Traffic & Route Evaluation Study

Dogwood Solar Project

Lunenburg County, Virginia

December 9, 2021

Prepared For:

Apex Clean Energy, Inc

ESA Solar Energy, LLC

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

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Lunenburg County, Virginia

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1 PROJECT OVERVIEW

Timmons Group, at the request of Apex Clean Energy and ESA Solar Energy, completed a transportation assessment for the proposed Dogwood Solar project, located in Lunenburg County, Virginia. This work has been prepared to identify any potential transportation issues associated with the construction or operation phases of the proposed project. The tasks associated with this assessment included:

- Review of data and documents provided by the Client relative to the project;
- Coordination with the Client on access, schedule, and other parameters that are reflected in the traffic assessment;
- Obtaining available geometric (roadway widths, intersection control, etc.) and speed limit data that is readily available via a review of available aerial imagery through Google Earth, Bing, or County GIS systems;
- Obtaining available VDOT traffic data for those roads adjacent to the site;
- Calculating site-generated traffic based on information provided;
- Completing a turn lane warrant and operational analysis of the adjacent Route 40/Dogwood Road/Williams Road intersection; and
- Preparing a narrative summarizing existing conditions and traffic along the adjacent roadway network, anticipated traffic generated by the proposed site – during and post construction, and impacts, if any, anticipated with the site-generated traffic along with potential mitigation measures.

2 EXISTING CONDITIONS

Timmons Group compiled existing roadway conditions and traffic data for facilities adjacent to the proposed Dogwood Solar site. The proposed 4 MW AC facility is located on Route 40 (K-V Road), just west of the border of Kenbridge Town (approximately two (2) miles west of Kenbridge Town Center) and approximately four (4) miles east of Victoria Town Center. Access to the site is proposed via a single entrance with direct access to Route 40 via Dogwood Road.

The project location is shown on Figure 1 (all figures are located at the end of the study) and a preliminary site plan can be found in Figure 2.

REGIONAL HAUL ROUTES

Timmons Group identified potential regional haul routes that could be utilized during construction to safely and effectively direct heavy vehicle traffic to and from the site. VDOT functional classification mapping (see Figure 3) was used to identify suitable secondary roads in vicinity of the site that provide connections to regional arterials.

Based on this effort, three (3) potential haul routes were identified:

- Haul Route #1 utilizes Route 49 From US Route 460 at Crewe to Victoria; vehicles would then proceed east on Route 40 (K-V Road) to the proposed site.
- Haul Route #2 utilizes Route 40 (and Route 606) from US Route 460 through Blackstone to Kenbridge; vehicles would then proceed west on Route 40 (K-V Road) to the proposed site.
- Haul Route #3 utilizes Routes 138/137 from South Hill/Interstate 85/US Route 1 Kenbridge; vehicles would then proceed west on Route 40 (K-V Road) to the proposed site.

These three (3) haul routes are shown graphically on Figure 4.

With respect to the identified routes, there are several items to note:

- It is not anticipated that two (2) routes from US Route 460 will be necessary.
- The recommended option from US Route 460 is Haul Route #2, which utilizes Route 606 and Route 40 via Blackstone and Kenbridge.
    - There is a grade-separated interchange at the US Route 460/Route 606 intersection (see inset, Figure 4).
    - The available road network allows heavy vehicle traffic to bypass the Downtown/South Main Street corridor in Blackstone.
    - Haul Route #2 is the shorter/more direct route from US Route 460 to the Dogwood Solar site.
- Haul Route #3 from the south, which utilizes Routes 138/137 from South Hill, is anticipated to be necessary to serve traffic from the south originating from Interstate 85 and US Route 1.

Whichever routes are agreed upon, it is recommended that the local communities (South Hill, Crewe, Victoria, Blackstone, Kenbridge) be coordinated with and consulted regarding potential traffic flows.

ADJACENT ROADWAYS AND INTERSECTIONS

There are a couple VDOT-maintained facilities in the immediate vicinity of the site that should be noted.

Route 40 (K-V Road) is a 2-lane, undivided, east/west minor arterial with 2 – 12' travel lanes and 4' paved shoulders. The posted speed limit in the vicinity of the Dogwood Road/Williams Road intersection is 55 mph; the speed limit drops to the east and west, as Route 40 enters Kenbridge and Victoria. Available 2019 VDOT traffic data indicates Route 40 carries 4,400 ADT and includes 9% heavy vehicles.

Dogwood Road (north) and Williams Road (south) are both 2 lane, undivided local roads that are approximately 18' wide with no shoulders. Available 2019 VDOT traffic data indicates Dogwood Road carries 70 ADT and Williams Road carries 60 ADT. Both roads are paved and stop bars are present at their termini with Route 40. Speed limits were not posted on either of these facilities.

At the Dogwood Road/Williams Road intersection, no auxiliary turn lanes are present on mainline Route 40 or the side street approaches.

Based on the available imagery, Route 40 is flat and straight in the vicinity of this intersection and sight distance appear to be acceptable.

