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To: Jamie Oliver, Isle of Wight County Transportation Manager

From: Kevin Siegel, PE

Date: August 5, 2022

Re: Turner Drive Safety Review

The purpose of this memorandum is to summarize the outcome of a traffic safety review of Turner Drive (Route 644) between Smithfield Middle School and Scotts Factory Road (Route 620) and determine high-level alternative measures to improve safety.

EXISTING CONDITIONS SUMMARY

Turner Drive between Scotts Factory Road and the Smithfield Middle School/High School property is classified as a Rural Major Collector roadway and currently carries 2,800 vehicles per day with less than 1% trucks according to 2020 VDOT traffic count data. The segment being studied is approximately 1.4 miles in length and starts at the intersection of Scotts Factory Road (milepost 14.26) and ends at the Smithfield Middle School property (milepost 15.66). The speed limit through the section being evaluated is not posted, so a statutory speed limit of 55 miles per hour applies. The current roadway cross-section varies slightly throughout the length of the project, but generally consists of 10-foot lanes with a zero to one-foot gravel shoulder, and little to no recovery area.

Publicly available information was sourced for the existing condition analysis including GIS data (parcels, utilities, buildings, etc) from the County website, aerial and LIDAR data available from the VDOT VGIN website, previous studies, and field photos from the ATCS site visit. Existing right of way is noted to be approximately 40 feet wide with roadway centered for a significant portion of the project limits. Based on the field visit, several utilities (Figure 1) including fiber optic cables, underground telecommunication copper cables, overhead electric lines and poles, and a petroleum gas pipe crossing were observed.



Figure 1 – Utilities present in corridor

Existing geometric condition analysis reveals that two of the curves near Hollydale Lane are sub-standard and currently only meet 45 mph horizontally (Figure 2). As noted later in this memorandum, this is also the segment of the corridor where a majority of the crashes have occurred. It is unclear whether these curves provide adequate superelevation for the vehicles traveling at 55 mph which could also be a potential indicator for off-road departures. In addition, sub-

standard Stopping Sight Distance (SSD) is also noted to be an issue with the curve at Hollydale Lane that cannot meet 55 mph design speed due to heavy vegetation and side slopes. It is worth noting that VDOT recently conducted a Speed Study (dated February 2022) on this corridor within the project limits to determine if an adjustment to the current statutory 55 mph speed limit is warranted. The VDOT Speed Study did not recommend a reduction in the statutory 55 mph speed limit based on the 85th percentile speed of 54.80 mph.

