George Washington Regional Commission

Development and Prioritization of Transportation Needs in King George County

April 2020

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I: Introduction and Purpose

The Virginia Department of Transportation (VDOT) allocates part of the State Planning and Research (SPR) funding to provide annual transportation planning assistance for non-urbanized areas within the Commonwealth of Virginia. The Rural Transportation Planning (RTP) Program was created to aid the State in fulfilling the requirements of the State Planning Process to address the transportation needs of non-metropolitan areas. In FY-2020 each planning district commission or regional commission that has rural areas received funding from VDOT's Rural Transportation Planning Assistance Program to be put towards rural transportation planning activities. The George Washington Regional Commission (GWRC), which includes the Counties of Spotsylvania, Stafford, Caroline and King George along with the City of Fredericksburg, is responsible for such efforts in these jurisdictions, specifically Caroline and King George Counties which are classified as being rural areas.

One of these planning activities is a study to develop and prioritize transportation needs within the County of King George. This study set out to utilize the results of the recently completed US 301/Route 207 and Route 3 studies, the findings from the 2045 GWRC Long Range Transportation Plan (LRTP) and Bicycle/Pedestrian Plan, along with the FY 20-25 Six Year Improvement Plan (SYIP) projects. Using this data, the goal of this study is to review transportation needs within King George County, along with developing a prioritization of project recommendations.

Included in this document is an overview of the King George County region, which details the geography and current infrastructure of the county. Next is an outline and analysis of the current rural transportation systems and their conditions within King George, along with the currently ongoing improvement projects. Following this is an explanation of the prioritization methods for selecting future improvements and projects, along with recommendations. Lastly, this document provides a framework for how these recommendations should be implemented as well as the overall conclusions drawn from this study.

II: Overview of Region

King George County, founded in 1720, is home to over 26,000 residents and is the northernmost county within the Northern Neck, situated between the Potomac River to the north and Rappahannock River to the south. With over 130 miles of collective shoreline and over 70,000 acres of forest including Caledon State Park, King George County is well-known for its vast amount of natural, cultural and historic resources. It is bordered by the Counties of Stafford to the west, Caroline and Essex to the south, along with Westmorland to the east. King George County has a large military presence with the Naval Surface Warfare Research Center, Dahlgren Division in Dahlgren (NSWCDD), which is one of the largest employers in the region. See Figure 1.0 below for an overview of the region.

Figure 1.0: Overview of King George County and the Surrounding Region

Transportation connectivity within King George County relies heavily on highway and local road networks. Route 3 runs through the center of King George, connecting with Westmorland and Stafford Counties. US 301, running north-south throughout the region provides access to Caroline County and Charles County, Maryland via the Governor Harry W. Nice Memorial Bridge over the Potomac River. Route 205 is in the eastern part of the county, providing access to northwestern Westmoreland County and Colonial Beach. Route 206 connects the NSWCDD in the northern part of the county to Route 3 in the south. Route 218 connects King George residents to Route 1 and US 17 to the east in Stafford County. Figure 1.1 is a detailed map of the King George County transportation networks.

Alternate modes of transportation and robust bicycle/pedestrian infrastructure are still in the very early stages of development. The Dahlgren Railroad Heritage Trail is a 15.7-mile long trail which provides access from the NSWCDD to Route 605 for hikers, bikers, horseback riders, and runners. A portion of the Richmond, Fredericksburg, and Potomac (RF&P) Subdivision railroad line operated by CSX Transportation, known as the Dahlgren Junction, is in the western most portion of the county and connects to the VRE Leeland Road Station at Falmouth in Stafford County. Sidewalks are spread sporadically throughout King George, with major clusters in the Hopyard Farm subdivision off Port Conway Road, Arnolds Corner and Downtown King George, along with Dahlgren and Chatham Village off Owens Drive.

Land cover analysis shows that King George County easily fits the description of a rural jurisdiction. Of the 188 square miles of area within King George County, 156 square miles are classified as being forest, tree, pasture, cropland, or wetlands. That is about 83 percent of the total area within the county. Areas deemed to be impervious surfaces, such as roadways, urban areas, and buildings, account for only 5.2 square miles or about 2.75 percent of the total area within King George County. See Figure 1.2 for a detailed land cover map of King George, and Figure 1.3 for the totality of land cover data.

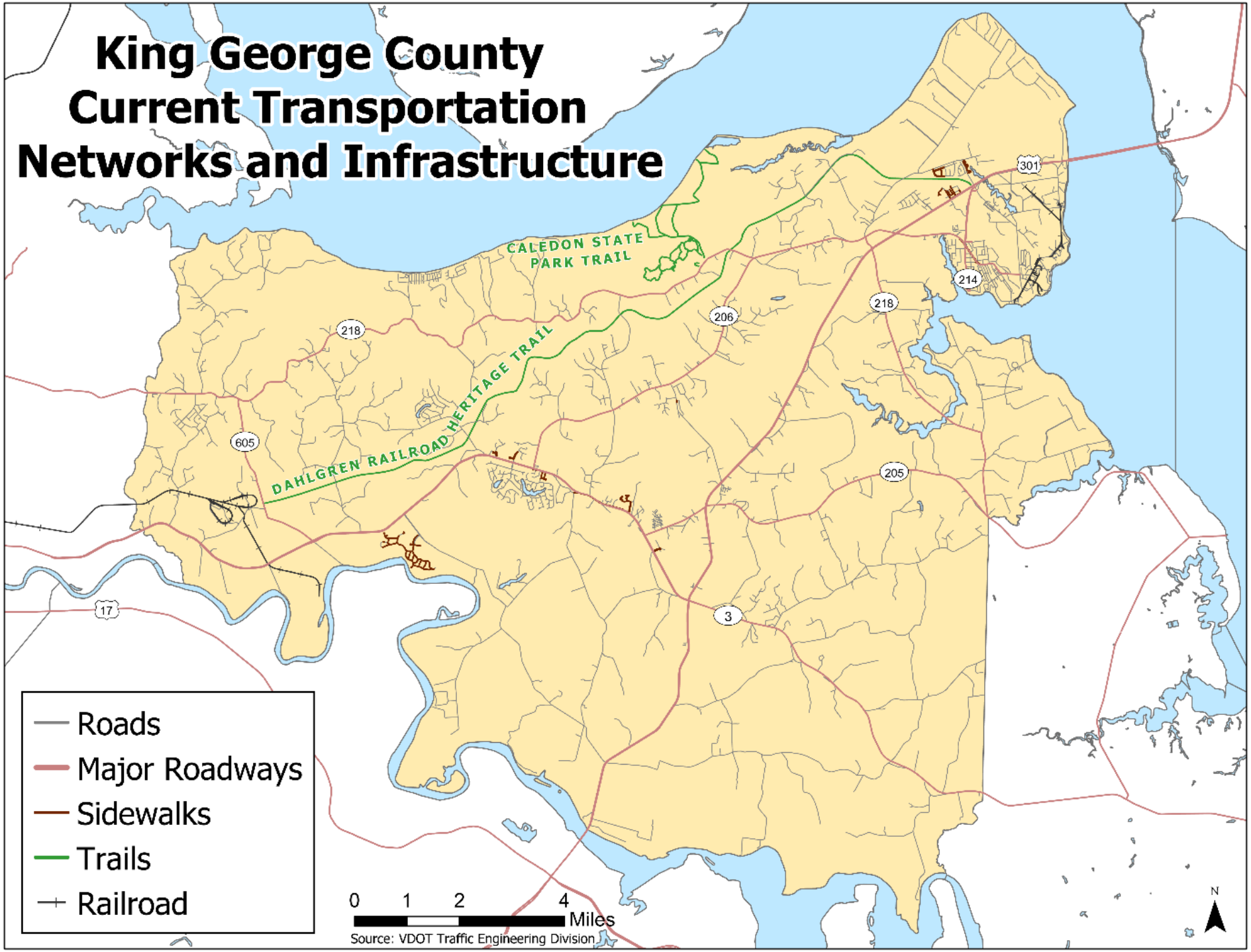

Figure 1.1: King George County Current Transportation Networks and Infrastructure