Images of the Route 40/Dogwood Road/Williams Road intersection are shown on Figure 5.

3 SITE ACCESS

SITE ACCESS

Dogwood Solar will be served by a single entrance with direct access to Route 40 via Dogwood Road.

The site, along with the proposed entrance location, is shown on Figure 6.

New gravel access roads will be installed at the point of ingress/egress and throughout the site to facilitate construction and subsequent operations/maintenance traffic throughout the solar project. Temporary staging and assembly areas will be used during the construction period for the storage of construction vehicles and equipment, as well as staging of components of the solar facility. All temporary staging, parking, and assembly areas will be located within the project area boundaries.

PROXIMAL TRAFFIC ROUTES

Based on the existing road network and types of traffic associated with the site, it is anticipated that all construction equipment, aggregate, supplies and general construction traffic will access the site utilizing Route 40 and Dogwood Road.

The geometry and volumes present along these facilities do not prohibit the accommodation of site-generated traffic, during construction or operation/maintenance.

4 SITE-GENERATED TRAFFIC

General construction traffic will consist of the following:

- Component deliveries (i.e. solar panels, inverters, gravel/concrete trucks, construction equipment, etc.) via single-unit heavy vehicles; and
- Passenger vehicles (pick-up trucks) carrying personnel, tools and minor equipment to and around the construction site.

The following assumptions were used in calculating a truck load estimate for the proposed solar site:

- 12,000 total solar panels;
- Approximately 1 linear mile of 12' wide internal roadway;
- An anticipated six (6) month construction period (6/2023 – 12/2023) of :
    - 2 months of grading and site preparation;
    - 3 months of solar panel installation; and
    - 1 month of mechanical/electrical work and inspection.

Based on the above information and an assumed carrying capacity of 80,000 pounds for a standard tractor trailer (WB-50 or WB-62) and 15 cubic yards/dump truck for gravel, it is estimated that over the six (6) month construction period, the site will generate a total of approximately 525 truck trips.

Once this number is separated across site preparation (initial 15% of site-generated traffic), site construction (80% of site-generated traffic), and mechanical/electrical work/inspection (5% of site-generated traffic), it is estimated that the site will generate approximately two (2) truck trips/day during site preparation, seven (7) truck trips/day during panel installation, and one (1) truck trip/day during the mechanical/electrical inspection period.

Construction employees will consist of laborers, electricians, supervisory personnel, support personnel, and construction management personnel. It is anticipated that there will be an average of 25 workers on-site during the construction period with a maximum 50 workers for limited periods. Construction work generally will occur during daylight hours, with non-daylight hour work relating to the completion of critical construction activities that could not be completed during daylight hours.

Table 1 summarizes anticipated site-generated traffic by respective phase and classification based on the available information for this site.

Table 1
Site-Generated Traffic

Phase		Grading/Soil Preparation	Panel Installation	Mechanical/Electrical Inspection	Decommisioniong
Duration		2 months	3 months	1 month	1 month
Weeks (Average)		8	12	4	4
Total Work Days		40	60	20	20
Employee Traffic (Daily)		10	25- 50	25	20
Heavy Vehicle Traffic (loads)					
Land Clearing/Prep	10	10	-	-	-
Gravel/Concrete Delivery	150	50	85	15	-
Piles/Racks	325	-	325	-	-
Solar Panels	15	-	15	-	-
Electrical Equipment	12	-	-	10	-
Inverters	1	-	-	1	-
	513	60	425	26	
Average Heavy Vehicle Traffic (loads/day)		2	7	1	10

Following construction of the site, the operation and maintenance of Dogwood Solar will not generate significant volumes of traffic. Once the solar site is operational, daily traffic will be weekly visits by one (1) or two (2) vehicles for the purpose of inspection and maintenance.

For completeness, the table above also includes trip generation information for the anticipated decommissioning of the site. Based on the provided report, it is anticipated the site will be operable for at least 35 years, with a decommissioning date to be agreed upon by the system owner and the landowner. At that time, it is estimated that decommissioning will approximately four (4) weeks to complete and traffic flows will consist of up to 20 employees and 10 truck trips/day to remove equipment from the site and remediate any land disturbance.

In support of the project, Timmons Group estimated AM and PM peak hour traffic volumes for the Route 40/Dogwood Road/Williams Road intersection at peak construction. This was accomplished as follows:

- 2019 hourly directional traffic counts for Route 40 were obtained from VDOT Central Office
- 2019 ADT counts for Dogwood Road and Williams Road were obtained from the VDOT Central Office
- Traffic estimates for the heaviest construction phase were calculated based on data provided by the Client
    - 25 full time employees are assumed at the peak of construction. It is assumed that all 25 will arrive during the AM peak hour and leave during the PM peak hour. 55% will approach from/depart to the east and 45% will approach from/depart to the west; this split is based on existing peak hour traffic distribution on Route 40.

- Up to 7 trucks/day are expected at peak construction. For analysis purposes, it was assumed that 75% (5 trucks) will arrive during the AM peak and that two (2) trucks would depart the site during the PM peak hour.

