

CR 19 (Slate Quarry Rd) Safety Assessment

NYS Route 9G to White Schoolhouse Rd, Town of Rhinebeck



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1. Background

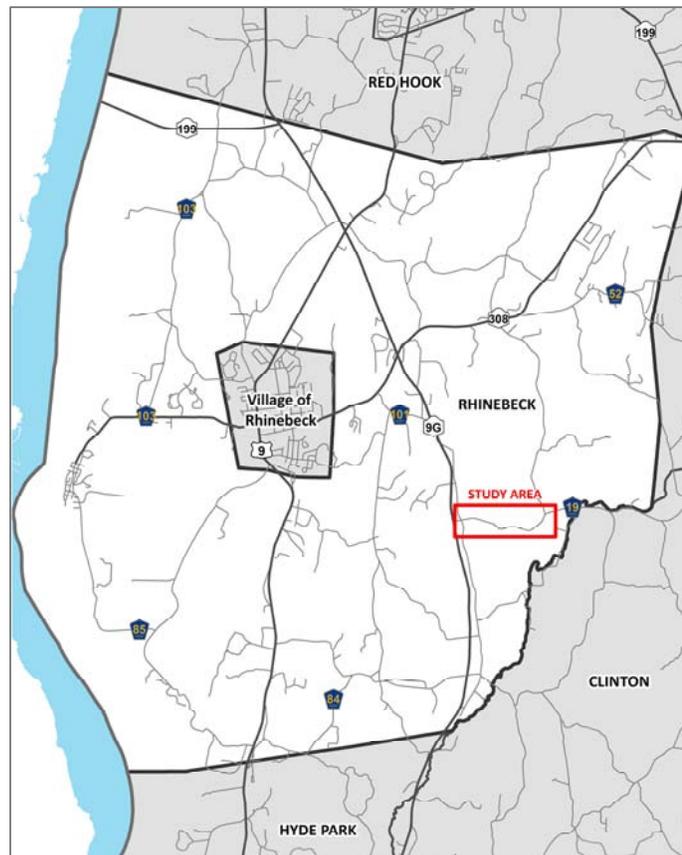
The Poughkeepsie-Dutchess County Transportation Council (PDCTC) conducted a Safety Assessment (SA) of CR19 (Slate Quarry Rd) from NYS Route 9G to White Schoolhouse Rd in support of its goal to improve transportation safety in Dutchess County. The SA is intended to provide the facility owner, Dutchess County, with a list of opportunities for low-cost, short-range safety improvements, and if warranted, more expensive and/or longer-range improvements. The PDCTC, in consultation with the Dutchess County Department of Public Works (DCDPW) and the Town of Rhinebeck, selected the assessment location based on a county-wide analysis of crash data from 2009-2013.

2. Road Characteristics

CR19 (Slate Quarry Rd) runs in an east-west direction between NYS Route 9G in Rhinebeck east to the Taconic State Parkway in the Town of Clinton, and eventually to NYS Route 82 in the Town of Stanford. During its course, the 11.3 mile road changes its name to Bulls Head Rd at the intersection of CR18 (Centre Rd) in Clinton. The road is maintained by the Dutchess County Department of Public Works (DCDPW). This SA focused on a one-mile portion of CR19 that is in the Town of Rhinebeck and locally referred to as Slate Quarry Rd. See Figure 1.

Within the one mile study area, Slate Quarry Rd is a two-way, two-lane rural collector with asphalt shoulders and an un-posted 55 mile per hour (mph) speed limit – though this will soon change upon implementation of a newly-approved 45 mph speed limit between Route 9G and Centre Rd (CR18) (Note: DCDPW intends to have new speed limit signs installed by mid-December). While CR19 east of Centre Road is relatively wide and straight, the segment west of Centre Rd is narrower and has substantial horizontal and vertical curves at several locations. The pavement is in excellent condition, having just been repaved (between Wurtemberg and Zipfeldburg Rd) in October 2014 due to concerns about insufficient pavement friction during wet weather. Based on measurements at the site, the width of the road varies between 26-28 feet.

Figure 1. Study Area



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At the time of the SA, lane markings had not yet been added, though DCDPW has subsequently striped the road. The travel lanes are 11 feet wide, which allow for 2-3 foot paved shoulders depending on shoulder conditions. DCDPW indicated that additional shoulder work was planned to reduce the drop-off at the paved edges, which will increase useable shoulder width. The approaching Town roads of Wurtemberg Rd and White Schoolhouse Rd are in fair to good condition with some longitudinal cracking.

Slate Quarry Rd serves as a popular east-west connection between NYS Route 9G and the Taconic State Parkway. Heavy vehicles use the road based on its proximity to a local quarry, while school buses use the road to transport students to/from nearby schools. In addition, a new mine has been proposed on White Schoolhouse Rd, which could add about 80 trucks per day to Slate Quarry Rd east of White Schoolhouse Rd. The limited shoulder width, road curvature, and high speeds likely discourage walking and bicycling, though one pedestrian was observed during an October 27th site visit.

Traffic volumes collected in 2014 indicate an annual average daily traffic (AADT) volume of approximately 4,200 vehicles per day, with peak hour volumes of approximately 340 vehicles per hour in the morning (8 to 9 a.m.) and 410 vehicles in the evening (5 to 6 p.m.). Based on 2014 vehicle classification counts, 5.4 percent of vehicles were classified as heavy-duty trucks or buses. The same 2014 data indicated an 85th percentile speed of close to 53 mph eastbound and 50 mph westbound, meaning 85 percent of measured speeds were at or below these speeds; average speeds were 46.4 mph eastbound and 43.8 mph southbound. Table 1 shows recent and historic traffic data for the study area.

Table 1. CR19 (Slate Quarry Rd) Traffic Volumes & Speeds: NYS Route 9G to White Schoolhouse Rd

Year	AADT	Peak Hour Volumes		85% speed		% heavy vehicles
		8-9 AM	5-6 PM	EB	WB	
2007	3,720	300	355	n/a	n/a	n/a
2010	3,991	310	384	53.4	52.5	8.5%
2014	4,181	340	409	52.7	49.7	5.4%

AADT: Annual Average Daily Traffic

The Wurtemberg Rd approach to Slate Quarry Rd is STOP sign controlled, while White Schoolhouse Rd is STOP and YIELD sign controlled (for left and right turns, respectively). Stop bar markings, albeit worn, are present at Wurtemberg Rd, though not at White Schoolhouse Rd. DCDPW intends to mark Slate Quarry Rd with a double yellow center line and white edge lines. The approaching Town roads are not striped. Throughout the corridor, a variety of warning signs are used, including curve warning signs with speed advisory plaques, chevrons, and slippery when wet warning signs. Guiderails are also present along some sections of Slate Quarry Rd.