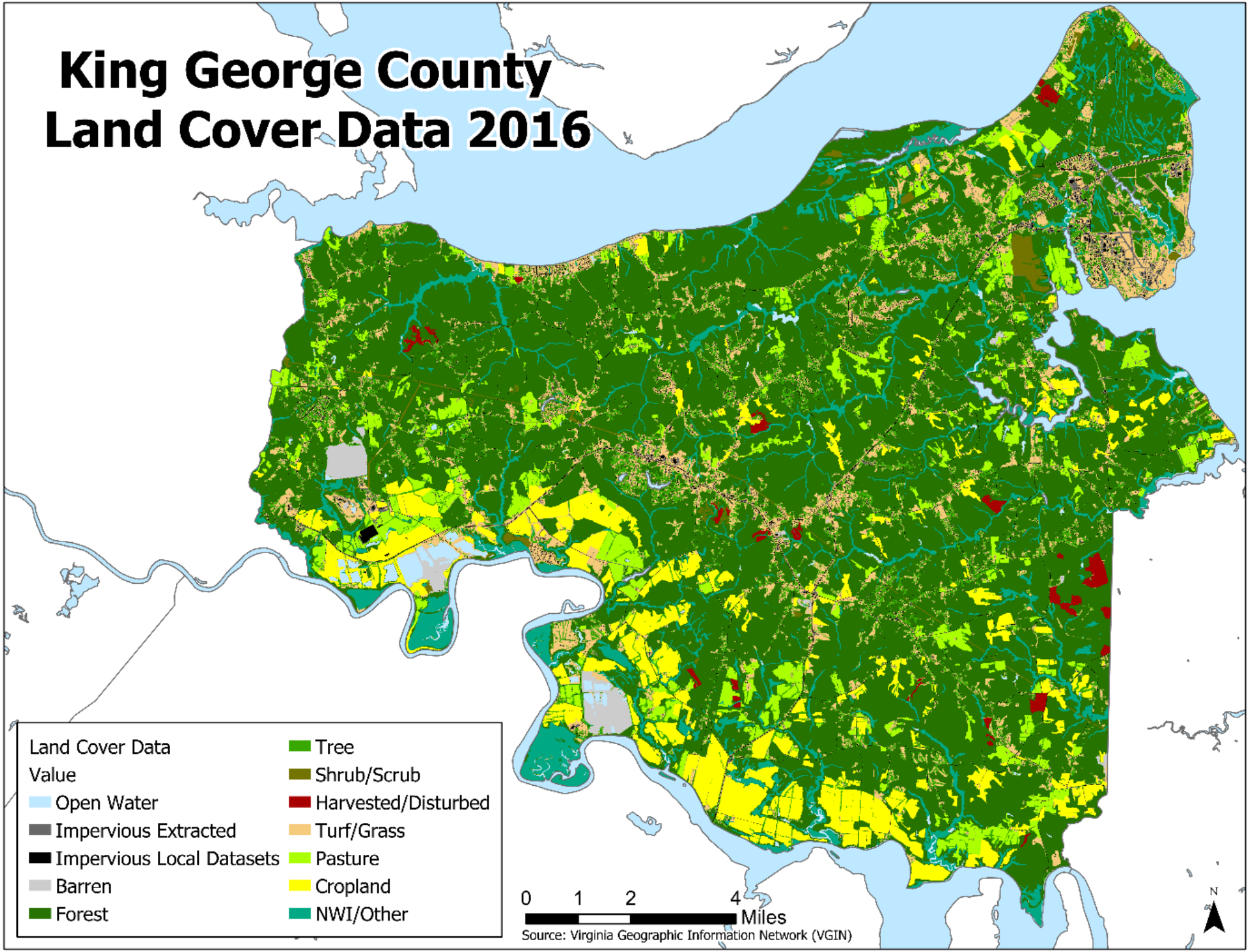

Figure 1.2: King George County Land Cover Data as of 2016

Land Cover Class	Acres	Square Miles	Percent of Total Area
Open Water	6208	9.7	5.17%
Impervious Extracted	1430	2.23	1.19%
Impervious Local Datasets	1910	2.98	1.59%
Barren	1035	1.62	0.86%
Forest	66462	103.85	55.31%
Tree	8883	13.88	7.40%
Shrub/Scrub	741	1.16	0.62%
Harvested/Disturbed	713	1.11	0.59%
Turf/Grass	9278	14.5	7.72%
Pasture	6688	10.45	5.57%
Cropland	8620	13.47	7.17%
NWI/Other	8195	12.8	6.82%
Total:	**120162**	**187.75**	

Figure 1.3: King George County Land Cover Data Statistics

III: Current Transportation System and Conditions

Results from the recently completed US 301/Route 207 and Route 3 studies, the 2045 GWRC LRTP and Bicycle/Pedestrian Plan, along with the FY 20-25 SYIP projects shed light on the current rural transportation system, conditions, and planned improvements throughout King George County (see Figure 1.4). Information was also collected about roadway safety, one of the most important factors in transportation planning in rural jurisdictions. Roadway safety can be measured through crash datasets such as vehicular and bicycle/pedestrian crash data, which were developed by the VDOT Traffic Engineering Division since 2013. Also, included in this analysis was the SMART SCALE project files for King George created by VDOT Transportation and Mobility Planning Division. The aforementioned crash data were analyzed in terms of locations, severity, and causes (See figures 1.5, 1.6, 1.7, and 1.8).

Figure 1.4 shows the current conditions and potential safety improvement recommendations for major roadways and intersections throughout King George County along with the current SMART SCALE projects for fiscal year 2020. The metrics for these conditions and improvements include Potential for Safety Improvement (PSI) intersections and segments from VDOT Traffic Engineering Division, along with intersections deemed in need of improvement cited in the VDOT Route 301 and Route 207 Arterial Preservation Plan. PSI intersections and segments were identified by VDOT after conducting a roadway network screening process utilizing the latest Highway Safety Manual methods. The analysis results shown are for the years 2013 through 2017, and highlight intersections and segments with recurring safety issues in need of improvement.

The Route 301 and Route 207 Arterial Preservation Plan was a study conducted by VDOT released in June 2018 which had the goal of identifying and developing methods to ensure the safety and preserve the capacity of the Commonwealth's arterial highway network without wide-scale roadway widenings or increased signal proliferation. The cited intersections were deemed by this study in need of improvements to ensure sufficient capacity and safety within the corridor. Included in Figure 1.4 are intersections cited from the Route 301 and 207 Arterial Preservation Plan in need of improvements.

SMART SCALE is a method of selecting and funding the right transportation projects in Virginia. SMART SCALE stands for System for the Management and Allocation of Resources for Transportation, and the key factors used in evaluating a project's merits: improvements to safety, congestion reduction, accessibility, land use, economic development and the environment. Included in SMART SCALE is a scoring system for selecting and prioritizing transportation projects based on the key factors mentioned previously. Projects applied for within SMART SCALE are scored relative to one another, with the highest scoring projects being selected for future funding and development. Specific regions within Virginia are designated in different weighting typologies such as A, B, C, or D to better reflect the type and scale of needs in those particular regions. King George County is designated as Category D, which puts much more emphasis on safety and economic development in its scoring matrix. Included in Figure 1.4 are the current SMART SCALE projects in King George County for fiscal year 2020.