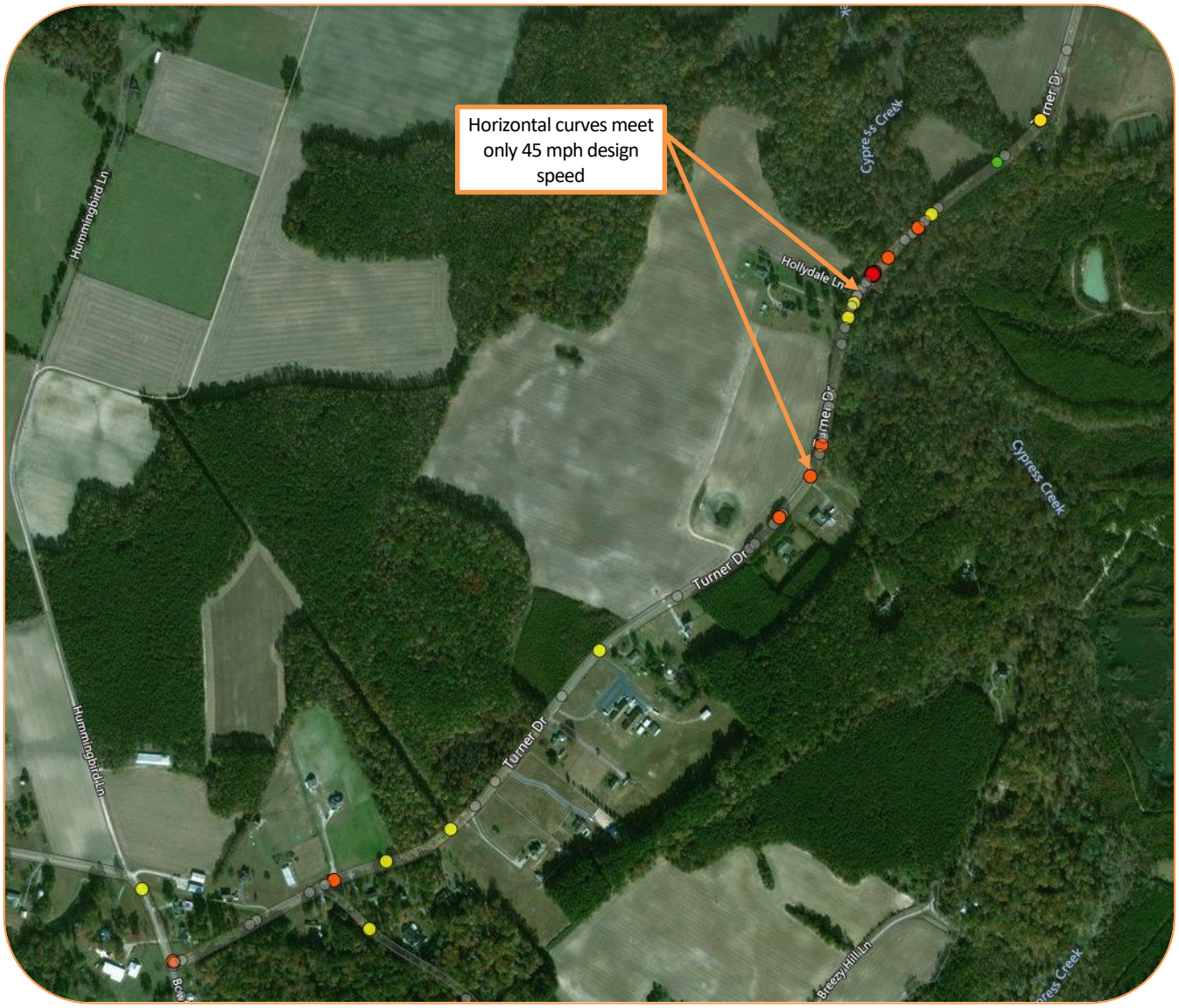


Figure 2 – Sub-standard Curve Locations

SAFETY EVALUATION

The most recent crash data between 2015 and 2021 was pulled from VDOT's PowerBI online tool and assessed to determine if there are strategies to address the specific safety concerns on this section of roadway in a cost-efficient manner. It was identified that 56 crashes occurred over a 7-year period from 2015 through 2021. A table of the crashes by type, condition, and severity is presented in Table 1, and a map of the crashes along the roadway segment are presented in Figure 3.

Year	Crash Type							Light Condition					Weather					Severity					
	Rear End	Angle	Other	Animal	Side swipe	Non-Collision	Fixed Object	Dawn	Daylight	Dusk	Dark - Lit	Dark - Not Lit	Dry	Rain	Mist	Fog	Snow	K. Fatal	Severe Injury	Visible Injury	Non visible Iniurv	PDO	Total
2015	0	0	1	0	0	0	3	0	1	0	0	3	3	0	0	0	1	0	2	0	0	2	4
2016	0	0	1	0	0	1	10	0	10	0	1	1	10	2	0	0	0	0	4	0	1	7	12
2017	0	0	0	2	0	0	6	1	4	0	1	2	6	1	0	1	0	1	1	3	0	3	8
2018	1	0	1	1	1	3	2	0	5	1	0	3	8	1	0	0	0	0	0	1	0	8	9
2019	0	2	0	2	0	0	4	0	5	0	1	2	8	0	0	0	0	0	0	1	0	7	8
2020	0	0	0	0	0	0	6	0	4	0	1	1	3	3	0	0	0	0	1	0	0	5	6
2021	0	1	1	1	0	2	4	1	5	0	1	2	7	1	1	0	0	0	0	2	0	7	9
Total	1	3	4	6	1	6	35	2	34	1	5	14	45	8	1	1	1	1	8	7	1	39	56