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3. Safety Assessment Process

This project represents the third application of the SA process in Dutchess County, building upon previous SAs in 2013 for CR9 (Beekman Road) in the Town of Beekman and in 2014 for CR16 (North Quaker Ln) in the Town of Hyde Park. As before, the PDCTC conducted this SA consistent with Road Safety Audit (RSA) guidance from the Federal Highway Administration (FHWA) and Safety Assessment Guidelines from the New York State Association of Metropolitan Planning Associations (NYSAMPO). This SA relied on the participation of an interdisciplinary team of staff from partner agencies, which included the following individuals:

- Robert Balkind – Deputy Commissioner, Dutchess County DPW
- Stephen Gill – Traffic Engineer, Dutchess County DPW
- Rob Zahorsky – Dutchess County DPW-Highway Maintenance
- Brian Engel – Trooper, New York State Police
- Lt. Mike Dampf – Dutchess County Sheriff's Office
- Sgt. Jon Begor – Dutchess County Sheriff's Office
- Sgt. Peter Dunn – Officer in Charge, Rhinebeck Police Department
- Elizabeth Spinzia – Supervisor, Town of Rhinebeck
- Kathy Kinsella – Highway Superintendent, Town of Rhinebeck
- Henry Campbell – Emergency Services Coordinator, Town of Rhinebeck
- Mark Debald – Transportation Program Administrator, PDCTC
- Emily Dozier – Senior Planner, PDCTC



Figure 2. The CR19 (Slate Quarry Rd) Safety Assessment relied on a multi-disciplinary team to review existing conditions and identify potential solutions to improve safety.

The SA took place on October 29-30, 2014, starting with a pre-assessment meeting on October 29th, followed by site visits that afternoon (both during daylight and dusk) and on the morning of October 30th. A post assessment meeting was held at Town Hall on October 30th to discuss the team's observations and explore possible safety improvements using the prompt list included with the FHWA RSA software program. The SA team used a variety of information to complete the SA, including crash and traffic data, aerial photography, and field work. The key

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issues identified included high vehicle speeds, narrow shoulders, horizontal and vertical curves, limited sight distances, and wet-weather crashes. The SA team strove to identify low-cost, high-impact improvements to address these issues.

4. Crash Analysis

The PDCTC collected crash data from 2009-2013 (the latest calendar year available) from the NYS Accident Location Information System (ALIS) database, which is a multi-agency reporting system operated by the NYS Office of Cyber Security & Critical Infrastructure Coordination (CSCIC), the NYS Department of Motor Vehicles (DMV) and the NYS Department of Transportation (NYSDOT). ALIS data originates from the Traffic and Criminal Software (TraCS) system used by police agencies and submitted via DMV accident report forms (Form MV-104).

The one mile segment of Slate Quarry Rd experienced 59 crashes from 2009-2013, which resulted in one fatality and 26 reported injuries, three of which were classified as serious. Note: in June 2012, a fatality occurred near Slate Quarry Rd at the Route 9G intersection; since this was located outside the study area it was not included in the crash analysis. The crash analysis indicated that the majority of crashes (76 percent) occurred during daylight, and wet or snowy road surface conditions were present at approximately half of the crashes. Of the 59 crashes, 19 (or 32 percent) occurred within 100 feet of the White Schoolhouse Rd intersection. The number of crashes spiked in 2013, when 20 crashes occurred, which accounted for 34 percent of all the crashes during the five year period. The most frequent crash type was collisions with earth, rock cuts, or ditches (16 crashes), followed by collisions with deer (13 crashes). The most prevalent collision factor was unsafe speed, followed by slippery pavement and animal’s action. Over 80 percent of crashes occurred on a curve. Table 2 summarizes crash data for the study area.

Table 2. CR19 (Slate Quarry Rd) Crash Summary: Wurtemberg Rd to White Schoolhouse Rd

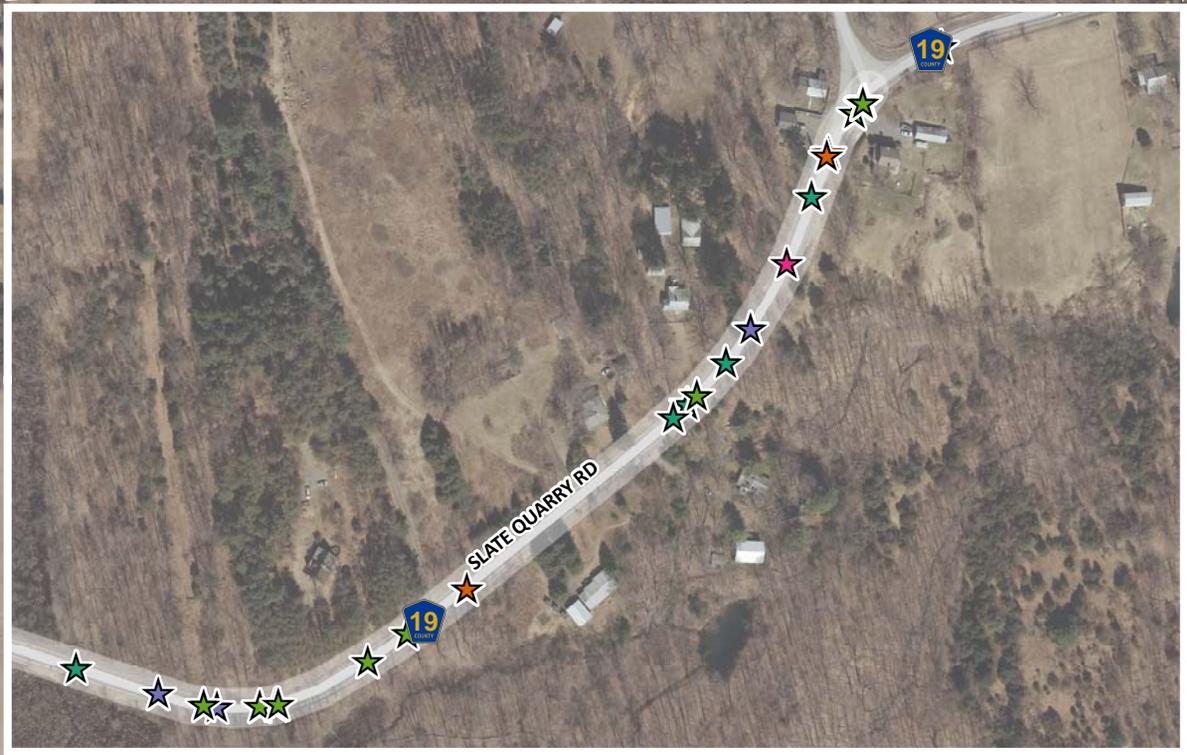
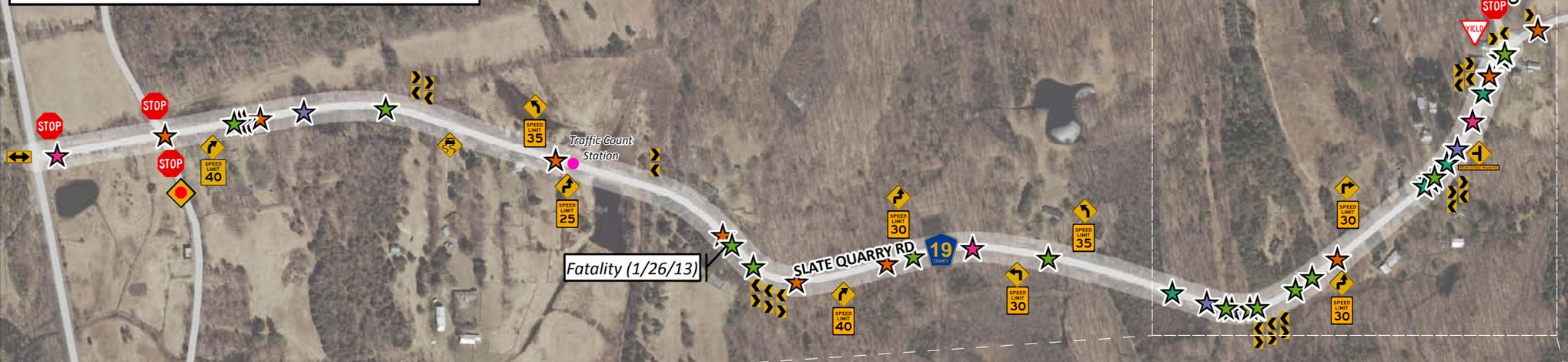
Year	Number of Crashes	Number of Fatalities	Number of Injuries	Light Conditions		Road Surface Condition		
				Daylight	Dark	Dry	Wet	Snow
2009	11	0	3	9	2	8	3	0
2010	15	0	6	12	3	10	4	1
2011	7	0	3	3	4	3	2	2
2012	6	0	2	6	0	4	2	0
2013	20	1	12	15	5	5	13	2
Total	59	1	26	45	14	30	24	5