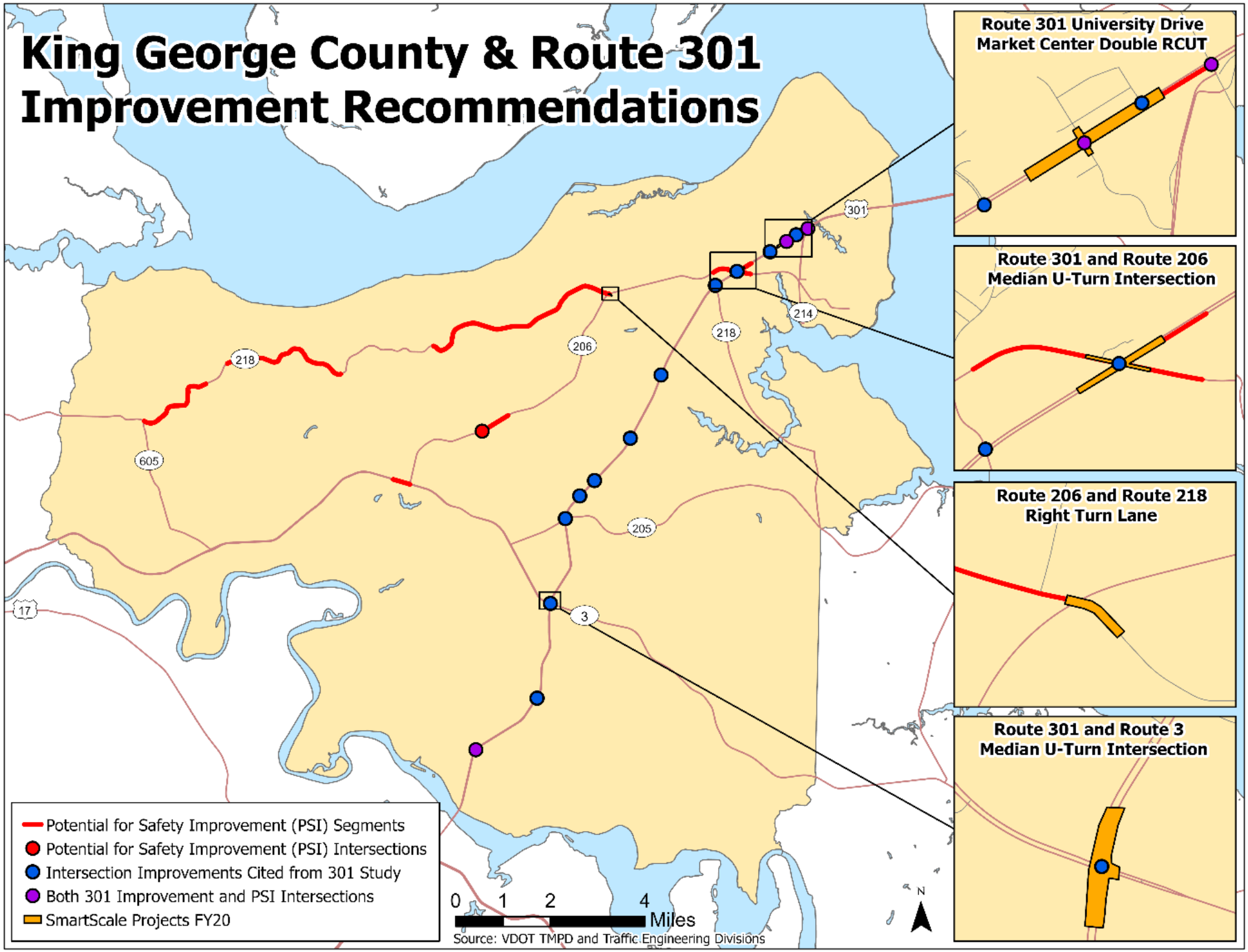

Figure 1.4: King George County & Route 301 Improvement Recommendations

One of the most pressing concerns for rural jurisdictions such as King George is safety on public roadways. The crash datasets created by VDOT Traffic Engineering Division not only provide information on the location of the crashes, but also the causes and severity of the accidents among other things. The crash data follows the "KABCO" scale of crash severity. The letters and their respective equivalencies are as follows:

- K: a fatality has occurred on the scene or within 30 days following the accident
- A: severe injuries have occurred such as skull fractures, broken bones, or major burns
- B: moderate injuries have occurred such as abrasions and minor lacerations
- C: minor or nonvisible injuries have occurred such as hysteria, nausea, or unconsciousness
- O: no fatalities or injuries, property damage only

A full breakdown of the total amount of crashes sorted by the KABCO scale of crash severity within King George County since 2013 can be seen in Figure 1.5.

Heat maps are important and useful for data analysis because they help better visualize the volumes of locations within a dataset, in this case relating to the volume of crash data. Figure 1.6 shows the frequency of vehicular accidents in King George County since 2013. This was done by calculating the density of all the crash point locations relative to one another. No weighting of the points is considered in this analysis. Clusters of "Hot Spots" are located at the intersections between Routes 3 and 206, Routes 301 and 206, along with Routes 301 and 214.

Another factor to consider in analyzing current transportation conditions is not only the totality of crash data, but focusing on the vehicular fatalities specifically. Figure 1.7 shows all occurrences of vehicular fatalities in King George County between 2013 and 2019. Since 2013, 29 of the 41 fatalities occurred along major roadways in King George County. The most common cause for these fatalities was the vehicle running off the road into a ditch or hitting a tree. This accounted for 18 of the 41 fatalities that occurred in this time period.