Table 1 – Crash Types, Condition, and Severity

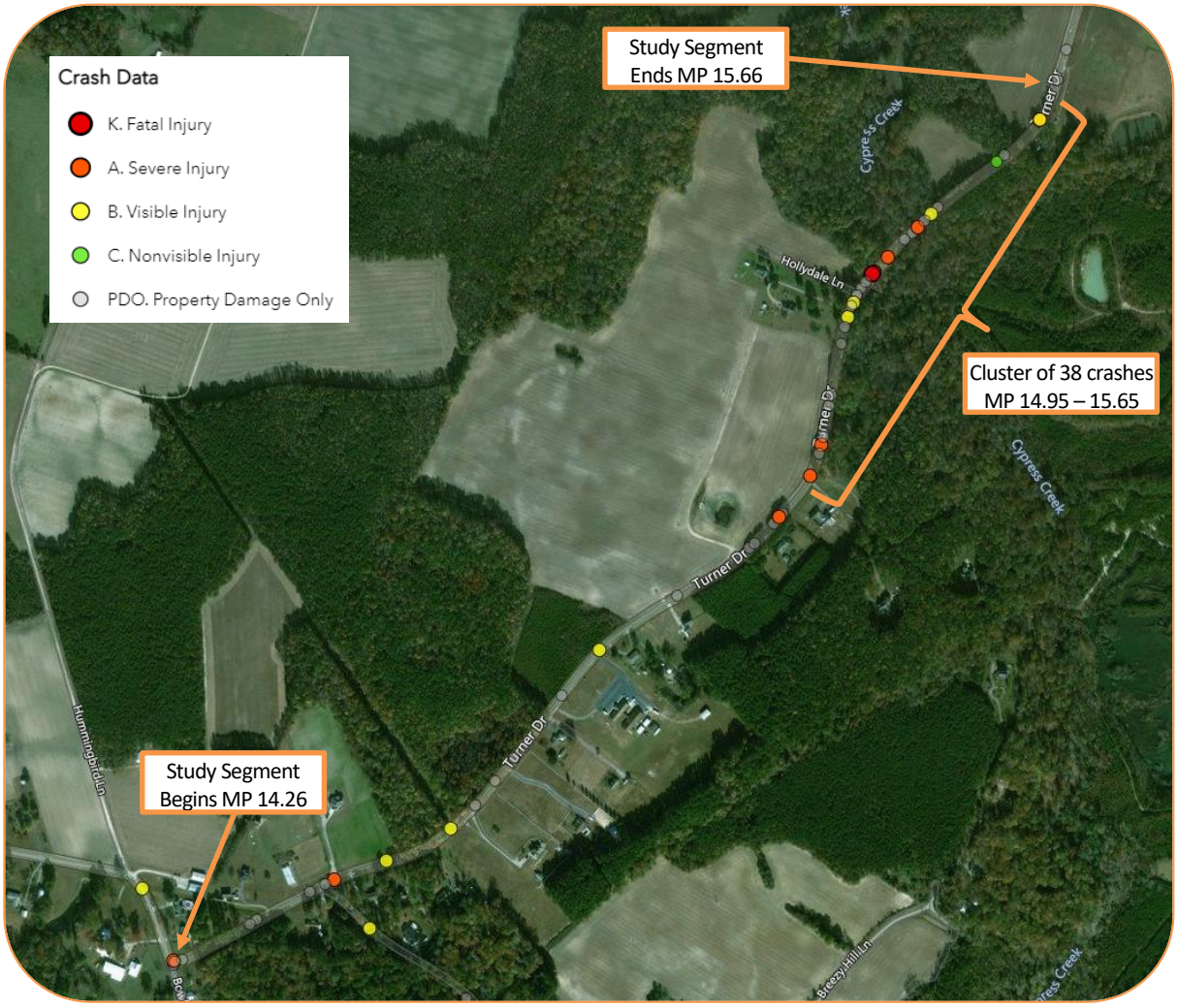


Figure 3 Turner Drive Crash Map

It should be noted that there was a fatality in 2017, due to an alcohol related crash. The fatal crash occurred on Saturday, November 18, 2017 at 11:15pm just north of Hollydale Lane in a horizontal curve on dry pavement. The passenger car was traveling westbound on Turner Drive when it ran off the road to the right, struck a ditch, then struck a tree. The crash occurred at night and there is no roadway lighting. The speed before the crash was estimated at 55 MPH. The driver of the vehicle was drinking alcohol and was wearing their seat belt and suffered serious injuries. There was one passenger in the vehicle who was not using a seat belt and was partially ejected during the crash. The passenger died approximately 2 weeks after the crash succumbing to injuries related to the crash.

With an AADT of 2,800, a study segment length of 1.4 miles, 7 years of crash data, and 56 total crashes (17 with injuries), the calculation of the crash rate based on the following equation yields the following conclusions for this segment of Turner Drive:

Equation 1- Crash Rate

$$R = \frac{100{,}000{,}000 \times C}{365 \times N \times V \times L}$$

Where:

R = Crash rate for the road segment expressed as crashes per 100 million vehicle-miles of travel (VMT).
C = Total number of crashes in the study period.
N = Number of years of data.
V = Number of vehicles per day (both directions).[9]
L = Length of the roadway segment in miles.

- Turner Drive has a **total crash rate of 559.1 per 100 million** vehicle-miles of traveled and an **injury crash rate of 169.7**
- **The statewide average crash rate for Rural Major Collectors** as determined from the VDOT Tableau Crash Summary Tool from 2020 **is 222.04, with an injury crash rate of 73.60**
- The **Hampton Roads District average for secondary roadways** such as Turner Drive **is 203.35**, **with injury crash rate of 68.31**

Thus, this segment of Turner Drive is experiencing crash rates 2-3 times higher than average crash rates, and therefore should be strongly considered for improvements targeted to correct for roadway departure-type crashes.