- Background traffic volumes were combined with employee and heavy vehicle estimates for the site to estimate total peak construction traffic.

Total projected AM and PM peak hour construction volumes are shown on Figure 7.

TURN LANE WARRANT ANALYSIS

Using the peak hour volumes shown on Figure 7, left- and right-turn lane warrant analyses were completed for the Route 40/Dogwood Road/Williams Road intersection. Turn-lane nomographs from Appendix F of the VDOT *Road Design Manual* were utilized for the analysis.

The results of the turn lane warrant analyses indicate that neither a westbound right turn lane nor an eastbound left turn lane are warranted at the Route 40/Dogwood Road/Williams Road intersection based on the projected construction volumes.

The turn lane nomographs are shown on Figure 8.

As noted prior, traffic volumes associated with operations and maintenance will be less than those witnessed during construction and will also not warrant auxiliary turn lanes at the study intersection.

OPERATIONAL ANALYSIS

An operational and queuing analysis was performed using SYNCHRO Version 10 and HCM 6th Edition methodologies. The analysis assumed level terrain, exclusion of bus or parking impacts, exclusion of pedestrians, heavy vehicle percentages based on available traffic data, and use of a minimum of 0.92 peak hour factor for the opening day analysis.

The table below summarizes the opening day intersection level of service (LOS), delay, and 95th percentile queue lengths based on the traffic volumes shown on Figure 7 and the existing intersection geometry.

Table 2
Operational Summary – Route 40/Dogwood Road/William Road

Intersection and Type of Control	Movement and Approach	Effective Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	SYNCHRO 95th Percentile Queue Length (ft)	SimTraffic Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	SYNCHRO 95th Percentile Queue Length (ft)	SimTraffic Maximum Queue Length (ft)
1. Route 40 (E-W) at	EB L-T-R		7.8	A	0	35	7.8	A	0	8
Dogwood Road/Williams Road (N-S)	*EB Approach*		*0.5*	*A*	--	--	*0.1*	*A*	--	--
Unsignalized	WB L-T-R		7.6	A	0	7	7.7	A	0	18
	WB Approach		*0.0*	*A*	--	--	*0.0*	*A*	--	--
	NB L-T-R		10.8	B	0	18	11.1	B	0	0
	NB Approach		*10.8*	*B*	--	--	*11.1*	*B*	--	--
	SB L-T-R		11.0	B	0	29	11.9	B	5	61
	SB Approach		*11.0*	*B*	--	--	*11.9*	*B*	--	--

As shown in the table, mainline Route 40 operates at a LOS A during both the AM and PM peak hours with no/minimal queuing. The stop-controlled side streets, Dogwood Road and Williams Road, operate at a LOS B during both the AM and PM peak hours, again, with minimal delay and queuing. Based on this analysis, no geometric improvements are necessary.

Traffic Mitigation

Throughout construction of the site, the contractor will coordinate with the representatives from Lunenburg County and VDOT to determine appropriate transportation management procedures which may include, but are not limited to, traffic control, lane closures, road access restrictions, truck restrictions, and temporary/short-term road closures.

Based on the existing roadway conditions, the locations for proposed access points, and the available average daily traffic number for the transport roads, the anticipated construction traffic volumes will not exceed available roadway capacities; the roadways should not be significantly impacted by standard construction traffic. During operation and maintenance, the facility will not generate a significant volume of traffic with the anticipation of only a few pickup trucks each week.

Construction-related traffic will access the Dogwood Solar site via state-maintained roadways. Given the existing posted speeds and anticipated slower entering/exiting traffic, temporary traffic control (TTC) measures may be necessary. Pertinent signage should be installed prior to the site preparation work and removed when mechanical/electrical work/inspections begin. It is not anticipated that daily vehicular traffic following construction will disrupt local traffic flows during normal peak hours.

Outside of the previously noted mitigation efforts, should a traffic issue arise during construction, the contactor will work Lunenburg County and VDOT to appropriately address the specific concern.

5 DECOMMISSIONING

The proposed solar facility is expected to be capable of operating for at least 35 years, with decommissioning at a time that is agreed upon by the system owner and the landowner who is leasing the land. At the end of the project's life , the system owner is ultimately responsible for the removal off all equipment from the site and returning the site to its "pre-developed" condition which includes re-seeding and re-vegetating the disturbed area to allow them to return to their original state.

It is anticipated that vacating and restoring the site will be a concise undertaking with a duration four (4) weeks. During that time there will be two (2) main traffic flows:

- Employee traffic – it is projected that there will be approximately 20 employees on site for the duration of decommissioning. This includes, supervisors, equipment operators, and general laborers. A portion of the employees are anticipated to carpool to the site and they are generally expected to arrive in the AM peak and depart in the PM peak; mid-day traffic is anticipated to minimal.

- Heavy vehicle traffic – initially, there will be the outfitting of the site with earthmoving/ excavation equipment. Subsequently, heavy vehicle traffic will shift to multi-axle trucks/trailers that will be responsible to removing equipment from the site and bringing any necessary agricultural supplies to grade/re-seed/re-vegetate the site. It is estimated that there will be up to five (5) trucks on the site for the 50% of the decommissioning period (i.e. 2 weeks) and that each truck will make two (2) trips per day.