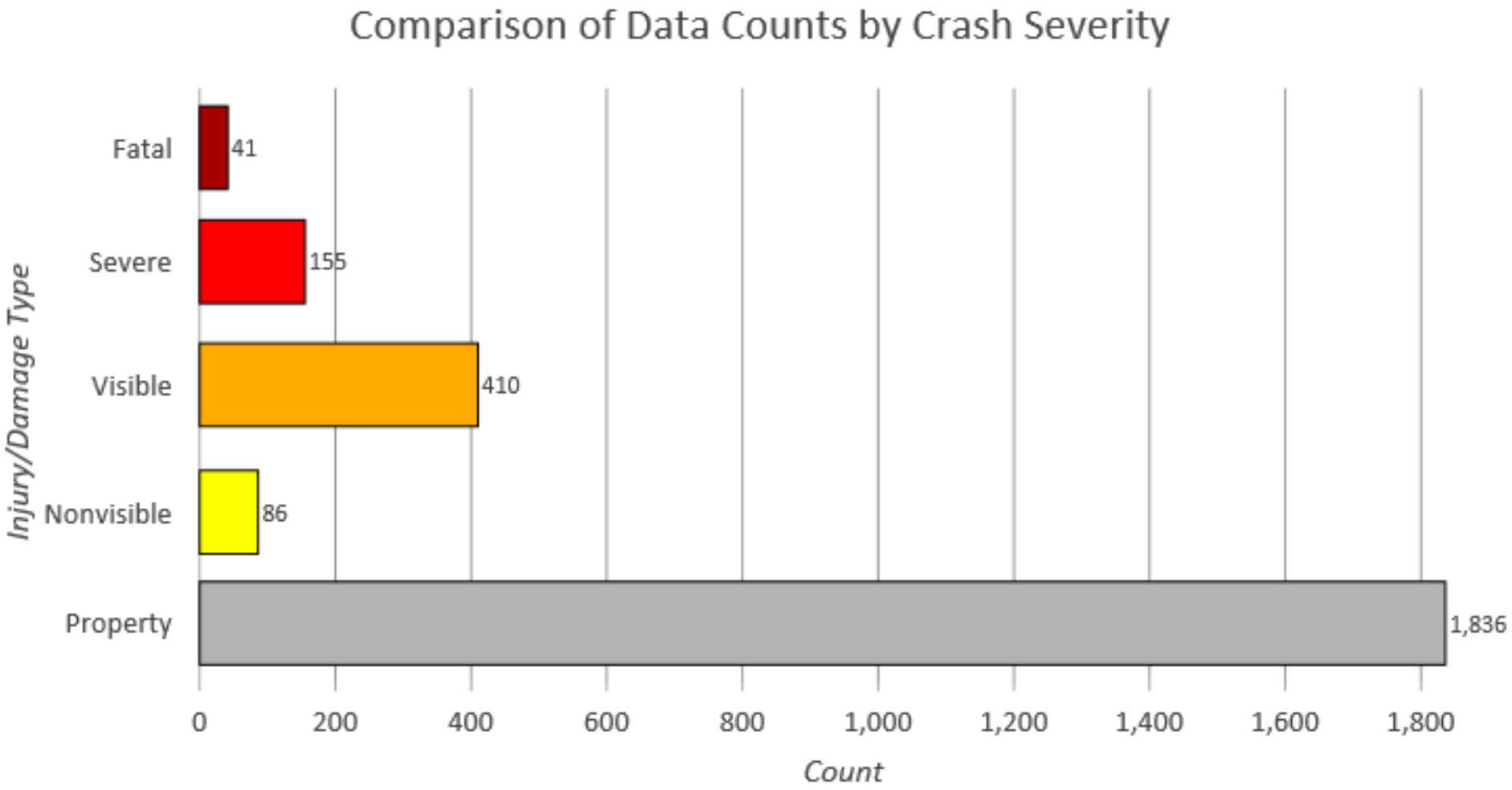

Figure 1.5: King George Vehicular Crashes Sorted by the KABCO Scale of Crash Severity