A detailed review of the overall crash data revealed that a significant portion of the crash types that occurred on this segment were found to be roadway-departure related crashes. A detailed review of the of the four "Other" and six "Non-Collision" crash types were crashes that could also be classified as roadway departure crashes. Therefore, the crash data reveals that **82% of all crashes on the roadway segment studied were roadway departure crashes**, which can be mitigated through the provision of wider lanes, wider shoulders, and the provision of clear zones.

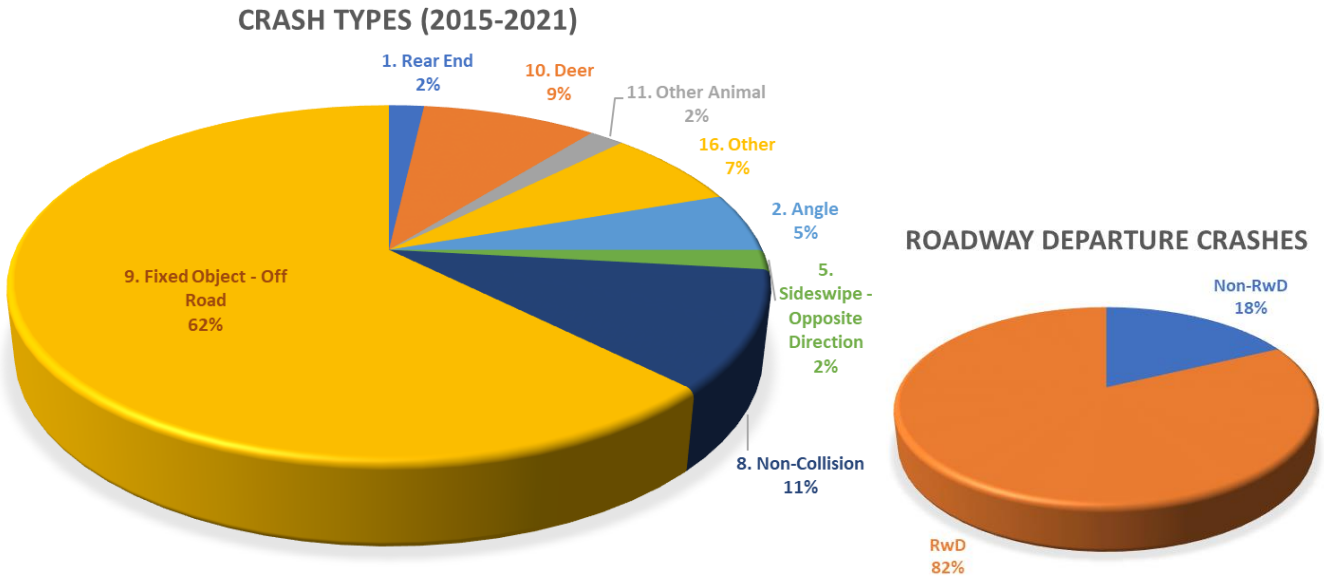


Figure 4 – Crash data by type

As illustrated earlier in Figure 3, there has been a significant cluster of crashes (38 of the 56 total crashes = 68%) in the study area that all occurred in the four curves between mileposts 14.95 and 15.65 which are within 0.35 miles north and south of Hollydale Lane where the existing roadway alignment travels through wooded area with multiple horizontal and vertical curves. The cluster of crashes experienced through the curve sections indicates **that lane widening, shoulder widening, and clear zone improvements would have the most effect between mile posts 14.95 to 15.65.** As shown in the photo of the high-crash occurrence location (Figure 5), there are narrow lanes, no recovery area, and large obstacles within 5-6 feet of the travel way.



Figure 5 - High crash occurrence location between Cypress Creek and Hollydale Lane

RECOMMENDED IMPROVEMENTS

Short Term

Due to numerous recent studies of this roadway segment completed by VDOT within the last 4 years that resulted in the installation of improvements such as additional curve warning signs, edge lines, deer warning signs, and more, there are no additional pavement marking or signing improvements recommended as part of this evaluation. It should be noted that although centerline or edge line rumble strips would normally be low-cost measures that could be implemented to mitigate roadway departure crashes, they are not feasible on this particular roadway segment. This is because the existing roadway width of 20-22 feet does not provide sufficient width to feasibly install either of those two measures. Therefore, no additional short-term improvements are recommended as part of this evaluation.

Long Term

A safety analysis comparing crash reductions for various typical sections was completed to assist in determining the most cost-efficient long-term design improvements that could be implemented to meet the safety needs of the project. In order to determine the safety benefits of various typical sections for widening, a safety analysis was completed using the FHWA's Highway Safety Manual Rural Two-Lane Road Safety Spreadsheet tool. Factors including lane widths, shoulder widths and shoulder types, and clear zone can be input into the spreadsheet tool to determine the predicted crash modification factors and corresponding predicted crash reductions per section. The tool results revealed the crash reductions associated with the proposed alternative sections as shown in Table 2. The crash reduction benefit calculations for the improvements were generated using FHWA's Highway Safety Benefit-Cost Analysis Model (Version 2.0) spreadsheet.