Note: Out of the 59 total crashes, 13 involved deer.

Figure 3 shows the general locations and years of crashes in the study area as well as warning sign locations, while Figure 4 shows the nature of the crashes.

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Reported Crashes (2009-2013) by Year

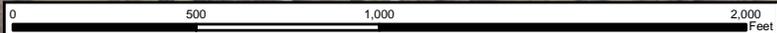


Crash Year

- ★ 2009
- ★ 2010
- ★ 2011
- ★ 2012
- ★ 2013

Disclaimer: Crash data provided by the NYS Department of Transportation's Accident Location Information System (ALIS).

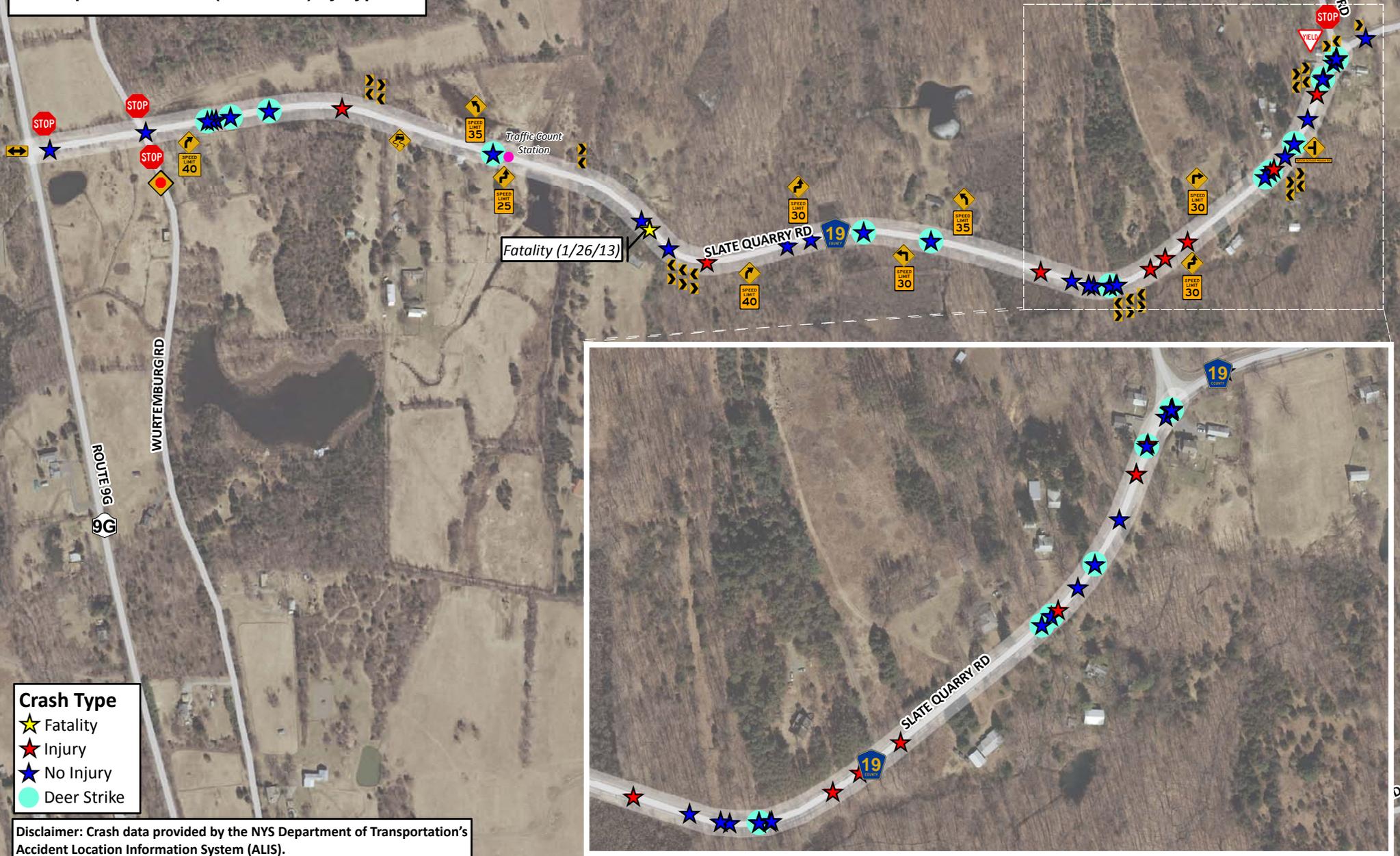
This map is intended for planning purposes only. The PDCTC shall not be held liable for any misuse or misrepresentation of this information. Map contents and data are subject to change.



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Reported Crashes (2009-2013) by Type

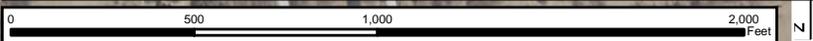
Figure 4



- Crash Type**
- ★ Fatality
 - ★ Injury
 - ★ No Injury
 - ★ Deer Strike

Disclaimer: Crash data provided by the NYS Department of Transportation's Accident Location Information System (ALIS).

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5. Findings

This assessment outlines the issues identified by the SA team as opportunities to improve overall safety along the corridor and on approaching roadways. For each safety issue, an assessment of the safety risk and suggestions for improvements are included. These suggestions should not be viewed as design-level recommendations. They are intended to be illustrative of potential solutions to identified safety issues and are presented for consideration by the facility owner. The findings are organized by first addressing safety issues for the corridor as a whole and then specific issues related to three sections of the study area (see Figures 5-10):

- Overall Safety Issues
- CR19 (Slate Quarry Rd)/White Schoolhouse Rd intersection
- CR19 (Slate Quarry Rd) from Wurtemberg Rd to White Schoolhouse Rd
- CR19 (Slate Quarry Rd)/Wurtemberg Rd intersection

Many of the suggested improvements relate to the use of warning signs; therefore, where possible, the sign number from the 2009 Manual on Uniform Traffic Control Devices (MUTCD) is included with the sign name. In making its recommendations, the SA team attempted to balance the need to inform drivers about conditions without over-saturating the corridor with signs. As per the MUTCD, regulatory and warning signs should be used conservatively because they lose their effectiveness if used to excess. Unless noted otherwise, suggested improvements would be the responsibility of the facility owner: DCDPW. See also Table 3.