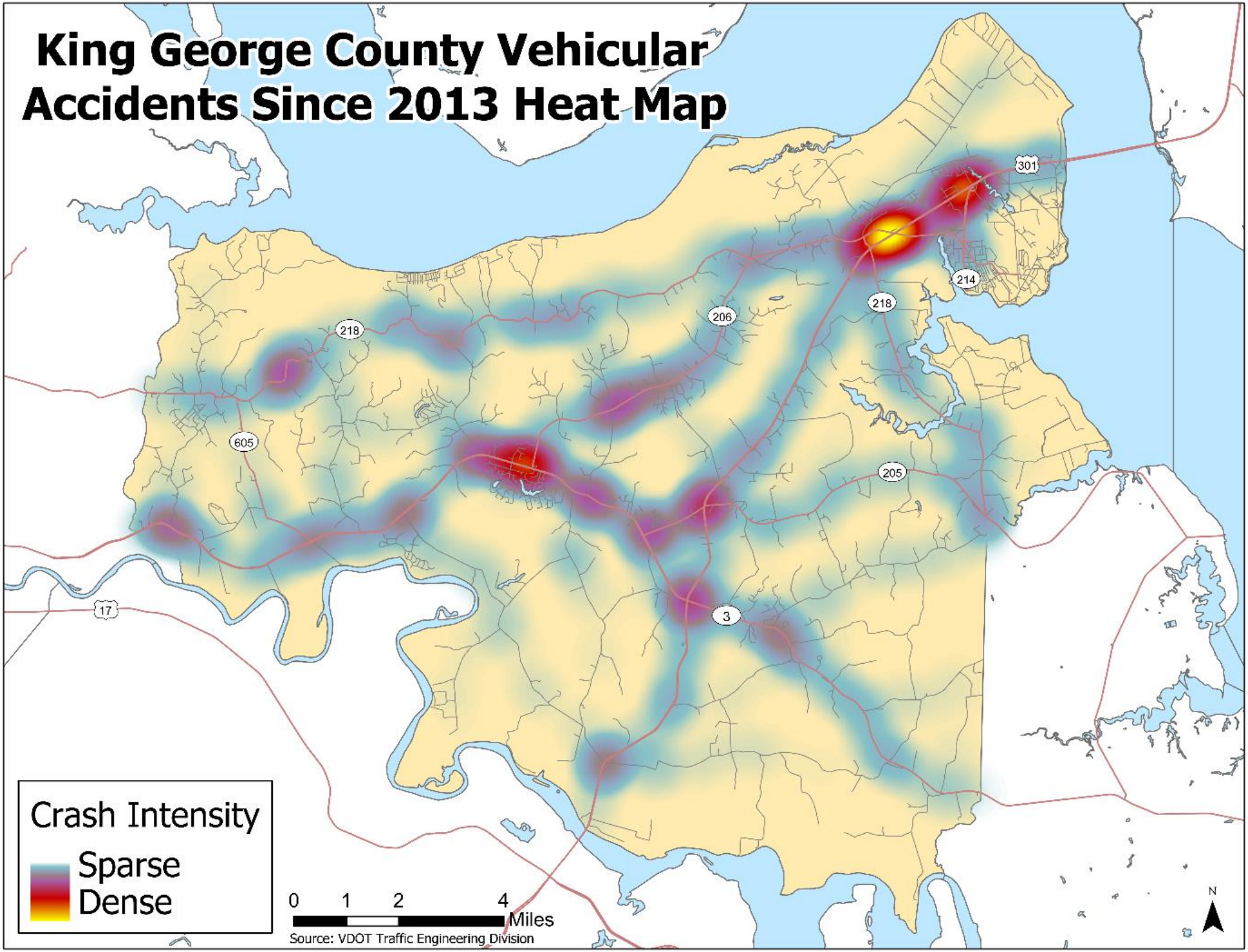

Figure 1.6: King George County Vehicular Accidents Since 2013 Heat Map

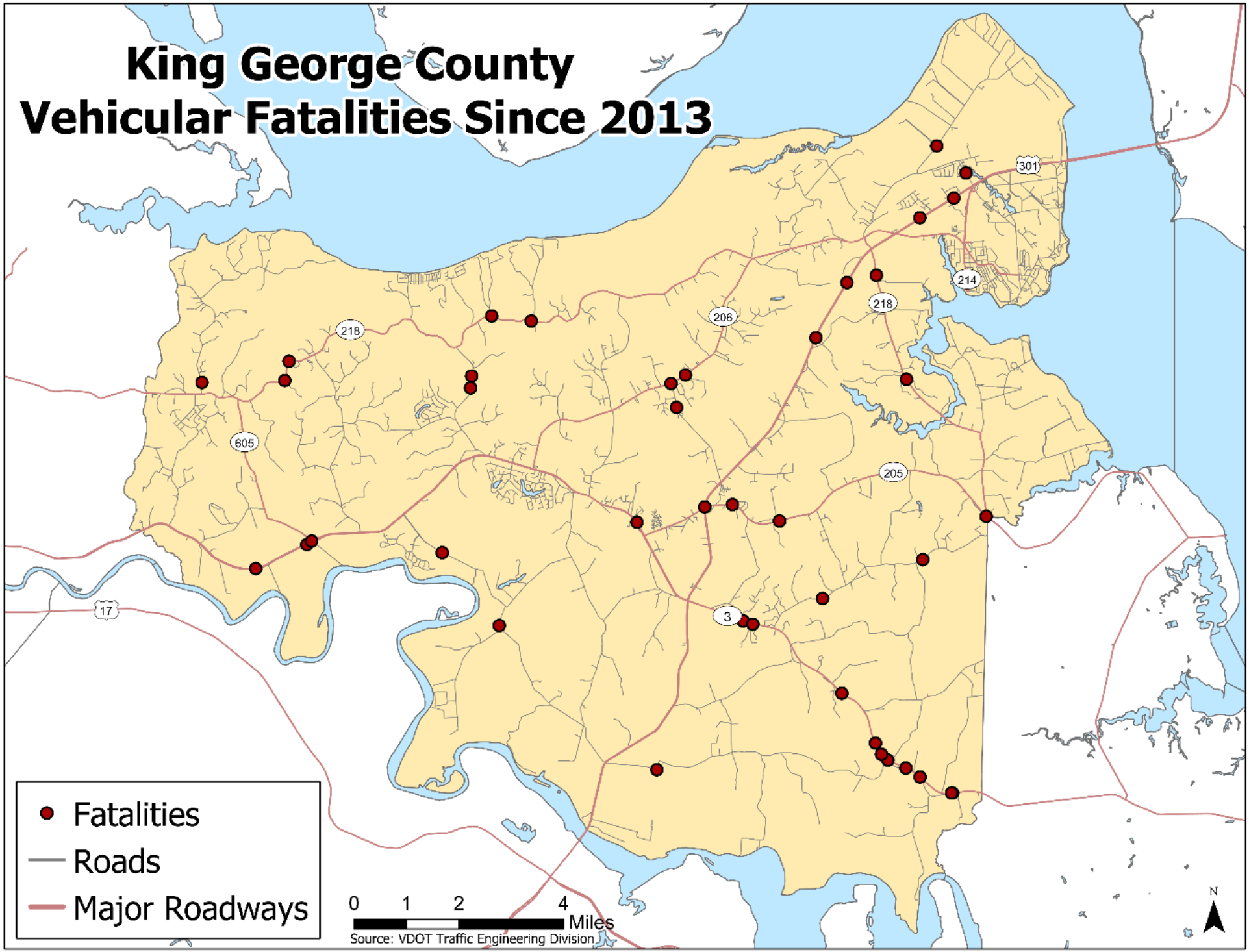

Figure 1.7: King George County Vehicular Fatalities Since 2013

Figure 1.8 shows the frequency of vehicular accidents in King George County since 2013. This was done by calculating the density of all the crash point locations relative to one another.. The Equivalent Property Damage Only (EPDO) methodology is a nationally recognized approach that applies weights to crashes based on their average costs to society. The 2010 Highway Safety Improvement Program User's Manual (FHWA, 2009) provides guidance on severity weights based on nationally averaged data:

- One Fatal crash = 567 PDO crashes
- One Injury crash= 33 PDO crashes
- One PDO crash = 1 PDO crash

In comparison to the heat map from Figure 1.6 (the "no weighting" heat map), the EPDO heat map from Figure 1.8 better represents the distribution of vehicular fatalities as seen in Figure 1.7. Areas such as the stretch of Route 3 in the south close to the Westmorland County border, along with a clustering in the center of Route 206 which were not deemed too severe in the no weighting heat map are now considered much more severe in the weighted EPDO heat map. This shows that these areas have a higher amount of fatalities clustered in their respective areas.

Another observation to note is the stretch of roadway along Route 301, between its intersection with Route 218 and where it connects with the Governor Harry W. Nice Memorial Bridge. In the no weighting heat map, there was a higher severity at the intersection of Routes 301 and 218 compared to the intersection of Routes 301 and 214. However, in the EPDO heat map this difference in severity is reversed, with the intersection of Routes 301 and 214 having a higher severity compared to the intersection of Routes 301 and 218. This shows that while the intersection of Routes 301 and 218 might have more vehicular crash numbers, the severity of the vehicular crashes as the intersection of Routes 301 and 214 is much higher. Inspecting Figure 1.7 the vehicular fatalities map supports this observation, as there are more fatalities in the vicinity of the intersection of Routes 301 and 214 compared to the intersection of Routes 301 and 218.

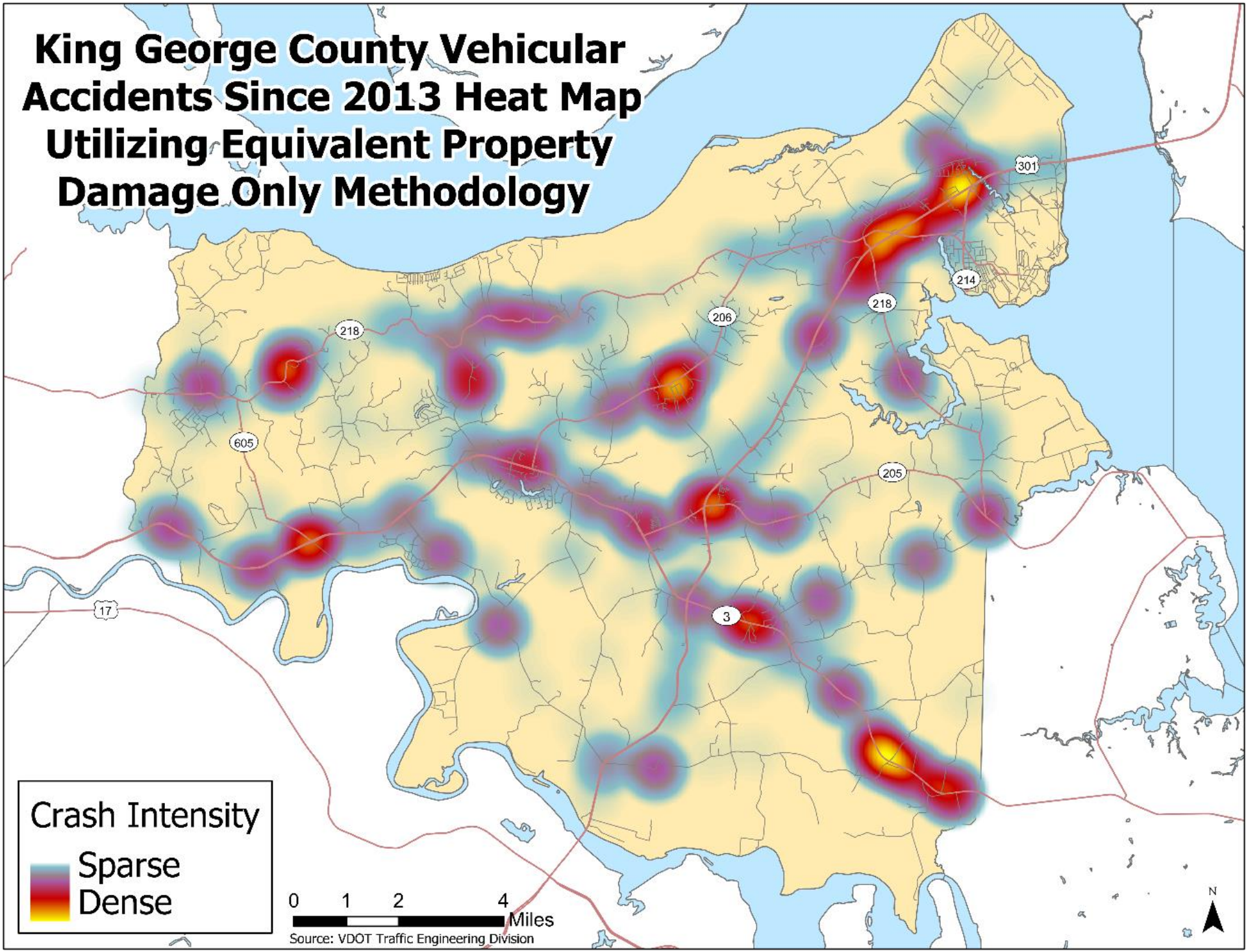

Figure 1.8: King George County Vehicular Accidents Since 2013 Heat Map, EPDO Methodology

One final aspect examined in assessing the current rural transportation systems and conditions is the safety of pedestrians and bicyclists within King George County. Similar to the vehicular crash data explored previously, the crash data analyzed involving pedestrians and bicyclists follows the KABCO scale of crash severity. However, in this case category O (no fatalities of injuries, property damage only) is omitted. Figure 1.9 shows all accidents within King George County since 2013 involving pedestrians and bicyclists. Areas that show a clustering of crashes involving pedestrians and bicyclists include the stretch of US 301 and Route 206 north and northwest of the NSWCDD. Of the 27 accidents involving pedestrians and bicyclists in King George County since 2013, 13 of them occurred in this general area including a pair of fatalities.