Given the numbers above, it is expected that the heavy vehicle traffic will be heavier during decommissioning than during construction. This is due to the shorter time frame, combined with the amount of material that need to be moved. It should be noted that these numbers will not exceed the available capacity of the adjacent roads; however, consideration should be given to posting signs in the immediate vicinity of the site alerting drivers in the area to the presence of truck traffic.

6 CONCLUSIONS

Based on our review of the compilation of available data relating to the site, existing conditions, and estimated traffic, the following is offered:

- The proposed Dogwood Solar project is located on Route 40 (K-V Road), just west of the border of Kenbridge Town (approximately two (2) miles west of Kenbridge Town Center) and approximately four (4) miles east of Victoria Town Center (see Figure 1).

- Truck traffic associated with the site is estimated to range from two (2) trucks/day (during the site preparation and electrical/inspection stages) to seven (7) trucks/day during the peak construction period.

- Access to the site will be provided via Route 40 and Dogwood Road.

- Each of these roadway facilities has the available capacity to accommodate site generated traffic, both during construction and operations/maintenance activities based on existing ADTs.

- Assuming site-traffic is focused along Route 40 (K-V Road) and Dogwood Road, no improvements are necessary/anticipated to accommodate site-generated traffic; this was demonstrated through the turn lane warrant and operational analysis.

- It is recommended that temporary traffic control measures be considered for the duration of the site preparation/construction phase.

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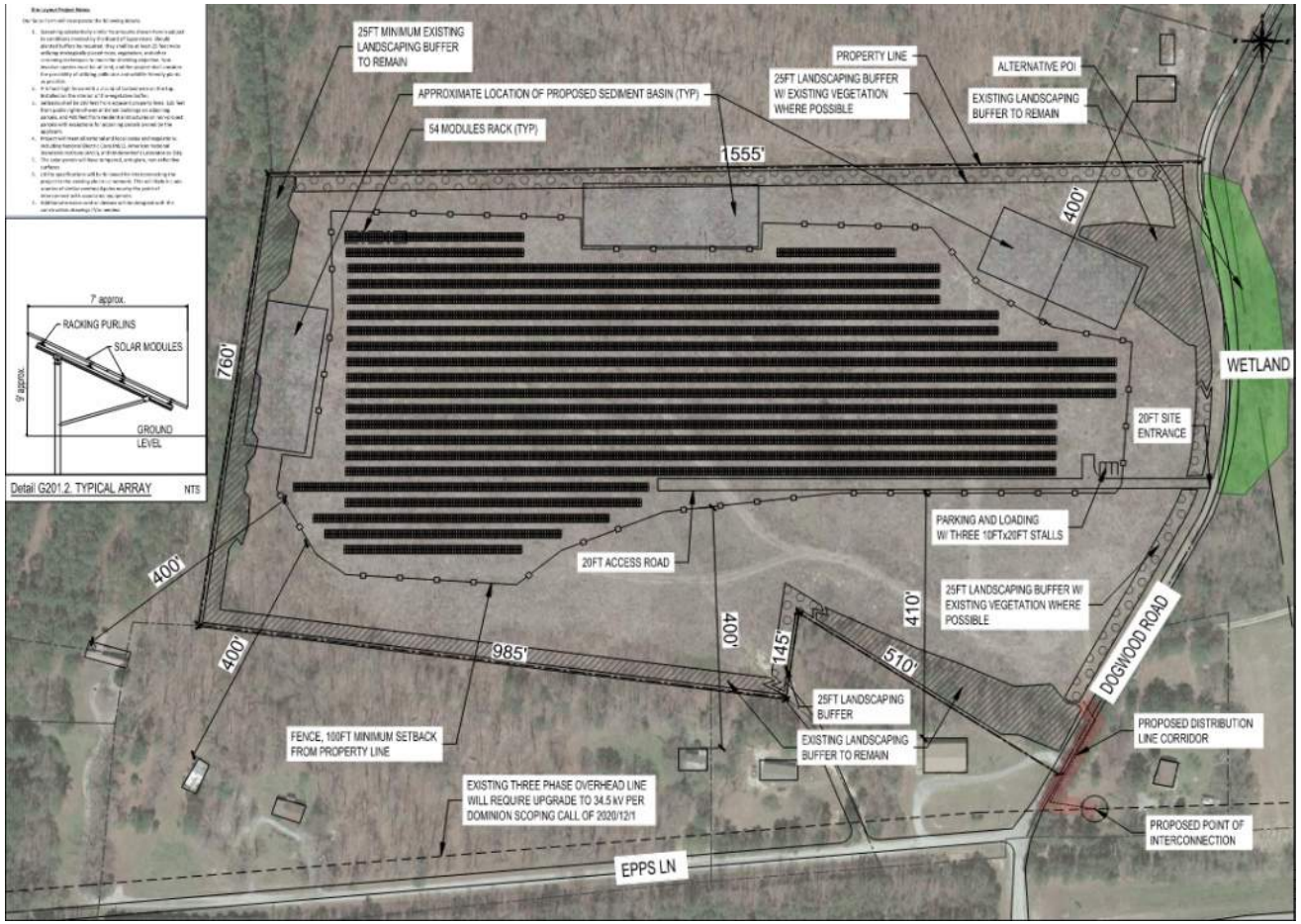
Vicinity Map
Dogwood Solar
Lunenburg County, Virginia