Overall Safety Issues

Issue #1: New Speed Limit

Safety Concern: Motorists may not be aware of the pending speed reduction and continue to operate at speeds too high for the facility.

Observations: The regulatory speed limit was recently reduced from 55 mph to 45 mph, though as of the site visit, new signs had not yet been installed. Operating speeds may continue to be too high for the corridor, especially for the two major curves in the eastern half of the study area. Unsafe speed was cited as a contributing factor in 27 of the 59 crashes from 2009-2013. Observed speeds, even when lower than the to-be-posted 45 mph limit, may pose a safety issue for vehicles entering the curves. This is evidenced by the various advisory speeds along Slate Quarry Rd. Educating motorists about the new speed limit will help reduce speeds.

Risk Analysis: Elevated operating speeds increase the probability of severe collisions. The existing horizontal and vertical geometries at the various curves do not support safe motor vehicle operations at 45 mph. This substantially increases the risk of a collision.

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Figure 5. The intersection of Slate Quarry/White Schoolhouse Rd, looking west. The width of the intersection, coupled with the STOP and YIELD signs, creates a confusing situation for drivers.



Figure 6. The width of the White Schoolhouse Rd approach to Slate Quarry Rd necessitates the placement of sign posts in the middle of the intersection.

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Figure 7. Slate Quarry Rd, recently repaved, looking east. At the time of the Safety Assessment, lane markings had not yet been added.



Figure 8. Another view of Slate Quarry Rd, looking east towards one of two major curves along the study corridor.

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Figure 9. View of the Slate Quarry/Wurtemberg Rd intersection looking west towards NYS Route 9G.



Figure 10. A second view of the Slate Quarry Rd/Wurtemberg Rd intersection looking north. Notice the faded stop line on Wurtemberg Rd (highlighted).

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Suggestions:

1. Install 45 mph speed limit signs (R2-1) along the corridor. This is especially needed east of the NYS Route 9G intersection to inform motorists entering Slate Quarry Rd from Route 9G. These signs should be supplemented by a NEW plaque (W16-15P) to warn drivers of the new speed limit. In accordance with the MUTCD, the NEW plaque should be removed after six months.
2. Install a 45 mph REDUCED SPEED LIMIT AHEAD warning sign (W3-5) east of Centre Rd to inform drivers of the reduced speed.
3. Increase enforcement of speed limits to educate drivers, especially in conjunction with the unveiling of the new speed limit. Consider opportunities for pull-off areas, such as east of White Schoolhouse Rd (County Sheriff).
4. The County Sheriff could employ its radar speed feedback signs to alert drivers of their operating speeds (County Sheriff).
5. Contact local media outlets to raise awareness of the new speed limit (Town and DCDPW).
6. Consider narrowing travel lanes from 11 feet to 10 feet (with wider shoulders) in order to calm traffic. Since this may increase the potential for sideswipe crashes involving heavy vehicles, the SA team eliminated this suggestion from further consideration.



Priority for Consideration:

- Suggestions 1-5: High
- Suggestion 6: Dismissed

Issue #2: Lane & Shoulder Markings

Safety Concern: Due to recent repaving, travel and shoulder lane markings have not been added yet.

Observations: During the field visit, SA team members noted that the newly paved roadway did not have lane markings, nor were there any warnings to drivers that lane markings were not present. The SA Team discussed the possibility of using a 6 inch edge lines (versus the standard 4 inch edge); however, since these are can become slippery when wet, the Team determined that a 4 inch width was best. [Note: DCDPW subsequently added lane markings on Slate Quarry Rd.]

Risk Analysis: The temporary lack of lane markings may lead to driver confusion and increase the risk of crashes, especially during dark conditions.

Suggestions:

1. Install temporary NO CENTER LINE plaques (W8-12) at both ends of the newly paved section of Slate Quarry Rd, until the lane markings



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- are added.
2. Stripe edge lines with epoxy paint and high-visibility beads. Include a solid edge line along Slate Quarry Rd at the White Schoolhouse Rd intersection.
 3. Review the retro-reflectivity of centerline and shoulder striping upon installation.
 4. Develop a county-wide sign reflectivity monitoring program to enforce retro-reflectivity standards.

Priority for Consideration:

Suggestion 1: Moderate

Suggestion 2: High

Suggestions 3-4: Low

Issue #3: Shoulder (Pavement Edge) Drop-offs

Safety Concern: The newly paved road contains significant shoulder (pavement edge) drop-offs throughout the study area.

Observations: Given that travel lanes will be 11 feet wide, the resulting paved shoulders will vary from 2 to 3 feet in width, with an additional 2 to 4 feet of unpaved shoulder. In many cases, these paved shoulders drop off substantially at the edge and thus represent a hazard to all users, including those walking and biking along the road. DCDPW indicated that these shoulder drop-offs would be backfilled, and that pavement at entrances to the residential driveways would be blended with the new pavement height to remove any abrupt dips. See Figures 11-12.

Risk Analysis: Steep edge drop-offs can cause loss of control when a vehicle drifts towards the shoulder. If a driver attempts a sudden correction to regain control, the vehicle can become destabilized, resulting in a crash. The lack of adequate clear areas and relatively high operating speeds along the road increase the chances of a severe crash.

Suggestions:

1. Reduce shoulder drop-offs by installing shoulder backup material. The material should be compacted and designed to limit future erosion. Compacted sub-base material treated with *alignosulfonate* (natural wood polymer acting as a binder) is one possibility.
2. Consider adding a safety wedge, which allows drivers who drift off the road to return to the road safely. Instead of a vertical drop-off, the Safety Edge shapes the edge of the pavement to 30 degrees. FHWA-supported research has shown that this is the optimal angle to allow drivers to re-enter the roadway safely.

Priority for Consideration:

Suggestion 1: High

Suggestion 2: Low

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Figure 11. Due to the recent repaving, the shoulders along Slate Quarry Rd have steep drop-offs, which can destabilize errant vehicles.