Other areas with a handful of clustered accidents include the unincorporated community of Arnolds Corner along Route 3 and a pair of fatalities along Comorn Road which connects Routes 3 and 218. No fatal or severe injuries occurred within Arnolds Corner. Both of the pedestrian fatalities which occurred along Comorn road, with a speed limit of 55 miles per hour, were by drivers under the influence of alcohol at night.

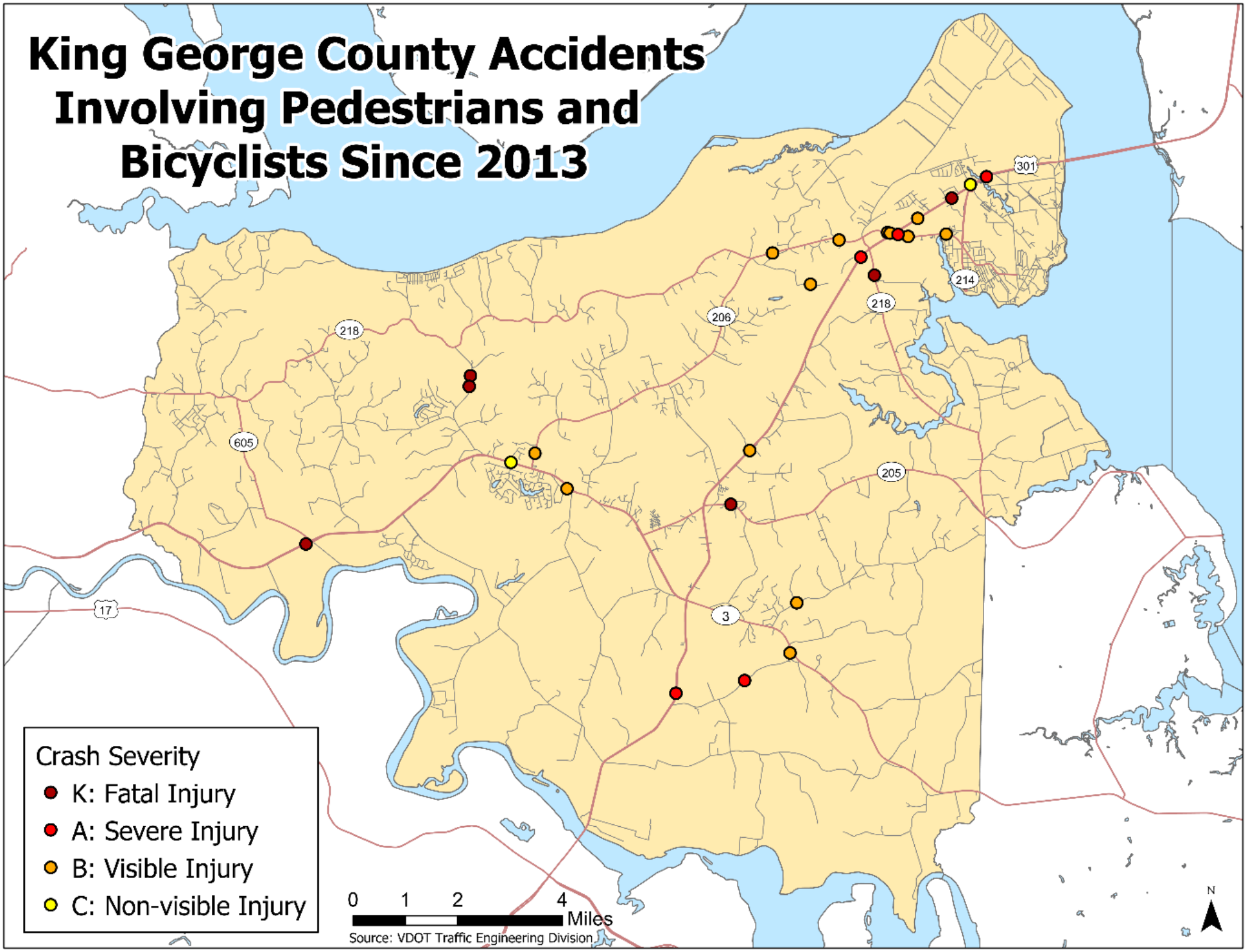

Figure 1.9: King George Accidents Involving Pedestrians and Bicyclists Since 2013

IV: Prioritization Methods:

One of the primary goals of this study was to develop a prioritization methodology for selecting future transportation projects. This effort set out to utilize the results of the recently completed US 301/Route 207 and Route 3 studies, the findings from the 2045 GWRC Long Range Transportation Plan (LRTP) and Bicycle/Pedestrian Plan, along with the FY 20-25 Six Year Improvement Plan (SYIP) projects. Project prioritizations need to be tailored for each locality's individual needs, so this prioritization methodology reiterated the emphasis on safety and economic development, two of the most important factors in the Category D weighting typology in SMART SCALE, along with congestion. Taking these ideas and data analysis into consideration, the King George County Project Prioritization Matrix was created.

The first factor taken into consideration when establishing the prioritization of a given area for a project is safety. This was determined through the density of vehicular crashes in the area. Consistent with the SMART SCALE methodology, the EPDO heat map, (Figure 1.8) which takes into account the severity crashes in relation to one another, is used to determine how the given area is scored under the safety category in the King George County Project Prioritization Matrix. Areas in the EPDO heat map which are colored yellow are scored a 5, orange areas scored a 4, red areas scored a 3, purple areas scored a 2 and blue areas scored a 1.

The second factor taken into consideration when prioritizing a project is economic development. This is determined through the zoning district of the area a given project would be in. Projects in areas zoned for retail or industry have a higher weight in comparison to projects in areas zoned for agriculture. Areas zoned as Retail Commercial, General Trade, Industrial, Industrial Light, or Government District are scored a 5. Areas zoned as One-Family Dwelling, General Dwelling, or Multi-Family Dwelling are scored a 3. Areas zoned as Limited Agriculture, Rural Agriculture, or General Agriculture are scored a 1. Caledon State Park is omitted from being scored. A full map depicting the zoning districts of can be seen in figure 2.0.

The third and final factor taken into consideration when prioritizing a project is congestion. This is determined through the volume to capacity ratio of the roadway a given project would be in. The volume to capacity ratio is a measurement of the operating capacity of a roadway where the number of vehicles passing through is divided by the number of vehicles that could theoretically pass through when at full capacity. Roadways with a ratio of 0 to 0.25 are scored a 1, 0.26 to 0.50 are scored a 2, 0.51 to 0.75 are scored a 3, 0.76 to 1.00 are scored a 4, and any ratio over 1.00 are scored a 5. A full map depicting the volume to capacity ratios on roadways in King George County can be seen in figure 2.1.