Figure
1



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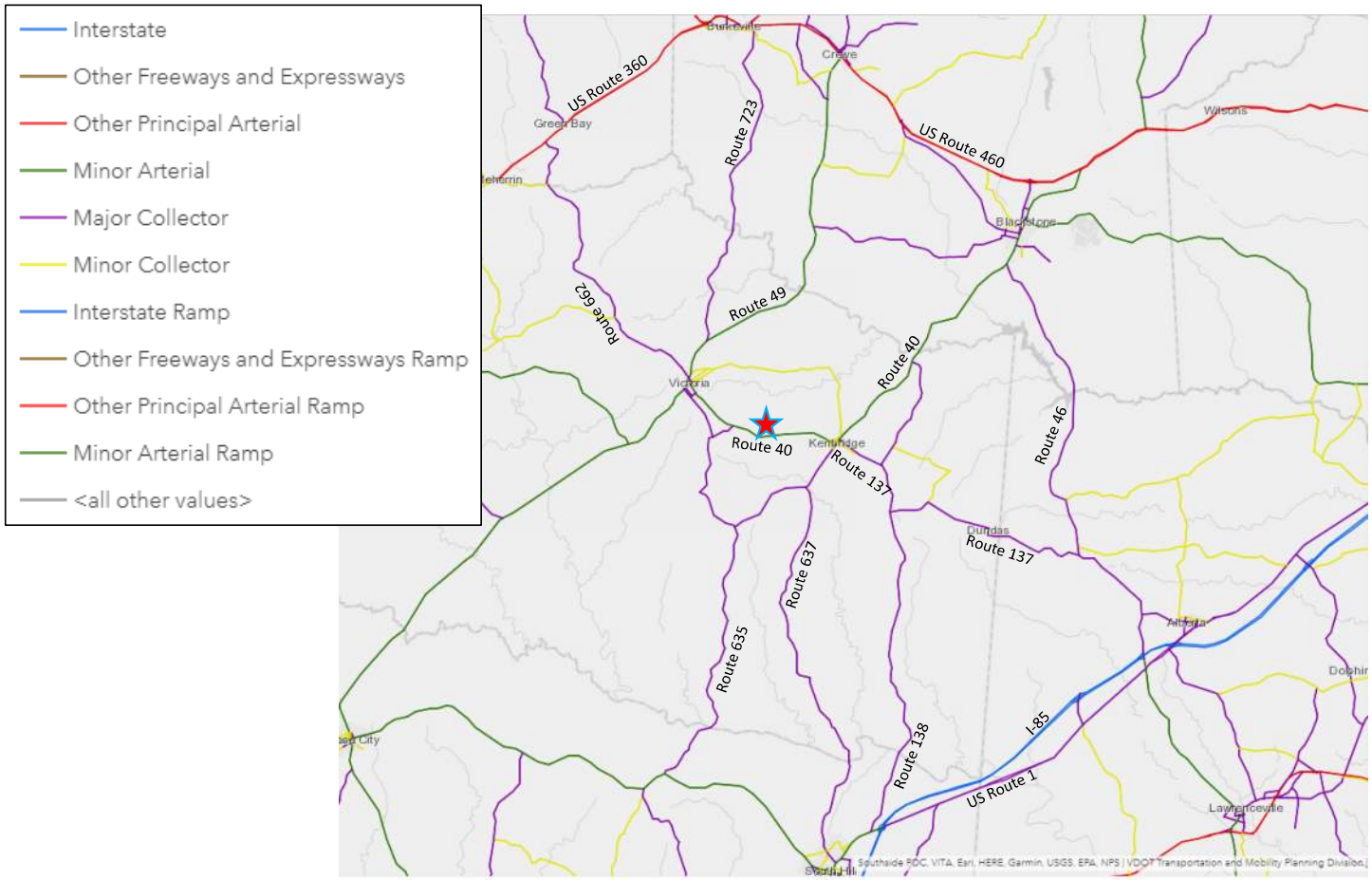
Preliminary Site Plan
Dogwood Solar
Lunenburg County, Virginia