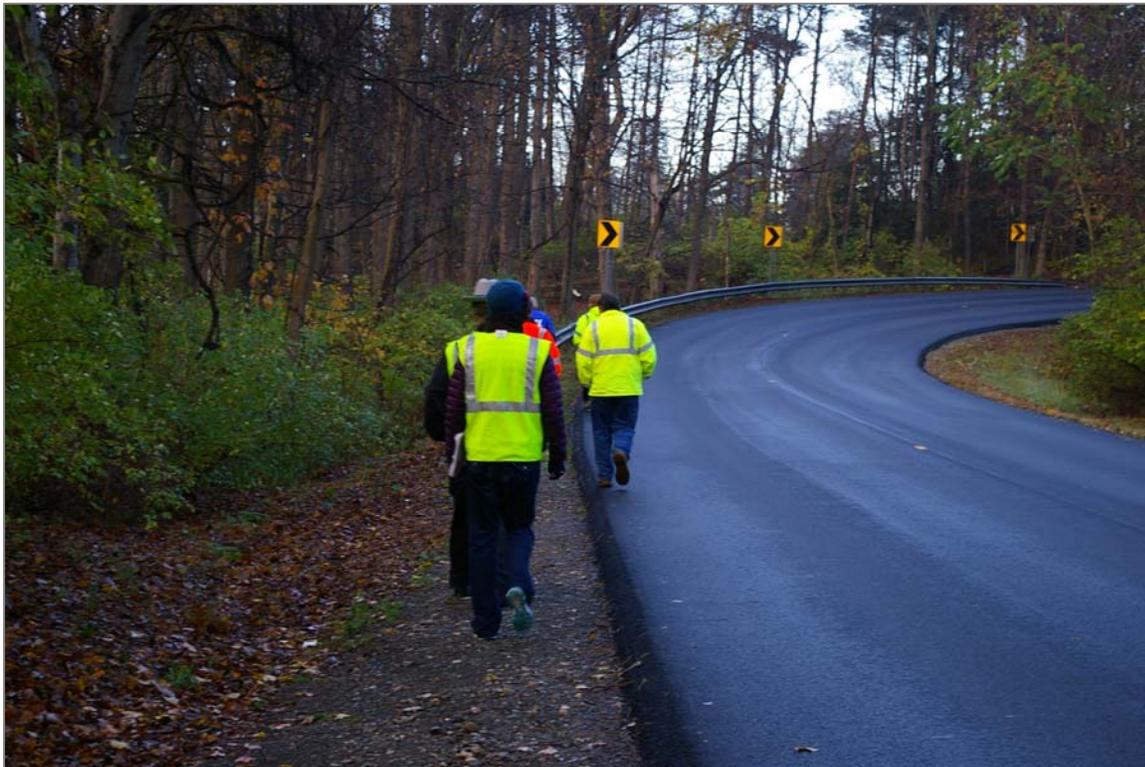


Figure 12. The steep pavement edges make it difficult to walk or bike along Slate Quarry Rd.

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Issue #4: Unfamiliar Drivers

Safety Concern: The horizontal and vertical alignments along Slate Quarry Rd may prove challenging to motorists who are unfamiliar with the area.

Observation: The area around Slate Quarry Rd attracts visitors who may not be familiar with local road conditions. Even with the existing warning signs and advisory speeds, motorists may not fully understand the driving demands of the road until it's too late. This risk may be amplified for eastbound motorists who previously travelled on NYS Route 9G – a much straighter and faster road than Slate Quarry.

Risk Analysis: Drivers may not fully comprehend the nature of Slate Quarry Rd and may not be prepared to negotiate approaching curves or respond to vehicles entering from intersecting driveways and roads.

Suggestion: Install one or more flashing beacons to supplement warning signs along the corridor. One possible location could be on the curve warning sign located on the south side of Slate Quarry Rd, just east of the Wurtemberg Rd intersection. Flashing beacons would alert drivers coming from NYS Route 9G of upcoming conditions on the road. Beacons could also be placed on signs on the north side of Slate Quarry Rd at the east end of the study area to highlight the curve sections.

Priority for Consideration: Low

Issue #5: Deer Strikes

Safety Concern: Of the 59 total crashes reported within the study from 2009-2013, 13 involved deer strikes.

Observation: Given the rural nature of the study area, deer may be a common sight along Slate Quarry Rd. The crash data showed a small cluster of deer strikes east of Wurtemberg Rd. The SA Team discovered the remains of one deer along Slate Quarry Rd, apparently hit earlier by a vehicle. However, DCDPW staff noted that they do not see a lot of deer along the road.

Risk Analysis: Deer strikes can cause serious property damage and injury. The presence of deer in the study area adds another level of risk on a road that already demands full driver attention.

Suggestion: Determine if the number of deer strikes warrants the need for one or more DEER warning signs (W11-3) along Slate Quarry Rd.

Priority for Consideration: Low



W11-3 (Deer)

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Issue #6: Street Name Signs

Safety Concern: Street name signs may be difficult for older drivers to read.

Observations: The street name signs for Wurtemberg Rd and White Schoolhouse Rd use an older style with all capital lettering, which has been superseded by a preferred style with upper and lower case letters. The FHWA has determined that the new style is better suited for older drivers. Although there is no deadline for adherence, the new standard should be used when replacing street signs in the future.

Risk Analysis: Lack of clear navigational information increases the risk of last minute decision making and maneuvers, which may in turn increase the risk of a collision. This condition would affect unfamiliar motorists to a greater extent than locals.

Suggestion: Upgrade street name signs to meet the larger, mixed-case sign standard as per the 2009 MUTCD.

Priority for Consideration: Moderate



Figure 13. The street name signs in the study area (left) use the old lettering style that has now been superseded by a mixed-case style (above). Source: 2009 MUTCD.

Issue #7: Heavy Duty Vehicles & School Buses

Safety Concern: Heavy-duty vehicles and school buses use Slate Quarry Rd as an important east-west connection through Rhinebeck and Clinton.

Observations: Based on field observations, numerous large, multi-axle trucks and buses travel through the corridor. School bus activity is especially high in the morning, while a variety of semi-trailers and dump trucks were observed in the morning and afternoon.

Risk Analysis: Heavy vehicles may cross over the centerline of Slate Quarry Rd in order to negotiate the curves, which could pose a safety hazard, especially under wet road conditions.

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Suggestion: Ensure that road shoulders are maintained so that they can effectively accommodate large vehicles, especially if the quarry on White Schoolhouse Rd becomes fully operational or is expanded.

Priority for Consideration: Low



Figure 14. Heavy-duty vehicles use Slate Quarry Rd as an east-west connector through Rhinebeck to NYS Route 9G.

CR19 (Slate Quarry Rd)/White Schoolhouse Rd Intersection

The intersection of Slate Quarry Rd and White Schoolhouse Rd has the largest cluster of crashes within the study area. The challenges of wet weather driving, magnified by the road's geometry, have resulted in numerous road departure crashes. Beyond short term improvements such as improved signage and pavement markings, DCDPW should consider realigning the intersection to improve safety.

Issue #1: Contradictory Regulatory Signs

Safety Concern: The White Schoolhouse Rd approach to Slate Quarry Rd has two conflicting regulatory signs: a STOP sign in the middle of the intersection and a YIELD sign located on the right-hand side. In theory, the STOP sign is directed towards drivers turning left onto Slate Quarry Rd, while the YIELD sign is directed towards drivers turning right. Though this may be locally understood, the two signs are confusing and not intuitive to drivers unfamiliar with the area.

Observations: During the site visit, almost all southbound vehicles on White Schoolhouse Rd stopped at the intersection prior to entering Slate Quarry Rd. Since drivers are already stopping at this location, removing the YIELD sign will not significantly impact operations. Stop control for both left and right turns would also increase safety. See Figure 15.

Risk Analysis: Competing regulatory signs lead to driver confusion and may entice some to follow the less restrictive movement, increasing the possibility of a collision.

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Figure 15. The Slate Quarry/White Schoolhouse Rd intersection looking west. Note the width of the intersection and contradictory STOP and YIELD signs.



Figure 16. The Slate Quarry Rd/White Schoolhouse Rd intersection looking east, up the hill.