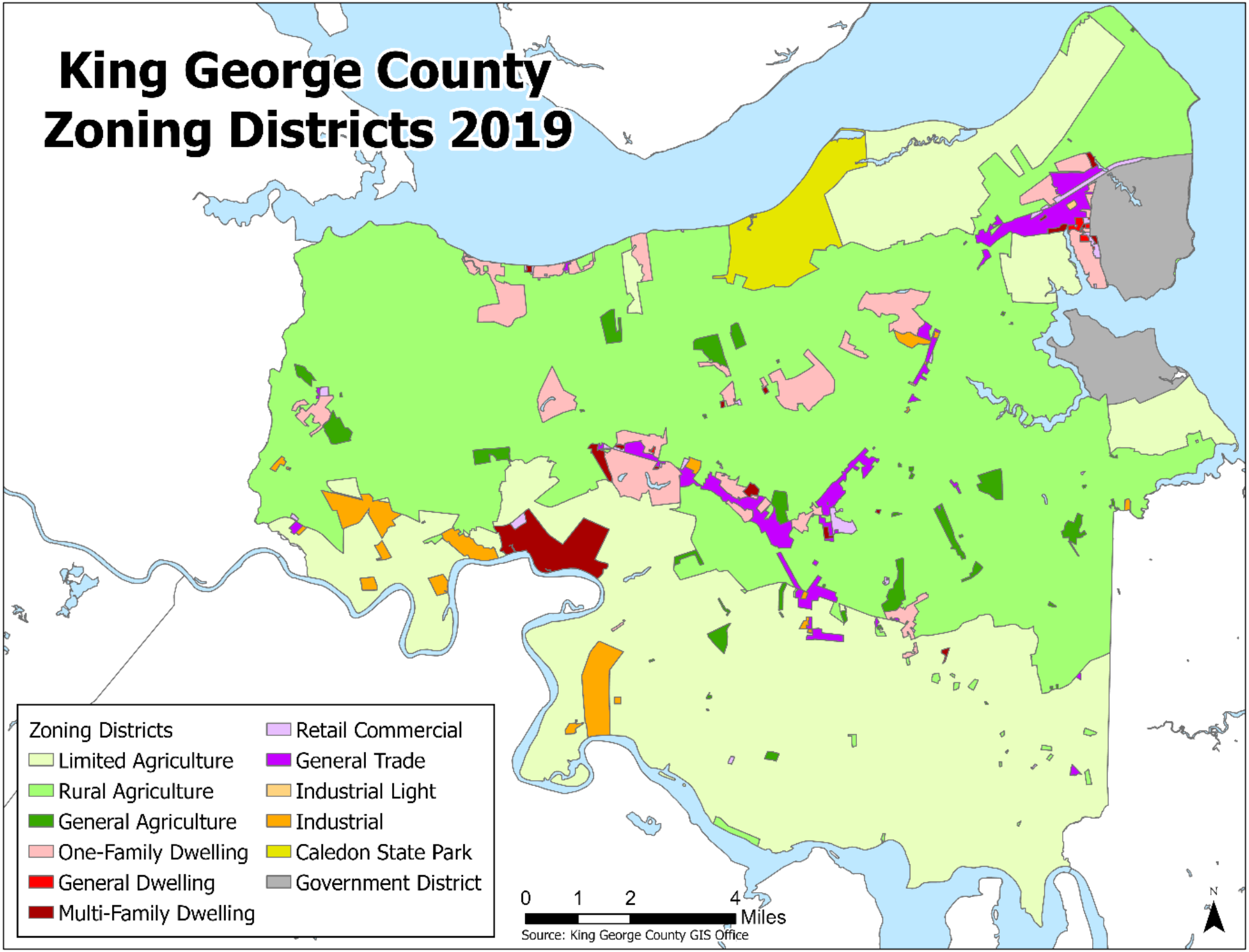

Figure 2.0: King George County Zoning Districts 2019

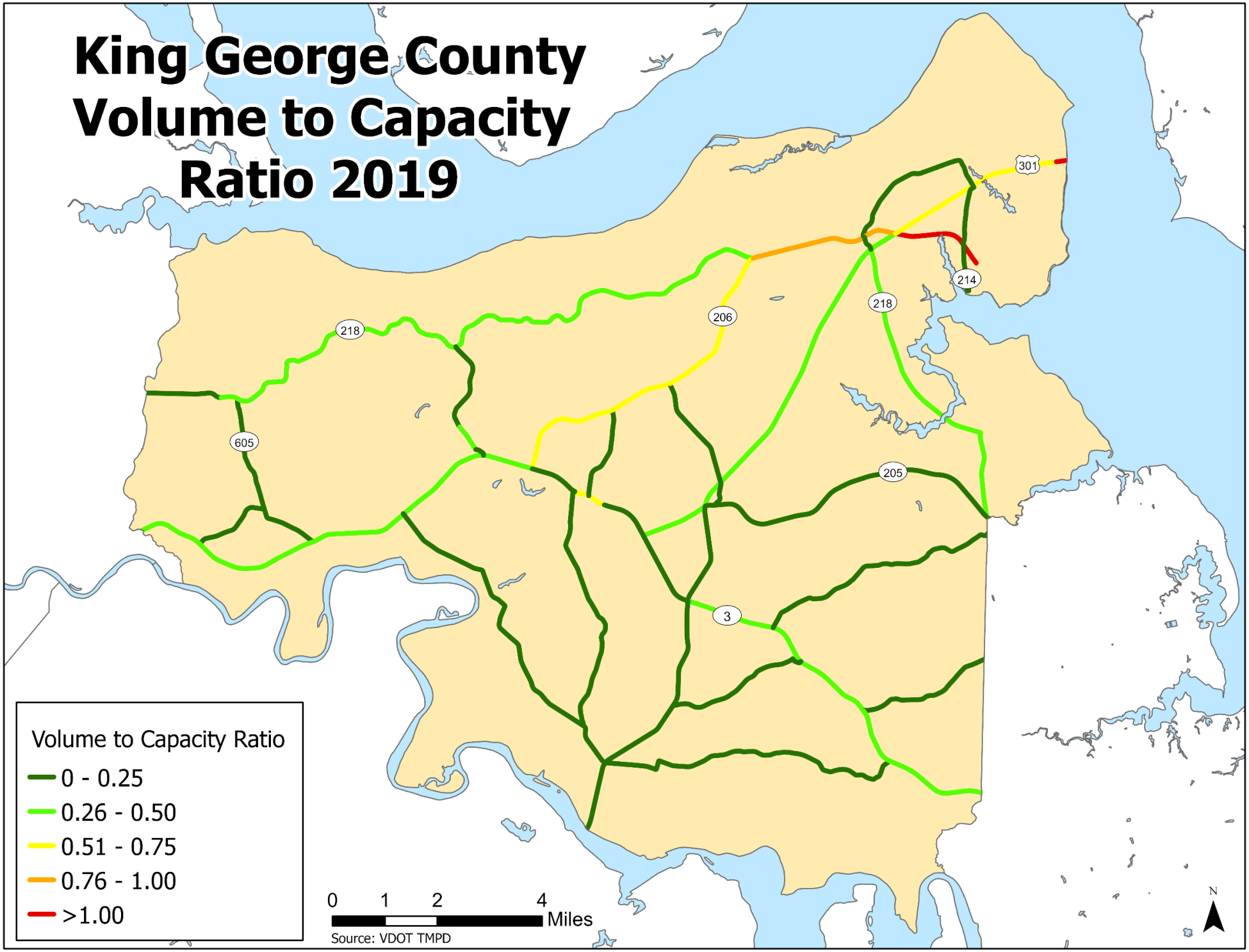

Figure 2.1: King George County Volume to Capacity Ratio 2019

V: Transportation Project Scoring Results:

Intersection or Roadway	Description of Needs	EPDO Color	Safety	Zoning District	Econ. Dev.	V/C Ratio	Congestion	Total Score	Project Source
Dahlgren Road with US 301	Left-turn volume from US 301 is minimal and creates delay for all other movements at the intersection. Existing operations have been observed to be poor with LOS D in AM and LOS E in PM. Minimally managed conditions will not be able to accommodate growth with a LOS E in AM and LOS F in PM. In addition, commercial driveways are within the intersection influence area and do not meet VDOT Road Design Manual Standards spacing standards.	Orange	4	General Trade	5	> 1.00	5	14	FY20 SMART SCALE and Route 301 and Route 207 Arterial Preservation Plan
University Drive with US 301	Reconfigure the intersection to Restrict Crossing U-Turn (RCUT) intersection.	Yellow	5	General Trade	5	0.51 - 0.75	3	13	FY20 SMART SCALE and FY20-25 SYIP
Market Center with US 301	Reconfigure the intersection to a directional median permitting only U-turns/left-turns from US 301 as part of the RCUT improvement at University Drive.	Yellow	5	General Trade	5	0.51 - 0.75	3	13	FY20 SMART SCALE and FY20-25 SYIP
Owens Drive with US 301	Reconfigure the intersection to a Quadrant Roadway (QR)	Yellow	5	Government District	5	0.51 - 0.75	3	13	Route 301 and Route 207 Arterial Preservation Plan
Ridge Road (Route 205) with US 301	Reconfigure the intersection to a Median U-Turn (MUT) intersection and consolidate commercial access points	Orange	4	General Trade	5	0.26 - 0.50	2	11	Route 301 and Route 207 Arterial Preservation Plan
Danube Drive with US 301	Reconfigure the intersection to a directional median to allow only left turns from northbound US 301. Utilize existing crossover south of the intersection for movements heading northbound on US 301 from Danube Drive.	Red	3	General Trade	5	0.51 - 0.75	3	11	Route 301 and Route 207 Arterial Preservation Plan
Route 206 with Indiantown Road	This intersection is in need of improved stop signage control and has been identified as a Potential for Safety Improvement (PSI) intersection. The roadway segment northbound along Route 206 has also been identified as a Potential for Safety Improvement (PSI) roadway segment.	Purple	2	Retail Commercial	5	0.51 - 0.75	3	10	VDOT Highway Safety Manual Screening 2019
Route 3 with US 301	The intersection will not be able to accommodate future traffic in the Minimally Managed conditions, operating at LOS F during both the AM and PM peak hours. Additionally, commercial driveways are within the intersection influence area and do not meet VDOT Road Design Manual Standards spacing standards.	Purple	2	General Trade	5	0.26 - 0.50	2	9	FY20 SMART SCALE and FY20-25 SYIP

Intersection or Roadway	Description of Needs	EPDO Color	Safety	Zoning District	Econ. Dev.	V/C Ratio	Congestion	Total Score	Project Source
Eden Road with US 301	Lengthen the existing northbound left-turn lane on US 301.	Blue	1	General Trade	5	0.26 - 0.50	2	8	Route 301 and Route 207 Arterial Preservation Plan
State Road with US 301	Lengthen the existing southbound left-turn lane and construct a northbound left-turn lane on US 301.	Blue	1	General Trade	5	0.26 - 0.50	2	8	Route 301 and Route 207 Arterial Preservation Plan
Windsor Drive (Route 218) with US 301	Reconfigure the intersection to a Restricted Crossing U-Turn (RCUT) intersection and provide an acceleration lane for right turn movements the westbound approach.	Red	3	Rural Agriculture	1	0.26 - 0.50	2	6	Route 301 and Route 207 Arterial Preservation Plan
Route 206 with Route 218	Creation of a right turn lane at the intersection of Route 206 and 218. This stretch of Route 218 has been identified as a Potential for Safety Improvement (PSI) roadway segment	Blue	1	Rural Agriculture	1	0.76 - 1.00	4	6	FY20 SMART SCALE and FY20-25 SYIP
Washington Mill Road with US 301	Lengthen the existing southbound left-turn lane and construct a northbound left-turn lane on US 301.	Purple	2	Rural Agriculture	1	0.26 - 0.50	2	5	Route 301 and Route 207 Arterial Preservation Plan
Port Conway Road with US 301	Lengthen existing left-turn lanes on US 301. A future VDOT project will reconfigure intersection to Restricted Crossing U-Turn.	Purple	2	Limited Agriculture	1	0 - 0.25	1	4	Route 301 and Route 207 Arterial Preservation Plan
Poplar Neck Road with US 301	Lengthen all existing turn lanes on US 301.	Blue	1	Rural Agriculture	1	0.26 - 0.50	2	4	Route 301 and Route 207 Arterial Preservation Plan
Jersey Road with US 301	Lengthen the existing left-turn lanes on US 301 and widen the median opening.	Blue	1	Limited Agriculture	1	0 - 0.25	1	3	Route 301 and Route 207 Arterial Preservation Plan

VI: Conclusions and Recommendations

Analysis of the King George County Prioritization Matrix shows that existing transportation planning efforts are already generally consistent with the prioritized list of projects. There are four scheduled SMART SCALE Projects for King George County, three of which were funded for FY20, covering five intersections from Round 3 including:

- Route 301 University Drive Market Center double RCUT
- Route 301 and Route 206 median U-Turn intersection
- Route 206 and Route 218 right turn lane
- Route 301 and Route 3 median U-turn intersection

These SMART SCALE Projects scored a 13 and 13, 9, 14, and 9 respectively on the Prioritization Matrix, with only the Route 301 and Route 206 median U-Turn intersection not receiving funding for FY20. This shows that for the most part areas that scored well based off safety, economic development, and congestion are getting the improvements that they need.

In terms of recommendations, the top three highest scoring future projects in King George County which are most worthy for prioritization and development include the following:

- Owens Drive with US 301
- Ridge Road (Route 205) with US 301
- Danube Drive with US 301

Owens Drive with US 301 (Figure 2.2) is a prime target for improvements. The intersection had the highest scores of 5 in both the safety and economic development metrics, being located inside the NSWCDD with a large number of accidents. Congestion, with a volume to capacity ratio score of 3, was fairly high as well. The project calls for a quadrant roadway intersection in order to improve traffic flow traveling to and from the Governor Harry W. Nice Memorial Bridge along Route 301. Considering the intersection's high scoring and relative location, the Owens Drive with US 301 project from the Route 301 and Route 207 Arterial Preservation Plan is recommended to have the highest priority moving forward.

Ridge Road (Route 205) with US 301 (Figure 2.3) is another intersection in need of improvements. This intersection scored a 4 and 5 with the safety and economic development scores respectively, while scoring a 2 in the congestion category. This

intersection is not a prime target of congestion improvements; however, this project does call for the implementation of a Median U-Turn and the consolidation of commercial access points. This will be done to improve safety along the roadway and aid businesses located in this area which has been zoned as General Trade. These needs of safety and economic development reflect the high scoring in their respective categories, and would be another project which should hold priority in future planning efforts.

Danube Drive with US 301 (Figure 2.4) is another optimal location for roadway improvements. This intersection scored a 3 and 5 with the safety and economic development scores respectively, while scoring a 3 in the congestion category. This project calls for the reconfiguration of the intersection to a directional median to allow only left turns from northbound US 301. This should not only reduce accidents from vehicles not turning left from Danube Drive onto Route 301, but it will make accessing Danube Drive from Route 301 easier to do, which bodes well for businesses along Danube Drive, an area which has been zoned General Trade. This project scores and addresses all three scoring matrixes well, and should be a project prioritized for the future.

Bicycle and pedestrian improvements are also needed, specifically on US 301 and Route 206 north and northwest of the NSWCDD. A little under half of all accidents involving bicyclists and pedestrians within King George County since 2013 occurred in this area, so efforts for improvements should be focused here. Shared use paths and signalized crosswalks along these major roadways could help safely accommodate these travelers, and provide access to the NSWCDD from the other sides of US 301 and Route 206. Of the 13 accidents involving bicyclists and pedestrians, 6 of them occurred during the hours between 6PM and 6AM. This is the time of day when the amount of pedestrian and bicyclist activity should be at its lowest. Not only should shared use paths and crosswalks be considered for potential improvements, but also ways to increase visibility along the roadways of US 301 and Route 206 at night as well.

These three intersections – Owens Drive with US 301, Ridge Road (Route 205) with US 301, and Danube Drive with US 301 – were amongst the intersections which scored the highest on the Prioritization Matrix. They scored a 13, 11, and 11 respectively, while not already being a funded SMART SCALE Project from Round 3. While there are many more areas in need of improvement, it is these top three intersections, along with pedestrian and bicyclist improvements alongside US 301 and Route 206 north and northwest of the NSWCDD, which would best satisfy the metrics of safety, economic development, and congestion in the years moving forward.

Figure 2.2: Owens Drive with US 301 from Google Maps

Figure 2.3: Ridge Road (Route 205) with US 301 from Google Maps

Figure 2.4: Danube Drive with US 301 from Google Maps