Figure
2



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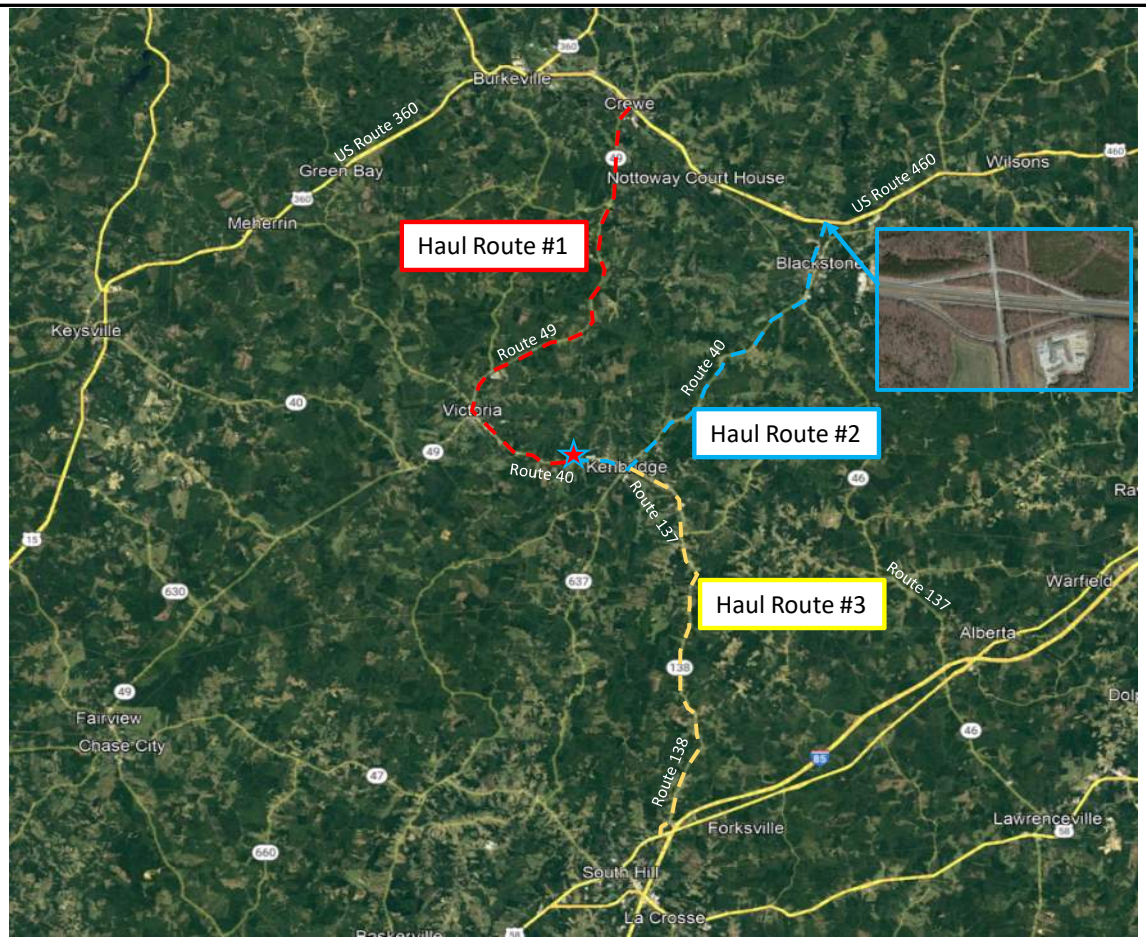
Roadway Network – Functional Classification
Dogwood Solar
Lunenburg County, Virginia