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Suggestions:

1. Remove the YIELD sign located on the northwest corner of the intersection and replace it with a STOP sign (R1-1).
2. Install a STOP sign (R1-1) sign on the northeast corner of the intersection.
3. Increase the size of both STOP signs from 30x30 inches to 36x36 inches.
4. Consider installing a STOP AHEAD warning sign (W3-1) on White Schoolhouse Rd for the southbound approach to Slate Quarry Rd.
5. Consider adding a stop line on White Schoolhouse Rd to position drivers at the optimal position to observe approaching vehicles on Slate Quarry Rd. This should be done in conjunction with the suggested intersection narrowing and added lane markings.



Priority for Consideration:

Suggestions 1-3: High

Suggestions 4-5: Moderate

Issue #2: Intersection Configuration

Safety Concern: The White Schoolhouse Rd approach to Slate Quarry Rd appears excessively wide, measuring approximately 100 feet from edge to edge. In addition, there is a de facto triangular island in the middle of the approach, with a STOP sign and chevrons in the middle. This configuration creates a confusing situation for drivers on White Schoolhouse Rd, who may not know on which side of the island to position their vehicle when turning. It may also confuse drivers turning from Slate Quarry Rd who may not know where to turn into White Schoolhouse Rd. The intersection's width practically necessitates placing the STOP sign in the middle of White Schoolhouse Rd. In addition, the three sign posts (fixed objects) represent a safety hazard for drivers travelling on both roads. A 'T' configuration would provide better visibility and safety than the existing 'Y' configuration.

Observations: The wide approach on White Schoolhouse Rd allows left and right turning vehicles to pull up side by side at the STOP/YIELD sign. This can result in poor sight lines for one of the turning vehicles, especially when one is a large SUV or heavy duty vehicle and the other is a passenger car. The SA Team recognized that the intersection should accommodate heavy duty vehicles, though this may not warrant the existing intersection width. The Team also observed some confusion among drivers on Slate Quarry Rd as where to enter White Schoolhouse Rd (i.e. to the left or right of the sign posts), though this may have been due to the number of SA Team vehicles in the area.

Risk Analysis: The configuration of the intersection, coupled with the three sign posts in the middle of the intersection and the lack of lane markings, creates a confusing environment for drivers, increasing the possibility of a crash. This risk is compounded by

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the routine presence of heavy-duty vehicles using the intersection.

Suggestions:

1. Narrow the White Schoolhouse approach with pavement markings. Narrowing the pavement width would discourage side by side stops and direct drivers to a safe stopping position. This could be implemented by visually narrowing the travel lanes on the east and west sides with hatching, and adjusting the configuration to be more of a 'T'. This would offer an opportunity to review a possible new stop line location, balancing truck turning needs and sight distance considerations for vehicles turning onto Slate Quarry Rd. The SA Team recognized that painted features require additional maintenance and there would be no physical feature to prevent incursions into the intersection shoulder areas and side-by-side vehicle queuing.
2. Physically narrow the existing pavement. This would involve removing excess pavement and narrowing the White Schoolhouse Rd approach (SA Team members pointed to Mulberry St in the Village of Rhinebeck as a useful model). The west leg of the Y could be eliminated, so that all drivers would use what is currently the east leg, making the intersection more of a 'T'. Design vehicle turning templates would need to be reviewed prior to making any physical changes. Narrowing the pavement could also offer an opportunity to address the regulatory sign issues identified above.

Priority for Consideration:

Suggestion 1: High

Suggestion 2: Moderate

Issue #3: Sight Distance

Safety Concern: Sight distance on Slate Quarry Rd is limited both eastbound and westbound near White Schoolhouse Rd. In particular, there is limited sight distance for eastbound traffic on Slate Quarry Rd turning left onto White Schoolhouse Rd, and limited stop line sight distance for traffic on White Schoolhouse Rd turning left onto Slate Quarry Rd.

Observations: Drivers on Slate Quarry Rd have difficulty seeing vehicles approaching from the opposite direction as they reach White Schoolhouse Rd. Though the intersection itself is visible from Slate Quarry Rd, approaching vehicles in the opposite lane are masked by an outcrop of trees and bushes on the south side of Slate Quarry Rd, directly opposite White Schoolhouse Rd. These trees may prevent drivers from recognizing vehicles that intend to turn onto White Schoolhouse Rd, and in turn, make them lose valuable reaction time. In particular, the SA Team noted that the sight line for Slate Quarry Rd could be improved by removing the large tree located on the inside of the curve. DCDPW previously discussed removal of this tree with the landowner (220 Slate Quarry Rd), but no changes have been made. The SA Team reported that residents at 209 Slate Quarry Rd had also complained of poor visibility from their driveway, particularly looking east. Sight lines from White

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Schoolhouse Rd looking east up the hill are also restricted by the general horizontal and vertical geometry of Slate Quarry Rd. See Figures 16-18.

Risk Analysis: The lack of adequate sight distance decreases driver reaction time, increasing the risk of a collision. Operating speeds on Slate Quarry Rd increase the probability of a severe collision, especially as westbound vehicles descend the hill on Slate Quarry Rd towards White Schoolhouse Rd.

Suggestions:

1. Trim and/or Remove Existing Vegetation. Pursue trimming or removal of the bushes and trees on the south side of Slate Quarry Rd across from and east of White Schoolhouse Rd.
2. Lower Vertical and Straighten Horizontal Curves on Slate Quarry Rd. This would improve sight distance for both eastbound Slate Quarry Rd drivers and those stopped at the intersection. The SA Team realized that this would require significant funding, so identified this as a low priority.
3. Trim the trees at the northeast corner of the Slate Quarry Rd/White Schoolhouse Rd intersection (on the north side of Slate Quarry Rd).
4. Remove rock and brush on both sides of the driveway to 209 Slate Quarry Rd, and consider installing a DRIVEWAY warning sign.

Priority for Consideration:

- Suggestion 1: Moderate
- Suggestions 3-4: Low
- Suggestion 4: Moderate

Issue #4: SCHOOL BUS STOP AHEAD Sign

Safety Concern: Warning signs that rely on text rather than images require more driver attention and may become a distraction.

Observations: The SCHOOL BUS STOP AHEAD warning sign on the north side of Slate Quarry Rd, east of the White Schoolhouse Rd intersection uses the older, text-based style.



S3-1

Risk Analysis: Approaching drivers might become distracted by the text-based warning sign and lose reaction time as they approach the White Schoolhouse Rd intersection.

Suggestion: Install the current graphic-based SCHOOL BUS STOP AHEAD SIGN (S3-1) in advance of White Schoolhouse Rd.

Priority for Consideration: Low

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Figure 17. Looking towards White Schoolhouse Rd from eastbound Slate Quarry Rd. Note the change in horizontal geometry towards the curve.



Figure 18. Looking towards White Schoolhouse Rd from westbound Slate Quarry Rd. The trees located to the left, inside the curve, obscure approaching vehicles.

CR19 (Slate Quarry Rd) from White Schoolhouse Rd to Wurtemberg Rd

Issue #1: Sight Distances

Safety Concern: Limited visibility at two major curves on Slate Quarry Rd and from approaching driveways may lead to crashes. The horizontal and vertical changes on Slate Quarry Rd restrict sight distances from driveways, the White Schoolhouse Rd intersection, and on Slate Quarry Rd itself.