Alternative Section ID#	Lane Width (ft)	Shoulder Width (ft)	Clear Zone (ft)	Predicted Overall Crash Reduction	CMF (Crash Mod. Factor)	Benefit ($ M)	Constr. Cost ($ M)	B/C Ratio
1	12	3	14	49.6%	0.504	$19.54	$9.29	2.10
2	12	6	14	55.0%	0.450	$21.67	$10.52	2.06
1 (cluster only)	12	3	14	49.6%	0.504	$18.05	$4.17	4.33
2 (cluster only)	12	6	14	55.0%	0.450	$20.01	$4.72	4.24

Table 2 – Safety and Cost Comparison of Typical Sections

As shown in Table 2, the improvements to shoulder widths for the full length of the corridor will generate a benefit of $19.54 or $21.67 million dollars over a 20-year period. Therefore, a construction project with a cost less than its benefits should score very well as a safety project through the Smart Scale or HSP program processes.

Additional analysis was also completed to determine the crash reduction benefits if the widening improvements were only applied through the segment of road where the crash cluster has been identified from milepost 14.95 to 15.65. The crash reduction improvement would still apply to 38 total crashes and result in a calculated benefit of $18.05 or $20.01 million for each of the alternative sections.

Benefit/Costs for both the full corridor length and the crash cluster segment only were analyzed for both typical sections. Table 2 reveals that the alternative section with the highest B/C ratios (both for the full length and the cluster section) is **Alternative Section ID # 1**, consisting of **12-foot lanes, 3-foot composite shoulders, and 14 feet of clear zone**. This section is estimated to cost $9.29 million in construction costs over the full length of the project (7,400 feet) and is predicted to have $19.54 million dollars of safety benefit over a 20-year life cycle. It should also be noted that the **Alternative Section ID # 2**, consisting of **12-foot lanes, 6-foot composite shoulders, and 14 feet of clear zone** , is a more costly improvement, with a cost of $10.52 million (approximately $1.2 million more than Alternative Section ID #1). This

section is predicted to have $21.67 million in safety benefits over a 20-year life cycle. As shown in Table 2, the Benefit/Cost ratios increase significantly when just the crash cluster section is analyzed.

ALTERNATIVE SECTIONS + COSTS

The proposed alternative sections utilized in the "Long Term Recommendations" above generally consist of 12-foot travel lanes with a 14-foot clear zone, while varying in the total shoulder widths provided (i.e., 3-foot composite shoulder consisting of 2-foot paved plus a 1-foot graded shoulder vs. a 6-foot composite shoulder consisting of 4-foot paved plus a 2-foot graded shoulder). Both options are proposed to widen the existing right-of-way from 40-feet to 60-feet to allow for additional recovery area, sight distance, and maintenance. The proposed 4-foot paved shoulder option also accommodates bicyclists per the County's bike plan as adopted into the County's comprehensive plan. This proposed typical section is shown in Figure 6 on the next page.

Note that the existing pavement structure and conditions are not known at this time; however, based upon previous VDOT studies on similar roadways in the County, it is assumed that Full Depth Reclamation is most likely to be required for any roadway improvements. The Cost Estimate Summaries for the two alternative sections (for both the full corridor length and the crash cluster section) are shown below in Table 3.

Cost Estimate Summary (full corridor length)

	Alternate 1 FDR - 2'P+1'G+14'CZ			Alternate 2 FDR - 4'P+2'G+14'CZ		
Phase	Base Estimate ($)	Contingency ($)	Total Phase	Base Estimate ($)	Contingency ($)	Total Phase
PE Phase Estimate	$ 754,000.00	$ 263,900.00	$ 1,017,900.00	$ 866,000.00	$ 303,100.00	$ 1,169,100.00
RW Phase Estimate	$ 1,150,680.00	$ 348,882.00	$ 1,499,562.00	$ 1,186,680.00	$ 365,982.00	$ 1,552,662.00
CN Phase Estimate(without CEI)	$ 4,575,442.50	$ 1,074,455.51	$ 5,649,898.01	$ 5,266,356.94	$ 1,235,959.44	$ 6,502,316.38
Total CEI	$ 831,898.64	$ 291,164.52	$ 1,123,063.16	$ 957,519.44	$ 335,131.81	$ 1,292,651.25
CN Phase Estimate(with CEI)	$ 5,407,341.14	$ 1,365,620.03	$ 6,772,961.17	$ 6,223,876.39	$ 1,571,091.24	$ 7,794,967.63
Total Estimate	***$ 7,312,021.14***	***$ 1,978,402.03***	***$ 9,290,423.17***	***$ 8,276,556.39***	***$ 2,240,173.24***	***$ 10,516,729.63***