Figure
3



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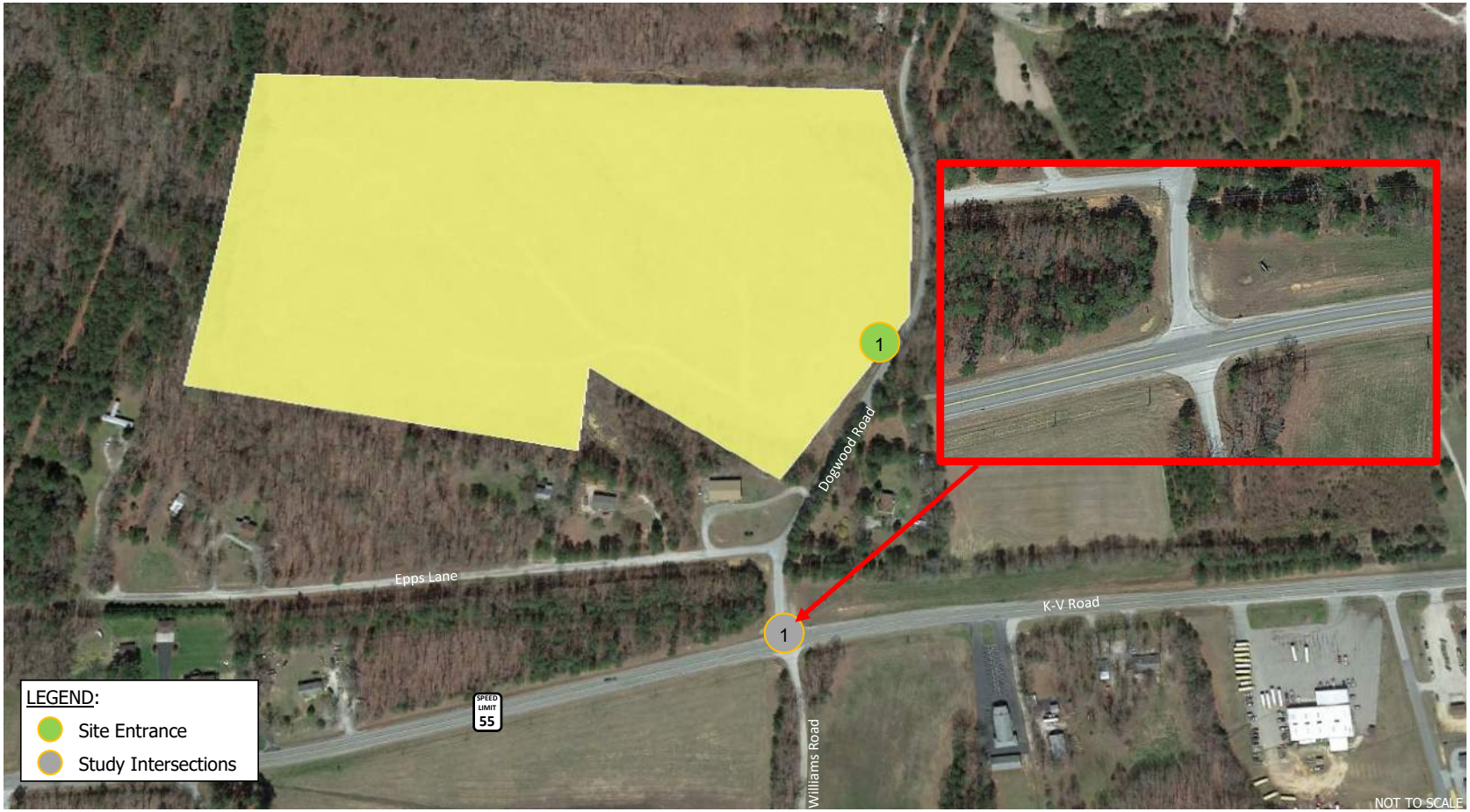
Potential Haul Routes
Dogwood Solar
Lunenburg County, Virginia

Figure
4



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Site Entrance and Study Intersection
Dogwood Solar
Lunenburg County, Virginia

Figure
5

Looking North,
Dogwood Road

Looking West,
Route 40

Looking East,
Route 40

Looking South,
Williams Road

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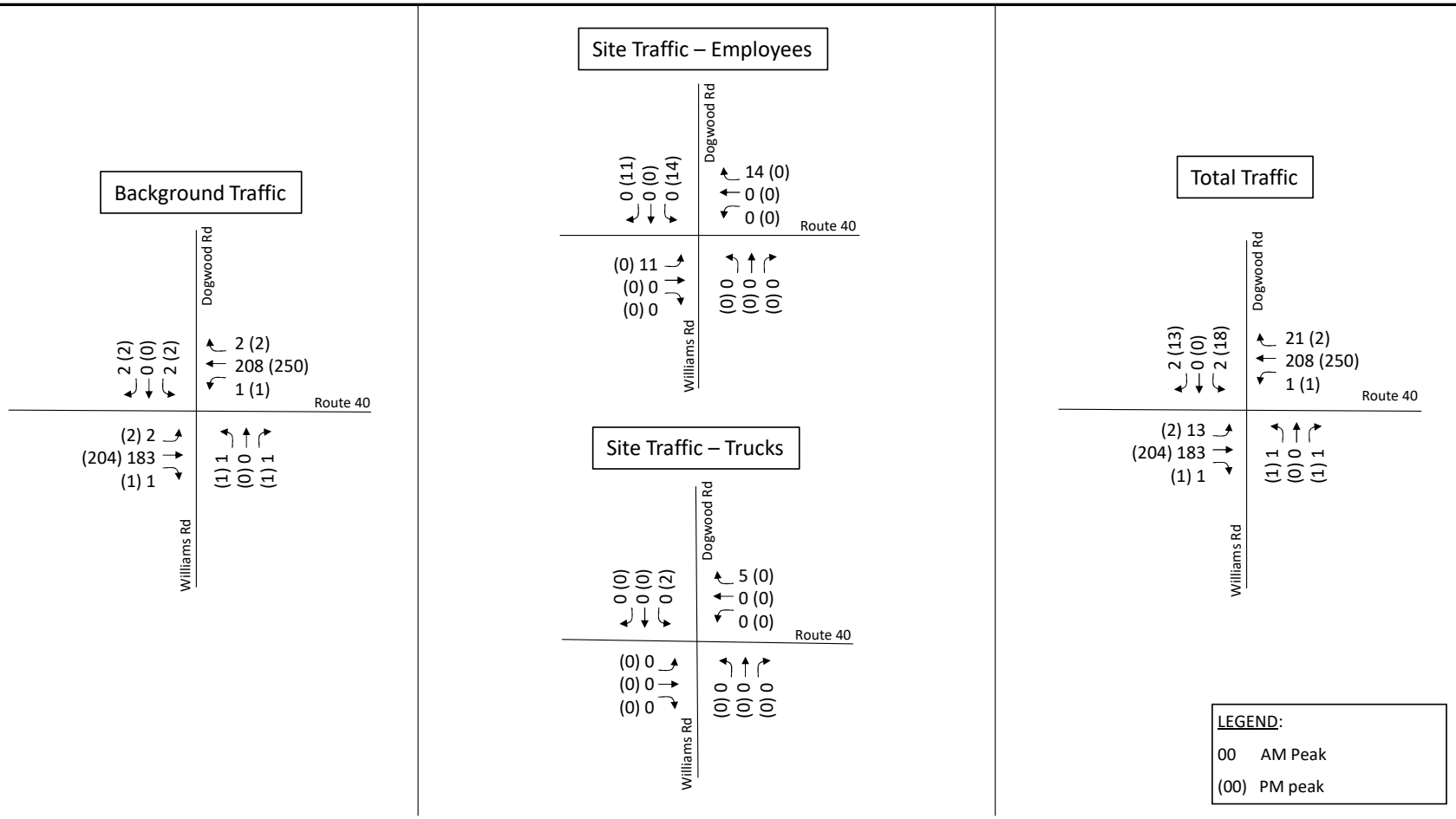
Route 40/Dogwood Road/Williams Road Intersection
Dogwood Solar
Lunenburg County, Virginia