Observations: The horizontal and vertical geometry of Slate Quarry Rd changes throughout the eastern half of the study area. This challenging geometry is complicated by the presence of earthen embankments and vegetation that restrict visibility and reduce driver reaction time. This is especially noticeable at the curve on Slate Quarry Rd in the middle of the study area (91 Slate Quarry Rd), where the inside curve is framed by a rock embankment that includes trees and bushes. These obstructions prevent drivers from seeing down the road and recognizing potential hazards. The crash data does not indicate a safety issue related to poor visibility from driveways, but the road's geometry creates limited sight distances of east and westbound vehicles from driveways. See Figures 19-20.

Risk Analysis: Inadequate sight distance increases the risk of a crash by reducing the driver's ability to accurately judge upcoming roadway features and approaching vehicles. For vehicles turning from driveways, a lack of adequate sight distance increases the risk of a collision by affecting the driver's ability to accurately judge and accept gaps in approaching traffic. Operating speeds on Slate Quarry Rd increase the probability of a severe collision.

Suggestions:

1. As part of normal tree maintenance, DCDPW should ensure that the County right-of-way is free and clear of obstructions and that the clear zone is sufficient for this type of facility. If vegetation is located on private property and is determined to compromise safety, DCDPW should notify the applicable property owner of the situation and suggest that they remove the obstruction(s).
2. Remove the rock embankment and trees located on the inside of the major curve located near 91 Slate Quarry Rd. DCDPW should investigate the ownership of this particular feature, since Dutchess County Parcel Access indicates that the rock embankment sits within the County's right-of-way and may not require taking property from local owners. It should be noted that the embankment is also bordered by a parcel that belongs to the mining operation at 410 White Schoolhouse Rd.
3. Reduce the horizontal and vertical curves at the two major curve sections on Slate Quarry Rd. This would improve sight distance for drivers exiting driveways along the road, while allowing drivers on Slate Quarry Rd to recognize oncoming vehicles earlier, increasing reaction times. Due to the cost and time needed for such improvements, the SA team identified this as a long-range suggestion.

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Figure 19. Looking west on Slate Quarry Rd, towards one of two major curves. The outcrop of trees and rocks to the right obscures oncoming vehicles.



Figure 20. Looking east on Slate Quarry Rd towards the rock embankment located on the inside of the curve shown above.

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Priority for Consideration:

Suggestion 1: Moderate

Suggestion 2: Low

Suggestion 3: Low

Issue #2: Advisory Speeds

Safety Concern: The range of posted advisory speeds along Slate Quarry Rd may lead to driver confusion and non-compliance.

Observation: The SA Team noted that there are four different advisory speeds along Slate Quarry Rd, ranging from a high of 40 mph at gradual curves, 35 mph at moderate curves, and 30 and 25 mph at sharper curves. In light of the speed limit reduction to 45 mph, the 40 mph advisory speed seems possibly too high; the same holds true for the 30 mph advisory speed when compared to subsequent 25 mph advisory speeds along the road.

Risk Analysis: Drivers may become confused by the inconsistent advisory speeds and ignore them, increasing the likelihood of a collision or road departure.

Suggestion: Re-evaluate the posted advisory speeds and consider using only two advisory speeds (e.g. 25 and 35 mph) on Slate Quarry Rd.

Priority for Consideration: High



Figure 21. A variety of advisory speeds are used along Slate Quarry Rd.

Issue #3: Guiderails (Existing & New)

Safety Concern: Portions of existing guiderails are in poor condition and use the older “W-beam” style of rail, while some roadside areas with steep drop-offs and water features may warrant the installation of additional guiderails.

Observations: Recurring vehicle impacts and general wear and tear have damaged sections of guiderail, some of which are missing structural members and many of which are missing delineators. The guiderails use the older “W-beam” design that includes gradually tapered end features. These guiderail ends can sometimes act as a ramp for vehicles that depart the roadway, vaulting them over the guiderail if hit at high speeds. Instead, it is recommended that the box-beam design be used for existing and new guiderails. The SA

team also noted that new guiderails might be needed on both sides of Slate Quarry Rd between the major curves on the eastern half of the study area: several locations have steep drop-offs and/or standing water, which could magnify the impact of road departures. However, some SA Team members noted that additional guiderails could potentially redirect errant vehicles back into the roadway and the path of oncoming vehicles. See Figures 22-27.

Risk Analysis: Lack of adequate guiderails can result in an errant vehicle traversing down a steep, non-recoverable slope. This is of special concern if the area at the toe of the slope contains fixed objects or other hazards such as deep water. Askew guiderail systems and turned down end sections can also increase the risk of vehicle launching.

Suggestions:

1. Repair exiting guiderails.
2. Install metal reflectors and/or add a reflective strip along the side of the guiderails to increase visibility at night.
3. Replace existing guiderails with a box-beam design. The SA Team noted that the County standard for new installations is box beam guiderail and that DCDPW has a program to identify and replace deficient systems.
4. Evaluate the need for installation of one more new guiderails along Slate Quarry Rd, especially in the section between the two major curves in the eastern half of the study area. DCDPW should weigh the benefit of a new guiderail with the potential of increasing possible head-on crashes if errant vehicles bounce back into traffic. As an alternative and where appropriate, DCDPW could consider raising shoulder and clear zone elevations to reduce drop-off distances.
5. As an interim measure, consider object markers at significant drop-off areas until guiderail can be installed.

Priority for Consideration:

Suggestions 1-2: High

Suggestions 3-5: Moderate

Issue #4: Passing Zones

Safety Concern: The horizontal and vertical geometry of Slate Quarry Rd, along with the reduced speed limit, do not support the need for passing zones.

Observations: Prior to its repaving, Slate Quarry Rd contained a short westbound passing zone near Wurtemberg Rd. However, its location near the stop-controlled Route 9G intersection makes the passing zone unnecessary.

Risk Analysis: A passing zone may encourage aggressive driving on Slate Quarry Rd and increase the risk of a collision.

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Figure 22. Some of the guidrails along Slate Quarry Rd are in need of repair (left), while delineators should be checked for retro-reflectivity (right).



Figure 23. The guidrails along Slate Quarry Rd use the older “W-beam” design, which should be replaced with a “box-beam” design (as shown above on CR16). A significant issue with the “W-beam” design involves the end treatment, which can act as a ramp for vehicles that depart the road.

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Figure 24. Sections of Slate Quarry Rd may warrant guiderails to prevent vehicles from travelling down steep embankments such as the one shown above.



Figure 25. Some of the major culverts on Slate Quarry Rd remain unprotected by barriers, which could prevent vehicles from entering areas of standing water.

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Figure 26. This area of Slate Quarry Rd may warrant guiderails to prevent vehicles from travelling into the adjacent swamp/marsh, as evidenced by the tire tracks in the shoulder.



Figure 27. A close-up of the above photo, showing the tire tracks entering the swamp/marsh.

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Suggestion: Install a double-yellow centerline (no passing zone) for the length of Slate Quarry Rd within the study area. [Note: DCDPW subsequently removed the passing zone when it added new lane markings to Slate Quarry Rd].

Priority for Consideration: High

Issue #5: Clear Zones

Safety Concern: Slate Quarry Rd does not contain a consistent clear zone – defined as an unobstructed, relatively flat area beyond the edge of the travel lane that allows a driver to stop safely or regain control of a vehicle that departs the road.

Observations: Insufficient clear zones are present along Slate Quarry Rd.