Cost Estimate Summary (cluster segment only)

Phase	Base Estimate ($)	Contingency ($)	Total Phase	Base Estimate ($)	Contingency ($)	Total Phase
PE Phase Estimate	$ 372,000.00	$ 130,200.00	$ 502,200.00	$ 425,000.00	$ 148,750.00	$ 573,750.00
RW Phase Estimate	$ 273,690.00	$ 59,724.25	$ 333,414.25	$ 273,690.00	$ 59,724.25	$ 333,414.25
CN Phase Estimate(without CEI)	$ 2,241,659.48	$ 539,970.60	$ 2,781,630.08	$ 2,567,409.63	$ 616,362.00	$ 3,183,771.63
Total CEI	$ 407,574.45	$ 142,651.06	$ 550,225.51	$ 466,801.75	$ 163,380.61	$ 630,182.36
CN Phase Estimate(with CEI)	$ 2,649,233.93	$ 682,621.66	$ 3,331,855.59	$ 3,034,211.38	$ 779,742.61	$ 3,813,953.99
Total Estimate	***$ 3,294,923.93***	***$ 872,545.91***	***$ 4,167,469.84***	***$ 3,732,901.38***	***$ 988,216.86***	***$ 4,721,118.24***

Table 3 – Cost Estimate Summaries

Cost Estimate Assumptions:

1. Costs are based on current dollars and do not include inflation factors. Project funding status and schedule are unknown at this time.
2. Utility costs include only those observed during the field visit and desktop review, which includes relocation of impacted electric poles (~12), underground FO cable (assume full length of the project limits on both sides), and relocation/strengthening around the gas line crossing for 200 LF (not required on crash cluster option). 50% contingency is included to account for additional utility relocations that were no observed.
3. For the full corridor length, both alternative sections are estimated to impact approximately 30 parcels (based on 60-foot proposed right-of-way width) and includes cost of right-of-way acquisition and temporary construction easements. Estimate accounts for administrative, condemnation, incidental and

other appropriate costs. Based on the varying land zoning along the corridor, an average $0.28/SF was used for the estimate for the total square footage of impacts. No additional right-of-way or easement costs were included for any other items including potential Storm Water Management basin (number, size, and location are unknown), staging area, etc. Attachment A, "Crash Cluster Segment Exhibit", highlights the potential parcels that may be impacted within the cluster area only.

4. Right-of-Way & utility relocation estimates were not reviewed by VDOT RW & Utility division, which typically provides these estimates. Total project costs may vary depending future cost estimates performed by VDOT.
5. Potential wetland/stream impacts, mitigation, permits, or any other environmental factors we not included.
6. Both alternatives are assumed to mitigate the sub-standard horizontal curve speeds (45MPH design speed) with the design superelevation to meet 55MPH design speed. Re-alignment of the roadway at the curve locations to meet 55MPH was not an option considered for this analysis.
7. Unit prices were based on 1-year state and district averages. VDOT Bid Express was utilized for items with missing unit prices in the district/state-wide averages as appropriate.
8. The FDR pavement design (pavement manipulation depth, CBR-15, geotextile fabric, stone material) were based upon the typical section for a similar study in the County.