Figure
6



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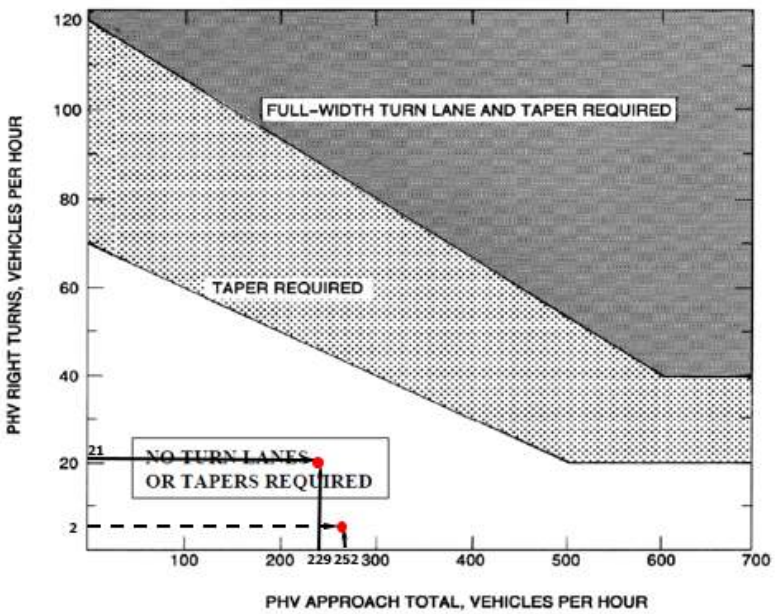
Peak Hour Traffic Volumes – Route 40/Dogwood Road/Williams Road
Dogwood Solar
Lunenburg County, Virginia

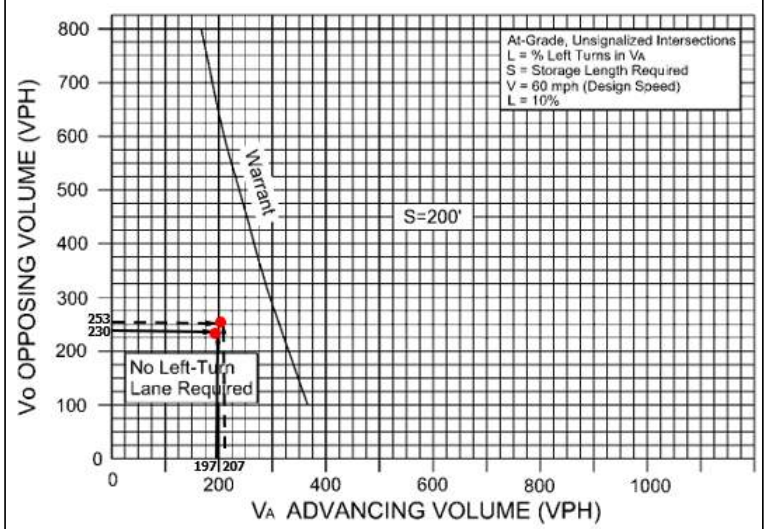
Figure 7

GUIDELINES FOR RIGHT TURN TREATMENT (2-LANE HIGHWAY)
FIGURE 3-26 VDOT ROAD DESIGN MANUAL APPENDIX F



NO RIGHT TURN LANE OR TAPER REQUIRED

WARRANT FOR LEFT-TURN STORAGE LANES
ON TWO-LANE HIGHWAYS (60 MPH)
FIGURE 3-18 VDOT ROAD DESIGN MANUAL APPENDIX F



NO LEFT TURN LANE REQUIRED

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Turn Lane Nomographs – Route 40/Dogwood Road/Williams Road
Dogwood Solar
Lunenburg County, Virginia

Figure
8