Risk Analysis: The lack of a clear zone may increase the severity of a crash by limiting the ability of a driver to recover from a road departure.

Suggestion: Ensure that road shoulders and adjacent areas are maintained so that they can effectively accommodate potential road departures or breakdowns.

Priority for Consideration: Moderate

Issue #6: Culverts

Safety Concern: Some culverts on Slate Quarry Rd do not have protective barriers, which prevent errant vehicles from entering water features.

Observations: A number of culverts along Slate Quarry Rd do not have barriers to prevent vehicles from entering nearby water and possibly becoming submerged. See Figure 25.

Risk Analysis: A vehicle that departs the road at or near a culvert could become submerged in standing water, thus increasing the risk of injury or death.

Suggestion: Conduct an engineering evaluation of existing culverts to determine if they warrant barriers.

Priority for Consideration: Moderate

Issue #7: Superelevation

Safety Concern: Given the recently approved change in speed limit, the superelevation along Slate Quarry Road may need to be re-evaluated.

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Observations: The SA Team noted that the road's current superelevations may not be consistent with the design standards associated with a 45 mph facility.

Risk Analysis: Improper superelevations may reduce driver safety, since they may not be appropriate for posted speed limits.

Suggestion: Evaluate the superelevation along Slate Quarry Rd to determine if it needs to be changed.

Priority for Consideration: Moderate

CR19 (Slate Quarry Rd)/Wurtemberg Rd intersection

Issue #1: Visibility of Wurtemberg Rd STOP Sign

Safety Concern: The STOP sign on northbound Wurtemberg Rd is partially obstructed by a large tree.

Observations: A large tree partially obscures the STOP sign on northbound Wurtemberg Rd as it approaches Slate Quarry Rd. The SA Team also noted that the stop lines on both approaches to Slate Quarry Rd were faded. Stop lines help motorists recognize the need to stop and designate proper positioning for optimal sight distance prior to entering the intersection. See Figure 28.

Risk Analysis: Inadequate STOP sign visibility can result in a high-speed, severe right-angle crash.

Suggestions:

1. Move the STOP (R1-1) sign post away from the large tree at the southeast corner of the intersection.
2. Consider the use of a vertical retro-reflective strip on the STOP (R1-1) sign support to enhance visibility.
3. Install a new pictorial STOP AHEAD warning sign (W3-1) on Wurtemberg Rd to warn drivers of the upcoming STOP sign. [Note: this was subsequently installed].
4. Consider restriping the stop lines on both Wurtemberg Rd approaches to Slate Quarry Rd, using the NYSDOT recommended standard width of 18 inches or the wider 24 inches, which would provide an additional cue to drivers.



Priority for Consideration:

Suggestions 1-2: High

Suggestions 3-4: Moderate



Figure 28. A large tree obscures the STOP sign on the southern approach of Wurtemberg Rd, as it intersects Slate Quarry Rd.

6. Next Steps

The PDCTC, through the work of the SA Team, has prepared this report to assist DCDPW and the Town of Rhinebeck with prioritizing opportunities to improve safety within the study area. A draft was circulated to the SA Team for review in November, and comments were incorporated into the final draft. The suggestions are for consideration only and are in no way intended to serve as design or operational recommendations. DPW documented its responses to the issues and suggestions in a formal response, which is attached to the final report. The SA Team believes it has been thorough and diligent in its work, given the information available and its field reviews. This report does not preclude the identification of additional issues pertaining to safety by the owners or the emergence of new issues over time. It is recommended that DCDPW track progress towards the implementation of safety improvements prompted by this assessment.

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Table 3. Suggested Actions and Priority by Location

Issue	Suggested Action	Priority
Overall Safety		
1-1	Install new 45 mph (R2-1) signs with NEW (W16-10P) placards.	High
1-2	Install 45 mph REDUCED SPEED LIMIT AHEAD sign (W3-5).	High
1-3	Increase speed enforcement/employ DC Sheriff's VMS trailer.	High
1-4	Employ VMS/radar feedback trailer to alert drivers of their speed.	High
1-5	Contact local media to publicize new speed limit.	High
1-6	Consider narrowing travel lanes from 11 to 10 feet.	Dismissed
2-1	Install temporary NO CENTER LINE (W8-12) plaques.	Moderate
2-2	Stripe edge lines with epoxy paint and high-visibility beads.	High
2-3	Review retro-reflectivity of new pavement markings.	Low
2-4	Develop a County-wide sign reflectivity monitoring program.	Low
3-1	Reduce shoulder drop-offs by installing back-up material.	High
3-2	Consider adding safety wedges as per FHWA best practice.	Low
4-1	Install one or more flashing beacons on Slate Quarry Rd.	Low
5-1	Determine if number of deer strikes warrant DEER signs (W11-3).	Low
6-1	Upgrade street name signs to meet 2009 MUTCD standards.	Moderate
7-1	Ensure road shoulders can accommodate heavy duty vehicles.	Low
CR19 (Slate Quarry Rd)/White Schoolhouse Rd Intersection		
1-1	Remove YIELD sign on northwest corner.	High
1-2	Install STOP (R1-1) sign on northwest corner of White Schoolhouse Rd.	High
1-3	Increase size of STOP signs to 36x36 inches.	High
1-4	Consider a STOP AHEAD (W3-1) sign on White Schoolhouse Rd.	Moderate
1-5	Consider a stop line for southbound White Schoolhouse Rd.	Moderate
2-1	Narrow the White Schoolhouse Rd approach with pavement markings.	High
2-2	Physically narrow the White Schoolhouse Rd intersection.	Moderate
3-1	Trim or remove trees across from intersection.	Moderate
3-2	Lower vertical/straighten horizontal curves on Slate Quarry Rd.	Low
3-3	Trim trees at the northwest corner of intersection.	Low
3-4	Remove rock and brush near driveway at 209 Slate Quarry Rd.	Moderate
4-1	Install recommended SCHOOL BUS STOP AHEAD (S3-1) sign.	Low

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1-1	Remove vegetation/obstructions within right of way.	Moderate
1-2	Remove rock embankment near 91 Slate Quarry Rd.	Low
1-3	Reduce variation in horizontal and vertical geometry at major curves.	Low
2-1	Re-evaluate advisory speeds on Slate Quarry Rd.	High
3-1	Repair existing guiderails.	High
3-2	Consider upgrading reflective delineators on existing guiderails.	High
3-3	Replace "W-beam" guiderails with box-beam design.	Moderate
3-4	Consider installation of one or more new guiderails.	Moderate
3-5	Consider object markers for steep drop-off areas.	Moderate
4-1	Install double-yellow centerline (no passing zone) on Slate Quarry Rd.	High
5-1	Maintain road shoulders to accommodate vehicle road departures.	Moderate
6-1	Evaluate barrier warrants for culverts on Slate Quarry Rd.	Moderate
7-1	Evaluate the superelevation of Slate Quarry Rd.	Moderate

CR19 (Slate Quarry Rd/Wurtemberg Rd intersection)

1-1	Move STOP (R1-1) sign away from large tree on southeast corner.	High
1-2	Restripe worn stop lines on both approaches of Wurtemberg Rd.	High
1-3	Install new pictorial STOP AHEAD (W3-1) sign on Wurtemberg Rd.	Moderate
1-4	Consider the use of a vertical reflective strip on the STOP sign post.	Moderate