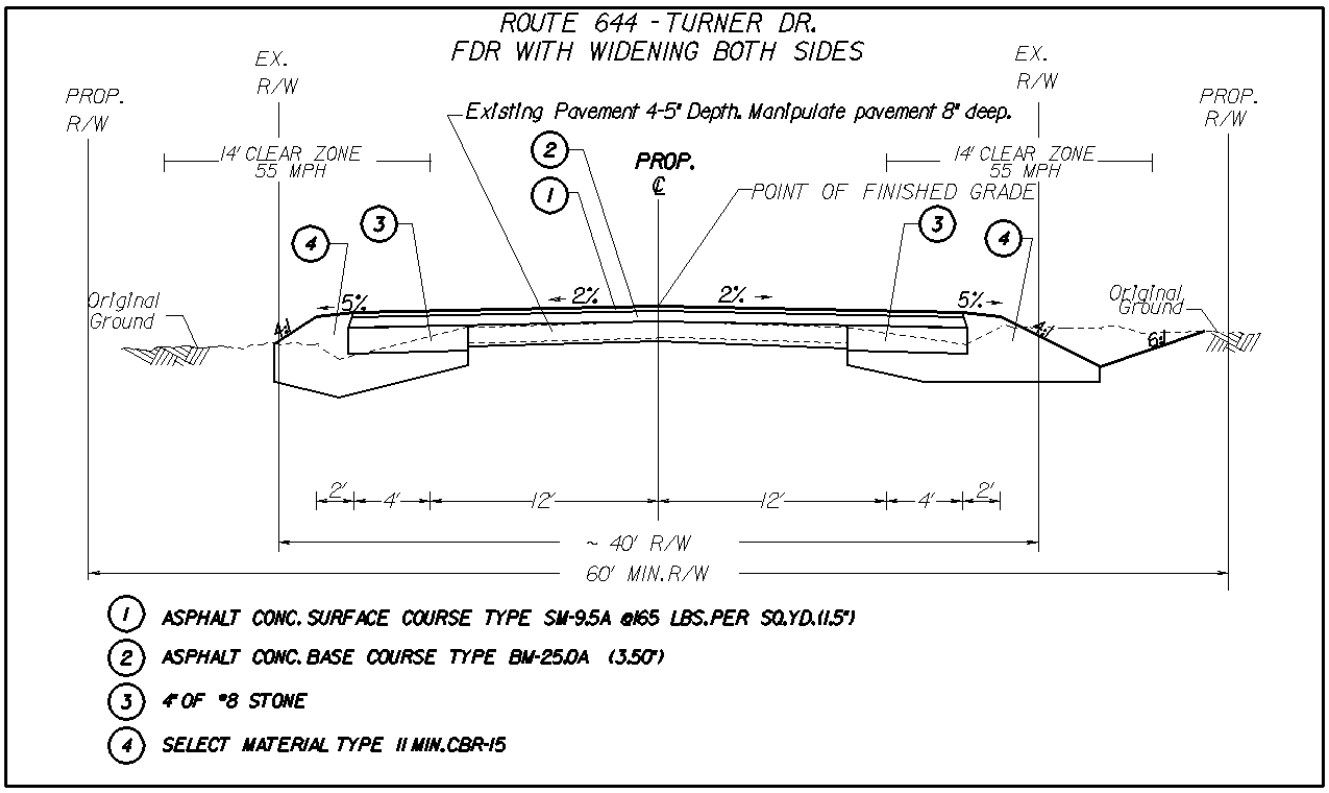


Figure 6 – FDR Section with 6-foot Composite Shoulder

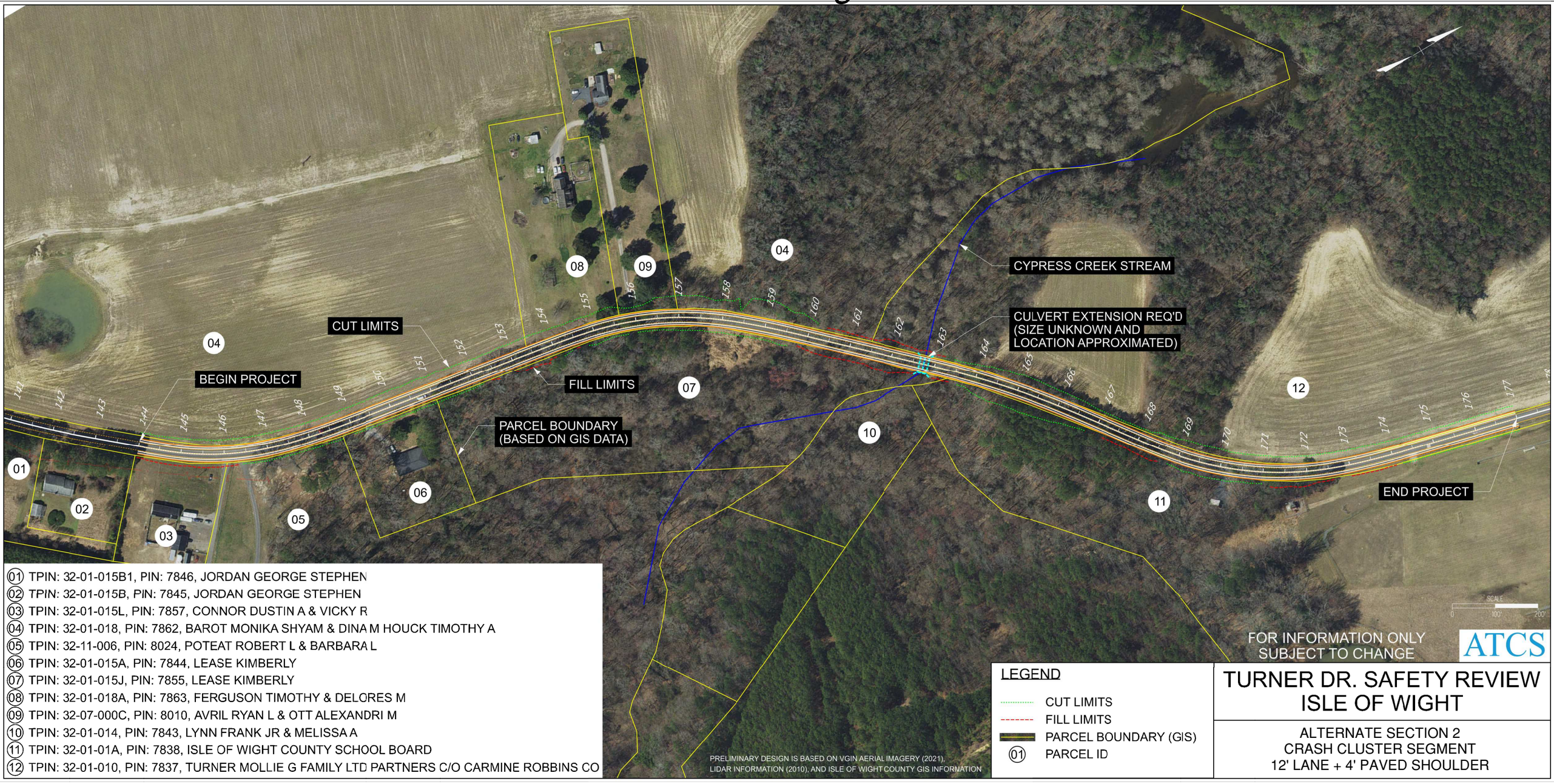
Potential Cost Savings Strategies:

ATCS has developed the following potential strategies to reduce project costs. It should be carefully noted that this effort is based on preliminary GIS information to develop order-of-magnitude costs saving estimates. Further investigation and design would be required to advance alternatives and better define project budgets.

The following are proposed cost savings strategies:

1. Further investigate utility avoidance alternatives by coordinating with impacted utility companies to better understand the design constraints, alternative designs and avoidance measures to define more detailed costs.
2. Further investigate the need (or lack of need) for full depth pavement reclamation (FDR) of the existing alignment. A combination of mill and overlay of the existing pavement, along with full depth pavement limited to the widening, could provide additional savings to either alternative.
3. As noted in the safety review, the primary safety concern exists in the curves and wooded areas between mileposts 14.95 and 15.65, which is where the highest cluster of crashes have occurred. Limiting the improvements to this segment of roadway would provide potential cost savings to the project of over 50%.
4. The existing curves between milepost 14.95 and 15.65 could potentially be repaved in an attempt to improve superelevation, in lieu of widening and full reconstruction; along with associated warning signs and other safety measures. Topographic survey information is not available at this time to determine the existing superelevation or the extent of improvement that could be achieved by doing this.

ATTACHMENT A
"*Crash Cluster Segment Exhibit*"



01 TPIN: 32-01-015B1, PIN: 7846, JORDAN GEORGE STEPHEN
02 TPIN: 32-01-015B, PIN: 7845, JORDAN GEORGE STEPHEN
03 TPIN: 32-01-015L, PIN: 7857, CONNOR DUSTIN A & VICKY R
04 TPIN: 32-01-018, PIN: 7862, BAROT MONIKA SHYAM & DINA M HOUCK TIMOTHY A
05 TPIN: 32-11-006, PIN: 8024, POTEAT ROBERT L & BARBARA L
06 TPIN: 32-01-015A, PIN: 7844, LEASE KIMBERLY
07 TPIN: 32-01-015J, PIN: 7855, LEASE KIMBERLY
08 TPIN: 32-01-018A, PIN: 7863, FERGUSON TIMOTHY & DELORES M
09 TPIN: 32-07-000C, PIN: 8010, AVRIL RYAN L & OTT ALEXANDRI M
10 TPIN: 32-01-014, PIN: 7843, LYNN FRANK JR & MELISSA A
11 TPIN: 32-01-01A, PIN: 7838, ISLE OF WIGHT COUNTY SCHOOL BOARD
12 TPIN: 32-01-010, PIN: 7837, TURNER MOLLIE G FAMILY LTD PARTNERS C/O CARMINE ROBBINS CO

PRELIMINARY DESIGN IS BASED ON VGIN AERIAL IMAGERY (2021), LIDAR INFORMATION (2010), AND ISLE OF WIGHT COUNTY GIS INFORMATION

FOR INFORMATION ONLY
SUBJECT TO CHANGE

ATCS

LEGEND

- CUT LIMITS
- FILL LIMITS
- PARCEL BOUNDARY (GIS)
- 01 PARCEL ID

TURNER DR. SAFETY REVIEW
ISLE OF WIGHT

ALTERNATE SECTION 2
CRASH CLUSTER SEGMENT
12' LANE + 4' PAVED SHOULDER