by a tangent distance of less than 600 feet, the Reverse Turn (W1-3) sign should be used instead of multiple Turn (W1-1) signs and the Reverse Curve (W1-4) sign should be used instead of multiple Curve (W1-2) signs.

Option:

04 A Winding Road (W1-5) sign may be used instead of multiple Turn (W1-1) or Curve (W1-2) signs where there are three or more changes in roadway alignment each separated by a tangent distance of less than 600 feet.

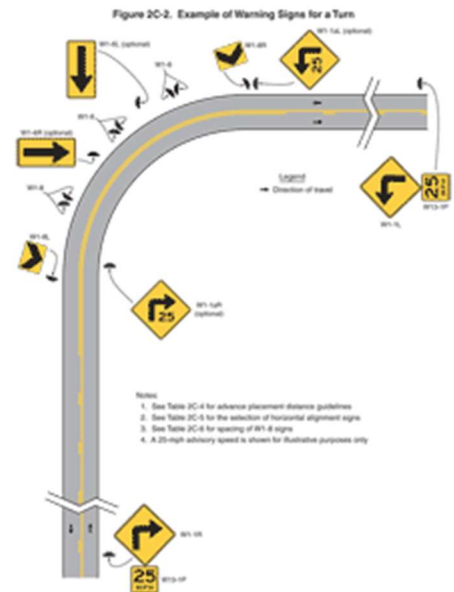
05 A NEXT XX MILES (W7-3aP) supplemental distance plaque (see [Section 2C.55](#)) may be installed below the Winding Road sign where continuous roadway curves exist for a specific distance.

06 If the curve has a change in horizontal alignment of 135 degrees or more, the Hairpin Curve (W1-11) sign may be used instead of a Curve or Turn sign.

07 If the curve has a change of direction of approximately 270 degrees, such as on a cloverleaf interchange ramp, the 270-degree Loop (W1-15) sign may be used instead of a Curve or Turn sign.

Guidance:

08 When the Hairpin Curve sign or the 270-degree Loop sign is installed, either a One-Direction



Large Arrow (W1-6) sign or Chevron Alignment (W1-8) signs should be installed on the outside of the turn or curve.

Section 2C.08 Advisory Speed Plaque (W13-1P)

Option:

01 The Advisory Speed (W13-1P) plaque (see [Figure 2C-1](#)) may be used to supplement any warning sign to indicate the advisory speed for a condition.

Standard:

02 The use of the Advisory Speed plaque for horizontal curves shall be in accordance with the information shown in [Table 2C-5](#). The Advisory Speed plaque shall also be used where an engineering study indicates a need to advise road users of the advisory speed for other roadway conditions.

03 If used, the Advisory Speed plaque shall carry the message XX MPH. The speed displayed shall be a multiple of 5 mph.

04 Except in emergencies or when the condition is temporary, an Advisory Speed plaque shall not be installed until the advisory speed has been determined by an engineering study.

05 The Advisory Speed plaque shall only be used to supplement a warning sign and shall not be installed as a separate sign installation.

06 The advisory speed shall be determined by an engineering study that follows established engineering practices.

Support:

07 Among the established engineering practices that are appropriate for the determination of the recommended advisory speed for a horizontal curve are the following:

- A. An accelerometer that provides a direct determination of side friction factors
- B. A design speed equation
- C. A traditional ball-bank indicator using the following criteria:
 - 1. 16 degrees of ball-bank for speeds of 20 mph or less
 - 2. 14 degrees of ball-bank for speeds of 25 to 30 mph
 - 3. 12 degrees of ball-bank for speeds of 35 mph and higher

08 The 16, 14, and 12 degrees of ball-bank criteria are comparable to the current AASHTO horizontal curve design guidance. Research has shown that drivers often exceed existing posted advisory curve speeds by 7 to 10 mph.

Guidance:

09 The advisory speed should be determined based on free-flowing traffic conditions.

10 Because changes in conditions, such as roadway geometrics, surface characteristics, or sight distance, might affect the advisory speed, each location should be evaluated periodically or when conditions change.

Section 2C.16 Hill Signs (W7-1, W7-1a)

Guidance:

01 The Hill (W7-1) sign (see [Figure 2C-4](#))

[Figure 2C-4](#) Vertical Grade Signs and Plaques

02 The Hill sign and supplemental grade (W7-3P) plaque (see [Section 2C.57](#)) used in combination, or the W7-1a sign used alone, should be installed in advance of downgrades for the following conditions:

- A. 5% grade that is more than 3,000 feet in length,
- B. 6% grade that is more than 2,000 feet in length,
- C. 7% grade that is more than 1,000 feet in length,
- D. 8% grade that is more than 750 feet in length, or
- E. 9% grade that is more than 500 feet in length.



03 These signs should also be installed for steeper grades or where crash experience and field observations indicate a need.

04 Supplemental plaques (see [Section 2C.57](#)) and larger signs should be used for emphasis or where special hill characteristics exist. On longer grades, the use of the Hill sign with a distance (W7-3aP) plaque or the combination distance/grade (W7-3bP) plaque at periodic intervals of approximately 1-mile spacing should be considered.

Standard:

05 If the percent grade is displayed on a supplemental plaque, the plaque shall be placed below the Hill (W7-1) sign.

Option:

06 A USE LOW GEAR (W7-2P) or TRUCKS USE LOWER GEAR (W7-2bP) supplemental plaque (see [Figure 2C-4](#)) may be used to indicate a situation where downshifting as well as braking might be advisable.